FIRST YEAR HIGHER SECONDARY EXAMINATION, JUNE 2022

Part III

PHYSICS

FY 24

Date: 29.06.2022

Maximum: 60 Score

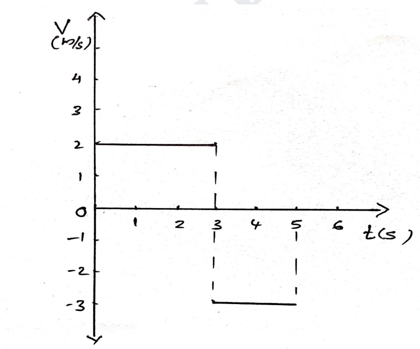
ANSWER KEY (unofficial) **HSPTA KANNUR**

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total

Answer any 5 questions from 1 to 7. Each carries 1 score [5 x 1 = 5]

1		Optics	1	1
2		MT^{-2}	1	1
3		90^0	1	1
4		2.38 km/s	1	1
5		decreases	1	1
6		Light body	1	1
7		Zero	1	1

Answer any 5 questions from 8 to 14. Each carries 2 score [5x 2 = 10]

8		 Total Displacement = Area under the graph = (2 x 3)+(-3 x 2) = Zero	1 1	2
9		Velocity $u_x = u\cos\theta$ $u_x = 5\cos 30$ $u_x = 2.5\sqrt{3}$ m/s Acceleration $a = -g$	1 1	2
10	a) b)	Law of conservation of linear momentum $V = -[m/M]\,u$ $V = -[15X10^{-3}/2]\ X\ 100$ $V = 0.75$ m/s	1 1	2

FIRST YEAR HIGHER SECONDARY MODEL EXAMINATION, JUNE 2022

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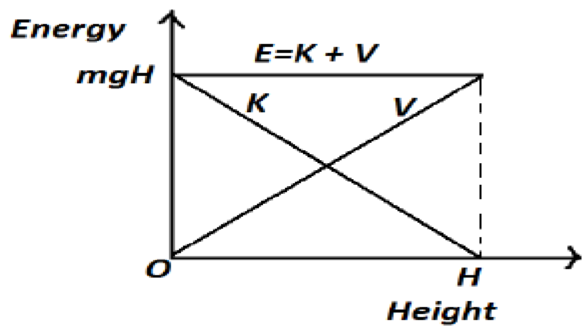
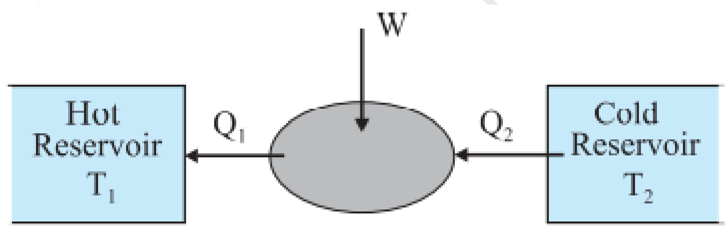
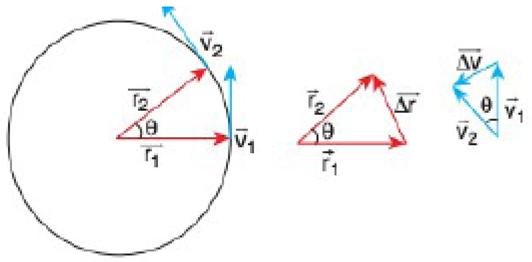
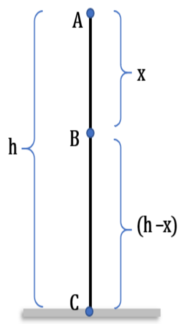
11			2	2
12	a) b) c) d)	A - Proportional Limit B - Elastic Limit Or Yield point E - Fracture Point OO' - Permanent Set	½ ½ ½ ½	2
13		 $\alpha = \frac{Q_2}{W}$ $\alpha = \frac{Q_2}{Q_1 - Q_2}$	1 1	2
14		$I_1\omega_1 = I_2\omega_2$ $\frac{I_1}{I_2} = \frac{\omega_2}{\omega_1}$ $\frac{MK_1^2}{MK_2^2} = \frac{\omega_2}{\omega_1}$ $\boxed{\frac{K_1}{K_2} = \sqrt{\frac{\omega_2}{\omega_1}}}$	2	2

