HIGHER SECONDARY FIRST YEAR EXAMINATION – SEPTEMBER 2023

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 the corresponding answer.
3. For answers in Part-II, Part-III and 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.

PART – I

Answer all the questions. **15x1=15**

Q. No.	OPTION	TYPE – A	Q. No.	OPTION	TYPE – B
1	(d)	7%	9	(d)	1 : 2
2	(d)	$[LT^{-3}]$	10	(b)	3/2 k
3	(d)	None of these	11	(b)	$V_A = 20\ ms^{-1}$ and $V_B = 10\ ms^{-1}$
4	(a)	$1\ ms^{-2}$	12	(a)	Pure rotation
5	(d)	$\frac{2u}{g}$	13	(a)	$L\sqrt{2}$
6	(c)	$\leq$ distance	14	(b)	Decreases
7	(b)	Only in rotating frames	15	(c)	Zero
8	(d)	Both a and b			

PART – II

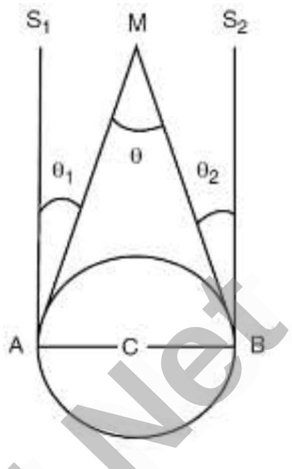
Answer any **six** questions. Question number **24** is compulsory. 6x2=12

16	Newton's law of gravitation states that a particle of mass M_1 attracts any other particle of mass M_2 in the universe with an attractive force. The strength of **this force of attraction** was found to be **directly proportional to the product of their masses and is inversely proportional to the square of the distance between them.**	2	2
	(OR)		
	$\vec{F} = -\frac{GM_1M_2}{r^2}\hat{r}$ (if , formula alone)	1	

17	**Screw gauge:** The screw gauge is an instrument used for measuring accurately the **dimensions of objects up to a maximum of about 50 mm.** The principle of the instrument is the magnification of linear motion using the circular motion of a screw. The least count of the screw gauge is 0.01 mm	2	2
18	**Non Uniform Circular Motion:** If the speed of the object in **circular motion is not constant**, then we have non-uniform circular motion. For example, **when the bob attached to a string moves in vertical circle**	2	2
19	The magnitude of the vector $\hat{r} = 3\hat{i} + 2\hat{j}$ $\lvert\hat{r}\rvert = \sqrt{3^2} + 2^2 = \sqrt{9+4} = \sqrt{13}$; $\hat{r} = \frac{\vec{r}}{\lvert\vec{r}\rvert} = \frac{3\hat{i}+2\hat{j}}{\sqrt{13}}$	2	2
20	**Angle of repose.** The same as angle of friction. But the difference is that the angle of repose refers to **inclined surfaces and the angle of friction is applicable** to any **type of surface.** **Applications of angle of repose: (any 1)** 1. The angle of inclination of **sand trap** is made to be **equal to angle of repose.** 2. Children are fond of **playing on sliding board**. Sliding will be easier when the **angle of inclination of the board is greater** than the **angle of repose.**	1 1	2
21	**Coefficient of restitution:** It is defined as the ratio of **velocity of separation (relative velocity)** after **collision to the velocity of approach (relative velocity)** before collision, i.e., e = $\frac{\text{Velocity of separation (after collision)}}{\text{Velocity of approach (before collision)}}$; $\frac{(v_2-v_1)}{(u_1-u_2)}$	2	2
22	Work done by gravitational force: W= FS =30 x 10= **300 J**	1 1	2
23	A point where the entire mass of the body appears to be concentrated.	2	2
24	$F_{cp} = \frac{mv^2}{r}$; $\frac{\frac{1}{4} \times (2)^2}{3}$ = 0.333N	1 ½ ½	2

