

JEE MAIN SYSTEM OF PARTICLES AND ROTATIONAL MOTION — TORQUE AND ANGULAR MOMENTUM — PYQS

Max. Marks: 44

Questions: 11

Section A (MCQ) — 7 questions

- Q.1** The position of an object having mass 0.1 kg as a function of time t is given as $\vec{r} = (10t^2\hat{i} + 5t^3\hat{j})$ m. At $t = 1$ s, which of the following statements are **correct**?

- A. The linear momentum $\vec{p} = (2\hat{i} + 1.5\hat{j})$ kg·m/s.
 B. The force acting on the object $\vec{F} = (2\hat{i} + 3\hat{j})$ N.
 C. The angular momentum of the object about its origin $\vec{L} = 15\hat{k}$ J·s.
 D. The torque acting on the object about its origin $\vec{\tau} = 20\hat{k}$ N·m.

Choose the **correct** answer from the options given below: [JEE Main 2026 (Online) 2nd April Morning Shift]

- (1) A, B and C only (2) B, C and D only
 (3) A, C and D only (4) A, B and D only

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full solution



- Q.2** When the position vector $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ changes sign as $-\vec{r}$, which one of the following vector will not flip under sign change?

[JEE Main 2026 (Online) 28th January Evening Shift]

- (1) Velocity (2) Linear momentum
 (3) Acceleration (4) Angular momentum

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- Q.3** Two cars A and B each of mass 10^3 kg are moving on parallel tracks separated by a distance of 10 m, in same direction with speeds 72 km/h and 36 km/h. The magnitude of angular momentum of car A with respect to car B is _____ J·s.

[JEE Main 2026 (Online) 21st January Evening Shift]

- (1) 3.6×10^5 (2) 10^5
 (3) 3×10^5 (4) 2×10^5

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- Q.4** Which of the following are correct expressions for torque acting on a body?
 ($\vec{r}$ = position vector; $\vec{p}$ = linear momentum; $\vec{L}$ = angular momentum; $\vec{\alpha}$ = angular acceleration; I = moment of inertia; $\vec{F}$ = force; t = time)

A. $\vec{\tau} = \vec{r} \times \vec{L}$

B. $\vec{\tau} = \frac{d}{dt}(\vec{r} \times \vec{p})$

C. $\vec{\tau} = \vec{r} \times \frac{d\vec{p}}{dt}$

D. $\vec{\tau} = I\vec{\alpha}$

E. $\vec{\tau} = \vec{r} \times \vec{F}$

Choose the correct answer from the options given below: [JEE Main 2025 (Online) 4th April Morning Shift]

- (1) A, B, D and E Only (2) C and D Only
 (3) B, C, D and E Only (4) B, D and E Only

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- Q.5** An object of mass 'm' is projected from origin in a vertical xy plane at an angle 45° with the x-axis with an initial velocity v_0 . The magnitude and direction of the angular momentum of the object with respect to origin, when it reaches at the maximum height, will be [g is acceleration due to gravity]

[JEE Main 2025 (Online) 24th January Morning Shift]

(1) $\frac{mv_0^3}{2\sqrt{2}g}$ along negative z-axis

(2) $\frac{mv_0^3}{2\sqrt{2}g}$ along positive z-axis

(3) $\frac{mv_0^3}{4\sqrt{2}g}$ along positive z-axis

(4) $\frac{mv_0^3}{4\sqrt{2}g}$ along negative z-axis

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- Q.6** The torque due to the force $(2\hat{i} + \hat{j} + 2\hat{k})$ about the origin, acting on a particle whose position vector is $(\hat{i} + \hat{j} + \hat{k})$, would be

[JEE Main 2025 (Online) 22nd January Evening Shift]

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

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

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- Q.7** A particle of mass m is projected with a velocity ' u ' making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is :

[JEE Main 2024 (Online) 30th January Morning Shift]

- (1) $\frac{mu^3}{\sqrt{2}g}$ (2) zero
(3) $\frac{\sqrt{3}}{2} \frac{mu^2}{g}$ (4) $\frac{\sqrt{3}}{16} \frac{mu^3}{g}$

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Section B (Numerical) — 4 questions

- Q.8** The coordinates of a particle with respect to origin in a given reference frame is $(1, 1, 1)$ meters. If a force of $\vec{F} = \hat{i} - \hat{j} + \hat{k}$ acts on the particle, then the magnitude of torque (with respect to origin) in z -direction is _____.

[JEE Main 2025 (Online) 29th January Morning Shift]

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- Q.9** The position vectors of two 1 kg particles, (A) and (B), are given by $\vec{r}_A = (\alpha_1 t^2 \hat{i} + \alpha_2 t \hat{j} + \alpha_3 t \hat{k})m$ and $\vec{r}_B = (\beta_1 t \hat{i} + \beta_2 t^2 \hat{j} + \beta_3 t \hat{k})m$, respectively; $(\alpha_1 = 1 \text{ m/s}^2, \alpha_2 = 3n \text{ m/s}, \alpha_3 = 2 \text{ m/s}, \beta_1 = 2 \text{ m/s}, \beta_2 = -1 \text{ m/s}^2, \beta_3 = 4p \text{ m/s})$, 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 $\sqrt{L} \text{ kg m}^2 \text{ s}^{-1}$. The value of L is _____.

[JEE Main 2025 (Online) 22nd January Morning Shift]

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- Q.10** A body of mass ' m ' is projected with a speed ' u ' making an angle of 45° with the ground. The angular momentum of the body about the point of projection, at the highest point is expressed as $\frac{\sqrt{2}mu^3}{Xg}$. The value of ' X ' is _____.

[JEE Main 2024 (Online) 31st January Evening Shift]

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- Q.11** A body of mass 5 kg moving with a uniform speed $3\sqrt{2} \text{ ms}^{-1}$ in $X - Y$ plane along the line $y = x + 4$. The angular momentum of the particle about the origin will be _____ $\text{kg m}^2 \text{ s}^{-1}$.

[JEE Main 2024 (Online) 29th January Evening Shift]

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ANSWER KEY

Section A (MCQ) — 7 questions

Ques.	1	2	3	4	5	6	7				
Ans.	4	4	2	3	4	2	4				

Section B (Numerical) — 4 questions

Ques.	8	9	10	11							
Ans.	2	90	8	60							