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STD: XI **14.3.2019**

SUBJECT: PHYSICS **TENTATIVE ANSWER KEY** **MARKS : 70**

Q.NO	SECTION - I		MARKS
	CODE A	CODE B	
1	c)	c) 2.5 rad	1
2	a) 10 m	b) convection	1
3	b) convection	d) torque and energy	1
4	d) decrease	c) 1/2	1
5	a) 0.157 ms^{-1}	c) bigger will grow until they collapse	1
6	c) bigger will grow until they collapse	c) 66.67 J	1
7	c) increases	d) decrease	1
8	b) sin (x + vt)	d) remains the same	1
9	d) torque and energy	a) 10 m	1
10	d) remains the same	c)	1
11	c) 1/2	c) W = 0	1
12	c) 66.67 J	a) 0.157 ms^{-1}	1
13	d) 0.2 %	c) increases	1
14	c) 2.5 rad	b) sin (x + vt)	1
15	c) W = 0	d) 0.2 %	1

Q.NO	SECTION - II	MARKS
16	Instrumental errors, imperfections in experimental technique, personal errors, errors due to external causes, least count error (write any two errors with explanation)	2
17	When an object is thrown in the air with some initial velocity and then allowed to move under the action of gravity alone, the object is known as a projectile. Eg., an object dropped from window of a moving train, a bullet fired from rifle	1 1
18	The force acting on an object is equal to the rate of change of its momentum $\vec{F} = \frac{\overrightarrow{dp}}{dt}$ (eqn. alone 1 mark)	2
19	$F_{cf} = \frac{mv^2}{r}$ $= \frac{60 \times 50^2}{10} = 15000$ N (without unit reduce ½ mark)	1 1
20	It is difficult to revolve the stone by tying it to a longer string than tying it to a shorter string because the moment of inertia of stone tied with longer string is more than that tied with smaller string.	2
21	Stefan Boltzmann law states that, the total amount of heat radiated per second per unit area of a black body is directly proportional to the fourth power of its absolute temperature. $E \propto T^4$ or $E = \sigma T^4$ (formula only award 1 mark)	2
22	1. Brownian motion increases with increasing temperature. 2. Brownian motion decreases with bigger particle size, high viscosity and density of the liquid (or) gas.	2
23	Soldiers are not allowed to march on a bridge. This is to avoid resonant vibration of the bridge. While crossing a bridge, if the period of stepping on the ground by marching soldiers equals the natural frequency of the bridge, it may result in resonance vibrations. This may be so large that the bridge may collapse.	2

24	work done = total surface area x surface tension $W = 2 \times 4\pi r^2 \times T$ $= 2 \times 4 \times 3.14 \times (0.05)^2 \times 0.03$ $= 0.0025 \times 0.03 \times 8 \times 3.14$ $= 1.884 \times 10^{-3}$ J Without unit reduce ½ marks	½ ½ 1
Q.NO	**SECTION - III**	**MARKS**
25	$\vec{\tau} = \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 5 \\ 3 & -2 & 4 \end{vmatrix}$ $\vec{\tau} = (12-(-10))\hat{i} + (15-8)\hat{j} + (-4-9)\hat{k}$ $\vec{\tau} = 22\hat{i} + 7\hat{j} - 13\hat{k}$ Nm^{-1}	1 1 1
26	Types of friction 1. Static friction 2. kinetic friction 3. rolling friction Methods to reduce friction 1. by polishing the surface 2. by lubricating 3. by using ball bearings	1 ½ 1 ½
27	$KE = \frac{p^2}{2m}$ $KE \ \alpha \ \frac{1}{m}$ So smaller mass has greater kinetic energy (or any similar equivalent answer)	3
28	$\left.\begin{array}{l} KE = \frac{1}{2} I\omega^2 \\ I = MR^2 \end{array}\right\}$ $\left.\begin{array}{l} I = 9 \times 3^2 = 9 \times 9 = 81 \text{ kg m}^2 \\ \omega = 240 \text{ rpm} = \frac{240 \times 2\pi}{60} \text{rad s}^{-1} \\ KE = \frac{1}{2} \times 81 \times \left(\frac{240 \times 2\pi}{60}\right)^2 = \frac{1}{2} \times 81 \times (8\pi)^2 \end{array}\right\}$ $\left.\begin{array}{l} KE = \frac{1}{2} \times 81 \times 64 \times (\pi)^2 = 2592 \times (\pi)^2 \\ KE \approx 25920 \text{ J} \quad \because (\pi)^2 \approx 10 \\ KE = 25.920 \text{ kJ} \end{array}\right\}$	1 1 1

