DIRECTORATE OF GOVERNMENT EXAMINATIONS. CHENNAI -6

HIGHER SECONDRAY FIRST YEAR EXAMINATION – MAY 2022

PHYSICS KEY ANSWER

NOTE:

1. Answers written with Blue or Black ink only to be evaluated.
2. Choose the most suitable answer in Part A from the given alternatives and write the option code and their corresponding answer.
3. For answers in Part – II, Part – III, Part – IV like reasoning, explanation, narration, description and listing of points, students may write in their own words but without changing the concepts and without skipping any point.
4. In numerical problems if formula is not written, marks should be given for the remaining correct steps.
5. In graphical representation, physical variables for X-axis and Y-axis should be marked.

TOTAL MARKS: 70

PART – I **Answer all the questions. 15×1 = 15**

Q. NO	OPTION	TYPE – A	Q. NO	OPTION	TYPE – B
1	a	-z direction	1	c	100 Hz and 6 m
2	a	27/17	2	b	inertia of direction
3	b	inertia of direction	3	a	-9 ms^{-1} and 5 ms^{-1}
4	a	9.86	4	b	$R_{30}{}^{o} = R_{60}{}^{o}$
5	c	stress	5	b	$M^oL^oT^o$
6	b	pure rotation	6	a	26.8 %
7	b	$R_{30}{}^{o} = R_{60}{}^{o}$	7	c	stress
8	d	2 times of original value	8	a	-z direction
9		Mere attempt	9	a	27/17
10	d	g/2	10		Mere attempt
11	b	$M^oL^oT^o$	11	d	$T \propto \frac{1}{\sqrt{g^2 + a^2}}$
12	a	26.8 %	12	b	pure rotation
13	a	-9 ms^{-1} and 5 ms^{-1}	13	d	g/2
14	c	100Hz and 6m	14	a	9.86
15	d	$T \propto \frac{1}{\sqrt{g^2 + a^2}}$	15	d	2 times of original value

PART – II Answer any Six questions: Q.No 24 is Compulsory. 6×2=12

16	Reynold's number is a dimensionless number, which is used to find out the nature of the flow of the liquid. (or) It is the number which is used to find out the nature of the flow of fluid whether it is streamlined or turbulent. $R_c = \frac{\rho VD}{\eta}$ (equation only)	1 1	2
17	Degrees of freedom The minimum number of independent coordinates needed to specify the position and configuration of a thermo dynamical system in space is called the degree of freedom of the system.		2
18	$d = \frac{vt}{2}$ or (equivalent formula) $\frac{1460 \times 80}{2}$ d = 58400 m (or) 58.4 km	½ ½ ½+½	2
19	Wien's displacement Law Wien's Law states that the wavelength of maximum intensity of emission of a black body radiation is inversely proportional to the absolute temperature of the black body. (or) $\lambda_m \propto \frac{1}{T}$ (or) $\lambda_m = \frac{b}{T}$ (equation only)	1 1	2
20	Gravitational potential The gravitational potential at a distance *r* due to a mass is defined as the amount of work required to bring unit mass from infinity to the distance *r*. (or) any other equivalent definition $V = \frac{-Gm}{r}$ (equation only)	1 1	2
21	Simple harmonic motion 1. The acceleration or force on the particle is directly proportional to its displacement from a fixed point and is always directed towards that fixed point. (or) 2. The simple Harmonic motion can also be defined as the motion of the projection of a particle on any diameter of a circle of reference $a \propto y$ (or) $a = -ky$ (or) $F = -kr$	1 1	2
22	Newtons's Second law: The force acting on an object is equal to the rate of change of its momentum. (or) $\vec{F} = \frac{d\vec{p}}{dt}$ Equation only	1 1	2

23	State conservation of angular momentum: When no external torque acts on the body, the net angular momentum of a rotating rigid body remains constant. (or) $\tau = \frac{dL}{dt}$ (or) L=Constant	1	2
24	$V = \frac{dx}{dt}$ $V = \frac{d}{dt}(2 - 5t + 6t^2)$ ∴Initial Velocity = - 5 m/s	½ ½ ½+½	2

