

PHYSICS · JEE MAIN

Centre of Mass & Linear Momentum

Chapter-wise previous year questions, with answer key

32

PYQS

2020–2025

PAPERS

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TOPICS

Centre of Mass

Conservation of Linear Momentum

Impulse-Momentum Theorem

Rocket Propulsion

- 1 Attempt each question on paper first — they're grouped by topic, newest papers first.
- 2 Check yourself against the answer key at the end.
- 3 Got one wrong? Tap “Step-by-step solution” under it for the full working.

Stuck on a question?

Every question has a free step-by-step solution on PrepWiser — tap “Step-by-step solution” under it.

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Centre of Mass · 10 PYQs

Q1 JEE Main 2025 · 23 Jan · Shift 1

Consider a circular disc of radius 20 cm with centre located at the origin. A circular hole of radius 5 cm is cut from this disc in such a way that the edge of the hole touches the edge of the disc. The distance of centre of mass of residual or remaining disc from the origin will be

- (A) 1.5 cm (B) 2.0 cm
(C) 0.5 cm (D) 1.0 cm

[Step-by-step solution ► prepwisser.in/questions/77cN85KBun](https://www.prepwisser.in/questions/77cN85KBun)

Q2 JEE Main 2025 · 22 Jan · Shift 1

The position vectors of two 1 kg particles, (A) and (B), are given by

$$\vec{r}_A = (\alpha_1 t^2 \hat{i} + \alpha_2 t \hat{j} + \alpha_3 t \hat{k}) \text{ m and } \vec{r}_B = (\beta_1 t \hat{i} + \beta_2 t^2 \hat{j} + \beta_3 t \hat{k}) \text{ m, respectively;}$$

$(\alpha_1 = 1\text{m/s}^2, \alpha_2 = 3\text{nm/s}, \alpha_3 = 2\text{m/s}, \beta_1 = 2\text{m/s}, \beta_2 = -1\text{m/s}^2, \beta_3 = 4\text{pm/s})$, where t is time, n and p are constants. At $t = 1\text{s}$, $|\vec{V}_A| = |\vec{V}_B|$ and velocities $\vec{V}_A$ and $\vec{V}_B$ of the particles are orthogonal to each other. At $t = 1\text{s}$, the magnitude of angular momentum of particle (A) with respect to the position of particle (B) is $\sqrt{L}\text{kgm}^2\text{s}^{-1}$. The value of L is _____.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/_CwpJQhqbB](https://www.prepwisser.in/questions/_CwpJQhqbB)

Q3 JEE Main 2024 · 4 Apr · Shift 2

In a system two particles of masses $m_1 = 3\text{kg}$ and $m_2 = 2\text{kg}$ are placed at certain distance from each other. The particle of mass m_1 is moved towards the center of mass of the system through a distance 2cm. In order to keep the center of mass of the system at the original position, the particle of mass m_2 should move towards the center of mass by the distance _____ cm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/3TbpM4an21](https://www.prepwisser.in/questions/3TbpM4an21)

Q4 JEE Main 2024 · 1 Feb · Shift 1

Three identical spheres each of mass $2M$ are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 4m each. Taking point of intersection of these two sides as origin, the magnitude of position vector of the centre of mass of the system is $\frac{4\sqrt{2}}{x}$, where the value of x is _____.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisser.in/questions/V0ce68K6Yk](https://www.prepwisser.in/questions/V0ce68K6Yk)

Q5 JEE Main 2022 · 29 Jul · Shift 1

Two bodies of mass 1kg and 3kg have position vectors $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$ respectively. The magnitude of position vector of centre of mass of this system will be similar to the magnitude of vector :

- (A) $\hat{i} + 2\hat{j} + \hat{k}$ (B) $-3\hat{i} - 2\hat{j} + \hat{k}$
(C) $-2\hat{i} + 2\hat{k}$ (D) $2\hat{i} - \hat{j} + 2\hat{k}$

[Step-by-step solution ► prepwisser.in/questions/ckSdHTgj-G](https://www.prepwisser.in/questions/ckSdHTgj-G)

Q6 JEE Main 2022 · 28 Jul · Shift 2

The distance of centre of mass from end A of a one dimensional rod (AB) having mass density $\rho = \rho_0 \left(1 - \frac{x^2}{L^2}\right)$ kg/m and length L (in meter) is $\frac{3L}{\alpha}$ m. The value of α is _____. (where x is the distance from end A)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/zUV05-1vWy](https://www.prepwiser.in/questions/zUV05-1vWy)