PART – II

Answer **any six** questions. Question number **33 is compulsory.** 6x3=18

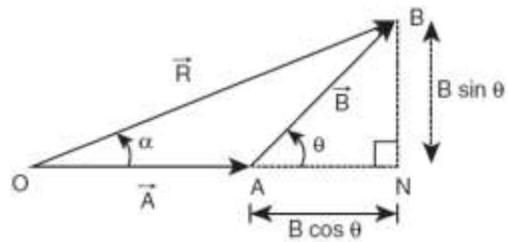
25	**Parallax Method:** **C is the centre of the Earth. A and B** are two diametrically **opposite places on the surface of the Earth**. From A and B, the parallaxes **θ_1 and θ_2** respectively of Moon M with respect to some **distant star are determined with the help of an astronomical telescope.** Thus, the total parallax of the Moon subtended on Earth $\angle AMB = \theta_1 + \theta_2 = \theta$. If θ is measured in radians, then $\theta = \frac{AB}{AM}$; AM≈MC $\theta = \frac{AB}{MC} \Longrightarrow MC = \frac{AB}{\theta}$.Knowing the values of AB and θ, we can calculate the distance MC of Moon from the Earth.  	3	3
26	**Properties of vector (cross) product.** **1)** **The vector product of any two vectors** is always another vector whose direction is **perpendicular to the plane** containing these two vectors, i.e., orthogonal to both the vectors $\vec{A}$ and $\vec{B}$, even though the vectors $\vec{A}$ and $\vec{B}$ may or may not be mutually orthogonal. 2) The **vector product of two vectors is not commutative**, i.e., $\vec{A} x \vec{B} \neq \vec{B} x \vec{A}$ But, $\vec{A} x \vec{B} = -[\vec{B} \text{ x } \vec{A}]$. Here it is worthwhile to note that $\lvert\vec{A} x \vec{B}\rvert = \lvert\vec{B} x \vec{A}\rvert$ = AB Sin θ. i.e. in the case of the product vectors $\vec{A} x \vec{B}$ and $\vec{B} x \vec{A}$, the magnitudes are equal but directions are opposite to each other 3) The **vector product of two vectors will have maximum magnitude** when sin θ = 1, i.e., θ = 90^0 i.e., when the vectors $\vec{A}$ and $\vec{B}$, are orthogonal to each other. $(\vec{A} \text{ x } \vec{B})_{max} = AB\hat{n}$ 4) The **vector product of two non–zero vectors will be minimum** when sin θ = 0, i.e.,θ = 0^0 *or* 180^0 $[\vec{A} \text{ x } \vec{B}]_{min} = 0$ i.e., the vector product of two non–zero vectors vanishes, if the vectors are either parallel or anti-parallel. 5) The self–cross product, i.e., **product of a vector with itself is the null vector $\vec{A}$ x $\vec{A}$ = AA** Sin θ $\hat{n} = \vec{0}$ In physics the null vector $\vec{0}$ is simply denoted as zero. 6) The self–vector products of unit vectors are thus zero. $\hat{\imath} \text{ x } \hat{\imath} = \hat{\jmath} \text{ x } \hat{\jmath} = \hat{k} \text{ x } \hat{k} = \vec{0}$	6 x ½ =3	3

<table>
<tr><td>27</td><td>p = mv
For the mass of 10 g, m = 0.01 kg; p = 0.01 × 10 = 0.1 kg ms^{-1}
For the mass of 1 kg; p = 1 × 10 = 10 kg ms^{-1}
Thus even though both the masses have the same speed, the momentum of the heavier mass is 100 times greater than that of the lighter mass.</td><td>1
1
1</td><td>3</td></tr>
<tr><td>28</td><td>Newton's First law.
Every object continues to be in the state of rest or of uniform motion unless there is external force acting on it.
Newton's second law.
The force acting on an object is equal to the rate of change of its momentum. $\vec{F} = \frac{d\vec{p}}{dt}$
Newton's Third law.
For every action there is an equal and opposite reaction.</td><td>1
1
1</td><td>3</td></tr>
<tr><td>29</td><td><table>
<tr><th>Conservative forces</th><th>Non-conservative forces</th></tr>
<tr><td>Work done is independent of the path</td><td>Work done depends upon the path</td></tr>
<tr><td>Work done in a round trip is zero</td><td>Work done in a round trip is not zero</td></tr>
<tr><td>Total energy remains constant</td><td>Energy is dissipated as heat energy</td></tr>
<tr><td>Work done is completely recoverable</td><td>Work done is not completely recoverable</td></tr>
<tr><td>Force is the negative gradient of potential energy</td><td>No such relation exists.</td></tr>
</table></td><td>1
½
½
1</td><td>3</td></tr>
<tr><td>30</td><td>Translational equilibrium:
1) Linear momentum is constant 2) Net force is zero
Rotational equilibrium:
1) Angular momentum is constant 2) Net torque is zero
Static equilibrium:
1) Linear momentum and angular momentum are zero
2) Net force and net torque are zero
Dynamic equilibrium:
1) Linear momentum and angular momentum are constant
2) Net force and net torque are zero</td><td>1
1
1</td><td>3</td></tr>
<tr><td>31</td><td>Satellites that orbiting the Earth at the height of about 36000 km and appears to be stationary when seen from Earth are called geo stationary satellite. The satellite orbiting the Earth have different time periods corresponding to different radii.
$R_E + h = \left(\frac{GM_E T^2}{4\pi^2}\right)^{1/3}$ India uses INSAT group of satellites that are basically geo- stationary satellites for the purpose of telecommunication.</td><td>1
½
½
1</td><td>3</td></tr>
</table>