PART – III

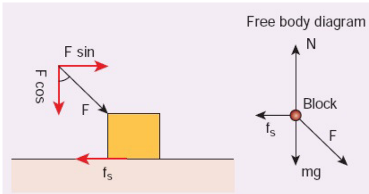
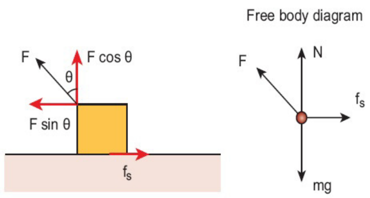
Answer any Six questions :Q.No 33 is Compulsory. **6×3=18**

25

S. No	Elastic Collision	Inelastic Collision
1.	Total momentum is conserved.	Total momentum is conserved.
2.	Total kinetic energy is conserved.	Total kinetic energy is not conserved.
3.	Forces involved are conservative forces	Forces involved are non-conservative forces.
4.	Mechanical energy is not dissipated.	Mechanical energy is dissipated into heat, light, sound etc.

Any 3 points — 3

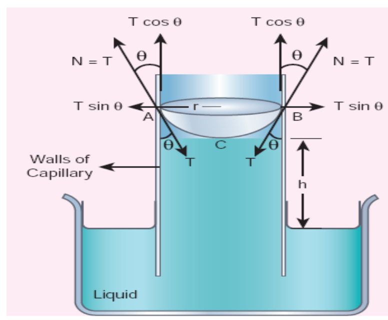
26	**The Law of Transverse vibrations in stretched strings.** **The law of Length:** For a given tension (T) and mass per unit length (µ), the frequency is inversely proportional to vibrating length (*l*) (or) $i.e. \quad f \propto \frac{1}{l}$; Equation only --- ½ **The law of Tension:** For a given vibrating length (*l*) and mass per unit length (µ), the frequency is directly proportional to square root of the tension (T). (or) $i.e. \quad f \propto \sqrt{T}$; Equation only --- ½ **The law of Mass:** For a given vibrating length (*l*) and tension (T), the frequency is inversely proportional to square root of the mass per unit length (µ). (or) $i.e. \quad f \propto \frac{1}{\sqrt{\mu}}$; Equation only ---½	1 1 1	3

27	It is easier to pull an object than to push to make it move.  (Any one Diagram) N_{push}= mg + Fcosθ(or) Equivalent equation  (Any one Diagram) N_{pull} = mg –Fcosθ (or) Equivalent equation	1 ½ ½ ½ ½	3
28	$\vec{A} \times \vec{B}$ $= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & -2 & 1 \\ 5 & 3 & -4 \end{vmatrix}$ (or) $= (8-3)\hat{\imath} + [5-(-16)]\,\hat{\jmath} + [12-(-10]\,\hat{k}$ Answer: $\vec{A} \times \vec{B} = 5\,\hat{i} + 21\,\hat{j} + 22\,\hat{k}$	1 1 1	3
29	Polar satellites: 1. The satellites which orbiting Earth from north to south at the height of 500 to 800 km from the surface of Earth are called Polar satellites. 2. The time period of a polar satellite is nearly 100 minutes. So they completes many revolutions in a day. 3. A Polar satellite cover a small strip of area from pole to pole during one revolution. 4. In the next revolution it covers a different strip of area, since the Earth would have moved by a small angle. 5. In this way polar satellites cover the entire surface area of the Earth .	Any 3 points 3×1	3
30	Applications of Viscosity: 1) The oil used as a lubricant for heavy machinery parts should have a high viscous coefficient. To select a suitable lubricant, we should know its viscosity and how it varies with temperature. 2) The highly viscous liquid is used to damp the motion of some instruments and is used as brake oil in hydraulic brakes. 3) Blood circulation through arteries and veins depends upon the viscosity of fluids. 4) Millikan conducted the oil drop experiment to determine the charge of an electron. He used the knowledge of viscosity to determine the charge.	Any 3 points 3×1	3

