SHRI VIDHYABHARATHI MATRIC HR.SEC.SCHOOL

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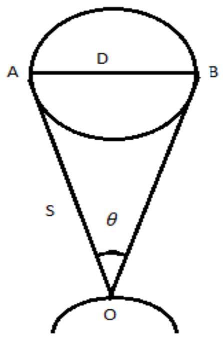
STD: XI

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

Q.N	SECTION - I		MARKS
	OPTION	ANSWER	
1	d)	4	1
2	d)	$[ML^{-1}T^{0}]$	1
3	a)	increases	1
4	b)	10 %	1
5	c)	20 m	1
6	c)	2 : 1	1
7	c)	C	1
8	b)	Only in rotational frames	1
9	d)	1 : 2	1
10	d)	0.6 %	1
11	c)	$\sqrt{5gR}$	1
12	a)	increases	1
13	b)	L/2	1
14	c)	$\sqrt{2}v_0$	1
15	b)	work	1

16	$A = \pi r^2$ $= 3.14 \times 3.12 \times 3.12 = 30.566016$ According to the rule of significant figures $A = 30.6\ m^2$	½ ½ 1
17	When an object is thrown in the air with some initial velocity (NOT just upwards), and then allowed to move under the action of gravity alone, the object is known as a projectile. 1. An object dropped from window of a moving train. 2. A bullet fired from a rifle.	1 1
18	Idealized mass is called "point mass". It has no internal structure like shape and size. Mathematically a point mass has finite mass with zero dimension. To analyse the motion of Earth with respect to Sun, Earth can be treated as a point mass. If we throw an irregular object like a small stone in the air, to analyse its motion it is simpler to consider the stone as a point mass as it moves in space.	1 1
19	The coefficient of static friction between the tyre and the surface of the road determines what maximum speed, the car can have for safe turn. $$\mu_s < \frac{v^2}{rg} (skid)$$ If the static friction is not able to provide enough centripetal force to turn, the vehicle will start to skid	2
20	$F = \frac{mv^2}{r} = \frac{60 \times 50 \times 50}{10} = 15{,}000\ N$	2
21	Correct Definition	2
22	Any Four Points Each Point Carries ½ Marks	2
23	A point where the entire mass of the body appears to be concentrated. A point where the entire weight of the body appears to be concentrated.	1 1

Q.N		MARKS
24	The required speed at the highest point $v_2 = \sqrt{gr} = \sqrt{10 \times 0.5} = \sqrt{5}\ \mathrm{m}s^{-1}$. The speed at lowest point $v_1 = \sqrt{5gr} = \sqrt{5} \times \sqrt{gr} = \sqrt{5}$ $\times \sqrt{5}\ = 5\ \mathrm{m}s^{-1}$	2
Q.N	**SECTION - III**	**MARKS**
25	Let AB=D be the diameter of the moon which is to be measured from the earth by an observer A. A telescope is focused on the moon and angle AOB is found.  Since $\theta = \frac{Arc}{Radius} = \frac{D}{S}$ D = S.θ i.e., Linear diameter =Distance x Angular diameter	3
26	Definition Any four properties Each property carries ½ mark	1 2
27	$R = \frac{u^2 \sin 2\theta}{g}$ $\theta = \pi/4$ $u=$ $v_0 = 10m\ s^{-1}$ $\therefore R_{earth} = \frac{(10)^2\ \sin \pi/2}{9.8} = 100/9.8$ $R_{earth} = 10.20\ m$ (Approximately 10 m) $g_{moon} = \frac{g}{6}$ $R_{moon} = \frac{u^2 \sin 2\theta}{g_{moon}} = \frac{v_0^{\ 2} \sin 2\theta}{g/6}$ $\therefore R_{moon} = 6R_{earth}$ $R_{moon} = 6 \times 10.20 = 61.20\ m$ (Approximately 60 m)	1 ½ 1 ½