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total

Answer any 6 questions from 15 to 22. Each carries 3 scores **[6 x 3= 18]**

15		$[v]=L^1T^{-1}$=LHS G=$M^{-1}L^3T^{-2}$ RHS=$(M^{-1}L^3T^{-2}\ M^1\ L^{-1})^{½}=L^1T^{-1}$=LHS Dimensionally correct.	3	3
16		 The magnitudes of the displacement **Δr** and of **Δv** satisfy the following relation. $\frac{\lvert\Delta r\rvert}{r} = \frac{\lvert\Delta v\rvert}{v} = \theta$ => $\Delta v = v\frac{\Delta r}{r}$ $a = \frac{\Delta v}{\Delta t} = \frac{v\,\Delta r}{r\,\Delta t} = \frac{v^2}{r}$ ie, $a = \frac{v^2}{r}$ Also $v=r\omega$ Therefore, $a = \frac{\omega^2 r^2}{r} = \omega^2 r$	3	3
17		 At A PE = mgh, KE = 0, TE = mgh At B PE = mg(h-x), KE = mgx, TE = mgh At C PE= 0, KE = ½ mv2 = mgh	3	3

FIRST YEAR HIGHER SECONDARY MODEL EXAMINATION, JUNE 2022

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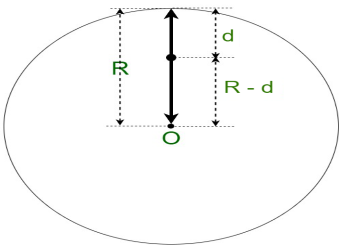
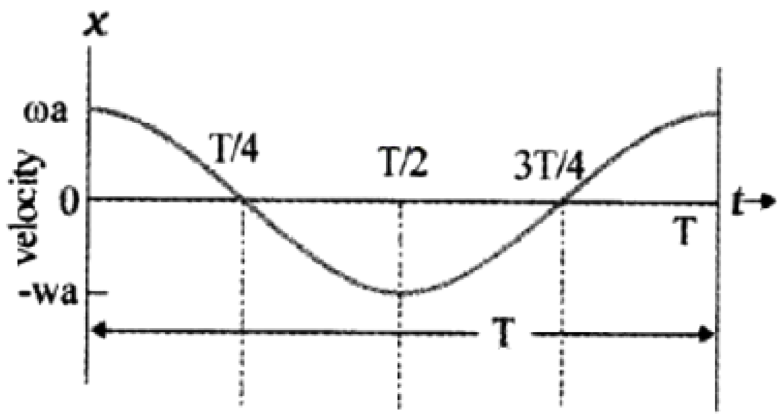
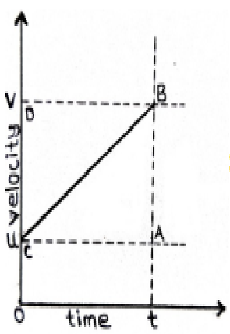
Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
		TE at A = TE at B = TE at C Total mechanical energy is conserved.		
18	a) b)	 $g=GM/R^2$ $\rho=M/(4/3\ \pi R^3)$ $M=\rho\ 4/3\ \pi\ R^3$ $g=\frac{G\rho\ 4/3\ \pi\ R^3}{R^2} = G\rho\ 4/3\ R$ ------(1) $g' = G\rho\ 4/3\ (R-d)$ ------------(2) (2)/(1) $g' = g\ (R-d)/R = g(1-d/R)$ Zero	2 1	3
19	a) b)	The pressure applied to an enclosed fluid will be transmitted without a change in magnitude to every point of the fluid and the walls of the container. $F_1/A_1=F_2/A_2$ $F_2=F_1\ A_2/A_1$	1 2	3
20	a) b)	Radiation $t_1=1/k\ \ln\frac{(94-20)}{(86-20)} = 2$ --------(1) $t_2=1/k\ \ln\frac{(71-20)}{(69-20)}$ ----------(2) (2)/(1) $t_2=\frac{2\ \ln(51/49)}{\ln(74/66)} = 0.699$ minutes	1 2	3

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
21		PV=RT PV=⅓ Nmv^2 RT=⅓ Nmv^2 3/2RT=½ Nm v^2 3/2 RT=½ Mv^2	3	3
22	a)		1	3
	b)	F=Kx20 50=Kx20 K=250N/m A=-K/m y A=-250/2 x 0.10=-12.5m/s^2 Kinetic energy=½ x 2 x 250/2x(20^2-10^2)10^{-4}=300x250x1/2x10^{-4}=3.75J	2	

Answer any 3 questions from 23to 27. Each carries 4 scores	**[3 x 4 = 12]**

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
23	a)	 Displacement = Area under the velocity-time graph => $S = Area\ of\ \Delta ABC + Area\ of\ \square ACOt$ => $S=\frac{1}{2}(v-u)t+ut$ ....(2) Substitute $v=u+at$ in (2) (2) => $S=ut+1/2(u+at-u)t$ => $S=ut+\frac{1}{2}at^2$ ....(3) (OR) $S=\frac{1}{2}(u+v)t$ This is the second equation of motion	2	4