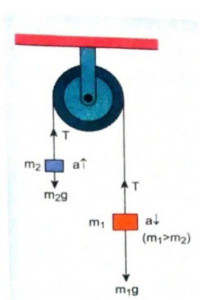
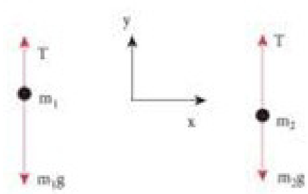
31	Torque is defined as the moment of the external applied force about a point or axis of rotation. (or) $\vec{\tau} = \vec{r} \times \vec{F}$ ------1 Examples: The opening and closing of a door. The hinges and turning of a nut using a wrench.	2 1	3
32	Periodic motion Any motion which repeats itself in a fixed time interval is known as periodic motion. Examples : (Any two examples) Hands in pendulum clock, swing of a cradle, the revolution of the Earth around the Sun, waxing and waning of Moon, etc. Non-Periodic motion Any motion which does not repeat itself after a regular interval of time is known as non-periodic motion. Example : (Any two examples) Occurance of Earth quake, eruption of volcano, etc.	½ ½+½ ½ ½+½	3
33	Work done on the system W = -30kJ = -30,000 J (½ Mark) Heat flowing out of the system Q = - 5 Kcal = - 5 x 4184 (½ Mark) = - 20920 J Δ u = Q – w (1 Mark) = - 20920 – (-30,000) = 9080 J (½+½ Mark) **(Another Method)**	 ½ ½ 1 1	3
	1 Kcal = 4186 W = -30 KJ = -30,000 J (½ Mark) Q = - 5 Kcal = - 5 x 4186 (½ Mark) = - 20930 J Δ u = Q – w (1 Mark) = - 20930 – (-30,000) =9070 J (½+½ Mark)	 ½ ½ 1 1	3

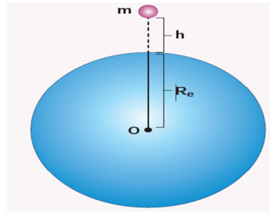
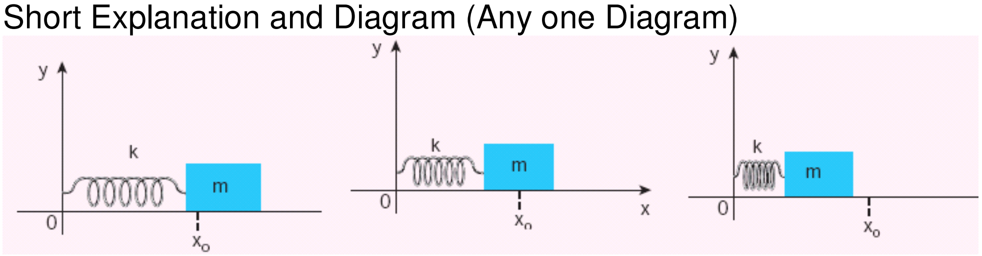
PART – IV

Answer all the questions. **5×5 = 25**

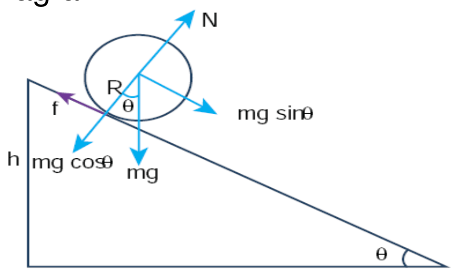
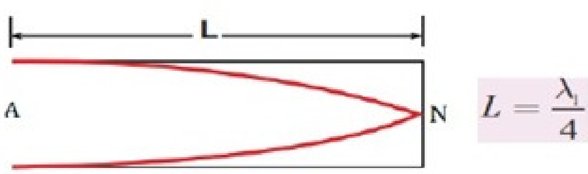
Q.No			
34 a)i)	**Applications of Dimensional Analysis.** 1. Convert a physical quantity from one system of units to another. 2. Check the dimensional correctness of a given physical equation. 3. Establish relations among various physical quantities.	3	5
ii)	$[M]\ [LT^{-1}]^2 = [M]\ [LT^{-2}]\ [L]$	1	
	$[ML^2T^{-2}] = [ML^2T^{-2}]$ **(or)** The given equation is dimensionally correct	1	
34 b)	**The surface tension of a liquid by capillary rise method.** **Theory explanation** **Diagram**	1	5
		1	
	$V = \pi r^2 h + \left(\pi r^2 \times r - \frac{2}{3}\pi r^3\right) \Rightarrow V = \pi r^2 h + \frac{1}{3}\pi r^3$	1	
	$2\pi r T\cos\theta = \pi r^2\left(h + \frac{1}{3}r\right)\rho g \Rightarrow T = \frac{r\left(h + \frac{1}{3}r\right)\rho g}{2\cos\theta}$	1	
	$T = \frac{r\rho g h}{2\cos\theta}$	1	

