AIPMT 2009

1. Two bodies of mass 1 kg and 3kg have position vectors $\hat{i}+2\hat{j}+\hat{k}$ and $-3\hat{i}-2\hat{j}+\hat{k}$, respectively. The centre of mass of this system has a position vector:-

(1) $-\hat{i}+\hat{j}+\hat{k}$ (2) $-2\hat{i}+2\hat{k}$

(3) $-2\hat{i}-\hat{j}+\hat{k}$ (4) $2\hat{i}-\hat{j}-2\hat{k}$

2. An explosion blows a rock into three parts. Two parts go off at right angles to each other. These two are, 1 kg first part moving with a velocity of 12 m/s and 2 kg second part moving with a velocity of 8 m/s. If the third part flies off with a velocity of 4 m/s, its mass would be :-

(1) 3 kg (2) 5 kg (3) 7 kg (4) 17 kg

AIPMT 2010

3. A ball moving with velocity 2 m/s collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5, then their velocities (in m/s) after collision will be :-

(1) 0, 2 (2) 0, 1 (3) 1, 1 (4) 1, 0.5

AIPMT (Pre) 2010

4. Two particles which are initially at rest, move towards each other under the action of their mutual attraction. If their speeds are v and 2v at any instant, then the speed of centre of mass of the system will be :-

(1) v (2) 2v (3) Zero (4) 1.5 v

5. A man of 50 kg mass is standing in a gravity free space at a height of 10 m above the floor. He throws a stone of 0.5 kg mass downwards with a speed 2 m/s. When the stone reaches the floor, the distance of the man above the floor will be :-

(1) 20 m (2) 9.9 m (3) 10.1 m (4) 10 m

AIPMT (Pre) 2012

6. Two persons of masses 55 kg and 65 kg respectively, are at the opposite ends of a boat. The length of the boat is 3.0 m and weighs 100 kg. The 55 kg man walks up to the 65 kg man and sits with him. If the boat is in still water the centre of mass of the system shifts by :

(1) zero (2) 0.75 m (3) 3.0 m (4) 2.3 m

7. Two spheres A and B of masses m_1 and m_2 respectively collide. A is at rest initially and B is moving with velocity v along x-axis. After collision B has a velocity $\frac{v}{2}$ in a direction perpendicular to the original direction. The mass A moves after collision in the direction.

(1) $\theta = \tan^{-1}(1/2)$ to the x-axis

(2) $\theta = \tan^{-1}(-1/2)$ to the x-axis

(3) same as that of B

(4) opposite to that of B

AIPMT 2015

8. Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2. On collision, one of the particles get excited to higher level, after absorbing energy ε. If final velocities of particles be v_1 and v_2 then we must have :

(1) $\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2=\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2-\varepsilon$

(2) $\frac{1}{2}m_1u_1^2+\frac{1}{2}m_2u_2^2-\varepsilon=\frac{1}{2}m_1v_1^2+\frac{1}{2}m_2v_2^2$

(3) $\frac{1}{2}m_1^2u_1^2+\frac{1}{2}m_2^2u_2^2+\varepsilon=\frac{1}{2}m_1^2v_1^2+\frac{1}{2}m_2^2v_2^2$

(4) $m_1^2u_1 + m_2^2u_2 - \varepsilon = m_1^2v_1 + m_2^2v_2$

9. Two spherical bodies of mass M and 5M and radii R and 2R are released in free space with initial separation between their centres equal to 12R. If they attract each other due to gravitational force only, then the distance covered by the smaller body before collision is :-

(1) 4.5R (2) 7.5R (3) 1.5R (4) 2.5R

Re-AIPMT 2015

10. A ball is thrown vertically downwards from a height of 20 m with an initial velocity v_0. It collides with the ground, loses 50% of its energy in collision and rebounds to the same height. The initial velocity v_0 is :

(Take $g = 10\ m/s^2$)

(1) 10 m/s (2) 14 m/s

(3) 20 m/s (4) 28 m/s

11. On a frictionless surface, a block of mass. M moving at speed v collides elastically with another block of same mass M which is initially at rest. After collision the first block moves at an angle θ to its initial direction and has a speed $\frac{v}{3}$. The second block's speed after the collision is :-

(1) $\frac{\sqrt{3}}{2}v$ (2) $\frac{2\sqrt{2}}{3}v$ (3) $\frac{3}{4}v$ (4) $\frac{3}{\sqrt{2}}v$