32	Power, P = 75 W Time of usage, t = 8 hour × 30 days = 240 hours Electrical energy consumed is the product of power and time of usage. **Electrical energy = power × time of usage = P × t** =75 watt x 240 hour =18000 watt hour =18 kilowatt hour = 18kWh 1 electrical unit = 1kWh ; Electrical energy =18 unit	1 1 1	3
33	t = 80s , v = 1460 ms^{-1}, D = ? $D = \frac{v\,t}{2} = \frac{1460 \times 80}{2}$; = 1460 x 40 ; 58400m **D = 58.4km**	1 1 1	3

PART – IV

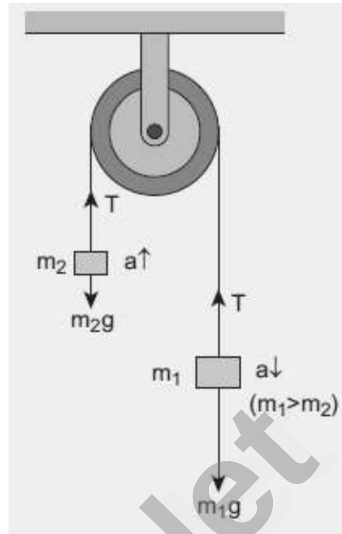
Answer **all** the questions. 5x5=25

34 (a)	**Triangular Law of 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** taken in the **opposite order**. The magnitude of $\vec{R}$ (resultant) is given geometrically by the length of $\vec{R}$ (OQ) and the direction of the resultant vector is the angle between $\vec{R}$ and $\vec{A}$ Thus we write $\vec{R} = \vec{A} + \vec{B}$. ∵ $\overrightarrow{OQ} = \overrightarrow{OP} + \overrightarrow{PQ}$	1	
	Magnitude of resultant vector: (Diagram + Explanation ½ + ½ =1 Consider the triangle ABN, which is obtained by extending the side OA to ON. ABN is a right angled triangle.  	1	5
	$\cos\theta = \frac{AN}{B}$ ∴ AN = B Cos θ *and* $\sin\theta = \frac{BN}{B}$ ∴ BN = B Sin θ	1	
	For ΔOBN, we have $OB^2 = ON^2 + BN^2 \Rightarrow R^2 = (A + B\cos\theta)^2 + (B\sin\theta)^2$ $\Rightarrow R^2 = A^2 + B^2\cos^2\theta + 2AB\cos\theta + B^2\sin^2\theta$ $\Rightarrow R^2 = A^2 + B^2(\cos^2\theta + \sin^2\theta) + 2AB\cos\theta$ $\Rightarrow \mathbf{R = \sqrt{A^2 + B^2 + 2AB\cos\theta}}$	1	
	$\alpha = \tan^{-1}\left(\frac{B\sin\theta}{A + B\cos\theta}\right)$	1	

34 (b)

Case 1: Vertical motion:

i) Consider **two blocks of masses m_1 and m_2 ($m_1 > m_2$)** connected by a light and inextensible string that passes over a pulley. 1