29	Freely falling objects experience only gravitational force. As they fall freely, they are not in contact with any surface (by neglecting air friction). The normal force acting on the object is zero. The downward acceleration is equal to the acceleration due to the gravity of the Earth. i.e (a = g). $a = g \therefore N = m(g - g) = 0$. This is called the state of weightlessness. Eg. When the lift falls (when the lift wire cuts) with downward acceleration a = g, the person inside the elevator is in the state of weightlessness	1 ½ 1 ½
30	Explanation + Diagram $F_G = mg = \frac{4}{3}\pi r^3 \rho g$ (downward force) Up thrust, $U = \frac{4}{3}\pi r^3 \sigma g$ (upward force) viscous force $F = 6\pi\eta r v_t$ At terminal velocity v_t. downward force = upward force $F_G - U = F \Rightarrow \frac{4}{3}\pi r^3 \rho g - \frac{4}{3}\pi r^3 \sigma g = 6\pi\eta r v_t$ $v_t = \frac{2}{9} \times \frac{r^2(\rho - \sigma)}{\eta} g \Rightarrow v_t \propto r^2$	1 1 1
31	The increase in length of a body due to the increase in its temperature is called linear expansion. Diagram In solids, for a small change in temperature ΔT, the fractional change in length is directly proportional to ΔT. $\frac{\Delta L}{L} = \alpha_L \Delta T$ $\alpha_L = \frac{\Delta L}{L\Delta T}$ Where, α_L = coefficient of linear expansion. ΔL = Change in length L = Original length	1 ½ 1 ½

	ΔT = Change in temperature.	
32	Any six points (each point carries ½ marks) 1. All the molecules of a gas are identical, elastic spheres. 2. The molecules of different gases are different. 3. The number of molecules in a gas is very large and the average separation between them is larger than size of the gas molecules. 4. The molecules of a gas are in a state of continuous random motion. 5. The molecules collide with one another and also with the walls of the container. 6. These collisions are perfectly elastic so that there is no loss of kinetic energy during collisions. 7. Between two successive collisions, a molecule moves with uniform velocity. 8. The molecules do not exert any force of attraction or repulsion on each other except during collision. The molecules do not possess any potential energy and the energy is wholly kinetic. 9. The collisions are instantaneous. The time spent by a molecule in each collision is very small compared to the time elapsed between two consecutive collisions. 10. These molecules obey Newton's laws of motion even though they move randomly.	3
33	$V = \lambda f$ $f = v/\lambda$ $f_1 = \frac{v}{\lambda_1} = \frac{396}{0.99} = 400$ Hz $f_2 = \frac{v}{\lambda_2} = \frac{396}{1} = 396$ Hz $n = f_2 - f_1 = 400 - 396 = 4$ beats per second	1 1
Q.NO	**SECTION - IV**	**MARKS**
34 (a)	The principle of homogeneity of dimensions states that the dimensions of all the terms in a physical expression should be the same. For example, in the physical expression $v^2 = u^2 + 2as$, the dimensions of v^2, u^2 and $2as$ are the same and equal to $[L^2T^{-2}]$	1 1

