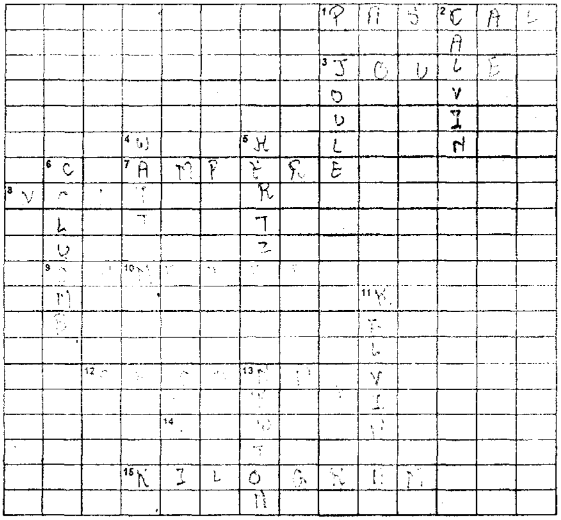
BANSAL CLASSES
Target IIT JEE 2006

PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) ***DATE : 27-28/04/2005*** ***DPP. NO.-1***

Q.1 Complete the cross word by filling either left to right or vertically the unit of appropriate physical quantity



1. Pressure
2. Temperature
3. Across : Energy
   down : Heat
4. Power
5. Frequency
6. Charge
7. Current
8. Potential difference
9. Resistance
10. Length
11. Absolute temperature
12. Time
13. Force
14. Weight
15. Mass

Q.2 A uniform wire of length L and mass M is stretched between two fixed points, keeping a tension force F. A sound of frequency μ is impressed on it. Then the maximum vibrational energy is existing in the wire when μ=

(A) $\frac{1}{2}\sqrt{\frac{ML}{F}}$ (B) $\sqrt{\frac{FL}{M}}$ (C) $2\times\sqrt{\frac{FM}{L}}$ (D) $\frac{1}{2}\sqrt{\frac{F}{ML}}$

Q.3 Which of the following physical quantities represents the dimensional formula $[M^1L^{-2}T^{-2}]$.
(A) Energy/Area (B) Pressure (C) Force × length (D) Pressure per unit length

Q.4 In a particular system of unit, if the unit of mass becomes twice & that of time becomes half, then 8 Joules will be written as _______ units of work
(A) 16 (B) 1 (C) 4 (D) 64

Q.5 Which of the following equations can be dimensionally incorrect.(Symbol have their usual notations.)

(A) $t = 2\pi\sqrt{\frac{ml^2}{E}}$ (B) $l = \frac{F}{m(f_1^2 - f_2^2)}$ (C) $t = \sqrt{\frac{ml}{6F\sin\theta}}$ (D) $a = \left(\frac{lv^2}{Gm}\right)^2$

Q.6 The time dependence of a physical quantity p is given by $p = p_0 e^{(-\alpha t^2)}$ where α is constant and t is time. The constant α
(A) is dimensionless (B) has dimensions T^{-2}
(C) has dimensions T^2 (D) has dimensions of p

BANSAL CLASSES
Target IIT JEE 2006

PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) | *DATE : 29-30/04/2005* | *DPP. NO.-2*

Q.1 A gas bubble oscillates with a time period T proportional to $P^a d^b E^c$ where P is pressure, d is the density and E is the energy. The values of a, b & c are :

(A) $a = \frac{3}{2}$, $b = -\frac{1}{3}$, $c = \frac{1}{2}$ (B) $a = -\frac{5}{6}$, $b = \frac{1}{3}$, $c = \frac{1}{2}$

(C) $a = -\frac{5}{6}$, $b = \frac{1}{2}$, $c = \frac{1}{3}$ (D) $a = \frac{3}{2}$, $b = -\frac{1}{3}$, $c = \frac{1}{2}$

Q.2 If the unit of length be doubled then the numerical value of the universal gravitation constant G will become (with respect to present value)

(A) double (B) half (C) 8 times (D) 1/8times

Q.3 Force F and density d are related as $F = \frac{\alpha}{\beta + \sqrt{d}}$ then find the dimensions of α and β.

Q.4 In the following equations, the distance x is in metres, the time t in seconds and the velocity v in metres/second. What are the SI units of the constants C_1 and C_2?

(a) $v^2 = 2C_1x$ (b) $x = C_1 \cos C_2 t$ (c) $v = C_1 e^{-C_2 t}$

Q.5 In the formula $p = \frac{nRT}{V-b} e^{-\frac{a}{RTV}}$. Find the dimensions of a and b where p=pressure, n=no. of moles, T=temperature, V=volume and R=universal gas constant.

Q.6 The value of Stefan's constant in CGS system is $\sigma = 5.67 \times 10^{-5}$ erg s^{-1} cm^{-2} K^{-4}. Its value in SI units is ________.

Q.7 Match the following :

COLUMN–I	COLUMN–II
(a) Latent heat constant	(i) $M^0 L^0 T^0$ (b)
(b) Reynold number	(ii) $M L^2$ (f)
(c) coefficient of friction	(iii) $M L^0 T^{-3}$ (e)
(d) Avogadro constant	(iv) $L^2 T^{-2}$ (a)
(e) Intensity of wave	(v) $M^0 L^0 T^0$ (c)
(f) Moment of inertia	(vi) mol^{-1} (d)

Q.8 The loss of pressure when a fluid flows through a pipe is given by $P = k \rho^a l V^b d^c \mu$ where d and l are diameter and length of the pipe respectively, ρ and μ are the mass density and coefficient of viscosity of the fluid, V is the mean velocity of flow through the pipe and k is a numerical constant. Find the values of a, b and c.

Q.9 In two systems of units, the relation between velocity, acceleration and force is given by $v_2 = \frac{v_1 \varepsilon^2}{\tau}$, $a_2 = a_1 \varepsilon \tau$, $F_2 = \frac{F_1}{\varepsilon \tau}$, where ε and τ are constants then find in this new system (a) $\frac{m_2}{m_1}$ (b) $\frac{L_2}{L_1}$

Q.10 If K represent kinetic energy, v velocity and T time and these are chosen as the fundamental units then find the dimension of surface tension in terms of K, V, T.

BANSAL CLASSES — **Target IIT JEE 2007**

PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) *DATE : 02-03/05/2005* *DPP. NO.-3*

Q.1 A vector $\vec{A}$ is directed along 30° west of north direction and another vector $\vec{B}$ along 15° south of east. Their resultant cannot be in ______________ direction.
(A) North (B) East (C) North-East (D) South

Q.2 Two forces P and Q are in ratio P : Q = 1 : 2. If their resultant is at an angle $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ to vector P, then angle between P and Q is :
(A) $\tan^{-1}\left(\frac{1}{2}\right)$ (B) 45° (C) 30° (D) 60°

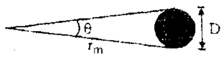
Q.3 If the speed of light (C), acceleration due to gravity(g) and pressure (P) are taken as fundamental units, the dimensions of gravitational constant (G) are
(A) $c^2g^3p^2$ (B) $c^0g^2p^{-1}$ (C) $c^2g^2p^{-2}$ (D) c^0gp^{-3}

Q.4 A force of 6kg and another of 8kg can be applied together to produce the effect of a single force of:
(A) 1 kg (B) 11 kg (C) 15 kg (D) 20 kg

Q.5 The horizontal component of a force of 10 N inclined at 30° to vertical is :
(A) 3 N (B) $5\sqrt{3}$ (C) 5 N (D) $\frac{10}{\sqrt{3}}$ N

Q.6 A particle is moving westward with a velocity $\vec{v}_1 = 5$ m/s. Its velocity changed to $\vec{v}_2 = 5$ m/s northward. The change in velocity vector $\left(\Delta\vec{V} = \vec{v}_2 - \vec{v}_1\right)$ is :
(A) $5\sqrt{2}$ m/s towards north east (B) 5 m/s towards north west
(C) zero (D) $5\sqrt{2}$ m/s towards north west

Q.7 The angle subtended by the moon's diameter at a point on the earth is about 0.524°. Use this and the fact that the moon is about 384 Mm away to find the diameter of the moon.



Q.8 Using 1AU (mean earth-sun distance) = 1.5×10^{11}m and parsec as distance at which 1 AU subtends an angle of 1 sec of arc, find parsec in metres.

Q.9 ABCDEF is a regular hexagon in which $\vec{AB}$ represent a vector $\vec{p}$ & $\vec{BC}$ represents a vector $\vec{q}$. Find the vectors which the $\vec{CD}$, $\vec{DE}$, $\vec{EF}$, & $\vec{FA}$ represent in terms of $\vec{p}$ and $\vec{q}$.

Q.10 A man is travelling in east direction with a velocity of 6 m/s. Rain is falling down vertically with a speed of 4 m/s. Find the velocity of rain with respect to man and its angle with the vertical using the concept that relative velocity of B w.r.t A = $\vec{v}_B - \vec{v}_A$.

Q.1 Which of the following quantities are dimensionless? (symbols have their usual meaning)

(A) $\frac{I\omega^2}{mvr}$ (B) $\frac{G\rho}{T}$ (C) $\frac{\rho v r}{\eta}$ (D) $\frac{\tau\theta}{I\omega}$

[Useful relation $I = \frac{2}{5}mr^2$, $F = 6\pi\eta r v$]

Q.2 $|\vec a| = 2$; $|\vec b| = 3$; $|\vec c| = 6$. Angle between $\vec a$ and $\vec b$; $\vec b$ and $\vec c$ and $\vec c$ and $\vec a$ is 120° each, find $|\vec a + \vec b + \vec c|$

(A) $\sqrt{15}$ (B) $\sqrt{17}$ (C) $\sqrt{13}$ (D) $\sqrt{11}$

Q.3 Which of the following quantities have dimensions of $\frac{\pi P r^4}{3Q\ell}$: (Q = volume flow rate in m^3/s)

(A) surface tension (S) (B) coefficient of viscosity
(C) energy (D) power

Q.4 A force $\vec F = 6\hat i - 8\hat j + 10\hat k$ newton produces acceleration 1 m/s^2 in a body. The mass of the body is (in kg)

(A) $6\hat i - 8\hat j + 10\hat k$ (B) 100 (C) $10\sqrt{2}$ (D) 10

Q.5 A particle is acted upon by the forces $\vec F_1 = 2\hat i + a\hat j - 3\hat k$, $\vec F_2 = 5\hat i + c\hat j - b\hat k$, $\vec F_3 = b\hat i + 5\hat j - 7\hat k$, $\vec F_4 = c\hat i + 6\hat j - a\hat k$. . Find the values of the constants a, b, c in order that the particle will be in equilibrium.

Q.6 The x and y components of vector $\vec A$ are 4m and 6m respectively. The x,y components of vector $\vec A + \vec B$ are 10m and 9m respectively. The length of $\vec B$ is ____ and angle that $\vec B$ makes with the x axis is given by ____.

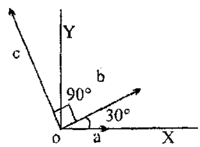
Q.7 The angle $\sqrt{3}\,\hat i - \hat j$ vector makes with the positive x-axis is _____.

Q.8 Three vectors as shown in the fig have magnitudes

$|\vec a| = 3$, $|\vec b| = 4$ and $|\vec c| = 10$.

(i) Find the x and y components of these vectors.

(ii) Find the numbers p and q such that $\vec c = p\vec a + q\vec b$.



Q.9 A 300 gm mass has a velocity of $\vec v = 3\hat i + 4\hat j$ m/s at certain instant. Its kinetic energy is ______.

Q.10 At t = 0, a particle at (1, 0, 0) moves with velocity vector = (15i + 20j + 60k) m/s. Find its position vector at time t = 2 sec.

Q.1 Choose the option, whose pair doesn't have same dimensions.
(A) (Pressure × Volume) & Work done (B) (Force × Time) & Change in momentum
(C) Kilocalorie & Joule (D) Angle & no. of moles

Q.2 ABCD is a quadrilateral. Forces $\vec{BA}$, $\vec{BC}$, $\vec{CD}$ & $\vec{DA}$ act at a point. Their resultant is
(A) $2\,\vec{AB}$ (B) $2\,\vec{DA}$ (C) zero vector (D) $2\,\vec{BA}$

Q.3 $\vec{A}+\vec{B}=2\hat{i}$ and $\vec{A}-\vec{B}=4\hat{j}$ then angle between $\vec{A}$ and $\vec{B}$ is
(A) 127° (B) 143° (C) 53° (D) 37°

Q.4 A force $\vec{F}=3\hat{i}+c\hat{j}+2\hat{k}$ acting on a particle causes a displacement $\vec{d}=-4\hat{i}+2\hat{j}+3\hat{k}$. If the work done is 6J then the value of 'c' is
(A) 12 (B) 0 (C) 6 (D) 1

Q.5 A particle is displaced from A ≡ (2, 2, 4) to B ≡ (5, –3, –1). A constant force of 34N acts in the direction of $\vec{AP}$. where P ≡ (10, 2, –11). (Coordinates are in m).
(i) Find the ($\vec{F}$). (ii) Find the work done by the force to cause the displacement.

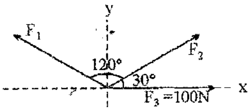
Q.6 A vector $\vec{B}$ which has a magnitude 8.0 is added to a vector $\vec{A}$ which lie along the x-axis. The sum of these two vectors is a third vector which lie along the y-axis and has a magnitude that is twice the magnitude of $\vec{A}$. The magnitude of $\vec{A}$ is ____.

Q.7 A particle travels with speed 50m/s from the point (3, –7) in a direction $7\hat{i}-24\hat{j}$. Find its position vector after 3 seconds.

Q.8 When two vectors of magnitudes P and Q are inclined at an angle θ the magnitude of their resultant 2P. When the inclination is changed to $180-\theta$ the magnitude of the resultant is halved. Find the ratio of P to Q

Q.9 A particle whose speed is 50 m/s moves along the line from A (2, 1) to B (9, 25). Find its velocity vector in the form of $a\hat{i}+b\hat{j}$.

Q.10 A particle of mass 10 kg moves in x-y plane such that its coordinates are given by ($5t^2$, $15t^2$). Find



(a) acceleration vector of the particle
(b) this acceleration is produced by three forces. They are acting in the direction shown in the figure. Find the magnitude of forces F_1 and F_2.
(c) Find the work done by $\vec{F}_1$ and work done by $\vec{F}_2$ from t = 1 to t = 2 sec.

Q.1 E, m, L, G denote energy, mass, angular momentum & gravitation constant respectively. The dimensions of $\frac{EL^2}{m^5G^2}$ will be that of :

(A) angle (B) length (C) mass (D) time

Q.2 The position of a particle at time t, is given by the reaction, $x(t) = \frac{v_0}{\alpha}(1 - e^{-\alpha t})$, where v_0 is a constant and $\alpha > 0$. The dimensions of v_0 & α are respectively.

(A) $M^0 L^1 T^0$ & T^{-1} (B) $M^0 L^1 T^{-1}$ & T
(C) $M^0 L^1 T^{-1}$ & T^{-1} (D) $M^1 L^1 T^{-1}$ & LT^{-2}

Q.3 Given the vectors

$$\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$$
$$\vec{B} = 3\hat{i} - 2\hat{j} - 2\hat{k}$$
& $$\vec{C} = p\hat{i} + p\hat{j} + 2p\hat{k}$$

Find the angle between $(\vec{A} - \vec{B})$ & $\vec{C}$

(A) $\theta = \cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (B) $\theta = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (C) $\theta = \cos^{-1}\left(\frac{\sqrt{2}}{3}\right)$ (D) none of these

Q.4 $\vec{A} = \hat{i} + \hat{j} - \hat{k}$; $\vec{B} = 2\hat{i} + 3\hat{j} + 5\hat{k}$ angle between $\vec{A}$ and $\vec{B}$ is

(A) 120° (B) 90° (C) 60° (D) 30°

Q.5 If P is the pressure of a gas and ρ is its density, then dimension of velocity is given by

(A) $P^{1/2} \rho^{-1/2}$ (B) $P^{1/2} \rho^{1/2}$ (C) $P^{-1/2} \rho^{1/2}$ (D) $P^{-1/2} \rho^{-1/2}$

Q.6 A force $\vec{F} = 3\hat{i} + 2\hat{j} + c\hat{k}$ newton causes a displacement $\vec{r} = c\hat{i} + 4\hat{j} + c\hat{k}$ meter. The work done is 36 joule. Find the value (s) of 'c'.

Q.7 A force of 35 N acts in the direction parallel to $2\hat{i} + 3\hat{j} + 6\hat{k}$ and it displaces a body from (1m, 0m, 3m) to (3m, 4m, 1m)

(a) Express the force vector (in unit vector form)
(b) Find the work done.

Q.8 (a) Calculate $\vec{r} = \vec{a} - \vec{b} + \vec{c}$ where $\vec{a} = 5\hat{i} + 4\hat{j} - 6\hat{k}$, $\vec{b} = -2\hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{c} = 4\hat{i} + 3\hat{j} + 2\hat{k}$.

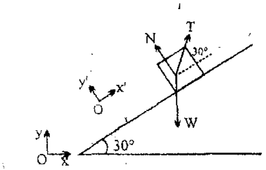
(b) Calculate the angle between $\vec{r}$ and the z-axis.

(c) Find the angle between $\vec{a}$ and $\vec{b}$

Q.9 If $\vec{A} = 2\hat{i} + \hat{j}$ & $\vec{B} = \hat{i} - \hat{j}$ sketch vectors graphically & find component of $\vec{A}$ along $\vec{B}$ & perpendicular to $\vec{B}$

Q.10 A body is supported on a smooth plane inclined at 30° to the horizontal by a string attached to the body and held at an angle of 30° to the plane. Draw a diagram showing the forces acting on the body and resolve each of these forces (forces are strings Tension T, weight W & normal reaction by plane)

(a) horizontally and vertically.
(b) parallel and perpendicular to the plane.



Q.1 A man moves in an open field such that after moving 10 m in a straight line, he makes a sharp turn of 60° to his left. Find the total displacement of the man just after 7 such turns.
(A) 10 m (B) 20 m (C) 70 m (D) 30 m

Q.2 Momentum of a body moving in a straight line is $p = (t^2 + 2t + 1)$ kg m/s. Force acting on a body at t = 2sec
(A) 6 N (B) 8 N (C) 4 N (D) 2 N

Q.3 From the following pairs of physical quantities, in which group dimensions are not same :
(A) momentum & Impulse (B) torque & energy
(C) energy & work (D) light year & minute

Q.4 A particle moves along a straight line such that at time t its displacement from a fixed point O on the line is $3t^2 - 2$. The velocity of the particle when t = 2 is:
(A) 8 ms^{-1} (B) 4 ms^{-1} (C) 12 ms^{-1} (D) 0

Q.5 If the distance 's' travelled by a body in time 't' is given by $s = \frac{a}{t} + bt^2$ then the acceleration equals
(A) $\frac{2a}{t^3} + 2b$ (B) $\frac{2s}{t^2}$ (C) $2b - \frac{2a}{t^3}$ (D) $\frac{s}{t^2}$

Q.6 Forces of magnitudes 2P, 4P, 3P and P act on a particle in directions parallel to the sides $\vec{AB}, \vec{BC}, \vec{CD}$ and $\vec{DE}$ of a regular hexagon. Find the magnitude and direction of their resultant.

Q.7 Show that energy, density and power form a fundamental system of units. Find the dimensional formula of universal gravitational constant (G) in this system.

Q.8 The area 'A' of a blot of ink is growing such that after t sec. its area is given by $A = 3t^2 + 7 cm^2$. Calculate the rate of increase of area at t = 5 sec.

Q.9 The angle θ through which a pulley turns with time t is specified by the function $\theta = t^2 + 3t - 5$. Find the angular velocity $\omega = \frac{d\theta}{dt}$ at t = 5 sec.

Q.10 The motion of a particle in a straight line is defined by the relation $x = t^4 - 12t^2 - 40$ where x is in metres and t is in sec. Determine the position x, velocity v and accleration a of the particle at t = 2sec.

Q.1 In a given system of units, 1 unit of mass = 2 kg, 1 unit of length = 5 m and 1 unit of time = 5 sec. Then in this system, 1 N represents :

(A) $\frac{5}{2}$ units of force (B) $\frac{2}{5}$ units of force (C) 2 units of force (D) $\frac{1}{2}$ units of force

Q.2 The sum of three forces $\vec{F}_1 = 100N$, $\vec{F}_2 = 80N$ & $\vec{F}_3 = 60N$ acting on a particle is zero. The angle between $\vec{F}_1$ & $\vec{F}_2$ is nearly

(A) 53° (B) 143° (C) 37° (D) 127° (E) 90°

Q.3 A point moves in a straight line so that its displacement is x m at time t sec, given by $x^2 = t^2 + 1$. Its acceleration in m/s^2 at time t sec is :

(A) $\frac{1}{x}$ (B) $\frac{1}{x} - \frac{1}{x^2}$ (C) $-\frac{t}{x^2}$ (D) $-\frac{t^2}{x^3}$ (E) $\frac{1}{x^3}$

Q.4 A particle moves in the xy plane and at time t is at the point whose coordinates are $(t^2, t^3 - 2t)$. Then at what instant of time will its velocity and acceleration vectors be perpendicular to each other?

(A) 1/3 sec (B) 2/3 sec (C) 3/2 sec (D) never

Q.5 The co-ordinates of a moving particle at a time t, are given by, $x = 5 \sin 10t$, $y = 5 \cos 10t$. The speed of the particle is :

(A) 25 (B) 50 (C) 10 (D) None

Q.6 The momentum of a particle moving in straight line is given by

$$p = \ln t + \frac{1}{t} \text{ (in m/s)}$$

find the (time $t > 0$) at which the net force acting on particle is 0 and it's momentum at that time.

Q.7 The x-y coordinates in meter of a body of mass 2 kg are given as $(4t^2 + 1, 3t^2 - 16t + 16)$. Find

(i) times when the particle crosses x-axis and position of body at these times

(ii) (a) time when velocity is perpendicular to acceleration.

(b) momentum of the particle at this instant

Q.8 A point moves in a straight line so that its distance from the start in time t is equal to

$$s = \frac{1}{4} t^4 - 4t^3 + 16t^2.$$

(a) At what times was the point at its starting position?

(b) At what times is its velocity equal to zero?

Q.9 An object of weight W is fastened to one end of a string whose other end is fixed and is pulled sideways by a horizontal force P until the string is inclined at 37° to the vertical. Draw a diagram showing the forces acting on the object and resolve each force parallel and perpendicular to the string.

Q.10 If instead of mass length and time as fundamental quantities we choose velocity, acceleration and force as fundamental quantities and express their dimensional symbols as V, A and F repectively. Show that the dimensions of Young's modulus can be expressed as FA^2V^{-4}.

BANSAL CLASSES — PHYSICS

Target IIT JEE 2007 — **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 16-17/05/2005* *MAX.TIME : 60 Min.* *DPP. NO.-9*

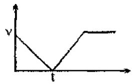
Q.1 The dimensional formula for which of the following pair is not the same
(A) impulse and momentum (B) torque and work
(C) stress and pressure (D) momentum and angular momentum

Q.2 Which of the following forces cannot be a resultant of 5N force and 7N force?
(A) 2N (B) 10N (C) 14N (D) 5N

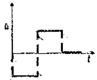
Q.3 The velocity of a particle moving on the x-axis is given by $v = x^2 + x$ where v is in m/s and x is in m. Find its acceleration in m/s^2 when passing through the point x = 2m
(A) 0 (B) 5 (C) 11 (D) 30

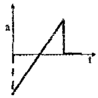
Q.4 A particle moves in space such that
$x = 2t^3 + 3t + 4$; $y = t^2 + 4t - 1$; $z = 2\sin \pi t$
where x, y, z are measured in meter and t in second. The acceleration of the particle at t = 3s is
(A) $36\hat{i} + 2\hat{j} + \hat{k}\ ms^{-2}$ (B) $36\hat{i} + 2\hat{j} + \pi\hat{k}\ ms^{-2}$ (C) $36\hat{i} + 2\hat{j}\ ms^{-2}$ (D) $12\hat{i} + 2\hat{j}\ ms^{-2}$

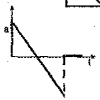
Q.5 The velocity of a particle moving in straight line is given by the graph shown here. Then its acceleration is best represented by



(A) 

(B) 

(C) 

(D) 

Q.6 Assuming that the period of vibration of a tuning fork depends upon the length of the prongs (l), on the density (d) and the Young's modulus of the material (Y), find by the method of dimensions, the formula for the period of vibration.

Q.7 A force $\vec{F} = 5\hat{i} + 2\hat{j} + \hat{k}$ displaces a body from a point of coordinate (1, 1, 1) to another point of coordinates (2, 0, 3). Calculate the work done by the force.

Q.8 A body whose mass is 3 kg performs rectilinear motion according to the formula $s = 1 + t + t^2$, where s is measured in centimeters & t in seconds. Determine the kinetic energy $\frac{1}{2}mv^2$ of the body in 5 sec after its start.

Q.9 The angle rotated by a disc is given by $\theta = \frac{2}{3}t^3 - \frac{25}{2}t^2 + 77t + 5$, where θ is in rad. and t in seconds.
(a) Find the times at which the angular velocity of the disc is zero.
(b) Its angular acceleration at these times.

Q.10 A body of mass 1 kg moves in x-y plane such that its position vector is given by $\vec{r} = \sin(t)\hat{i} + \cos(t)\hat{j}$
(i) Find its equation of trajectory.
(ii) Find the velocity of the particle at the initial time.
(iii) Find the component of its acceleration in the direction of velocity at time t.
(iv) Find angle between velocity vector and acceleration vector at time t.

PHYSICS
Daily Practice Problems

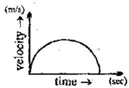
CLASS : XI (P, Q, R, S) *DATE : 18-19/05/2005* *MAX.TIME : 60 Min.* *DPP. NO.-10*

Q.1 If $\vec{a}, \vec{b}$ and $\vec{c}$ are unit vectors such that $\vec{a}+\vec{b}-\vec{c}=\vec{0}$, then the angle between $\vec{a}$ and $\vec{b}$ is
(A) 30° (B) 60° (C) 90° (D) 120°

Q.2 The velocity of a body moving in a straight line is given by $V = (3x^2 + x)$ m/s. Find acceleration at $x = 2$m.
(A) 182 m/s^2 (B) 172 m/s^2 (C) 192 m/s^2 (D) 162 m/s^2

Q.3 A particle moves in a straight line, according to the law $x = 4a\left[t + a\sin\left(\frac{t}{a}\right)\right]$, where x is its position in meters, t in sec. & a is some constants, then the velocity is zero at
(A) $x = 4a^2\pi$ meters (B) $t = \pi$ sec. (C) $t = 0$ sec (D) none

Q.4 Velocity time graph of a particle is in shape of a semicircle of radius R as shown in figure. Its average acceleration from T = 0 to T = R is:
(A) 0 m/s^2 (B) 1 m/s^2
(C) R m/s^2 (D) 2R m/sec^2



Q.5 Coordinates of a moving particle are given by $x = ct^2$ and $y = bt^2$. The speed of the particle is given by
(A) $2t(c+b)$ (B) $2t\sqrt{c^2-b^2}$ (C) $t\sqrt{c^2+b^2}$ (D) $2t\sqrt{c^2+b^2}$

Q.6 Four forces of magnitudes P, 2P, 3P and 4P act along the four sides of a square ABCD in cyclic order. Use the vector method to find the resultant force.

Q.7 The displacement of air particle in a flute is given by $x = a\sin(\omega t)\cos(kx)$ where w is a quantity which depends on the length of the flute (L), gas constant (R), temperature of air (T) and mass per unit mole of the air (μ). Find an expression for ω in terms of all these quantities [Use PV = nRT]

Q.8 A wheel rotates so that the angle of rotation is proportional to the square of time. The first revolution was performed by the wheel for 8 sec. Find the angular velocity ω, 32 sec after the wheel started.

Q.9 A particle of mass 10 kg moves in x-y plane such that its position is given by (3 sin t, 4 cos t). where t is the time find **(i)** its momentum vector at time $t = \pi$ sec. **(ii)** net force acting on it at this time

Q.10 Two vectors $\vec{a}$ & $\vec{b}$ are varying with time as $\vec{a} = 3t\,\hat{i} + 4t^2\,\hat{j}$ & $\vec{b} = (6t+3)\,\hat{i} + (7\sin t)\,\hat{j}$
Find the magnitude of the rate of change of $\vec{a}.\vec{b}$ at $t = \pi/2$ sec.

Q.11 The velocity of a point moving in straight line changes according to the equation $V = (3t^2 + 2t + 1)$ m/s. Find the path covered by the point during 10 seconds from the start.

CLASS : XI (P, Q, R, S) *DATE : 20-21/05/2005* *MAX. TIME : 60 Min.* *DPP. NO.-11*

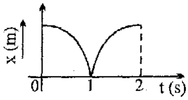
Q.1 Which of the following pairs don't have same dimensions?
(A) solid angle and unit vector
(B) potential energy and torque
(C) (area × velocity) and rate of change of volume with time
(D) none of these

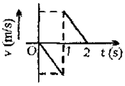
Q.2 Which of the following is not a vector quantity ?
(A) force (B) current (C) velocity (D) torque

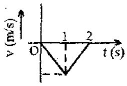
Q.3 A body moves with velocity $v = \ell n\, x$ m/s where x is its position. The net force acting on body is zero at:
(A) 0 m (B) $x = e^2$ m (C) $x = e$ m (D) $x = 1$ m

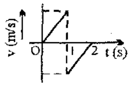
Q.4 The initial velocity of a particle is u and the acceleration is given by (kt), where k is a positive constant. The distance travelled in time t is :
(A) $s = ut^2 + kt^2$ (B) $s = ut + (kt^3/6)$ (C) $s = ut + (kt^3/2)$ (D) $s = (ut^2/2) + (kt^3/6)$

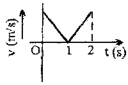
Q.5 The displacement-time graph of a moving particle with constant acceleration is shown in the figure. The velocity-time graph is best given by



(A) 

(B) 

(C) 

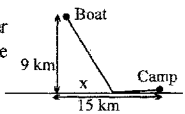
(D) 

Q.6 A force of 40N is responsible for the motion of a body governed by the equation $s=2t+2t^2$ where s is in metres and t in sec. What is the momentum of the body at t=2 sec?

Q.7 The position vector of a body of mass m=6kg is given as $\mathbf{r} = \hat{\mathbf{i}}(3t^2-6t) + \hat{\mathbf{j}}(-4t^3)$m. Find:
(a) the force ($\mathbf{F} = m\mathbf{a}$) acting on the particle
(b) the power ($\mathbf{P} = \mathbf{F} \cdot \mathbf{v}$) generated by the force.
(c) the momentum($\mathbf{p} = m\mathbf{v}$)

Q.8 The slope of the velocity diaplacement graph of a particle moving along a staight line is 10 units at a position where velocity is 5 units. The acceleration of the particle at that position is ________ units.

Q.9 A fishing boat is anchored 9km away from the nearest point on shore. A messenger must be sent from the fishing boat to a camp, 15km from the point on shore closest to the boat. If the messenger can walk at a speed of 5km per hour and can row at 4km per hour.

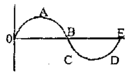


(i) Form an expression relating time taken to reach the camp t with distance x on shore where he lands.
(ii) At what point on shore must he land in order to reach the camp in the shortest possible time?

Q.10 The acceleration of the particle moving in straight line is given by $a = 4t-30$ where a is in m/s^2 and t is in sec. Determine the velocity and displacement as function of time. The initial displacement at $t = 0$ is $s_0 = -5$m and the initial velocity is $v_0=3$m/s.

Q.11 A particle is accelerated with acceleration 3+2t where t is time. At t = 0 the velocity is 4. Find the velocity as a function of time and the distance between the position of the particle at time zero and time 4.

Q.1 A particle has a rectilinear motion and the figure gives its displacement as a function of time. Which of the following statements are true with respect to the motion



(A) in the motion between O and A the velocity is positive and acceleration is negative
(B) between A and B the velocity and acceleration are positive
(C) between B and C the velocity is negative and acceleration is positive
(D) between D and E the acceleration is positive

Q.2 A particle moves in the x–y plane with velocity $v_x = 8t-2$ and $v_y = 2$. If it passes through the point x = 14 and y = 4 at t = 2 sec. The equation of the path is
(A) $x = y^2-y+2$ (B) $x = y+2$ (C) $x = y^2+2$ (D) $x = y^2+y+2$

Q.3 A particle moves along x–axis according to the law $x=t^3-3t^2-9t+5$ m then
(A) in the interval $3<t<5$, the particle is moving in +x direction
(B) the particle reverses its direction of motion twice in entire motion if it starts at t=0
(C) the average acceleration from $1 \le t \le 2$ sec is 6 m/s^2
(D) in the interval $5 \le t \le 6$ sec, the distance travelled is equal to the displacement

Q.4 A motor boat of mass m moves along a lake with velocity V_0. At t = 0, the engine of the boat is shut down. Magnitude of resistance force offered to the boat is equal to rV. (V is instantaneous speed). What is the total distance coverd till it stops completely?
(A) mV_0/r (B) $3\,mV_0/2r$ (C) $mV_0/2r$ (D) $2\,mV_0/r$

Q.5 A particle having a velocity $v = v_0$ at t = 0 is decelerated at the rate $|a| = \alpha\sqrt{v}$, where α is a positive constant.
(A) The particle comes to rest at $t = \dfrac{2\sqrt{v_0}}{\alpha}$
(B) The particle will come to rest at infinity.
(C) The distance travelled by the particle is $\dfrac{2v_0^{3/2}}{\alpha}$.
(D) The distance travelled by the particle is $\dfrac{2}{3}\dfrac{v_0^{3/2}}{\alpha}$.

Q.6 $\vec{F} = (\sin t)i + (\cos t)j$, m = 1, $\vec{r}_0 = -j$, $\vec{v}_0 = i$. Find $\vec{v}$ and $\vec{r}$.

Q.7 The velocity of a body is given by $v = \dfrac{1}{t^2+4}$ m/s where t is time elapsed. If it is located at origin initially, find its position at t = 2 sec. Useful relation : $\int \dfrac{dx}{x^2+a^2} = \dfrac{1}{a}\tan^{-1}\left(\dfrac{x}{a}\right)+C$

Q.8 The velocity of a certain particle moving along the x axis is proportional to x. At time t=0 the particle is located at x=2 and at time t=10 it is at x=4. Find the position at t=5.

Q.9 A particle moves in a straight line with acceleration $(-\dfrac{1}{3v^2})$ where v is its velocity at time t. Initially the particle is at O, a fixed point on the line, with velocity u. Find in terms of u the time at which the velocity is zero and the displacement of the particle from O at this time.

Q.10 The position coordinate of a particle that is confined to move along a straight line is given by $x = 2t^3-24t+6$ where x is measured from a convenient origin and t is in seconds. Determine the distance travelled by the particle during the interval from t=1 sec to t = 4 sec.

CLASS : XI (P, Q, R, S) *DATE : 30-31/05/2005* *MAX.TIME : 60 Min.* *DPP. NO.-13*

Q.1 If a, b, c are three unit vectors such that a + b + c = 0, then a.b + b.c + c.a is equal to

(A) –1 (B) 3 (C) 0 (D) $-\frac{3}{2}$

Q.2 Two forces P and Q act at a point and have resultant R. If Q is replaced by $\frac{(R^2-P^2)}{Q}$ acting in the direction opposite to that of Q, the resultant
(A) remains same (B) becomes half (C) becomes twice (D) none of these

Q.3 A particle moving along a straight line with uniform acceleration has velocities 7m/s at A and 17m/s at C. B is the mid point of AC. Then
(A) the velocity at B is 12m/s
(B) the average velocity between A and B is 10m/s
(C) the ratio of the time to go from A to B to that from B to C is 3 : 2
(D) the average velocity between B and C is 15m/s

Q.4 A bird flies for 4 sec with a velocity of $|t-2|$ m/s in a straight line, where t = time in seconds. It covers a distance of
(A) 2 m (B) 4 m (C) 6 m (D) 8 m

Q.5 The greatest acceleration or deceleration that a train may have is a. The minimum time in which the train may reach from one station to the other separated by a distance d is

(A) $\sqrt{\frac{d}{a}}$ (B) $\sqrt{\frac{2d}{a}}$ (C) $\frac{1}{2}\sqrt{\frac{d}{a}}$ (D) $2\sqrt{\frac{d}{a}}$

Q.6 Two towns A and B are connected by a regular bus service with a bus leaving in either direction every T minutes. A man cycling with speed of 20km/h in the direction A to B, notices that a bus goes past him every $t_1 = 18$ minutes in the direction of motion, and every $t_2 = 6$ minutes in the opposite direction. What is the period T of the bus service? Assume that velocity of cyclist is less than velocity of bus
(A) 4.5 minutes (B) 24 minutes (C) 9 minutes (D) 12 minutes

Q.7 The displacement of a body of mass m 3 kg is given as, $\vec{S} = 2\sin t(\hat{i}) + \tan t(\hat{j})$ the velocity & K.E. of the body at time $t = \pi/6$ sec. are given as__________.

Q.8 (a) Find a unit vector at an angle of 45° with x-axis.
(b) Resolve a vector $\vec{R} = 2\hat{i} - 3\hat{j}$ into two perpendicular components such that.
One of its components makes an angle of 45° with (+ x-axis).

Q.9 If energy, density and power form a fundamental system of units. Find the dimensional formula of momentum in terms of these quantities.

Q.10 At a distance L = 400m from the traffic light brakes are applied to a locomotive moving at a velocity v = 54 km/hr. Determine the position of the locomotive relative to the traffic light 1 min after the application of the brakes if its acceleration is $-0.3 m/sec^2$.

CLASS : XI (P, Q, R, S) **DATE : 01-02/06/2005** **MAX.TIME : 60 Min.** **DPP. NO.-14**

Q.1 The vector $i + xj + 3k$ is rotated through an angle θ and doubled in magnitude, then it becomes $4i + (4x-2)j + 2k$. The values of x are

(A) $-\frac{2}{3}$ (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) 2

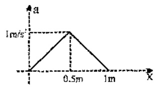
Q.2 If the resultant of two forces of magnitudes P and 2P is perpendicular to P, then the angle between the forces is

(A) $\frac{2\pi}{3}$ (B) $\frac{3\pi}{4}$ (C) $\frac{4\pi}{5}$ (D) $\frac{5\pi}{6}$

Q.3 A ball is thrown at an angle θ such that its range R is related to its time of flight T as $R = 5T^2$. If $g = 10ms^{-2}$, the value of θ is

(A) 45° (B) 90° (C) 30° (D) 60°

Q.4 A body initially at rest, starts moving along x-axis in such a way so that its acceleration vs displacement plot is as shown in figure. The maximum velocity of particle is



(A) 1 m/s (B) 6 m/s
(C) 2 m/s (D) none

Q.5 A body is thrown up in a lift with a velocity u relative to the lift and the time of flight is found to be t. The acceleration with which the lift is moving up is

(A) $\frac{u-gt}{t}$ (B) $\frac{2u-gt}{t}$ (C) $\frac{u+gt}{t}$ (D) $\frac{2u+gt}{t}$

Q.6 A car is moving with uniform acceleration along a straight line between two stops X and Y. Its speed at X and Y are 2m/s and 14m/s. Then
(A) Its speed at mid point of XY is 15m/s
(B) Its speed at a point A such that XA : AY = 1 : 3 is 5m/s
(C) The time to go form X to the mixed point of XY is double of that to go from mid point to Y.
(D) The distance travel in first half of the total time is half of the distance travelled in the second half of the time.

Q.7 If the velocity of the particle is given by

$$v = \frac{a}{t} + bt^2$$

The dimensions of a & b are given as ________.

Q.8 The heat given to a body to raise it's temperature is given as,

$$Q = ms\,\Delta t$$

where $Q \longrightarrow$ heat given
$m \longrightarrow$ mass of the body
$s \longrightarrow$ specific heat
$\Delta t \longrightarrow$ change in temperature.

Find the dimensions of specific heat (s).

Q.9 Find the relation between torque (τ), time (t) and angular momentum (L).
If torque (τ) = length × force,
angular momentum (L) = length × momentum.

Q.10 A lift starts from the top of a mine shaft & descends with a constant speed of $10\,m\,s^{-1}$. 4 sec. later a boy throws a stone vertically upwards from the top of the shaft with a speed of $30\,m\,s^{-1}$. Find when & where stone hits the lift. ($g = 10\,m/s^2$)

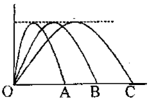
Q.1 If the resultant of three forces $F_1 = pi + 3j - k$, $F_2 = -5i + j + 2k$ and $F_3 = 6i - k$ acting on a particle has magnitude equal to 5 units, then the value (s) of p is (are)
(A) – 6 (B) – 4 (C) 2 (D) 4

Q.2 The angle between $(\hat{i}+\hat{j}+\hat{k})$ & $(2\hat{i}+2\hat{j}-2\hat{k})$ is
(A) $\text{Cos}^{-1}\frac{1}{3}$ (B) $\text{Cos}^{-1}\frac{1}{\sqrt{3}}$ (C) $\text{Sin}^{-1}\frac{1}{3}$ (D) None of these.

Q.3 A ball is thrown vertically upwards with a velocity 'u' from the balloon descending with velocity V. The ball will pass by the balloon after time.
(A) $\frac{u-V}{2g}$ (B) $\frac{u+V}{2g}$ (C) $\frac{2(u-V)}{g}$ (D) $\frac{2(u+V)}{g}$

Q.4 A projectile is thrown from ground. With what minimum velocity, the projectile should be thrown so that is passes through a point (3, 4). (Take $g = 10\ m/s^2$)
(A) $3\sqrt{5}$ m/s (B) 7.5 m/s (C) $\sqrt{10}$ m/s (D) $3\sqrt{10}$ m/s

Q.5 Three projectiles A, B and C are thrown simultaneously from the same point in the same vertical plane. Their trajectories are shown in the figure. Then which of the following statement is **false**.



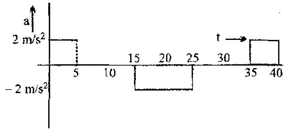
(A) The time of flight is the same for all the three.
(B) The launch speed is greatest for particle C.
(C) The vertical velocity component for particle C is greater than that for the other particles
(D) Y–coordinate of all particles is always same

Q.6 Two balls are thrown simultaneously at two different angles with the same speed v_0 from the same position so that both have equal ranges. If H_1 and H_2 be the maximum heights attained in two cases, then the summation $H_1 + H_2$ is equal to
(A) $\frac{v_0^2}{2g}$ (B) $\frac{v_0^2}{g}$ (C) $\frac{2v_0^2}{g}$ (D) $\frac{v_0^2}{4g}$

Q.7 The velocity of the particle is given as $v = 3t^3 + t - \frac{1}{t^2}$. Calculate the net force acting on the body at time t = 2 sec, if the mass of the body is 5 kg __________.

Q.8 Two forces of magnitudes P & Q are inclined at an angle (θ) the magnitude of their resultant is 3Q. When the inclination is changed to (180 – θ) the magnitude of the resultant force becomes Q. Find the ratio of the forces.

Q.9 Figure shows a graph of acceleration of a particle moving on the x-axis. Plot the following graphs if the particle is at origin and at rest at t = 0.



(i) velocity-time graph
(ii) displacement-time graph
(ii) distance-time graph.

Q.10 As a car passes the point A on a straight road its speed is 10 m/s. The car moves with constant acceleration a m/s^2 along the road for T seconds till it reaches the point B where its speed is *v* m/s. The car travels at this speed for a further 10 sec till it reaches the point C. From C it travels for a further T seconds with constant acceleration 3a m/s^2 until it reaches a speed of 20 m/s at point D.
(i) Find *v*
Given that the distance between A & D is 675 m find
(ii) a & T.

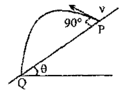
BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) *DATE : 06-07/06/2005* *MAX.TIME : 60 Min.* *DPP. NO.-16*

Q.1 A body is projected at time (t = 0) from a certain point on a planet's surface with a certain velocity at a certain angle with the planet's surface (assumed horizontal). The horizontal and vertical displacements x & y (in meter) respectively vary with time t in second as, $x = 10\sqrt{3}\ t$ and $y = 10t - t^2$. Then the maximum height attained by the body is :
(A) 200 m (B) 100 m (C) 50 m (D) 25 m

Q.2 If time taken by the projectile to reach Q is T, than PQ =
(A) $Tv \sin\theta$ (B) $Tv \cos\theta$
(C) _ . $\sec\theta$ (D) $Tv \tan\theta$



Q.3 If R is the range of a projectile on a horizontal plane and h its maximum height, then maximum horizontal range with the same speed of projection is
(A) 2h (B) $\frac{R^2}{8h}$ (C) $2R + \frac{h^2}{8R}$ (D) $2h + \frac{R^2}{8h}$

Q.4 A football is thrown in a parabolic way. Is there any point at which the acceleration is parallel to velocity? Perpendicular to velocity?

Q.5 A ball is thrown upward at an angle of 30° to the horizontal and lands on the top edge of a building that is 20m away. The top edge is 5m above the throwing point. How fast was the ball thrown?

Q.6 A ball rolls off edge of a tabletop 1m above the floor and strikes the floor at a point 1.5m horizontally from the edge of the table. (a) Find the time of flight (b) Find the initial velocity (c) Find the magnitude and direction of the velocity of the ball just before it strikes the floor.

Q.7 A stone is thrown horizontally . In 0.5 second after the stone began to move, the magnitude of its velocity was 1.5 times its initial velocity. Find the initial velocity of the stone.

Q.8 A level flight plane flying at an altitude of 1024ft with a speed of 240ft/sec. is overtaking a motor boat travelling at 80ft/sec. in the same direction as the plane. At what horizontal distance before the boat should a bag be dropped from the plane in order to hit the boat? [$g = 32 ft/s^2$]

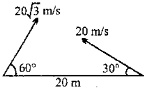
Q.9 A ball is projected at an angle of 30° above with the horizontal from the top of a tower and strikes the ground in 5 sec at an angle of 45° with the horizontal . Find the height of the tower and the speed with which it was projected. [$g = 10\ m/s^2$]

Q.10 A boy throws a water filled balloon at an angle of 53° with a speed of 10m/sec. A car is advancing toward the boy at a constant speed of 5m/sec. If the balloon is to hit the car, how far away should the car be when the balloon is thrown?

