FY 224
Date of Exam : 04.10.2021

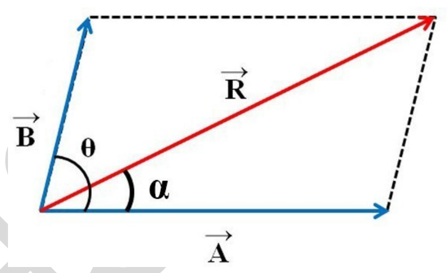
FIRST YEAR HIGHER SECONDARY EXAMINATION, SEPTEMBER 2021

Part – III

PHYSICS

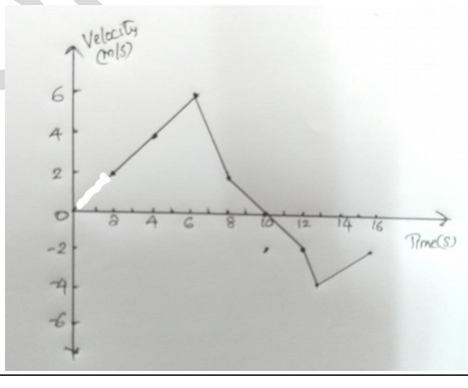
Maximum : 60 Scores

ANSWER KEY

Qn No	Qn Sub No	Split Scores	Total Score
1		i) Gravitational force	1
2		Astrophysics or Astronomy	1
3		Vector	1
4		Moment of inertia	1
5		PV = nRT or PV = μRT	1
6		Plane angle is the ratio of length of an arc to radius or Plane angle = $\frac{arc\ length}{radius}$	2
7		Velocity = 0 Acceleration = -g = $-9.8 m/s^2$	2
8			2
9		Two vectors are equal if they have same magnitude and same direction	2
10	a b	Negative 1 Zero 1	2
11		Unit : joule or J or Nm 1 Dimensional formula : ML^2T^{-2} 1	2
12		Every body in this universe attract every other body with a force which is directly proportional to product of their masses and inversly proportional to square of the	2

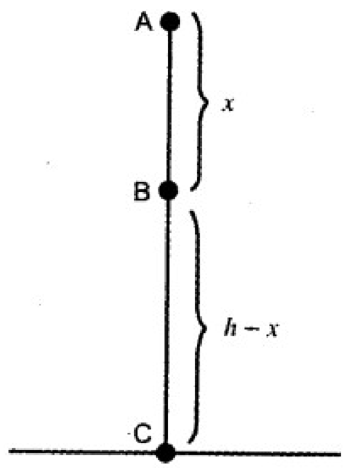
<table>
<tr><td></td><td></td><td>distance between them

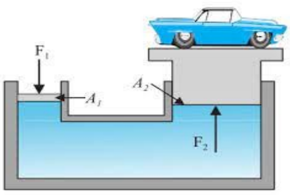
OR

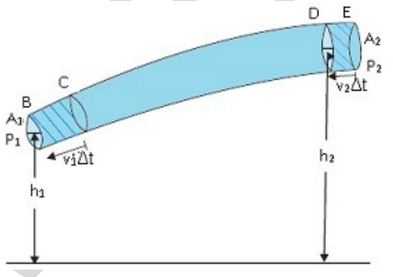
$F = \frac{Gm_1m_2}{r^2}$</td><td></td></tr>
<tr><td>13</td><td></td><td>Within elastic limit stress on a body is directly proportional to strain
Stress α Strain
OR
$\frac{stress}{strain}$ = a constatnt</td><td>2</td></tr>
<tr><td>14</td><td></td><td>A : Proportinal limit 1
B : Yield point or Elastic limit 1</td><td>2</td></tr>
<tr><td>15</td><td></td><td>Heat given to a system is the sum of increase in internal energy and work done
$\Delta Q = \Delta U + W$</td><td>2</td></tr>
<tr><td>16</td><td></td><td>Isobaric process is a process taking place at consstant pressure.
Or $W = P\Delta V$ 1
Isochoric process is a process taking place at constant Volume
or $W = 0$ 1</td><td>2</td></tr>
<tr><td>17</td><td></td><td><table>
<tr><th>Name of Base quantity</th><th>Name of SI unit</th></tr>
<tr><td>Length</td><td>metre</td></tr>
<tr><td>Mass</td><td>kilogram</td></tr>
<tr><td>Time</td><td>second</td></tr>
<tr><td>Electric Current</td><td>ampere</td></tr>
<tr><td>Thermodynamic Temperature</td><td>kelvin</td></tr>
<tr><td>Amount of substance</td><td>mole</td></tr>
<tr><td>Luminous Intensity</td><td>candela</td></tr>
</table></td><td>3</td></tr>
<tr><td>18</td><td></td><td>
</td><td>3</td></tr>
<tr><td>19</td><td></td><td>Rate of change of momentum of a body is directly proportional to applied force and takesplace in the direction of force. 1