NEET-II 2016

12. A bullet of mass 10g moving horizontally with a velocity of 400 m/s strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the centre of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be :-

(1) 120 m/s (2) 160 m/s
(3) 100 m/s (4) 80 m/s

13. Two identical balls A and B having velocities of 0.5 m/s and –0.3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be :-

(1) –0.3 m/s and 0.5 m/s
(2) 0.3 m/s and 0.5 m/s
(3) –0.5 m/s and 0.3 m/s
(4) 0.5 m/s and –0.3 m/s

NEET(UG) 2018

14. A moving block having mass m, collides with another stationary block having mass 4m. The lighter block comes to rest after collision. When the initial velocity of the lighter block is v, then the value of coefficient of restitution (e) will be :-

(1) 0.5 (2) 0.25 (3) 0.8 (4) 0.4

NEET(UG) 2019

15. Body A of mass 4m moving with speed *u* collides with another body B of mass 2m, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is :

(1) $\frac{1}{9}$ (2) $\frac{8}{9}$ (3) $\frac{4}{9}$ (4) $\frac{5}{9}$

NEET(UG) 2019 (Odisha)

16. An object flying in air with velocity $\left(20\hat{i}+25\hat{j}-12\hat{k}\right)$ suddenly breaks in two pieces whose masses are in the ratio 1 : 5. The smaller mass flies off with a velocity $\left(100\hat{i}+35\hat{j}+8\hat{k}\right)$. The velocity of the larger piece will be :-

(1) $4\hat{i}+23\hat{j}-16\hat{k}$ (2) $-100\hat{i}-35\hat{j}-8\hat{k}$
(3) $20\hat{i}+15\hat{j}-80\hat{k}$ (4) $-20\hat{i}-15\hat{j}-80\hat{k}$

17. A particle of mass 5 m at rest suddenly breaks on its own into three fragments. Two fragments of mass m each move along mutually perpendicular direction with speed v each. The energy released during the process is :

(1) $\frac{3}{5}mv^2$ (2) $\frac{5}{3}mv^2$
(3) $\frac{3}{2}mv^2$ (4) $\frac{4}{3}mv^2$

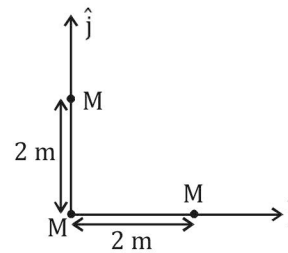
NEET(UG) 2020

18. Two particles of mass 5 kg and 10 kg respectively are attached to the two ends of a rigid rod of length 1 m with negligible mass. The centre of mass of the system from the 5 kg particle is nearly at a distance of :

(1) 80 cm (2) 33 cm
(3) 50 cm (4) 67 cm

NEET(UG) 2020 (COVID-19)

19. Three identical spheres, each of mass M, are placed at the corners of a right angle triangle with mutually perpendicular sides equal to 2 m (see figure). Taking the point of intersection of the two mutually perpendicular sides as the origin, find the position vector of centre of mass.



(1) $2(\hat{i}+\hat{j})$ (2) $(\hat{i}+\hat{j})$
(3) $\frac{2}{3}(\hat{i}+\hat{j})$ (4) $\frac{4}{3}(\hat{i}+\hat{j})$

NEET(UG) 2022

20. Two objects of mass 10 kg and 20 kg respectively are connected to the two ends of a rigid rod of length 10 m with negligible mass. The distance of the center of mass of the system from the 10 kg mass is :

(1) $\frac{20}{3}$m (2) 10 m

(3) 5 m (4) $\frac{10}{3}$m

21. A shell of mass m is at rest initially. It explodes into three fragments having mass in the ratio 2 : 2 : 1. If the fragments having equal mass fly off along mutually perpendicular directions with speed v, the speed of the third (lighter) fragment is

(1) $\sqrt{2}$ v (2) $2\sqrt{2}$ v

(3) $3\sqrt{2}$ v (4) v

RE-NEET(UG) 2022

22. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R),

Assertion (A) :

When a fire cracker (rocket) explodes in mid air, its fragments fly in such a way that they continue moving in the same path, which the fire cracker would have followed, had it not exploded.