CLASS : XI (P, Q, R, S) *DATE : 08-09/06/2005* *MAX.TIME : 60 Min.* *DPP. NO.-17*

Q.1 A particle is projected with a certain velocity at an angle θ above the horizontal from the foot of a given plane inclined at an angle of 45° to the horizontal. If the particle strike the plane normally then θ equals
(A) $\tan^{-1}(1/3)$ (B) $\tan^{-1}(1/2)$ (C) $\tan^{-1}(1/\sqrt{2})$ (D) $\tan^{-1} 3$

Q.2 In the figure shown, the two projectiles are fired simultaneously. The minimum distance between them during their flight is



(A) 20 m (B) $10\sqrt{3}$ m (C) 10 m (D) None

Q.3 A projectle is fired horizontally from an inclined plane (of inclination 30° with horizontal) with speed = 50 m/s. If $g = 10\ m/s^2$, the range measured along the incline is
(A) 500 m (B) 1000/3 m (C) $200\sqrt{2}$ m (D) $100\sqrt{3}$ m

Q.4 A child moving on a smooth horizontal ground throws a ball at 10 m/s and 60° from horizontal with respect to himself. Ball strikes a box placed at a distance 10 m from the point of projection after 1 sec of projection. The velocity with which child now moving is :
(A) 2.5 m/s (B) 5 m/s (C) 10 m/s (D) 20 m/s

Q.5 A train is moving on a track at 30 m/s. A ball is thrown from it perpendicular to the direction of motion at 30 m/s at 45° from horizontal. Find the distance of ball from the point of projection on train when it strikes the ground.
(A) 90 m (B) $90\sqrt{3}$ m (C) 60 m (D) $60\sqrt{3}$ m

Q.6 Two trains A and B are travelling from station P to Q starting from P and stopping at Q. Train A has constant acceleration a for (1/3)rd of time, constant velocity for second $(1/3)^{rd}$ of time and constant retardation a for last (1/3)rd of time. Train B has same constant acceleration a for first (1/3)rd of distance, constant velocity for 2nd (1/3)rd of distance & constant retardation a for last (1/3)rd of distance. Find the ratio of time taken by train A and train B from P to Q.

Q.7 A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10km/h. He finds that raindrops are hitting his head vertically. Find the speed of the raindrops w.r.t. (a) the road, (b) the moving man.

Q.8 A man wishes to cross a river to an exactly opposite point on the other bank ; if he can pull his boat with twice the velocity of the current, find at what inclination to the current he must point the boat.

Q.9 A man who can swim at the rate of 2 km/hr. crosses a river to an exactly opposite point on the other bank by swimming in a direction of 120° to the flow of the water in the river. The velocity of the water current in km/hr is ______________.

Q.10 Velocity of water current in a river is 2 km/hr. A boat rowing with a velocity of 8 k /hr. A boat rowing with a velocity of 8 km/hr. is directed towards exactly opposite point on the other side of the bank. However the boat strikes the opposite bank 75 m away from the desired point. The width of the river is ________.

Q.1 A stationary man observes that the rain strikes him at an angle 60° to the horizontal. When he begins to move with a velocity of 25 m/s then the drops appear to strike him at an angle of 30° from horizontal. the velocity of the rain drops is :

(A) 25 m/s (B) 50 m/s (C) 12.5 m/s (D) $24\sqrt{2}$ m/s

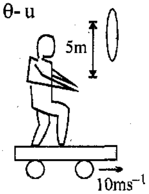
Q.2 Three ships A, B & C are in motion. The motion of A as seen by B is with speed v towards north – east. The motion of B as seen by C is with speed v towards the north – west. Then as seen by A, C will be moving towards

(A) north (B) south (C) east (D) west

Q.3 A projectile is fired with a velocity u making an angle θ with the horizontal. What is the change in velocity when it is at the highest point ?

(A) $u\cos\theta$ (B) u (C) $u\sin\theta$ (D) $u\cos\theta - u$

Q.4 A girl is riding on a flat car travelling with a constant velocity $10\ ms^{-1}$ as shown in the fig. She wishes to throw a ball through a stationary hoop in such a manner that the ball will move horizontally as it passes through the hoop. She throws the ball with an initial speed $\sqrt{136}\ ms^{-1}$ with respect to car. The horizontal distance in front of the hoop at which ball has to be thrown is



(A) 1m (B) 2m
(C) 4m (D) 16m

Q.5 An airplane pilot wants to fly from city A to city B which is 1000 km due north of city A. The speed of the plane in still air is 500 km/hr. The pilot neglects the effect of the wind and directs his plane due north and 2 hours later find himself 300km due north-east of city B. The wind velocity is

(A) 150km/hr at 45°N of E (B) 106km/hr at 45°N of E
(C) 150 km/he at 45°N of W (D) 106 km/hr at 45°N of W

Q.6 A river of width 500 m is flowing from west to east with speed of 3 km/hr. Two boatmen, Raju & Kaju start from the same point on southern bank of river. Raju travels at 5 km/hr in still water, while Kaju travels at 4 km/hr in still water. Raju crosses the river along shortest path while Kaju crosses the river along a path which will take him shortest time to cross the river. Find

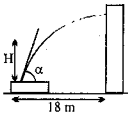
(a) the distance between the points where they land on the other bank.
(b) the times taken by Raju & Kaju to reach the other bank.

Q.7 A man holding a flag is running in North-East direction with speed 10 m/s. Wind is blowing in east direction with speed $5\sqrt{2}$ m/s. Find the direction in which flag will flutter.

Q.8 Two ships are 10km apart on a line running south to north. The one further north is steaming west at 40km/hr. The other is steaming north at 40km/hr. What is their distance of closest approach and how long do they take to reach it?

Q.9 A target is fixed on the top of a pole 13 m high. A person standing at a distance of 50 m from the pole is capable of projecting a stone with a velocity of $10\sqrt{g}$ m/s. If his aim is to strike the target in least time what should be the angle of elevation of the stone.

Q.10 A fire nozzle situated at a distance 18 m from the building discharges water with an initial velocity of 30 m/s as shown in the figure. Find :



(i) the maximum height h that can be reached by water.
(ii) the corresponding angle α.

BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
HOME TEST-1

CLASS : XI (P1) *DATE : 11/06/2005* *TIME : 90 Min.* *MAX.MARKS: 50*

Q.1 A grass hope jump maximum distance 1.6m. It spends negligible time on the ground. How far will go in 10 seconds ? **[2]**

(A) $5\sqrt{2}$ m (B) $10\sqrt{2}$ m (C) $20\sqrt{2}$ m (D) $40\sqrt{2}$ m

Q.2 The coordinates of a moving particle at any time t are given $x = at^2$ and $y = bt^2$, $z = 0$. The speed of particle at time t is given by **[2]**

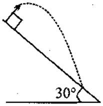
(A) $t\sqrt{a^2+b^2}$ (B) $2t\sqrt{a^2+b^2}$ (C) $\sqrt{a^2+b^2}$ (D) $2t^2\sqrt{a^2+b^2}$

Q.3 A projectle is fired horizontally from an inclined plane (of inclination 45° with horizontal) with speed = 50 m/s. If $g = 10$ m/s^2, the range measured along the incline is **[2]**

(A) 500 m (B) $500\sqrt{2}$ m (C) $200\sqrt{2}$ m (D) none of these

Q.4 A ball is thrown vertically upwards from the ground. It crosses a point at the height of 25 m twice at an interval of 4 secs. The ball was thrown with the velocity of **[2]**
(A) 20m/sec. (B) 25 m/sec. (C) 30m/sec. (D) 35 m/sec.

Q.5 A ball is projected from point A with velocity 10m/sec. perpendicular to the inclined plane as in figure. Range of the ball on the incline is **[2]**
(A) $40\sqrt{3}$m (B) 20/13 m (C) 13/20 m D) 40/3m



Q.6 A body is projected at an angle 60° with the horizontal ground with kinetic energy k. When the velocity makes an angle 30° with the horizontal, the kinetic energy of the body will be **[3]**
(A) k/2 (B) k/3 (C) 2k/3 (D) 3k/2

Q.7 A particle moves along a straight line in such a way that its acceleration is increasing at the rate of 2 m/s^3. Its initial acceleration and velocity were zero. Then, the distance which it will cover in the 3rd second is: **[3]**

(A) 19/3 m (B) 12/5 m (C) 17/5 m (D) 19/4 m

Q.8 An object is thrown horizontally from a tower H meter high with a velocity of $\sqrt{2gH}$ m/s. Its speed on striking the ground will be : **[3]**

(A) $\sqrt{2gH}$ (B) $\sqrt{6gH}$ (C) $2\sqrt{gH}$ (D) $2\sqrt{2gH}$

Q.9 Two particles are fired from the same point, with speeds 100 m/s and 100 m/s, and firing angles with horizontal = 60° and 120° respectively. The time after which their velocity vectors become perpendicular to each other, is **[3]**

(A) 5 s (B) $5(\sqrt{3}-1)$ s (C) $5\sqrt{3}$ s (D) $5\sqrt{3}/2$ s

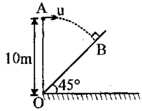
Q.10 The equation of the path of the projectile is $y = 0.5x - 0.04x^2$. The initial speed of the projectile is **[3]**
(A) 10 m/s (B) 15 m/s (C) 12.5 m/s (D) None

Q.11 A stationary man observes that the rain strikes him at an angle 60° to the horizontal. When he begins to move with a velocity of 25 m/s then the drops appear to strike him at an angle of 30° from horizontal. Find the velocity of the rain drops. **[5]**

Q.12 A particle is projected horizontally with speed u from point A, which is 10 m above the ground. If the particle hits the inclined plane perpendicularly at point B. [$g = 10\ m/s^2$]

(a) Find horizontal speed with which the particle was projected.

b Find the length OB along the inclined plane. **[5]**

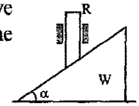


Q.13 Man A sitting in a car moving at 54 km/hr observes a man B in front of the car crossing perpendicularly the road of width 15 m in three seconds. Find the velocity of man B. **[5]**

Q.14 A man can swim in still water at a speed of 5 km/hr. He wants to cross a river 6 km wide, flowing at the rate of 4 km/hr. If he heads in a direction making an angle of 127° with stream direction. Find the distance he drifts along the river by the time he reaches the opposite bank. **[5]**

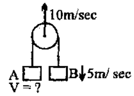
Q.15 Raindrops are falling vertically with a velocity of 10 m/s. To a cyclist moving on a straight road the raindrops appear to be coming with a velocity of 20 m/s. Find the velocity of cyclist. **[5]**

Q.1 In the arrangement shown, all surfaces are frictionless. The rod R is constrained to move vertically. The vertical acceleration of R is a_1 and the horizontal acceleration of the wedge W is a_2. The ratio a_1/a_2 is equal to

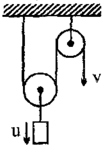


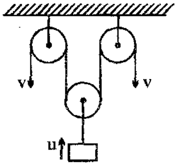
(A) sin α (B) cos α (C) tan α (D) cot α

Q.2 The pulley moves up with a velocity of 10m/sec. Two blocks are tied by a string which passes over a pulley. The velocity V will be ________.
Given: $v_B = 5$m/s↓



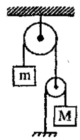
Q.3 In the figure shown, the strings are inextensible. Determine the value of u in terms of v.



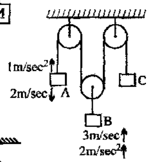


i u = ______________. (ii) u = ______________

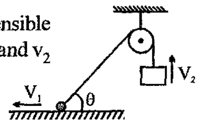
Q.4 In the pulley system shown, find the relationship between acceleration of m and that of M.



Q.5 For the system shown, calculate velocity and acceleration of C. The velocity and acclerations of A and B with respect to ground are marked.



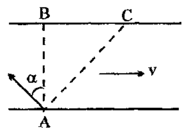
Q.6 In the figure, a ball and a block are joined together with an inextensible string. The ball can slide on a smooth horizontal surface. If v_1 and v_2 are the respective speeds of the ball and the block, then determine the constraint relative between the two.



Q.7 Two cars A and B moves on two straight paths at right angles with speeds 20 km/hr and 15 km/hr respectively. When a reaches the intersection of the paths b is 25 km far from it. The shortest distance between the cars is ________ km and they are closest after _______ min from the moment when A was at intersection of the paths.

Q.8 A ball is thrown at an angle to the horizontal such that it just grazes past the top of a pole 4 m high. If the initial velocity of projection is 20 m/s, angle of projection is 53° and the ball reaches the pole during its downward flight, the distance of the pole from the point of projection.

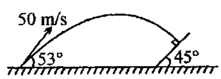
Q.9 If a man in a boat crosses a river from point A and rows perpendicular to the banks then he will reach point C lying at distance 120 m downstream from point B in 10 minutes. If the man heads at a certain angle α to the straight line AB, (perpendicular to banks) against the current he will reach point B after 12.5 minutes. Find the width of the river d, velocity of boat u relative to water, the speed of the current v and the angle α. Assume the velocity of boat relative to the water to be constant and same in both cases.



Q.10 A projectile is thrown with velocity of 50 m/s towards an inclined plane from ground such that it strikes the inclined plane perpendicularly. The angle of projection of the projectile is 53° with the horizontal and the inclined plane is inclined at an angle of 45° to the horizontal.

(a) Find the time of flight.

(b) Find the distance between the point of projection and the foot of inclined plane.



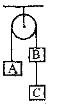
BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) ***DATE : 15-16/06/2005*** ***MAX.TIME : 60 Min.*** ***DPP. NO.-20***

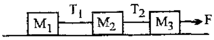
Q.1 A man is standing in a lift which goes up and comes down with the same constant acceleration. If the ratio of the apparent weights in the two cases is 2 : 1, then the acceleration of the lift is
(A) 3.33 ms^{-2} (B) 2.50 ms^{-2} (C) 2.00 ms^{-2} (D) 1.67 ms^{-2}

Q.2 Three equal weights of mass 2kg each are hanging by a string passing over a fixed pulley. The tension in the string (in N) connecting B and C is
(A)4g/3 (B)g/3 (C)2g/3 (D) g/2

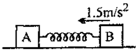


Q.3 A 10kg monkey is climbing a massless rope attached to a 15kg mass over a tree limb. The mass is lying on the ground. In order to raise the mass from the ground he must climb with
(A) uniform acceleration greater than $5 m/sec^2$ (B) uniform acceleration greater than $2.5 m/sec^2$
(C) high speed (D) uniform acceleration greater than $10 m/sec^2$

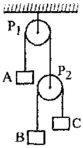
Q.4 Three blocks are connected as shown in the figure, on a horizontal frictionless table and pulled to the right with a force at 60N. if $M_1 = 10$kg, $M_2 = 20$kg and $M_3 = 30$ kg then the value of T_2 is
(A) 40N (B) 30N (C) 20N (D) 10N



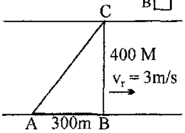
Q.5 Two blocks A & B with mass 4 kg and 6 kg respectively are connected by a stretched spring of negligible mass as in figure. When the two blocks are released simultaneously the initial acceleartion of B is 1.5 m/s^2 westward. The acceleration of A is :
(A) 1 m/s^2 westward (B) 2.25 m/s^2 eastward
(C) 1 m/ ^{2}e t ard (D) 2.75 m ^{2} westward



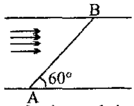
Q.6 The three blocks shown move with constant velocities. Find the velocity of block A and B. Given V_{P2}=10m/s↓, V_c=2m/s ↑.



Q.7 2 men Ram & Gopal are competing to cross a river. Ram start from point A runs to bridge BC and then crosses bridge maintaining a speed of 7 m/s. Gopal swims across to point C starting from point A. His velocity in still water is 4m/s and river flows with velocity of 3 m/s. What is the time taken by each person.



Q.8 A swimmer starts to swim from point A to cross a river. He wants to reach a point B on the opposite side of the river. The line AB makes on angle 60° with the river flow as shown. The velocity of the swimmer in still water is same as that of the river.



(a) In what direction should he try to direct his velocity? Calculate angle between his velocity and river velocity.
(b) Find the ratio of the time taken to cross the river in this situation to the minimum time in which he can cross this river.

Q.9 A projectile is thrown from a platform at a height 10 m above the ground with velocity of 20 m/sec. At what angle should the projectile be thrown to reach the farthest point from O, which is vertically below the point from which it is thrown. [$g = 10 m/s^2$]

Q.10 A particle P is projected horizontally, with speed V, from a point O on a plane which is inclined at an angle β to the horizontal. The particle hits the plane at a point A which is on the line of greatest slope through O. (a) Find the time of flight. (b) Find the tangent of the acute angle between the horizontal and the direction of motion of P when P reached A. A second particle Q is projected from O, with speed V, in a direction perpendicular to the plane. (c) Find the time taken for Q to return to the plane and (d) show that Q hits the plane at A.

BANSAL CLASSES — PHYSICS

Target IIT JEE 2007 — Daily Practice Problems

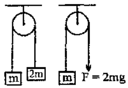
CLASS : XI (P, Q, R, S)   DATE : 17-18/06/2005   MAX.TIME : 60 Min.   DPP. NO.-21

Q.1 A uniform thick string of length 5 m is resting on a horizontal frictionless surface. It is pulled by a horizontal force of 5 N from one end. The tension in the string at 1m from the force applied is :

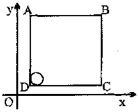
(A) zero (B) 5 N (C) 4 N (D) 1 N

Q.2 Fig shows two pulley arrangements for lifting a mass m. In (a) the mass is lifted by attaching a mass 2m while in (b) the mass is lifted by pulling the other end with a downward force F=2mg, If f_a and f_b are the accelerations of the two masses then

(A) $f_a=f_b$ (B) $f_a=f_b/2$ (C) $f_a=f_b/3$ (D) $f_a=2f_b$



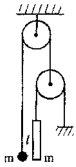
Q.3 A solid sphere of mass 2kg is resting inside a cube as shown in the figure. $V=(5t\hat{i}+2t\hat{j})$m/s. Here t is the time in second. All surfaces are smooth. The sphere is at rest with respect to the cube. What is the total force exerted by the sphere on the cube. (Take $g=10\text{m/s}^2$ & y-axis along vertical)



(A) $\sqrt{29}$ N (B) 29 N

(C) 26 N (D) $\sqrt{89}$ N

Q.4 In the figure shown, all pulleys are massless and frictionless. The acceleration of the time taken by the ball to reach the upper end of the rod is :



(A) $\sqrt{\frac{10l}{3g}}$ (B) $\sqrt{\frac{5l}{3g}}$

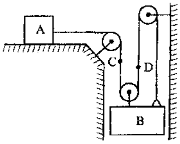
(C) $\sqrt{\frac{3l}{4g}}$ (D) $\sqrt{\frac{3l}{10g}}$

Q.5 Slider block A move to the left with a constant velocity of 6 m/s. Determine

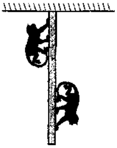
(a) the velocity of block b,

(b) the velocity of portion D of the cable.

(c) the relative velocity of portion C of the cable with respect to portion D.

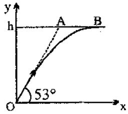


Q.6 Two monkeys of masses 10 and 8 kg are moving along a vertical rope, the former climbing up with an acceleration of 2m/s^2 while the latter coming down with a uniform velocity of 2m/s. Find the tension in the rope at the fixed support.



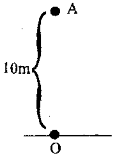
Q.7 A pulley fixed to the ceiling of a lift carries a string whose ends are tied to blocks of mass 2 kg and 1 kg. The lift is having a downward acceleration of 2 m/s^2. Calculate the acceleration of the blocks relative the lift and relative to ground. Also find the tension in the string connecting the blocks.

Q.8 A bird is flying along a horizontal straight line AB, h meters above level ground. It flies with constant speed of 10 m/s over a point O on the ground, where there is a hunter with a shotgun. The hunter fires directly at the bird when it is at A, where OA makes an angle of 53° with the horizontal, as shown in the diagram. The shot leaves the gun at a speed of 80 ms^{-1}. If the shot hits the bird at B, find h and also the coordinates of point B with respect to point of projection O.



Q.9 A man can row a boat in still water at 3 km/h. He can walk at a speed of 5 km/h on the shore. The water in the river flows at 2 km/h. If the man rows across the river and walks along the shore to reach the opposite point on the river bank find the direction with the river flow in which he should row the boat so that he could reach the opposite shore in the least possible time. The width of the river is 500 m.

Q.10 A helicopter is moving vertically upwards with a velocity 5 m/s. When the helicopter is at a height 10m from ground. A stone is thrown with a velocity $(3\hat{i}+4\hat{j})$ m/s from the helicopter w.r.t. the man in it. Considering the point on ground vertically below the helicopter as the origin of coordinates, and the ground below as xy plane, find the coordinates of the point where the stone will fall. Its distance from origin & the distance between the helicopter & the stone, at the instant the stone strikes the ground, assuming helicopter moves upwards with the same velocity.



BANSAL CLASSES
TARGET IIT- JEE 2007

PHYSICS
REVIEW TEST-1

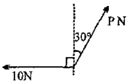
Max. Marks : 50	*Class: XI (P, Q, R, S)*	*Time : 90 Min*	*Date : 29-05-2005*

General Remarks :
1. The question paper contain 12 questions. All questions are compulsory.
2. Each subjective question should begin after the end of the previous question after drawing a line.
3. Sub part in respect of a subjective question should be done at the same place (if applicable).
4. Use of Calculator, Log table, Slide Rule and Mobile is not permitted.
5. Legibility and clearity in answering the question will be appreciated.
6. Put a cross ($\times$) on the rough work done by you.

Q.1 A particle is moved by a force $\vec{F} = 20\hat{i} - 30\hat{j} + 15\hat{k}$ along a straight line from point A to point B with position vectors $2\hat{i} + 7\hat{j} - 3\hat{k}$ and $5\hat{i} - 3\hat{j} - 6\hat{k}$ respectively. Find the work done. **[3]**

Q.2 The period of oscillation of a nonlinear oscillator depends on the mass m with dimensions of M; a restoring force constant k with dimensions of $ML^{-2}T^{-2}$ and the amplitude A with dimensions of L. By dimensional analysis find the expression for period of oscillation. **[3]**

Q.3 Two horizontal forces of magnitudes 10 N & P N act on a particle. The force of magnitude 10 N acts due west & the force of magnitude P N acts on a bearing of 30° east of north as shown in figure. The resultant of these two force acts due north. Find the magnitude of this resultant. **[3]**



Q.4 Porous rock through which groundwater can move is called an aquifer. The volume V of water that, in time t, moves through a cross section of area A of the aquifer is given by

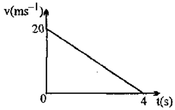
$$V/t = KAH/L,$$

where H is the vertical height of the aquifer over the horizontal distance L. This relation is called Darcy's law. The quantity K is the hydraulic conductivity of the aquifer. What are the SI units of K? **[3]**

Q.5 A particle moves in a straight line with an acceleration 2s where 's' is its displacement from a fixed point on the line, and $v = 0$ when $s = 0$. Find its velocity when its displacement is 's'. **[3]**

Q.6 A car starts from rest and for the first 4 sec of its motion the acceleration a m/s^2 at time t seconds after starting is given by $a = 6 - 2t$
(a) find the maximum velocity of the car
(b) find the velocity of the car after 4 sec and the distance travelled up to this time. **[5]**

Q.7 The diagram shows the (v, t) graph for the motion of a car of mass 600 kg which slows down uniformly from a speed of 20 ms^{-1} to rest in 4 s. The car is moving on a straight level road.



(a) Calculate the magnitude of the braking force that is applied to the car.
(b) Sketch (v, t) graph for the motion of the car when the braking force applied is initially less than the value calculated in part (a) but increases in magnitude as the car slows down. Assume that the initial speed of the car and the time for the car to stop are the same as before. **[5]**

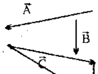
Q.8 A particle moves along the space curve defind by $x = e^{-t}\cos t$, $y = e^{-t}\sin t$, $z = e^{-t}$. Find the magnitude of the **(a)** velocity and **(b)** acceleration at any time t. **[5]**

Q.9 At $t = 0$ a flower pot A is dropped from rest from the window of a highrise building, some height h_A above the ground. Also $t = 0$, another flower pot B is thrown downward from a window higher up (height h_B above ground) with some initial downward speed v_0.

(a) For now, consider only pot A: Find the time at which it arrives at the ground, and the speed it has immediately before hitting the ground. Give each answer in terms of any of h_A and g.

(b) Assume that B, on its way down, passes A without touching it. Find the time at which B catches up with A. Give your answer in terms of any of h_A, h_B, v_0, and g. **[5]**

Q.10 Given the three vectors $\vec{A}, \vec{B}$ and $\vec{C}$ shown.



(i) Which simple combination of any Two of these results in a vector of the largest possible magnitude? (e.g., $\vec{A}-\vec{B}, \vec{B}+\vec{C}$ etc.)

(ii) Which simple combination of all three of these results in a vector of the smallest possible magnitude? (e.g. $\vec{A}+\vec{B}+\vec{C}, \vec{C}-\vec{B}-\vec{A}$ etc.)

(iii) Suppose a complicated physics problem yields the result, $Q = \left(\sqrt{3g/2L_1}\right)(L_1 - L_2)^2/(vL_1)$, where g is the magnitude of some acceleration, the L's are distances, and v is some speed. What are the units of the quantity Q? (Simplify as much as possible) **[5]**

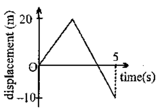
Q.11 Starting at $t = 0$, a mobile robot moves on a horizontal surface such that its position is described by $x(t) = x_0 + \alpha t - \beta t^2$, $y(t) = y_0 - \gamma t^3$, where x_0, y_0, α, β, γ are given constants.

(i) Write an expression for the magnitude $|\vec{a}|$ of the robot's acceleration, in terms of any x_0, y_0, α, β, γ and t.

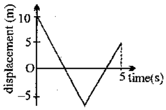
(ii) Is $|\vec{a}|$ constant? If yes, explain why. If not, does it increase or decrease with time? **[5]**

Q.12

(a) The diagram shows the displacement-time graph for a particle moving in a straight line. Find the average velocity for the interval from $t = 0$ to $t = 5$.

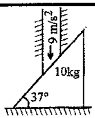


(b) The diagram shows the displacement-time graph for a particle moving in a straight line. Find the average speed for the interval from $t = 0$ to $t = 5$. **[5]**



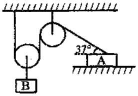
CLASS : XI (P, Q, R, S) **DATE : 20-21/06/2005** **MAX.TIME : 60 Min.** **DPP. NO.-22**

Q.1 System is shown in figure. All the surfaces are smooth. Rod is moved by external agent with acceleration 9 m/s^2 vertically downwards. Force exerted on the rod by the wedge will be:



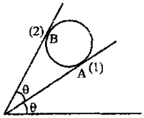
(A) 120 N (B) 200 N (C) 135/2 N (D) 225/2 N

Q.2 In the figure shown the block B moves down with velocity 10 m/s. The velocity of A in the position shown is :



(A) 12.5 m/s (B) 25 m/s
(C) 6.25 m/s (D) none of these

Q.3 A sphere of mass m is kept between two inclined walls, as shown in the figure. If the coefficient of friction between each wall and the sphere is zero, then the ratio of normal reaction (N_1/N_2) offered by the walls 1 and 2 on the sphere will be

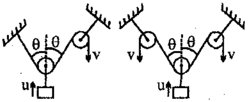


(A) $\tan\theta$ (B) $\tan 2\theta$
(C) $2\cos\theta$ (D) $\cos 2\theta$

Q.4 How could a 10 kg object be lowered down from a height using a cord with a breakup strength of 80 N, without breaking the cord.
(A) lowering the object very slowly
(B) lowering it with an acceleration less than 2 m/s^2.
(C) lowering it with an acceleration greater than 2 m/s^2.
(D) object cannot be lowered down without breaking the cord.

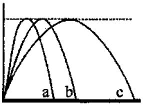
Q.5 A block of weight 9.8N is placed on a table. The table surface exerts an upward force of 10N on the block. Assume g=9.8m/s^2.
(A) The block exerts a force of 10N on the table
(B) The block exerts a force of 19.8N on the table
(C) The block exerts a force of 9.8N on the table
(D) The block has an upward acceleration.

Q.6 If the strings in inextensible, determine the velocity u of each block in terms of v and θ.

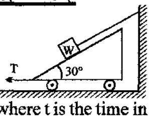


(i) Fig. (A) u = ________. (ii) Fig. (B) u = ________.

Q.7 Trajectories are shown in figure for three kicked footballs. Ignoring air resistance, order the trajectories according to
(a) time of flight
(b) initial vertical velocity component
(c) initial horizontal velocity component
(d) initial speed.
Order from largest to smallest.

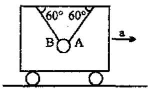


Q.8 Find the tension T needed to hold the cart in equilibrium, if there is no friction.



Q.9 A block of mass 10 kg is kept on ground. A vertically upward force F = 20t N, where t is the time in seconds starts acting on it at t = 0.
(a) Find the time at which the normal reaction acting on the block is zero.
(b) The height of the block from ground at t = 10 sec.

Q.10 A steel ball is suspended from the ceiling of an accelerating carriage by means of two cords A and B. Determine the acceleration a of the carriage which will cause the tension in A to be twice that in B.

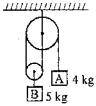


BANSAL CLASSES — PHYSICS

Target IIT JEE 2007 — **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 22-23/06/2005* *MAX.TIME : 60 Min.* *DPP. NO.-23*

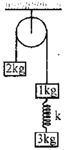
Q.1 The acceleration of the blocks (A) and (B) respectively in situation shown in the figure is : (pulleys & strings are massless)



(A) $\frac{2g}{7}$ downward, $\frac{g}{7}$ upward (B) $\frac{g}{3}$ downward, $\frac{g}{3}$ upward

(C) $\frac{10g}{13}$ downward, $\frac{5g}{13}$ upward (D) none of these'

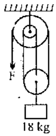
Q.2 From the fixed pulley, masses 2 kg, 1 kg and 3 kg are suspended as shown in the figure. Find the extension in the spring if k = 100 N/m. (Neglect oscillations due to spring)



(A) 0.1 m (B) 0.2 m

(C) 0.3 m (D) 0

Q.3 In the fig. at the free end of the light string, a force F is appled to keep the suspended mass of 18 kg at rest. Assuming pulley is light then the force exerted by the ceiling on the system is:



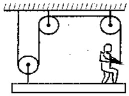
(A) 200 N

(B) 120 N

(C) 180 N

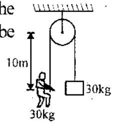
( ) 4 . .

Q.4 A 50 kg person stand on a 25 kg platform. He pulls on the rope which is attached to the platform via the frictionless pulleys as shown in the figure. The platform moves upwards at a steady rate if the force with which the person pulls the rope is



(A) 500 N (B) 250 N (C) 25 N (D) None

Q.5 In the figure shown man is balanced by counter weight of same mass. He starts to climb the rope with an accelerator of 2 m/s^2 w.r.t. rope. The time after which he reaches the pulley will be



(A) $\sqrt{10}$ sec (B) $2\sqrt{5}$ sec

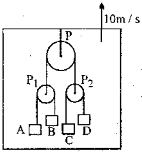
(C) infinity (D) None of these

Q.6 A particle is projected at an angle α to the horizontal from the foot of an inclined plane so as to strike the inclined plane. It moves in the vertical plane containing the line of greatest slope, which is inclined at $\tan^{-1}\left(\frac{1}{2}\right)$ to the horizontal.

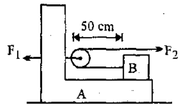
(a) Find α if the particle strikes the inclined plane at right angles.

(b) If $\alpha = \tan^{-1}(2)$ at what angle to the horizontal would it be travelling just before the impact.

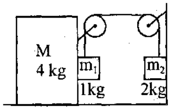
Q.7 A lift goes up with velocity 10 m/s. A pulley P is fixed to the ceiling of the lift. To this pulley other two pulleys P_1 and P_2 are attached. P_1 moves up with velocity 30m/s. A moves up with velocity 10m/s. D is moving downwards with velocity 10m/s at same instant of time. The velocity of B is ____ and that of C is ____ at that instant. Assume that all velocities are relative to the ground.



Q.8 A 1kg block 'B' rests as shown on a bracket 'A' of same mass. Constant forces $F_1 = 20N$ and $F_2 = 8N$ start to act at time $t = 0$ when the distance of block B from pulley is 50cm. Time when block B reaches the pulley is ________.



Q.9 Find tension in the string and acceleration of all blocks with respect to ground. Assume friction absent and string and pulley light.



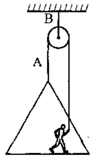
Q.10 To point the side of a building, painter normally hoists himself up by pulling on the rope A as in figure. The painter and platform together weigh 200N. The rope B can withstand 300N. Find

(a) the maximum acceleration of the painter.

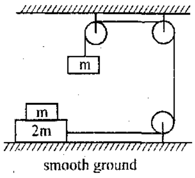
(b) tension in rope A

(i) when painter is at rest

(ii) when painter moves up with an acceleration $2\ m/s^2$.

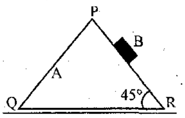


Q.1 In the arrangement shown in figure, there is friction between the blocks of masses m and 2m which are in contact. The ground is smooth. The mass of the suspended block is m. The block of mass m which is kept on mass 2m is stationary with respect to block of mass 2 m. The force of friction between m and 2m is (pulleys and strings are light and frictionless) :



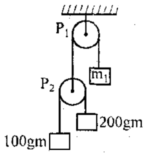
(A) $\frac{mg}{2}$ (B) $\frac{mg}{\sqrt{2}}$ (C) $\frac{mg}{4}$ (D) $\frac{mg}{3}$

Q.2 A particle B of mass 0.6 kg slides down the smooth face PR of a wedge A of mass 1.7 kg which can move freely on a smooth horizontal surface. The inclination of the face PR to the horizontal is 45°. Then:



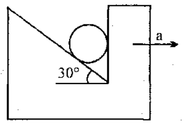
(A) the acceleration of A is 3g/20
(B) the vertical component of the acceleration of B is 23 g/40
(C) the horizontal component of the acceleration of B is 17 g/40
(D) none of these

Q.3 In the system of pulleys shown what should be the value of m_1 such that 100gm remains at rest w.r.t. ground :



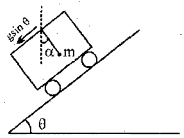
(A) 180gm (B) 160gm (C) 100gm (D) 200gm

Q.4 A heavy spherical ball is constrained in a frame as in figure. The inclined surface is smooth. The maximum acceleration with which the frame can move without causing the ball to leave the frame :



(A) g/2 (B) $g\sqrt{3}$ (C) $g/\sqrt{3}$ (D) $g/\sqrt{2}$

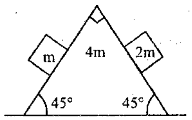
Q.5 A trolley is accelerating down an incline of angle θ with acceleration g sinθ. Which of the following is correct. (α is the angle made by the string with vertical).



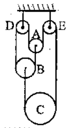
(A) $\alpha = \theta$ (B) $\alpha = 0^0$
(C) Tension in the string, T = mg (D) Tension in the string, T = mg sec θ

Q.6 A fixed rifle is aimed at a point on a vertical wall 1440 m horizontally away and 1080 m high above the point of the rifle end. A bullet is fired at 150 m/s towards the target. 10 sec after firing the gravitational field vanishes, find where the bullet will hit the vertical wall.[$g = 10\ m/s^2$]

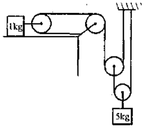
Q.7 Find the acceleration of wedge of mass 4m placed on smooth horizontal surface as two blocks of masses m and 2m slide over it.



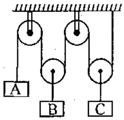
Q.8 A pulley system is set up as in figure. The movable pulleys A, B and C are each of 1 kg. Pulley D and E are fixed. All pulleys are smooth and string is light and inextensible. Find the acceleration of pulley C and the tension in the string.



Q.9 If the system is released from rest find
(a) total kinetic energy of the blocks after t = 2 sec of motion.
(b) distance moved by the 1 kg block during this time.
(all surfaces and pulleys are frictionless)



Q.10 In the pulley system shown here pulleys are ideal and string is inextensible. Mass of all the blocks is M.
(a) Draw the free body diagram for all the blocks.
(b) Find the constraint relationship between acceleration of the masses.
(c Find the acceleration of all the three masses and tension in the string.



BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
Daily Practice Problems

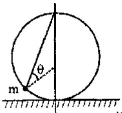
CLASS : XI (P, Q, R, S) *DATE : 27-28/06/2005* *DPP. NO.-26*

Time : Exact 2 hour. *Max. Marks : 60*

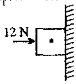
PRACTICE TEST

[Take : $g = 10\ m/s^2$]

Q.1 One end of a string is connecte to top o t e xe ver ca r ng as s own in   e figure. The other end is connected to a bead free to slide smoothly on the ring. If the string is taut in the shown configuration, find tension in it. [3]



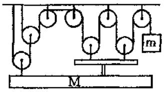
Q.2 A block of weight 5 N is pushed against a vertical wall by a force 12 N. The coefficient of friction between the wall and block is 0.6. Find the magnitude of the force exerted by the wall on the block. [3]



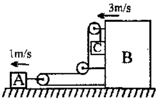
Q.3 A particle is thrown upwards from ground. It experiences a constant resistance force which can produce retardation $2\ m/s^2$. Find the ratio of time of ascent to the time of descent. [3]

Q.4 The equation of a projectile is $y = \sqrt{3}\,x - \frac{gx^2}{2}$. The angle of projectile is ________ and initial velocity is __________. [3]

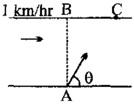
Q.5 Find the minimum value of mass m required to lift the load M shown in figure. Treat pulley as light and string inextensible. [3]



Q.6 The velocities of A and B are marked in the figure. Find the velocity of block C. (assume that the pulleys are ideal and string inextensible) [3]

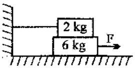


Q.7 A river is flowing with a speed of 1 km/hr. A swimmer wants to go to point 'C' starting from 'A'. He swims with a speed of 5 km/hr, at an angle θ w.r.t. the river. If AB = BC = 400 m. Then find the value of θ. [4]

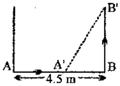


Q.8 A block is given certain upward velocity along the incline of elevation α. The time of ascent to upper point was found to be half the time of descent to initial point. Find the co-efficient of friction between block and incline. [4]

Q.9 If the coefficient of friction at all surfaces is 0.4, then find the force required to pull out the 6 kg block with an acceleration of $1.5\ m/s^2$. [4]



Q.10 Two Particles instantaneously at A & B respectively 4.5 meters apart are moving with uniform velocities as shown in the figure. The former towards B at 1.5 m/sec and the latter perpendicular to AB at 1.125 m/sec. Find the instant when they are nearest. [4]



Q.11 Two particles A & B projected along different directions from the same point P on the ground with the same speed of 70 m/s in the same vertical plane. They hit the ground at the same point Q such that PQ = 480 m. Then : (Use $g = 9.8\ m/s^2$, $\sin^{-1} 0.96 = 74°$, $\sin^{-1} 0.6 = 37°$)

(a) find the ratio of their times of flights.

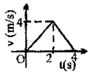
(b) find the ratio of their maximum heights.

(c) find the ratio of their minimum speeds during flight. [5]

Q.12 The velocity - time graph of a particle moving along a straight line is shown in fig.

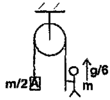
(i) If the particle starts its motion from x = – 4 m , then draw the a - t and x - t graphs.

(ii) Find the position of the particle at t = 3 s. [5]



Q.13 A stone thrown with the velocity $v_0 = 12$ m/s at an angle $\alpha = 45°$ to the horizontal, dropped to the ground at a distance s from the point where it was thrown. From what height h should the stone be thrown in a horizontal direction with the same initial velocity v_0 for it to fall at the same spot ? [5]

Q.14 Block A of mass m/2 is connected to one end of light rope which passes over a pulley as shown in the Fig. Man of mass m climbs the other end of rope with a relative acceleration of g/6 with respect to rope find acceleration of block A and tension in the rope. [5]



Q.15 A particle moving with uniform acceleration along a straight line passes three successive points A, B & C where the distances AB : BC is 3 : 5 & the time taken from
A to B is 40 sec. If the velocities at A & C are 5 m/s & 15 m/s respectively. Find

(a) the velocity of the particle at B

(b) acceleration of the particle

(c) time taken to cover B to C

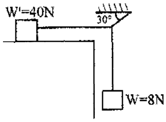
(d) total distance from A to C. [6]

BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
Daily Practice Problems

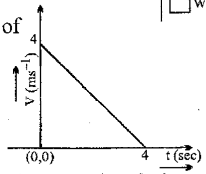
CLASS : XI (P, Q, R, S) ***DATE : 27-28/06/2005*** ***MAX.TIME : 60 Min.*** ***DPP. NO.-25***

Q.1 T e system s own is just on t e verge of slipping. e co-e icien of s atic fri i n ... n h ... k nd ... ble p is:



(A) 0.5 (B) 0.95
(C) 0.15 (D) 0.35

Q.2 The velocity time graph of the fig. shows the motion of a wooden block of mass 1 kg which is given an initial push t = 0, along a horizontal table.

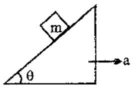


(A) The coefficient of friction between the blocks and the table is 0.1
(B) The coefficien of fric ion be ween e locks and t e ta le is 0.2
(C) If the table was half of its present roughness, the time taken by the block to complete the journey is 4 sec.
(D) If the table was half of its present roughness, the time taken by the block to complete the journey is 8 sec.

Q.3 A bead of mass 'm' can slide on a thin vertical rod, with sliding friction coefficient between them = μ. The rod is translated horizontally with a constant acceleration 'a'. For what value of 'a' will an Earth observer see equal horizontal and vertical components of the acceleration of the bead?
(A) $g/(1+\mu)$ (B) $g/(1-\mu)$ (C) μg (D) none

Q.4 The force required just to move a body up an inclined plane is double the force required just to prevent the body from sliding down. If μ is the coefficient of friction, the inclination of plane to the horizontal is
(A) $\theta = \tan^{-1}(3\mu)$ (B) $\theta = \tan^{-1}(2\mu)$ (C) $\theta = \tan^{-1}(4\mu)$ (D) $\theta = \tan^{-1}(\mu)$

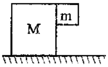
Q.5 k f ... y l ... w g w ... w g accelerated with acceleration a. The friction force acting on the block is [μ = coefficient of friction between wedge and block]



(A) μ m (g ... θ − a ... nθ) (B) m (g ... nθ − a ... θ)
(C) m (g sinθ + a cosθ) (D) ma sinθ

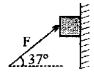
Q.6 The rear side of a truck is open and a box of mass 20kg is placed on the truck 4 meters away from the open end $\mu = 0.15$ and $g = 10 m/sec^2$. The truck starts from rest with an acceleration of $2 m/sec^2$ on a straight road. The box will fall off the truck when truck is at a distance from the starting point equal to:
(A) 4 metres (B) 8 metres (C) 16 metres (D) 32 metres

Q.7 With what minimum acceleration mass M must be moved on frictionless surface so that m remains stick to it as shown. The coefficient of friction between M & m is μ.



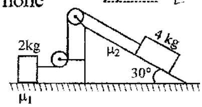
(A) μg (B) $\frac{g}{\mu}$ (C) $\frac{\mu mg}{M+m}$ (D) $\frac{\mu mg}{M}$

Q.8 A 1 g oc s e ng pus e aga nst a wa y a orce F = 75 N as shown n t e Figure. The coefficient of friction is 0.25. The magnitude of acceleration of the block is

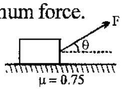


(A) $10 m/s^2$ (B) 2 ... $/s^2$ (C) 5 ... $/s^2$ (D) none

Q.9 If the tension in the string in figure shown is 16 N and the acceleration of each block is $0.5 m/s^2$. Find the friction coefficient at the two contacts with the blocks, where wedge is fixed.



Q.10 A block of mass m =10 kg is to be pulled on a horizontal rough surface with the minimum force.
(i) The block should be pulled at an angle θ = ____________.
(ii) the magnitude of the force F is equal to ____________.

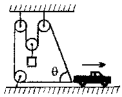


CLASS : XI (P, Q, R, S)   DATE : 04-05/07/2005   MAX.TIME : 60 Min.   DPP. NO.-27

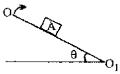
Q.1 A boat is moving towards east with velocity 4 m/s with respect to still water and river is flowing towards north with velocity 2 m/s and the wind is blowing towards north with velocity 6 m/s. The direction of the flag blown over by the wind hoisted on the boat is:
(A) north-west (B) south-east (C) $\tan^{-1}(1/2)$ with east (D) north

Q.2 Two blocks A(1kg) and B(3kg) rest over the other on a smooth horizontal plane (A over B). The coefficient of static and dynamic friction between A and B is the same and equal to 0.75. The maximum horizontal force in newton that can be applied to A in order that both A and B do not have relative motion is : $[g = 9.8\ m/s^2]$
(A) 19.6 (B) 14.7 (C) 9.8 (D) 4.9

Q.3 In the figure shown, the speed of the truck is v to the right. The speed with which the block is moving up at $\theta = 60°$ is :
(A) v (B) 2v/3 (C) 3v/4 (D) none

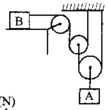


Q.4 A block A kept on a rough plate (OO_1) with coefficient of static friction $\mu_s = 0.75$ & coefficient of kinetic friction $\mu_k = 0.5$. The plate is leaning with horizontal at an angle $\theta = \tan^{-1}(\mu_s)$. If the plate is further tilted slig..tly -- --e accele.ati..n -- -l.c.. ..ill -e
(A) $1.5\ m/s^2$ (B) $2\ m/s^2$ (C) $2.5\ m/s^2$ (D) none of these

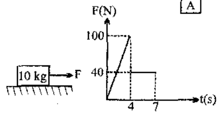


Q.5 The upper portion of an inclined plane of inclination α is smooth and the lower portion is rough. A particle slides down from rest from the top and just comes to rest at the foot. If the ratio of smooth length to rough length is m :n, find the coefficient of friction.

Q.6 Determine the acceleration of the 5 kg block A. Neglect the mass of the pulley and cords. The block B has a mass of 10 kg. The coefficient of kinetic friction between block B and the surface is $\mu_k = 0.1$. (Take $g = 10\ m/s^2$)

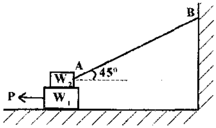


Q.7 The 110 kg block is resting on the horizontal surface when the force F is applied to it for 7 seconds. The variation of F with time is shown. Calculate the maximum velocit reached b the b c n t e t during which the block is in motion. The coefficient of static and kinetic fricti n are b h 0.50.



Q.8 A block is to be raised a height h from rest to rest. If the rope used to lift the block can bear a maximum tension of λmg ($\lambda > 1$), where m is the mass of the block, the find the minimum time in which we can raise the bl--k.

Q.9 Calculate the force P required to cause the block of weight W_1 =200N just to slide under the block of weight W_2 = 100 N. What is the tension in the string AB ? [Coefficient of friction $\mu = 0.25$ for all surfaces in contact].



Q.10 A body is at rest at the bottom of a plane of incline angle α, which is greater than angle of repose. It is given initial velocity & launched up the plane. It reaches its maximum height on incline in time t_1. It then slides back down, the time of descent is $t_2 = ct_1$ where c is constant & greater than 1. Find the coefficient of kinetic friction.

BANSAL CLASSES
Target IIT JEE 2007

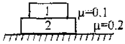
PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) ***DATE : 06-07/06/2005*** ***MAX.TIME : 60 Min.*** ***DPP. NO.-28***

Q.1 A plank of mass 2kg and length 1 m is placed on a horizontal floor. A small block of mass 1 kg is placed on top of the plank, at its right extreme end. The coefficient of friction between plank and floor is 0.5 and that between plank and block is 0.2. If a horizontal force = 30 N starts acting on the plank to the right, the time after which the block will fall off the plank is ($g = 10\ m/s^2$)

(A) (2/3) s (B) 1.5 s (C) 0.75 s (D) (4/3) s

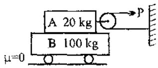
Q.2 For the two blocks initially at rest under constant ext. forces of mass1 kg and 2kg shown, $a_1 = 5\ m/s^2 \rightarrow$, $a_2 = 2\ m/s^2 \leftarrow$. Which of the following is correct?



