Physics answer key Model - 2020

1 to 5 3 x 1 = 3 M

1 Nuclear force 1
2 Linear momentum 1
3 Energy 1
4 Principle of conservation of energy 1
5 $C_P - C_v = R$ 1

6 to 15 8 x 2 = 16 M

6 (a) $\frac{\Delta Z}{Z} = 4\frac{\Delta A}{A} + \frac{1}{3}\frac{\Delta B}{B} + \frac{\Delta C}{C} + \frac{3}{2}\frac{\Delta D}{D}$ 1
(b) (1)-2 (2)- 5 1

7 Distance= area = 1/2 x 10 x 12 = 60 m 2

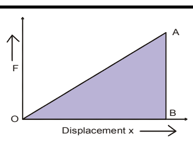
8 (a) The static friction f_s is directly proportional to normal reaction N. $f_s = \mu_s N$ 1
(b) Reason for friction is molecular interaction between the two surfaces in relative motion. When body rolls, the molecules in contact between the two surfaces is very less. 1

9 (a) Freezing, or solidification 1
(b) The quantity of heat absorbed or released by a substance undergoing a change of state, at constant temperature and pressure. Q = Lm 1

10 (a) (ii) $\sqrt{\frac{3RT}{M}}$ 1
(b) $\sqrt{\frac{3RT}{M}} = \sqrt{\frac{3x8.31x373}{32x10^{-3}}} = 5.39x10^2$ m/s 1

11 (a) When no external torque acts on the body, the net angular momentum of a rotating rigid body remains constant. 1
(b) v decreases, L decreases L = r p = mvr 1

12 (a) 1



(b) Area = work done = Potential energy 1

13 (a) First law of thermodynamics states that the energy supplied to the system goes in partly to increase the internal energy of the system and the rest in work on the environment. $\Delta Q = \Delta U + \Delta W$ 1
(b) $\Delta U = \Delta Q - \Delta W = 100 - 75 = 25$ J/s 1

14 (a) 1

$$\frac{1}{2}m\omega^2x^2 = \frac{1}{2}m\omega^2(A^2 - x^2)$$
$$2x^2 = A^2$$
$$x = \frac{A}{\sqrt{2}}$$

(b) $V = \omega\sqrt{A^2 - x^2} = \frac{V_{max}}{2}$ $V_{max} = \omega A$ 1

$$\omega\sqrt{A^2 - x^2} = \frac{\omega A}{2}$$
$$x^2 = \frac{3}{4}A^2$$
$$x = \pm\frac{\sqrt{3}}{2}A$$

15 (a) Isothermal expansion, Adiabatic expansion, Isothermal compression, Adiabatic compression 1
(b) $\eta = 1 - \frac{T_2}{T_1}$ If efficiency $\eta = 1$ then $T_2 = 0$ or $T_1 = \infty$. Both of them are not possible 1

16 to 23 5 x 3 = 15 M

16 (a) True, eg: Plane angle-radian, Solid angle-steradian 1
(b) $[v^2] = [M^0L^2T^0]$ 2

$[v_0^2] = [M^0L^2T^0]$

$[2ax] = [M^0LT^{-2}L] = [M^0L^2T^0]$

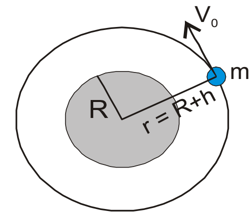
This equation is dimensionally correct.

17 (a) Elastomers 1
(b) $\beta = 1/K = 0.5x10^{-9}$ m²/N 1
(c) Steel is more elastic than rubber 1
Under same stress, steel suffer less strain compared to rubber therefore elasticity is more for steel. Since elasticity is ratio of stress and strain

18 (a) For the orbiting satellite, gravitational force provides the centripetal force, 2

$$\frac{mV_o^2}{h+R} = \frac{GMm}{(h+R)^2}$$

$$V_o = \sqrt{\frac{GM}{h+R}} = \sqrt{\frac{gR^2}{h+R}}$$



(b) V_o, Orbital velocity independent of mass of satellite. 1

19 (a) AB sinθ = AB cosθ 1

θ = 45°

(b) $F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$ 2

$= \sqrt{5^2 + 7^2 + 2x5x7\cos 60} = 10.44$ N

20 (a) True, motion of planet around the sun is periodic but not SHM. Oscillations of a mass suspended from a spring is SHM and is also periodic. 1
(b) A pendulum has time period, T = 2 sec. 1
(c) $T = 2\pi\sqrt{\frac{L}{g}} = 2$ sec 1