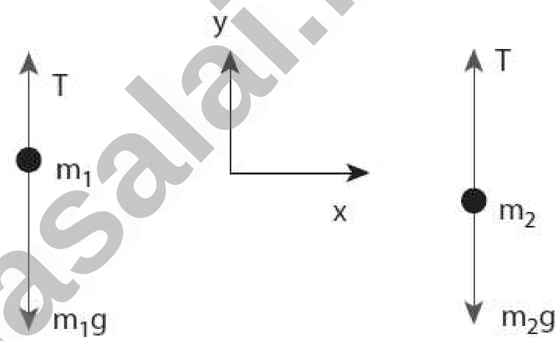
ii) Let the tension in the string be T and acceleration *a*. When the system is released, both the blocks start moving, m_2 vertically upward and m_1 downward with same acceleration. The gravitational force m_1g on mass m_1 is used in lifting the mass m_2.

Applying Newton's second law for mass m_2,

$T\hat{j} - m_2g\hat{j} = m_2a\hat{j}$

iii) The left-hand side of the above equation is the total force that acts on m_2 and the right-hand side is the product of mass and acceleration of m_2 in y direction.

By comparing the components on both sides, we get



$T - m_1g = m_2a$ ----------- (1) 1

Similarly, applying Newton's second law for mass m_1

$T\hat{j} - m_1g\hat{j} = -m_1a\hat{j}$ 5

As mass m1 moves downward ($-\hat{j}$), its acceleration is along($-\hat{j}$)

iv) By comparing the components on both sides, we get

$T - m_1g = -m_1a$; $m_1g - T = m_1a$ ------------ (2) 1

Adding equations (1) and (2), we get

$m_1g - m_2g = m_1a + m_2a$; $(m_1 - m_2)g = (m_1 + m_2)a$ ------- (3)

From equation (3), the acceleration of both the masses is

$a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) g$ ------(4)

If both the masses are equal ($m_1 = m_2$), from equation (4) $a = 0$

v) This shows that if the masses are equal, there is no acceleration and the system as a whole will be at rest. To find the tension acting on the string, substitute the acceleration from the equation (4) into the equation (1).

$T - m_2g = m_2\left(\frac{m_1 - m_2}{m_1 + m_2}\right)$; $T - m_2g + m_2\left(\frac{m_1 - m_2}{m_1 + m_2}\right)g$ --- (5) 1

By taking m2g common in the RHS of equation (5)

$T = m_2g\left(1 + \frac{m_1 - m_2}{m_1 + m_2}\right)$;

$T = m_2g\left(\frac{m_1 + m_2 + m_1 - m_2}{m_1 + m_2}\right)$ 1

$T = \left(\frac{2m_1m_2}{m_1 + m_2}\right)g$

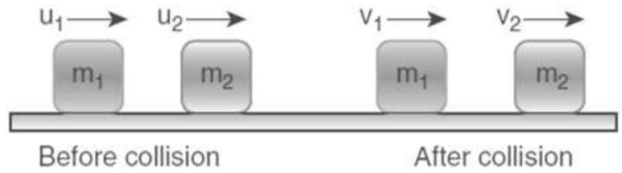
Q.No	Answer	Mark	Total
35 (a)	T ∝ $m^a l^b g^c$;	½	
	T = k $m^a l^b g^c$	½	
	$[T^1] = [M^a]\,[L^b]\,[LT^{-2}]^c$ **(OR)** $[M^0L^0T^1] = [M^a\,L^{b+c}\,T^{-2c}]$	1	
	a = 0, b = ½ , and c = −½	1	5
	T = k $m^0\, l^{1/2}\, g^{-1/2}$ **(OR)** T = k $\left(\frac{l}{g}\right)^{1/2}$ **(OR)** T = k $\sqrt{l/g}$;	1	
	T = 2π $\sqrt{l/g}$	1	

35 (b)

Centripetal force	Centrifugal force	Mark	Total
It is a **real force** which is exerted on the body by the external agencies like gravitational force, tension in the string, normal force etc.	It is **a pseudo force or fictitious force** Which cannot arise from gravitational force, tension force, normal force etc.	1	
Acts in **both inertial and non-inertial frames**	**Acts only in rotating frames** (non-inertial frame)	1	
It **acts** towards the **axis of rotation** or center of the circle in circular motion	It **acts outwards from the axis of rotation** or radially outwards from the center of the circular motion	1	
$\lvert F_{cp}\rvert = m\omega^2 r = \frac{mv^2}{r}$	$\lvert F_{cf}\rvert = m\omega^2 r = \frac{mv^2}{r}$	1	5
Real force and has real effects.	**Pseudo force but has real effects**		
Origin of **centripetal force is interaction between two objects**	Origin of **centrifugal force** is inertia. It does not arise from interaction.	1	
In **inertial frames centripetal force** has to be included when free body diagrams are drawn.	In an inertial frame the object's inertial motion appears as centrifugal force in the rotating frame. In inertial frames there is **no centrifugal force**. In rotating frames, both centripetal and centrifugal force have to be included when free body diagrams are drawn.		