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
		(b) Total time = time fro upward motion + time for downward motion **For upward motion ,** v= 0 u=20 m/s a= -10m/s^2 v= u + at 0 =20 + -10t 10 t =20 t = 20/10 = 2 s **For downward motion,** u = 0 s =- 45m a = -10m/s^2 s= ut + ½ at^2 - 45 = 0 - ½ x 10 x t^2 - 45 = -5 t^2 t^2 = 9 , t = 3 s **Total time = 2 + 3 = 5s**	2	
24	a) b) c)	Apparent weight increases W= m(g+a) W = m(g-a) = 30(9.8- 5) =144 N	1 1 2	4
25	a)	We know **L= r x p** differentiate with respect to time $\frac{d\vec{L}}{dt}=\frac{d}{dt}(\vec{r}\times\vec{P})$ $=\frac{d\vec{r}}{dt}\times\vec{P}+\vec{r}\times\frac{d\vec{P}}{dt}$ $=\vec{v}\times m\vec{v}+\vec{r}\times\vec{F}$ $=0+\tau$ ie, $\boxed{\frac{d\vec{L}}{dt}=\vec{\tau}}$ Thus the time rate of change of angular momentum of a particle is equal to the torque acting on it.	2 2	4
	b)	$V_2=\frac{1}{8}V_1$ $\frac{4}{3}\pi R_2^3=\frac{1}{8}\times\frac{4}{3}\pi R_1^3$ $R_2=\frac{R_1}{2}$ ---------(1)		4

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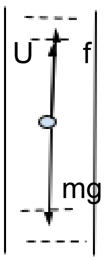
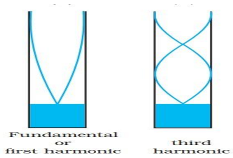
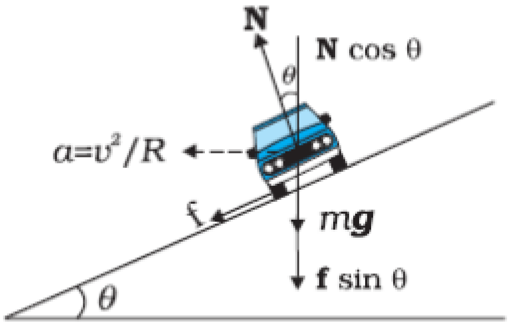
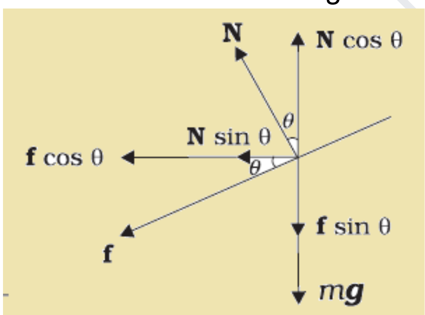
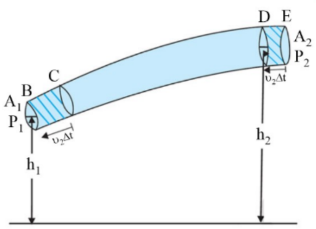
Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
		$I_2=\frac{I_1}{4}$ ——---(2) (since I $=\frac{2}{5}MR^2$) $I_1\omega_1=I_1\omega_1$ $I_1\frac{2\pi}{T_1}=I_2\frac{2\pi}{T_2}$ $T_2=\frac{T_1}{4}=\frac{24}{4}$=6 hours	2	
26	(a)	Viscous force, Upthrust and Weight	$1\frac{1}{2}$	
	(b)	 When the sphere attains the terminal velocity, the viscous force balances the weight of the body. U + f =mg f = mg – U $6\pi\eta rv = \rho V g - \sigma Vg$ $6\pi\eta rv = Vg(\rho - \sigma)$ $6\pi\eta rv = \frac{4}{3}\pi r^3 g(\rho-\sigma)$ $6\eta v = \frac{4}{3} r^2 g(\rho-\sigma)$ $v = \frac{2}{9\eta} a^2 g(\rho-\sigma)$	$2\frac{1}{2}$	
27	(a)	λ ν 	2	
	(b)	1. <u>First mode of vibration</u> $L=\frac{1}{4}$ OR $\lambda_1=4L$ $\nu_1=\frac{\vartheta}{\lambda_1}$ OR $\nu_1=\frac{\vartheta}{4L}$ 2. <u>Second mode of vibration</u> $L=\frac{\lambda_2}{4}$ OR $\lambda_2=\frac{4}{3}L$ $\nu_2=\frac{\vartheta}{\lambda_2}$ OR $\nu_2=\frac{3\vartheta}{4L}$ $\nu_2=3\nu_1$	2	4