	$F \propto m^a v^b r^c$ $F = k\, m^a v^b r^c$ $[MLT^{-2}] = [M]^a [LT^{-1}]^b [L]^c$ $= [M^a L^b T^{-b} L^c]$ $[MLT^{-2}] = [M^a][L^{b+c}][T^{-b}]$	1
	$a = 1;\ b + c = 1 \quad -b = -2$ $2 + c = 1 \quad b = 2$ $a = 1\ b = 2$ and $c = -1$	1
	$F = m^a v^b r^c$ $F = m^1 v^2 r^{-1}$ or $F = \frac{mv^2}{r}$	1
34 (b)	According to Bernoulli's theorem, the sum of pressure energy, kinetic energy, and potential energy per unit mass of an incompressible, non-viscous fluid in a streamlined flow remains a constant	1
	Diagram and Explanation	1
	$W = F_A d = P_A V$ $E_{PA} = P_A V = P_A V \times \left(\frac{m}{m}\right) = m\frac{P_A}{\rho}$ Potential energy of the liquid at A, $PE_A = mg\, h_A$, Due to the flow of liquid, the kinetic energy of the liquid at A, $KE_A = \frac{1}{2} m\, v_A^2$	1
	$E_A = EP_A + KE_A + PE_A$ $E_A = m\frac{P_A}{\rho} + \frac{1}{2} mv_A^2 + mg\, h_A$ $E_B = m\frac{P_B}{\rho} + \frac{1}{2} mv_B^2 + mg\, h_B$	1

	From the law of conservation of energy, EA = EB $m\frac{P_A}{\rho} + \frac{1}{2}mv_A^2 + mgh_A = m\frac{P_B}{\rho} + \frac{1}{2}mv_B^2 + mgh_B$ $\frac{P_A}{\rho} + \frac{1}{2}v_A^2 + gh_A = \frac{P_B}{\rho} + \frac{1}{2}v_B^2 + gh_B = \text{constant}$ Thus, the above equation can be written as $\frac{P}{\rho g} + \frac{1}{2}\frac{v^2}{g} + h = \text{constant}$	1
35 (a)	If there are no external forces acting on the system, then the total linear momentum of the system ($\overrightarrow{p_{tot}}$) is always a constant vector $\vec{F}_{21} = -\vec{F}_{12}$ $\vec{F}_{12} = \frac{d\vec{p}_1}{dt}$ and $\vec{F}_{21} = \frac{d\vec{p}_2}{dt}$ $\frac{d\vec{p}_1}{dt} = -\frac{d\vec{p}_2}{dt}$ $\frac{d\vec{p}_1}{dt} + \frac{d\vec{p}_2}{dt} = 0$ $\frac{d}{dt}(\vec{p}_1 + \vec{p}_2) = 0$ $\vec{p}_1 + \vec{p}_2 =$ constant vector Recoil velocity of gun When the gun is fired, the bullet moves forward and the gun recoils backward. Let v_b and v_g are their respective velocities, the total momentum of the bullet – gun system, after firing is $m_b v_b + m_g v_g$ According to the law of conservation of momentum, total momentum before firing is equal to total momentum after firing. (i.e) $0 = m_b v_b + m_g v_g$ (or) $v_g = -\frac{m_b}{m_g} v_b$	1 1 1 1 1
35 (b)	Definition Diagram + explanation	2 1

	$I=\sum m(x+d)^2$ $I=\sum m(x^2+d^2+2xd)$ $I=\sum(mx^2+md^2+2dmx)$ $I=\sum mx^2+\sum md^2+2d\sum mx$	1
	$I_C=\sum mx^2$ The term, $\sum mx=0$ because, x can take positive and negative values with respect to the axis AB. The summation $\left(\sum mx\right)$ will be zero.	½
	Thus, $I=I_C+\sum md^2=I_C+\left(\sum m\right)d^2$ Here, $\sum m$ is the entire mass M of the object $\left(\sum m=M\right)$ $I=I_C+Md^2$	½
36 (a)	In a collision, the total initial kinetic energy of the bodies (before collision) is equal to the total final kinetic energy of the bodies (after collision) then, it is called as elastic collision. i.e., Total kinetic energy before collision = Total kinetic energy after collision	1
	Diagram $u_1 > u_2$	½
	$m_1u_1+m_2u_2=m_1v_1+m_2v_2$ Or $m_1(u_1-v_1)=m_2(v_2-u_2)$ $\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2=\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2$ $m_1(u_1^2-v_1^2)=m_2(v_2^2-u_2^2)$ $\frac{m_1(u_1+v_1)(u_1-v_1)}{m_1(u_1-v_1)}=\frac{m_2(v_2+u_2)(v_2-u_2)}{m_2(v_2-u_2)}$ $u_1+v_1=v_2+u_2$ $u_1-u_2=v_2-v_1$ $u_1-u_2=-(v_1-v_2)$	1

