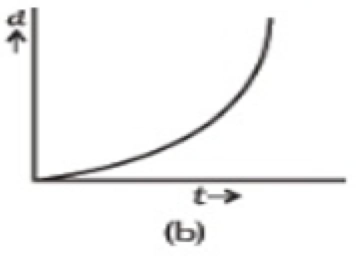
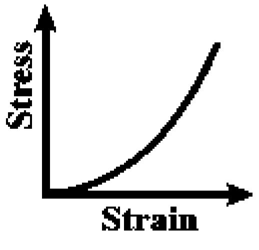
ANSWER KEY – CLASS 11 –PHYSICS – AT - 2 – SET 2 – 2023 – 24		
SL.NO	SECTION A	
1.	d. MLT^{-3} and MLT^{-4}	1
2.	(a) 1 AU = 1.496×10^{11}m.	1
3.	(b) simultaneously	1
4.	(d)1: 3	1
5.	(b) 30°	1
6.	(c) Going up with uniform velocity.	1
7.		1
8.	(b) $\frac{-1}{3}$, $\frac{8}{3}$	1
9.	(c) v α r	1
10.	(c) Infinity	1
11.	(b) Y and η remain the same.	1
12.	(a) 	1
13.	c) If Assertion is true but Reason is false.	1

14.	c) If Assertion is true but Reason is false**.**	1
15.	a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.	1
16.	a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.	1
	SECTION B	
17.	SOLUTION. Here $\theta = 90° - 30° = 60°$	1/2
	Horizontal velocity $= u \cos 60° = 19.6 \text{ ms}^{-1}$	1/2
	$\therefore \quad u = \dfrac{19.6}{\cos 60°} = \dfrac{19.6}{0.5} = 39.2 \text{ ms}^{-1}$	1/2
	$\therefore$ Maximum height, $H = \dfrac{u^2 \sin^2 60°}{2g} = \dfrac{(39.2)^2}{2 \times 9.8} \times \left(\dfrac{\sqrt{3}}{2} \right)^2 = \mathbf{58.8\ m}$	1/2
	OR	
	SOLUTION. Here $\theta = 90° - 30° = 60°$	1/2
	Horizontal velocity $= u \cos 60° = 19.6 \text{ ms}^{-1}$ $\therefore \quad u = \dfrac{19.6}{\cos 60°} = \dfrac{19.6}{0.5} = 39.2 \text{ ms}^{-1}$	½
	Horizontal range, $R = \dfrac{u^2 \sin 2\theta}{g} = \dfrac{(39.2)^2 \times \sin 120°}{9.8}$	½
	$= \dfrac{(39.2)^2}{9.8} \times \left(\dfrac{\sqrt{3}}{2} \right) = \mathbf{135.8\ m}$	1/2

18.	Diagram Work done by an external force to stretch the spring a distance dx dw = F.dx= Fdxcoso = Fdx (applied force and displacement are in same direction) To stretch the string from $x = x_1$ to $x = x_2$ work done on the system w = $\int F.dx$ $= \int_{x_1}^{x_2} kxdx$ w= $\frac{k(x^2)}{2}$ this work done by the applied force is stored in the form of potential energy Hence the potential energy in a string stretched a distance x from its natural length is given by U = $\frac{kx^2}{2}$	1/ 1/2 1/2 1/2
19.	Diagram $v_1 = r_1\omega,$ $v_2 = r_2\omega,$ $v_3 = r_3\omega, ...$ K.E. of particles of mass m_1 is $\frac{1}{2} m_1 v_1^2 = \frac{1}{2} m(r_1\omega)^2 = \frac{1}{2} m_1 r_1^2 \omega^2$ Similarly, K.E. of other particles of the body are : $\frac{1}{2} m_2 r_2^2 \omega^2, \frac{1}{2} m_3 r_3^2 \omega^2 ......$ $\therefore$ K.E. of rotation of the body $= \frac{1}{2} m_1 r_1^2 \omega^2 + \frac{1}{2} m_2 r_2^2 \omega^2 + \frac{1}{2} m_3 r_3^2 \omega^2 + ...$ $= \frac{1}{2} (m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + ...) \omega^2$ $= \frac{1}{2} \left(\sum_{i=1}^{i=n} \frac{1}{2} m_i r_i^2 \right) \omega^2$ $= \frac{1}{2} I\omega^2$ *i.e.,* K.E. of rotation $= \frac{1}{2} I\omega^2$	1/2 ½ ½ ½