28

Static friction	Kinetic friction
It opposes the starting of motion	It opposes the relative motion of the object with respect to the surface
Independent of surface of contact	Independent of surface of contact
μ_s depends on the nature of materials in mutual contact	μ_k depends on nature of materials and temperature of the surface
Depends on the magnitude of applied force	Independent of magnitude of applied force
It can take values from zero to $\mu_s N$	It can never be zero and always equals to $\mu_k N$ whatever be the speed (true $< 10\ ms^{-1}$)
$f_s^{max} > f_k$	It is less than maximal value of static friction
$\mu_s > \mu_k$	Coefficient of kinetic friction is less than coefficient of static friction

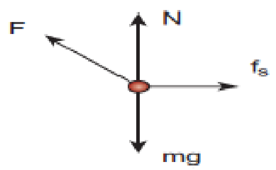
3

29

An object pushed at an angle θ :

- $N_{push} = mg + F\ \cos\theta$ ....(1)
- $f_s^{max} = \mu_s(mg + F\ \cos\theta)$

Free body diagram



1 ½

An object pulled at an angle θ :

- $N_{pull} = mg - F\ \cos\theta$ ....(2)
- $N_{pull} < N_{push}$
- It is easier to pull an object than to push to make it move

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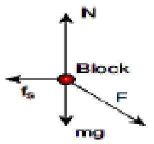


1 ½

30

Explanation

½

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\vec{v}.\vec{v}\right)$$

1

$$KE = \frac{1}{2}\frac{m^2\left(\vec{v}.\vec{v}\right)}{m}$$

$$= \frac{1}{2}\frac{\left(m\vec{v}\right).\left(m\vec{v}\right)}{m} \quad [\vec{p} = m\vec{v}]$$

$$= \frac{1}{2}\frac{\vec{p}\cdot\vec{p}}{m}$$

$$= \frac{p^2}{2m} \qquad K\,E = \frac{p^2}{2m}$$

1 ½

$$\left|\vec{p}\right| = p = \sqrt{2m\ (KE)}$$

31	P = (resistive force + mass × acceleration) (velocity) $P = \vec{F}_{-tot}\vec{v} = (F_{resistive} + F)\vec{v}$ $P = \vec{F}_{tot} \cdot \vec{v} = (F_{resistive} + ma)\vec{v}$ = [500 + (1250 x 0.25)] x 30 = 24.375 kW	1 1 1
32	Torque is defi ned as the moment of the external applied force about a point or axis of rotation. Its unit is Nm. To mention a few; the opening and closing of a door about the hinges and turning of a nut using a wrench.	1 1 1
33	$m_1 = 10\,kg$ $m_2 = 5\,kg$ $\vec{r}_1 = (-3\hat{i} + 2\hat{j} + 4\hat{k})\,m$ $\vec{r}_2 = (3\hat{i} + 6\hat{j} + 5\hat{k})\,m$ $\vec{r} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2}$ $\therefore \vec{r} = \frac{10(-3\hat{i} + 2\hat{j} + 4\hat{k}) + 5(3\hat{i} + 6\hat{j} + 5\hat{k})}{10+5}$ $= \frac{-30\hat{i} + 20\hat{j} + 40\hat{k} + 15\hat{i} + 30\hat{j} + 25\hat{k}}{15}$ $= \frac{-15\hat{i} + 50\hat{j} + 65\hat{k}}{15}$ $\vec{r} = \left(-\hat{i} + \frac{10}{3}\hat{j} + \frac{13}{3}\hat{k}\right)\,m$	1 1 1
Q.N	**SECTION - IV**	**MARKS**
34 (a)	$T \;\alpha\; m^a l^b g^c$ $T = k.\quad m^a l^b g^c$	1