Q7 JEE Main 2022 · 27 Jun · Shift 1

Two blocks of masses 10 kg and 30 kg are placed on the same straight line with coordinates (0, 0) cm and (x, 0) cm respectively. The block of 10 kg is moved on the same line through a distance of 6 cm towards the other block. The distance through which the block of 30 kg must be moved to keep the position of centre of mass of the system unchanged is :

- (A) 4 cm towards the 10 kg block (B) 2 cm away from the 10 kg block
(C) 2 cm towards the 10 kg block (D) 4 cm away from the 10 kg block

[Step-by-step solution ► prepwiser.in/questions/3k9HTJY22q](https://www.prepwiser.in/questions/3k9HTJY22q)

Q8 JEE Main 2021 · 22 Jul · Shift 2

The position of the centre of mass of a uniform semi-circular wire of radius 'R' placed in x-y plane with its centre at the origin and the line joining its ends as x-axis is given by $\left(0, \frac{xR}{\pi}\right)$. Then, the value of | x | is _____.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/jl79oWcVtC](https://www.prepwiser.in/questions/jl79oWcVtC)

Q9 JEE Main 2020 · 6 Sep · Shift 2

The centre of mass of solid hemisphere of radius 8 cm is x from the centre of the flat surface. Then value of x is _____.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/COd5xfWaBv](https://www.prepwiser.in/questions/COd5xfWaBv)

Q10 JEE Main 2020 · 9 Jan · Shift 2

A rod of length L has non-uniform linear mass density given by $\rho(x) = a + b\left(\frac{x}{L}\right)^2$, where a and b are constants and $0 \leq x \leq L$. The value of x for the centre of mass of the rod is at :

- (A) $\frac{3}{2} \left(\frac{a+b}{2a+b}\right) L$
(B) $\frac{4}{3} \left(\frac{a+b}{2a+3b}\right) L$
(C) $\frac{3}{4} \left(\frac{2a+b}{3a+b}\right) L$
(D) $\frac{3}{2} \left(\frac{2a+b}{3a+b}\right) L$

[Step-by-step solution ► prepwiser.in/questions/X7cYKfYt7Z](https://www.prepwiser.in/questions/X7cYKfYt7Z)

Conservation of Linear Momentum · 11 PYQs

Q11 JEE Main 2024 · 9 Apr · Shift 2

A nucleus at rest disintegrates into two smaller nuclei with their masses in the ratio of 2 : 1. After disintegration they will move :

- (A) in opposite directions with speed in the ratio of 1 : 2 respectively.
- (B) in the same direction with same speed.
- (C) in opposite directions with speed in the ratio of 2 : 1 respectively.
- (D) in opposite directions with the same speed.

[Step-by-step solution ► prepwiser.in/questions/CApirA9tVI](https://www.prepwiser.in/questions/CApirA9tVI)

Q12 JEE Main 2024 · 8 Apr · Shift 1

Three bodies A, B and C have equal kinetic energies and their masses are 400g, 1.2kg and 1.6kg respectively. The ratio of their linear momenta is :

- (A) $1 : \sqrt{3} : 2$
- (B) $\sqrt{3} : \sqrt{2} : 1$
- (C) $1 : \sqrt{3} : \sqrt{2}$
- (D) $\sqrt{2} : \sqrt{3} : 1$

[Step-by-step solution ► prepwiser.in/questions/JUm8grzyB5](https://www.prepwiser.in/questions/JUm8grzyB5)

Q13 JEE Main 2024 · 8 Apr · Shift 1

A stationary particle breaks into two parts of masses m_A and m_B which move with velocities v_A and v_B respectively. The ratio of their kinetic energies ($K_B : K_A$) is :

- (A) $v_B : v_A$
- (B) $1 : 1$
- (C) $m_B v_B : m_A v_A$
- (D) $m_B : m_A$

[Step-by-step solution ► prepwiser.in/questions/Q-iOf_jkGc](https://www.prepwiser.in/questions/Q-iOf_jkGc)

Q14 JEE Main 2024 · 31 Jan · Shift 1

An artillery piece of mass M_1 fires a shell of mass M_2 horizontally. Instantaneously after the firing, the ratio of kinetic energy of the artillery and that of the shell is:

- (A) $M_1 / (M_1 + M_2)$
- (B) $\frac{M_2}{M_1}$
- (C) $\frac{M_1}{M_2}$
- (D) $M_2 / (M_1 + M_2)$

[Step-by-step solution ► prepwiser.in/questions/lv8my1Osc-](https://www.prepwiser.in/questions/lv8my1Osc-)

Q15 JEE Main 2024 · 27 Jan · Shift 1

Two bodies of mass 4g and 25g are moving with equal kinetic energies. The ratio of magnitude of their linear momentum is :