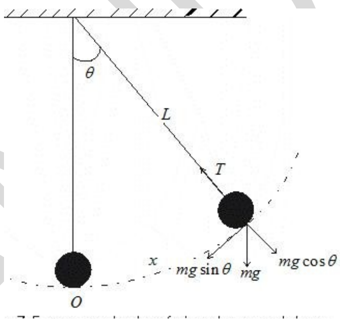
$F = \frac{\Delta P}{\Delta t}$ or $F = ma$ 2</td><td>3</td></tr>
</table>

20		Maximum static friction is independant of area of contact Maximum static friction f_{ms} α N, normal reaction or $f_{ms} = \mu_s N$ or $f_s \leqslant \mu_s N$	3
21	a b	It is the angular displacement in unit time or Angle covered by radius ector in unit time or $\omega = \frac{\Delta\Theta}{\Delta t}$ 1 v = rω or $\vec{V} = \vec{\omega} X \vec{r}$ 2	3
22		1. Mass 2. distributon of mass around the axis of rotation/ distance of mass from axis of rotation / Size and shape of body / Orientation of the body about axis	3
23		On the surface g = $\frac{GM}{R^2}$ At the height h, g' = $\frac{GM}{(R+h)^2}$ $\frac{g'}{g} = \frac{R^2}{(R+h)^2} = \left(1+\frac{h}{R}\right)^{-2} =$ g' = g (1-2 $\frac{h}{R}$)	3
24		P = $\frac{1}{3}$ nm $\bar{v}^2$ 1 score = $\frac{1}{3}$ $\frac{N}{V}$ m $\bar{v}^2$ PV = $\frac{1}{3}$ Nm $\bar{v}^2$ Nk_BT = $\frac{1}{3}$ Nm $\bar{v}^2$, $\frac{1}{2}$ m $\bar{v}^2$ = $\frac{3}{2}$ k_BT , $\overline{KE}$ = $\sqrt{\frac{3}{2} k_B T}$ 2 score	3
25		Consider vertical motion upto maximum height $v^2 = u^2 + 2as$ $0 = (usin\Theta)^2 + 2 X - g X H$ 1 $0 = u^2 \sin^2\Theta - 2gH$ $H = \frac{u^2 \sin^2\Theta}{2g}$ 1 Consider horizontal uniform motion R = ucosθ X T 1 = ucosθ X $\frac{2usin\Theta}{g}$ = $\frac{2u^2 sin\Theta cos\Theta}{g}$ = $\frac{u^2 \sin 2\Theta}{g}$ 1	4

26		$T = \frac{25}{14} = 1.785\,s$ 1 $\omega = \frac{25}{T} = \frac{6.28}{1.785} = 3.52$ rad/s 1 $a = r\omega^2$ 1 $= 0.8 \text{ X } 3.52^2 = 9.91 m/s^2$ 1	4
27		Elastic collision : both momentum and KE are conserved Inelastic collision : Momentum is conserve but KE is not conserved 1  $m_1u_1 + 0 = (m_1 + m_2)\, v$ $v = \frac{m_1 u_1}{m_1+m_2}$ 1 loss of KE = $\frac{1}{2} m_1 u_1^2 - \frac{1}{2}(m_1+m_2)v^2 = \frac{1}{2} m_1 u_1^2 - \frac{1}{2}(m_1+m_2)\left(\frac{m_1 u_1}{m_1+m_2}\right)^2$ $= \frac{1}{2}\frac{m_1 m_2 u_1^2}{m_1+m_2}$ **2**	4
28		Principle of conservation of energy states that energy can neither be created nor be distroyed At point A K.E=0 P.E=mgh Total Energy=mgh At point B,  K.E = $\frac{1}{2}$ mv^2 $2gx=V^2-O^2$ $V^2=2gx$ K.E= $\frac{1}{2}$ mv^2 = $\frac{1}{2}$ mX 2gx = mgx P.E=m.g.(h−x) Total Energy = K.E+P.E = mgx+mg(h−x)= mgh At point C,	4