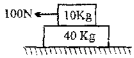
(A) Force of friction on 1 due to 2 is 1 N to right. (B) Force of friction on 2 due to 1 is 1 N to right.
(C) Force of friction on 2 due to ground is 4 N to right. (D) Force of friction on 2 due to ground is 6 N to right.

Q.3 Block A is placed on cart B as shown id figure. If the coefficients of static and kinetic friction between the 20 kg block A and 100 kg cart B are both essentially the same value of 0.5 [$g = 10\ m/s^2$]

(A) The blocks A and B will have a common acceleration if P = 60 N
(B) Acceleration of cart B is $0.98\ m/s^2$ if P = 40 N
(C) Acceleration of cart B is greater than that of A if P = 60 N
(D) The common acceleration of both the blocks is $0.667\ m/s^2$ if P = 40 N

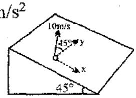


Q.4 A 40kg slab rests on a frictionless floor. A 10 kg block rests on top of the slab as shown in the Fig. The coefficient of static friction between the block and slab is 0.60 and coeffecient of kinetic friction is 0.40. The 10kg block is acted upon by a horizontal force of 100N. The resulting acceleration of slab will be

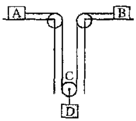


(A) $1\ m/s^2$ (B) $1.47\ m/s^2$ (C) $1.52\ m/s^2$ (D) $6.1\ m/s^2$

Q.5 The small marble is projected with a velocity of 10 m/s in a direction 45° from the horizontal y-direction on the smooth inclined plane. Calculate the magnitude v of its velocit_ after 2 seconds. Take _ $=10\ m/s^2$.

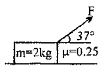


Q.6 Particles A and B of mass 5 kg and 3 kg are connected by a light inextensible string passing under a smooth light pulley C which carries a particle D of mass 4 kg. A and B rest on a horizontal rough surfaces as shown in the diagram. The coefficient of friction is same for both A and B and is just sufficient to prevent A, but not B, from moving. Find the coefficient of friction.

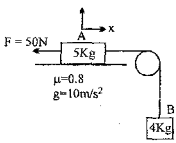


Q.7 O is a point at the bottom of a rough plane inclined at an angle α to the horizontal. Up to a vertical height h above O the coefficient of friction is $2\tan\alpha$, above this height it is $(\tan\alpha)/2$. A particle is projected up the plane with a velocity V. Find the minimum value of V so that the particle returns to O.

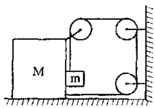
Q.8 A force F=20N is applied to a block (at rest) as shown in fig. After the block has moved a distance of 8m to the right, the direction of horizontal comopnent of the force F is reversed. Find the velocity with which block arrives at its starting point.



Q.9 Find the acceleration of the blocks and magnitude & direction of frictional force between block A and table, if block A is pulled towards left with a force of 50N.



Q.10 In the figure M = 2m. The coefficient of friction at all surfaces is μ. Find the acceleration of bigger block. String is light and inextensible and all the pulleys are smooth.



BANSAL CLASSES **PHYSICS**

Target IIT JEE 2007 **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 08-09/07/2005* *DPP. NO.-29*

Time : Exact 1 hour. *Max. Marks : 60*

HOME TEST

Q.1 A block rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block (in kg) is (take g = 10 m/s^2)
(A) 2.0 (B) 4.0 (C) 1.6 (D) 2.5

Q.2 A swimmer swims in still water at a speed = 5 km/hr. He enters a 200 m wide river, having river flow speed = 4 km/hr at point A and proceeds to swim at an angle of 127° (sin 37° = 0.6) with the river flow direction. Another point B is located directly across A on the other side. The swimmer lands on the other bank at a point C, from which he walks the distance CB with a speed = 3 km/hr. The total time in which he reachrs from A to B is
(A) 5 minutes (B) 4 minutes (C) 3 minutes (D) None

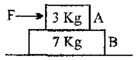
Q.3 Two bullets are fired at angles θ and $90 - \theta$, the ratio of their time of flights is :
(A) 1 : 1 (B) $\tan\theta : 1$ (C) $1 : \tan\theta$ (D) $\tan^2\theta : 1$

Q.4 Two particles, one with constant velocity 50m/s and the other with uniform acceleration 10m/s^2, start moving simultaneously from the same place in the same direction. They will be at a distance of 125m from each other after
(A) 5 sec. (B) $5(1 + \sqrt{2})$ sec. (C) 10sec. (D) $10(\sqrt{2} + 1)$sec.

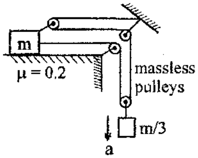
Q.5 A rope of length L and mass M is being puled on a rough horizontal floor by a constant horizontal force F = Mg. The force is acting at one end of the rope in the same direction as the length of the rope. The coefficient of kinetic friction between rope and floor is 1/2. Then, the tension at the midpoint of the rope is
(A) Mg / 4 (B) 2Mg / 5 (C) Mg / 8 (D) Mg / 2

Q.6 A block is lying on a long horioznt al conveyer belt moving at a constant velocity receives a velocity v=5m/s relative to ground in a direction opposite to the direction of motion of conveyer. After t=4sec the velocity of block becomes equal to the velocity of the belt. If μ=0.2 find the velocity of the belt.

Q.7 Two blocks A and B are placed one over the other on a smooth horizontal surface. The maximum horizontal force that can be applied to the upper block A so that A and B move without separation is 49N. The coefficient of friction between A and B is ____

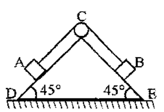


Q.8 Find 'a'.



Q.9 A block A of mass 2kg rests on another block B of mass 8kg which rests on a horizontal floor. The coefficient of friction between A and B is 0.2 while that between B and floor is 0.5. When a horizontal force F of 25N is applied on the block B, the force of friction between A and B is ____

Q.10 Two particles A and B of masses 3kg and 2kg are connected by a light inextensible string. The particles are in contact with the smooth faces of a wedge DCE of mass 10kg resting on a smooth horizontal plane. When the system is moving freely find the acceleration of the wedge and the acc r i B.



BANSAL CLASSES

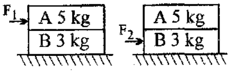
Target IIT JEE 2007

PHYSICS

Daily Practice Problems

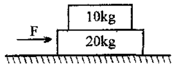
CLASS : XI (P, Q, R, S)   DATE : 11-12/07/2005   MAX.TIME : 60 Min.   DPP. NO.-30

Q.1 A block A (5 kg) rests over another block B (3 kg) placed over a smooth horizontal surface. There is friction between A and B. A horizontal force F_1 gradually increasing from zero to a maximum is applied to A so that the blocks move together without relative motion. Instead of this another horizontal force F_2, gradually increaseing from zero to a maximum is applied to B so that the blocks move together without relative motion. Then



(A) $F_1\,(max) = F_2\,(max)$ (B) $F_1\,(max) > F_2\,(max)$
(C) $F_1(max) < F_2\,(max)$ (D) $F_1\,(max) : F_2(max) = 5 : 3$

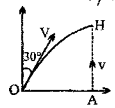
Q.2 A block of mass 10 kg is placed on the top of a block of mass 20 kg, resting on a table. A force F in the horizontal direction is applied to the lower mass such that they both move together to the right with acceleration a. The coefficients of static and kinetic friction between the blocks are 0.4 and 0.2 respectively. The upper block does not slide relative to the lower one if



(A) $a \le 0.4\ g$ (B) $a \le 0.2\ g$
(C) $a \ge 0.4\ g$ (D) $a \ge 0.2\ g$

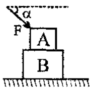
Q.3 Two boats were going down stream with different velocities. When one overtook the other a plastic ball was dropped from one of the boats. Some time later both boats turned back simultaneously & went at the same speeds as before (relative to the water) towards the spot where the ball had been dropped. Which boat will reach the ball first?
(A) the boat which has greater velocity (relative to water)
(B) the boat which has lesser velocity (relative to water)
(C) both will reach the ball simultaneously
(D) cannot be decided unless we know the actual values of the velocities and the time after which they turned around.

Q.4 A particle is projected with a speed V from a point O making an angle of 30° with the vertical. At the same instant, a second particle is thrown vertically upward from a point A with speed v. The two particle reach H, the highest point on the parabolic path of the first particle simultaneously, then the ratio V/v



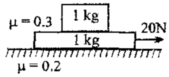
(A) $3\sqrt{2}$ (B) $2\sqrt{3}$ (C) $\dfrac{2}{\sqrt{3}}$ (D) $\dfrac{\sqrt{3}}{2}$

Q.5 Two blocks A and B of mass 1 kg and 2 kg respectively are placed over a smooth
..o..z..nta.. s..r.ace as s....wn ..n ..g..re. ....e ...e......e.... ..f fri....i.... b......... bl........ ....d...
is $\mu = 1/2$. An external force of magnitude F is applied to the top block at an angle $\alpha = 30°$ below the horizontal.

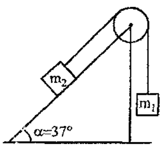


( ) I.. h.. .... ve ..ge......, fi..... ...e.... .....l....t....n i....t......s .....
(b) Find the maximum values of F so that both the blocks move together with same acceleration.($g=10\ m/s^2$)

Q.6 Find acceleration of upper block it static & kinetic friction coefficients have same value.

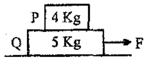


Q.7 A block of mass m_2 lies on a plane inclined at an angle $\alpha = 37°$ to the horizontal. Another block of mass m_1 is connected to the block m_2 by a thread slung over a pulley. Coefficient of friction between m_2 and the plane is 0.5. Calculate the acceleration of the blocks and the frictional force on m_2 in the following cases.
(a) $m_1 = 2kg,\ m_2 = 5kg$ (b) $m_1 = 6kg,\ m_2 = 5kg$

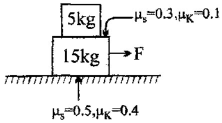


Q.8 A particle inside a hollow sphere of radius r, having a coefficient of friction ($1/\sqrt{3}$) can rest up to a height of_____.

Q.9 If the lower block is held fixed and force is applied to P minimum force required to slide P on Q is 12N. Now if Q is free to move on frictionless surface and force is applied to Q then the minimum force F required to slide P on Q is____.



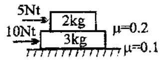
Q.10(a) In the figure shown a constant force F is applied on lower block, just large enough to make this block on the verge of sliding out from between the upper block and the table. Determine the force F at this instant and common acceleration of each block. Take $g = 10\ m/s^2$.



(b) It instead of a constant force F we apply a time varying force F = (20t) Newton. Plot a graph between acceleration of both the blocks and time.

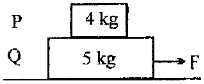
CLASS : XI (P, Q, R, S)   DATE : 13-14/06/2005   MAX.TIME : 60 Min.   DPP. NO.-31

Q.1 The system shown in figure is released



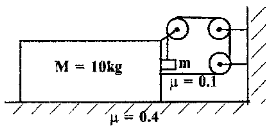
(A) $a_1 = 0.35\ m/s^2$; $a_2 = 4.5\ m/s^2$ (B) $a_1 = 3\ m/s^2$; $a_2 = 0.5\ m/s^2$
(C) $a_1 = 2\ m/s^2$; $a_2 = 2\ m/s^2$ (D) $a_1 = 0.5\ m/s^2$; $a_2 = 3\ m/s^2$

Q.2 The coefficient of friction between 4kg and 5 kg blocks is 0.2 and between 5kg block and ground is 0.1 respectively. Choose the correct statements



(A) Minimum force needed to cause system to move is 17N
(B) When force is 4N static friction at all surfaces is 4N to keep system at rest
(C) Maximum acceleration of 4kg block is $2m/s^2$
(D) Slipping between 4kg and 5 kg ocks start when F s 17N

Q.3 The maximum value of m(in kg) so that the arrangement shown in the figure is in equilibrium is given by

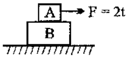


(A) 2 (B) 2.5 (C) 3 (D) 3.5

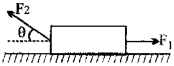
Q.4 Two particles are moving along two long straight lines, in the same plane, with the same speed = 20 cm/s. The angle between the two lines is 60°, and their intersection point is O. At a certain moment, the two particles are located at distances 3m and 4m from O, and are moving towards O. Subsequently, the shortest distance between them will be

(A) 50 cm (B) $40\sqrt{2}$ cm (C) $50\sqrt{2}$ cm (D) $50\sqrt{3}$ cm

Q.5 Two blocks A and B of mass 2 kg and 4 kg are placed one over the other as shown in figure. A time varying horizontal force F = 2t is applied on the upper block as shown in figure. Here t is in second and F is in newton. Draw a graph showing accelerations of A and B on y-axis and time on x-axis. Coefficient of friction between A and B is $\mu = 1/2$ and the horizontal surface over which B is placed is smooth. ($g = 10\ m/s^2$)

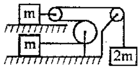


Q.6 A block of mass m = 3 kg is experiencing two forces acting on it as shown.
(a) If $F_2 = 20$ N and $\theta = 60°$, determine the minimum and maximum values of F_1 so that the block remains at rest. (Take : $\mu_s = 1/\sqrt{3}$ and $\mu_k = 1/3$, $g = 10m/s^2$)

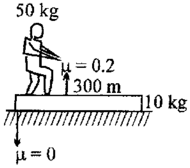


(b) Calculate the magnitude and direction of frictional force on the block if $F_1 = 12$ N.

Q.7 Find the acceleration of the three masses A, B and C shown in figure. Friction coefficient between all surfaces is 0.5. Pulleys are smooth.

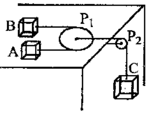


Q.8 A man of mass 50 kg is standing on one end of a stationary wooden plank resting on a frictionless surface. The mass of the plank is 10 kg, its length is 300 m and the coefficient of friction between the man and the plank is 0.2. Find the shortest time in which the man can reach the other end starting from rest and stopping at the other end.



Q.9 A block of weight w rests on a rough horizontal plank. The slope angle of of the plank θ is gradually increased upto 90°. Draw two graphs, both with θ along the x–axis. In one graph show the ratio of the normal force to the weight as a function of θ. In the second graph, show the ratio of the friction force to the weight. Indicate the regions of no motion and where motion exists.

Q.10 Two masses A and B, lie on a frictionless table. They are attached to either end of a light rope which passes around a horizontal movable pulley of negligible mass. Find the acceleration of each mass $M_A = 1$ kg, $M_B = 2$ kg, $M_C = 4$ kg. The pulley P_2 is vertical.



Time : Exact 1 hour. *Max. Marks : 60*

HOME TEST

Q.1 A body is thrown with velocity 20 m/s at an angle of 60° with the horizontal. Find the time gap between the two positions of body where velocity of body makes an angle of 30° with horizontal
(A) 1.15 sec. (B) 0.95 sec. (C) 1 sec. (D) 1.5 sec.

Q.2 To man running at a speed of 5 m/sec,the rain drops appear to be falling at an angle of 45° from the vertical. If the rain drops are actually falling vertically downwards , then velocity in m/sec is
(A) 5 (B) $5\sqrt{3}$ (C) $5\sqrt{2}$ (D) 4

Q.3 A river is flowing from west to east at a speed of 5 meters per minute. A man on the south bank of the river, capable of swimming at 10 metres per minute in still water, wants to swim across the river in the shortest time. He should swim in a direction
(A) due north (B) 30° east of north (C) 30° north of west (D) 60° east of north

Q.4 An object of mass m is projected with a momentum P at such an angle that its maximum height (H) is $1/4^{th}$ of its horizontal range (R). Its minimum kinetic energy in its path will be
(A) $\frac{p^2}{8m}$ (B) $\frac{p^2}{4m}$ (C) $\frac{3p^2}{4m}$ (D) $\frac{p^2}{m}$

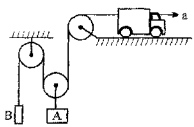
Q.5 On an inclined plane inclined at an angle of 30° to the horizontal, a ball is thrown upwards with a velocity of 10 m/s, at an angle of 60° to the inclined plane. Its range on the inclined plane is :
(A) 10 m (B) $5\sqrt{3}$ m (C) 0 m (D) $10\sqrt{3}$ m

Q.6 A particle moving with a speed v changes direction by an angle θ, without change in speed.
(A) The change in the magnitude of its velocity is zero.
(B) The change in the magnitude of its velocity is $2v\sin(\theta/2)$.
(C) The magnitude of the change in velocity is $2v\sin(\theta/2)$
(D) The magnitude of the change in its velocity is $v(1 - \cos\theta)$.

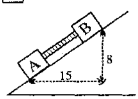
Q.7 A particle is projected vertically upward with initial velocity 25 m/s. For its motion during third second, which of the following statement is correct?
(A) Displacement of the particle is 30 m
(B) Distance covered by the particle is 30 m.
(C) Distance covered by the particle is 2.5 m
(D) None of these

Q.8 A body of mass 2kg rests on a horizontal plane having coefficient of friction $\mu = 0.5$. At t = 0 a horizontal force $\vec{F}$ is applied that varies with time F = 2t. The time constant t_0 at which motion starts and distance moved in $t = 2t_0$ second will be ____ and _______ respectively.

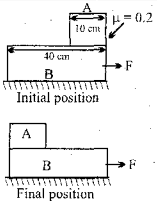
Q.9 A truck shown in the figure is driven with an acceleration $a = 3\ m/s^2$. Find the acceleration of the bodies A and B of masses 10 kg and 5 kg respectively, assuming pulleys are massless and friction is absent everywhere.



Q.10 Blocks A and B in the figure are connected with a bar of negligible weight. If A and B each weight 170 kg and $\mu_A = 0.2$ and $\mu_B = 0.4$, where μ_A and μ_B are the coefficients of limiting friction between plane and the bodies respectively, calculate the acceleration of the system and force in the bar.

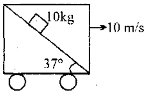


Q.1 A block 'A' of mass 45 kg is placed on a block 'B' of mass 123 kg. Now block 'B' is displaced by external agent by 50 cm horizontally towards right. During the same time block 'A' just reaches to the left end of block B. Initial & final position are shown in figure. Refer to the figure & find the workdone by frictional force on block A in ground frame during above time.



(A) – 18 Nm (B) 18 Nm (C) 36 Nm (D) – 36 Nm

Q.2 A block of mass 10 kg is release ' on a fixe ' we 'ge insi 'c a car' which is moved with constant velocity 10 m/s towards right. Take initial velocity of block with respect to cart zero. Then work done by normal reaction on ___c__ ... ___c_n_ m g._un_ f._me ..ill _e: ($g = 1\_\ m\ s^2$)



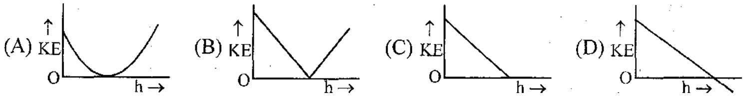
(A) zero (B) 960 J (C) 1200 J (D) none of these

Q.3 A spring of force constant k is cut in two part at its one third length. when both the parts are stretched by same amount. The work done in the two parts, will be

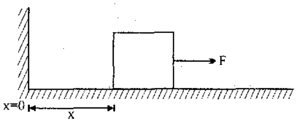
(A) equal in both (B) greater for the longer part

(C) greater for the shorter part (D) data insufficient.

Q.4 A ball is projected vertically up with an initial velocity. Which of the following graphs represents the KE of the ball?



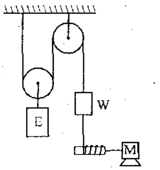
Q.5 The block of mass 'm' initially at x = 0 is acted upon by a horizontal force $F = a - bx$ as shown in the figure. The coefficient of friction between the surfaces of contact is μ. The net work done on the block is zero if the block travels a distance of ____________.



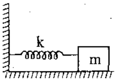
Q.6 T e e evator E as a mass of 3000 kg when fully loaded and is connected as shown to a counterweight W of mass 1000 kg. Determine the power in kilowatts delivered by the motor

(a) when the elevator is moving down at a constant speed of 3 m/s,

(b) when it has an upward velocity of 3 m/s and a deceleration of $0.5\ m/s^2$.



Q.7 A block of mass 'm' is attached to one end of a massless spring of spring constant 'k'. The other end of the spring is fixed to a wall. The block can move on a horizontal rough surface. The coefficient of friction between the block and the surface is μ. The block is released when the spring has a compression of $\frac{2\mu mg}{k}$.



(a) Find the initial acceleration of block, (b) Find the maximum speed of the block.

Q.8 Power applied to a particle varies with time as $P = 2t + 1$. If the body of mass 1 kg is initially at rest. Find its kinetic energy at $t = 3$ sec.

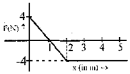
Q.9 A spring constant $K = 100$ N/m is initially in the relaxed state. It undergoes two steps slowly under application of an external force.

Step I : Stretched by 10cm from initial position

Step II : Then compressed through a distance of 25cm (from position attained after step I.)

Find: (a) work done by spring force in step I (b) work done by external force in step II

Q.10 The only force acting on a 2kg body as it moves along the x-axis varies as shown in figure. The velocity of the body at $x = 0$ is 4m/s

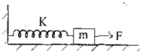


(a) What is the K.E.of the body at $x = 3.0$ m?

(b) At what value of x will the body have a K.E. of 8 J ?

(c) What is the maximum K.E. attained by the body between $x = 0$ to $x = 5$ meter?

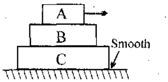
Q.1 A constant force produces maximum velocity V on the block connected to the spring of force constant K as shown in the fig. When the force constant of spring becomes 4K, the maximum velocity of the block is



(A) $\frac{V}{4}$ (B) 2V (C) $\frac{V}{2}$ (D) V

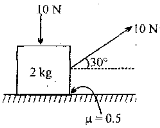
Q.2 A small sphere of mass 'm' is dropped from a great height. After it has fallen through 100 m it attains its terminal velocity and continues to fall. The work done against air friction during first 100 m fall is
(A) greater than the work done during second 100 m fall
(B) less than the work done during second 100 m fall
(C) equal to weight mg
(D) greater than weight mg

Q.3 Three blocks A, B and C are kept as shown in the figure. The coefficient of friction between A and B is 0.2, B and C is 0.1, C and ground is 0.0. The mass of A, B and C are 3 kg, 2 kg and 1 kg respectively. A is given a horizontal velocity 10 m/s. A, B and C always remain in contact i.e. lies as in figure. The total work done by friction will be



(A) – 75 J (B) 75 J (C) – 150 J (D) – 100 J

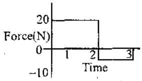
Q.4 A body of mass 2 kg is kept on a rough horizontal surface as shown in the figure. Find the work done by frictional force in the time interval t = 0 to t = 5 sec.



(A) zero (B) + 15 J
(C) – 20 J (D) data insufficient

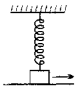
Q.5 An object is attracted towards the origin with a force given by $F_x = -k/x^2$ Calculate the work done by the force F_x when the object moves in the x direction from x_1 to $x_2 (x_2 > x_1)$.

Q.6 Starting at rest, a 5kg object is acted upon by only one force as indicated in fig. Find the total work done by the force.

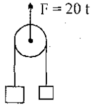


Q.7 An object has several forces acting on it. One of these forces is $\vec{F} = 3xy\hat{i}$. Calculate the work done on the object by this force for following displacements (a) (0,4) to (2,4) parallel to x axis. (b) (2,0) to (2,4) parallel to y axis (c) From (0,0) to (2,4) along y=2x.

Q.8 A spring is attached with a block of mass m and a fixed horizontal rod. The block is lying on a smooth horizontal table and initially the spring is vertical and unstretched. Natural length of spring is $3l_0$. A constant horizontal force F is applied on the block so that block moves in the direction of force. When length of the spring becomes $5l_0$ block leaves contact with the table.
Find the constant force F, if initial and final velocity of block is zero.



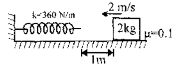
Q.9 Two blocks A and B of mass 1 kg and 2kg respectively are connected by a string, passing over a light frictionless pulley. Both the blocks are resting on a horizontal floor and the pulley is held such that string remains just taut. At moment $t=0$, a force $F=20t$ newton starts acting on the pulley along vertically upward direction, as in Fig. Calculate (a) velocity of A when B loses contact with the floor (b) height raised by the pulley upto that instant and (c) work done by the force F upto that instant.



Q.10 A block of mass 2 kg kept 1 m away from a spring is projected with velocity of 2 m/s towards the spring.

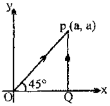
(a) What is the maximum compression in the spring?

(b) At what distance from the spring will the block finally come to rest.

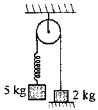


HOME TEST

Q.1 A particle is moved from (0, 0) to (a, a) under a force $\vec{F} = (3\hat{i} + 4\hat{j})$ from two paths. Path 1 is OP and path 2 is OQP. Find the ratio $\frac{W_1}{W_2}$ the work done by this force in these two paths. [3]

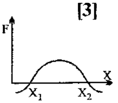


Q.2 System shown in the figure is released from rest. When spring is unstretched pulley and spring is massless and friction is absent everywhere. Find speed of 5 kg block when 2 kg block leaves the contact with ground.
(Take force constant of spring k = 40 N/m and g = 10 m/s^2) [3]

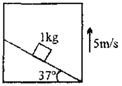


Q.3 A motor drives a body along a straight line with a constant force. Draw the graph of power p developed by the motor must varying with time t [3]

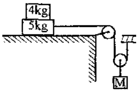
Q.4 The force acting on a body moving along x axis varies with the position of the particle as shown in the fig. State the nature if equilibrium of body at x_1 & x_2. [3]



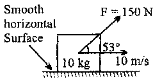
Q.5 A block of mass 1 kg is kept on smooth inclined surface of an elevator moving up with a constant velocity of 5 m/s. Find the work done by normal reaction (as seen from ground) on the block is 10 sec. [3]



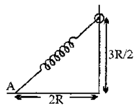
Q.6 A pulley block system is shown in figure. Find the maximum mass M so that 4 kg and 5 kg block will move together. Static friction coefficient between surfaces of 4 kg and 5 kg block is 0.8 and all other surfaces are considered to be frictionless. [3]



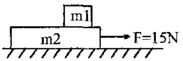
Q.7 In the figure shown, an external force F = 150 N making an angle 53° with the horizontal is applied to the block. Find the displacement of the block in four seconds. Initial velocity of the block is 10 m/s towards right. [4]



Q.8 A ring of mass m can slide over a smooth vertical rod. The ring is connected to a spring of force constant $K = \frac{4mg}{R}$ where R is the natural length of the spring. The other end of the spring is fixed to the ground at a horizontal distance 2R from the base of the rod. The mass is released at a height of 1.5R from ground
(a) calculate the work done by the spring.
(b) calculate the velocity of the ring as it reaches the ground. [4]



Q.9 A slab of mass m_2 (= 10 kg) is resting on a frictionless floor with a second mass m_1 (= 1kg) on its top. The coefficient of friction between m_1 and m_2 is μ = 0.1. A horizontal force of 15 N is applied to the lower block at t = 0.



(a) calculate the time required by the smaller block to move a distance of 0.5 m on the bigger block.
(b) What is the distance moved by m_2 in this time? [5]

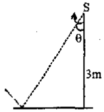
Q.10 The velocity of a particle when it is at its greatest height $\sqrt{2/5}$ is of its velocity when it is at its half the maximum height. Find the angle of projection and the velocity vector angle at half the maximum height. [5]

Q.1 A car is moving on circular path of radius 100m such that its speed is increasing at the rate of $5 m/s^2$. At $t = 0$ it starts from rest. The radial acceleration of car at the instant it makes one complete round trip, will be ____.

Q.2 A particle moves in the x-y plane with the velocity $\vec{v} = a\hat{i} + bt\hat{j}$. At the instant $t = a\sqrt{3}/b$ the magnitude of tangential, normal and total acceleration are _____, _______, & _________.

Q.3 A car goes on a horizontal circular road of radius R, the speed is increasing at a constant rate $dV/dt = a$. The friction coefficient between the road and the tyre is μ. The speed at which the car will skid is _________.

Q.4 A spotlight S rotates in a horizontal plane with a constant angular velocity of 0.1 rad/sec. The spot of light P moves along the wall at a distance of 3m. The velocity of the spot P when $\theta = 45°$ is _____ m/sec.



Q.5 A point traversed half a circle of radius R = 160cm during time interval $\tau = 10.0$s. Calculate the following quantities averaged over that time:
(a) average speed
(b) magnitude of average velocity
(c) magnitude of average acceleration if the point moved with constant tangential acceleration.

Q.6 A particle is moving along a circular path of radius R in such a way that at any instant magnitude of radial acceleration & tangential acceleration are equal. If at $t = 0$ velocity of particle is V_0. Find the speed of the particle after time $t = \frac{R}{2V_0}$

Q.7 A particle is travelling in a circular path of radius 4m. At a certain instant the particle is moving at 20m/s and its acceleration is at an angle of 37° from the direction to the centre of the circle as seen from the particle
(a) At what rate is the speed of the particle increasing?
(b) What is the magnitude of the acceleration?

Q.8 A boy whirls a stone in a horizontal circle 2m above the ground by means of a string 1.5m long. The string breaks and the stone flies off horizontally and strikes the ground 10m horizontally away. What was the centripetal acceleration of the stone while in circular motion?

Q.9 A stone is thrown horizontally with the velocity 15m/s. Determine the tangential and normal accelerations of the stone in 1 second after it begins to move.

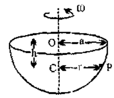
Q.10 A particle begins to move with a tangential acceleration of $0.6 m/s^2$ in a circular path. If it slips when its total acceleration becomes $1 m/s^2$, find the angle in degrees that it would have turned before it starts to slip.

BANSAL CLASSES **PHYSICS**

Target IIT JEE 2007 **Daily Practice Problems**

CLASS : XI (P, Q, R, S) ***DATE : 27-28/07/2005*** ***TIME : 1 Hour*** ***DPP. NO.-37***

Q.1 A particle P of mass m kg moves on the smooth inner surface of a fixed hollow hemisphere with centre O, radius a metres and axis vertical. The particle moves in a horizontal circle with centre C and radius r metres, and CP rotates with angular speed ω rad s^{-1}. The distance OC is h metres (see diagram).

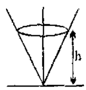


(a) Evaluate "ω" in terms of 'g' and 'h'?

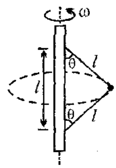
(b) Express the magnitude of the normal contact force between P and the surface in terms of m, g, a and h.

Q.2 A new car model is tested first along a specially designed horizontal rough track. First, the car is driven along a straight stretch of the track of length r. If the car starts from rest at its maximum (constant) acceleration, it takes the amount of time t to cover distance r. The car is then brought to rest and is accelerated again along a circular loop of the track that has a radius r having same friction coefficient. Assuming that the car is speeding up at the maximum possible constant rate that allows it to remain on the track, how long would it take complete one revolution?

Q.3 A right circular cone is fixed with its axis vertical and vertex down. A particle is in contact with its smooth inside surface and describes circular motion in a horizontal plane at a height of 20cm above the vertex. Find its velocity in m/s.



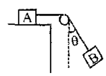
Q.4 A particle of mass m is attached to a vertical rod with two inextensible strings of equal lengths l. The distance between the points of suspension is l.
Determine the tension in each string.



Q.5 Particles of masses 3 kg and 5 kg are attached to the ends of a light string of length 1 m which passes through a fixed ring at O. The lighter particle describes a horizontal circle about the heavier particle which remains stationary as centre. Prove that the two particles lie in a horizontal plane at a distance $\frac{3}{8}$ m below O and that the time period for one complete revolution is $\pi\sqrt{\frac{3}{2g}}$.

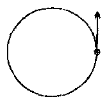
Q.6 A heavy particle is tied to one end of a string 0.4m long, whose other end is fixed. The particle is projected horizontally from its lower position The string becomes slack when it makes an angle of 60° with the upward vertical. The velocity in m/s of the particle at that instant is ______.

Q.7 Two particles A and B each of mass m are connected by a massless string. A is placed on the rough table. The string passes over a small, smooth peg. B is left from a position making an angle θ with the vertical. Find the minimum coefficient of friction between A and the table so that A does not slip during the motion of mass B.

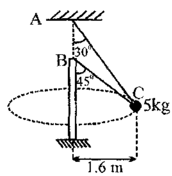


Q.8 A body is projected with a velocity 10 ms^{-1} at an inclination 45° to the horizontal. Minimum radius of curvature of the trajectory described by the particle is ____________.

Q.9 A wire ring of radius R is fixed in a gravity free region. A small bead having a hole through its centre can slide on the wire ring. The coefficient of kinetic friction between the bead and the wire ring is μ. At 't' = 0, the bead is imparted a velocity = v_0 tangentially along the ring, as shown. Find the speed of the bead 'v' and its angular displacement 'θ' as function of time.



Q.10 Two light wires AC and BC are tied at C to a sphere which revolves at constant speed v in the horizontal circle shown in the figure. Determine the range of values of v for which both wires remain tight.



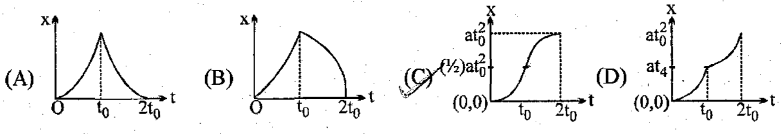
PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) *DATE : 30/07/2005* *TIME : 90 Min.* *DPP. NO.-38*

OBJECTIVE PRACTICE TEST

Select the correct alternative. Only one is correct. **[3 × 25 = 75]**
For each wrong answer **1 mark** will be deducted.

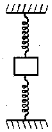
Q.1 A particle starts from origin accelerates for t sec then decelerates with same acceleration till $2t_0$ sec along the x-direction. The graph representing variation of displacement (x) with time(t) is



Q.2 A uniform chain of length L and mass M is lying on a smooth table and one third of its length is hanging vertically down over the edge of the table. If g is acceleration due to gravity, the work required to pull the hanging part on to the table is

(A) mgL (B) $\frac{mgL}{3}$ (C) $\frac{mgL}{9}$ (D) $\frac{mgL}{18}$

Q.3 A block tied between two springs is in equilibrium. If upper spring is cut then the acceleration of the block just after cut is 6 m/s^2 downwards. Now, if instead of upper spring, lower spring is being cut then the acceleration of the block just after the cut will be:



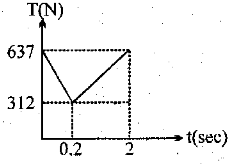
(A) 16 m/s^2 (B) 4 m/s^2 (C) cannot be determined (D) none of these

Q.4 A paricle of unit mass moves along a smooth horizontal surface under the action of a horizontal force of magnitude $[5 - K\sqrt{S}]$ N, where S is its distance from a fixed point O on the surface. The force is directed always away from O. If it starts from rest at O and comes to instantaneous rest again 400 m from O, the value of the constant K will be

(A) $\frac{3}{8}$ (B) $\frac{3}{5}$ (C) $\frac{2}{3}$ (D) $\frac{2}{7}$

Q.5 Power delivered to a body varies as $P = 3t^2$. Find out the change in kinetic energy of the body from t = 2 to t = 4 sec.
(A) 12 J (B) 56 J (C) 24 J (D) 36 J

Q.6 A mountain climber is sliding down a vertical rope. Her total mass including the equipments is 65 kg. By adjusting the friction on the rope, she controls the tension force on the rope as a function of time is shown in the fig. The speed of the mountaineer at the end of 2 sec if she starts from rest is [Take $g = 9.8\ ms^{-2}$]



(A) 2.25 ms^{-1} (B) 4.5 ms^{-1}
(C) 5 ms^{-1} (D) 2.5 ms^{-1}

Q.7 A force $\vec{F} = (3t\hat{i} + 5\hat{j})$ N acts on a body due to which its displacement varies as $\vec{s} = (2t^2\hat{i} - 5\hat{j})$. Work done by this force in t = 0 to 2 sec is:
(A) 23 J (B) 32 J (C) zero (D) can't be obtained.

Q.8 Man A sitting in a car moving at 54 km/hr observes a man B in front of the car crossing perpendicularly the road of width 15 m in three seconds. Then the velocity of man B will be

(A) $5\sqrt{10}$ towards the car (B) $5\sqrt{10}$ away from the car
(C) 5 m/s perpendicular to the road (D) None

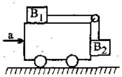
Q.9 Two blocks, A and B, of same masses, are resting in equilibrium on an inclined plane having inclination with horizontal = α. The blocks are touching each other with block B higher than A. Coefficient of static friction of A with incline = 1.2 and of B = 0.8. If motion is not imminent,
(A) $\alpha < 30°$ (B) $(\text{Friction})_A > (\text{Friction})_B$
(C) $\alpha < 45°$ (D) $(\text{Friction})_A = (\text{Friction})_B$

Q.10 The horsepower of a pump of efficiency 80%, which sucks up water from 10 m below ground and ejects it through a pipe opening at ground level of area 2 cm^2 with a velocity of 10 m/s, is about
(A) 1.0 hp (B) 0.5 hp (C) 0.75 hp (D) 4.5 hp

Q.11 The position of a particle changes according to the equation $\vec{r} = (2\hat{i} - 4t^2\hat{j})$ m. Which of following is not correct?
(A) $\vec{v} = -8t\hat{j}$ (B) $\vec{s} = 4t^2\hat{j}$ (C) $\vec{a} = -8\hat{j}$ (D) None of these

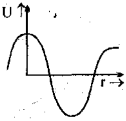
Q.12 The potential energy of a particle varies with x according to the relation $U(x) = x^2 - 4x$. The point $x = 2$ is a point of
(A) stable equilibrium (B) unstable equilibrium (C) neutral equilibrium (D) none of above

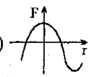
Q.13 Two blocks B_1 & B_2 of masses m_1 & m_2 respectively are connected with the help of a pulley and string as shown. Upper surface of vehicle is smooth but vertical surface is rough. Given $a = g/7$ & $m_1 = 7.5\ m_2$. Blocks B_1 & B_2 do not slide, then minimum coefficient of friction between block B_2 and side of vehicle is:
(A) 0.4 (B) 0.5 (C) 0.6 (D) 0.3

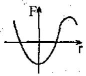


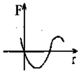
Q.14 A stone is released from an elevator going up with an acceleration a. The acceleration of the stone after the release is
(A) a upward (B) (g – a) upward (C) (g – a) downward (D) g downward

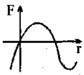
Q. P gy p p e g ph
shown. Then force position graph can be



(A) 

(B) 

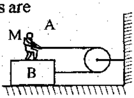
(C) 

(D) 

Q.16 As shown in the figure, M is a man of mass 60 kg standing on a block of mass 40 kg kept on ground. The coefficient of friction between the feet of the man and the block is 0.3 and that between B and the ground is 0.2. If the person pulls the string with 125 N force, then the correct statements are

I. B will slide on ground
II A and B will move together with acceleration 0.5 m/s^{-2}
III The friction force acting between A & B will be 40 N
IV The friction force acting between A & B will be 180 N.

(A) I & II (B) II & III (C) I and III (D) I, II and III



Q.17 A particle is moving on x-axis has potential energy $U = 2 - 20X + 5x^2$ Joules along x-axis. The particle is released at $x = -3$. The maximum value of 'x' will be [x is in meters and U is in joules]

(A) 5 m (B) 3 m (C) 7 m (D) 8 m

Q.18 A motor boat is to reach at a point 30° upstream (w.r.t. normal) on other side of a river flowing with velocity 5m/s. Velocity of motorboat w.r.t. water is $5\sqrt{3}$ m/s. The driver should steer the boat at an angle

(A) 120° w.r.t. stream direction

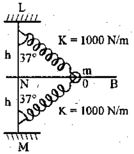
(B) 30° w.r.t. normal to the bank

(C) 30° w.r.t. the line of destination from starting point.

(D) none of these

Q.19 A varying horizontal force F = at acts on a block of mass m kept on a smooth horizontal surface. An identical block is kept on the first block. The coefficient of friction between the blocks is μ. The time after which the relative sliding between the blocks prevails is

(A) 2 mg/a (B) 2μmg/a (C) μmg/a (D) None



Q.20 A bead of mass 5kg is free to slide on the horizontal rod AB. They are connected to two identical springs of natural length h ms. as shown. If initially bead was at O & M is vertically below L then, velocity of bead at point N will be

(A) 5h m/s (B) 40h/3 m/s

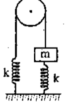
(C) 8h m/s (D) none of these

Q.21 Two blocks of masses $m_1 = 1$kg and $m_2 = 2$kg are connected by a non - deformed light spring. They are lying on a rough horizontal surface. The coefficient of friction between the blocks and the surface is 0.4. What minimum constant force F has to be applied in horizontal direction to the block of mass m_1 in order to shift the other block? (g= 10m/s²)

(A) 8 N (B) 15 N (C) 10 N (D) 12 N

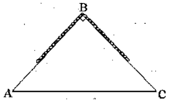
Hint :- $F = \mu\left(m_1 + \frac{m_2}{2}\right)g$

Q.22 Consider the system of ideal pulley spring and block of mass m. When the system is released from state of rest, the maximum distance moved by the block of mass 'm' is



(A) $\frac{mg}{2k}$ (B) $\frac{2mg}{k}$ (C) $\frac{mg}{k}$ (D) $\frac{mg}{3k}$

Q.23 A flexible chain of length $L = 20\sqrt{2}$ m and weight W = 10kg is intially placed at rest on a smooth frictionless wedge surface ABC. It is given a slight jerk on one side so that it will start sliding on the side. Find the speed of the chain when its one end will leave the vertex of the wedge:

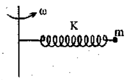


(A) $10\sqrt{2}$ m/s (B) 10 m/s (C) 4 m/s (D) $(10\sqrt{2})^{1/2}$

Q.24 The tangential acceleration of a particle in a circular motion of radius 2 m is $a_t = \alpha t$ m/s² (where α is a constant) Initially the particle as rest. Total acceleration of the particle makes 45° with the radial acceleration after 2 sec. The value of constant α is :

(A) 1/2 m/s³ (B) 1 m/s³ (C) 2 m/s³ (D) data are insufficient

Q.25 A particle of mass m is fixed to one end of a light spring of force constant k and unstretched length l. The system is rotated about the other end of the spring with an angular velocity ω in gravity free space. The increase in length of the spring is



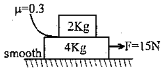
(A) $\frac{m\omega^2\ell}{k}$ (B) $\frac{m\omega^2\ell}{k - m\omega^2}$ (C) $\frac{m\omega^2\ell}{k + m\omega^2}$ (D) none of these

CLASS : XI (P, Q, R, S) *DATE : 1-2/08/2005* *TIME : 1 Hour* *DPP. NO.-39*

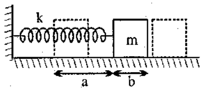
OBJECTIVE PRACTICE TEST

Select the correct alternative. Only one is correct. **[3 × 25 = 75]**
For each wrong answer **1 mark** will be deducted.

Q.1 Find the friction force between the blocks in the adjacent figure
(A) 6N (B) 18N
(C) 5N (D) 12 N



Q.2 The spring is compressed by distance a and the system is released. The block again comes to rest when the spring is elongated by a distance b. During this process



(A) work done by the spring on the block $= \frac{1}{2}k(a-b)^2$

(B) work done by the spring on the block $= \frac{1}{2}k(a^2+b^2)$

(C) coefficient of friction $= \frac{k(a-b)}{2mg}$

(D) coefficient of friction $= \frac{k(a+b)}{2mg}$

Q.3 A particle moves in x-y coordinate system such that its position coordinates are gives as $\vec{r} = 2\sin t\hat{i} + 4\sin t\hat{j}$, The path of the particle is:
(A) straight line (B) parabola (C) circular (D) ellipse

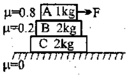
Q.4 Which of the following is correct about kinetic friction?
(A) Always acts in opposite direction of the applied force.
(B) total work done by this force on the system may be zero.
(C) direction of friction is always apposite to direction of velocity.
(D) it can increase velocity.

Q.5 Two springs having spring constant 9 N/m and 16 N/m are stretched by forces F_1 and F_2 till they have same potential energy. The value of F_1/F_2 is
(A) 4 : 3 (B) 3 : 4 (C) 16 : 9 (D) 9 : 16

Q.6 A body starts from rest with uniform acceleration. Its velocity after 2n second in v_0. The displacement of the body in last n seconds is
(A) $\frac{v_0(2n-3)}{6}$ (B) $\frac{v_0}{4n}(2n-1)$ (C) $\frac{3v_0 n}{4}$ (D) $\frac{3v_0 n}{2}$

Q.7 A bucket tied to a string is lowered at a constant acceleration of g/4. If the mass of the bucket is M and is lowered by a distance d, the work done by the string will be (assume the string to be massless)
(A) $\frac{1}{4}$Mgd (B) $-\frac{4}{3}$Mgd (C) $\frac{4}{3}$Mgd (D) $-\frac{3}{4}$Mgd

Q.8 Three blocks lie on each other as shown. Horizontal force F (variable) is applied on block A. Choose the correct statements. ($g = 10\ m/s^2$)



I. maximum acceleration of block B can be $2\ m/s^2$.

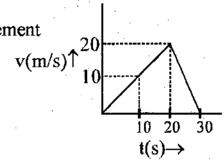
II slipping between B and C cannot take place.

III slipping between A and B starts when F is more than 8N

IV maximum acceleration of block C can be $3\ m/s^2$.

(A) I & II (B) II & III (C) I and III (D) I, II and III

Q.9 V-t graph of an object of mass 1 kg is as shown. Select the ***wrong*** statement



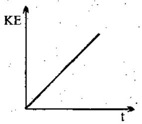
(A) work done on the object in 30s is zero

(B) the average acceleration of the object is zero

(C) the average velocity of object is zero

D t e orce act ng on part c e at t = 10 sec s 1 Newton.

Q.10 The K.E. of a body moving along a straight line varies with time as shown in the figure. The force acting on the body is



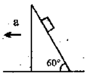
(A) zero

(B) constant

(C) directly proportional to velocity

(D) inversely proportional to velocity

Q.11 The wedge is moved with constant horizontal acceleration a. For which of the following values of a will the acceleration of the block be different from its acceleration in other three cases.

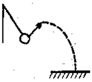
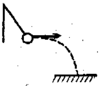


(A) 2 g (B) $\sqrt{3}$ g (C) g (D) $\frac{g}{10}$

Q.12 A force of $(3\hat{i} - 1.5\hat{j})$ N acts on a 5 kg body. The body is at a position of $(2\hat{i} - 3\hat{j})$m and is travelling at $4\ ms^{-1}$. The force acts on the body until it is at the position $(\hat{i} + 5\hat{j})$m. Assuming no other force does work on the body, the final speed of the body is

(A) $20\ ms^{-1}$ (B) $10\ ms^{-1}$ (C) $\sqrt{20}\ ms^{-1}$ (D) $\sqrt{10}\ ms^{-1}$

Q.13 A pendulum bob is swinging in a vertical plane such that its angular amplitude is less than 90^0. At its highest point, the string is cut. Which trajectory is possible for the bob afterwards.