Reason (R) :

Explosion of cracker (rocket) occurs due to internal forces only and no external force acts for this explosion.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(3) (A) is correct but (R) is not correct

(4) (A) is not correct but (R) is correct

EXERCISE-II (Previous Year Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	2	2	3	3	1	1, 2	2	2	3	2	1	4	2	2
Question	16	17	18	19	20	21	22								
Answer	1	4	4	3	1	2	4								

1. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : Two blocks of masses m_1 & m_2 are at rest. They are now moving towards each other under a mutual internal force. The velocity of centre of mass is zero.

Reason (R) : If no external force acts on the system, then velocity of centre of mass remains unchanged but can never be zero.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.

(3) **(A)** is true but **(R)** is false.

(4) **(A)** is false but **(R)** is true.

2. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : Quick collisions are more violent than slow collisions.

Reason (R) : Quick collision are inelastic in nature.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.

(3) **(A)** is true but **(R)** is false.

(4) **(A)** is false but **(R)** is true.

3. Which of following statement is true.

(1) COM of a rigid body is always inside the body.

(2) Mass must be present physically at COM.

(3) COM of two particle system is closer to particle with greater mass.

(4) All above statements are true.

4. Which of following statement is false.

(1) KE in an elastic collision between two bodies remains same before and after collision.

(2) There may or may not be physical contact between two bodies for collision to occur.

(3) KE of two object system remains conserved during collision in elastic collision.

(4) None of the above

5. A projectile is projected at a speed u at an angle θ with horizontal. At the highest point projectile splits into two fragments of mass ratio 1 : 2. The smaller fragment coming to rest. Then consider following statements :-

(A) In a given time both parts will cover equal vertical displacement.

(B) COM of two fragments will follow the same path as the object would have followed if not exploded.

(C) Linear momentum is conserved in vertical direction only.

Which of the following is correct?

(1) A, B, C (2) A, B

(3) B, C (4) A, C

6. A particle of mass m moving with a velocity $(3\hat{i}+2\hat{j})$ m/s collides with stationary body of mass M and finally moves with velocity $(-2\hat{i}+\hat{j})$ m/s then

(A) Impulse received by m = $m(5\hat{i}-5\hat{j})$

(B) Impulse received by m = $m(-5\hat{i}-\hat{j})$

(C) Impulse received by M = $m(5\hat{i}+\hat{j})$

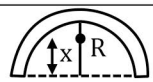
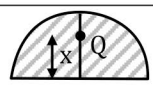
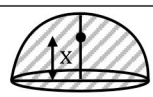
(D) Impulse received by M = $m(5\hat{i}-\hat{j})$

then correct statements are

(1) B, C (2) A, C

(3) B, D (4) A, D

7. Match the following columns with respective positions of centre of mass -

Column – I		Column - II	
(A)	 uniform rod length = R	(P)	$x=\frac{3R}{8}$
(B)	 uniform thin semicircular ring of radius R	(Q)	$x=\frac{R}{2}$
(C)	 uniform semicircular disc of radius R	(R)	$x=\frac{4R}{3\pi}$
(D)	 uniform solid hemisphere of radius R	(S)	$x=\frac{2R}{\pi}$

(1) A : P, B : R, C : Q, D : S
(2) A : Q, B : P, C : R, D : S
(3) A : Q, B : S, C : R, D : P
(4) A : S, B : P, C : Q, D : R

8. Particle of mass m, kinetic energy K and momentum P collides head on elastically with another particle of mass 2m at rest. After collision:

Column I		Column II	
(A)	Momentum of Ist particle	(P)	$\frac{4}{3}P$
(B)	Momentum of IInd particle	(Q)	$\frac{K}{9}$
(C)	KE of Ist particle	(R)	$\frac{8K}{9}$
(D)	KE of IInd particle	(S)	$-\frac{P}{3}$

(1) A $\rightarrow$ S; B $\rightarrow$ P, C $\rightarrow$ Q, D $\rightarrow$ R
(2) A $\rightarrow$ P; B $\rightarrow$ S, C $\rightarrow$ Q, D $\rightarrow$ R
(3) A $\rightarrow$ P; B $\rightarrow$ S, C $\rightarrow$ R, D $\rightarrow$ Q
(4) A $\rightarrow$ S; B $\rightarrow$ P, C $\rightarrow$ R, D $\rightarrow$ Q

EXERCISE-III (Analytical Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8
Answer	3	3	3	3	2	1	3	1