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total

Answer any 3 questions from 28 to 32. Each carries 5 scores **[3 x 5 = 15]**

28	a)	 	2	
	b)	Resolving the forces in the above figure we get  There is no acceleration on the vertical direction So, **N**cosθ = m**g** + **f**sinθ The centripetal force is provided by the horizontal components **N**sinθ + **f**cosθ = mv^2/R To obtain maximum velocity we take **f** = μ_sN Substitute this value in the concerned equations and obtain The maximum safe speed of vehicle at banked road with frictional force. $$v_{max} = \left(Rg\frac{\mu_s + tan\theta}{1 - \mu_s\, tan\theta}\right)^{\frac{1}{2}}$$	3	5
29	a)	Gravitational force must be equal to centripetal force $$\frac{GMm}{(R+h)^2} = \frac{mv^2}{R+h}$$ On solving for v		

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
		$v = \sqrt{\frac{GM}{R+h}}$	$1\frac{1}{2}$	
		Time period of the satellite = perimeter of the orbit/orbital velocity Then $T = \frac{2\Pi(R+h)}{\sqrt{GM/(R+h)}}$ $= 2\Pi\sqrt{\frac{(R+h)3}{GM}}$	$1\frac{1}{2}$	5
	b)	Geostationary satellite- Used in telecommunications Polar satellites- Used in Remote sensing	1 1	
30	a)	For a steady flow of an incompressible non viscous fluid through a pipe;the sum of the pressure, kinetic energy per unit volume and potential energy per unit volume is a constant.  Work done on the fluid at the region BC is $W_1 = F_1.S_1$ ie $W_1 = P_1A_1.v_1\Delta t = P_1\Delta v$ Similarly at region DE $W_2 = P_2\Delta v$ Net work done $\Delta W = W_1 - W_2 = (P_1 - P_2)\Delta v$ Work-energy theorem states that a part of this work is used to change the KE and the other half is used to change the PE. ie $\Delta W = \Delta KE + \Delta PE$ ------------(1) $\Delta KE = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$ $= \frac{1}{2}\rho\Delta v(v_2^2 - v_1^2)$ $\Delta PE = mgh_2 - mgh_1 = \rho\Delta vg(h_2 - h_1)$ Substituting these values of ΔW, ΔKE and ΔPE in (1) $P_1 + \frac{1}{2}\rho v_1^2 + \rho gh_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho gh_2$ Or, $P + \frac{1}{2}\rho v^2 + \rho gh$ is a constant	4	

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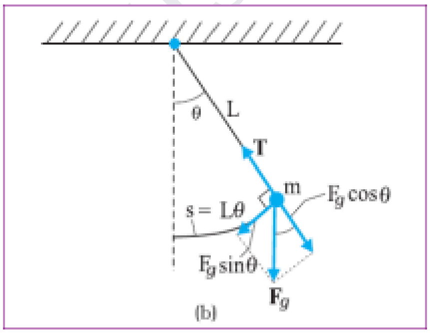
Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
	b)	1. Fluid must be incompressible 2. The flow must be steady	$\frac{1}{2}$ $\frac{1}{2}$	5
31	a)	PV = Constant	1	5
	b)	Let an ideal gas go from a state (P_1,V_1) to a state (P_2,V_2) at constant temperature T. Then for a small change in volume dV , work done, $dW = PdV$ Therefore the total work done, $W = \int_{V_1}^{V_2} P\,dV$ $= \mu RT \int_{V_1}^{V_2} \frac{dV}{V} = \mu RT \ln \frac{V_2}{V_1}$	1 1 1	
	c)	Efficiency, $\eta = 1 - \frac{T_2}{T_1}$ $= 1 - 293/398$ $= 0.2638 = 26.38\%$	1	
32	a)	 The radial component of force $F_g \cos\theta$ is cancelled by tension The tangential component $F_g \sin\theta$ produces restoring torque, $\tau = -LF_g \sin\theta$ For rotational motion , $\tau = I\alpha$ Therefore $-LF_g \sin\theta = I\alpha$	1	

Qn No.	Qn Sub No.	Scoring Indicators	Split score	Total
		Or $-Lmg\sin\theta = I\alpha$ If θ is small $\sin\theta \approx \theta$. Therefore $$\alpha = -\frac{mgL}{I}\theta$$ This is the equation for a simple harmonic motion. Therefore the oscillations of a simple pendulum are simple harmonic	1	5
	b)	$$T = 2\pi\sqrt{\frac{L}{g}}$$	1	
	c)	Pendulum whose time period is 2s is called as seconds pendulum. $$T = 2\pi\sqrt{\frac{L}{g}}$$ Therefore $$L = \frac{gT^2}{4\pi^2}$$ $= 9.8 \times 4 / (4\pi^2) = 1m$	1 1	

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