

What is Moment of Inertia?

Worksheet

Moment of inertia is $I = mr^2$ for a system of point masses, or $I = mr^2$ for a single point mass a distance r from the axis, measured in kgm.

$$I = \sum_i m_i r_i^2$$

Questions

1. A point mass of 4 kg is 3 m from an axis. Find I .

- A) 12 kgm
- B) 36 kgm
- C) 7 kgm
- D) 24 kgm

2. Doubling the distance r from the axis multiplies I by:

- A) 2
- B) 4
- C) 0.5
- D) 1

3. Which shape has the largest I for the same mass and radius?

- A) Solid sphere
- B) Solid disk
- C) Hoop
- D) Hollow sphere

4. Moment of inertia is the rotational analogue of:

- A) velocity
- B) mass
- C) force
- D) energy

5. A point mass of 3 kg sits 2 m from the axis. Find its moment of inertia.

6. A solid disk of mass 5 kg and radius 0.4 m rotates about its center ($I = mr^2$). Find I .

7. Two point masses on a light rod: $m = 2$ kg at $r = 1$ m, and $m = 3$ kg at $r = 2$ m from the same axis. Find the total moment of inertia.

8. Define: What is moment of inertia?

9. Define: Formula for a point mass?

10. Define: Does moment of inertia depend on mass distribution?

Answer Key

1. B) $36 \text{ kgm} - I = mr = 4 \cdot 3 = 4 \cdot 9 = 36 \text{ kgm}$.
2. B) $4 - I r$, so doubling r quadruples I .
3. C) Hoop - A hoop has all mass at radius r , giving $I = mr^2$ - the maximum for that m and r .
4. B) mass - Just as mass resists linear acceleration, moment of inertia resists angular acceleration.
5. $I = mr^2 = 3 \cdot 2^2 = 3 \cdot 4 = 12 \text{ kgm}^2$
6. $I = 0.5 m r^2 = 0.5 \cdot 5 \cdot 0.4^2 = 0.5 \cdot 5 \cdot 0.16 = 0.4 \text{ kgm}^2$
7. $I = mr^2 = (2 \cdot 1^2) + (3 \cdot 2^2) = 2 + 12 = 14 \text{ kgm}^2$
8. A measure of an object's resistance to rotational acceleration; the rotational analogue of mass.
9. $I = mr^2$, where r is the distance from the axis of rotation.
10. Yes - mass farther from the axis contributes much more (r^2 term).

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