$[T^1] = [M^a]\ [L^b]\ [LT^{-2}]^c$ 1

$[M^0L^0T^1] = [M^a\ L^{b+c}\ T^{-2c}]$

Comparing the powers of M, L and T on both sides, a=0, b+c=0, -2c=1

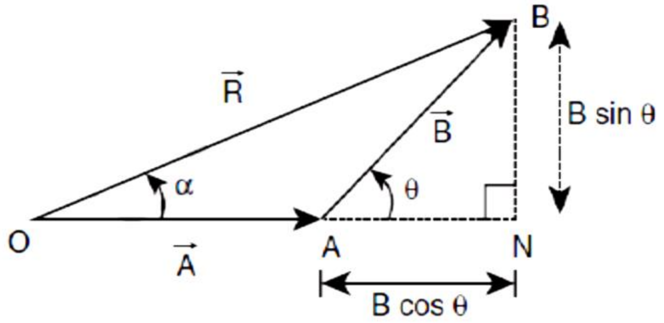
Solving for a,b and c a = 0, b = 1/2, and c = −1/2 2

From the above equation $T = k.\ m^0\ \ell^{1/2} g^{-1/2}$

$$T = k\left(\frac{\ell}{g}\right)^{1/2} = k\sqrt{\ell/g}$$ 1

k = 2π, hence $T = 2\pi\sqrt{\ell/g}$

34 (b)



1

Triangle law of vector addition:

Represent the vectors $\vec{A}$ and $\vec{B}$ by the two adjacent sides of a triangle taken in the same order, then the resultant is given by the third side of the triangle. 1

Magnitude of resultant vector:

- $AN = B\cos\theta$
- $BN = B\sin\theta$
- For $\Delta\, OBN$, $OB^2 = ON^2 + BN^2$
- $R^2 = (A + B\cos\theta)^2 + (B\sin\theta)^2$
- $R^2 = A^2 + B^2\cos^2\theta + 2AB\cos\theta + B^2\sin^2\theta$
- $R^2 = A^2 + B^2(\cos^2\theta + \sin^2\theta) + 2AB\cos\theta$
- $R^2 = A^2 + B^2 + 2AB\cos\theta$ 2
- $R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

Direction of resultant vector:

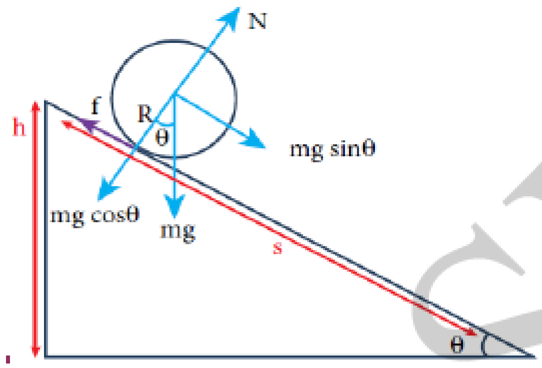
- $\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta}$ 1
- $\alpha = \tan^{-1}\left(\frac{B\sin\theta}{A + B\cos\theta}\right)$

35 (a)	Each error type with explanation carries one mark	5
35 (b)	The total initial kinetic energy of the bodies (before collision) is not equal to the total final kinetic energy of the bodies (after collision) then, it is called as inelastic collision. i.e., Total kinetic energy before collision ≠ Total kinetic energy after collision	1
	$KE_i = \frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2$	1
	$KE_f = \frac{1}{2}(m_1 + m_2)v^2$	1
	$\Delta Q = KE_i - KE_f$ $= \frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \frac{1}{2}(m_1 + m_2)v^2$	1
	Loss of KE, $\Delta Q = \frac{1}{2}\left(\frac{m_1m_2}{m_1 + m_2}\right)(u_1 - u_2)^2$	1
36 (a)	(table below)	5

velocity - time	displacement - time	velocity - acceleration
$a = \frac{dv}{dt}$	$v = \frac{ds}{dt}$	$a = \frac{dv}{ds}v$
$dv = a\,dt$	$ds = (u + at)dt$	$ds = \frac{1}{2a}d(v^2)$
$\int_u^v dv = \int_0^t a dt$	$\int_0^s ds = u\int_0^t dt + a\int_0^t t\,dt$	$\int_0^s ds = \frac{1}{2a}\int_u^v d(v^2)$
$v = u + at$	$s = ut + \frac{1}{2}at^2$	$v^2 = u^2 + 2as$
	$s = \frac{(u + v)t}{2}$	

36 (b)