		P.E=0 $2gh=v^2-0^2 = v^2$ K.E= $\frac{1}{2}$ $m.v^2$ = mX 2gh = mgh Total Energy = K.E+P.E = mgh+0= mgh Thus, in all the points the energy is same.	
29		P = 100W Energy = P X t = 100 X 10 = 1000 Wh = 1kWh or P = 1000 X 3600 =3600000Ws = 3.6×10^6 J	4
30		On the surface PE = $\frac{-GMm}{R}$ 1 KE = $\frac{1}{2} mv_e^2$ Total Energy = PE + KE = $\frac{-GMm}{R} + \frac{1}{2} mv_e^2$ 1 At infinity Toal Energy = 0 By Conservation of Energy Total Energy at surface = Total Energy at infinity $\frac{-GMm}{R} + \frac{1}{2} mv_e^2 = 0$ 1 $\frac{1}{2} mv_e^2 = \frac{GMm}{R}$ Ve = $\sqrt{\frac{2GM}{R}}$ or Ve = $\sqrt{2gR}$ 1	4
31		According to Pascal's law for the transmission of fluids, whenever external pressure is applied on any part of a fluid contained in a vessel, it is transmitted undiminished and equally in all directions.  In a hydraulic lift, two pistons are separated by the space filled with a liquid. A piston of small cross-section A_1 is used to exert a force F_1 directly on the liquid. The pressure P =F/A is transmitted throughout the liquid to the larger cylinder attached to a larger piston	4

		of area A_2, which results in an upward force F_2 Therefore, the piston is capable of supporting a large force $\frac{F_1}{A_1}=\frac{F_2}{A_2}$ $F_2=\frac{F_1 X A_2}{A_1}$ Thus, the applied force has been increased by a factor of A_2/A_1	
32		Bernoulli's Theorem: According to Bernoulli's theorem, the sum of the energies possessed by a flowing ideal liquid at a point is constant provided that the liquid is incompressible and non-viscous and flow in streamline. Consider the flow of liquid. Let at any time, the liquid lies between two areas of flowing liquid A_1 and A_2. In time interval Δt, the liquid displaces from A_1 by $\Delta x_1=v_1\Delta t$ and displaces from A_2 by $\Delta x_2=v_2\Delta t$. Here v_1 and v_2 are the velocities of the liquid at A_1 and A_2.  The work done on the liquid is $P_1A_1\Delta x_1$ by the force and $P_2A_2\Delta x_2$ against the force respectively. Net work done, $W=P_1A_1\Delta x_1-P_2A_2\Delta x_2$ $=(P_1-P_2)\Delta V$ ....(1) Here, $\Delta V\rightarrow$ the volume of liquid that flows through a cross-section is same (from equation of continuity). But, the work done is equal to net change in energy (K.E. + P.E.) of the liquid, and $\Delta K= \frac{1}{2}\rho\Delta V(v_1^2-v_2^2)$........ and $\Delta U=\rho\Delta V(h_2-h_1)$ .... $\therefore(P_1-P_2)\Delta V= \rho\Delta V(v_1^2-v_2^2)+\rho g\Delta V(h_2-h_1)$ $P_1+\frac{1}{2}v_1^2+\rho gh_1=P_2+\frac{1}{2}v_2^2+\rho gh_2$ or $P+\frac{1}{2}\rho v^2+\rho gh=constant$	4