35 a)	**Definition of equipartition of energy** **Definition :** According to kinetic theory, the average kinetic energy of system of molecules in thermal equilibrium at temperature T is uniformly distributed to all degrees of freedom (x or y or z), so that each degree of freedom will get $\frac{1}{2}\boldsymbol{kT}$ of energy. This is called equipartition of energy.	2	5
	<u>Average Kinetic energy of mono , di and tri atomic molecules</u> : **1)** For mono atomic molecule, $f = 3$. So the average kinetic energy is , $[KE] = 3\ X\ \frac{1}{2}\ k\,T = \frac{3}{2}\ k\,T$	1	
	2) For di atomic molecule, at low temperature, $f = 5$. So the average kinetic energy $[KE_{low}] = 5\ X\ \frac{1}{2}\ k\,T = \frac{5}{2}\ k\,T$	½	
	For di atomic molecule, at high temperature, $f = 7$. So the average kinetic energy $[KE_{high}] = 7\ X\ \frac{1}{2}\ k\,T = \frac{7}{2}\ k\,T$	½	
	3) For Linear tri atomic molecule, $f = 7$. So the average kinetic energy is $[KE_{linear}] = 7\ X\ \frac{1}{2}\ k\,T = \frac{7}{2}\ k\,T$	½	
	For Non - Linear tri atomic molecule, $f = 6$. So the average kinetic energy is $[KE_{non-linear}] = 6\ X\ \frac{1}{2}\ k\,T = 3\ k\,T$	½	
35 b)	Kinematic equations of motion for constant acceleration. i) Velocity - time relation $a = \frac{dv}{dt}$ or $dv = a\,dt$ $\int_u^v dv = \int_0^t a\,dt = a\int_0^t dt \Rightarrow [v]_u^v = a[t]_0^t$ $v - u = at \quad (or) \quad v = u + at$	1½	5
	ii) Displacement – time relation $v = \frac{ds}{dt}\ or\ ds = v dt$ and since $v = u + at$, We get $ds = (u + at)\,dt$ $\int_0^s ds = \int_0^t u\,dt + \int_0^t at\,dt \quad (or) \quad s = ut + \frac{1}{2}at^2$	1½	

	iii) Velocity – displacement relation $a = \frac{dv}{dt} = \frac{dv}{ds}\frac{ds}{dt} = \frac{dv}{ds}v$ [since ds/dt = v] where s is displacement traversed. This is rewritten as $a = \frac{1}{2}\frac{d}{ds}(v^2)$ or $ds = \frac{1}{2a}d(v^2)$ $\int_0^s ds = \int_u^v \frac{1}{2a}d\left(v^2\right)$ $\therefore s = \frac{1}{2a}\left(v^2 - u^2\right)$ $\therefore v^2 = u^2 + 2as$ $s = \frac{(u+v)}{2}\ t$ (or) (write only 4 Equations of motion) ---------------------- 2 Marks	1½ ½	
36 a)	The motion of blocks connected by a string in vertical motion. Explanation $T\hat{j} - m_2 g\hat{j} = m_2 a\hat{j}$ $T\hat{j} - m_1 g\hat{j} = -m_1 a\hat{j}$ Free body diagram  (or)  $a = \left[\frac{m_1 - m_2}{m_1 + m_2}\right] g$ $T = m_2 g + m_2\left(\frac{m_1 - m_2}{m_1 + m_2}\right) g$ $T = \left(\frac{2m_1 m_2}{m_1 + m_2}\right) g$	1 ½+½ 1 1 1	5