- (A) 3 : 5
- (B) 5 : 4
- (C) 2 : 5
- (D) 4 : 5

[Step-by-step solution ► prepwiser.in/questions/W_FLeE53Fm](https://www.prepwiser.in/questions/W_FLeE53Fm)

Q16 JEE Main 2024 · 27 Jan · Shift 1

A body of mass 1000kg is moving horizontally with a velocity 6m/s. If 200kg extra mass is added, the final velocity (in m/s) is:

- (A) 6 (B) 2
(C) 3 (D) 5

Step-by-step solution ► [prepwisar.in/questions/30J3TkEn2N](https://www.prepwisar.in/questions/30J3TkEn2N)

Q17 JEE Main 2023 · 30 Jan · Shift 2

A machine gun of mass 10kg fires 20g bullets at the rate of 180 bullets per minute with a speed of 100ms^{-1} each. The recoil velocity of the gun is

- (A) 0.02m/s (B) 1.5m/s
(C) 2.5m/s (D) 0.6m/s

Step-by-step solution ► [prepwisar.in/questions/Z4OfHz8WTG](https://www.prepwisar.in/questions/Z4OfHz8WTG)

Q18 JEE Main 2022 · 29 Jun · Shift 1

A body of mass M at rest explodes into three pieces, in the ratio of masses 1 : 1 : 2. Two smaller pieces fly off perpendicular to each other with velocities of 30 ms^{-1} and 40 ms^{-1} respectively. The velocity of the third piece will be :

- (A) 15 ms^{-1}
(B) 25 ms^{-1}
(C) 35 ms^{-1}
(D) 50 ms^{-1}

Step-by-step solution ► [prepwisar.in/questions/ZU3IJ-pRXI](https://www.prepwisar.in/questions/ZU3IJ-pRXI)

Q19 JEE Main 2022 · 28 Jun · Shift 1

A man of 60 kg is running on the road and suddenly jumps into a stationary trolley car of mass 120 kg. Then, the trolley car starts moving with velocity 2 ms^{-1} . The velocity of the running man was _____ ms^{-1} , when he jumps into the car.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisar.in/questions/yn9i583DG9](https://www.prepwisar.in/questions/yn9i583DG9)

Q20 JEE Main 2021 · 25 Feb · Shift 2

Two particles having masses 4 g and 16 g respectively are moving with equal kinetic energies. The ratio of the magnitudes of their linear momentum is n : 2. The value of n will be _____.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisar.in/questions/DjeIQUVKvR](https://www.prepwisar.in/questions/DjeIQUVKvR)

Q21 JEE Main 2021 · 24 Feb · Shift 2

Two solids A and B of mass 1 kg and 2 kg respectively are moving with equal linear momentum. The ratio of their kinetic energies $(\text{K.E.})_A : (\text{K.E.})_B$ will be $\frac{A}{1}$, so the value of A will be _____.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisar.in/questions/SBm99vwCv9](https://www.prepwisar.in/questions/SBm99vwCv9)

Impulse-Momentum Theorem · 9 PYQs

Q22 JEE Main 2024 · 1 Feb · Shift 2

A cricket player catches a ball of mass 120g moving with 25m/s speed. If the catching process is completed in 0.1s then the magnitude of force exerted by the ball on the hand of player will be (in SI unit) :

- (A) 30 (B) 24
(C) 12 (D) 25

[Step-by-step solution ► prepwiser.in/questions/qanOzAeo7N](https://www.prepwiser.in/questions/qanOzAeo7N)

Q23 JEE Main 2024 · 30 Jan · Shift 1

A spherical body of mass 100g is dropped from a height of 10m from the ground. After hitting the ground, the body rebounds to a height of 5m. The impulse of force imparted by the ground to the body is given by : (given, $g = 9.8\text{m/s}^2$)

- (A) 43.2kgms^{-1} (B) 2.39kgms^{-1}
(C) 4.32kgms^{-1} (D) 23.9kgms^{-1}

[Step-by-step solution ► prepwiser.in/questions/M3rRXT1I1Y](https://www.prepwiser.in/questions/M3rRXT1I1Y)

Q24 JEE Main 2023 · 13 Apr · Shift 1

A bullet of 10g leaves the barrel of gun with a velocity of 600m/s. If the barrel of gun is 50cm long and mass of gun is 3kg, then value of impulse supplied to the gun will be :

- (A) 12 Ns (B) 3 Ns
(C) 6 Ns (D) 36 Ns

[Step-by-step solution ► prepwiser.in/questions/b2KDD6BIHi](https://www.prepwiser.in/questions/b2KDD6BIHi)

Q25 JEE Main 2023 · 11 Apr · Shift 1

An average force of 125N is applied on a machine gun firing bullets each of mass 10g at the speed of 250m/s to keep it in position. The number of bullets fired per second by the machine gun is :