20.	Definition Initial potential energy at earths surface is $U_i = \frac{-GMm}{R}$ Final potential energy at height h = R $U_f = \frac{-GMm}{2R}$ As work done = change in PE $\therefore W = U_f - U_i$ $= \frac{GMm}{2R}$	1 ½ 1/2
21.	$\frac{\text{Stress}}{\text{Strain}} = \text{Modulus of elasticity}$ Given depth h = 3000 m, $\rho = 10^3\ kg/m^3$, $g = 10\ ms^{-2}$ $P = h\rho g = 3000 \times 10^3 \times 10$ $= 3 \times 10^7\ Nm^{-2}$ $\text{Bulk modulus} = -\frac{\Delta P}{\Delta V/V}$ $\frac{\Delta V}{V} = -\frac{\Delta P}{B} = \frac{3\times10^7}{2.2\times10^9} = 1.36 \times 10^{-2}$	½ ½ ½ + ½
	SECTION C	
22.	Yes, there are some physical quantities which have no dimensions but still have units. For eg., solid angle, angular velocity	1 1/2

$[E] = [ML^2T^{-2}], [m]$ 1/2

$= [M][l] = [ML^2T^{-1}], [G] = [M^{-1}L^3T^{-2}]$

$$\therefore [\frac{E]^2}{m^5G^2}] = \frac{[ML^2T^{-2}][M^2L^4T^{-2}]}{[M^5][M^{-2}L^6T^{-4}]}$$ 1/2

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

As angle has no dimensions, therefore $\frac{E]^5}{m^5G^2}$ has the same dimensions as that of angle. 1/2

OR

(a)

We know that $P = \frac{F}{A}$

So, the dimensions of Pressure is : (LHS)

$$P = \frac{[MLT^{-2}]}{[L^2]}.$$

$P = [ML^{-1}T^{-2}]$ ½

Then let's go for the RHS :

$= hdg$

After converting into dimensions :

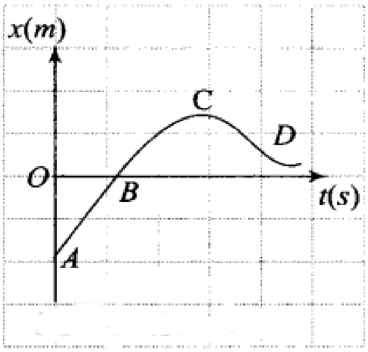
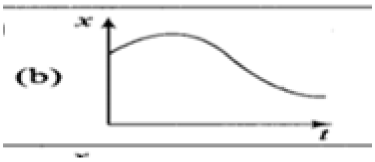
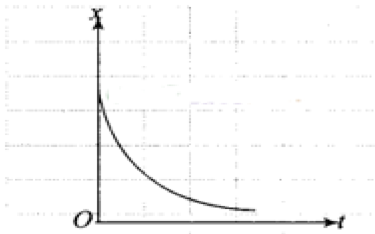
$= [L][ML^{-3}][LT^{-2}]$ ½

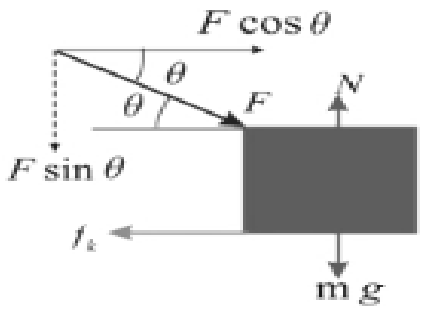
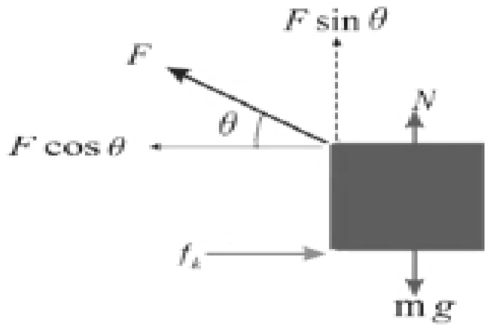
$= [L^2L^{-3}MT^{-2}]$ ½

$= [ML^{-1}T^{-2}]$

Thus, it is clear that LHS = RHS. ½

(b) Thus, the above equation is dimensionally consistent.