36 (a)	**Significant figure or digits.** The digits that are known reliably plus the first uncertain digit are known as significant figures or significant digits. All **non-zero digits** are significant. Ex.**1342** has **four** significant figures All **zeros between two non-zero** digits are significant. Ex. **2008 has four** significant figures. All **zeros to the right of a non-zero** digit but to the left of a decimal point are significant. Ex. **30700. has five** significant figures. The **number without a decimal point**, the terminal or trailing zero(s) are not significant. Ex. **30700 has three** significant figures. All zeros are significant if they come from a measurement Ex. **30700 m** has **five** significant figures If the number is **less than 1,** the zero (s) on the right of the decimal point but to left of the **first non-zero digit are not significant.** Ex. **0.00345** has **three** significant figures. All zeros to the right of a decimal point and to the right of non-zero digit are significant. Ex. **40.00 has four** significant figures and **0.030400** has **five** significant figures.	1 4	5
36 (b)	Work Energy Principle: Work It states that work done by the force acting on a body is equal to the change produced in the kinetic energy of the body. 2) Consider a body of mass m at rest on a frictionless horizontal surface. 3) The work (W) done by the constant force (F) for a displacement (s) in the same direction is, W = Fs ------------ (1) The constant force is given by the equation, F = ma --------- (2) The **third equation of motion** can be written as, $v^2 = u^2 + 2as$ $a = \frac{v^2-u^2}{2s}$ ------------------ (3) Substituting for a in equation (2), $F = m\left(\frac{v^2-u^2}{2s}\right)$ ------------ (4) Substituting equation (4) in (1), $W = m\left(\frac{v^2}{2s}s\right) - m\left(\frac{u^2}{2s}s\right)$ $W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ -------------------- (5) **The expression for kinetic energy:** i) The term ½ (mv^2) in the above equation is the kinetic energy of the body of mass (m) moving with velocity (v). $KE = \frac{1}{2}mv^2$ ----------------- (6) Kinetic energy of the body is always positive. equations (5) and (6) $\Delta KE = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ ---------------(7) thus, $W = \Delta KE$ iii) The expression on the right hand side (RHS) of equation (7) is the change in kinetic energy (ΔKE) of the body. iv) This implies that **the work done by the force on the body changes the kinetic energy of the body**. This is called work-kinetic energy theorem.	1 1 1 1 1	5

37(a)



Consider two elastic bodies of masses m_1 and m_2 moving in a straight line (along positive x direction) on a frictionless horizontal surface.

i) In order to have collision, we assume that the mass m_1 moves faster than mass m_2 i.e.,$\mu_1 > \mu_2$ For elastic collision, the total linear momentum and kinetic energies of the two bodies before and after collision must remain the same. **1**

From the law of conservation of linear momentum,

Total momentum before collision (pi) = Total momentum after collision (pf)

$\mathbf{m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2}$ ——— (1) (or)

$\mathbf{m_1(u_1 - v_1) = m_2(v_2 - u_2)}$ ---------------- (2)

For elastic collision,

Total kinetic energy before collision KE_i = Total kinetic energy after collision KE_f **1**

$\mathbf{\frac{1}{2} m_1u_1^2 + \frac{1}{2} m_2u_2^2 = \frac{1}{2} m_1v_1^2 + \frac{1}{2} m_2v_2^2}$ ——— (3)

After simplifying and rearranging the terms,

$m_1(u_1^2 - v_1^2) = m_2(v_2^2 - u_2^2)$

Using the formula, $a^2 - b^2 = (a + b)(a - b)$, we can rewrite the above equation as

$\mathbf{m_1(u_1 + v_1)(u_1 - v_1) = m_2(v_2 + u_2)(v_2 - u_2)}$ -------- (4) **5**