	$v_1 = v_2 + u_2 - u_1$ Or $v_2 = u_1 + v_1 - u_2$	½
	$m_1(u_1 - v_1) = m_2(u_1 + v_1 - u_2 - u_2)$ $m_1(u_1 - v_1) = m_2(u_1 + v_1 - 2u_2)$ $m_1u_1 - m_1v_1 = m_2u_1 + m_2v_1 - 2m_2u_2$ $m_1u_1 - m_2u_1 + 2m_2u_2 = m_1v_1 + m_2v_1$ $(m_1 - m_2)u_1 + 2m_2u_2 = (m_1 + m_2)v_1$ or $v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)u_1 + \left(\frac{2m_2}{m_1 + m_2}\right)u_2$	1
	$v_2 = \left(\frac{2m_1}{m_1 + m_2}\right)u_1 + \left(\frac{m_2 - m_1}{m_1 + m_2}\right)u_2$	1
36 (b)	Diagram	1
	Explanation	1
	$\frac{1}{4}\lambda = L_1$ $\frac{1}{4}\lambda = L_1 + e$ $\frac{3}{4}\lambda = L_2 + e$	1
	$\frac{3}{4}\lambda - \frac{1}{4}\lambda = (L_2 + e) - (L_1 + e)$ $\Rightarrow \frac{1}{2}\lambda = L_2 - L_1 = \Delta L$ $\Rightarrow \lambda = 2\Delta L$	1
	$v = f\lambda = 2f\Delta L$	1
37 (a)	Explanation	1
	$dU = \mu C_v dT$ $Q = \mu C_p dT$	1
	$W = PdV$ $Q = dU + W$	1

	$\mu C_p dT = \mu C_v dT + PdV$ $PV = \mu RT \Rightarrow PdV + VdP = \mu RdT$ Since the pressure is constant, dP=0 $\therefore C_p dT = C_v dT + RdT$	1
	$\therefore C_p = C_v + R \quad (\text{or}) \quad C_p - C_v = R$	1
37 (b)	Diagram	1
	Explanation	1
	$F \propto x$ $F = -kx$	1
	$m\frac{d^2x}{dt^2} = -kx$ $\frac{d^2x}{dt^2} = -\frac{k}{m}x$ $\omega^2 = \frac{k}{m}$ $\omega = \sqrt{\frac{k}{m}}$ rad s^{-1}	1
	$f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ Hertz $T = \frac{1}{f} = 2\pi\sqrt{\frac{m}{k}}$ seconds	1
38 (a)	i) $v = u + gt$ $y = ut + \frac{1}{2}gt^2$ $v^2 = u^2 + 2gy$	1
	Particle start from rest u = 0	½

	$v = gt$ $y = \frac{1}{2}gt^2$ $v^2 = 2gy$ ii) $-h = ut - \frac{1}{2} gt^2$ $- h = 19.6 \times 6 - \frac{1}{2} \times 9.8 \times 6^2$ $- h = - 58.8$ m $h = 58.8$ m	1 ½ ½ ½ 1
38 (b)	i) The horizontal velocity that has to be imparted to a satellite at a determined height so that it makes a circular orbit around the planet is called orbital velocity $\frac{Mv^2}{(R_E + h)} = \frac{GMM_E}{(R_e + h)^2}$ $v^2 = \frac{GM_E}{(R_E + h)}$ $v = \sqrt{\frac{GM_E}{(R_E + h)}}$ ii) $v = \sqrt{\frac{GM_e}{R_e + h}}$ $v = \sqrt{\frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{(6400+1000) \times 10^3}}$ $v = 7.353$ kms^{-1} (Without unit reduce ½ mark)	1 2 ½ ½ ½

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