	A dimensional constant is a physical quantity that has dimensions and, has a fixed value. Examples of these constants include gravitational constants, electrostatic force constant.	½ + ½
23	(a) (ii) In graph (a), There is a point (B) on the curve for which displacement is zero. So curve, (a) matches with (ii).  (b) (iii)  (c) (i) In graph (c), In this graph the slope is always negative, hence velocity will be negative or v < 0. Also x-t graph opens up, it represents positive acceleration. So curve (c) matches with (i).  	1/2 1/2 1/2 1/2 1/2 1/2
24.	(a) Ans: False. The net acceleration of a particle in circular motion is not always directed along the radius of the circle toward the centre. It happens only in the case of uniform circular motion.	1/2 1/2

	(b) Ans.True At a point on a circular path, a particle appears to move tangentially to the circular path on which it is moving. (c)Ans- False Horizontal range is maximum when angle =45°and the maximum height attained by projectile is largest when angle is 90°	1/2 1/2 1/2 1/2
25.	 Notice that Fsinθ acts downwards along with the weight m*g and therefore increases the normal reaction N (Normal reaction is equal to sum of all the vertical forces). And friction is directly dependent on Normal reaction; More is N more is the frictional force. Now see this Free Body Diagram for Pulling:  Notice that Fsinθ acts upwards along with the weight m*g and therefore decreases the normal reaction N. Therefore the frictional force is reduced. Therefore it is easier to Pull than to Push.	1 1 1

26.	Velocity of pendulum bob in mean position $v_1 = \sqrt{2gh} = \sqrt{2 \times 10 \times 5 \times 10^{-2}} = 1\frac{m}{s}$ when the bob picks up a mass 10^{-3}kg at the bottom, then by conservation of liner momentum, the velocity of the coalesced mass is given by $m_1v_1 + m_2v_2 = (m_1 + m_2)V$ $10^{-2} \times 1 + 10^{-3} \times 0 = (10^{-2}) + 10^{-3()V}$ or $V = \frac{10}{11} m/s$ if h' is the height risen by the combine mass, we have $\frac{1}{2}(m_1 + m_2)V^2 = (m_1 + m_2)gh'$ $\therefore h' = \frac{V^2}{2g} = \frac{\left(\frac{10}{11}\right)^2}{2 \times 10} m = \frac{5}{121} m = 0.413m$	½ + ½ ½ ½ ½ ½
27.	(a) Here, h = 32 km, R = 6400 km Now, $g' = g\left(1 - \frac{2h}{R}\right) = g - \frac{2hg}{R}$ (or) $g - g' = 2\frac{gh}{R}$ $\therefore$ percentage decrease in weight $= \frac{mg - mg'}{mg} \times 100$ $= \frac{g - g'}{g} \times 100 = \frac{2gh}{gR} \times 100 = \frac{2h}{R} \times 100$ $= 2 \times \frac{32}{6400} \times 100 = 1\,\%$ Acceleration due to gravity at a height h is • g' = g[1 - 2h/R] Acceleration due to gravity at depth h is • g'' = g[1 - h/R] From above two equations it's clear that acceleration due to gravity at depth h is more than that at height h (b) Therefore weight of the body will be more at depth of 1 km.	½ + ½ ½ ½ ½

		½
28.	: Mass of the cylinder is given as, $m = 20kg$ Angular speed is given as, $\omega = 100 rad/s$ Radius of the cylinder, $r = 0.25m$ The moment of inertia of the solid cylinder can be given as: $I = \frac{mr^2}{2}$ Now, $\Rightarrow I = \frac{1}{2} \times 20 \times (0.25)^2$ $\Rightarrow I = 0.625 kgm^2$ Kinetic energy can be given as: $K.E. = \frac{1}{2} I\omega^2$ $\Rightarrow K.E. = \frac{1}{2} \times 6.25 \times (100)^2 = 3125J$ Angular momentum can be given as, $L = I\omega$ $\Rightarrow L = 6.25 \times 100$ $\Rightarrow L = 62.5 Js$	1/2 1/2 ½ 1/2 1/2 1/2
	SECTION D	
29.	(I) (d) -0.99m/s (II) (d) -4v (iii) (b) 2 kgm/s (iv) (b) -v/2. OR (a) 2mv	1 1 1 1
30.	(i) (b)A, as the slope of the graph of B is less than that of A (ii) (d) $10^{11} N/m^2$ (iii) c) tensile strength (iv) (d) B, as it has less plastic region OR a) A, as it has more plastic region	1 1 1 1