Dividing equation (4) by (2) gives,

$$\frac{m_1(u_1+v_1)(u_1-v_1)}{m_1(u_1-v_1)} = \frac{m_2(v_2+u_2)(v_2-u_2)}{m_2(v_2-u_2)}$$ **1**

$\mathbf{u_1 + v_1 = v_2 + u_2}$, Re-arranging $\mathbf{u_1 - u_2 = v_2 - v_1}$ ------------ (5)

Equation (5) can be rewritten as $(u_1 - u_2 = -(v_1 - v_2)$

This means that for any elastic head on collision, the relative speed of the two elastic bodies after the collision has the same magnitude as before collision but in opposite direction. Further note that this result is independent of mass.

Rewriting the above equation for v_1 and v_2 ,

$v_1 = v_2 + u_2 - u_1$ ----------- (6) or $\mathbf{v_2 = u_1 + v_1 - u_2}$ --------------(7) **1**

To find the final velocities v_1 and v_2:

Substituting equation (7) in equation (2) gives the velocity of m_1 as

$m_1(u_1 - v_1) = m_2(u_1 + v_1 - u_2 - u_2)$

$m_1(u_1 - v_1) = m_2(u_1 + v_1 - 2u_2)$

$m_1u_1 - m_1v_1 = m_2u_1 + m_2v_1 - 2m_2u_2$

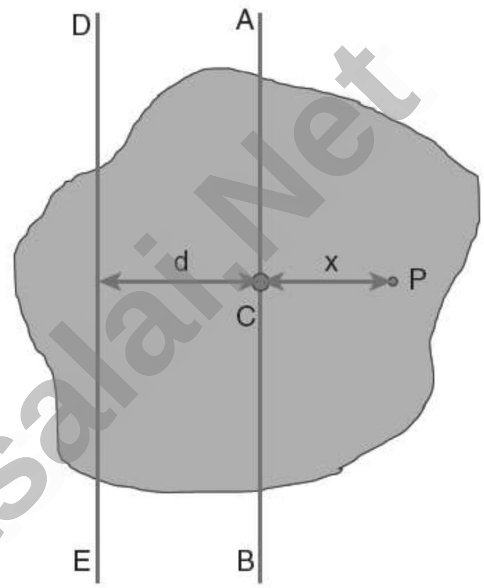
$m_1u_1 - m_2u_1 + 2m_2u_2 = m_1v_1 + m_2v_1$

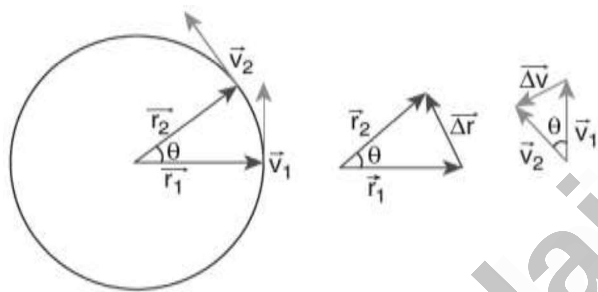
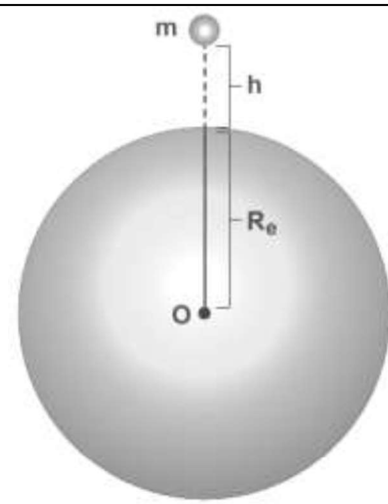
$(m_1 - m_2)u_1 + 2m_2u_2 = (m_1 + m_2)v_1$ **(or)** **1**

$$\mathbf{v_1} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)\mathbf{u_1} + \left(\frac{2m_2}{m_1 + m_2}\right)\mathbf{u_2} \text{ ---------(8)}$$

Similarly, by substituting (6) in equation (2) or substituting equation (8) in equation (7), we get the final velocity of m_2 as

$$\mathbf{v_2} = \left(\frac{2m_1}{m_1 + m_2}\right)\mathbf{u_1} + \left(\frac{m_2 - m_1}{m_1 + m_2}\right)\mathbf{u_2} \text{ --------- (9)}$$