(A)  (B)  (C)  (D) 

Q.14 A load attached to the end of a spring and in equilibrium produces 9 cm extension of spring. If the spring is cut into three equal parts and one end of each is fixed at 'O' and other ends are attached to the same load, the extension in cm of the combination in equilibrium now is:

(A) 1 (B) 3 (C) 6 (D) 9

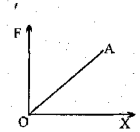
Q.15 A 15 gm ball is shot from a spring gun whose spring has a force constant of 600 N/m. The spring is compressed by 5 cm. The greatest possible horizontal range of the ball for this compression is ($g = 10 m/s^2$)

(A) 6.0 m (B) 12.0 m (C) 10.0 m (D) 8.0 m

Q.16 Three particles start from origin at the same time with a velocity $2ms^{-1}$ along positive x-axis, the second with a velocity $6ms^{-1}$ along negative y-axis. Find the velocity of the third particle along x = y line so that the three particles may always lie in a straight line

(A) $-3\sqrt{3}$ (B) $3\sqrt{2}$ (C) $-3\sqrt{2}$ (D) $2\sqrt{2}$

Q.17 The fo~ce requi~ed to stretc~ a sp~ing va~ies wit~ t~e distance as s~own in t~e figure. If the experiment is performed with the above spring of half its natural length, the line OA will



(A) rotate clockwise (B) rotate anticlockwise
(C) ~~~~i~ ~~ it i~ (D) b~~~~~~ d~~bl~ i~ le~gth

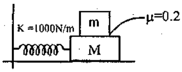
Q.18 Power supplied to a particle of mass 2 kg varies with time as $P = \frac{3t^2}{2}$ watt. Here t is in second. If velocity of particle at t = 0 is v = 0. The velocity of particle at time t = 2 s will be

(A) 1 m/s (B) 4 m/s (C) 2 m/s (D) $2\sqrt{2}$ m/s

Q.19 The motion of a body falling from rest in a resisting medium is described by the equation $\frac{dv}{dt} = a - bv$ where a and b are constants. The velocity at any time t is

(A) $v_t = \frac{a}{b}\left(1 - e^{-bt}\right)$ (B) $v_t = \frac{b}{a}e^{-bt}$ (C) $v_t = \frac{a}{b}\left(1 + e^{-bt}\right)$ (D) $v_t = \frac{b}{a}e^{bt}$

Q.20 A block of mass M = 4kg is kept on a smooth horizontal plane. A bar of mass m = 1kg is kept on it. They are connected to a spring as shown & the spring is compressed. Then what is the maximum compression in the spring for which the bar will not slip on the block when released if coefficient of friction between them is 0.2 & spring constant k = 1000 N/m.



(A) 1cm (B) 1m (C) 1.25 cm (D) 10cm

Q.21 The potential energy in joules of a particle of mass 1 kg moving in a plane is given by U = 3x + 4y, the position coordinates of the point being x and y, measured in metres. If the particle is initially at rest at (6,4), then choose the correct statements

I its acceleration is of magnitude 5 m/s^2

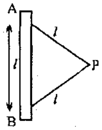
II its speed when it crosses the y-axis is 10 m/s

III it crosses the y-axis (x = 0) at y = -4

IV it moves in a straight line passing through the origin (0,0)

(A) I only (B) I & II (C) I, II and III (D) I, II, III and IV

Q.__ A p__i_l__ ....ss __ is ......h.... . e__c_l __ is _y t... s__i_gs. __ ...... __ length l each. The separation AB=l. P rotates around the axis with an angular velocity ω. The tensions in the two strings are T_1 and T_2



I. $_1 = _2$

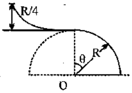
II $T_1+T_2=m\omega^2 l$

III $T_1-T_2=2mg$

IV BP will remain taut only if $\omega \geq \sqrt{\frac{2g}{\ell}}$

(A) I only (B) II & III (C) II, III and IV (D) I, II, III and IV

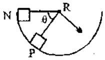
Q.23 A skier plans to ski a smooth fixed hemisphere of radius R. He starts from rest from a curved smooth surface of height (R/4). The angle θ at which he leaves the hemisphere is



(A) $\cos^{-1}(2/3)$ (B) $\cos^{-1}(5/\sqrt{3})$

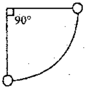
(C) $\cos^{-1}(5/6)$ (D) $\cos^{-1}(5/2\sqrt{3})$

Q.24 An object of mass m is released from rest at A to move along the fixed smooth circular track as in fig. The ratio of magnitudes of centripetal force and normal reaction of the track on the object at any point P at any angle θ would be:



(A) $2/3\sin\theta$ (B) $3/2\cos\theta$ (C) 2/3 (D) 3/2

Q.25 A simple pendulum is vibrating with an angular amplitude of 90° as shown in fig. For what value of α (angle between string and vertical) during its motion, the total acceleration is directly horizontally?



(A) 0 (B) 90° (C) $\cos^{-1}\left(1/\sqrt{3}\right)$ (D) $\sin^{-1}\left(1/\sqrt{3}\right)$

OBJECTIVE PRACTICE TEST

Select the correct alternative. Only one is correct. **[$3 \times 25 = 75$]**
For each wrong answer **1 mark** will be deducted.

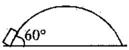
Q.1 The potential energy of a particle of mass 5kg moving in the XY plane is given by V= –7x+24y joules, x and y being in metres. Initially at t=0 the particle is at the origin (0,0) moving with a velocity of $6[\hat{i}(2.4)+\hat{j}(0.7)]$ m/s. Then choose the correct statement

I the magnitude of velocity of the particle at t = 4 sec is 25m/s
II the magnitude of acceleration of the particle is $5 m/s^2$
III the direction of motion of the particle initially at t=0 is at right angles to the direction of acceleration
IV the path of the particle is a circle.

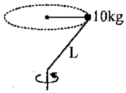
(A) I only (B) I & II (C) I, II and III (D) I, II, III and IV

Q.2 A particle when projected in vertical plane moves along smooth surface with initial velocity 20m/s at an angle of 60°, so that its normal reaction on the surface remains zero throughout the motion. Then the slope of the tangent to the surface at height 5 m from the point of projection will be

(A) [illegible] (B) [illegible]
(C) $\tan^{-1}(2)$ (D) $\tan^{-1}(\sqrt{2})$

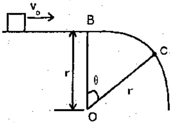


Q.3 A 10 kg ball attached to the end of a rigid massless rod of length 1 m rotates at constant speed in a horizontal circle of radius 0.5 m and period 1.57 sec as in fig. The force exerted by rod on the ball is



(A) 1.28 N (B) 128 N (C) 10 N (D) 12.8 N

Q.4 A small block slides with velocity $0.5\sqrt{gr}$ on the horizontal frictionless surface as shown in the Figure. The block leaves the surface at point C. The angle θ in the Figure is



(A) $\cos^{-1}(4/9)$ (B) $\cos^{-1}(3/4)$
(C) $\cos^{-1}(1/2)$ (D) none of the above

Q.5 Each of the system shown below is initially at rest. Pulleys are massless and frictionless. Choose the correct statement(s).

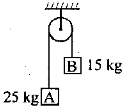


Fig. (1)

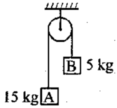


Fig. (2)

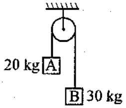


Fig. (3)

I. Acceleration of block A in figure 1 is same as that in figure 2.
II. Acceleration of block A in figure 1 is less than that in figure 2 and greater than that in figure 3.
III The ratio of velocity of block A in figure 1 to that in fig. 2 after it has moved through 1 m is 1.
IV The ratio of velocity of block A in figure 1 to that in fig. 2 after it has moved through 1 m is $\frac{1}{\sqrt{2}}$.

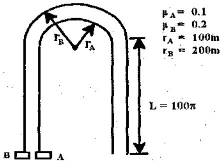
(A) I & II only (B) II & III (C) I & IV (D) I, II, III and IV

Q.6 At a certain moment of time the angle between velocity and the acceleration of a particle, is greater than 90°. What can be inferred about its motion at that moment?
(A) It is curvilinear and decelerated (B) It is rectilinear and accelerated
(C) It is curvilinear and accelerated (D) It is rectilinear and decelerated

Q.7 A uniform flexible chain of mass m and length $2l$ hangs in equilibrium over a smooth horizontal pin of negligible diameter. One end of the chain is given a small vertical displacement so that the chain slips over pin. The speed of the chain when it leaves pin is
(A) $\sqrt{3g\ell}$ (B) $\sqrt{2g\ell}$ (C) $\sqrt{g\ell}$ (D) $\sqrt{4g\ell}$

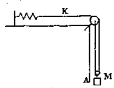
Q.8 Two bodies A & B rotate about an axis, such that angle θ_A (in radians) covered by first body is proportional to square of time, & θ_B (in radians) covered by second body varies linearly. At $t = 0$, $\theta_A = \theta_B = 0$. If A completes its first revolution in $\sqrt{\pi}$ sec. & B needs 4π sec. to complete half revolution then; angular velocity $\omega_A : \omega_B$ at $t = 5$ sec. are in the ratio
(A) 4 : 1 (B) 20 : 1 (C) 80 : 1 (D) 20 : 4

Q.9 Two cars A and B start racing at the same time on a flat race track which consists of two straight sections each of length 100π and one circular section as in Fig. The rule of the race is that each car must travel at constant speed at all times without ever skidding
(A) car A completes its journey before car B
(B) both cars complete their journey in same time
(C) velocity of car A is greater than that of car B
(D) car B completes its journey before car A.



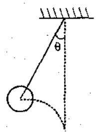
Q.10 A force F acting on a particle of mass 5 kg placed on a smooth horizontal surface. F = 40 Nt remains constant but its vector rotates in a vertical plane at an angular speed 2 rad/sec. If a t = 0, vector F is horizontal, find the velocity of block at $t = \pi/4\omega$ sec.
(A) 1 m/s (B) $\sqrt{2}$ m/s (C) 2 m/s (D) $2\sqrt{2}$ m/s

Q.11 Block A in the figure is released from rest when the extension in the spring is x_0. The maximum downwards displacement of the block is

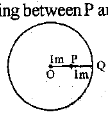


(A) $\frac{Mg}{2K} - x_0$ (B) $\frac{Mg}{2K} + x_0$ (C) $\frac{2Mg}{K} - x_0$ (D) $\frac{2Mg}{K} + x_0$

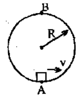
Q.12 A ball is held in the position shown with string of length 1 m just taut & then projected horizontally with a velocity of 3 m/s. If the string becomes taut again when it is vertical, angle θ is given by
(A) 53° (B) 30° (C) 45° (D) 37°



Q.13 Two particles of equal mass are attached to a string of length 2m as shown in figure. The string and particles are then whirled in a horizontal circle about O. The ratio of the tension in string between P and Q to and tension in the string between P and O is
(A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{3}{2}$ (D) 2



Q.14 A bloc̃k of mass m is projected on a smooth horizontal circular track with velocity v. What is average normal force exerted by the circular walls on the block during its motion from A to B.



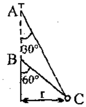
(A) $\frac{mv^2}{R}$ (B) $\frac{mv^2}{\pi R}$ (C) $\frac{2mv^2}{R}$ (D) $\frac{2mv^2}{\pi R}$

Q.15 Two particles starts moving on the same circle of radius 2 m, from the same point P at t = 0, with constant tangential accelerations = 2 m/s^2 and 6 m/s^2, clockwise and anticlockwise, respectively. The point where they meet for the first time is Q. The smaller angle subtended by PQ at center of circle is
(A) 120° (B) 60° (C) 135° (D) 90°

Q.16 A stunt man jumps his car over a crater as shown (neglect air resistance)

(A) during the whole flight the driver experiences weightlessness
(B) during the whole flight the driver never experiences weightlessness
(C) during the whole flight the driver experiences weightlessness only at the highest point
(D) the apparent weight increases during upward journey

Q.17 A single wire ACB passes through a smooth ring at C which revolves at a constant speed in the horizontal circle of radius r as shown in the fig. The speed of revolution is

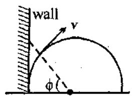


(A) $\sqrt{rg}$ (B) $\sqrt{2rg}$ (C) $2\sqrt{2rg}$ (D) $2\sqrt{rg}$

Q.18 AB is the vertical diameter of a circle in a vertical plane. Another diameter CD makes an angle of 60^0 with AB; then the ratio of the time taken by a particle to slide along AB to the time taken by it to slide along CD, is
(A) 1 : 1 (B) $\sqrt{2}$: 1 (C) $3^{1/4} : 2^{1/2}$ (D) 1 : $\sqrt{2}$

Q.19 A body is thrown with a velocity of 10 m/s at an angle of 45° to the horizontal. The radius of curvature of its trajectory in $t = 1/\sqrt{2}$ sec after the body began to move is :
(A) 0 m (B) 2.5 m (C) 5 m (D) None

Q.20 On a particle moving on a circular path with a constant speed v, light is thrown from a projectors placed at the centre of the circular path. The shadow of the particle is formed on the wall. the velocity of shadow up the wall is



(A) v $\sec^2\phi$ B) v $\cos^2\phi$ C) A) v $\cos\phi$ (D)none

Q.21 The length of second's hand in a watch is 1 cm. The change in velocity of its tip in 15 sec is :
(A) zero (B) $\pi/30\sqrt{2}$ cm/s (C) $\pi/30$ cm/s (D) $\pi\sqrt{2}/30$ cm/s

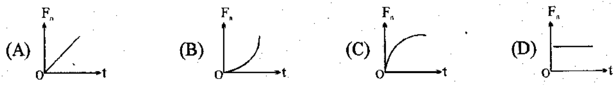
Q.22 A point P moves along a circle of radius r with constant speed v. Its angular velocity about any fixed point on the circle will be
(A) v/r (B) v/2r (C) v/r^2 (D) $v/2r^2$

Q.23 A heavy particle hanging from a string of length l is projected horizontally with speed $\sqrt{gl}$. The speed of the particle at the point where the tension in the string equals weight of the particle is:
(A) $\sqrt{2gl}$ (B) $\sqrt{3gl}$ (C) $\sqrt{gl/2}$ (D) $\sqrt{gl/3}$

Q.24 A particle of small mass m is joined to a very heavy body by a light sting passing over a light pulley. Both bodies are free to move. The total downward force on the pulley is nearly

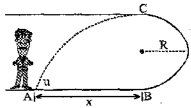
(A) mg (B) 2mg (C) 4mg (D) >> mg

Q.25 The speed of a particle moving along a circular path is increasing at a constant rate a_0. Identify the correct graph, which shows the variation of centripetal force F_n with time t.



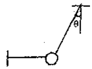
CLASS : XI (P, Q, R, S) *DATE : 08-09/08/2005* *TIME : 90 MIN* *DPP. NO.-41*

Q.1 A person roll a all b ll with d th fl f i t. If $x = 3R$, determine the required speed u so that the ball returns to A after rolling on the circular surface in the vertical plane from B to C and becoming a projectile at C. What is the minimum value of x for which the game could be played if contact must be maintained to point C? Neglect friction.

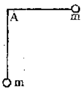


Q.2 The corner of a motor racing track is banked at an angle of 30°. If the coefficient of friction between the tyre and track is $\sqrt{3}/2$ find the ratio of the maximum speed at which car can take the turn with the corresponding speed of car if there is no friction.

Q.3 A ball is held at rest in position A by two light cords (as in figure) The horizontal cord is cut and the ball starts swinging as pendulum. The ratio of the tension in the supporting cord before and immediatel after the strin is cut will be________

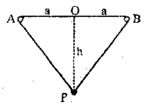


Q.4 A ball of mass is attached with a strong of length l and fixed at point A. The ball is released from the position when the string is horizontal. Draw graph between tension (T) in the string and $\sin\theta$ (for $\theta = \leq 90°$), where θ is angle made by the string with the horizontal.



Q.5 The bob of a pendulum of length l is projected horizontally from its lowest position. The string becomes slack at some position. What is the maximum possible value of the vertical component of its velocity at that instant. (Initial velocity can be varied).

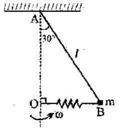
Q.6 The point O is mid-way between two small smooth pegs A and B which are fixed at the same horizontal level at distance $2a$ apart. Two light elastic strings, f t ll t a d f t k h d fix d t O d attached at the other end to a particle P of mass m. One of the strings passes over peg A and the other passes over peg B. The particle hangs in equilibrium at a distance h vertically below O, as shown in the diagram.



(_) F h p l i q l

(b) If particle is held at O and released, find the maximum distance descended by the particle.

Q.7 The end A of an inextensible light string of length l is attached to a fixed point, and an object of mass m is attached to the other end B. A light spring of natural length $\frac{1}{4}$ l and stiffness $\frac{\sqrt{3}mg}{l}$ is attached to B and to a smooth pivot at the point O. The system rotates with angular speed ω about the vertical line OA. The angle $OAB = 30°$ and OB is horizontal, as shown in the figure.



(a) Evaluate the tension in the string "AB" in terms of 'm' and 'g'

(b) Evaluate the tension in the spring OB in terms of 'm' and 'g'.

(c) Find "ω" in terms of 'g' and 'l'.

Q.8 A particle P of mass m is attached by a light inextensible string of length 2a to a fixed point O. When vertically below O, P is given a horizontal velocity u. When OP becomes horizontal the string hits a small smooth peg, Q, distant a from O and the particle continues to rotate about Q as centre. If the particle just describes complete circles about the rail, find the value of u.

Q.9 The potential energy in a conservative force field is given by $U = 3x^2 + 4y^2$.

(a) Find work done by the conservative force in moving from a body from (0, 2) to (2, 0)

(b) If mass of the body = 2 kg and its velocity at (4, 0) was 1 m/s find its velocity at (0, 0)

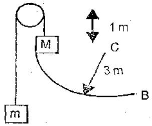
Q.10 A small ball is tied to one end of an inelastic string the other end of which is attached to a fixed point O. It is held, with the string tight, at a point which is 1.5m above O and then let fall; if the length of the string be 3 m. Find its velocity immediately after the string again becomes tight.

BANSAL CLASSES — **Target IIT JEE 2007**

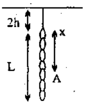
PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) *DATE : 10-11/08/2005* *TIME : 90 MIN* *DPP. NO.-42*

Q.1 A body of mass M=5kg is attached to a small body of mass m=1kg by a very long massless rope passing over a frictionless pulley. Mass M is held in contact with a vertical portion of a circular frictionless slope of radius 3m with its centre at C. Determine the velocity of both masses when M just reaches B on a horizontal base.



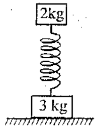
Q.2 A uniform chain of length L is suspended from a strip of elastic rubber, of natural length h & is in equilibrium in the position shown. The chain is then cut at point A. Determine the length x, knowing that the remaining portion of the chain will rise sufficiently: (i) to allow rubber strip to become slack. (ii) to touch the ceiling.



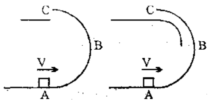
Q.3 A mass m is being lifted upward by means of a vertical spring of force constant k, with a uniform upward acceleration a. If at the instant its velocity is $v = \left(\sqrt{3m/k}\right)g$ the upper end of the spring is suddenly brought to rest, calculate the maximum compression in the spring.

Q.4 A uniform chain of mass m and length l hangs from a hook. Determine the amount of work required to raise the middle link to the hook.

Q.5 The ends of spring are attached to blocks of mass 3kg and 2kg. The 3kg block rests on a horizontal surface and the 2kg block which is vertically above it is in equilibrium producing a compression of 1cm of the spring. The 2kg mass must be compressed further by at least _______, so that when it is released, the 3 kg block may be lifted off the ground.



Q.6 A small package of weight w is projected into a vertical return loop at A w..h a , elocity v. The package travels ..i...out friction along a circle of radius r and is deposited on a horizontal surface at C. For each of the two loops shown, determine (a) the smallest velocity for which the package will reach the horizontal surface at C. (b) the corresponding ...... x ...... y ... l ... m ...... kag. as it ass s int B.

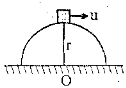


Q.7 A small block of mass m is projected horizontally from the top of the smoothhemisphere of radius r with speed u as shown. For values of $u \geq u_0$, it does not slide on the hemisphere(i.e. leaves the surface at the top itself).

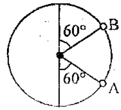
(a) For $u = 2u_0$, it lands at point P on ground Find OP.

(b) For $u = u_0/3$, Find the height from the ground at which it leaves the hemisphere.

(c) Find its net acceleration at the instant it leaves the hemisphere.

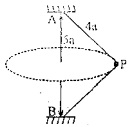


Q.8 A p 'icle is ''ac' e ' 'o one end of s ring ' e o ' er en ' of w' ic' is fixe '. ‴ e particle moves in vertical plane. The velocity at the lowest point is such that the particle can just complete the circle. The ratio of acceleration at A & B is________.



Q.9 A light inextensible string AB has length 7a and breaking tension 4mg. A particle of mass m is fastened to the string at a point P, where AP = 4a. The ends A and B are secured to fixed points, A being at a height 5a vertically above B. If the particle is revolving in a horizontal circle with both portions of the string taut,

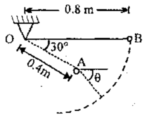
s_o.. ____ ____ o_ o_e _evolu_ion lies _e..._en $3\pi\sqrt{\frac{a}{5g}}$ and $8\pi\sqrt{\frac{a}{5g}}$



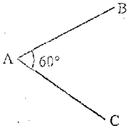
Q.10 A small sphere B of mass m is released from rest in the position shown and swings freely in a vertical plane, first about O and then about the peg A after the cord comes in contact with the peg. Determine the tension in the cord.

(a) just before the sphere comes in contact with the peg,

(b) just after it comes in contact with the peg.

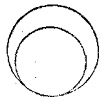


Q.1 A uniform wire of length l is bent into the shape of 'V' as shown. The distance of its centre of mass from the vertex A is



(A) $l/2$ (B) $\frac{l\sqrt{3}}{4}$ (C) $\frac{l\sqrt{3}}{8}$ (D) none of these

Q.2 From a thin circular disc of radius R, a circular hole of radius 4R/5 is cut as shown. The distance of the centre of mass of remaining disc, from the centre of the original disc is

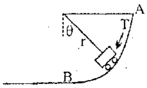


(A) 15R/40 (B) R/3
(C) R/4 (D) 16R/45

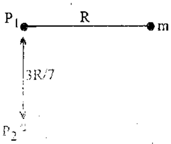
Q.3 The centre of mass of a non uniform rod of length L whose mass per unit length varies as $\rho = kx^2/L$ (where k is a constant and x is the distance measured form one end) is at the following distance from the same end.
(A) 3L/4 (B) L/4 (C) 2L/3 (D) L/3

Q.4 Two ice–skaters of mass 120kg and 200kg are initially hugging on a frictionless ice surface. Ten seconds after they push off from each other, they are 8.0m apart. The distance moved by the skater of mass 200 kg is
(A) 3.0 m (B) 4.0 m (C) 5.0 m (D) 6.0 m

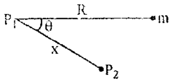
Q.5 A small rocket propelled vehicle of mass m travels down the smooth circular path of effective radius r under the action of its ownweight and a constant thrust T from its rocket motor. Find the tangential acceleration of m as function of angle θ. If the vehicle starts from rest at A, determine its speed v when it reaches B and the magnitude N of the force exerted by the path on the wheels jut prior to reaching B and just after crossing B. Neglect any loss of mass of rocket.



Q.6 A simple pendulum consists of a bob of mass m and a string of length R suspended from a peg P_1 on the wall. A second peg P_2 is fixed vertically below the first one at a distance $3R/7$ from it. The pendulum is drawn aside such that the string is horizontal and released. Calculate the maximum height (with respect to the lowest point) to which it rises.

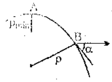


Q.7 If peg P_2 is fixed to the wall at a distance $x < R$ from P_1 making an angle θ with the initial horizontal position of the pendulum, what should be the minimum value of θ for which the mass m will make a complete circle about P_2.

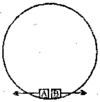


Q.8 Consider a uniform spring of mass M, unstretched length L, and spring constant k. It's one end is fixed and other end moving with speed v. Calculate the kinetic energy of the spring in terms of M and v.

Q.9 If ρ_{min} is radius of curvature of trajectory of a projectile at highest point A, then find the radius of curvature ρ of the trajectory at B where it forms α angle with horizontal.



Q.10 Two particles A & B are projected tangentially from lowest point inside a smooth vertical circular track of radius 5 m with velocity $v = 10\sqrt{2}$ m/s in opposite directions. Find the coordinates of the point where A & B collide with respect to initial point of projection.



CLASS : XI (P, Q, R, S) ***DATE : 22-23/08/2005*** ***TIME : 90 MIN*** ***DPP. NO.-44***

Q.1 A pendulum consists of a wooden bob of mass m and length L. A bullet of mass m_1 is fired towards the pendulum with speed v_1. The bullet comes out of the bob with speed $v_1/3$, the pendulum just completes motion along vertical circle. The velocity v_1 is

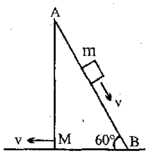
(A) $\frac{3}{2}\frac{m}{m_1}\sqrt{5g\ell}$ (B) $\frac{m}{m_1}\sqrt{5g\ell}$ (C) $\frac{3}{2}\frac{m}{m_1}\sqrt{g\ell}$ (D) $\frac{3}{2}\frac{m_1}{m}\sqrt{5g\ell}$

Q.2 A rock explodes breaking into three pieces. Two pieces fly off perpendicular to one another. One piece of mass 1 kg has velocity 12 m/s and the second of mass 2 kg has velocity 8m/s. If the third mass flies off at a velocity of 40 m/s. What is its mass

(A) 2 kg (B) 1 kg (C) 1/2 kg (D) 3 kg.

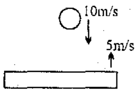
Q.3 A particle of mass m = 0.1 kg is released from rest from a point A of a wedge of mass M = 2.4 kg free to slide on a frictionless horizontal plane. The particle slides down the smooth face AB of the wedge. When the velocity of the wedge is 0.2 m/s the velocity of the particle in m/s relative to the wedge is

(A) 4.8 (B) 5 (C) 7.5 (D) 10



Q.4 A ball of mass 1kg strikes a heavy platform, elastically, moving upwards with a velocity of 5m/s. The speed of the ball just before the collision is 10m/s downwards. Then the impulse imparted by the platform on the ball is

(A) 15 N – s (B) 10 N – s (C) 20 N – s (D) 30 N – s



Q.5 Two blocks A(3 kg) and B(2 kg) resting on a smooth horizontal surface is connected by a spring of stiffness 480 N/m. Initially the spring is undeformed and a velocity of 2 m/s is imparted to A along the line of the spring away from B. The maximum extension in meters of the spring during subsequent motion is

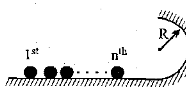
(A) $\frac{1}{10}$ (B) $\frac{1}{2\sqrt{10}}$ (C) $\frac{1}{2\sqrt{15}}$ (D) 0.15

Q.6 Two particles, each of mass m, are connected by a light inextensible string of length $2l$. Initially they lie on a smooth horizontal table at points A and B distant l apart. The particle at A is projected across the table with velocity u. Find the speed with which the second particle begins to move if the direction of u is, (a) along BA, (b) at an angle of 120° with AB, (c) perpendicular to AB. In each case calculate (in terms of m and u) the impulsive tension in the string.

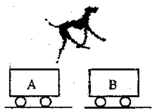
Q.7 A bullet of mass m moving with a velocity u strikes a block of mass M, which is free to move in the direction of motion of bullet, and is embedded in it. If the bullet is embedded into the block, by a distance b meters & the resistance of the block to the bullet is assumed to be uniform, find :

(a) ratio of final & initial kinetic energy of the system.
(b) time of penetration.
(c) distance moved by the block during the time of penetration.

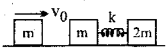
Q.8 'n' elastic ball are placed at rest on a smooth horizontal plane which is circular at the end with radius R as shown in the figure. The masses of the ball are m, $\frac{m}{2}, \frac{m}{2^2}, \ldots\ldots \frac{m}{2^{n-1}}$ respectively. Find the minimum velocity which should be imparted to the first ball m such that the n^{th} ball will complete the vertical circle.



Q.9 In a circus act, a 4kg dog is trained to jump from B cart to A and then immediately back to the B cart. The carts each have a mass of 20kg and they are initially at rest. In both cases the dog jumps at 6m/s relative to the cart. If the cart moves along the same line with negligible friction calculate the final velocity of each cart with respect to the floor.



Q.10 Two bodies A & B of masses m & 2m respectively are placed on a smooth floor. They are connected by a spring. A third body C of mass m moves with velocity v_0 along AB and collides elastically with A. After collision at the instant of maximum compression of x_0, find common velocity and spring constant.



BANSAL CLASSES **PHYSICS**

Target IIT JEE 2007 **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 24-25/08/2005* *TIME : 90 MIN* *DPP. NO.-45*

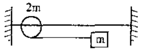
Q.1 Two ball of same mass are dropped from the same height onto the floor. The first ball bounces upwards from the floor elastically. The second ball sticks to the floor. The first applies an impulse to the floor of I_1 and the second applies an impulse I_2. The impulses obey

(A) $I_2=2I_1$ (B) $I_2=I_1/2$ (C) $I_2=4I_1$ (D) $I_2=I_1/4$

Q.2 Two bodies of mass 1 kg and 2 kg move towards each other in mutually perpendicular direction with the velocities 3 m/s and 2 m/s respectively. If the bodies stick together after collision theheat liberated will be

(A)13 J (B) 13/3 J (C) 8 J (D) 7 J.

Q.3 A bead can slide on a smooth straight wire and a particle of mass m attached to the bead by a light string of length L. The particle is held in contact with the wire and with the string taut and is then let fall. If the bead has mass 2m then when the string makes an angle θ with the wire, the bead will have slipped a distance

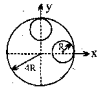


(A) L (1 – cos θ) (B) (L/2) (1 – cos θ) (C) (L/3) (1 – cos θ) (D) (L/6)(1 – cos θ).

Q.4 A man of 80 kg attempts to jump from the small boat of mass 40 kg on to the shore. He can generate a relative velocity of 6 m/s between him and boat. His velocity towards shore is

(A) 4 m/s (B) 8 m/s (C) 2 m/s (D) 3 m/s.

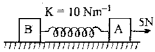
Q.5 From the circular disc of radius 4R two small disc of radius R are cut off. The centre of mass of the new structure will be :



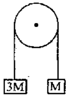
(A) $i\frac{r}{5}+j\frac{r}{5}$ (B) $-i\frac{r}{5}+j\frac{r}{5}$

(C) $-i\frac{r}{5}-j\frac{r}{5}$ (D) $\frac{-3r}{14}\hat{i}-\frac{3r}{14}\hat{j}$

Q.6 Two blocks A and B of equal mass are connected by a spring of force constant $10\ Nm^{-1}$ and separated by a distance 1 m. A constant force 5 N is acting on block A. Find the maximum separartion during the motion. (Neglect the frictional force between the block and surface).



Q.7 Two block of mass M and 3 M are connected by a light cord which passes over a light frictionless pulley as shown in the figure. The blocks are released from rest and are at the same height at t = 0. Find the acceleration of the centre of mass.



Q.8 A body of mass 8kg is travelling at 2m/s under the influence of no external agency. At a certain instant an internal explosion occurs, splitting the body into two pierces each of mass 4kg. 16J of KE is imparted to the two pieces by the explosion. They continue to move along their initial line of motion after explosion. Determine their speed and direction of motion of each piece after the explosion.

Q.9 A smooth sphere A of mass 0.1 kg is moving with speed 5m/s when it collides head on with another smooth stationary sphere of same radius. If A is brought to rest by the impact and $e = \frac{1}{2}$, find the mass of B, its speed just after impact and magnitude of impulse during collision.

Q.10 A plate in the form of a semicircle of radius a has a mass per unit area of kr where k is a constant and r is the distance from the centre of the straight edge. By dividing the plate into semicircular rings find the distance of the centre of mass of the plate from the centre of its straight edge.

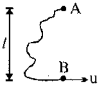
BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) *DATE : 26-27/08/2005* *TIME : 90 MIN* *DPP. NO.-46*

Q.1 A ball is thrown downwards with initial speed = 6 m/s, from a point at height = 3.2 m above a horizontal floor. If the ball rebounds back to the same height then coefficient of restitution equals to
(A) 1/2 (B) 0.75 (C) 0.8 (D) None

Q.2 Two particles A and B each of mass m are attached by a light inextensible string of length $2l$. The whole system lies on a smooth horizontal table with B initially at a distance l from A. The particle at end B is projected across the table with speed u perpendicular to AB. Velocity of ball A just after the jurk, is

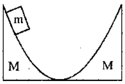


(A) $\frac{u\sqrt{3}}{4}$ (B) $u\sqrt{3}$ (C) $\frac{u\sqrt{3}}{2}$ (D) $\frac{u}{2}$

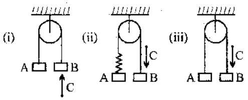
Q.3 The inclined surfaces of two movable wedges of same mass M are smoothly conjugated with the horizontal plane as shown in figure. A washer of mass m slides down the left wedge from a height h. To what maximum height will the washer rise along the right wedge? Neglect friction.

(A) $\frac{[illegible]}{(M+m)^2}$ (B) $\frac{h\ldots}{(M+m)^2}$

(C) $h\left(\frac{M}{M+m}\right)^2$ (D) $h\left(\frac{M}{M+m}\right)$



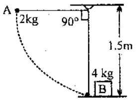
Q.4 In the figure (i), (ii) & (iii) shown the objects A, B & C are of same mass. String, spring & pulley are massless. C strikes B with velocity 'u' in each case and sticks to it. The ratio of velocity of B in case (i) to (ii) to (iii) is
(A) 1 : 1 : 1 (B) 3 : 3 : 2
(C) 3 : 2 : 2 (D) none of these



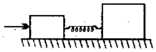
Q.5 A particle of mass m and momentum $\vec{P}$ moves an a smooth horizontal table and collides directly and perfectly elastically with a similar particle (of mass m) having momentum $-2\vec{P}$. The loss (–) or gain (+) in the kinetic energy of the first particle in the collision is

(A) $+\frac{p^2}{2m}$ (B) $-\frac{p^2}{4m}$ (C) $+\frac{3p^2}{2m}$ (D) zero

Q.6 A sphere A is released from rest in the position shown and strikes the block B which is at rest. If e = 0.75 between A and B and $\mu_k = 0.5$ between B and the support, determine
(a) the velocity of A just after the impact
(b) the maximum displacement of B after the impact.



Q.7 In the figure shown, the left block of mass 1 kg is struck sharply with an impulse J, horizontal to the right. The spring of stiffness 200 N/m was initially in its natural state. The floor has friction coefficient $\mu = 1/4$ and the mass of the right block is 2 kg. Find the minimum value of 'J' if the heavier block is to move at all.

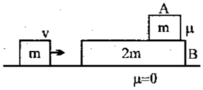


Q.8 A block of mass m is projected with velocity v as shown. The ground is smooth but there is friction between A and B. If collision is elastic

(a) Find the final common velocity of A & B.

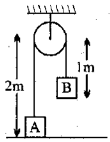
(b) Find total energy dissipated in friction.

Assume that A does not fall off B.



Q.9 A billiard ball, 200 g moving with a velocity of 2 m/s collides head on with another identical ball at rest. The collision is inelastic with a coefficient of resistitution 0.5. Calculate the loss in energy.

Q.10 Two masses A & B each of 5 kg are suspended by a light inextensible string passing over a smooth massless pulley such that mass A rest on smooth table & B is held at the position shown. Mass B is now gently lifted up to the pulley and allowed to fall from rest. Determine up to what height will A rise for the ensuing motion.



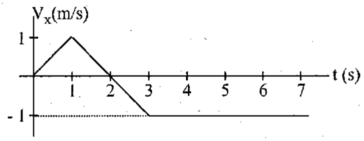
BANSAL CLASSES — **Target IIT JEE 2007**

PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) | *DATE : 29-30/08/2005* | *TIME : 90 MIN* | *DPP. NO.-47*

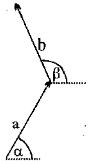
This is the test paper of Class-XI (J-Batch) held on 28-08-2005.

Q.1 The velocity of a particle moving along the x–axis is shown. If the particle is located at x = 3.5 m at t = 0, what is the value of x for the particle at t = 3.0 s?

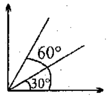


Q.2 A bus moves away from rest at a bus stop with an acceleration of 1 ms^{-2}. As the bus starts to move a man who is 4 m behind the stop runs with a constant speed after the bus. If he just manages to catch the bus find his speed.

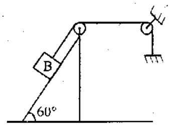
Q.3 If a = 12 m, b = 16 m, $\alpha = 30°$, $\beta = 145°$, and $\vec{c} = \vec{a} - \vec{b}$, determine $|\vec{c}|$



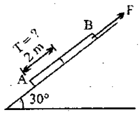
Q.4 Two particles are projected simultaneously at angles 60° and 30° with the horizontal, from the same point and with the same initial speed. Find the angle after time t which the line joining the particle makes with the vertical.



Q.5 If acceleration of wedge = 5 m/s² to the right. Find the magnitude of acceleration of the block B. The string is inextensible



Q.6 A uniform string of length 10 m and mass 20 kg lies on a smooth frictionless inclined plane. A force of 200 N is applied as shown in the figure.



(a) Find the acceleration of the string.

(b) Find the tension in the string at 2m from end A

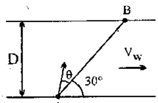
Q.7 A police officer sits on a parked motorcycle. A car travelling at a constant speed of $v_0 = 40.0$ m/s passes by at t =0. At that instant, the officer accelerates the motorcycle at a constant rate, and at time $t_1 = 20.0$s overtakes the speeder.

(a) (i) Find the acceleration of the motorcycle.

(ii) Find the speed of the motorcycle at the instant it overtakes the car.

(b) In the same graph, sketch the position–time graph of the car and that of the motorcycle. Label clearly.

Q.8 Two ports A and B are separated by a river of width D. Water in the river flows with speed V_w. A boat crosses the river from port A to port B. The speed of the boat relative to water is V_B. Given $V_w = \sqrt{3}V_B$



(a) Find the angle "θ" with AB in which the boat should start relative to water so that it moves along AB.

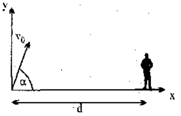
(b) Find the time taken by the boat to reach the port B in terms of D and V_B.

Q.9 Given the setup shown in figure. A projectile is launched with initial speed $v_0 = 50$ m/s at a given angle $\alpha = 53°$ above the horizontal. At a horizontal distance d = 30m from the launch point stands an observer. (Neglect the height of observer)

(a) Find the height at which the projectile passes directly overhead of the observer.

(b) Give the components of the projectile's velocity
(i) at the highest point of its trajectory
(ii) at the instant it is directly above the observer.

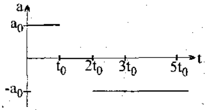
(c) Suppose that at the instant the projectile is launched, the observer also launches as "interceptor" vertically upward. With what initial speed must the interceptor be launched such that it hits the projectile?



Q.10 An object starts at rest at the origin at t = 0 and accelerates according to the graph shown. The motion is one – dimensional.

(a) Sketch a graph of velocity versus time. Show and clearly label all values

(b) At what time (expressed in terms of t_0) does the object return to the origin?

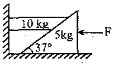


Q.11 The system is in equilibrium

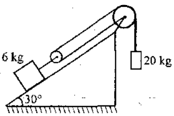
(a) Draw FBD of 10 kg block.

(b) Draw FBD of 5 kg wedge.

(c) Find "F" so that the system is in equilibrium
Neglect friction



Q.12 (a) Draw the FBD of 20 kg block.
(b) Draw the FBD of 6 kg block.
(c) Find the acceleration of the masses
Neglect friction, masses of pulleys and strings. Strings are nextensible

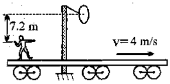


Q.13 Rain drops are falling vertically w.r.t. ground. To a man running at 8 km/hr, rain drops appear to him coming at a speed of 10 km/hr.

(a) Find the speed of rain w.r.t. ground.

(b) Find the speed with which he should run so that the rain drops appear to him coming at an angle of 45° with vertical.

Q.14 A man is riding a flatcar travelling with constant speed of 4 m/s. There is a stationary ring above the line of motion of the car. Height of the ring above man's hand is 7.2 m. He wishes to throw a ball through the ring in such a manner that the ball passes through the ring moving horizontally. He throws the ball with a speed of 20 m/s with respect to himself (car).



(a) What must be the vertical component of the initial velocity of the ball?

(b) How many seconds after he releases the ball will it pass through the ring?

(c) When the ball leaves the man's hand, what is the direction of its velocity relative to the frame of reference of the flatcar?

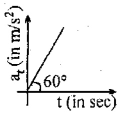
(d) At what horizontal distance in front of the ring must he release the ball?

CLASS : XI (P, Q, R, S) *DATE : 31/08/2005* *TIME : 90 MIN* *DPP. NO.-48*

Q.1 A stone of mass 1 kg tied to a light inextensible string of length L = 10/3 m is whirling in a circular path of radius L in a vertical plane. If the ratio of the maximum tension in the string to the minimum tension in the string is 4 and if g is taken to be 10 m/sec^2, the speed of the stone at the highest point of the circle is:

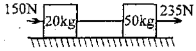
(A) 20 m/sec (B) $10\sqrt{3}$ m/s (C) $5\sqrt{2}$ m/sec (D) 10 m/sec.

Q.2 Tangential acceleration of a particle starting from rest and moving in a circle of radius 1 metre varies with time as in graph. Time after which total acceleration of particle makes an angle of 30° with radial acceleration is :



(A) 4 sec (B) 4/3 sec
(C) $2^{2/3}$ sec (D) $\sqrt{2}$ sec

Q.3 Two blocks of masses 20 kg and 50 kg are lying on a horizontal floor (coefficient of friction $\mu = 0.5$). Initially string is just taut and blocks are at rest. Now two forces 235 N and 150N is applied on two blocks as shown in figure. What is acceleration of 20 kg block (g = 10 m/s^2)



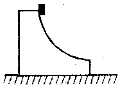
(A) 0.5 m/s^2 (B) zero (C) 2.5 m/s^2 (D) cannot be determined

Q.4 A ball is dropped on to a fixed horizontal surface from a height h, the coefficient of restitution is e. The average speed of the ball from the instant it is dropped till it goes to maximum height after first impact with ground

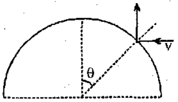
(A) $\dfrac{(1+e)\sqrt{2gh}}{(1-e)}$ (B) $\dfrac{(1+e^2)}{(1+e)}\sqrt{\dfrac{gh}{2}}$ (C) $\dfrac{(1-e^2)\sqrt{2gh}}{(1+e)^2}$ (D) $\dfrac{(1-e)\sqrt{2gh}}{(1+e)}$

Q.5 The masses of five balls at rest in a straight line form a geometrical progression whose ratio is 2. The coefficients of restitution are each 2/3. If the first ball be started towards the second with a velocity u, find the velocity communicated to the fifth ball.

Q.6 A quarter-circular tracks of radius R is carved in a block so that the mass of the r m ining li i 4m. A y m ' ' 1 fr m th p h track, as shown in the figure above, so that it slides down the track. Find the velocity of the disc with respect to Earth when it leaves the track. Also find the recoil velocity of the track. All surfaces are frictionless.



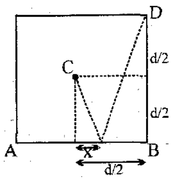
Q.7 A particle travelling horizontally strikes a smooth fixed spherical surface as shown. If coefficient of restitution is e = 1/3, what should be angle θ so that it rebounds vertically.



Q.8 A ball of mass 1 kg moving with 5 m/s strikes a massive wall moving with velocity of 5 m/s. The ball is approaching the wall & coefficient of restitution between them is e = 1/2. Find the impulse exerted by the wall on the ball during collision.

Q.9 A sphere, of mass m, impinges obliquely on a sphere, of mass M, which is at rest. Show that, if m = eM, the directions of motion of the spheres after impact are at right angles.

Q.10 In a carrom board play Queen at C is to be shot after rebound from edge AB into hole D. Find the distance x from centre of edge AB at which it should strike if coefficient of restitution is 0.5.



BANSAL CLASSES — PHYSICS

Target IIT JEE 2007 — **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 02-03/09/2005* *TIME : 90 MIN* *DPP. NO.-49*

Q.1 A ball is thrown vertically downwards with velocity $\sqrt{2gh}$ from a height h. After colliding with the ground it just reaches the starting point. Coefficient of restitution is

(A) $1/\sqrt{2}$ (B) 1/2 (C) 1 (D) $\sqrt{2}$

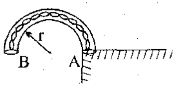
Q.2 A ball falls vertically for 2 seconds and hits a plane inclined at 30^0 to horizon. If the coefficient of restitution is 3/4, find the time that elapses before it again hits the plane.

(A) 3 seconds (B) 2 seconds (C) 5 seconds (D) 4 seconds

Q.3 A simple pendulum has a string of length l and bob of mass m. When the bob is at its lowest position, it is given the minimum horizontal speed necessary for it to move in a circular path about the point of suspension. When the string is horizontal the net force on the bob is

(A) mg (B) 3mg (C) $\sqrt{10}$mg (D) 4mg

Q.4 A ... h ... i i ... la t b AB f di ... i fi ed i ... v ti al pl ... e a d contains a heavy flexible chain of length πr and weight $W\pi r$ as shown. Assuming a slight disturbance to start the chain in motion, the ...ci.y ... h ... i h ... ill m ge ... m ... p n en B ... h ... u ... is



(A) $\frac{4gr}{\pi}$ (B) $\frac{2gr}{\pi}$ (C) $\sqrt{2gr\left(\frac{2}{\pi}+\pi\right)}$ (D) $\sqrt{2gr\left(\frac{2}{\pi}+\frac{\pi}{2}\right)}$

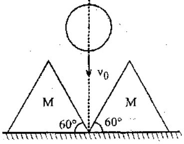
Q.5 A small ball thrown at an initial velocity v_0 at an angle α to the horizontal strikes a vertical massive smooth wall moving towards it at a horizontal velocity v and is bounced elastically to the point from which it was thrown. Determine the time t from the beginning of motion to the moment of impact, neglecting friction losses.

Q.6 Two particle P of mass 2m and Q of mass m are subjected to mutual force of attraction and no other acts on them. At time t = 0, P is at rest at a fixed O and Q is directly moving away from O with a speed 5 u. At a later instant when t = T before any collision has taken place Q is moving towards O with speed u.

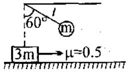
(a) Find in terms of m and u the total work done by the forces of attraction during the time interval $0 \le t \le T$.

(b) At the instant t = T, impulses of magnitude J and K are applied to P and Q bringing them to rest. Find the val...s ...f J a...d K.

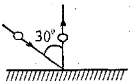
Q.7 Two identical equilateral triangular wedges of mass M rest on a smooth horizontal surface. A smooth sphere of mass m moving vertically down with a velocity v_0 strikes the wedges symmetrically. If the coefficient of restitution is e find the velocities of the sphere and that of the wedges just after collision.