36 b)	Acceleration due to gravity Consider an object of mass m at a height h from the surface of the Earth.	1	5
	Diagram 	½	
	$$g' = \frac{GM}{(R_e + h)^2}$$	1	
	$$g' = \frac{GM}{R_e^{\,2}}\left(1 + \frac{h}{R_e}\right)^{-2}$$	1	
	$$g' = \frac{GM}{R_e^{\,2}}\left(1 - 2\frac{h}{R_e}\right)$$ (or) $$g' = g\left(1 - 2\frac{h}{R_e}\right)$$ (Any one equation)	1	
	g'< g. This means that as altitude h increases the acceleration due to gravity g decreases.	½	
37 a)	Horizontal oscillations of a spring. Short Explanation and Diagram (Any one Diagram)		5
		1	
	$F \propto x$ (or) $F = -k\,x$	1	
	$$m\frac{d^2x}{dt^2} = -k\,x$$ (or) $$\frac{d^2x}{dt^2} = -\frac{k}{m}x$$	1	

	$\omega^2 = \frac{k}{m}$ (or) $\omega = \sqrt{\frac{k}{m}}$ rad s^{-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 ½+½	
37 b)	Work-kinetic energy theorem Definition Work and energy are equivalents. This is true in the case of kinetic energy also. To prove this, let us consider a body of mass m at rest on a frictionless horizontal surface. $W = Fs$ $F = ma$ $v^2 = u^2 + 2as$ $a = \frac{v^2 - u^2}{2s}$ $F = m\left(\frac{v^2 - u^2}{2s}\right)$ upto this equation $W = m\left(\frac{v^2}{2s}s\right) - m\left(\frac{u^2}{2s}s\right)$ $W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ $\Delta KE = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ Thus, $W = \Delta KE$ **The work-kinetic energy theorem inferences: (Any 2 Points)** 1. If the work done by the force on the body is positive then its kinetic energy increases. 2. If the work done by the force on the body is negative then its kinetic energy decreases. 3. If there is no work done by the force on the body then there is no change inits kinetic energy, which means that the body has moved at constant speed provided its mass remains constant.	1 ½+½ 1 ½ ½ 1	5

38 a)	Rolling on inclined plane and arrive at the expression for the acceleration.		5
	Explanation	1	
	Diagram 	1	
	$$mg\sin\theta - f = ma$$	1	
	$$mg\sin\theta - ma\left(\frac{K^2}{R^2}\right) = ma$$ $$mg\sin\theta = ma + ma\left(\frac{K^2}{R^2}\right)$$ $$a\left(1+\frac{K^2}{R^2}\right) = g\sin\theta$$ upto this equation	1	
	$$a = \frac{g\sin\theta}{\left(1+\frac{K^2}{R^2}\right)}$$	1	
38 b)	Closed organ pipe It is a pipe with one end closed and the other end open.	½	
	$$L = \frac{\lambda_1}{4} \quad (or) \quad \lambda_1 = 4L$$ $$\therefore \quad f_1 = \frac{v}{\lambda_1} = \frac{v}{4L}$$ 	1½	5

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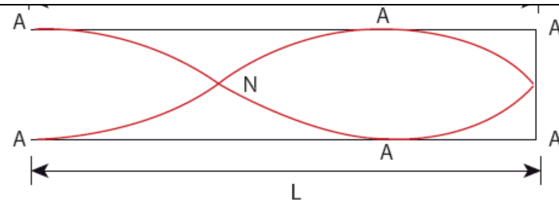
<td>

$4L = 3\lambda_2 \quad L = \frac{3\lambda_2}{4}$ or $\lambda_2 = \frac{4L}{3}$
$f_2 = \frac{3V}{4L} = 3f_1$</td>
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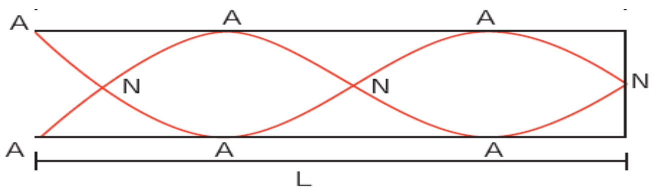
<td>

$4L = 5\lambda_3 \, (or) L = \frac{5\lambda_3}{4} \, (or) \lambda_3 = \frac{4L}{5}$
$f_3 = \frac{5V}{4L} = 5f_1$
3 Diagrams only = ----------------- ½+½+½ = 1½</td>
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