	SECTION E	
31.	Definition of elastic and inelastic collision Derivation of v1 and v2 (diagram) Conservation of linear momentum Conservation of kinetic energy Relation between v1, v2,u1 & u2 Steps for finding v1 or v2 Formula for v1 and v2	1+1 ½ ½ ½ ½ + ½
	OR . (i) Statement of the law of conservation of energy. Proof-diagram Proof of the steps ,Object at A, B & C Graph.	1 ½ 1 + 1 + ½ 1
32.	Statement of the law of conservation of angular momentum • IT STATES THAT WHEN THE TOTAL TORQUE ACTING ON A RIGID BODY IS ZERO, THE TOTAL ANGULAR MOMENTUM OF THE BODY IS CONSERVED. • SUPPOSE THE EXTETERNAL TORQUES ACTING ON A RIGID BODY DUE TO EXTERNAL FORCES IS ZERO • THEN τ = dL/dt =0 • Or l = constant • When τ = 0, l = iω = constant • i.e $i_1\omega_1 = i_2\omega_2$ Any one example of conservation of angular momentum and explanation	1 1 1 1 1

	Angular momentum of a particle performing uniform circular motion $L = I\omega$ Kinetic energy, $K = \frac{1}{2}I\omega^2$ Therefore, $L = \frac{2K}{\omega^2}\omega = \frac{2K}{\omega}$ $\frac{L_1}{L_2} = \frac{K_1\omega_2\ L_1}{K_2\omega_1\ L_2} = 2 \times 2 = 4$ $L_2 = \frac{L}{4}$.	
	OR Definition of term torque. SI unit – Nm ML^2T^{-2} Derivation of torque with diagram For second hand = T_s = 60 s $\omega_s = \frac{2\pi}{T_s} = \frac{2 \times 3.14}{60} = 0.105$ rad/s $v = r\,\omega = 10 \times 10^{-2} \times 0.105 = 1.05 \times 10^{-2}$ m/s = 1.05 cm/s	1 ½ ½ 1 ½ 1 ½
33.	Definition of acceleration due to gravity. Derivation of formula of acceleration due to gravity. Diagram $g = \frac{GM_e}{R_e^{\ 2}}$ & $M_e = \frac{4}{3}\pi R_e^{\ 3}\rho$ $\therefore\ g = \frac{4}{3}\frac{\pi G R_e \rho}{} \rightarrow (3)$ $g' = \frac{GM_e'}{(R_e - d)^2}$ & $M_e' = \frac{4}{3}\pi(R_e - d)^3\rho$ $\therefore g' = \frac{4}{3}\pi\rho G(R_e - d) \rightarrow (4)$	1 1/2 1 1/2

	$$\frac{g'}{g}=\frac{(R_e-d)}{R_e}\Rightarrow g'=g\left[1-\frac{d}{R_e}\right]$$	1/2
	Therefore, $F=mg=m\frac{GM}{R_e^2}$	1/2
	$$\frac{F_{Mars}}{F_{Earth}}=\frac{m[GM/R_e^2]\vert_{Mars}}{m[GM/R_e^2]\vert_{Earth}}$$	1l2
	$$\frac{F_{Mars}}{90kg}=\frac{(M_{earth}/9)}{(M_{earth})}\times\frac{(R_{Earth})^2}{(R_{Earth}/2)^2}=4/9$$	1/2
	$F_{Mars}=90\times 4/9=40kg\,f$	
	OR	
	Definition of escape velocity.	1
	Derivation with diagram	1/2 1 1/2
	For escape velocity the formula is, $$v_e=\sqrt{\frac{2GM}{R}}=\sqrt{\frac{2G\frac{4}{3}\pi R^3\rho}{R}}$$	½
	[ρ is density of the planet, R is radius.] $$=\sqrt{\frac{8}{3}G\pi R^2\rho}$$	1/2
	$$v_e=R\sqrt{\frac{8}{3}G\pi\rho}$$	
	$v_e\propto R$	1/2
	If radius becomes twice, v_e will also become twice. So new escape velocity $=2\times 11.2=22.4$km/sec	1/2

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