- (A) 25 (B) 50
(C) 5 (D) 100

[Step-by-step solution ► prepwiser.in/questions/AIAFNcEnS3](https://www.prepwiser.in/questions/AIAFNcEnS3)

Q26 JEE Main 2023 · 31 Jan · Shift 1

100 balls each of mass m moving with speed v simultaneously strike a wall normally and reflected back with same speed, in time t_s . The total force exerted by the balls on the wall is

- (A) $\frac{200mv}{t}$ (B) $\frac{100mv}{t}$
(C) $\frac{mv}{100t}$ (D) $200mvt$

[Step-by-step solution ► prepwiser.in/questions/K8SAkBC-iH](https://www.prepwiser.in/questions/K8SAkBC-iH)

Q27 JEE Main 2022 · 28 Jul · Shift 1

In two different experiments, an object of mass 5kg moving with a speed of 25ms^{-1} hits two different walls and comes to rest within (i) 3 second, (ii) 5 seconds, respectively. Choose the correct option out of the following :

- (A) Impulse and average force acting on the object will be same for both the cases.
- (B) Impulse will be same for both the cases but the average force will be different.
- (C) Average force will be same for both the cases but the impulse will be different.
- (D) Average force and impulse will be different for both the cases.

[Step-by-step solution ► prepwiser.in/questions/BqY9ne8VQR](https://www.prepwiser.in/questions/BqY9ne8VQR)

Q28 JEE Main 2022 · 26 Jul · Shift 2

A ball of mass 0.15kg hits the wall with its initial speed of 12ms^{-1} and bounces back without changing its initial speed. If the force applied by the wall on the ball during the contact is 100N , calculate the time duration of the contact of ball with the wall.

- (A) 0.018 s
- (B) 0.036 s
- (C) 0.009 s
- (D) 0.072 s

[Step-by-step solution ► prepwiser.in/questions/R3IIarz951](https://www.prepwiser.in/questions/R3IIarz951)

Q29 JEE Main 2022 · 26 Jun · Shift 2

A batsman hits back a ball of mass 0.4 kg straight in the direction of the bowler without changing its initial speed of 15 ms^{-1} . The impulse imparted to the ball is _____ Ns .

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/Twm5HuKKPF](https://www.prepwiser.in/questions/Twm5HuKKPF)

Q30 JEE Main 2021 · 22 Jul · Shift 2

A bullet of ' 4 g ' mass is fired from a gun of mass 4 kg . If the bullet moves with the muzzle speed of 50 ms^{-1} , the impulse imparted to the gun and velocity of recoil of gun are :

- (A) 0.2 kg ms^{-1} , 0.1 ms^{-1}
- (B) 0.4 kg ms^{-1} , 0.05 ms^{-1}
- (C) 0.2 kg ms^{-1} , 0.05 ms^{-1}
- (D) 0.4 kg ms^{-1} , 0.1 ms^{-1}

[Step-by-step solution ► prepwiser.in/questions/4mTVBo0ejv](https://www.prepwiser.in/questions/4mTVBo0ejv)

Rocket Propulsion · 2 PYQs

Q31 JEE Main 2022 · 28 Jul · Shift 1

A balloon has mass of 10g in air. The air escapes from the balloon at a uniform rate with velocity 4.5cm/s . If the balloon shrinks in 5s completely. Then, the average force acting on that balloon will be (in dyne).

- (A) 3
- (B) 9
- (C) 12
- (D) 18

[Step-by-step solution ► prepwiser.in/questions/usWf0SX7AC](https://www.prepwiser.in/questions/usWf0SX7AC)

A spaceship in space sweeps stationary interplanetary dust. As a result, its mass increases at a rate $\frac{dM(t)}{dt} = bv^2(t)$, where $v(t)$ is its instantaneous velocity. The instantaneous acceleration of the satellite is :

(A) $-bv^3(t)$

(B) $-\frac{2bv^3}{M(t)}$

(C) $-\frac{bv^3}{M(t)}$

(D) $-\frac{bv^3}{2M(t)}$

Step-by-step solution ► [prepwisar.in/questions/xbNI26Ubz6](https://www.prepwisar.in/questions/xbNI26Ubz6)

Answer key — Centre of Mass & Linear Momentum

Numbers match the question numbers above. For full working, open the solution link under each question.

1	D	2	90	3	3	4	3	5	A	6	8	7	C	8	2
9	3	10	C	11	A	12	A	13	A	14	B	15	C	16	D
17	D	18	B	19	6	20	1	21	2	22	A	23	B	24	C
25	B	26	A	27	B	28	B	29	12	30	C	31	B	32	C

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