$T' = 2\pi\sqrt{\frac{L/2}{g}} = T/\sqrt{2} = 2/\sqrt{2} = \sqrt{2} = 1.4$ sec

21 (a) Yes, a body thrown vertically upwards has zero velocity and a = g = 9.8m/s² at its highest point. 1
(b) (i) Distance = 2πR = 2x3.14x2000 = 12560 m 1

Displacement = 0

Av speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{12560}{5 \text{ x } 60} = 41.87$ m/s

(ii) Distance = πR = 3.14x2000 = 6280 m 1

Displacement = 2R = 4000m

Av speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{6280}{2.5 \text{ x } 60} = 41.87$ m/s

22 (a) In a closed fluid at rest, the pressure applied at any part is equally transmitted in all directions and in the same amount. 1
(b) $P_2 = P_1 + h\rho g = P_a + h\rho g$ 2

$= 1.013 \text{ x } 10^5 + 10 \text{ x } 10^3 \text{ x } 9.8$

$= 1.993 \text{ x } 10^5$ N/m²

23 (a) 2

$v_y = u_y + a_y t$

$0 = u\sin\theta - gt$

$t = \frac{u\sin\theta}{g}$

∴ Time of flight, $T = 2t = \frac{2u\sin\theta}{g}$

(b) $K.E = \frac{1}{2}mv_x^2 = \frac{1}{2}m(u\cos\theta)^2 = \frac{1}{2}mu^2\cos^2\theta$ 1

24 to 27 4 x 4 = 16 M

24 (a) (i) 2 1
(ii) 4 1
(b) dW = F dx = P a dx = P dV 2

$$\int_0^W dW = \int_{V_1}^{V_2} P\, dV$$

$$(dW) = \int_{V_1}^{V_2} \frac{RT}{V} dV \qquad P = \frac{RT}{V}$$

$$\Rightarrow W - 0 = W = RT\int_{V_1}^{V_2}\frac{dV}{V} = RT(\log_e V)_{V_1}^{V_2}$$

$$= RT(\log_e V_2 - \log_e V_1)$$

$$= RT\log_e\frac{V_2}{V_1}$$

$$W = 2.3026\, RT\log_{10}\frac{V_2}{V_1}$$

25 (a) No, $g_e = \frac{GM}{R_e^2}$ and $g_p = \frac{GM}{R_p^2}$ — 1

$\frac{g_e}{g_p} = \frac{R_p^2}{R_e^2}$ Since $R_e > R_p$, it follows that $g_e < g_p$

$\therefore W_e < W_p$

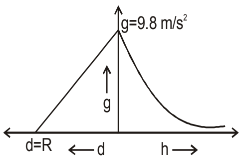
(b) $g_h = g_d$ — 2

$g(1 - \frac{2h}{R}) = g(1 - \frac{d}{R})$

$d = 2h$

$h = d/2 = 80/2 = 40\text{km}$

(c) — 1



26 (a) The work done by a force is equal to change in the kinetic energy of the body. — 1

(b) At point A : — 2

Total energy = K.E + P.E

$= 0 + mgh = mgh$

At point B :

$K.E = \frac{1}{2}mv^2 = \frac{1}{2}m(2gx) = mgx$

$P.E = mg(h - x)$

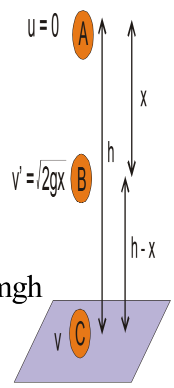
Total energy = $mgx + mg(h-x) = mgh$

At point C :

$K.E = \frac{1}{2}mv^2 = \frac{1}{2}m(2gh) = mgh$

$P.E = mg(0) = 0$

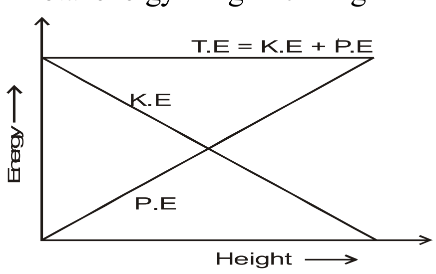
Total energy = $mgh + 0 = mgh$



$v^2 - 0^2 = 2gh$

$v^2 = 2gh$

(c) — 1



27 (a) Mass of the body, Position and orientation of the body, Size and shape of the body, Distribution of the mass of the body about the axis of rotation. — 1