Q.8 A pendulum of mass m & length l is released when it makes an angle of 60° with the vertical. It collides with a block of mass 3m, elastically, kept at the lowest position of its path. The block stops 1 second after the collision & coefficient of friction between the block & surface is 0.5. Find the length of the string ... maximum angle ..hich the ... ma..es ..ith vertical after the col.ision.



Q.9 A ... al ... o ... mass 1 kg moving wi ... a veloci y o ... 5m/s s rikes rough groun ... a ... an angle of 30° with vertical as shown. The collision between the ball & ground is elastic. What can be the minimum friction coefficient between the ball & the ground if the ball rebounds in vertical direction after collision?



Q.10 A massive vertical wall is approaching a man at a speed u . When it is at a distance of 10 m, the man throws a ball with speed 10 m/s at an angle of 37° which after completely elastic rebound reaches back directly into his hands . Find the velocity u of the wall .

BANSAL CLASSES — PHYSICS
Target IIT JEE 2007 — **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 5-6/09/2005* *TIME : 90 MIN* *DPP. NO.-50*

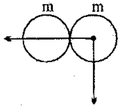
DPP OF THE WEEK

Q.1 A particle is projected from ground towards a vertical wall 80m away at an angle of 37° with horizontal with initial velocity of 50m/s. After its collision with wall & then once with ground find at what distance from wall will it strike the ground again if coefficient of restitution for both collisions is equal to 1/2.
(A) 70 m (B) 120 m (C) 140 m (D) none

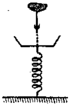
Q.2 A simple pendulum swings with angular amplitude θ. The tension in the string when it is vertical is twice the tension in its extreme position. Then, $\cos\theta$ is equal to
(A) 1 / 3 (B) 1 / 2 (C) 2 / 3 (D) 3 / 4

Q.3 A flexible chain of length 2m and mass 1kg initially held in vertical position such that its lower end just touches a horizontal surface, is released from rest at time t = 0. Assuming that any part of chain which strikes the plane immediately comes to rest and that the portion of chain lying on horizontal surface does not from any heap, the height of its centre of mass above surface at any instant $t = 1/\sqrt{5}$ (before it completely comes to rest) is
(A) 1 m (B) 0.5 m (C) 1.5 m (D) 0.25 m

Q.4 A ball impinges on another equal ball moving with same speed in a direction perpendicular to its own, the line joining the centres of the balls at the instant of impact being perpendicular to the direction of motion of the second ball; if e be the coefficient of restitution, show that the direction of motion of the second ball is turned through an angle $\tan^{-1}$

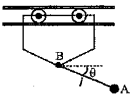


Q.5 A pan of mass 2 kg is resting in equilibrium on a spring of stiffness 200 N/m, as shown. A 0.5 kg lump of clay is released 5 m above the pan so that it hits the pan with some velocity and sticks to it. What will be the maximum downward descent of the pan from its initial position?

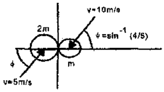


Q.6 A ball is thrown on to a rough floor at an angle of $\alpha = 45°$. If it rebounds at the same angle $\beta = 45°$, determine the coefficient of kinetic friction between the floor and the ball. The coefficient of restitution is e = 0.6.

Q.7 The simple pendulum A of mass m_A and length l is suspended from the trolley B of mass m_B. If the system is released from rest at $\theta = 0$, determine the velocity v_B of the trolley and tension in the string when $\theta = 90°$. Friction is negligible.

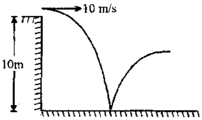


Q.8 Two smooth sphere made of identical material having masses m and 2m with an oblique impact as shown in fig. The initial velocities of the masses are also shown. The impact force is along the line joining their centres. The coefficient of restitution is 5/9. Calculate the velocities of the masses after the impact and the loss in kinetic energy.



Q.9 A particle is projected from point O on level ground towards a smooth vertical wall 50m from O and hits the wall. The initial velocity of the particle is 30m/s at 45° to the horizontal and the coefficient of restitution between the particle and the wall is e. Find the distance from O of the point at which the particle hits the ground again if (a) e = 0, (b) e = 1, (c) e = ½

Q.10 A ball is thrown horizontally from a cliff 10 m high with a velocity of 10 m/s. It strikes the smooth ground and rebounds as shown. The coefficient of restitution for collision with ground = $1/\sqrt{2}$. Find
(a) velocity of ball just before striking ground.
(b) angle of velocity vector with horizontal before striking.
(c) angle of velocity vector with horizontal after striking.
(d) range of ball after first collision.



BANSAL CLASSES
Target IIT JEE 2007

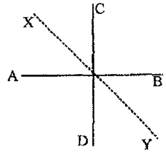
PHYSICS
Daily Practice Problems

CLASS : XI (P, Q, R, S) ***DATE : 07-08/09/2005*** ***TIME : 90 MIN*** ***DPP. NO.-51***

Q.1 A slender rod of mass M and length L is hinged about an end to swing freely in a vertical plane. However, its density is nonuniform and varies linearly from hinged end to the free end, doubling its value. The moment of inertia of the rod, about the rotation axis passing through the hinge point is:

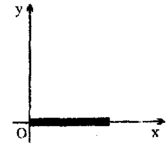
(A) $\frac{2ML^2}{9}$ (B) $\frac{3ML^2}{16}$ (C) $\frac{7ML^2}{18}$ (D) None

Q.2 AB and CD are two identical rods each of length L and mass M joined to form a cross. Find the M.I. of the system about a bisector of the angle between the rods (XY)



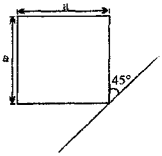
(A) $\frac{ML^2}{12}$ (B) $\frac{ML^2}{6}$ (C) $\frac{ML^2}{3}$ (D) $\frac{4ML^2}{3}$

Q.3 The figure shows a uniform rod lying along the x-axis. The locus of all the points lying on the xy-plane, about which the moment of inertia of the rod is same as that about O is



(A) an ellipse (B) a circle (C) a parabola (D) a straight line

Q.4 The moment of inertia of a thin sheet of mass M of the given shape about the specified axis is



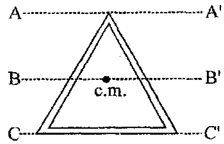
(A) $\frac{7}{12}$ Ma^2 (B) $\frac{5}{12}$ Ma^2 (C) $\frac{1}{3}$ Ma^2 (D) $\frac{1}{12}$ Ma^2

Q.5 Three identical rods, each of length l, are joined to form a rigid equilateral triangle. Its radius of gyration about an axis passing through a corner and perpendicular to the plane of the triangle is _____.

Q.6 Three identical rods are joined together to form an equilateral triangular frame. Three axes AA′, BB′ and CC′ lie in the plane of the frame as shown in the figure.

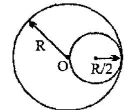
(i) The moment of inertia is least about the axis __________.

(ii) The moment of inertia is maximum about the axis ________.



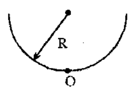
Q.7 Find the MI of a rod about an axis through its centre of mass and perpendicular to the length whose linear density varies as λ=ax where a is a constant and x is the position of an element of the rod relative to its left end. The length of the rod is l.

Q.8 A hole of radius R/2 is cut from a solid sphere of radius R. If the mass of the remaining plate is M, then moment of inertia of the body about an axis through O perpendicular to plane is ______.



Q.9 Four identical rods, each of mass m and length l, are joined to form a rigid square frame. The frame lies in the xy plane, with its centre at the origin and the sides parallel to the x and y axes. Its moment of inertia about (i) the x axis, (ii) the z axes, (iii) an axis parallel to the z-axes and passing through a corner, (iv) one side

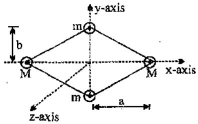
Q.10 Find the moment of inertia of thin semicircular wire of mass m about O as shown below. Mass of wire = m. The axis of rotation is perpendicular to the plane of the wire.



Q.1 A cone of radius r and height h rests on a rough horizontal surface, the coefficient of friction between the cone and the surface being μ. A gradually increasing horizontal force F is applied to the vertex of the cone. The largest value of μ for which the cone will slide before it topples is

(A) $\mu = \frac{r}{2h}$ (B) $\mu = \frac{2r}{5h}$ (C) $\mu = \frac{r}{h}$ (D) $\mu = \sqrt{\frac{r}{h}}$

Q.2 Four point masses are fastened to the corners of a frame of negligible mass lying in the xy plane. Let w be the angular speed of rotation. Then



(A) rotational kinetic energy associated with a given angular speed depends on the axis of rotation.

(B) rotational kinetic energy about y-axis is independent of m and its value is $Ma^2\omega^2$.

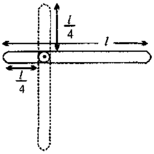
(C) rotational kinetic energy about z-axis depends on m and its value is $(Ma^2 + mb^2)\omega^2$.

(D) rotational kinetic energy about z-axis is independent of m and its value is $Mb^2\omega^2$.

Q.3 A rod is placed on a horizontal floor and imparted an angular velocity about a vertical axis passing through its mid-point. The mass of the rod is M, length L and friction coefficient with the surface is μ. Then, the total retarding torque of friction forces, assuming that the normal reaction is placed uniformly over the length of the rod, is

(A) μmgL (B) $\mu mgL/2$ (C) $\mu mgL/4$ (D) $\mu mgL/8$

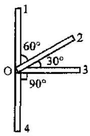
Q.4 For the pivoted slender rod of length l as shown in figure, the angular velocity as the bar reaches the vertical position after being released in the horizontal position is



(A) $\sqrt{\frac{g}{l}}$ (B) $\sqrt{\frac{24g}{19l}}$

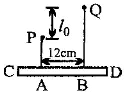
(C) $\sqrt{\frac{24g}{7l}}$ (D) $\sqrt{\frac{4g}{l}}$

Q.5 A thin rod free to rotate about a horizontal axis through one end O is initially in unstable equilibrium position 1 and falls due to gravity on being displaced infinitesimally. In positions 2,3 and 4 it makes 60°, 90° and 180° with the upward vertical. Let ω_2, ω_3, and ω_4 be angular velocities of the rod in theses positions then



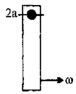
(A) $\omega_4 = 2\omega_3$ (B) $\omega_4 = 2\omega_2$ (C) $\omega_3 = 1.5\omega_2$ (D) $\omega_3 = \omega_2\sqrt{2}$

Q.6 An elastic string of natural length $3l_0$ is cut into two parts so that their natural lengths are $2l_0$ and l_0 respectively. They are attached to points P and Q the vertical distance between P and Q being l_0 and the horizontal distance being 12cm. A uniform rod CD=40cm is in equilibrium supported by the string at A and B. If the rod CD is horizontal then the lengths of the parts CA and BD in cms are

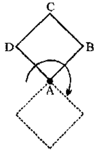


(A) 12,16 (B) 14,14 (C) 16,12 (D) 10,18

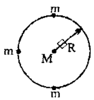
Q.7 A uniform rod of length 2a can turn freely about a horizontal axis passing through one end. What angular velocity must be imparted to it so that it may make a complete revolution in the vertical plane.



Q.8 Four uniform rods of equal length l and mass m are rigidly joined together at their ends to form a square framework ABCD. The framework is free to rotate in a vertical plane about a fixed smooth horizontal axis passing through A. The framework is slightly diaplced from its position of unstable equilibrium. Find the maximum angular velocity reached in subsequent motion.



Q.9 A solid cylinder of mass $M = 1$ kg & radius $R = 0.5$ m is pivoted at its centre & has three particles of mass $m = 0.1$ kg mounted at its perimeter as shown in the figure. The system is originally at rest. Find the angular speed of the cylinder, when it has swung through 90° in anticlockwise direction.



Q.10 A block of dimensions a × a × 2a is kept on an inclined plane of inclination 37°. The longer side is perpendicular to the plane. The coefficient of friction between the block and the plane is 0.8. Find whether the block will topple or not.

BANSAL CLASSES — PHYSICS

Target IIT JEE 2007 — **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 14-15/09/2005* *TIME : 90 MIN* *DPP. NO.-53*

Q.1 A body is in equilibrium under the influence of a number of forces. Each force has a different line of action. The minimum number of forces required is
(A) 2, if their lines of action pass through the centre of mass of the body.
(B) 3, if their lines of action are not parallel.
(C) 3, if their lines of action are parallel.
(D) 4, if their lines of action are parallel and all the forces have the same magnitude.

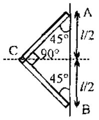
Q.2 A uniform cylinder of mass m can rotate freely about its own axis which is horizontal. A particle of mass m_0 hangs from the end of a light string wound round the cylinder which does not slip over it. When the system is allowed to move, the acceleration of the descending mass will be

(A) $\frac{2m_0 g}{m+2m_0}$ (B) $\frac{m_0 g}{m+m_0}$ (C) $\frac{2m_0 g}{m+m_0}$ (D) $\frac{m_0 g}{2m+m_0}$

Q.3 A uniform rod of length l, hinged at the lower end is free to rotate in the vertical plane. If the rod is held vertically in the beginning and then released, the angular acceleration of the rod when it makes an angle of 45° with the horizontal ($I = ml^2/3$)

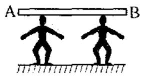
(A) $\frac{3g}{2\sqrt{2}\,l}$ (B) $\frac{6g}{\sqrt{2}\,l}$ (C) $\frac{\sqrt{2}\,g}{l}$ (D) $\frac{2g}{l}$

Q.4 A thin rod of linear mass density λ at right angle at its mid point (C) and fixed to points A and B such that it can rotate about an axis passes through AB. The moment of inertia about an axis passing through AB is



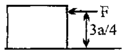
(A) $\frac{\lambda l^3}{4\sqrt{3}}$ (B) $\frac{\lambda l^3}{6\sqrt{2}}$ (C) $\frac{\lambda l^3}{4}$ (D) $\frac{\lambda l^3}{\sqrt{2}}$

Q.5 Two persons of equal height are carrying a long uniform wooden beam of length l. They are at distance $l/4$ and $l/6$ from nearest end of the rod. The ratio of normal reaction at their heads is



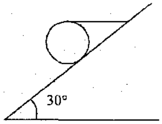
(A) 2 : 3 (B) 1 : 3 (C) 4 : 3 (D) 1 : 2

Q.6 A uniform cube of side a & mass m rests on a rough horizontal table. A horizontal force F is applied normal to one of the faces at a point that is directly above the centre of the face, at a height 3a/4 above the base. Find the minimum value of F for which the cube begins to tip about an edge. (assume that cube does not slide).

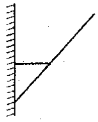


Q.7 A uniform meter scale balances at the 40-cm mark when weights of 10g and 20g are suspended from the 10-cm and 20-cm marks. The weight of the meter scale is __________.

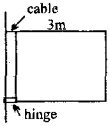
Q.8 A spherical ball of mass m = 5.0 kg is resting on a plane with angle of inclination 30° with respect to horizontal as shown in the figure. The bal is held in place by a rope attached horizontally to the top of the ball and to the slope. Frictional; force acting on the ball is _________.



Q.9 In the figure shown on the right, the rod is uniform and has a mass m, length L. Find the minimum value of friction coefficient between the lower end of rod and the vertical wall for the rod to be in equilibrium. The horizontal thread is connected to the rod at a point L/3 from lower end and angle between rod and wall is 60°.

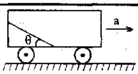


Q.10 In figure the uniform gate weighs 300N and is 3m wide and 2m high. It is supported by a hinge at the bottom left corner and a horizontal cable at the top left corner, as shown. Find, (a) the tension in the cable and (b) the force that the hinge exerts on the gate (magnitude and direction)



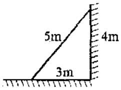
CLASS : XI (P, Q, R, S) *DATE : 16-17/09/2005* *TIME : 90 MIN* *DPP. NO.-54*

Q.1 A smooth rod of length ℓ is kept inside a trolley at an angle θ as shown in the figure. What should be the acceleration a of the trolley so that the rod remains in equilibrium with respect to it?



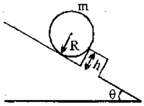
(A) $g \tan\theta$ (B) $g \cos\theta$ (C) $g \sin\theta$ (D) $g \cot\theta$

Q.2 A uniform ladder of length 5m is placed against the wall as shown in the figure. If coefficient of friction μ is the same for both the walls, what is the minimum value of μ for it not to slip?



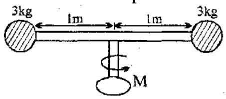
(A) $\mu = \frac{1}{2}$ (B) $\mu = \frac{1}{4}$ (C) $\mu = \frac{1}{3}$ (D) $\mu = \frac{1}{5}$

Q.3 Find minimum height of obstacle so that the sphere can stay in equilibrium.



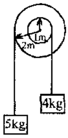
(A) $\frac{R}{1+\cos\theta}$ (B) $\frac{R}{1+\sin\theta}$
(C) $R(1-\sin\theta)$ (D) $R(1-\cos\theta)$

Q.4 The two spheres each have a mass of 3 kg and are attached to the rod of negligible mass. A torque M = 8t Nm, where t is in seconds is applied to the rod. Find the value of time when each sphere attains a speed of 3 m/s starting from rest.



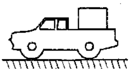
(A) $\sqrt{2}$ sec (B) $1.5\sqrt{2}$ sec
(C) [illegible] sec (D) $3\sqrt{}$ [illegible]c

Q.5 The moment of inertia of the pulley system as shown in the figure is 4 kgm^2. The radii of bigger and smaller pulleys 2m and 1m repsectively. The angular acceleration of the pulley system is



(A) 2.1 rad/s^2 (B) 4.2 rad/s^2
(C) 1.2 rad/s^2 (D) 0.6 rad/s^2

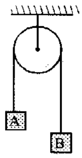
Q.6 A box of dimensions 1.5m x 0.75m x 0.75m and mass 250kg rests on a truck with the smaller face down.



(i) Assuming that the friction is strong enough so that the box does not slip, what is the maximum acceleration the truck can have with out the box tipping over.
(ii) If the acceleration of the truck is gradually increased what is the minimum value of friction coefficient for which the box tips before it slides.

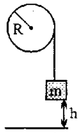
Q.7 A solid homogeneous cylinder of height h and base radius r is kept vertically on a conveyer belt moving horizontally with an increasing velocity $v = a + bt^2$. If the cylinder is not allowed to slip find the time when the cylinder is about to topple.

Q.8 In the figure A & B are two blocks of mass 4 kg & 2 kg respectively attached to the two ends of a light string passing over a disc C of mass 40 kg and radius 0.1 m. The disc is free to rotate about a fixed horizontal axes, coinciding with its own axis. The system is released from rest and the string does not slip over the disc. Find:

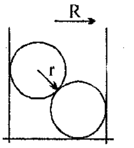


(i) the linear acceleration of mass B.
(ii) the number of revolutions made by the disc at the end of 10sec. from the start.
(iii) the tension in the string segment supporting the block A.

Q.9 A mass m is attached to a pulley through a cord as shown in the fig. The pulley is a solid disk with radius R. The cord does not slip on the disk. The mass is released from rest at a height h from the ground and at the instant the mass reaches the ground, the disk is rotating with angular velocity ω. Find the mass of the disk.

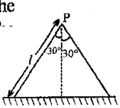


Q.10 Two identical uniform spheres are placed inside a smooth cylinder of inner radius R as in figure. The radius r of each sphere is the same and is within the range $(R/2)<r<R$. All surfaces are smooth. Draw a free body diagram for the bottom sphere indicating the magnitude of each force in terms of the weight W of each sphere and the radii r and R.



CLASS : XI (P, Q, R, S) *DATE : 23-24/09/2005* *TIME : 90 MIN* *DPP. NO.-55*

Q.1 A inverted "V" made up of two uniform boards each weighing 200 N. Each side has the same length and makes an angle 30° with the vertical as shown in figure. The magnitude of the static frictional force that acts on each of the lower end of the V is

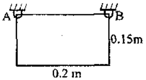


(A) $\frac{100}{\sqrt{3}}$ N (B) $100\sqrt{3}$ N (C) $\frac{200}{\sqrt{3}}$ N (D) $200\sqrt{3}$ N

Q.2 For a car taking a turn on a horizontal surface, let N_1 and N_2 be the normal reactions of the road on the inner and outer wheels respectively.
(A) N_1 is always greater than N_2
(B) N_2 is always greater than N_1.
(C) N_1 is always equal to N_2.
(D) Either (A) or (B) depending on the speed of the car and the radius of curvature of the road.

Q.3 A uniform cube of mass 'm' and side 'a' is resting in equilibrium on a rough 45° inclined surface. The distance of the point of application of normal reaction measured from the lower edge of the cube is :
(A) zero (B) a/3 (C) $a/\sqrt{2}$ (D) None

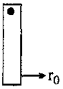
Q.4 A rectangular plate of mass 20kg is suspended from points A and B as shown. If pin B is removed determine the initial angular acceleration (in rad/s^2) of plate. (g= 10 m/s^2)



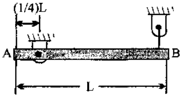
(A) 48 (B) 20 (C) 30 (D) 24

Q.5 The moment of inertia of a body about a given axis is 1.2 kg . m^2, initially the body is at rest. In order to produce a rotational kinetic energy of 1500 Joules, an angular acceleration of 25 radian/sec^2 must be applied about that axis for a duration of :
(A) 4 sec (B) 2 sec (C) 8 sec (D) 10 sec

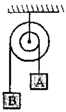
Q.6 A thin uniform rigid rod of length l is hinged at one end so that it can move in a vertical plane by rotating about a horizontal axis through upper end. The lower end is given a sharp blow and made to acquire a linear velocity v_0. Find the maximum height to which the lower end can rise.



Q.7 A uniform beam of length L and mass m is supported as shown. If the cable suddenly breaks, determine ;
(a) the acceleration of end B. (b) the reaction at the pin support.

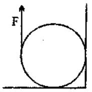


Q.8 A 0.6m radius drum carrying the load A is rigidly attached to a 0.9m radius pulley carrying the load B as shown. At the time t = 0, the load B moves with a velocity of 2m/s (downward) and a constant acceleration of 3m/s^2(downward). Over the time interval $0 \le t \le 2$s, determine
(i) the number of revolutions executed by the pulley.
(ii) the displacement of the load A.



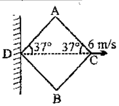
Q.9 A uniform rod of mass m, hinged at its upper end, is released from rest from a horizontal position. When it passes through the vertical position, the force on the hinge is________. If it is released from rest at an angle 30° with the horizontal force exerted by the rod on the hinge when it becomes horizontal is_________.

Q.10 Figure shows a vertical force F that is applied tangentially to a uniform cylinder of weight W. The coefficient of static friction between the cylinder and all surfaces is 0.5. Find in terms of W. the maximum force that can be applied without causing the cylinder to rotate.



CLASS : XI (P, Q, R, S) *DATE : 23-24/09/2005* *TIME : 90 MIN* *DPP. NO.-56*

Q.1 A rhombus ABCD is shown in the figure. The sides of the rhombus can rotate about vertex A, B, C & D. The vertex C is moving with a velocity of 6 m/s in horizontal direction. Determine the velocity of vertex A.

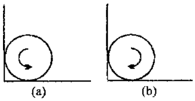


(A) 4.8 m/s (B) 4.5 m/s (C) 5 m/s (D) none of these.

Q.2 A sphere is placed rotating with its centre initially at rest in a corner as shown in figure (a) & (b). Coefficient of friction between all surfaces and the sphere is $\frac{1}{3}$. Find the ratio of the frictional force $\frac{f_a}{f_b}$ by ground in situations (a) & (b).

(A) 1 (B) $\frac{9}{10}$

(C) $\frac{10}{9}$ (D) none



Q.3 A rigid body can be hinged about any point on the x-axis. When it is hinged such that the hinge is at x, the moment of inertia is given by

$$I = 2x^2 - 12x + 27$$

The x-coordinate of centre of mass is

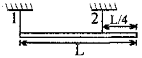
(A) x = 2 (B) x = 0 (C) x = 1 (D) x = 3

Q.4 A uniform thin bar of mass 6m and length $2l$ is bent to make a regular hexagon. Its moment of inertia about an axis passing through the centre of mass and perpendicular to the plane of hexagon is :

(A) $\frac{5}{9}ml^2$ (B) $6ml^2$ (C) $4ml^2$ (D) $\frac{1}{12}ml^2$

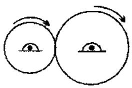
Q.5 A uniform rod of length L and weight W is suspended horizontally by two vertical ropes as shown. The first rope is attached to the left end of the rod while the second rope is attached a distance $L/4$ from the right end. The tension in the second rope is

(A) $\frac{W}{2}$ (B) $\frac{W}{4}$ (C) $\frac{W}{3}$ (D) $\frac{2W}{3}$

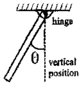


Q.6 ABC is a triangular frame of three uniform rods each of mass m and length $2l$. It is free to rotate in its own plane about a smooth horizontal axis through A which is perpendicular to ABC. If it is released from rest when AB is horizontal & C is above AB, find the maximum velocity of C in the subsequent motion.

Q.7 Two separate cylinders of masses m (=1kg) and 4m and radii R(=10cm) and 2R rotating in clockwise direction with ω_1=100rad/sec and ω_2=200rad/sec. Now they are held in contact with each other as in fig. Determine their angular velocities after the slipping between the cylinders stops.



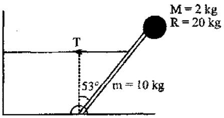
Q.8 A un form, thin rod of length L and mass M is free to rotate on a fr ctionless hinge and is initially held at rest at an angle θ with respect to the vertical as shown in the figure. The rod is then released. Find:



(i) the velocity of the centre of mass when the rod reached the vertical position.

(ii) the force exerted by the hinge on the rod at the instant the rod reaches the vertical position.

Q.9 A uniform, thin, cylindrical beam of length 3m and mass 10 kg is ... y fr ... g ... wit ... fig. The beam has a sphere of radius 20 cm and mass 2 kg attached to its end and is supported by a horizontal cable attached to the wall and to the midpoint of the beam. The beam is initially at rest at an angle of 53° with respect to the vertical. Find:

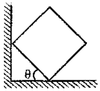


(i) the tension in the cable

(ii) the initial angular acceleration of the beam with sphere attached to it just after the cable is cut

(iii) the angular velocity of the beam when it reaches a horizontal position.
(Take $\sin 37° = 0.6$)

Q.10 A cube of mass M rests tilted against the wall as shown in the diagram. There is no friction between the wall and thecube, but the friction between the cube and floor is just sufficient to keep the cube from slipping. When $0 < \theta < 45°$, find the minimum coefficient of friction as a function of θ.



BANSAL CLASSES — PHYSICS

Target IIT JEE 2007 — **Daily Practice Problems**

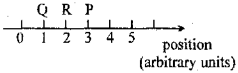
CLASS : XI (P, Q, R, S)   *DATE : 26-27/09/2005*   *DPP. NO.-57*

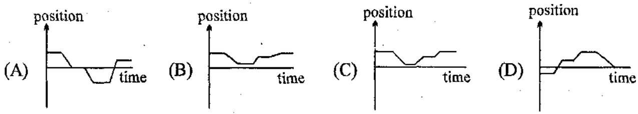
TIME : 1 HOUR   *MAX. MARKS: 69*

[Deduct one mark for each wrong Answer in the following question in which only one is correct]

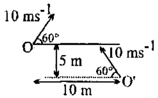
[23×3=69]

Q.1 A person initially at point P in the illustration stays there for some time and then moves along the axis to Q and stays there for some time. She then returns quickly to R, stays there for some time, and then strolls slowly back to P. Circle the position vs. time graph below that best represents this motion?





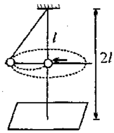
Q.2 Two particles are projected simultaneously from two points O and O' such that 10 m is the horizontal and 5 m is the vertical distance between them as shown in the figure. They are projected at the same inclination 60° to the horizontal with the same velocity 10 ms^{-1}. The time after which their separation becomes minimum is



(A) 2.5 sec (B) 1 sec (C) 5 sec (D) 10 sec

Question No. 3 to 12

A pendulum bob has mass m. The length of pendulum is l. It is initially at rest. A particle P of $\frac{m}{2}$ moving horizontally along –ve x-direction with velocity $\sqrt{2gl}$ collides with the bob and comes to rest. When the bob comes to rest, another particle Q of mass m moving horizontally along y direction collides with the bob and sticks to it. It is observed that the bob now moves along a horizontal circle. There is horizontal floor $2l$ distance below the point of suspension of the pendulum.



Q.3 For the first collision which quantity is conserved:
(A) Only mechanical energy (B) Only momentum
(C) Both (D) None

Q.4 Tension in string immediately after first collision

(A) 2mg (B) mg (C) $\frac{3}{2}$mg (D) $\frac{5}{2}$mg

Q.5 Tension in string just before the second collision

(A) $\frac{3}{4}$mg (B) $\frac{mg}{4}$ (C) $\frac{mg}{\sqrt{2}}$ (D) $\frac{\sqrt{3}}{2}$mg

Q.6 The height of the circular path above the floor is:

(A) $\frac{3l}{2}$ (B) $\frac{4l}{3}$ (C) $\frac{5l}{4}$ (D) Data not sufficient

Q.7 Which of the following is a possible value of the speed of particle Q just before its collision with the bob:

(A) $\sqrt{\frac{3lg}{4}}$ (B) $\sqrt{\frac{7lg}{4}}$ (C) $\sqrt{\frac{7lg}{3}}$ (D) None

Q.8 Time period of the circular motion:

(A) $2\pi\sqrt{\dfrac{l}{g}}$ (B) $2\pi\sqrt{\dfrac{\sqrt{7}\,l}{4g}}$ (C) $2\pi\sqrt{\dfrac{\sqrt{7}\,l}{3g}}$ (D) $2\pi\sqrt{\dfrac{3l}{4g}}$

Q.9 Magnitude of the net force on the particle during its circular motion

(A) $\dfrac{2\sqrt{7}}{3}$ mg (B) $\dfrac{2\sqrt{7}}{4}$ mg (C) $\dfrac{8}{3}$ mg (D) none

Q.10 Magnitude of average acceleration during half part of its circular motion

(A) $\dfrac{2\sqrt{7}g}{4\pi}$ (B) $\dfrac{2\sqrt{7}g}{3\pi}$ (C) $\dfrac{\sqrt{7}g}{4\pi}$ (D) none

Q.11 If the string breaks during the circular motion, the bob will hit the floor after a time:

(A) $\sqrt{\dfrac{5l}{2g}}$ (B) $\sqrt{\dfrac{4l}{2g}}$ (C) $\sqrt{\dfrac{4l}{g}}$ (D) none

Q.12 Distance of the point where the particle hits the floor from the vertical line through the point of suspension.

(A) $\sqrt{\dfrac{13}{3}}\,l$ (B) $\sqrt{\dfrac{10}{3}}\,l$ (C) $\sqrt{\dfrac{91}{48}}\,l$ (D) none

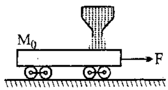
Question No. 13 to 17

In the figure shown a long cart moves on a smooth horizontal surface due to an external constant force of magnitude F. Initial mass of the cart is M_0 and velocity is zero. At t = 0 sand starts falling from a stationary hopper on to the cart with negligible velocity at constant rate μ kg/s and sticks to the cart. After time t_0 the sand starts leaking from the bottom at the same constant rate μ kg/s. Eventually at time $t = 2t_0$ the sands stops falling from the hopper on to the cart and force F also stops acting.

Q.13 The velocity of the cart at time t ($<t_0$)

(A) $\dfrac{Ft}{M_0}$ (B) $\dfrac{Ft}{M_0}e^{\mu t}$

(C) $\dfrac{Ft}{M_0+\mu t}e^{\mu t}$ (D) $\dfrac{Ft}{M_0+\mu t}$



Q.14 In the same model of the above question if the cart is to be moved with constant velocity v, then the power supplied by external agent applying that force is

(A) $2\mu v$ (B) μv (C) μv^2 (D) $\dfrac{1}{2}\mu v^2$

Q.15 In the above question the rate of increase of the kinetic energy of the cart (with sand) is

(A) $2\mu v^2$ (B) μv (C) μv^2 (D) $\dfrac{1}{2}\mu v^2$

Q.16 In the above model (for $t_0 < t < 2t_0$) what extra force is required to move the cart with the speed acquired at t_0

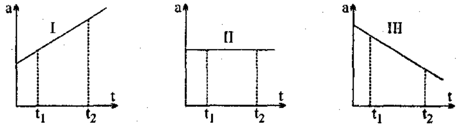
(A) μv towards right (B) 2μv towards right (C) zero (D) μv towards left

Q.17 In the above model at $t = 3t_0$ the momentum of cart and remaining sand in the cart is

(A) $\dfrac{Ft_0}{M_0+2\mu t_0}(M_0+\mu t_0)$ (B) $2Ft_0$

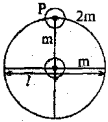
(C) $\dfrac{Ft_0M_0}{(M_0+3\mu t_0)}$ (D) $\dfrac{2Ft_0}{M_0+2\mu t_0}(M_0+\mu t_0)$

Q.18 Each of the three graphs represents acceleration versus time for an object that already has a positive velocity at time t_1. Which graphs show an object whose speed is increasing for the entire time interval between t_1 and t_2?



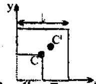
(A) graph I, only
(B) graphs I and II, only
(C) graphs I and III, only
(D) graphs I, II, and III

Q.19 A wheel comprises of a ring having mass 2m and two rods (mass m and length l) along two diameters as shown. Find moment of inertia of the wheel about an axis passing through point P and perpendicular to the plane of wheel.



(A) $\frac{2}{3}ml^2$
(B) $\frac{5}{3}ml^2$
(C) $\frac{7}{3}ml^2$
(D) none

Q.20 A square of side L/2 is removed from one corner of a square sandwich that has sides of length L. The center of mass of the ramainder of the sandwich moves from C to C'. The displacement of the x-coordinate of the center of mass (from C to C') is

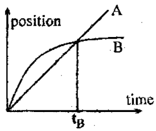


(A) $\frac{1}{12}L$
(B) $\frac{\sqrt{2}}{12}L$
(C) $\frac{1}{6}L$
(D) $\frac{\sqrt{2}}{8}L$

Q.21 Two cars start at the same point, but travel in opposite directions on a circular path of radius R, each at speed v. While each car travels a distance less than $(\pi/2)R$, (one quarter circle) the center of mass of the two cars

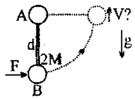
(A) remains at the initial point
(B) travels along a diameter of the circle at speed < v
(C) travels along a diameter of the circle at speed = v
(D) travels along a diameter of the circle at speed > v

Q.22 The graph shows position as a function of time for two trains running on parallel tracks. Which statement is true?



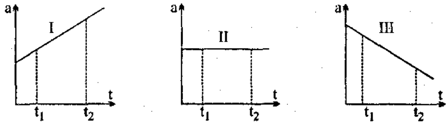
(A) At time t_B, both trains have the same velocity.
(B) Both trains have the same velocity at some time after t_B
(C) Both trains have the same velocity at some time before t_B.
(D) Somew' ere on '' e grap' , bo'' 'rains ' ave '' e same accelera'ion.

Q.23 E..d A of a ve..ical u..ifo.... lig..t .od, is attac..ed to a f.ic.io..less pivot a..d a sphere of mass 2M hangs at other end B. At some instant of time a strong wind begins to apply a constant horizontal force to B. As a result, the dumbbell rotates about A in a vertical plane. The speed of B at the instant when the dumbbell is ...riz...... is



(A) $\sqrt{\left(\frac{F}{2M}-g\right)\pi d}$
(B) $\sqrt{\left(\frac{Fd-2Mgd}{M}\right)}$
(C) $\sqrt{\frac{Fd\pi}{2M}}$
(D) $\sqrt{\frac{Fd\frac{\pi}{2}-2Mgd}{M}}$

Q.18 Each of the three graphs represents acceleration versus time for an object that already has a positive velocity at time t_1. Which graphs show an object whose speed is increasing for the entire time interval between t_1 and t_2?



(A) graph I, only
(B) graphs I and II, only
(C) graphs I and III, only
(D) graphs I, II, and III

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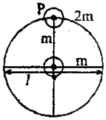
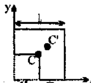


(A) $\frac{2}{3}ml^2$ (B) $\frac{5}{3}ml^2$ (C) $\frac{7}{3}ml^2$ (D) none

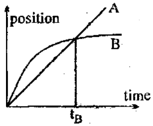
Q.20 A square of side L/2 is removed from one corner of a square sandwich that has sides of length L. The center of mass of the ramainder of the sandwich moves from C to C'. The displacement of the x-coordinate of the center of mass (from C to C') is



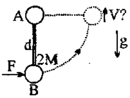
(A) $\frac{1}{12}L$ (B) $\frac{\sqrt{2}}{12}L$ (C) $\frac{1}{6}L$ (D) $\frac{\sqrt{2}}{8}L$

Q.21 Two cars start at the same point, but travel in opposite directions on a circular path of radius R, each at speed v. While each car travels a distance less than $(\pi/2)R$, (one quarter circle) the center of mass of the two cars
(A) remains at the initial point
(B) travels along a diameter of the circle at speed < v
(C) travels along a diameter of the circle at speed = v
(D) travels along a diameter of the circle at speed > v

Q.22 The graph shows position as a function of time for two trains running on parallel tracks. Which statement is true?
(A) At time t_B, both trains have the same velocity.
(B) Both trains have the same velocity at some time after t_B
(C) Both trains have the same velocity at some time before t_B.
(D) Somewhere on the graph, both trains have the same acceleration.



Q.23 End A of a vertical uniform light rod, is attached to a frictionless pivot and a sphere of mass 2M hangs at other end B. At some instant of time a strong wind begins to apply a constant horizontal force to B. As a result, the dumbbell rotates about A in a vertical plane. The speed of B at the instant when the dumbbell is horizontal is

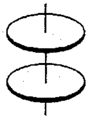


(A) $\sqrt{\left(\frac{F}{2M}-g\right)\pi d}$ (B) $\sqrt{\left(\frac{Fd-2Mgd}{M}\right)}$ (C) $\sqrt{\frac{Fd\pi}{2M}}$ (D) $\sqrt{\frac{Fd\frac{\pi}{2}-2Mgd}{M}}$

CLASS : XI (P, Q, R, S) *DATE : 28-29/09/2005* *TIME : 90 MIN* *DPP. NO.-58*

Q.1 A straight rod AB of mass M and length L is placed on a frictionless horizontal surface. A force having constant magnitude F and a fixed direction starts acting at the end A. The rod is initially perpendicular to the force. The initial acceleration of end B is
(A) zero (B) 2F/M (C) 4F/M (D) None

Q.2 Two identical disks are positioned on a vertical axis as shown in the figure. The bottom disk is rotating at angular velocity ω_0 and has rotational kinetic energy k_0. The top disk is initially at rest. It is allowed to fall and sticks to the bottom disk. The change in the rotational kinetic energy of the system after the collision is

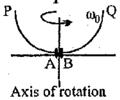


(A) $\frac{k_0}{2}$ (B) $-\frac{k_0}{2}$ (C) $-\frac{k_0}{4}$ (D) $\frac{k_0}{4}$

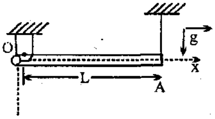
Q.3 A uniform circular disc can rotate freely about a rigid vertical axis through its centre O. A man stands at rest at A on the edge due east of O. The mass of the disc is 22 times the mass of the man. The man starts walking anticlockwise. When he reaches the point A after completing one rotation relative to the disc he will be :
(A) due east of O (B) 60° east of north
(C) 60° east of south (D) 30° south of east.

Q.4 Two insects P and Q are firmly sitting at the ends of a massless semicircular wire of radius R and two more insects A and B are firmly sitting at the bottom of the wire. The wire is given an angular velocity ω_0 about a vertical axis through its centre as shown in the figure. Mass of each insect is M. Now A and B crawl to the opposite ends to meet P and Q. Final angular velocity attained by the rod is equal to

(A) $\frac{\omega_0}{4}$ (B) $\frac{\omega_0}{2}$ (C) ω_0 (D) $2\,\omega_0$



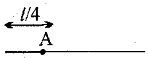
Q.5 A non uniform rod OA of linear mass density $\lambda = \lambda_0 x$ (λ_0 = const.) is suspended from ceiling with hinge joint O & light string as shown in figure. Find the angular acceleration of rod just after the string is cut.



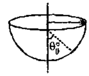
(A) $\frac{2g}{L}$ (B) $\frac{g}{L}$ (C) $\frac{4g}{3L}$ (D) none of these

Q.6 A uniform square plate of mass 'm' and side 'a' can rotate about a smooth vertical axis passing through one edge. It is initially at rest. A particle of mass 'm' is moving horizontally and perpendicular to the plane of the plate with velocity u. It collides with the plate elastically at the centre of the plate. Find the angular velocity of the plate just after collision.

Q.7 A uniform rod of mass m and length l is fixed from point A, which is at a distance $l/4$ from one end as shown in the figure. The rod is free to rotate in a vertical plane. The rod is released from horizontal position. Find the reaction force at the hinge, when kinetic energy of the rod is maximum.



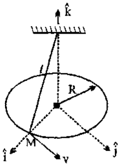
Q.8 A particle is projected horizontally along the interior of a smooth hemispherical bowl at rest of radius r and at angle θ_0 with vertical. Find the initial speed V_0 required for the particle to just reach the top of the bowl.



Q.9 A uniform rod of mass 3m and length 2a is free to rotate in a horizontal plane about a smooth fixed vertical axis passing through the midpoint O of the rod. Two small smooth rings of each of mass m are free to slide on the rod. At time t = 0, the rings are on opposite sides of O and are at a distance of a/2 from O. The rod is given an initial angular velocity $2\,(g/a)^{1/2}$. The rings being initially at rest relative to the rod. Find the angular velocity of the rod when the rings are about the slip off and the speed of either at this instant. The point O is at a height a above the horizontal plane. Find the distance between the points where the rings strike the plane.

Q.10 The end 'A' of a uniform rod AB of length l touches a horizontal smooth fixed surface. Initially the rod make an angle of 30° with the vertical. Find the magnitude of displacement of the end B just before it touches the ground after the rod is released.

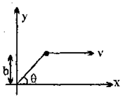
Q.1 A conical pendulum consists of a mass M suspended from a string of length l. The mass executes a circle of radius R in a horizontal plane with speed v. At time t, the mass is at position $R\,\hat{i}$ and has velocity $v\,\hat{j}$. At time t, the angular momentum vector of the mass M about the point from which the string suspended is :



(A) $MvR\,\hat{k}$ (B) $Mvl\,\hat{k}$

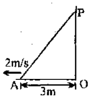
(C) $Mvl\left[\frac{\sqrt{l^2-R^2}}{l}\hat{i}+\frac{R}{l}\hat{k}\right]$ (D) $-Mvl\left[\frac{\sqrt{l^2-R^2}}{l}\hat{i}+\frac{R}{l}\hat{k}\right]$

Q.2 A particle parallel to x-axis as shown in the figure such that at all instants the y-axis component of its position vector is constant and is equal to 'b'. The angular velocity of the particle about the origin 'O' :



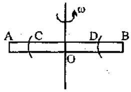
(A) remains constant (B) continuously increases
(C) continuously decreases (D) oscillates.

Q.3 A ladder AP of length 5 m is inclined to a vertical wall is sliding over a horizontal surface with velocity of 2 m/s, when A is at a distance 3m from ground what is the velocity of C.M. at this moment



(A) 1.25 m/s B) 0 m/s C) 1 m/s D) 2 m/s

Q.4 A rigid horizontal smooth rod AB of mass 0.75 kg and length 40 cm can rotate freely about a fixed vertical axis through its mid point O. Two rings each of mass 1 kg are initially at rest at a distance of 10 cm from O on either side of the rod. The rod is set in rotation with an angular velocity of 30 radians per second. The velocity of each ring along the length of the rod in m/s then they reach the ends of the rod is

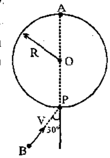


(A) 3 (B) 2 (C) 1 (D) 0.5

Q.5 A disc of radius 10 cm is moving with its centre's velocity = 1 m/s rightwards, at a certain moment, on a flat horizontal surface. At this moment, its angular velocity is 20 rad/s, anticlockwise. Then, the distance of a point on the disc (from its centre) whose instantaneous velocity is zero is
(A) 5 cm (B) 10/3 cm (C) 5/3 cm (D) 2.5 cm

Q.6 A thin rod AB of length a has variable mass per unit length $\rho_0\left(1+\frac{x}{a}\right)$ where x is the distance measured from A and ρ_0 is a constant.
(a) Find the mass M of the rod.
(b) Find the position of centre of mass of the rod.
(c) Find moment of inertia of the rod about an axis passing through A and perpendicular to AB. Rod is freely pivoted at A and is hanging in equilibrium when it is struck by a horizontal impulse of magnitude P at the point B.
(d) Find the angular velocity with which the rod begins to rotate.
(e) Find minimum value of impulse P if B passes through a point vertically above A.

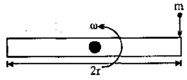
Q.7 A large circular disc shaped platform of mass M and radius R with a man A of mass M/2 standing on it, is free to rotate in the horizontal plane about a vertical axis through its center O. Another man B of mass M/4 jumps to the point P on the platform with a velocity V as shown in the figure. Now both the man move towards the center O such that their separation finally becomes 3R/4 while their CM lies at O. Determine the moment of inertia of the whole system about vertical axis passing through O and angular velocity of the platform.



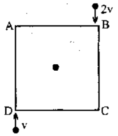
(a) Just after B jumped on to it and

(b) after their separation reduces to 3R/4.

Q.8 A uniform rod of length 2r and mass m is rotating in a horizontal plane about a fixed pivot through centre at a steady speed of ω rad/sec. A particle of mass m moving with speed $\omega r/4$ strikes an end of the rod perpendicularly. The rod and the particle are moving towards each other and the coefficient of restitution is 1/2. Compute the impulsive reaction at the pivot and the new speed of the rod.



Q.9 Four identical uniform rods of mass m and length l are joined together to form a rigid square frame ABCD which is hinged about O on a smooth horizontal floor. The frame is stationary initially. Two particles each of mass m hit the vertices B & D with velocities v and 2v directed along DA & BC respectively as shown. After impact, these particles strick to the frame



(a) Calculate Moment of Inertia of the frame about an axis passing through O perpendicular to its plane before & after the collision.

(b) Calculate the loss in kinetic energy of the system in the above collision process.

Q.10 A circular disc of mass 300 gm and radius 20 cm can rotate freely about a vertical axis passing through its centre of O. A small insect of mass 100 gm is initially at a point a on the close (which is initially stationary) the insect starts walking from rest along the rim of the disc with such a time varying relative velocity that the disc rotates in the opposite direction with a constant angular acceleration = 2π rad/s^2. After some time T, the insect is back at the point A. By what angle has the disc rotated till now ; as seen by a stationary earth observer? Also find the time T.

CLASS : XI (P, Q, R, S) *DATE : 03/10/2005* *DPP. NO.-60*

This is the test paper of Class-**XI (J-Batch)** held on **02-10-2005.** Take exactly 2 hours.

PART-A

Only one alternative is correct. **[20 × 1 = 20]**

There is *NEGATIVE* marking. For each wrong answer **0.5 mark** will be deducted.