33	a) b)	Latent heat of fusion is the amount of heat required to convert 1kg of a substance from solid state to liquid state. 1 Latent heat of vapourisation is the amount of heat required to convert 1kg of a substance from liquid state to gaseous state. 1 Steam will produce more severe burns than boiling water because steam has more heat energy than water due to its latent heat of vaporisation. 2	4
34		The torque tending to bring the mass to its equilibrium position, $\tau = mgL \times \sin\theta = I \times \alpha$ For small angles of oscillations $\sin\theta \approx \theta$, Therefore, $I\alpha = -mgL\theta$  $\alpha = -\dfrac{mgL\theta}{I}$ $-\omega^2\theta = -\dfrac{mgL\theta}{I}$ $\omega = \sqrt{\dfrac{mgL}{I}}$ Using $I = ML^2$, [where I denote the moment of inertia of bob] we get, $\omega = \sqrt{\dfrac{g}{L}}$ Therefore, the time period of a simple pendulum is given by, $T = 2\pi/\omega = 2\pi\sqrt{\dfrac{L}{g}}$ OR Restoring force $F = -mg\sin\theta$ For small angles of oscillations $\sin\theta \approx \theta$, $F = -mg\theta = -\dfrac{mgx}{L}$ $-m\omega^2 x = \dfrac{mgx}{L}$ $-\omega^2 = \dfrac{g}{L}$	4

		we get, $\omega = \sqrt{\frac{g}{L}}$ Therefore, the time period of a simple pendulum is given by, $T = 2\pi/\omega = 2\pi \sqrt{\frac{L}{g}}$	
35		$Y = a \sin(kx - \omega t)$ $y = 0.005 \sin(80x - 3t)$ Amplitude A = 0.005 m $k = \frac{2\pi}{\lambda} = 80 \text{rad/s}$ $\lambda = \frac{2\pi}{80} = \frac{\pi}{40} = 0.0785 \text{ m}$ $\omega = 3$ $T = \frac{2\pi}{\omega} = \frac{2\pi}{3}$ Frequency $\nu = \frac{1}{T} = \frac{3}{2\pi} = 0.477 \text{Hz}$	4
36		Dimensions of each term on either side of an equation are same $T \alpha r^a M^b G^c$ $T = K r^a M^b G^c$ .... (1) Equating dimensions $M^0 L^0 T^1 = L^a M^b (M^{-1} L^3 T^{-2})^C$ $b - c = 0$ $a + 3c = 0$ $-2c = 1$ $a = 3/2$ $b = -1/2$ $c = -1/2$ $T = K r^{3/2} M^{-1/2} G^{-1/2} = k\sqrt{\frac{r^3}{GM}}$	5
37		Displacement = Area under the graph $x = CD \times AC + \frac{1}{2} Ac \times BC$ $= v_0 t + \frac{1}{2} t (v - v_0)$ $= v_0 t + \frac{1}{2} at^2$	5

		x = average velocity X time $= \frac{v+v_0}{2} \times \frac{v-v_0}{a}$ $= \frac{v^2-v_0^2}{2a}$ $2ax = v^2 - v_0^2$	
38	a b	Force A = Normal reaction or N 1 Force B = Centrepital Force or $\frac{mv^2}{r}$ or NsinΘ + fcosΘ 1 $v = \sqrt{\mu_s rg}$ 1 $= \sqrt{0.1 X 3 X 9.8}$ 1 = 1.71 m/s 1	5
39	a b	Moment of inertia of aplane lamina about any axis perpendicular to its plane is the sum of moments of inertia about two mutually perpendicular axes on the plane passing through the point of intersection or $I_Z = I_X + I_Y$ 2 $I_X = I_Y = I_d$ 1 $\frac{MR^2}{2} = I_d + I_d = 2I_d$ 1 $Id = \frac{MR^2}{4}$ 1	5
40	a b	Nm^2kg^{-2} ; $M^{-1}L^3T^{-2}$ 2 On the surface $g = \frac{GM}{R^2} = \frac{G\frac{4}{3}\pi R^3\rho}{R^2} = \frac{4}{3}\pi G R\rho$ 1 At depth d , $g' = \frac{4}{3}\pi G(R-d)\rho$ 1 $\frac{g'}{g} = \frac{R-d}{R} = 1-\frac{d}{R}$ $g' = g\left(1-\frac{d}{R}\right)$ 1	5