Explanation — 1



1

* $mg\sin\theta - f = ma$
* $Rf = I\alpha$
* $I = MK^2$

* $\alpha = \frac{a}{R}$
* $f = ma\left(\frac{K^2}{R^2}\right)$
* $a = \frac{g\sin\theta}{\left(1+\frac{K^2}{R^2}\right)}$
* $v = \sqrt{\frac{2gh}{\left(1+\frac{K^2}{R^2}\right)}}$ — 3
* $t = \sqrt{\frac{2h\left(1+\frac{K^2}{R^2}\right)}{g\sin^2\theta}}$

37 (a)

If there are no external forces acting on the system, then the total linear momentum of the system is always a constant vector. — 1

Explanation — 1

- $\vec{F}_{12} = -\vec{F}_{21}$
- $\vec{F}_{12} = \frac{d\vec{p}_1}{dt}, \vec{F}_{21} = \frac{d\vec{p}_2}{dt}$
- $\frac{d\vec{p}_1}{dt} = -\frac{d\vec{p}_2}{dt}$ — 3
- $\frac{d\vec{p}_1}{dt} + \frac{d\vec{p}_2}{dt} = 0$
- $\frac{d}{dt}(\vec{p}_1 + \vec{p}_2) = 0$
- $\vec{p}_{tot} = \vec{p}_1 + \vec{p}_2$

37 (b)	Diagram Explanation $\mathrm{dI} = (\mathrm{dm})\mathrm{r}^2$ $\sigma = \frac{\text{mass}}{\text{area}} = \frac{\mathrm{M}}{\pi \mathrm{R}^2}$ $\mathrm{dm} = \sigma 2\pi \mathrm{r}\mathrm{dr} = \frac{\mathrm{M}}{\pi \mathrm{R}^2} 2\pi \mathrm{r}\mathrm{dr}$ Upto $\mathrm{dI} = \frac{2\mathrm{M}}{\mathrm{R}^2}\mathrm{r}^3\mathrm{dr}$ $\mathrm{I} = \int \mathrm{dI}$ $\mathrm{I} = \int_0^{\mathrm{R}} \frac{2\mathrm{M}}{\mathrm{R}^2} r^3 \mathrm{dr} = \frac{2\mathrm{M}}{\mathrm{R}^2}\int_0^{\mathrm{R}} r^3 \mathrm{dr}$ $\mathrm{I} = \frac{2\mathrm{M}}{\mathrm{R}^2}\left[\frac{r^4}{4}\right]_0^R = \frac{2\mathrm{M}}{\mathrm{R}^2}\left[\frac{R^4}{4} - 0\right]$ $\mathrm{I} = \frac{1}{2}\mathrm{MR}^2$	1 1 ½ ½ 3
38 (a)	The potential energy possessed by a spring due to a deforming force which stretches or compresses the spring is termed as elastic potential energy. Explanation Diagram $\vec{\mathrm{F}}_a = -\vec{\mathrm{F}}_s$ $\vec{\mathrm{F}}_s = -\mathrm{k}\vec{x}$ $\mathrm{U} = \int \vec{F}_a . d\vec{r} = \int_0^x \lvert\vec{\mathrm{F}}_a\rvert \lvert \mathrm{d}\vec{\mathrm{r}}\rvert \cos\theta$ $= \int_0^x F_a \mathrm{dx}\cos\theta$ $U = \int_0^x kx\mathrm{d}x$ $\mathrm{U} = \mathrm{k}\left[\frac{x^2}{2}\right]_0^x$ $\mathrm{U} = \frac{1}{2}kx^2$	1 1 1 2

	upto $U=\frac{1}{2}k\left(x_f^2-x_i^2\right)$	
38 (b)	Diagram Explanation $KE_i=\frac{1}{2}m_i v_i^2$ $KE_i=\frac{1}{2}m_i\left(r_i\omega\right)^2=\frac{1}{2}\left(m_i r_i^2\right)\omega^2$ $KE=\frac{1}{2}\left(\sum m_i r_i^2\right)\omega^2$ $I=\sum m_i r_i^2$ $KE=\frac{1}{2}I\omega^2$	1 1 3

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