For Q. 1 to Q.5 refer figure-1.

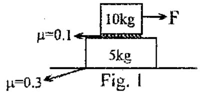


Fig. 1

Q.1 When F = 2N, the frictional force between 5 kg block and ground is
(A) 2N (B) 0
(C) 8 N (D) 10 N

Q.2 When F = 2N, the frictional force between 10 kg block and 5 kg block is
(A) 2N (B) 15 N (C) 10 N (D) None

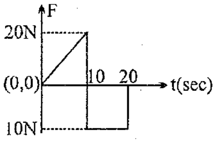
Q.3 The maximum "F" which will cause motion of any of the blocks.
(A) 10 N (B) 15 N (C) data insufficient (D) None

Q.4 The maximum acceleration of 5 kg block
(A) 1 m/s^2 (B) 3 m/s^2 (C) 0 (D) None

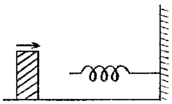
Q.5 The acceleration of 10 kg block when F = 30N
(A) 2 m/s^2 (B) 3 m/s^2 (C) 1 m/s^2 (D) None

Q.6 The P.E. of a certain spring when stretched from natural length through a distance 0.3 m is 10 J. The amount of work in joule that must be done on this spring to stretch it through an additional distance 0.15 m will be
(A) 10 J (B) 20 J (C) 7.5 J (D) 12.5 J

Q.7 A particle of mass 1 kg is acted upon by a force 'F' which varies as shown in the figure. If initial velocity of the particle is 10 ms^{-1}, the maximum velocity attained by the particle during the period is
(A) 210 ms^{-1} (B) 110 ms^{-1}
(C) 100 ms^{-1} (D) 90 ms^{-1}



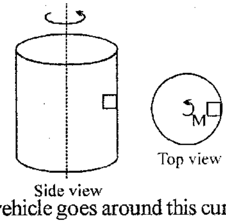
Q.8 A 1.0 kg block collides with a horizontal weightless spring of force constant 2.75 Nm^{-1} as shown in figure. The block compresses the spring 4.0 m from the rest position. If the coefficient of kinetic friction between the block and horizontal surface is 0.25, the speed of the block at the instant of collision is
(A) 0.4 ms^{-1} (B) 4 ms^{-1} (C) 0.8 ms^{-1} (D) 8 ms^{-1}



Q.9 Suppose a player hits several baseballs. Which baseball will be in the air for the longest time?
(A) The one with the farthest range. (B) The one which reaches maximum height.
(C) The one with the greatest initial velocity. (D) The one leaving the bat at 45° with respect to the ground.

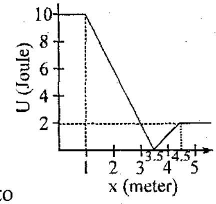
Q.10 A hollow vertical cylinder of radius R is rotated with angular velocity ω about an axis through its center. What is the minimum coefficient of static friction necessary to keep the mass M suspended on the inside of the cylinder as it rotates?

(A) $\mu = \dfrac{gR}{\omega^2}$ (B) $\mu = \dfrac{\omega^2 g}{R}$ (C) $\mu = \dfrac{\omega^2 R}{g}$ (D) $\mu = \dfrac{g}{\omega^2 R}$



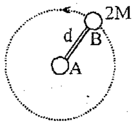
Q.11 A horizontal curve on a racing track is banked at a 45° angle. When a vehicle goes around this curve at the curve's safe speed (no friction needed to stay on the track), what is its centripetal acceleration?
(A) g (B) 2g (C) 0.5g (D) none

Q.12 A body with mass 2 kg moves in one direction in the presence of a force which is described by the potential energy graph. If the body is released from rest at x = 2m, then its speed when it crosses x = 5 m is



(A) zero (B) 1 ms^{-1}
(C) 2 ms^{-1} (D) 3 ms^{-1}

Q.13 The dumbell is placed on a frictionless horizontal table. Sphere A is attached to a fr ct onless p vot so t at B can be ma e to rotate a out A w t constant angu ar velocity. If B makes one revolution in period P, the tension in the rod is

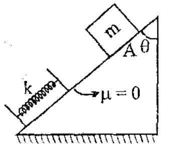


(A) $\frac{\pi^2 \; d}{P^2}$ (B) $\frac{8\pi^2}{P^2}$ (C) $\frac{4\pi^2 M}{P}$ (D) $\frac{2M}{P}$

Q.14 Two racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same time t. The ratio of the angular speeds of the first to the second car is
(A) 1 : 1 (B) $m_1 : m_2$ (C) $r_1 : r_2$ (D) $m_1m_2 : r_1r_2$

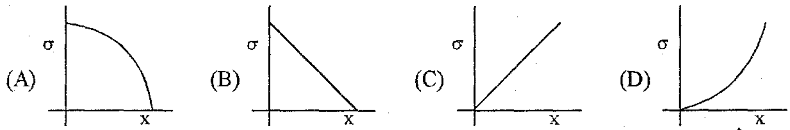
Q.15 A rod of length 2m rests on smooth horizontal floor. If the rod is heated from 0°C to 20°C. Find the lon itudinal strain develo ed? $\alpha = 5 \times 10^{-5}$/°C
(A) 10^{-3} (B) 2×10^{-3} (C) Zero (D) None

Q.16 A block of mass 'm' is released from rest at point A. The compression in spring, when the speed of block is maximum

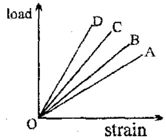


(A) $\frac{mg\sin\theta}{k}$ (B) $\frac{2mg\sin\theta}{k}$ (C) $\frac{mg\cos\theta}{\;}$ (D) $\frac{mg}{k}$

Q.17 A uniform rod of mass 'M' and length L is hanging from a ceiling. The variation of tensile stress with distance X from the ceiling is best represented by

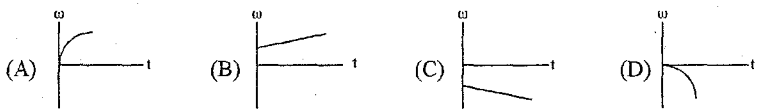


Q.18 The load versus strain graph for four wires of the same material is shown in the figure. The thickest wire is represented by the line

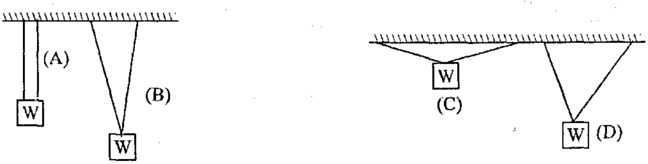


(A) OB (B) OA (C) OD (D) OC

Q.19 The graphs below show angular velocity as a function of time. In which one is the magnitude of the angular acceleration constantly decreasing?

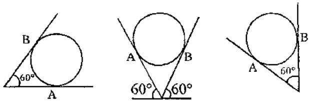


Q.20 A weight can be hung in any of the following four ways by string of same type. In which case is the string most likely to break?
(A) A (B) B (C) C (D) D



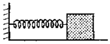
One or more than one alternative(s) is/are correct. **[5 × 2 = 10]**
There is **NO NEGATIVE** marking.

Q.21 An iron sphere weighing 10 N rests in a V shaped smooth trough whose sides form an angle of 60° as shown in the figure. Then the reaction forces are
(A) $R_A = 10$ N & $R_B = 0$ in case (i)
(B) $R_A = 10$ N & $R_B = 10$ N in case (ii)
(C) $R_A = \frac{20}{\sqrt{3}}$ N & $R_B = \frac{10}{\sqrt{3}}$ N in case (iii)
(D) $R_A = 10$ N & $R_B = 10$ N in all the three cases



(i) (ii) (iii)

Q.22 A spring block system is placed on a rough horizontal floor. The block is pulled towards right to give spring some elongation and released.
(A) The block may stop before the spring attains its mean position.
(B) The block must stop with spring having some compression.
(C) The block may stop with spring having some compression.
(D) It is not possible that the block stops at mean positon.



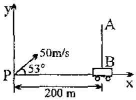
Q.23 In the above situation the block will have maximum velocity when
(A) the spring force becomes zero (B) the frictional force becomes zero
(C) the net force becomes zero (D) the acceleration of block becomes zero

Q.24 A ball is rolled off along the edge of a horizontal table with velocity 4 m/s. It hits the ground after time 0.4 s. Which of the following are correct?
(A) The height of the table is 0.8 m
(B) It hits the ground at an angle of 60° with the vertical
(C) It covers a horizontal distance 1.6 m from the table
(D) It hits the ground with vertical velocity 4 m/s

Q.25 A particle of mass m is at rest in a train moving with constant velocity with respect to ground. Now the particle is accelerated by a constant force F_0 acting along the direction of motion of train for time t_0. A girl in the train and a boy on the ground measure the work done by this force. Which of the following are **INCORRECT**?
(A) Both will measure the same work
(B) Boy will measure higher value than the girl
(C) Girl will measure higher value than the boy
(D) Data are insufficient for the measurement of work done by the force F_0

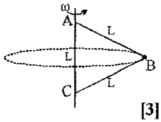
PART-B

Q.1 A ball is fired from point P, with an initial speed of 50 m/s at angle of 53°, with the horizontal. At the same time, a long wall AB at 200 m from point P, starts moving towards P with a constant speed of 10 m/s.



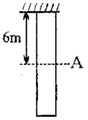
(a) Find the time when the ball collides with wall AB.
(b) Find the coordinate of point C, where the ball collides. Taking point P as origin? **[3]**

Q.2 Two light inextensible strings AB and BC each of length L are attached to a particle of mass m at B. The other ends A and C are fixed to two points in a vertical line such that A is distant L above C. The particle describes a horizontal circle with constant angular velocity ω.
Find (a) the tension in AB
(b) the least value of ω so that both strings shall be taut. **[3]**



Q.3 A circular race track is banked at 45° and has a radius of 40 m. At what speed does a car have no tendency to slip? If the coefficient of friction between the wheels and the track is 1/2, find the maximum speed at which the car can travel round the track without skidding. **[3]**

Q.4 An elastic rod of mass 10 kg and 10m length is hanging from ceiling. The area of cross-section of rod is 10^{-3}m^2. The young's modulus of the material is $Y = 10^{10}$ N/m^2



(a) Find the stress at point A, which is 6 m below the ceiling.

(b) A very small element of length 1mm is analysed at point A. Find approximate strain in this element?

(c) Find energy per unit volume stored in this element? **[3]**

Q.5 A small bucket of mass "m" rests at the bottom of a pit that has a depth h. A motor with an elastic cord is used to lift the bucket out of the pit. One end of the cord is attached to the bucket; the other end is attached to the shaft of the motor. There is a mark on the cord at the height 0.8h from the bottom of the pit. The cord is vertical and relaxed but taut. The motor begins to rotate slowly. It is noticed that the bucket loses contact with the ground just as the mark on the cord reaches the shaft.

(a) Find the elastic constant of the cord in terms of m, g and h.

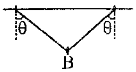
(b) Calculate the work done by the motor till that moment? **[3]**

Q.6 A stone is launched upward at 45° with speed v_0. A bee follows the trajectory of the stone at a constant speed equal to the initial speed of the stone.

(a) Find the radius of curvature at the top point of the trajectory.

(b) What is the acceleration of the bee at the top point of the trajectory? For the stone, neglect the air resistance. **[3]**

Q.7 A smooth bead B of mass 0.6 kg is threaded on a light inextensible string whose ends are attached to two identical rings, each of mass 0.4 kg. The rings can move on a fixed straight horizontal wire. The system rests in equilibrium with each section of the string making an angle θ with the vertical, as shown in the diagram.

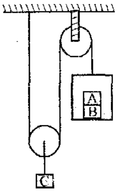


(a) Find the magnitude of the normal contact force exerted on each ring by the wire.

(b) Find, in terms of θ, the magnitude of the frictional force on each ring.

(c) Given that the coefficient of friction between each ring and the wire is 0.3, find the greatest possible value of θ for the system to be in equilibrium. **[4]**

Q.8 One end of a light inextensible string is attached to a ceiling. The string passes under a smooth light pulley carrying a weight C and then over a fixed smooth light pulley. To the free end of the string is attached a light scale pan in which two weights A and B are placed with A on top of B as shown. The portions of the string not in contact with the pulleys are vertical. Each of the weights A and B has a mass M and the weight C has a mass 5M. If the system is released from rest

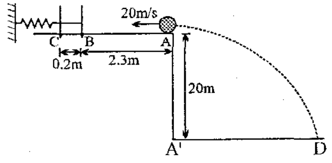


(a) find the acceleration of the movable pulley?

(b) the tension in the string.

(c) the reaction force between the weights A and B. **[4]**

Q.9 A small ball is thrown towards the spring with a speed of 20 m/s. The horizontal surface AC is rough with a friction coefficient μ=0.1. It comes in contact with spring at point B and then compresses the spring by 0.2 m and returns back to point A. After that the ball leaves the horizontal plane and follows the path of a projectile.



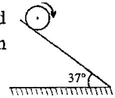
(a) Find the speed of ball when it returns back to A.

(b) Find the Range A' D of the ball. **[4]**

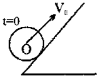
Q.1 A uniform slender rod of mass 'm' and length L is released from rest, with its lower end touching a frictionless horizontal floor. At the initial moment, the rod is inclined at an angle = 30° with the vertical. Then, the value of normal reaction from the floor just after released, will be :
(A) 4mg/7 (B) 5mg/9 (C) 2mg/5 (D) none

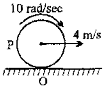
Q.2 In the above problem, the initial acceleration of the lower end of the rod will be
(A) $g\sqrt{3}/4$ (B) $g\sqrt{3}/5$ (C) $3g\sqrt{3}/7$ (D) none

Q.3 A hollow spherical ball is given an initial push up an incline of inclination angle a. The ball rolls purely. Coefficient of static friction between ball and incline = m. During its upward journey,
(A) friction acts up along the incline (B) $\mu \geq 2 \tan \alpha/5$
(C) friction acts down along the incline (D) $\mu \geq 2 \tan \alpha/7$

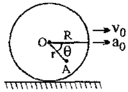
Q.4 A cylinder having radius 0.4 m, initially rotating (at t = 0) with ω_0 = 54 rad/sec is placed on a rough inclined plane with θ = 37° having friction coefficient μ = 0.5. The time taken by the cylinder to start pure rolling is :


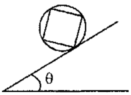
(A) [illegible] sec (B) 1.[illegible] sec
(C) 1.2 sec (D) 1.8 sec

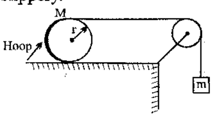
Q.5 A uniform disc of mass M and radius R is projected at t = 0, with velocity V_0 and angular velocity ω_0 = 0 along an inclined plane having inclination angle θ. The coefficient of friction between disc & inclined is μ = ½ tanθ. Find total time of rise of disc on inclined.


Q.6 A disc of radius 20 cm is rollign with slipping on a flat horizontal surface. At a certain instant, the velocity of its center is 4 m/s and its angular velocity is10 rad/s. The lowest contact point is O. Find


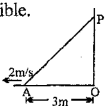
(a) the velocity of point O.
(b) the distance of instantaneous center of rotation from the point O. Mention whether it is above or below O.
(c) the velocity of point P.

Q.7 The wheel of radius R rols without slipping and its centre O has an acceleration a_0. A point A on the wheel is at a distance r from O. For given values of a_0, R and r, determine the angle θ and the velocity v_0 of the wheel for which A has no acceleration in this position.


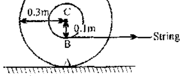
Q.8 Four identical slender rods each of mass m are welded at their ends to form a square and the corners are then welded to a light metal hoop of radius R. If the rigid assembly of rods and hoop is allowed to roll down the incline, determine the minimum value of coefficient of friction which will prevent slippery.


Q.9 For the system shown in figure , M = 1 kg, m = 0.2 kg, r = 0.2 m. Calculate


(a) the linear acceleration of hoop
(b) the angular acceleration of the hoop of mass M and
(c) the tension in the rope
Neglect the mass of small pulley and the friction between the hoop and the horizontal surface. Masses of the pulley and string and friction between the hoop and the horizontal surface are negligible.

Q.10 A ladder AP of length 5 m inclined to a vertical wall is slipping over a horizontal surface with velocity of 2 m/s, when A is at distance 3m from ground. What is the velocity of C.M. at this moment?


Q.1 A wheel is made to roll without slipping, towards right, by pulling a string wrapped round a coaxial spool as shown in figure. With what velocity the string should be pulled so that the centre of the wheel moves with a velocity __3 __/s?



(A) 3 m/s (B) 1 m/s (C) 3/2 m/s (D) 2 m/s

Q.2 A cylinder is pure rolling up an incline plane. It stops momentarily and then rolls back. The force of friction
(A) on the cyclinder is zero throughout the journey
(B) is directed opposite to the velocity of the centre of mass throughout the journey
(C) is directed up the plane throughout the journey
(D) is directed down the plane throughout the journey

Q.3 On a solid sphere lying on a horizontal surface a force F is applied at a height of R/2 from the centre of mass. The acceleration of a point at the top of the sphere is (there is no slipping at any point)

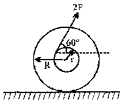
(A) $\frac{15F}{7M}$ (B) $\frac{15F}{14M}$ (C) $\frac{30F}{7M}$ (D) $\frac{F}{M}$

Q.4 On a train moving with acceleration 10 m/s^2 a ball starts rolling on floor of train along the width of the train with angular acceleration 2 rad/s^2, radius of ball is 1 m. Find the acceleration of the top point of ball at the time t = 3 s as seen from ground.

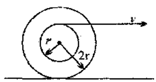
(A) 10 m/s^2 (B) $10\sqrt{14}$ m/s^2 (C) 100 m/s^2 (D) $\sqrt{1396}$ m/s^2

Q.5 A solid uniform disk of mass m rolls without slipping down a fixed inclined plane with an acceleration a. The frictional force on the disk due to surface of the plane is :
(A) 2 ma (B) 3/2 ma (C) ma (D) 1/2 ma

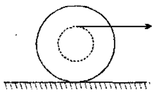
Q.6 A spool of mass m, with moment of inertia about its axis as $\frac{mR^2}{3}$, is placed on r.ug... ...rizontal su....c.. An .x...rnal ...rc. 2F is appli... t...oug.. a t..r.... a.. shown in the figure. Find the acceleration of the spool and the force of friction ac ing on he spoo'. ' ssume pure roi ing.



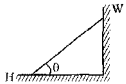
Q.7 A reel of mass 'm' and moment of inertia I relative to its own axis is being pulled along a horizontal surface by the string wrapped around as shown. There is no slipping between the reel and the surface throughout the motion.
(a) Find the angular spee.. ω of the reel at the instant when the en.. of .he string is being pulled at speed v.
(b) If the end of the string is being pulled at a constant acceleration 'a' find
n ... ... g.



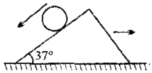
Q.8 A spool of inner radius R and outer radius 3R has a moment of inertia = MR^2 about an axis passing through its geometric centre, where M is the mass of the spool. A thread woudn on the inner surface of the spool is pulled horizontally with a constant force = Mg. Find the acceleration of the point on the thread which is being pulled assuming that the spool rolls purely on the floor.



Q.9 A uniform rod of length l is kept as shown in the figure. H is a horizontal smooth surface and W is a vertical smooth wall. The rod is released from this position. Find the angular acceleration of the rod just after the release.



Q.10 The wedge shown in the figure has a mass M and incline angle 37°. The floor is frictionless. The mass of the solid sphere is also M. Friction between the incline surface of the wedge and the sphere is sufficient to prevent any sliding so that the sphere rolls purely down the inclined surface of the wedge. Find the
.... g..



BANSAL CLASSES **PHYSICS**

Target IIT JEE 2007 **Daily Practice Problems**

CLASS : XI (P, Q, R, S) *DATE : 10-11/10/2005* *DPP. NO.-63*

Q.1 One ice skater of mass m moves with speed 2v to the right, while another of the same mass m moves with speed v toward the left, as shown in figure I. Their paths are separated by a distance b. At $t = 0$, when they are both at $x = 0$, they grasp a pole of length b and negligible mass. For $t > 0$, consider the system as a rigid body of two masses m separated by distance b, as shown in figure II. Which of the following is the correct formula for the motion after $t = 0$ of the skater initially at $y = b/2$?

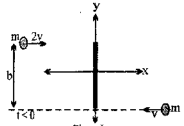


Figure I

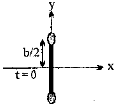


Figure II

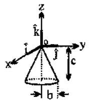
(A) $x = 2vt, y = b/2$

(B) $x = vt + 0.5b\sin(3vt/b), y = 0.5b\cos(3vt/b)$

(C) $x = 0.5vt + 0.5b\sin(3vt/b), y = 0.5b\cos(3vt/b)$

(D) $x = 0.5vt + 0.5b\sin(6vt/b), y = 0.5b\cos(6vt/b)$

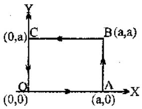
Q.2 A solid cone hangs from a frictionless pivot at the origin O, as shown. If $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors, and a, b, and c are positive constants, which of the following forces F applied to the rim of the cone at a point P results in a torque τ on the cone with a negative component τ_Z?



(A) $F = a\hat{k}$, P is (0,b,–c)
(B) $F = -a\hat{k}$, P is (0,–b,–c)

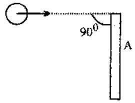
(C) $F = a\hat{j}$, P is (–b,0,–c)
(D) None

Q.3 The work done by the force $\vec{F} = x^2\hat{i} + y^2\hat{j}$ around the path shown in the figure is



(A) $\frac{2}{3}a^3$
(B) zero
(C) a^3
(D) $\frac{4}{3}a^3$

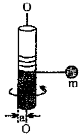
Q.4 A thin rod of mass M and length L is struck at one end by a ball of clay of mass m, moving with speed v as shown in figure. The ball sticks to the rod. After the collision, the angular momentum of the clay-rod system about A, the midpoint of the rod, is



(A) $\left(m + \frac{M}{3}\right)\left(\frac{vL}{2}\right)$
(B) $\left(m + \frac{M}{12}\right)\left(\frac{vL}{2}\right)$

(C) $\frac{mvL}{2}$
(D) mvL

Q.5 A small particle of mass m is given an initial high velocity in the horizontal plane and winds its cord around the fixed vertical shaft of radius a. All motion occurs essentially in the horizontal plane. If the angular velocity of the cord is ω_0 when the distance from the particle to the tangency point is r_0, then the angular velocity of the cord ω after it has turned through an angle θ is



(A) $\omega = \omega_0$
(B) $\omega = \frac{a\omega_0}{r_0}$
(C) $\omega = \frac{\omega_0}{1 - \frac{a\theta}{r_0}}$
(D) $\omega = \omega_0\theta$

Q.6 A small sphere is moving at a constant speed in a vertical circle. Below is a list of quantities that could be used to describe some aspect of the motion of the sphere.

I – kinetic energy

II – gravitational potential energy

III – momentum

Which of these quantities will change as this sphere moves around the circle?

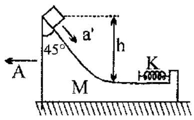
(A) I and II only (B) I and III only (C) III only (D) II and III only

Q.7 Starting from the rest, at the same time, a ring, a coin and a solid ball of same mass roll down an incline without slipping. The ratio of their translational kinetic energies at the bottom will be

(A) 1 : 1 : 1 (B) 10 : 5 : 4 (C) 21 : 28 : 30 (D) None

Question No. 8 to 10

Q.8 A small block of mass m is placed on a wedge of mass M as shown, which is initially at rest. All the surfaces are frictionless. The spring attached to the other end of wedge has force constant k. If a' is the acceleration of m relative to the wedge as it starts coming down and A is the acceleration acquired by the wedge as the block starts coming down, then



(A) $\frac{a'}{\sqrt{2}} < A < a'$ (B) $A < \frac{a'}{\sqrt{2}}$ (C) $A > a'$ (D) None

Q.9 Maximum velocity of M is:

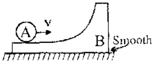
(A) $\sqrt{2gh}$ (B) $\sqrt{\frac{2ghm}{m+M}}$ (C) $\sqrt{\frac{2m^2gh}{mM+M^2}}$ (D) None

Q.10 Maximum retardation of M is:

(A) $\sqrt{\frac{2mghk}{M^2}}$ (B) $\sqrt{\frac{2kgh}{M}}$ (C) $\sqrt{\frac{2kgh}{m}}$ (D) None

Q.1 In the figure shown a ring A is initially rolling without sliding with a velocity v on the horizontal surface of the body B (of same mass as A). All surfaces are smooth. B has no initial velocity. What will be the maximum height reached by A on B.

(A) $\frac{3v^2}{4g}$ (B) $\frac{v^2}{4g}$ (C) $\frac{v^2}{2g}$ (D) $\frac{v^2}{3g}$

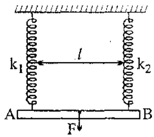


Q.2 A ring of radius R rolls without sliding with a constant velocity. The radius of curvature of the path followed by any particle of the ring at the highest point of its path will be
(A) R (B) 2R (C) 4R (D) none

Q.3 Two light vertical springs with equal natural lengths and spring constants k_1 and k_2 are separated by a distance l. Their upper ends are fixed to the ceiling and their lower ends to the ends A and B of a light horizontal rod AB. A vertical downwards force F is applied at point C on the rod. AB will remain orizontal in quil riu ft d t

(A) $\frac{l}{2}$ (B) $\frac{l k_1}{k_2+k_1}$

(C) $\frac{l k_2}{k_1}$ (D) $\frac{l k_2}{k_1+k_2}$



Question No. 4 to 5

A spring block system is placed on a rough horizontal floor. The block is pulled towards right to give spring an elongation less than $\frac{2\mu mg}{K}$ but more than $\frac{\mu mg}{K}$ and released.

Q.4 Which of the following laws/principles of physics can be applied on the spring block system

(A) conservation of mechanical energy (B) conservation of momentum
(C) work energy principle (D) None

Q.5 The correct statement is
(A) The block will cross the mean position.
(B) The block will come to rest when the forces acting on it are exactly balanced
(C) The block will come to rest when the work done by friction becomes equal to the change in energy stored in spring.
(D) None

Q.6 Consider the following statements
Assertion(A) : A cyclist always bends inwards while negotiating a curve
Reason(R) : By bending he lowers his centre of gravity
Of these statements,
(A) both A and R are true and R is the correct explanation of A
(B) both A and R are true but R is not the correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

Q.7 Consider the following statements:

Assertion(A) : A table cloth can be pulled from a table without dislodging the dishes

Reason(R) : To every action there is equal and opposite reaction

(A) both A and R are true and R is the correct explanation of A

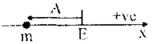
(B) both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

Question No. 8 to 10

A particle of mass m is constrained to move on x-axis. A force F acts on the particle. F always points toward the position labeled E. For example, when the particle is to the left of E, F points to the right. The magnitude of F is a constant F except at point E where it is zero.

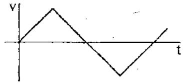


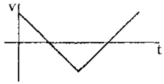
The system is horizontal. F is the net force acting on the particle. The particle is displaced a distance A towards left from the equilibrium position E and released from rest at t = 0.

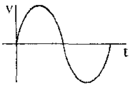
Q.8 What is the period of the motion?

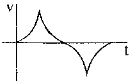
(A) $4\left(\sqrt{\frac{2Am}{F}}\right)$ (B) $2\left(\sqrt{\frac{2Am}{F}}\right)$ (C) $\left(\sqrt{\frac{2Am}{F}}\right)$ (D) None

Q.9 Velocity – time graph of the particle is

(A)


(B)


(C)


(D)


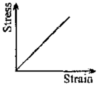
Q.10 Find minimum time it will take to reach from $x = -\frac{A}{2}$ to 0.

(A) $\frac{3}{2}\sqrt{\frac{mA}{F}}(\sqrt{2}-1)$ (B) $\sqrt{\frac{mA}{F}}(\sqrt{2}-1)$ (C) $2\sqrt{\frac{mA}{F}}(\sqrt{2}-1)$ (D) None

Q.1 Force constant of a spring (K) is syonymous to
(A) $\frac{YA}{L}$ (B) $\frac{YL}{A}$ (C) $\frac{AL}{Y}$ (D) ALY

Q.2 The amount of work done in increasing the length of a 1 m long wire through 1 cm when the Young's modulus is 8×10^8 N/m^2 will be :
(A) 20000 J (B) 40000 J (C) 80000 J (D) data insufficient

Q.3 Wire of different radii are used in Searle's experiment for measuring elasticity properties of a given material. In stress v/s strain graph, on using wire of larger radius. (Length of the wire remains constant)



(A) line will rotate clockwise (B) line will rotate anticlockwise
(C) line will not rotate at all (D) line will become curved.

Q.4 A wire can support a maximum load of W. If the wire is cut in 2 equal parts and joined in parallel, what is the maximum load it can now support.
(A) W (B) 2W (C) W/2 (D) 4W

Q.5 Overall changes in volume and radii of a uniform cylindrical steel wire are 0.2% and 0.02% respectively when subjected to some suitable force. Longitudinal tensile stress acting on the wire is
($Y = 2.0 \times 10^{11}$ Nm^{-2})
(A) 3.2×10^8 Nm^{-2} (B) 3.2×10^7 Nm^{-2} (C) 4.08×10^9 Nm^{-3} (D) 3.6×10^7 Nm^{-2}

Q.6 A composite rod consists of a steel rod of length 25 cm and area 2A and a copper rod of length 50cm and area A. The composite rod is subjected to an axial load F. If the Young's modulus of steel and copper are in the ratio 2 : 1.
(A) the extension produced in copper rod will be more .
(B) the extension in copper and steel parts will be in the ratio 2 : 1.
(C) the stress applied to the copper rod will be more.
(D) no extension will be produced in the steel rod.

Q.7 An object of mass 0.5kg is hung from the end of a steel wire of length 2m and of diameter 0.5mm. (Young's modulus = 2×10^{11} N/m^2). The object is lifted through a distance h (thus allowing the wire to become slack) and is then dropped so that the wire receives a sudden jerk. The ultimate strength of steel is 1.1×10^9 N/m^2. What is the largest possible value of h if the wire is not to break.[Assume stress remains proportional to strain throughout the motion]

Q.8 What is the change in the volume of an elastic uniform rod of length l under the action of a force F when its Young's modulus is Y and poisson ratio is σ.

Q.9 A thin uniform copper rod of length l and area cross section A mass m rotates uniformly with an angular velocity ω in a horizontal plane about a vertical axis passing through one of its end. Determine the tension in the rod as a function of the distance r from the rotation axis. Find the elongation of the rod also.

BANSAL CLASSES **PHYSICS**

Target IIT JEE 2007 **Daily Practice Problems**

CLASS : XI (PQRS) *DATE : 19-20/10/2005* *MAX.TIME : 60 Min.* *DPP. NO.-66*

Q.1 When a steel wire fixed at one end is pulled by a constant force F at its other end, its length increases by l. Which of the following statements is not correct?
(A) Work done by the external force is Fl.
(B) Some heat is produced in the wire in the process.
(C) The elastic potential energy of the wire is $Fl/2$.
(D) The heat produced is equal to half of the elastic potential energy of the wire.

Q.2 A solid sphere of radius R made of of material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area A floats on the surface of the liquid. When a mass m is placed on the piston to compress the liquid, the fractional change in the radius of the sphere $\delta R/R$ is
(A) mg/AK (B) mg/3AK (C) mg/A (D) mg/3AR

Q.3 A steel cylinderical rod of length l and radius r is suspended by its end from the ceiling.
[Density of cylinder – ρ, Young's modulus of elasticity – E]
(a) Find the elastic deformation energy U of the rod.
(b) Find U in terms of tensile strain $\Delta l/l$ of the rod.

Q.4 A steel rod (Young's modulus = 2×10^{11} Nm^{-2}) has an area of cross-section 3×10^{-4} m^2 and length 1 m. A force of 6×10^4 N stretched it axially. The elongation of the rod is
(A) 10^{-4} m (B) 5×10^{-3} m (C) 10^{-3} m (D) 5×10^{-2} m

Q.5 The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied
(A) Length = 50 cm and diameter = 0.5 mm (B) Length = 100 cm and diameter = 1 mm
(C) Length = 200 cm and diameter = 2 mm (D) Length = 300 cm and diameter = 3 mm

Q.6 A steel ring of radius r and cross-sectional area A is fitted on to a wooden disc of radius R (R > r). If Young's modulus be Y, then the force with which the steel ring is expanded is
(A) $AY\left(\frac{R}{r}\right)$ (B) $AY\left(\frac{R-r}{r}\right)$ (C) $\frac{Y}{A}\left(\frac{R-r}{r}\right)$ (D) $\frac{Yr}{AR}$

Q.7 A rope 1 cm in diameter breaks if the tension in it exceeds 500 N. The maximum tension that may be given to a similar rope of diameter 2 cm is
(A) 500 N (B) 250 N (C) 1000 N (D) 2000 N

Q.8 A cylindrical wire of radius 1 mm, length 1 m, Young's modulus = 2×10^{11} N/m^2, poisson's ratio $\mu = \pi/10$ is stretched by a force of 100 N. Its radius will become
(A) 0.99998 mm (B) 0.99999 mm (C) 0.99997 mm (D) 0.99995 mm

Q.9 A uniform steel wire hangs from the ceiling and elongates due to its own weight. The ratio of elongation of the upper half of the wire to the elongation of the lower half of wire is
(A) 4 : 1 (B) 3 : 1 (C) 3 : 2 (D) None

Q.1 A piece of metal floats on mercury. The coefficient of volume expansion of metal and mercury are γ_1 and γ_2 are respectively. If the temperature of both mercury and metal are increased by an amount ΔT, by what factor does the fraction of the volume of the metal submerged in mercury changes?

Q.2 A metal rod A of 25 cm length expands by 0.050 cm, when its temperature is raised from 0°C to 100°C. Another rod B of a different metal of length 40 cm expands by 0.04 cm for the same rise in temperature. A third rod C of 50 cm length is made up of pieces of rod A and B placed end to end expands by 0.03 cm on heating from 0°C to 50°C. Find the lengths of each portion of the composite rod.

Q.3 A clock with a metallic pendulum in 5 sec fast each day at a temperature of 15°C and 10 sec slow at a temperature of 30°C. Find α for the pendulum metal.

Q.4 A glass vessel is partially filled with mercury and when both are heated together, the volume of the unfilled part of vessel remain constant at all temperature. Find the initial volume of mercury if the empty part measures 34 cm^3. [Given : $\alpha_{vessel} = 9 \times 10^{-6}/°C$; $\gamma_{Hg} = 18 \times 10^{-5}/°C$]

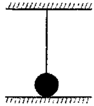
Q.5 A simple second pendulum is constructed out of a very thin isotropic string of thermal coefficient of linear expansion $\alpha = 20 \times 10^{-4}\,(C°)^{-1}$ and a heavy particle attached to one end. The free end of the string is suspended from the ceiling of an elevator at rest. The pendulum keeps correct time at 20°C. When the temperature rises to 51.2°C, the elevator operator of 60 kg being a student of Physics accelerates elevator vertically to keep correct time. Find the apparent weight of the operator when the pendulum keeps correct time at 51.2°C. [Take $g = 10\ ms^{-2}$]

Q.6 A solid body floats in a liquid at a temperature $t = 50°C$ being completely submerged in it. What fraction of the volume of the body is submerged in the liquid after its cooling to $t_0 = 0°C$, if the coefficient of cubic expansion for the solid is $\gamma_S = 0.3 \times 10^{-5}\,°C^{-1}$ and of the liquid $\gamma_t = 8 \times 10^{-5}\,°C^{-1}$.

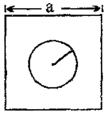
Q.7 Two rods of different materials but of equal cross-section and length (1.0 m each) are joined to make a rod of length 2.0 m. The metal of one rod has coefficient of linear thermal expansion 10^{-5} /°C and Young's modulus 3×10^{10} N/m^2. The other metal has the values 2×10^{-5} and 10^{10} N/m^2 respectively. How much pressure must be applied to the ends of the composite rod to prevent its expansion when the temperature is raised by 100°C?

Q.8 A steel wire of length 2 m and cross-sectional area = 2 mm^2 is fixed between two rigid supports in a state of negligible tension. If wire is stretched and tied firmly between two rigid supports, at a temperature = 20°C. At this moment, the tension in the wire is 200 N. At what temperature will the tension become zero? [Given : Y = 200 GPa, $\alpha = 10^{-5}$/°C]

Q.9 In the figure shown a sphere of mass 'm' is kept in a horizontal surface. A metallic wire of length l is tied to sphere. The other end of the wire is fixed to a ceiling. The wire is in natural length. The wire has coefficient of linear expansion a, area of cross-section A and Young's modulus Y. Neglecting the expansion of the sphere, find out the decrease in temperature, so that the sphere leaves contact with the surface.



Q.1 A square plate of a metal has a circular hole with centre at centre of plate. Side length of plate is a and radius of hole is a/2. Now temperature of the plate is changed by ΔT. Coefficient of linear expansion for material of plate is α.



(a) Find the new area of hole.

(b) Find the ratio of the area of hole and plate in final situation.

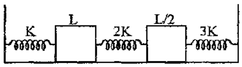
Q.2 Two vessels connected by a pipe with a sliding plug contain mercury. In one vessel, the height of mercury column is 39.2 cm and its temperature is 0°C, while in the other, the height of mercury column is 40cm and its temperature is 100°C. Find the coefficient of cubical expansion for mercury. The volume of the connecting pipe should be neglected.

Q.3 A thermometer has stem of internal diameter 0.8 mm and contains 0.07 gm of a liquid, the liquid level in the thermometer rises by 11.9 mm where the temperature changes from 0°C to 40°C. Find the coefficient of cubical expansion of the liquid. ($\gamma_{gl} = 1 \times 10^{-5}\ °C^{-1}$; density of liquid = 0.82 gm/cm^3)

Q.4 A box measured with a vernier caliper is found to be 180 mm long. The temperature during the measurement is 10°C. What will the measurement error be if the scale of the vernier caliper has been graduated at a temperature of 20°C? The coefficient of linear expansion of the material of vernier = $11 \times 10^{-6}\ °C^{-1}$.

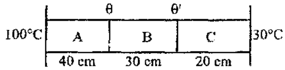
Q.5 Three rods A, B and C having identical shape and size are hinged together at ends to form an equilateral triangle. Rods A and B are made of same material having coefficient of linear thermal expansion $\alpha_1 = 11 \times 10^{-6}/°C$ while that of material of rod C is $\alpha_2 = 16 \times 10^{-6}/°C$. By how many kelvin must be the system of rods be heated to increase the angle opposite to rod C by $\Delta\theta = 0.01°$?

Q.6 The system shown consists of 3 springs & two rods. If the temperature of the rods is increased by ΔT, calculate the force exerted by springs on wall. Neglect friction & Thermal stress & take the coefficient of linear expansion of the material of rods equal to α.



Q.7 A hollow steel sphere, weighing 200 kg is floating on water. A weight of 10 kg is to be placed on it in order to submerge when the temperature is 20°C. How much less weight is to be placed when temperature increases to 25°C? Given : $\gamma_{water} = 1.5 \times 10^{-4}/°C$, $\alpha_{steel} = 1 \times 10^{-5}/°C$.

Q.8 A bar of uniform cross–section and of length 90cm is made of three materials A, B & C. Their lengths are 40cm, 30cm and 20cm respectively. The coefficients of their thermal conductivities are in the ratio 2 : 3 : 4. The ends are maintained at 100°C & 30°C & there is no loss of heat from the sides of the bar. When the rod is in steady state, find the temperatures θ and θ' of the interfaces.



Q.9 A composite rod is made by joining two rods of different material but of the same cross section. At 35°C the composite rod is 100 cm in length, out of which the length of the first rod is 40 cm. At 135°C the length of the composite rod increases by 2.1mm. When the composite rod is not allowed to expand by holding it between teo rigid walls it is found that the lengths of the two constituents do not change with rise in temperature. Young's modulus of the first rod is 1.2×10^{11} dyne/cm^2 and its coeficient of linear expansion is $1.5 \times 10^{-5}/°C$. Find the young's modulus and coeficient of linear expansion of the second rod.

BANSAL CLASSES **PHYSICS**

Target IIT JEE 2007 **Daily Practice Problems**

CLASS : XI (PQRS) ***DATE : 09-10/11/2005*** ***MAX.TIME : 60 Min.*** ***DPP. NO.-69***

Q.1 Pure water super cooled to $-15°C$ is contained in a thermally insulated flask. Small amount of ice is thrown into the flask. The fraction of water frozen into ice is :
(A) 3/35 (B) 6/35 (C) 6/29 (D) 2/35

Q.2 A 2100 W continuous flow geyser (instant geyser) has water inlet temperature = 10°C while the water flows out at the rate of 20 g/sec. The outlet temperature of water must be about
(A) 20°C (B) 30°C (C) 35°C (D) 40°C

Q.3 The bulk modulus of copper is 1.4×10^{11} Pa and the coefficient of linear expansion is $1.7 \times 10^{-5}\ (C°)^{-1}$. What hydrostatic pressure is necessary to prevent a copper block from expanding when its temperature is increased from 20°C to 30°C?
(A) 6.0×10^5 Pa (B) 7.1×10^7 Pa (C) 5.2×10^6 Pa (D) 40 atm

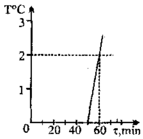
Q.4 The specific heat of a metal at low temperatures varies according to $S = aT^3$ where a is a constant and T is the absolute temperature. The heat energy needed to raise unit mass of the metal from $T = 1$ K to $T = 2$ K is
(A) 3 a (B) $\frac{15a}{4}$ (C) $\frac{2a}{3}$ (D) $\frac{12a}{5}$

Q.5 A crystal has a coefficient of expansion $0.13 \times 10^{-8}/°C$ in one direction and $2.31 \times 10^{-7}/°C$ in every direction at right angles to it. Then the cubical coefficient of expansion is :
(A) $4.62 \times 10^{-7}/°C$ (B) $2.44 \times 10^{-7}/°C$ (C) $4.75 \times 10^{-7}/°C$ (D) $2.57 \times 10^{-7}/°C$

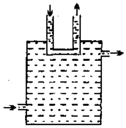
Q.6 The coefficient of apparent expansion of a liquid in a copper vessel is C and in a silver vessel is S. The coefficient of volume expansion of copper is γ_c. What is the coefficient of linear expansion of silver?
(A) $\frac{(C+\gamma_c+S)}{3}$ (B) $\frac{(C-\gamma_c+S)}{3}$ (C) $\frac{(C+\gamma_c-S)}{3}$ (D) $\frac{(C-\gamma_c-S)}{3}$

Q.7 5 gm of ice at 0°C is mixed with 10 gm of steam at 100°C. Find the final temperature and composition of the mixture if the mixing is done in a calorimeter of water equivalent 13 gm, initially at 0°C.

Q.8 A bucket contains a mixture of water and ice of mass m = 10kg. The bucket is brought into room after which the temperature of the mixture is immediately measured. The obtained $T(\tau)$ dependence is plotted in fig. The specific heat of water is $c_W = 4.2$kJ/kg-K and the latent heat of fusion of ice is 340 kJ/kg. Determine the mass m_{ice} of ice in the bucket at the moment it is brought in the room neglecting the heat capacity of the bucket.



Q.9 A conducting tube is passing through a bath. A liquid at temperature 90°C and specific heat s is entering at one end of tube. Rate of flow of liquid is 1 kg/s and exit temperature is 50°C. In bath another liquid having specific heat 2s and inlet temperature 20°C is entering at a rate of 2 kg/s. Find the exit temperature of liquid coming out of the bath. (assume steady state condition)



Q.10 A calorimeter whose water equivalent is 50 gm contains 450 gm of water and 100 gm ice at 0°C. What will be the final temperature if 50 gm of steam at 100°C is admitted to the calorimeter and contents?
Given : L_f ice = 80 cal/gm ; L_V of water = 540 cal/gm ; S_{ice} = 0.5 cal/gm k ; S_{water} = 1.0 cal/gm k

Q.1 Equal masses of three liquids A, B and C have temperatures 10°C, 25°C and 40°C respectively. If A and B are mixed, the mixture has a temperature of 15°C. If B and C are mixed, the mixture has a temperature of 30°C. If A and C are mixed, the mixture will have a temperature of
(A) 16°C (B) 20°C (C) 25°C (D) 29°C

Q.2 The temperature of a gas is doubled (i) on absolute scale (ii) on centigrade scale. The increase in root mean square velocity of gas will be
(A) More in case (i) (B) More in case (ii) (C) Same in both case (D) Information not sufficient

Q.3 The temperature of ice is –10°C (specific heat = 0.5 K cal/kg°C) and that of water 60°C. Their equal masses are mixed. What part of the ice will be melted? (Latent heat of fusion of ice = 80 Kcal/kg)
(A) 5/6 th (B) 11/16 th
(C) whole of it will be melted (D) 5/11 th

Q.4 A brass rod of length 2m and cross section area 2 cm^2 is attached end to end to a steel rod of length L and cross sectional area 1 cm^2. The compound rod is subjected to equal and opposite tensile force of magnitude 5×10^4 N at its ends. If the elongation of the two rods are equal. Then the length of steel rod is [$Y_{brass} = 10^{11}$ N/m^2, $Y_{steel} = 2 \times 10^{11}$ N/m^2]
(A) 1.5 m (B) 1.8 m (C) 2 m (D) none

Q.5 The density of a material A is 1500 kg/m^3 and that of another material B is 2000 kg/m^3. It is found that the heat capacity of 8 volumes of A is equal to heat capacity of 12 volumes of B. The ratio of specific heats of A and B will be
(A) 1 : 2 (B) 3 : 1 (C) 3 : 2 (D) 2 : 1

Q.6 Find the amount of heat supplied to decrease the volume of an ice water mixture by 1 cm^3 without any change in temperature. ($\rho_{ice} = 0.9\ \rho_{water}$, $L_{ice} = 80$ cal/gm).
(A) 360 cal (B) 500 cal (C) 720 cal (D) none of these

Q.7 Two cylinders of equal masses, one made of material A and the other of material B, are heated to 50°C and placed on two large blocks of ice at 0°C. If both the cylinders have the same height, find the ratio (h_A/h_B) of their maximum depth of penetration in the ice. Assume that no heat is lost to the surroundings.
$S_A = 0.3$ cal g^{-1} (C°)$^{-1}$; $\rho_A = 2.7$ g cm^{-3} ; $S_B = 0.1$ cal g^{-1} (C°)$^{-1}$; $\rho_B = 5.4$ g cm^{-3}

Q.8 A calorimeter of water equivalent 20 gm contain a liquid of mass 100 gm at 30°C. Specific heat capacity of the liquid is

$$S = \frac{1}{2}\left(1 + \frac{\theta}{500}\right) \text{cal/gm-°C}$$

where θ is temperature in degree Celsius.
m gm of ice at –10°C is put in the calorimeter such that final temperature of the mixture and calorimeter is 10°C. Specific heat capacity of water S_W = 1 cal/gm-°C, specific heat capacity of ice = 1/2 cal/gm-°C. Latent heat of fusion = 80 cal/gm. There is no loss of heat to surrounding.
(a) Find the heat lost by calorimeter only
(b) Find the value of m.

