

Exercise walk-through

5.4

Rotational Inertia

AP Physics 1

Rotational inertia

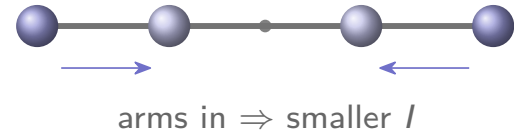
Rotational inertia I resists a change in spin – and depends on **how the mass is spread**:

Distance is squared

$$I = \sum mr^2$$

Parallel-axis theorem : $I = I_{cm} + md^2$.

Move mass out to $2\times$ the radius $\Rightarrow I$ grows $4\times$.



Exercises 2.1-2.3

2.1 Two 0.50 kg masses sit 0.40 m from an axis. Find the total rotational inertia. [2]

2.2 State how the rotational inertia changes if the masses are moved farther from the axis. [1]

2.3 A solid disc has $M = 4.0$ kg and $R = 0.30$ m. Find its moment of inertia ($I = \frac{1}{2}MR^2$). [2]

Exercises 2.1-2.3

2.1 Two 0.50 kg masses sit 0.40 m from an axis. Find the total rotational inertia. [2]

2.1

- $I = \sum mr^2 = 2 \times (0.50)(0.40)^2 = 0.16 \text{ kg m}^2$

2.2 State how the rotational inertia changes if the masses are moved farther from the axis. [1]

2.2

- it increases (each contributes mr^2 , which grows with r)
-

2.3 A solid disc has $M = 4.0 \text{ kg}$ and $R = 0.30 \text{ m}$. Find its moment of inertia ($I = \frac{1}{2}MR^2$). [2]

2.3

- $I = \frac{1}{2}(4.0)(0.30)^2 = 0.18 \text{ kg m}^2$

Exercises 3.1-3.2

3.1 The rotational inertia of an object depends on

[1]

☐

A its mass only

B its mass and how the mass is distributed about the axis

C its speed only

D the applied torque

☐

3.2 For the same mass and radius, which shape has the **largest** rotational inertia?

[1]

A solid disc

B hoop

C solid sphere

D rod about its centre

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3.1 B

- its mass and how the mass is distributed about the axis.

3.2 For the same mass and radius, which shape has the **largest** rotational inertia?

[1]

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A solid disc

B hoop

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3.2 B

- a hoop has all its mass at the rim, $I = MR^2$

Exercise 3.3 (a)

3.3 A 0.20 kg point mass is 0.50 m from an axis.

(a) Find its rotational inertia about that axis.

[2]

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(a) Find its rotational inertia about that axis.

[2]

(a)

- $I = mr^2 = 0.20 \times (0.50)^2 = 0.050 \text{ kg m}^2$

Exercise 3.3 (b)

3.3 A 0.20 kg point mass is 0.50 m from an axis.

(b) State its rotational inertia about a parallel axis passing through the mass itself. [1]

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(b) State its rotational inertia about a parallel axis passing through the mass itself. [1]

(b)

- 0 – a point mass has no size, so $I = 0$ about an axis through it