Q.No	Answer	Mark	Total
37 (b)	**Parallel Axis Theorem**: i) Parallel axis theorem states that **the moment of inertia of a body about any axis is equal to the sum of its moment of inertia about a parallel axis through its center of mass and the product of the mass of the body and the square of the perpendicular distance between the two axes.**	1	5
	ii) If IC is the moment of inertia of the body of mass M about an axis passing through the center of mass, then the moment of inertia I about a parallel axis at a distance d from it is given by the relation $I = I_C + Md^2$ iii) let us consider a rigid body as shown in Figure. Its **moment of inertia about an axis AB passing through the center of mass is I_C.** DE is another axis parallel to AB at a perpendicular distance d from AB. The moment of inertia of the body about DE is I. We attempt to get an expression for I in terms of I_C. For this, let us consider a point mass m on the body at position x from its center of mass.	1	
			
	iv) The moment of inertia of the point mass about the axis DE is, $m(x + d)^2$. The moment of inertia I of the whole body about DE is the summation of the above expression. $I = \Sigma m(x + d)^2$ This equation could further be written as,	1	
	$I = \Sigma m(x^2 + d^2 + 2xd)$ $I = \Sigma(mx^2 + md^2 + 2dmx)$ $I = \Sigma mx^2 + \Sigma md^2 + 2d\Sigma mx$	1	
	v) Here, Σmx^2 is the moment of inertia of the body about the center of mass. Hence, $I_C = \Sigma mx^2$ The term, $\Sigma mx = 0$ because, x can take positive and negative values with respect to the axis AB. The summation (Σmx) will be zero Thus, $I = I_C + \Sigma md^2$; $I_C + (\Sigma m)d^2$ vi) Here, Σm is the entire mass M of the object $(\Sigma m = M)$ $I = I_C + Md^2$ Hence, the parallel axis theorem is proved.	1	

38 (a)	**Centripetal acceleration** The centripetal acceleration is derived from a simple geometrical relationship between position and velocity vectors. ii) Let the directions of position and velocity vectors shift through the same angle θ in a small interval of time Δt, iii) For uniform circular motion, $r = \lvert\vec{r_1}\rvert = \lvert\vec{r_2}\rvert$ and $v = \lvert\vec{v_1}\rvert = \lvert\vec{v_2}\rvert$. If the particle moves from position vector $\vec{r_1}$ to $\vec{r_2}$, the displacement is given by $\Delta\vec{r} = \vec{r_2} - \vec{r_1}$ and the change in velocity from $\vec{v_1}$ to $\vec{v_2}$ is given by $\Delta\vec{v} = \vec{v_2} - \vec{v_1}$. iv) The magnitudes of the displacement Δr and of Δv satisfy the following relation $\frac{\Delta r}{r} = -\frac{\Delta v}{v} = \theta$  v) Here the negative sign implies that Δv points radially inward, towards the center of the circle. $\Delta v = v\left(\frac{\Delta r}{r}\right)$ then, $a = \frac{\Delta v}{\Delta t} = \frac{v}{r}\left(\frac{\Delta v}{\Delta t}\right)$; $= -\frac{v^2}{r}$ vi) For uniform circular motion $v = \omega r$, where ω is the angular velocity of the particle about the center. Then the centripetal acceleration can be written as $a = -\omega^2 r$	1 1 1 1 1	5
38 (b)	**Variation of g with altitude:**  Consider an object of mass m at a height h from the surface of the Earth. Acceleration experienced by the object due to Earth is $\mathbf{g' = \frac{GM}{(R_e+h)^2}}$ $g' = \frac{GM}{R_e^2\left(1+\frac{h}{R_e}\right)^2}$; $g' = \frac{GM}{R_e^2}\left(1+\frac{h}{R_e}\right)^{-2}$ If $h << R_e$. We can use Binomial expansion. Taking the terms upto first order $g' = \frac{GM}{R_e^2}\left(1-2\frac{h}{R_e}\right)$; $\mathbf{g' = g\left(1-2\frac{h}{R_e}\right)}$ We find that $\mathbf{g' < g}$. This means that **as altitude h increases the acceleration due to gravity g decreases.**	1 1 1 1 1	5