(b) Theorem of perpendicular axis :-The moment of inertia of a plane lamina about any axis perpendicular to its plane is equal to the sum of the moment of inertia of the lamina about any two mutually perpendicular axis in its own plane intersecting each other at the point through which the perpendicular axis passes. $I_z = I_x + I_y$ — 1

(c) $I_{ring} = MR^2$ $\quad I_{disc} = \frac{MR^2}{4}$ $\quad I_{ring} > I_{disc}$ — 2

28 to 30 2 x 5 = 10 M

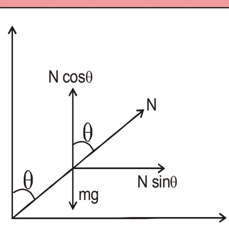
28 (a) Static friction — 1

(b) $\frac{mv^2}{R} = N\sin\theta$ — 2

$mg = N\cos\theta$

$\frac{v^2}{Rg} = \tan\theta$

$v = \sqrt{Rg\tan\theta}$



(c) $v_{max} = \sqrt{\mu_s R_{max} g} = \sqrt{0.1 \times 3 \times 9.8} = 1.715\text{ m/s}$ — 2

$v > v_{max}$, He will slip $\quad v = 5\text{ m/s}$

29 (a) mode 2 and mode 3 — 1

(b) mode 2 — 2

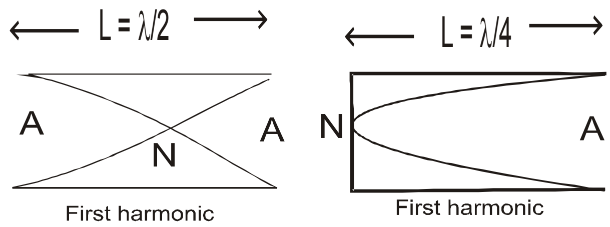
$\upsilon_2 = \frac{v}{\lambda_2} = \frac{3v}{4L} = 3\upsilon_1$

mode 3

$\upsilon_3 = \frac{v}{\lambda_2} = \frac{5v}{4L} = 5\upsilon_1$

$\upsilon_2 : \upsilon_3 = 3 : 5$

(c) — 2



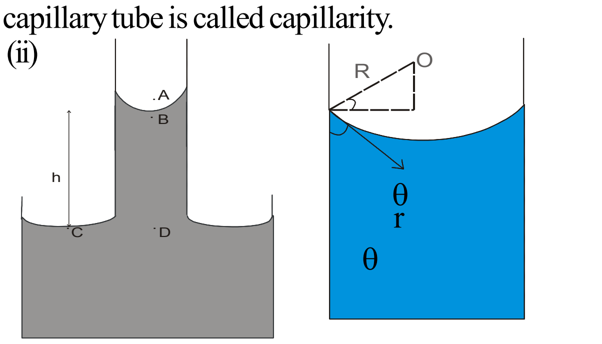
$\upsilon_{open} = \frac{v}{\lambda_1} = \frac{v}{2L}$ $\qquad \upsilon_{closed} = \frac{v}{\lambda_1} = \frac{v}{4L}$

$\frac{\upsilon_{open}}{\upsilon_{closed}} = 2$

$\upsilon_{open} = 2\,\upsilon_{closed}$

30 (a) (i)The phenomenon of rise or fall of liquid in a capillary tube is called capillarity. — 1

(ii) — 3



$P_B = P - \frac{2T}{R}$ ---- ---(1)

R is the radius of the meniscus

$P_B = P_D - h\rho g$ $\qquad P_C = P_D = P$

$= P - h\rho g$ -------- (2)

From eqn (1) and (2) we get

$P - \frac{2T}{R} = P - h\rho g$

$h = \frac{2T}{\rho g R}$

But from the figure, we have

$\cos\theta = \frac{r}{R}$

$R = \frac{r}{\cos\theta} \qquad \therefore \quad h = \frac{2T\cos\theta}{\rho g r}$

(b) Surface tension of soap solution is less than normal water. $h \propto T$ — 1

$h_{soap\ solution} < h_{water}$

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