Q.9 Two identical calorimeters A and B contain equal quantity of water at 20°C. A 5g piece of metal X of specific heat 0.2 cal g^{-1} (C°)$^{-1}$ is dropped into A and a 5g piece of metal Y into B. The equilibrium temperature in A is 22°C and B is 23°C. The initial temperature of both the metals is 40°C. The specific heat of metal Y in cal g^{-1} (C°)$^{-1}$ is ________.

Q.10 The specific gravity of ice is 0.92. A metal of mass 10gm at 100°C is immersed in a mixture of ice and water and the volume of mixture is found to be reduced by 0.1 cm^3 without change of temperatures. Find the specific heat of metal assuming the specfic gravity of water at 0°C to be unity and the latent heat of fusion of ice to be 80cal/gm.

CLASS : XI (PQRS) *DATE : 14-15/11/2005* *MAX.TIME : 60 Min.* *DPP. NO.-71*

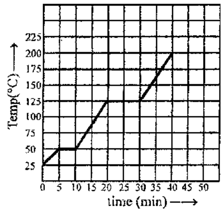
Q.1 Some steam at 100°C is passed into 1.1 kg of water contained in a calorimeter of water equivalent 0.02 kg at 15°C so that the temperature of the calorimeter and its contents rises to 80°C. What is the mass of steam condensing. (in kg)
(A) 0.130 (B) 0.065 (C) 0.260 (D) 0.135

Q.2 The ratio of densities of two bodies is 3:4 and the ratio of their specific heats is 4:3. The ratio of their heat capacities per unit volume is
(A) 1:1 (B) 1:3 (C) 9:16 (D) 16:9

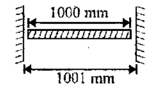
Q.3 A container is filled with water at 4°C. At one time the temperature is increased by few degrees above 4°C and at another time it is decreased by few degrees below 4°C. One shall observe that:
(A) the level remains constant in each case
(B) water overflows in both the cases
(C) water overflows in the latter case, while come down in the previous case
(D) in previous case water overflows while in later case its levels comes down

Q.4 Two liquids A and B are at 30°C and 20°C. When mixed in equal masses the temperature of the mixture is found to be 26°C. The ratio of specific heats of A and B is
(A) 3:2 (B) 2:3 (C) 1:1 (D) 4:3

Q.5 The graph shown in the figure represent change in the temperature of 5 kg of a substance as it abosrbs heat at a constant rate of 42 kJ min^{-1}. The latent heat of vapourazation of the substance is :
(A) 630 kJ kg^{-1}
(B) 126 kJ kg^{-1}
(C) 84 kJ kg^{-1}
(D) 12.6 kJ kg^{-1}



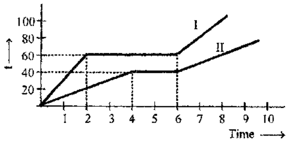
Q.6 A rod of length 1000 mm and coefficient of linear expansion $\alpha = 10^{-4}$ per degree is placed symmetrically between fixed walls separated by 1001 mm. The Young's modulus of the rod is 10^{11} N/m^2. If the temperature is increased by 20°C, then the stress developed in the rod is (in N/m^2) :
(A) 10 (B) 10^8
(C) 2×10^8 (D) cannot be calculated



Q.7 When the temperature of a copper coin is raised by 80°C, its diameter increases by 0.2%.
(A) Percentage rise in the area of a face is 0.4 %
(B) Percentage rise in the thickness is 0.4 %
(C) Percentage rise in the volume is 0.6 %
(D) Coefficient of linear expansion of copper is 0.25×10^{-4} $C^{\circ -1}$.

Q.8 A steel wire (Y = 200 GPa, $\alpha = 1 \times 10^{-5}$ /K) of length 1 m and cross-sectional are = 0.2 mm^2 is joined end to end with an aluminium alloy wire (Y = 100 GPa, $\alpha = 2 \times 10^{-5}$ /K) of length 50 cm and cross-sectional are = 0.5 mm^2. The free ends of the composite wire are fixed on rigid supports at T = 10°C, with negligible tension. Then the temperature of the two wires is lowered by 20°C. What is t-- t----- d-v-l-p-d -- th- ---- p -it i ?

Q.9 Two bodies of equal masses are heated at a uniform rate under identical conditions. The change in temperature in the two cases is shown graphically. What are their melting points?
Find the ratio of their specific heats and latent heats.



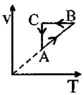
Q.10 3 identical calorimeters contain respectively 100g of water, 140g of water and 100g of liquid X. When heat is supplied to these calorimeters at same constant rate, it is found that after a given time interval, the respective rises in temperatures are 12°C, 9°C and 16°C. Find (a) the thermal capacity of each of the calorimeters (b) the specific heat of the liquid X.

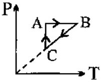
Q.1 During an experiment an ideal gas oberys an addition equation of state P^2V = constant. The initial temperature and pressure of gas are T and V respectively. When it expands to volume 2V, then its temperature will be :

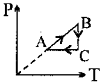
(A) T (B) $\sqrt{2}$ T (C) 2 T (D) $2\sqrt{2}$ T

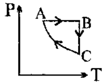
Q.2 Hydrogen gas and oxygen gas have volume 1 cm^3 each at N.T.P.
(A) Number of molecules is same in both the gases.
(B) The rms velocity of molecules of both the gases is the same.
(C) The internal energy of each gases is the same
(D) The average velocity of molecules of each gas is the same.

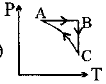
Q.3 An ideal gas undergoes a thermodynamics cycle as shown in figure. Which of the following graphs represents the same cycle?



(A) 

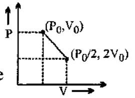
(B) 

(C) 

(D) 

Q.4 A barometer tube, containing mercury, is lowered in a vessel containing mercury until only 50 cm of the tube is above the level of mercury in the vessel. If the atmospheric pressure is 75 cm of mercury, what is the pressure at the top of the tube?
(A) 33.3 kPa (B) 66.7 kPa (C) 3.33 MPa (D) 6.67 MPa

Q.5 A gas expands obeying the relation as shown in the P/V diagram. The maximum temperature in this process is equal to



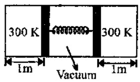
(A) $\frac{P_0V_0}{R}$ (B) $\frac{3P_0V_0}{R}$ (C) $\frac{9P_0V_0}{8R}$ (D) None of these

Q.6 A gas is enclosed in a vessel at a constant temperature at a pressure of 5 atmosphere and volume 4 litre. Due to a leakage in the vessel, after some time, the pressure is reduced to 4 atmosphere. As a result, the
(A) volume of the gas decreased by 20% (B) average K.E. of gas molecule decreases by 20%
(C) 20% of the gas escaped due to the leakage (D) 25% of the gas escaped due to the leakage

Q.7 For an ideal gas at absolute temperature T, temperature coefficient of volume expansion for an isobaric process is ____________.

Q.8 A mercury barometer (which is basically a vertical tube whose one end is open and dipped in mercury, the end of the tube is closed) whose scale is on the stand behind the glass tube, reads 740 mm. Because of the low reading, it is suspected that some air is present in the space above the mercury. The space is 60 mm long. The open end of the barometer is lowered farther into the mercury reservoir. When the barometer reading is 730 mm, the space above the mercury is 40 mm long. What is the true atmospheric pressure?

Q.9 Consider the shown diagram where the two chambers separated by piston-spring arrangement contain equal amounts of certain ideal gas. There is vacuum between the tight fitting pistons. Initially when the temperatures of the gas in both the chambers are kept at 300 K. The compression in the spring is 1 m. The temperature of the left and the right chambers are now raised to 400 K and 500 K respectively. If the pistons are free to slide, find the final compression in the spring.

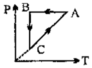


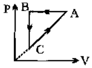
Q.10 A 20 litre vessel is filled with air at a pressure of 0.4MPa and connecting to another vessel from which all the air has been pumped out. The pressure in the two vessels equalise at 1×10^5 Pa. Assuming the process to be isothermal, find the volume of the second vessel.

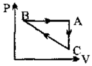
Q.11 A vessel of volume V = 30 litre contains an ideal gas at temperature T = 27°C. Keeping temperature constant, a part of gas is allowed to escape from the vessel causing the pressure to fall down by ΔP = 0.5 atm. Find the mass of gas released. It's density under normal condition is ρ = 1.25 g/litre.

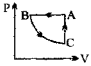
Q.1 N(<100) molecules of a gas have velocities 1, 2, 3........ N/km/s respectively. Then
(A) rms speed and average speed of molecules is same.
(B) ratio of rms speed to average speed is $\sqrt{(2N+1)(N+1)/6N}$
(C) ratio of rms speed to average speed is $\sqrt{(2N+1)(N+1)/6}$
(D) ratio of rms speed to average speed of a molecule is $2/\sqrt{6} \times \sqrt{(2N+1)/(N+1)}$

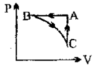
Q.2 A cyclic process ABCA is shown in PT diagram. When presented on PV, it would



(A) 

(B) 

(C) 

(D) 

Q.3 A vessel with open mouth contains air at 60°C. When the vessel is heated upto temperature T, one fourth of the air goes out. The value of T is
(A) 80°C (B) 171°C (C) 333°C (D) 444°C

Q.4 Five particles have speeds 1, 2, 3, 4, 5 m/s. the average velocity of the particles is (in m/s)
(A) 3 (B) 0 (C) 2.5 (D) cannot be calculated.

Q.5 During an experiment, an ideal gas is found to obey a condition VP^2 = constant. The gas is initially at a temperature T, pressure P and volume V. The gas expands to volume 4V.
(A) The pressure of gas changes to $\frac{P}{2}$
(B) The temperature of gas changes to 4T
(C) The graph of above process on the P-T diagram is parabola
(D) The graph of above process on the P-T diagram is hyperbola.

Q.6 During an experiment, an ideal gas is found to obey a condition $\frac{P^2}{\rho}$ = constant [ρ = density of the gas]. The gas is initially at temperature T, pressure P and density ρ. The gas expands such that density changes to $\rho/2$.
(A) The pressure of the gas changes to $\sqrt{2}$ P
(B) The temperature of the gas changes to $\sqrt{2}$ T
(C) The graph of above process on the P–T diagram is parabola
(D) The graph of the above process on the P–T diagram is hyperbola.

Q.7 A vessel of volume V=5litre contains m = 1.4gm of nitrogen at a temperature T = 1800K. Find the gas pressure, taking into account that η = 30% of molecules are dissociated into atoms at this temperature.

Q.8 Consider an ideal gas whose pressure varies with volume according to relation $p = p_o - aV^2$, where p_o and a are positive constant. If we subject the gas to different pressures what is the maximum temperature that the gas may attain.

Q.9 The r.m.s. speed of a molcule of oxygen at 127^0C is half that of a molecule hydrogen at __________.

Q.10 Two identical containers joined by a small pipe initially contain the same gas at pressure p_0 and absolute temperature T_0. One container is now maintained at the same temperature while the other is heated to $2T_0$. The common pressure of the gases will be _________.

Q.11 In the previous problem, let V_0 be the volume of each container. All other details remain the same. The number of moles of gas in the container at temperature $2T_0$ will be_______.

CLASS : XI (PQRS) *DATE : 21-22/11/2005* *MAX.TIME : 60 Min.* *DPP. NO.-74*

Q.1 28 gm of N_2 gas is contained in a flask at a pressure of 10 atm and at a temperature of 57°. It is found that due to leakage in the flask, the pressure is reduced to half and the temperature reduced to 27°C. The quantity of N_2 gas that leaked out is
(A) 11/20 gm (B) 20/11 gm (C) 5/63 gm (D) 63/5 gm

Q.2 Two monoatomic ideal gas at temperature T_1 and T_2 are mixed. There is no loss of energy. If the masses of molecules of the two gases are m_1 and m_2 and number of their molecules are n_1 and n_2 respectively. The temperature of the mixture will be :
(A) $\frac{T_1+T_2}{n_1+n_2}$ (B) $\frac{T_1}{n_1}+\frac{T_2}{n_2}$ (C) $\frac{n_2T_1+n_1T_2}{n_1+n_2}$ (D) $\frac{n_1T_1+n_2T_2}{n_1+n_2}$

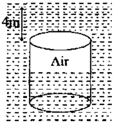
Q.3 If a mixture of 28 g of Nitrogen, 4 g of Hydrogen and 8 gm of Helium is contained in a vessel at temperature 400 K and pressure 8.3×10^5 Pa, the density of the mixture will be :
(A) 3 kg/m^3 (B) 0.2 kg/m^3 (C) 2 g/litre (D) 1.5 g/litre

Q.4 In case of hydrogen and oxygen at N.T.P., which of the following quantities is / are the same?
(A) average momentum per molecule (B) average kinetic energy per molecule
(C) kinetic energy per unit volume (D) kinetic energy per unit mass

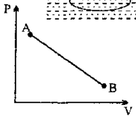
Q.5 A cylinder containing gas at 27°C is divided into two parts of equal volume each 100cc and at equal pressure by a piston of cross sectional area 10.85 cm^2. The gas in one part is raised in temperature to 100°C while the other maintained at original temperature. The piston and wall are perfect insulators. How far will the piston move during the change in temperature?
(A) 1 cm (B) 2 cm (C) 0.5 cm (D) 1.5 cm

Q.6 12gms of gas occupy a volume of 4×10^{-3} m^3 at a temperature of 7°C. After the gas is heated at constant pressure its density becomes 6×10^{-4}gm/cc. What is the temperature to which the gas was heated.
(A) 1000K (B) 1400K (C) 1200K (D) 800K

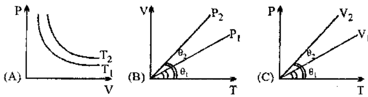
Q.7 An empty cylinder bucket 30cm in diameter and 50cm long whose wall thickness and weight can be considered negligible is entered open end (top) first, into water until its bottom is 4m below the surface. What force is required to keep it submerged. Consider process to be isothermal.



Q.8 20gm of He enclosed in a cylinder under a piston is transferred quasistatically from state A at pressure 18 atm and volume 4 lit. to state B 15.8 atm and volume 8.4 lit. as shown in the fig. (a) Draw the process on the T-V diagram. (b) Find the maximum temperature of the gas during the process.



Q.9 Explain whether (a) $T_2 > T_1$ (b) $P_2 > P_1$ (c) $V_2 > V_1$ or otherwise in fig. A, B and C which represent isothermal, isobaric and isochoric process respectively.



Q.10 One gramme mole of oxygen at 27°C and one atmospheric pressure is enclosed in a cubical vessel. (i) Assuming the molecules to be moving with v_{rms} equally in all direction ⊥ to wall, find the number of collisions per second which the molecuels make against one square metre of the vessel wall. (ii) The vessel is next thermally insulated and moved with a speed v_0. It is then suddenly stopped. The process results in the rise of temperature of the gas by $\Delta T = 1$°C. Calculate the speed v_0.

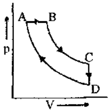
Q.11 Two ideal monoatomic & diatomic gases are mixed with one another to form an ideal gas mixture. The equation of the adiabatic process of the mixture is $PV^{\gamma} = $ constant, where $\gamma = 11/7$. If n_1 & n_2 are the number of moles of the mono atomic & diatomic gases in the mixture respectively, find the ratio n_1/n_2.

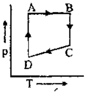
BANSAL CLASSES
Target IIT JEE 2007

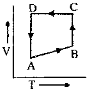
PHYSICS
Daily Practice Problems

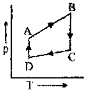
CLASS : XI (PQRS) ***DATE : 23-24/11/2005*** ***MAX.TIME : 60 Min.*** ***DPP. NO.-75***

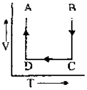
Q.1 A cyclic rocess ABCD is shown in the p-V diagram. Which of the following curves represents the same process if BC & DA are isothermal processes



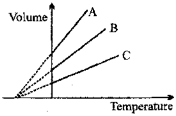
(A) 

(B) 

(C) 

(D) 

Q.2 The expansion of an ideal gas of mass m at a constant pressure P is given by the straight line B. Then the expansion of the same ideal gas of mass 2 m at a pressure 2P is given by the straight line



(A) C (B) A (C) B (D) none

Q.3 A vessel contains 1 mole of O_2 gas (molar mass 32) at a temperature T. The pressure of the gas is P. An identical vessel containing one mole of He gas (molar mass 4) at a temperature 2T has a pressure of
(A) P/8 (B) P (C) 2P (D) 8P

Q.4 A container X has volume double that of contianer Y and both are connected by a thin tube. Both contains same ideal gas. The temperature of X is 200K and that of Y is 400K. If mass of gas in X is m then in Y it will be:
(A) m/8 (B) m/6 (C) m/4 (D) m/2

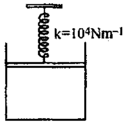
Q.5 A container holds 10^{26} molecules/m^3, each of mass 3×10^{-27} kg. Assume that 1/6 of the molecules move with velocity 2000 m/s directly towards one wall of the container while the remaining 5/6 of the molecules move either away from the wall or in perpendicular direciton, and all collisions of the molecules with the wall are elastic
(A) number of molecules hitting 1 m^2 of the wall every second is 3.33×10^{28}.
(B) number of molecules hitting 1 m^2 of the wall every second is 2×10^{29}.
(C) pressure exerted on the wall by molecules is 24×10^5Pa.
(D) pressure exerted on the wall by molecules is 4×10^5Pa.

Q.6 At temperature T, N molecules of gas A eac having mass m and at the same temperature 2N molecules of gas B each having mass 2m are filled in a container. The mean sqaure velocity of molecules of gas B is v^2 and mean square of x component of velocity of molecules of gas A is w^2. The ratio of w^2/v^2 is :
(A) 1 (B) 2 (C) 1/3 (D) 2/3

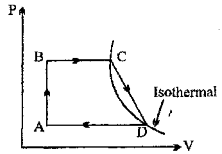
Q.7 5 gm of Helium having r.m.s. speed of molecules 1000 m/s and 24 gm of oxygen having r.m.s. speed of 1000 m/s are introduced into a thermally isolated vessel. Find the r.m.s. speeds of helium and oxygen individually when thermal equilibrium is attained.

Q.8 A cylinder 1 m long with a thin, massless piston clamped in such a way that it divided the cylinder into two equal parts. The cylinder is in a large bath at T = 300 K. The left side of the cylinder contains 1 mole of Helium gas at 4 atm. The right side contains helium gas at a pressure of 1 atm. Let the piston be slowly released. Find
(i) the equilibrium position of the piston
(ii) the heat transmitted to the bath in the process, when the equilibrium is established.

Q.9 One mole of an ideal mono-atomic gas is contained in a piston-cylinder arrangement as shown in the figure. The gas is initially at a pressure of 1 atom and temperature 27°C. The piston has cross-sectional area 0.005 m^2 and is connected to an undeformed spring of force constant 10^4 Nm^{-1}. How much heat must be added to the gas to increase the pressure to 3 atm.

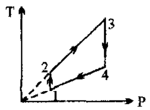


Q.10 One mole of an ideal monoatomic gas performs a cyclic process as shown in the figure.



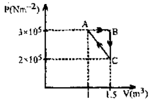
A → B : isochoric heating
B → C : isobaric expansion
C → D : straight line from C to D
D → A : isobaric compression
The temperatures in the states A, B and C are T_0, $2T_0$ and $4T_0$ respectively. Points C and D lie on the same isotherm. Find the work done by the gas during the cycle.

Q.11 Two moles of an ideal monoatomic gas undergoes a cyclic process as shown in the figure. The temperature in different states are $6T_1 = 3T_2 = 2T_4 = T_3 = 1800$ K. Determine the work done by the gas during the cycle.



Q.1 An ideal gas of Molar mass M is contained in a vertical tube of height H, closed at both ends. The tube is accelerating vertically upwards with acceleration g. Then, the ratio of pressure at the bottom and the mid point of the tube will be
(A) exp[2MgH/RT] (B) exp[–2MgH/RT] (C) exp[MgH/RT] (D) MgH/RT

Q.2 Considere the thermodynamics cycle shown on PV diagram. The process $A \to B$ is isobaric, $B \to C$ is isochoric and $C \to A$ is a straight line process. The following internal energy and heat are given :



$\Delta U_{A \to B} = +4$... J ..... $Q_{B \to}$ ... $= -50$ kJ
The heat flow in the process $Q_{C \to A}$ is :
(A) – 20 kJ (B) + 25 kJ (C) – 25 kJ (D) Data are insufficient

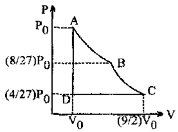
Q.3 1 kg of a gas does 20 kJ of work and receives 16 kJ of heat when it is expanded between two states. A second kind of expansion can be found between the initial and final state which requires a heat input of 9 kJ. The work done by the gas in the second expansion is :
(A) 32 kJ (B) 5 kJ (C) – 4 kJ (D) 13 kJ

Q.4 A vessel contains an ideal monoatomic gas which expands at constant pressure, when heat Q is given to it. Then the work done in expansion is :
(A) Q (B) $\frac{3}{5}Q$ (C) $\frac{2}{5}Q$ (D) $\frac{2}{3}Q$

Q.5 One mole of an ideal monoatomic gas at temperature T_0 expands slowly according to the law P/V = constant. If the final temperature is $2T_0$, heat supplied to the gas is :
(A) $2RT_0$ (B) $\frac{3}{2}RT_0$ (C) RT_0 (D) $\frac{1}{2}RT_0$

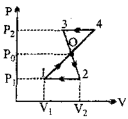
Q.6 One mole of a gas expands with temperature according to the relation $V = kT^{2/3}$. What is the workdone when the temperature changes by 30°C?
(A) 10R (B) 20R (C) 30R (D) 40R

Q.7 One mole of a gas ($\gamma = 1.5$) is taken through a cycle ABCD where,
AB $\to$ adiabatic process
BC $\to$ isothermal process
CD $\to$ isobaric process
AB $\to$ adiabatic rocess



Find the work done by the gas and also change in its internal energy in each process. Also find heat exchanged in each process.

Q.8 Determine the work W done by an ideal gas during a closed cycle $1\to4\to3\to2\to1$ shown in the Figure if $p_1 = 10^5$Pa, $p_0 = 3 \times 10^5$Pa, $p_2 = 4 \times 10^5$Pa, $V_2 - V_1 = 10l$, and segments 4–3 and 2–1 of the cycle are parallel to the V–axis.



Q.9 One mole of a mono-atomic ideal gas is to be taken from state A (P_0, V_0) to the state B $(P_0/2, V_0)$. The transfer of state is done in two different ways :

[1] The gas first expands from A isobarcally and then compressed to B in such a manner that its pressure is directly proportional to volume.

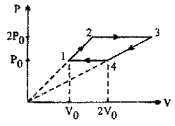
[2] The gas first undergoes an isothermal expansion from A & then is compressed to B through an isobaric process .

(a) Draw the P-V diagrams for both process 1 & 2.

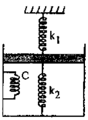
(b) Calculate the work done W_1 & W_2 for each process.

(c) Calculate the ratio Q_1/Q_2 where Q_1 = heat transfer in process 1 and Q_2-heat transfer in process 2.

Q.10 n moles of an ideal gas having adiabatic exponent γ undergoes a thermodynamic cycle shown in figure. Calculate its efficiency.



Q.11 3 moles of a diatomic ideal gas is enclosed in an adiabatic vertical cylinder fitted with a smooth, li ht adiabatic piston. The piston is connected to massless s ring as shown having spring constants $k_1 = 300$ N/m and $k_2 = 200$ N/m. Area of cross-section of the cylinder is 20 cm^2. Initially both the springs were at their natural length and the temperature of the gas is 300 k. Atmospheric pressure 100 kPa. The gas is heated slowly using a heating coil as shown so as to move the piston by 20 cm. Find the



(a) work done by the gas

(b) final temperature of the gas

(c) heat supplied by the heater.

BANSAL CLASSES | **PHYSICS**
Target IIT JEE 2007 | **Daily Practice Problems**

CLASS : XI (PQRS) *DATE : 30/11/2005* *MAX.TIME : 60 Min.* *DPP. NO.-78*

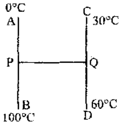
Q.1 A metallic rod of cross-sectional area 9.0 cm^2 and length 0.54 m, with the surface insulated to prevent heat loss, has one end immersed in boiling water and the other in ice-water mixture. The heat conducted through the rod melts the ice at the rate of 1 gm for every 33 sec. The thermal conductivity of the rod is
(A) 330 $Wm^{-1}K^{-1}$ (B) 60 $Wm^{-1}K^{-1}$ (C) 600 $Wm^{-1}K^{-1}$ (D) 33 $Wm^{-1}K^{-1}$

Q.2 Two sheets of thickness d and 3d, are touching each other. The temperature just outside the thinner sheet side is A, and on the side of the thicker sheet is C. The interface temperature is B. A, B and C are in arithmetic progressing, the ratio of thermal conductivity of thinner sheet and thicker sheet is
(A) 1 : 3 (B) 3 : 1 (C) 2 : 3 (D) 1 : 9

Q.3 A hollow sphere of inner radius R and outer radius 2R is made of a material of thermal conductivity K. It is surrounded by another hollow sphere of inner radius 2R and outer radius 3R made of same material of thermal conductivity K. The inside of smaller sphere is maintained at 0°C and the outside of bigger sphere at 100°C. The system is in steady state. The temperature of the interface will be :
(A) 50°C (B) 70°C (C) 75°C (D) 45°C

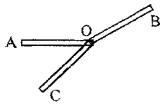
Q.4 A cylindrical rod with one end in a steam chamber and the outer end in ice results in melting of 0.1 gm of ice per second. If the rod is replaced by another with half the length and double the radius of the first and if the thermal conductivity of material of second rod is 1/4 that of first, the rate at which ice melts is gm/sec will be
(A) 3.2 (B) 1.6 (C) 0.2 (D) 0.1

Q.5 Three identical rods AB, CD and PQ are joined as shown. P and Q are mid points of AB and CD respectively. Ends A, B, C and D are maintained at 0°C, 100°C, 30°C and 60°C respectively. The direction of heat flow in PQ is
(A) from P to Q (B) from Q to P
(C) heat does not flow in PQ (D) data not sufficient



Q.6 In a 10–meter–deep lake, the bottom is at a constant temperature of 4°C. The air temperature is constant at –4°C. The thermal conductivity of ice is 3 times that of water. Neglecting the expansion of water on freezing, the maximum thickness of ice will be__________.

Q.7 Three rods AO, BO and CO having equal lengths and equal area of cross section are connected as shown in the figure. The temperature of ends A, B and C are 30°C, 60°C and 90° respectively. The thermal conductivities of rods AO, BO and CO are in the ratio of 1 : 2 : 3. What is the temperature of junction O?



Q.8 One end of a uniform brass rod 20cm long and the 10cm^2 cross-sectional area is kept at 100°C. The other end is in perfect thermal contact with another rod of identical cross-section and length 10cm. The free end of this rod is kept in melting ice and when the composite rod is well lagged and steady state has been reached, it is found that 360gm of ice melt per hour. Calculate the thermal conductivity of the rod, given that the thermal conductivity of brass is 0.25 cal/s/cm/°C and L = 80 cal/gm.

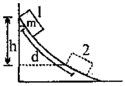
Q.9 One end of a uniform rod of length 1m is placed in boiling water while its other end is placed in melting ice. A point P on the rod is maintained at a constant temperature of 800°C. The mass of steam produced per second is equal to the mass of ice melted per second. If specific latent heat of steam is 7 times the specific latent heat of ice, the distance of P from the steam chamber must be ______.

Q.10 An electric heater is used in a room of total wall area 100 m^2 to maintain a constant temperature of 20°C inside when the outside temperature is – 10°C. The walls have three different layers. The innermost layer is of wood of thickness 2 cm, the middle layer is of cement of thickness 1 cm and the outermost layer is of brick of thickness 10 cm. Assuming that there is no loss of heat from the floor and the ceiling, find the power of the heater. The thermal conductivities of wood, cement and brick are 0.1, 0.2 and 0.5 W/m°C.

Q.1 The clock used to maintain Indian Standard time is
(A) Pendulum clock (B) Cesium Atomic Clock (C) Quartz clock (D) None

Q.2 A laser light pulse beamed at moon takes 2.56 s to return to earth. Radius of lunar orbit around earth is
(A) 3.84×10^5 km (B) 7.68×10^5 km (C) 1.92×10^5 km (D) 7.68×10^4 km

Q.3 A box of mass m is released from rest at position 1 on the frictionless curved track shown. It slides a distance d along the track in time t to reach position 2, dropping a vertical distance h. Let v and a be the instantaneous speed and instantaneous acceleration, respectively, of the box at position 2. Which of the following equations is valid for this situation?

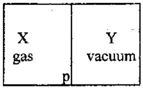


(A) h = vt (B) $h = (1/2)gt^2$ (C) $d = (1/2)at^2$ (D) $mgh = (1/2)mv^2$

Q.4 A piston is slowly pushed into a metal cylinder containing an ideal gas. Which of the following statements is incorrect?
(A) The pressure of the gas increases
(B) The number of the molecules per unit volume increases
(C) The average speed of gas molecules increases
(D) The frequency of collision of the gas molecules with the piston increases.

Q.5 Which of the following statements is not an assumption of the kinetic theory for an ideal gas?
(A) The duration of a collision is negligible as compared to the time between successive collisions
(B) The molecules have negligible attraction for each other
(C) The molecules have negligible momentum change on collision with the container walls
(D) There is no total kinetic energy change of the molecules on colliding with each other or with the walls of the container.

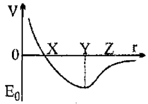
Q.6 A closed container is fully insulated from outside. One half of it is filled with an ideal gas X separated by a plate P from the other half Y which contains a vacuum as shown in figure. When P is removed, X moves into Y. Which of the following statements is correct?



(A) No work is done by X (B) X decreases in temperature
(C) X increases in internal energy (D) X doubles in pressure

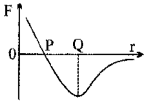
Q.7 The first law of thermodynamics can be written as $\Delta U = \Delta Q + \Delta W$ for an ideal gas. Which of the following statements is correct?
(A) ΔU is always zero when no heat enters or leaves the gas
(B) ΔW is the work done by the gas in this written law.
(C) ΔU is zero when heat is supplied and the temperature stays constant
(D) $\Delta Q = -\Delta W$ when the temperature increases very slowly.

Q.8 Figure, shows how the potential energy V for two neighbouring atoms varies with their separation r. Which statement is correct?



(A) the atoms are in equilibrium at separation OX
(B) the slope of the curve at Z is related to Hooke's law
(C) the force between atoms is repulsive for separation less than OY
(D) the force between atoms is repulsive for separation greater than OY

Q.9 Figure, shows roughly how the force F between two adjacent atoms in a solid varies with separation r. Which statements are correct?



[1] OQ is the equilibrium separation
[2] Hooke's law is obeyed around P
[3] The potential energy of the atoms is the gradient of [illegible]
[4] The energy to separate the atoms completely is obtained from the area enclosed below the axis of r
(A) 1 and 2 only (B) 2 and 4 only (C) 1 and 3 only (D) 1, 2, 3 only

Q.10 An experiment is perfomed to measure the specific heat of copper. A lump of copper is heated in an oven, then dropped into a beaker of water. To calculate the specific heat of copper, the experimenter must know or measure the value of all of the quantities below EXCEPT the

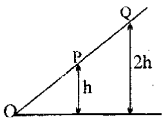
(A) heat capacity of water and beaker

(B) original temperature of the copper and the water

(C) final (equilibrium) temperature of the copper and the water

(D) time taken to achieve equilibrium after the copper is dropped into the water

Q.11 ... l ... ls ... a ... p ..., f g ... T ... all s first released from rest from P and then later from Q. Which of the following statement is/ are correct?



(i) The ball takes twice as much time to roll from Q to O as it does to roll from P to O.

(ii) The acceleration of the ball at Q is twice as large as the acceleration at P.

(iii) The ball has twice as much K.E. at O when rolling from Q as it does when rolling from P.

(A) i, ii only (B) ii, iii only (C) i only (D) iii only

Q.12 Consider the following statements

Assertion (A): The moment of inertia of a rigid body reduces to its minimum value as compared to any other parallel axis when the axis of rotation passes through its centre of mass.

Reason (R): The weight of a rigid body always acts through its centre of gravity.

Of these statements:

(A) both A and R are true and R is the correct explanation of A

(B) both A and R are true but R is not a correct explanation of A

(C) A is true but R is false

(D) A is false but R is true

Q.13 A ball is projected vertically upwards. Air resistance & variation in g may be neglected. The ball rises to its maximum height H in a time T, the height being h after a time t

[1] The graph of kinetic energy E_k of the ball against height h is shown in figure 1

[2] The graph of height h against time t is shown in figure 2

[3] The graph of gravitational energy E_g of the ball against height h is shown in figure 3

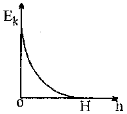


Fig. 1

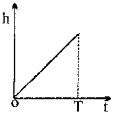


Fig. 2

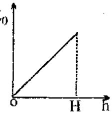
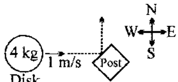


Fig. 3

Which of A, B, C, D, E shows the correct answers?

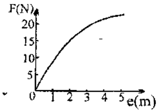
(A) 3 only (B) 1, 2 (C) 2, 3 (D) 1 only

Q.14 A 4-kilogram disk slides over level ice toward the east at a velocity of 1 meter per second, as shown. The disk strikes a post and rebounds toward the north at the same speed. The change in the magnitude of the eastward component of the momentum of the disk is



(A) –4 kg·m/s (B) –1 kg·m/s (C) 0 kg·m/s (D) 4 kg·m/s

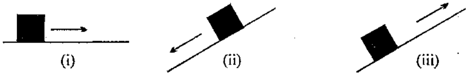
Q.15 The force (F) - extension (e) graph of figure shows that the work done by external agent in slowly streching the material under test for an extension of 4 m is greater than



(A) 100 J (B) 8 ... (C) 6 ... (D) ...

CLASS : XI (PQRS) *DATE : 07-08/12/2005* *MAX.TIME : 60 Min.* *DPP. NO.-81*

Q.1 Figure shows three situations involving a plane that is not frictionless and a block sliding along the plane. The block begins with the same speed in all three situations and slides until the kinetic frictional force has stopped it. Rank the situations according to the increase in thermal energy due to the sliding (neglecting losses to surrounding), in order taking the greatest first.

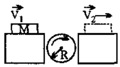


(A) (ii), (i), (iii) (B) (iii), (i), (ii) (C) (ii), (iii), (i) (D) (iii), (ii), (i)

Q.2 A particle of mass m is moving under the force $\vec{F}$. If $|\vec{F}|$ is constant, then the possible path of the particle can never be
(A) rectilinear (B) circular (C) parabolic (D) none

Q.3 The temperature of a body falls from 52°C to 36°C in 10 minutes when placed in a surrounding of constant temperature 20°C. What will be the temperature of the body after another 10 min. (Use Newton's law of cooling)
(A) 28°C (B) 20°C (C) 32°C (D) 24°C

Question No. 4 to 6
The axis of the uniform cylinder in figure is fixed. The cylinder is initially at rest. The block of mass M is initially moving to the right without friction and with speed v_1. It passes over the cylinder to the dashed position. When it first makes contact with the cylinder, it slips on the cylinder, but the friction is large enough so that slipping ceases before M loses contact with the cylinder. The cylinder has a radius R and a rotational inertia I.



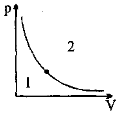
Q.4 For the entire process the quantity (ies) which will remain conserved for the (cylinder + block) system is/are (Angular momentum is considered about the cylinder axis)
(A) mechanical energy, momentum and angular momentum
(B) mechanical energy & angular momentum only
(C) momentum & angular momentum only
(D) angular momentum only

Q.5 If w is the final angular velocity of the cylinder, then
(A) $v_1 = \omega R$ (B) $v_2 = \omega R$ (C) $v_1 < \omega R$ (D) none

Q.6 Question given below consists of two statements each printed as Assertion (A) and Reason (R); while answering the question you are required to choose any one of the following four responses on the basis of above situation
(A) if both (A) and (R) are true and (R) is the correct explanation of (A)
(B) if both (A) and (R) are true but (R) is not correct explanation of (A)
(C) if (A) is true but (R) is false
(D) if (A) is false and (R) is true
Assertion: Momentum of the block-cylinder system is conserved.
Reason: Force of friction between block and cylinder is internal force of block-cylinder system.

Question No. 7 to 8

The dot in figure represents the initial state of a gas. An adiabat divides the p-V diagram into regions 1 and 2 as shown.



Q.7 Fo w ic f fi ll w gp c s , c p g uppl system Q is positive

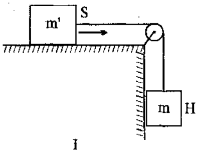
(A) the gas moves up along the adiabat, (B) it moves down along the adiabat,
(C) it moves to anywhere in region 1, (D) it moves to anywhere in region 2.

Q.8 As the gas moves down along the adiabatic, the temperature

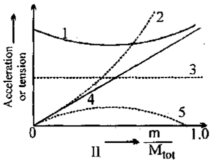
(A) increases (B) decreases
(C) remains constant (D) variation depends on type of gas

Question No. 9 to 11

Two containers of sand S and H are arranged like the blocks figure I. The containers alone have negligible mass; the sand in them has a total mass M_{tot}; the sand in the hanging container H has mass m. You are to measure the magnitude a of the acceleration of the system in a series of experiments where m varies from experiment to experiment but M_{tot} does not; that is, you will shift sand between the containers before each trial. $\frac{m}{M_{tot}}$ is taken on the horizontal axis for all the plots.



I



II

Q.9 The plot in figure II which gives the acceleration magnitude of the containers (taken on y-axis) as a function of ratio $\left(\frac{m}{M_{tot}}\right)$ is:

(A) 1 (B) 3 (C) 4 (D) 5

Q.10 The curve which gives tension in the connecting string (taken on y-axis) as a function of ratio $\left(\frac{m}{M_{tot}}\right)$ is:

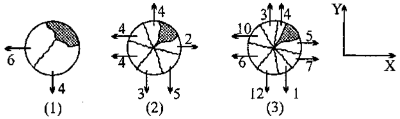
(A) 1 (B) 2 (C) 4 (D) 5

Q.11 The curve which gives the magnitude of net force, on container H (taken on y-axis) as a function of ratio $\left(\frac{m}{M_{tot}}\right)$ is:

(A) 1 (B) 2 (C) 4 (D) 5

Question No. 12 to 13

Figure shows top views of three two-dimensional explosions in which a stationary object is blown by a small firecracker into three pieces, seven pieces, and nine pieces. The pieces then slide over a frictionless floor. For each situation, figure also shows the directions and magnitudes of (linear) momentum vectors of all except one piece which is darkened in the figures; that piece has momentum $\vec{P}'$. The numbers next to the vectors are the magnitudes of the momentum (in kilogram-meters per second). Take coordinate axes x and y as shown.

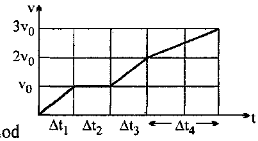


Q.12 The magnitude of momentum $\vec{P}'$ is:
(A) Maximum for situation (1)
(B) Maximum for situation (2)
(C) Maximum for situation (3)
(D) Same for all situations

Q.13 y-component of momentum $\vec{P}'$ is:
(A) Maximum for situation (1)
(B) Maximum for situation (2)
(C) Maximum for situation (3)
(D) Same for all situations

Question No. 14 to 15

Figure gives the velocity v versus time t graph of a carriage of constant mass being moved along an axis by applying force. The time axis shows four time periods, with $\Delta t_1 = \Delta t_2 = \Delta t_3$ and $\Delta t_4 = 2\Delta t_1$



Q.14 The work done by the force is maxmum during which time period
(A) Δt_3 and Δt_4
(B) Δt_1, Δt_3 and Δt_4
(C) Only Δt_3
(D) Only Δt_4

Q.15 The rate at which work done is maximum
(A) Only Δt_1
(B) Δt_1 and Δt_3
(C) Only Δt_3
(D) Only Δt_4

Q.1 A spherical black body with a radius of 12 cm radiates 450W power at 500K. If the radius were halved and the temperature doubled, the power radiated in watts would be________.

Q.2 The temperature of blackbody is increased by 1%. The amount of radiation emitted by it increases by_____.

Q.3 A sphere, a cube and a thin circular plate are heated to the same temperature. If they are made of same material and have equal masses then determine which of these three objects cools the fastest and which one cools the slowest?

Q.4 The energy radiated by a black body at 2300 K is found to have the maximum at a wavelength 1260 nm, its emissive power being 8000 Wm^{-2}. When the body is cooled to a temperature T K, the emissive power is found to decrease to 500 Wm^{-2}. Find:
(i) the temperature T
(ii) the wave length at which intensity of emission in maximum at the temperature T.

Q.5 At a temperature T_1, a body radiates maximum energy corresponding to a wavelength of 3000 Å. On increasing its temperature to T_2, the maximum energy is radiated for wavelength of 2000 Å. The surroundings are at 300 K, if the rate of loss of energy by the body at temperature T_2 is 6 times that at temperature T_1, find the temperatures T_1 and T_2.

Q.6 A cylinder fitted with a metal piston contains water and steam at constant temperature as in fig. The cross-sectional area of the cylinder is 2.5 cm^2. The piston is falling at a rate of 0.25 cm/sec. The density of steam under the piston is $6.0 \times 10^{-4} gm/cm^3$. Find
(i) the rate of condensation of steam
(ii) the rate with which heat is leaving the chamber. ($L_V = 2.25 \times 10^6$ J/kg)

Q.7 A body cools from 50° C to 40°C in 5 minutes. The surrounding temperature is 20°C. What will be its temperature 5 minutes after reading 40°C? Use approximate method.

Q.8 A solid copper sphere (density ρ, specific heat C) of radius r at an initial temperature 200 K is suspended inside a chamber whose walls are at almost 0K. Calculate the time required for the temperature of the sphere to drop to 100K. Neglect the effect of thermal contraction.

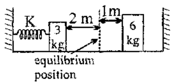
Q.9 The solar constant for a planet is S. The surface temperature of the sun is T K. The sun subtends an angle θ at the planet. Find S.
[Note: Solar constant is rate at which radiations are received from sun per unit surface area]

Q.10 A highly conducting solid sphere of radius R, density ρ and specific heat s is kept in an evacuated chamber. A parallel beam of electromagnetic radiation having uniform intensity I is incident on its surface. Assuming surface of the sphere to be perfectly black and its temperature at t = 0 to be equal to T_0, Calculate maximum attainable temperature of the sphere. (Stefan's constant = σ)

CLASS : XI (PQRS) *DATE : 19-20/12/2005* *MAX.TIME : 60 Min.* *DPP. NO.-83*

Question No. 1 to 2

Two blocks of masses 3 kg and 6 kg rest on on a horizontal frictionless surface. The 3 kg block is attached to a spring with a force constant K = 900 N/m which is compressed 2 m initially from its equilibrium position. When 3 kg mass is released, it strikes the 6 kg mass and the two stick together.



Q.1 The common velocity of the blocks after collision is
(A) 10 m/s (B) 30 m/s (C) 15 m/s (D) 2 m/s

Q.2 The amplitude of resulting oscillation after the collision is
(A) $\frac{1}{\sqrt{2}}$ m (B) $\frac{1}{\sqrt{3}}$ m (C) $\sqrt{2}$ m (D) $\sqrt{3}$ m

Question No. 3 to 4

A particle is projected with speed 100 m/s at angle $\theta = 60°$ with the horizontal at time t = 0. At time 't' the velocity vector of the particle becomes perpendicular to the direction of velocity of projection.

Q.3 Its tangential acceleration at time 't' is
(A) 10 m/s^2 (B) $5\sqrt{3}$ m/s^2 (C) 5 m/s^2 (D) zero

Q.4 Its radius of curvature at time 't' is
(A) $\frac{1}{\sqrt{3}}$ km (B) $\frac{2}{3\sqrt{3}}$ km (C) 2 km (D) $\sqrt{2}$ km

Question No. 5 to 6

Two particles A & B of masses m and 2m respectively are connected through a spring in its natural length. They are projected directly away from each other along spring with the same speed.

Q.5 At the moment of maximum distance between them
(A) The particles are moving with same speed in opposite direction
(B) The particles are moving with same speed in same direction
(C) Both the particles are at rest
(D) None of these

Q.6 Minimum individual speed of the particles are
(A) A zero & B non zero (B) A non-zero & B zero
(C) A & B both non-zero (D) A & B both zero

Q.7 An elastic string which obeys Hooke's law is found to extend by 1 cm when a mass is hung on it. It extends by another 1 cm when the attached mass uniformly moves in a horizontal circle forming a conical pendulum. The inclination of the string with the vertical is
(A) 30° (B) 45° (C) 60° (D) 90°

Q.8 Perpendicular axis theorem can't be applied for
(A) ring (B) cone (C) disc (D) rectangular plane

Q.9 The specific heat of the same substance is expressed in two units; C_1 cal/gm°C & C_2 cal/gm°F. Then which of the following relation is true?
(A) $C_1 > C_2$ (B) $C_1 = C_2$ (C) $C_1 < C_2$ (D) C_1 & C_2 cannot be compared

Q.10 A & B are two identical thermometers but bulb of A is spherical & that of B is cylindrical. Which of the thermometers will show the temperature quickly?
(A) A (B) B
(C) both (D) depends on the temperature to be measured

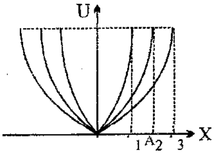
BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
Daily Practice Problems

CLASS : XI (PQRS) *DATE : 21-22/12/2005* *MAX.TIME : 60 Min.* *DPP. NO.-84*

Q.1 Consider the following statements
A particle executing uniform circular motion have
I. tangential velocity
II. radial acceleration
III tangential acceleration
IV radial velocity
of these statements
(A) I and II are correct (B) I and III are correct
(C) II and IV are correct (D) III and IV are correct

Q.2 The potential energy, U of three simple harmonic oscillations varies with di—l——t 'X' fr— tl— ——ition as s —w— i— t e figur—. Th—
oscillators have the same mass but different amplitudes A_1, A_2 and A_3. Their characteristic frequencies v_1, v_2 and v_3 are related to each other as



[I] $\frac{v_1}{A_1} = \frac{v_2}{A_2} = \frac{v_3}{A_3}$ [II] $v_1A_1 = v_2A_2 = v_3A_3$
[III] $v_1 > v_2 > v_3$ [IV] $v_1 < v_2 < v_3$
(A) [I] & [II] are correct (B) [I] & [III] are correct
(C) [II] & [III] are correct (D) [II] & [IV] are correct

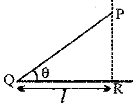
Q.3 Three metal rods A, B and C of same length and cross-section are placed end to end and a temperature difference is maintained between the free ends of A and C. If the thermal conductivity of B(K_B) is twice that of C(K_C) and half that of A(K_A), then the effective thermal conductivity of the system will be

(A) $\frac{K_A}{7}$ (B) $\frac{6K_B}{7}$ (C) $\frac{7K_B}{3}$ (D) $7K_C$

Q.4 Small beads of mass 4.5 g each are dropped from height h = 20 m on to a floor at a constant rate of 1000 beads per second. If the collision is perfectly inelastic, the force acting on the floor due to the beads at t = 10 second after they start hitting the floor ($g = 10 m/s^2$) is
(A) 450 N (B) 90 N (C) 540 N (D) 630 N

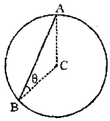
Q.5 The total work done on a particle is equal to the change in its kinetic energy
(A) always
(B) only if the forces acting on the body are conservative
(C) only if the forces acting on the body are gravitational
(D) only if the forces acting on the body are elastic

Q.6 PQ is a smooth inclined plane whose angle of inclination θ can be varied in such a way that point Q remains fixed & P can move on a vertical line PR. A particle slides from rest from point P. At different values of θ time for descent t_d from P to is noted. The followin statement is true about t_d:



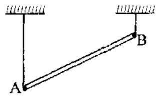
(A) minimum value of t_d is $2\sqrt{\frac{l}{g}}$ (B) t_d is minimum when θ approaches 90°
(C) t_d decreases continuously as θ is increased. (D) t_d first increases then decreases as θ is increased

Q.7 AB is a strin_ whose one end A is fixed at the highest_ oint of a ring placed in vertical plane. C is the centre of the ring. At other end B of the string, is attached a bead of mass m, which can slide along the ring. If the bead is in equilibrium at B & string is taut then the tenson in the string is



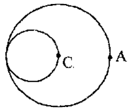
(A) mgsin2θ (B) mgcosθ
(C) 2mgcosθ D` none of `hese

Q.8 Two strings support a uniform rod as shown. String at end B is cut. Which of the following is true just after cut



[I] initial acceleration of A is vertical
[II] initial acceleration of A is horizontal
[III] initial acceleration of centre of mass of rod is vertical
[IV] i-iti-l ----l---ti-- -f ---t-- -f------ -f--d i- h--iz---t-l
(A) [I] & [II] (B) [II] & [III] (C) [III] & [IV] (D) [I] & [IV]

Q.9 A uniform circular disc with the hole lies over a smooth horizontal surface, C is centre of the disc and A is - p-i-t -- th- -i-- -f th- disc -s sh-w-. As th- t---p---tu-- is i--c---s--.



(A) C remains at rest& A to right
(B) Both A & C move to right
(C) Both remain at rest
D C moves to left & A to ri_ht

Q.10 Which one of the following is a set of dimensionless physical quantities?
(A) strain, specific gravity, angle (B) strain, work, couple
(C) work, angle, specific gravity (D) work, energy, frequency

Q.1 For a particle executing S.H.M., x = displacement from equilibrium position, v = velocity at any instant and a = acceleration at any instant, then
(A) v-x graph is a circle
(B) v-x graph is an ellipse
(C) a-x graph is a straight line
(D) a-v graph is an ellipse

Q.2 A small mass executes linear SHM about O with amplitude a and period T. Its displacement from O at time T/8 after passing through O is:
(A) a/8 (B) $a/2\sqrt{2}$ (C) a/2 (D) $a/\sqrt{2}$

Q.3 A particle performs SHM with a period T and amplitude a. The mean velocity of the particle over the time interval during which it travels a distance a/2 from the extreme position is
(A) 2a/T (B) 3a/T (C) a/2T (D) none

Q.4 A particle executes SHM of period 1.2 sec and amplitude 8 cm. Find the time it takes to travel 3cm from the positive extremity of its oscillation.
(A) 0.28 sec (B) 0.32 sec (C) 0.17 sec (D) 0.42 sec

Q.5 A particle executes SHM on a straight line path. The amplitude of oscillation is 2 cm. When the displacement of the particle from the mean position is 1 cm, the numerical value of magnitude of acceleration is equal to the numerical value of magnitude of velocity. The frequency of SHM (in second^{-1}) is:
(A) $2\pi\sqrt{3}$ (B) $2\pi/\sqrt{3}$ (C) $\sqrt{3}/(2\pi)$ (D) $1/(2\pi\sqrt{3})$

Q.6 A particle of mass 4 kg moves between two points A and B on a smooth horizontal surface under the action of two forces such that when it is at a point P, the forces are $2\overrightarrow{PA}$ N and $2\overrightarrow{PB}$ N. If the particle is released from rest at A, find the time it takes to travel a quarter of the way from A to B.
(A) π/2 s (B) π/3 s (C) πs (D) π/4 s

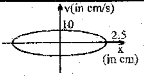
Q.7 A stone is swinging in a horizontal circle 0.8 m in diameter at 30 rev / min. A distant light causes a shadow of the stone to be formed on a nearly vertical wall. The amplitude and period of the simple harmonic motion for the shadow of the stone are
(A) 0.4 m, 4 s (B) 0.2 m, 2 s (C) 0.4 m, 2 s (D) 0.8 m, 2 s

Q.8 A particle moves along the x-axis according to : $x = A[1 + \sin \omega t]$. What distance does is travel between $t = 0$ and $t = 2.5\pi/\omega$?
(A) 4A (B) 6A (C) 5A (D) None

Q.9 A spring has natural length 40 cm and spring constant 500 N/m. A block of mass 1 kg is attached at one end of the spring and other end of the spring is attached to ceiling. The block released from the position, where the spring has length 45 cm.
(A) the block will perform SHM of amplitude 5 cm.
(B) the block will have maximum velocity $30\sqrt{5}$ cm/sec.
(C) the block will have maximum acceleration 15 m/s^2
(D) the minimum potential energy of the spring will be zero.

Q.10 A mass at the end of a spring executes harmonic motion about an equilibrium position with an amplitude A. Its speed as it passes through the equilibrium position is V. If extended 2A and released, the speed of the mass passing through the equilibrium position will be
(A) 2V (B) 4V (C) $\frac{V}{2}$ (D) $\frac{V}{4}$

Q.1 The figure shows a graph between velocity and displacement (from mean position) of a particle performing SHM:

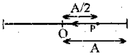


(A) the time period of the particle is 1.57s
(B) the maximum acceleration will be $40 cm/s^2$
(C) the velocity of particle is $2\sqrt{21}$ cm/s when it is at a distance 1 cm from the mean position.
(D) none of these

Q.2 A man of mass 60 kg standing on a plateform executing S.H.M. in the vertical plane. The displacement from the mean position varies as $y = 0.5 \sin(2\pi ft)$. The minimum value of f, for which the man will feel weight less ness at the highest point is : (y is in metres)

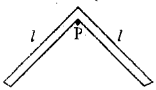
(A) $\frac{g}{4\pi}$ (B) $4\pi g$ (C) $\frac{\sqrt{2g}}{2\pi}$ (D) $2\pi\sqrt{2g}$

Q.3 A particle starts from a point P at a distance of A/2 from the mean position O & travels towards left as shown in the figure. If the time period of SHM, executed about O is T and amplitude A then the equation of motion of particle is :



(A) $x = A\sin\left(\frac{2\pi}{T}t + \frac{\pi}{6}\right)$ (B) $x = A\sin\left(\frac{2\pi}{T}t + \frac{5\pi}{6}\right)$ (C) $x = A\cos\left(\frac{2\pi}{T}t + \frac{\pi}{6}\right)$ (D) $x = A\cos\left(\frac{2\pi}{T}t + \frac{\pi}{3}\right)$

Q.4 A system of two identical rods (L-shaped) of mass *m* and length *l* are resting on a peg P as shown in the figure. If the system is displaced in its plane by a small angle θ, find the period of oscillations:



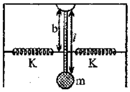
(A) $2\pi\sqrt{\frac{\sqrt{2}l}{3g}}$ (B) $2\pi\sqrt{\frac{2\sqrt{2}l}{3g}}$ (C) $2\pi\sqrt{\frac{2l}{3g}}$ (D) $3\pi\sqrt{\frac{l}{3g}}$

Q.5 A circular disc has a tiny hole in it, at a distance z from its center. Its mass is M and radius R (R>z). A horizontal shaft is passed through the hole and held fixed so that the disc can freely swing in the vertical plane. For small disturbance, the disc performs SHM whose time period is minimum for z =

(A) $R/2$ (B) $R/3$ (C) $R/\sqrt{2}$ (D) $R/\sqrt{3}$

Q.6 A platform is executing simple harmonic motion in a vertical direction with an amplitude of 5 cm and a frequency of $10/\pi$ vibrations per seconds. A block is placed on the platform at the lowest point of its path.
(a) At what height above the lowest point will the block leave the platform?
(b) How far will the block rise above the highest point reached by the platform?

Q.7 Find the time period of small oscillations of the spring loaded pendulum. The equilibrium position is vertical as shown. The mass of the rod is negligible and treat mass as a particle.



Q.8 A particle is doing SHM of amplitude 0.5 m and period π seconds. When in a position of instantaneous rest, it is given an impulse which imparts a velocity of 1 m/s towards the equilibrium position. Find the new amplitude of oscillation and find how much less time will it take to arrive at the next position of instantaneous rest as compared to the case if the impulse had not been applied.

Q.9 A block of mass 1kg hangs without vibrating at the end of a spring with a force constant 1N/cm attached to the ceiling of an elevator. The elevator is rising with an upward acceleration of g/4. The acceleration of the elevator suddenly ceases. What is the amplitude of the resulting oscillations.

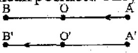
Q.10 A particle is oscillating in a straight line about a centre of force O, towards which when at a distance x the force is mn^2x where m is the mass, n a constant. The amplitude is a = 15 cm. When at a distance $a\sqrt{3}/2$ from O the particle receives a blow in the direction of motion which generates extra velocity na. If the velocity is away from O, find the new amplitude. What is the answer if the velocity of block was towards origin.

BANSAL CLASSES
Target IIT JEE 2007

PHYSICS
Daily Practice Problems

CLASS : XI (PQRS) *DATE : 28-29/12/2005* *MAX.TIME : 60 Min.* *DPP. NO.- 87*

Q.1 Two particles undergo SHM along parallel lines with the same time period (T) and equal amplitudes. At a particular instant, one particle is at its extreme position while the other is at its mean position. They move in the same direction. They will cross each other after a further time



(A) T/8 (B) 3T/8 (C) T/6 (D) 4T/3

Q.2 Equations $y = 2A\cos^2 \omega t$ and $y = A(\sin \omega t + \sqrt{3}\cos \omega t)$ represent the motion of two particles.
(A) Only one of these is S.H.M. (B) Ratio of maximum speeds is 2 : 1
(C) Ratio of maximum speeds is 1 : 1 (D) Ratio of maximum accelerations is 1 : 4

Q.3 A heavy brass sphere is hung from a light spring and is set in vertical small oscillation with a period T. The sphere is now immersed in a non-viscous liquid with a density 1/10th the density of the sphere. If the system is now set in vertical S.H.M., its period will be
(A) (9/10)T (B) $(9/10)^2$T (C) (10/9) T (D) T

Q.4 A cylindrical block of density ρ is partially immersed in a liquid of density 3ρ. The plane surface of the block remains parallel to the surface of the liquid. The height of the block is 60 cm. The block performs SHM when displaced from its mean position. [Use $g = 9.8\ m/s^2$]
(A) the maximum amplitude is 20 cm. (B) the maximum amplitude is 40 cm
(C) the time period will be $2\pi/7$ seconds. (D) none

Q.5 If the potential energy of a harmonic oscillator of mass 2 kg on its equilibrium position is 5 joules and the total energy is 9 joules when the amplitude is one meter the period of the oscillator (in sec) is:
(A) 1.5 (B) 3.14 (C) 6.28 (D) 4.67
[Hint : Total energy = $U(0) + 1/2\ kA^2$]

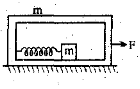
Q.6 Two particles of mass 3M/4 and M, are connected by a massless spring of free length L and force constant k. These masses are initially at rest L apart on a horizontal frictionless table. A particle of mass M/4 moving with speed v along the line joining the two connected masses, collides with and sticks to the particle of mass 3M/4. Find the amplitude and period with which the spring between the two masses vibration.

Q.7 Two equal particles are connected by an elastic string which is just taut on a smooth table, the string being such that the weight of either particle would produce in it an extension a. If one of the particles is projected with velocity u directly away from the other, calculate the distance each particle would have travelled when the string first return to its natural length.

Q.8 A particle is executing SHM on a straight line. A and B are two points at which its velocity is zero. It passes through a certain point P (AP<PB) at successive intervals of 0.5 and 1.5 sec with a speed of 3m/s. Determine the maximum speed and also the ratio AP/PB.

Q.9 A uniform rod AB of mass m and length $4l$ is free to rotate in a vertical plane about a smooth horizontal axis through a point P, distant x from the centre of the rod of the rod and performs small oscillations about its equilibrium position find period of oscillation and also find the value of x for which time period is minimum.

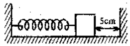
Q.10 A container of empty mass m is pulled by a constant force in which a second block of same mass m is placed connected to the wall by a mass less spring of constant k. Initially the spring is in its natural length. Calculate the velocity of the container at the instant the compression in the spring is maximum for the first time.



BANSAL CLASSES **PHYSICS**
Target IIT JEE 2007 **Daily Practice Problems**
CLASS : XI (PQRS) *DATE : 30-31/12/2005* *MAX.TIME : 60 Min.* *DPP. NO.- 88*

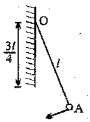
Q.1 A ball of mass m is attached to the lower end of a light vertical spring of force constant k. The upper end of the spring is fixed. The ball is released from rest with the spring at its normal length, and comes to rest again after descending through a distance x.
(A) $x = mg/k$
(B) $x = 2mg/k$
(C) The ball will have no acceleration at the position where it has descended through x/2
(D) The ball will have an upward acceleration equal to g at its lowermost position.

Q.2 A block of mass 100 gm attached to a spring of stiffness 100 N/m is lying on a frictionless floor as shown. The block is moved to compress the spring by 10 cm and released. If the collision with the wall is elastic the time period of motion is
(A) 0.2 sec (B) 0.1 sec
(C) 0.155 sec (D) 0.133 sec



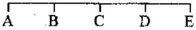
Q.3 A wire frame in the shape of an equilateral triangle is hinged at one vertex so that it can swing freely in a vertical plane, with the plane of the Δ always remaining vertical. The side of the frame is $1/\sqrt{3}$ m. The time period in seconds of small oscillations of the frame will be
(A) $\frac{\pi}{\sqrt{2}}$ (B) $\pi\sqrt{2}$ (C) $\frac{\pi}{\sqrt{6}}$ (D) $\frac{\pi}{\sqrt{5}}$

Q.4 A small bob attached to a light inextensible thread of length l has a periodic time T when allowed to vibrate as a simple pendulum. The thread is now suspended from a fixed end O of a vertical rigid rod of length $\frac{3l}{4}$ (as in figure). If now the pendulum performs periodic oscillations in this arrangement, the periodic time will be



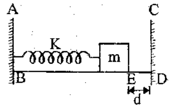
(A) $\frac{3T}{4}$ (B) $\frac{T}{2}$ (C) T (D) 2T

Q.5 A body performs simple harmonic oscillations along the straight line ABCDE with C as the midpoint of AE. Its kinetic energies at B and D are each one fourth of its maximum value. If AE = 2R, the distance between B and D is
(A) $\frac{\sqrt{3}R}{2}$ (B) $\frac{R}{\sqrt{2}}$ (C) $\sqrt{3}$ R (D) $\sqrt{2}$ R



Q.6 A particular S.H.M. has an amplitude of A & period T. The magnitude of its velocity and acceleration T/8 seconds after the particle reaches the extreme position would be ______ & ______ respectively.

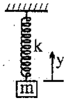
Q.7 A spring block system is kept on a horizontal smooth plane as shown AB & CD are two rigid elastic walls. Separation between the block and wall CD is d.
(i) What is the maximum velocity that can be imparted to the block, of mass m, towards the wall CD such that time period of the oscillations under the action of spring force, is $2\pi\sqrt{m/k}$ · sec where K is the spring constant of the ideal massless spring.
(ii) If the velocity imparted to the block is twice this maximum value find the time period of oscillations of the spring block system.



Q.8 Suppose the mass m is attached to a long uniform spring of length L and observed to oscillate at a frequency f_0. Now the spring is cut into two pieces of lengths xL and (1 – x)L. Mass m is divided into two pieces in this same ratio with $m_1 = xm$ and $m_2 = (1 - x)m$. The larger mass is attached to the shorter spring and the smaller mass to the larger spring. Find the frequency of oscillation for each of the two spring.

Q.9 A block of mass M=1kg resting on a smooth horizontal surface, is connected to a horizontal light spring of spring constant K=6N/m whose other end is fixed to a vertical wall. Another block of mass m = 0.5kg is mounted on the block M. If the coefficient of friction between the two blocks is μ=0.4, find the maximum kinetic energy that the system can have for simple harmonic oscillations under the action of the spring.

Q.10 A block of mass m is attached to a vertical springs as shown. The block is held such that initial elongation in spring is $\frac{3mg}{K}$. The block is released from this position. Find the displacement of the block from its initial position as a function of time & plot graph of block's v y w n ne s n fte ele se.



CLASS : XI (PQRS) *DATE : 02-03/01/2006* *MAX.TIME : 60 Min.* *DPP. NO.- 89*

Q.1 Two particles execute SHM of same amplitude of 20 cm with same period along the same line about the same equilibrium position. The maximum distance between the two is 20 cm. Their phase difference in radians is

(A) $\frac{2\pi}{3}$ (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

Q.2 A particle executes SHM with time period T and amplitude A. The maximum possible average velocity in time $\frac{T}{4}$ is

(A) $\frac{2A}{T}$ (B) $\frac{4A}{T}$ (C) $\frac{8A}{T}$ (D) $\frac{4\sqrt{2}A}{T}$

Q.3 Two particles P and Q describe simple harmonic motions of same period, same amplitude, along the same line about the same equilibrium position O. When P and Q are on opposite sides of O at the same distance from O they have the same speed of 1.2 m/s in the same direction, when their displacements are the same they have the same speed of 1.6 m/s in opposite directions. The maximum velocity in m/s of either particle is

(A) 2.8 (B) 2.5 (C) 2.4 (D) 2

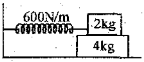
Q.4 Two particles A and B perform SHM along the same straight line with the same amplitude 'a', same frequency 'f' and same equilibrium position 'O'. The greatest distance between them is found to be 3a/2. At some instant of time they have the same displacement from mean position. What is the displacement?

(A) a/2 (B) $a\sqrt{7}/4$ (C) $\sqrt{3}\,a/2$ (D) $3a/4$

Q.5 A particle of mass *m* moves in a one-dimensional potential energy $U(x) = -ax^2 + bx^4$, where 'a' and 'b' are positive constants. The angular frequency of small oscillations about the minima of the potential energy is equal to

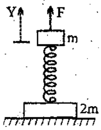
(A) $\pi\sqrt{\frac{a}{2b}}$ (B) $2\sqrt{\frac{a}{m}}$ (C) $\sqrt{\frac{2a}{m}}$ (D) $\sqrt{\frac{a}{2m}}$

Q.6 In the arrangement shown, the spring of force constant 600N/m is in the unstretched position. The coefficient of friction between the two blocks is 0.4 and that between the lower block & ground surface is zero. If both the blocks are displaced slightly and released, the system executes SHM.

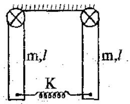


(a) Find time period of their oscillation if they do not slip w.r.t. each other.
(b) What is the maximum amplitude of the oscillation for which sliding between them does not occur.

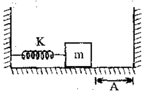
Q.7 A block of mass 'm' is interconnected to a block of mass '2m' by a massless linear spring of force constant 'k', as shown. The upper block is initially resting in equilibrium. A constant force 'F' starts acting on the upper block at a certain instant of time, t = 0. If F = mg, find 'y' as a function of time 't' where y = upward displacement of 'm' from its



Q.8 In the figure shown a light spring of spring constant 'k' is attached at the ends of two uniform identical rods of mass 'm' and length 'l' each. The rods can rotate about other ends. They are rotated by same and small angles in opposite direction in the plane of the figure and released. Neglecting the effect of gravity, find the frequency of oscillation of the rods.



Q.9 In the figure shown the spring is relaxed. The spring is compressed by 2 A and released. Mass m attached with the spring collides with the wall & loses two third of its kinetic energy & returns. Find the time after which the spring will have maximum compression first time after releasing.(Neglect Friction)

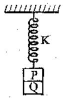


Q.10 Two blocks P and Q of masses 0.3 kg and 0.4 kg respectively are stuck to each other by some weak glue as shown in the figure. They hang together at the end of a spring with a spring constant $K = 200\ Nm^{-1}$. The block Q suddenly falls free due to failure of glue find

(i) period of SHM block P

(ii) Amplitude of its SHM

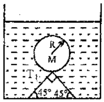
(iii) Total energy of oscillation of the system



Q.1 The pressure at the bottom of a tank of water is 3P where P is the atmospheric pressure. If the water is drawn out till the level of water is lowered by one fifth., the pressure at the bottom of the tank will now be
(A) 2P (B) (13/5) P (C) (8/5) P (D) (4/5)P

Q.2 A wooden ball of density ρ is immersed in water of density σ to depth h and then released. The height H above the surface of water up to which the ball will jump out of water is
(A) $\frac{\sigma h}{\rho}$ (B) $\left(\frac{\sigma}{\rho}-1\right)h$ (C) h (D) zero

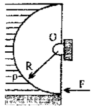
Q.3 A hollow sphere of mass M and radius r is immersed in a tank of water (density ρ_w). The sphere would float if it were set free. The sphere is tied to the bottom of the tank by two wires which makes angle 45° with the horizontal as shown in the figure. The tension T_1 in the wire is :



(A) $\frac{\frac{4}{3}\pi R^3\rho_w g - Mg}{\sqrt{2}}$ (B) $\frac{2}{3}\pi R^3\rho_w g - Mg$
(C) $\frac{\frac{4}{3}\pi R^3\rho_w g - Mg}{2}$ (D) $\frac{4}{3}\pi R^3\rho_w g + Mg$

Q.4 A metal ball of density 7800 kg/m^3 is suspected to have a large number of cavities. It weighs 9.8 kg when weighed directly on a balance and 1.5 kg less when immersed in water. The fraction by volume of the cavities in the metal ball is approximately :
(A) 20 % (B) 30 % (C) 16 % (D) 11 %

Q.5 [illegible]g[illegible]t sem[illegible] cy[illegible]n[illegible]r[illegible]ca[illegible] gate o[illegible] ra[illegible]us[illegible] s p[illegible]ovte[illegible] at [illegible]ts m[illegible] po[illegible]nt O, o[illegible]t[illegible] e [illegible]ameter as shown in the figure holding liquid of density ρ. The force F required to prevent the rotation of the gate is equal to



([illegible]) 2π[illegible]$^3\rho g$ (B) $2\rho g$[illegible]$^3 l$ (C) $\frac{2R^2 l\rho g}{3}$ ([illegible]D) [illegible]e[illegible]sc

Q.6 A cube of wood supporting 200 g mass just floats in water. When the mass is removed, the cube rises by 2 cm. What is the size of the cube?

Q.7 The time period of a simple pendulum is T. Now the bob is immersed in a liquid of density σ. If density of material of bob is ρ, what will be the new time period of the pendulum.

Q.8 An object hangs from a spring balance. The balance registers 30 N in air, 20 N when this object is immersed in water, and 24 N when the object is immersed in another liquid of unknown density. What is the density of that other liquid?

Q.9 A piece of ice floats in a vessel with water above which a layer of a lighter oil is poured. How will the level of the interface change after the whole of ice melts? What will be the change in the total level of liquid in the vessel?

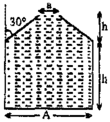
Q.10 Two bodies of the same volume but of different masses are in equlibrium on a lever. Will the equilibrium be violated if the lever is immersed in water so that the bodies are completely submerged?

CLASS : XI (PQRS) *DATE : 01-02/01/2006* *MAX.TIME : 60 Min.* *DPP. NO.- 100*

Q.1 A sphere of radius R and made of material of relative density σ has a concentric cavity of radius r. It just floats when placed in a tank full of water. The value of the ratio R/r will be

(A) $\left(\frac{\sigma}{\sigma-1}\right)^{1/3}$ (B) $\left(\frac{\sigma-1}{\sigma}\right)^{1/3}$ (C) $\left(\frac{\sigma+1}{\sigma}\right)^{1/3}$ (D) $\left(\frac{\sigma-1}{\sigma+1}\right)^{1/3}$

Q.2 The vessel shown in the figure has two sections. The lower part is a rectangular vessel with area of cross-section A and height h. The upper part is a conical vessel of height h with base area 'A' and top area 'a' and the walls of the vessel are inclined at an angle 30° with the vertical. A liquid of density ρ fills both the sections upto a height 2h. Neglecting atmospheric pressure.



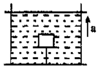
(A) The force F exerted by the liquid on the base of the vessel is $2h\rho g\,\frac{(A+a)}{2}$

(B) the pressure P at the base of the vessel is $2h\rho g\,\frac{A}{a}$

(C) the weight of the liquid W is greater than the force exerted by the liquid on the base

(D) the walls of the vessel exert a downward force (F–W) on the liquid.

Q.3 A body having volume V and density ρ is attached to the bottom of a container as shown. Density of the liquid is $d(>\rho)$. Container has a constant upward acceleration a. Tension in the string is



(A) $V[Dg-\rho(g+a)]$ (B) $V(g+a)(d-\rho)$ (C) $V(d-\rho)g$ (D) none

Q.4 A hollow cone floats with its axis vertical upto one-third of its height in a liquid of relative density 0.8 and with its vertex submerged. When another liquid of relative density ρ is filled in it upto one-third of its height, the cone floats upto half its vertical height. The height of the cone is 0.10 m and the radius of the circular base is 0.05 m. The specific gravity ρ is given by

(A) 1.0 (B) 1.5 (C) 2.1 (D) 1.9

Q.5 A beaker containing water is placed on the platform of a spring balance. The balance reads 1.5 kg. A stone of mass 0.5 kg and density 500 kg/m^3 is immersed in water without touching the walls of beaker. What will be the balance reading now?

(A) 2 kg (B) 2.5 kg (C) 1 kg (D) 3 kg

Q.6 A rod of length 6m has a mass 12 kg. It is hinged at one end at a distance of 3m below water surface.
(a) What weight must be attached to the other end of the rod so that 5m of the rod is submerged.
(b) Find the magnitude and direction of the force exerted by the hinge on the rod.
(specific gravity of the rod is 0.5)

Q.7 There are three immiscible liquids of densities ρ_1, ρ_2 and ρ_3. If the first two li~uids ~re t~ke~ in ~ U–tube then they stand like fig(i). When all the three liquids are taken in U–tube, they stand like fig(ii). Find the ratio of the densities of the three liquids.

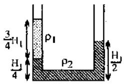


Fig.(i)

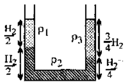


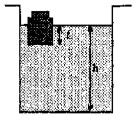
Fig.(ii)

Q.8 A cylindrical block of density ρ is partially immersed in a liquid of density 3ρ. The plane surface of the block remains parallel to the surface of the liquid. The height of the block is 60 cm. The block performs SHM when displaced from its mean position, find [Use $g = 9.8\ m/s^2$]

(a) the maximum amplitude

(b) the time period

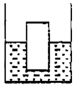
Q.9 A wooden block (having cross-sectional area A), with a coin (having volume V and density d) placed on its top floats in water as shown in figure. If the coin is lifted and then dropped into water, find



(a) change in the submerged length (l) of the block.

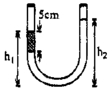
(b) change in the water level (h) in container. Cross sectional area of the container is A_1 & density of water is ρ.

Q.10 A liquid of density 2ρ is filled in a cylindrical vessel, whose cross-sectional area is 2A. A wooden cylinder of height H, cross-sectional area A and density ρ is floating in the liquid at equilibrium with its axis vertical. The cylinder is pushed down by a s...a.l ..ista...e x fr.....s eq..ili...... p..s...........s..., F...i..i..i...



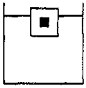
CLASS : XI (PQRS) *DATE : 03-04/01/2006* *MAX.TIME : 60 Min.* *DPP. NO.- 101*

Q.1 An open-ended U-tube of uniform cross-sectional area contains water (density 1.0 gram/centimeter^3) standing initially 20 centimeters from the bottom in each arm. An immiscible liquid of density 4.0 grams/ centimeter^3 is added to one arm until a layer 5 centimeters high forms, as shown in the figure above. What is the [illegible]?



(A) 3/1 (B) 5/2 (C) 2/1 (D) 3/2

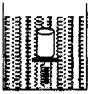
Q.2 There is a metal cube inside a block of ice which is floating on the surface of water. The ice melts completely and metal falls in the water. Water level in the container



(A) Rises (B) Falls
(C) Remains same (D) Nothing can be concluded

Q.3 A uniform solid cylinder of density 0.8 g/cm^3 floats in equilibrium in a combination of two non-mixing liquid A and B with its axis vertical. The densities of liquid A and B are 0.7 g/cm^3 and 1.2 gm/cm^3. The height of liquid A is h_A = 1.2 cm and the length of the part of cylinder immersed in liquid B is h_B = 0.8 cm. Then the length part of the cylinder in air is
(A) 0.21 cm (B) 0.25 cm (C) 0.35 cm (D) 0.4 cm

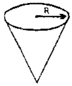
Q.4 A cylindrical block of area of cross–section A and of material of density ρ is placed in a liquid of density one–third of density of block. The block compresses a spring and compression in the spring is one–third of the length of the block. If acceleration due to gravity is g, the spring constant of the spring is:



(A) ρAg (B) $2\rho Ag$ (C) $2\rho Ag/3$ (D) $\rho Ag/3$

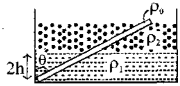
Q.5 A heavy hollow cone of radius R and height h is placed on a horizontal table surface, with its flat base on the table. The whole volume inside the cone is filled with water of density ρ. The circular rim of the cone's base has a watertight seal with the table's surface and the top apex of the cone has a small hole. Neglecting atmospheric pressure find the total upward force exerted by water on the cone is
(A) $(2/3)\pi R^2 h\rho g$ (B) $(1/3)\pi R^2 h\rho g$ (C) $\pi R^2 h\rho g$ (D) None

Q.6 An inverted hollow cone, of height H and radius at the top = R, is filled completely with a liquid of density d. Neglect atmosphere pressure.

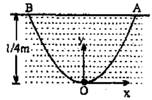


(a) Find horizontal component of the force which the liquid exerts on half curved side wall of the cone.
(b) Find the vertical downward component of the thrush force due to water pressure which the liquid exerts on half side curved wall of the cone.

Q.7 A uniform rod of length 2L and density ρ_0 is hinged at one end which is in liquid of density ρ_1, at a depth 2h below the surface. A liquid of smaller density ρ_2 is added on the top of the first liquid, if in the inclined position of equilibrium, the rod is just covered by the liquid. Then find [illegible] in[illegible]lin[illegible]i[illegible] (θ) [illegible]



Q.8 A parabolic smooth wire frame of equation $y = x^2$ is fixed inside water as shown. A small bead of specific gravity 0.5 is threaded on wire and is kept at the origin at rest. When it is pushed gently towards + ve x-axis, it moves on the wire frame.



(a) What is the velocity of the ball when it reaches the surface of the water?

(b) What are the coordinates of the ball when it hits water after leaving the surface at A? Neglect effects of viscosity.

Q.9 A liquid of density 2ρ is filled in a cylindrical vessel, whose cross-sectional area is 2A. A wooden cylinder of height H, cross-sectional area A and density ρ is floating in the liquid at equilibrium with its axis vertical. Find the minimum work which external agent has to do to pull the cylinder completely out of the liquid.

Q.10 A hollow cylinder of radius R open at the top contains some liquid spins about its vertical axis.

(a) Calculate the height of vessel so that the liquid just reaches the top of the vessel and begins to uncover the base at angular speed ω.

(b) If the speed is now increased to 2ω. What area of the base will be uncovered?

BANSAL CLASSES — **Target IIT JEE 2007**

PHYSICS — **Daily Practice Problems**

CLASS : XI (PQRS) *DATE : 06-07/02/2006* *MAX.TIME : 60 Min.* *DPP. NO.- 102*

Q.1 A water barrel stands on a table of height h. If a small hole is punched in the side of the barrel at its base, it is found that the resultant stream of water strikes the ground at a horizonatl distance R from the barrel. The depth of water in the barrel is

(A) $\frac{R}{2}$ (B) $\frac{R^2}{4h}$ (C) $\frac{R^2}{h}$ (D) $\frac{h}{2}$

Q.2 A cyclindrical vessel of cross-sectional area 1000 cm^2, is fitted with a frictionless piston of mass 10 kg, and filled with water completely. A small hole of cross-sectional area 10 mm^2 is opened at a point 50 cm deep from the lower surface of the piston. The velocity of efflux from the hole will be

(A) 10.5 m/s (B) 3.4 m/s (C) 0.8 m/s (D) 0.2 m/s

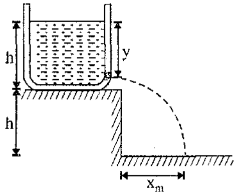
Q.3 A laminar stream is flowing vertically down from a tap of cross-section area 1 cm^2. At a distance 10 cm below the tap, the cross-section area of the stream has reduced to 1/2 cm^2. The volumetric flow rate of water from the tap must be about

(A) 2.2 litre/min (B) 4.9 litre/min (C) 0.5 litre/min (D) 7.6 litre/min

Q.4 A horizontal right angle pipe bend has crosssectional area = 10 cm^2 and water flows through it at speed = 20 m/s. The force on the pipe bend due to the turning of water is :

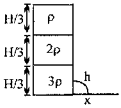
(A) 565.7 N (B) 400 N (C) 20 N (D) 282.8 N

Q.5 A tank is filled upto a height h with a liquid and is placed on a platform of height h from the ground. To get maximum range x_m a small hole is punched at a distance of y from the free surface of the liquid. Then



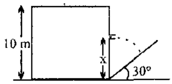
(A) $x_m = 2h$
(B) $x_m = 1.5\ h$
(C) $y = h$
(D) $y = 0.75\ h$

Q.6 A fixed container of large uniform cross sectional area A resting on a horizontal surface holds three immiscible, non-viscous and incompressible liquids of densities ρ, 2ρ and 3ρ each of height H/3 as shown. The liquid with lowest density is open to atmosphere (having pressure P_0). A tiny hole of area S (S << A) is punched on the vertical side of the container at a height h (h < H/3). Determine

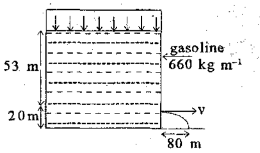


(i) the initial speed of efflux of the liquid through the hole
(ii) the horizontal distance x travelled by the liquid initially
(iii) the height h_m ($\le$ H/3) at which the hole should be punched so that the liquid travels the maximum distance X_m.

Q.7 A rectangular tank of height 10m filled with water, is placed near the bottom of an incline of angle 30°. At height x from bottom a small hole is made as shown figure such that the stream coming out from hole, strikes the inclined plane normally. Find x.



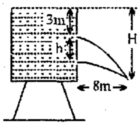
Q.8 A tank containing gasoline is sealed and the gasoline is under pressure P_0 as shown in figure. The stored gasoline has a density of 660 kg m^{-3}. A sniper fires a rifle bullet into the gasoline tank, making a small hole 53 m below the surface of the gasoline. The total height of gasoline is 73 m from the base. The jet of gasoline shooting out of the hole strikes the ground at a distance of 80m from the tank initially. Find the pressure P_0 above the gasoline surface. The local atmospheric pressure is $10^5 Nm^{-2}$.



Q.9 Two identical orifices are made on one side of an open tank along same vertical line. The height of water above the upper orifice is 3 m. If the jets of water from the two orifices intersect at a horizontal distance 8 m from the tank.

(a) Estimate the vertical distance between the two orifices.

(b) Also calculate the vertical distance of the point of intersection of the jets from the water level in the tank.

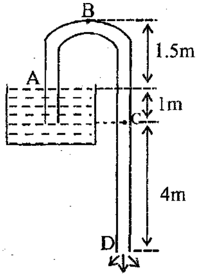


Q.10 A siphon tube is discharging a liquid of specific gravity 0.9 from a reservoir as shown in fig. find

(a) find the velocity of the liquid coming out of siphon at D

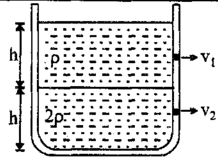
(b) find the pressure at the highest point B

(c) find the pressure at point C, here g = 10 m/s^2.



CLASS : XI (PQRS) *DATE : 08-09/02/2006* *MAX.TIME : 60 Min.* *DPP. NO.- 103*

Q.1 Equal volumes of two immiscible liquids of densities ρ and 2ρ are filled in a vessel as shown in figure. Two small holes are punched at depth $h/2$ and $3h/2$ from the surface of lighter liquid. If v_1 and v_2 are the velocities of a flux at these two holes, then v_1/v_2 is :

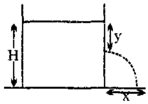


(A) $\frac{1}{2\sqrt{2}}$ (B) $\frac{1}{2}$ (C) $\frac{1}{4}$ (D) $\frac{1}{\sqrt{2}}$

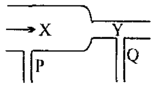
Q.2 A horizontal pipe line carries water in a streamline flow. At a point along the tube where the cross-sectional area is 10^{-2} m^2, the water velocity is 2 ms^{-1} and the pressure is 8000 Pa. The pressure of water at another point where the cross-sectional area is 0.5×10^{-2} m^2 is :
(A) 4000 Pa (B) 1000 Pa (C) 2000 Pa (D) 3000 Pa

Q.3 Water coming out of a horizontal tube at a speed v strikes normally a vertically wall close to the mouth of the tube and falls down vertically after impact. When the speed of water is increased to 2v.
(A) the thrust exerted by the water on the wall will be doubled
(B) the thrust exerted by the water on the wall will be four times
(C) the energy lost per second by water strikeup the wall will also be four times
(D) the energy lost per second by water striking the wall be increased eight times.

Q.4 A cylindrical vessel is filled with a liquid up to height H. A small hole is made in the vessel at a distance y below the liquid surface as shown in figure. The liquid emerging from the hole strike the ground at distance x
(A) if y is increased from zero to H, x will decrease and then increase
(B) x is maximum for $y = \frac{H}{2}$
(C) the maximum value of x is $\frac{H}{2}$
(D) the maximum value of x increases with the increases in density of the liquid



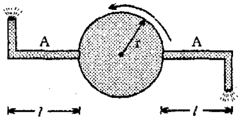
Q.5 A steady flow of water passes along a horizontal tube from a wide section X to the narrower section Y, see figure. Manometers are placed at P and Q at the sections. Which of the statements A, B, C, D, E is most correct?
(A) water velocity at X is greater than at Y
(B) the manometer at P shows lower pressure than at Q
(C) kinetic energy per m^3 of water at X = kinetic energy per m^3 at Y
(D) the manometer at P shows greater pressure than at Y



Q.6 A cylindrical vessel open at the top is 20 cm high and 10 cm in diameter. A circular hole whose cross-sectional area 1 cm^2 is cut at the centre of the bottom of the vessel. Water flows from a tube above it into the vessel at the rate 100 cm^3 s^{-1}. Find the height of water in the vessel under steady state. (Take g = 1000 cm s^{-2})

Q.7 A cylindrical vessel filled with water upto height of H stands on a horizontal plane. The side wall of the vessel has a plugged circular hole touching the bottom. The coefficient of friction between the bottom of vessel and plane is μ and total mass of water plus vessel is M. What should be minimum diameter of hole so that the vessel begins to move on the floor if plug is removed (here density of water is ρ)?

Q.8 Shows the top view of a cylindrical can mounted on a turntable. The can is filled with water. At a depth h below the water surface are two horizontal tubes of length l and cross-sectional area a, with right-angle bends at their ends. Show that, as the water jets emerge from the tubes, there is a torque τ exerted on the system given by the expression $t = 4\rho gh(r + l)a$, where ρ is the density of the water.

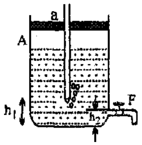


Q.9 A vessel A filled with water communicates with the atmosphere through a narrow glass tube A passing through the throat of the vessel as in the given figure. A hole F is $h_2 = 2$cm from the bottom of the vessel.

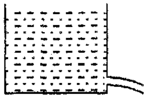
(a) Find the velocity with which the water flows out of the hole F if the distance between the end of the tube and the bottom of the vessel is $h_1 = 10$cm

b) Also find the time in which the water level in vessel falls by 5 cm.

Given area of cross section of vessel is 1000 times the area of hole.



Q.10 In a cylindrical vessel of base area 0.01 m^2, a hole is made on side walls and water is found to emerge with a velocity of 10 m/s. Find the velocity of water coming out if a block of wood of mass 1 kg is gently floated on same water surface. Assume that the hole is of negligible cross section area and the total volume of water is same in both the cases.

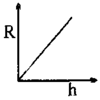


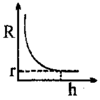
BANSAL CLASSES — PHYSICS

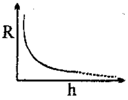
Target IIT JEE 2007 — **Daily Practice Problems**

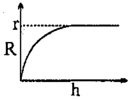
CLASS : XI (PQRS) *DATE : 10-11/02/2006* *MAX.TIME : 60 Min.* *DPP. NO.- 104*

Q.1 A long capillary tyube of radius 'r' is initially just vertically completely imerged inside a liquid of angle of contact 0^0. If the tube is slowly raised then relation between radius of curvature of of miniscus inside the capillary tube and displacement (h) of tube can be represented by

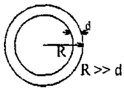
(A)


(B)


(C)


(D)


Q.2 A soap bubble has radius R and thickness d (<<R) as shown. It colapses into a spherical drop. The ratio of excess pressure in the drop to the excess pressure inside the bubble is



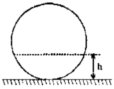
(A) $\left(\frac{R}{3d}\right)^{\frac{1}{3}}$ (B) $\left(\frac{R}{6d}\right)^{\frac{1}{3}}$ (C) $\left(\frac{R}{24d}\right)^{\frac{1}{3}}$ (D) None

Q.3 When an air bubble rises from the bottom of a deep lake to a point just below the water surface, the pressure of air inside the bubble

(A) is greater than the pressure outside it (B) is less than the pressure outside it

(C) increases as the bubble moves up (D) decreases as the bubble moves up

Q.4 A liquid is filled in a spherical container of radius R till a height h. At this positions the liquid surface at the edges is also horizontal. The contact angle is

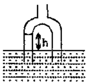


(A) 0 (B) $\cos^{-1}\left(\frac{R-h}{R}\right)$

(C) $\cos^{-1}\left(\frac{h-R}{R}\right)$ (D) $\sin^{-1}\left(\frac{R-h}{R}\right)$

Q.5 A cylinder with movable piston contains in it air under pressure P_1 and a soap bubble of radius r. Surface tension is T and temperature is maintained constant. Determine the pressure P_2 to which the air should be compressed by moving piston into cylinder for the soap bubble to reduce its radius to r/2.

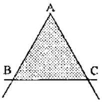
Q.6 The figure shows an inverted U like tube with straight limbs of unequal radii $r_1 = 0.25$mm and $r_2 = 0.50$ mm. Both the open ends of the tube are immersed below the free surface of water. The air is pumped into the upper part of the tube at such pressure so that the water in the wider tube is at level with the water outside. Find the height h of water in the other limbs. Take angle of contact as zero and surface tension of water $= 7 \times 10^{-2}$ N/m.



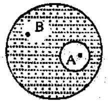
Q.7 A soap film is formed on a vertical equilateral triangular frame ABC. Side BC can move vertically always remaining horizontal. If m is the mass of rod BC, and T is surface tension of soap film find

(a) the length of BC in equilibrium.

(b) the time period of small oscillations about the equilibrium position.

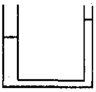


Q.8 There is an air bubble of radius R inside a drop of water of radius 3R. Find the ratio of gauge pressure at point A to the gauge pressure at point B.



Q.9 A long vertical capillary of radius R is dipped in a liquid having surface tension T. Find the gauge pressure at the mid point of the liquid column in the capillary. Take angle of contact θ.

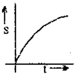
Q.10 A U tube has 2 tubes of radius 1 mm and 1.5 mm what will be the difference in water level in two limbs?
Given : Contact angle q = $0°$, surface tension = 7.5×10^{-2} N/m.

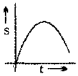


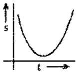
Q.1 There is a 1mm thick layer of glycerine between a flat plate of area 100 cm^2 & a big fixed plate. If the coefficient of viscosity of glycerine is 1.0 kg/m-s then how much force is required to move the plate with a velocity of 7 cm/s?
(A) 3.5 N (B) 0.7 N (C) 1.4 N (D) None

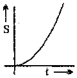
Q.2 A sphere of mass m is released from rest in a stationary viscous medium. In addition to the gravitational force of magnitude mg, the sphere experiences a retarding force of magnitude bv, where v is the speed of the sphere and b is a constant. Assume that the buoyant force is negligible. Which of the following statements about the sphere is correct?
(A) Its kinetic energy decreases due to the retarding force.
(B) Its kinetic energy increases to a maximum, then decreases to zero due to the retarding force.
(C) Its speed increases to a maximum, then decreases back to a final terminal speed.
(D) Its speed increases monotonically, approaching a terminal speed that depends on b but not on m.
(E) Its speed increases monotonically, approaching a terminal speed that depends on both b and m.

Q.3 The displacement of a ball falling from rest in a viscous medium is platted against time. Choose a possible option

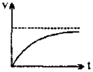
(A) 

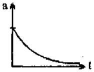
(B) 

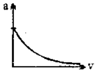
(C) 

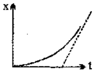
(D) 

Q.4 Which of the following is the ***incorrect*** graph for a sphere falling in a viscous liquid? (Given at t = 0, velocity v = 0 and displacement x = 0.)

(A) 

(B) 

(C) 

(D) 

Q.5 A ball of mass m and radius r is gently released in a viscous liquid. The mass of the liquid displaced by it is m' such that m > m'. The terminal velocity is proportional to
(A) $\frac{m-m'}{r}$ (B) $\frac{m+m'}{r}$ (C) $\frac{(m+m')}{r^2}$ (D) $(m-m')\,r^2$

Q.6 A thin plate is placed between two flat surfaces h cm apart such that the viscosity of liquids on the top and bottom of the plate are μ_1 and μ_2 respectively. Determine the position of the thin plate such that the viscous resistance to uniform motion of the thin plate is minimum. [Assume h to be very small].

Q.7 The space between two coaxial disks each of 20 cm diameter is filled with oil of 0.01 cm thickness. If the coefficient of viscosity of the oil is 0.08 N-s/m^2. Calculate the torque required to rotate one disk relative to the other at 10 rev/sec.

Q.8 Two equal drops of water fall through air with a steday velocity of 10 cm/s. If the drops coalesce. What will be the new terminal velocity.

Q.9 A sphere of having radius r and density ρ is projected vertically downwards into a liquid of density 2ρ and viscosity η with a velocity v_0. Find the time when the sphere is at its lowest position in terms of v_0 and g. (Given $v_0 = \dfrac{2\rho r^2 g}{9\eta}$).

Q.10 Two balls of same material of density ρ but radius r_1 and r_2 are joined by a light inextensible vertical thread and released from a large height in a medium of coefficient of viscosity $= \eta$. Find the terminal velocity acquired by the balls. Also find the tension in the string connecting both the balls when both of them are moving with terminal velocity. Neglect buoyancy and change in acceleration due to gravity.