

5.4 Rotational Inertia

Name: _____ Class: _____ Date: _____

Total: 14 marks**KEY WORDS** rotational inertia 转动惯量

Objective

Build the skills to answer exam questions on **rotational inertia**.**You must be able to:**

- describe **rotational inertia** 转动惯量 I as resistance to a change in rotation
- use $I = \sum m_i r_i^2$ for point masses
- explain that mass farther from the axis contributes more
- recall that I depends on the mass distribution and the axis chosen

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Rotational inertia of point masses

$$I = \sum m_i r_i^2.$$

A 2 kg mass at $r = 3$ m from the axis has $I = 2 \times 3^2 = 18$ kg m².

■ Distance matters most

Because r is squared, mass far from the axis dominates. Moving a mass from 1 m to 2 m quadruples its contribution.

■ It depends on the axis

The same object has different I about different axes. A rod is easier to spin about its centre than about one end.

2 Practice

Now apply the methods above.

2.1 A 3 kg mass sits 2 m from the axis. Find its rotational inertia. [2]**2.2** State what rotational inertia measures. [1]**2.3** Two 1 kg masses sit at $r = 1$ m and $r = 2$ m. Find the total I . [2]**2.4** If a mass is moved twice as far from the axis, by what factor does its contribution to I change? [1]

3 Exam-style questions

3.1 Rotational inertia depends on [1]

A	B
C	D

A only the total mass**B** the mass and how it is distributed about the axis**C** only the speed**D** the colour of the object**3.2** A point mass's contribution to rotational inertia is [1]

A	B
C	D

A mr **B** mr^2 **C** $\frac{1}{2}mr^2$ **D** m/r

3.3 A 4 kg mass sits at $r = 1.5$ m and a 2 kg mass at $r = 3$ m on a light rod.

(a) Find the total rotational inertia. [2]

(b) State which mass contributes more, and why. [1]

3.4 A solid disc and a ring have the same mass and radius.

(a) State which has the larger rotational inertia. [1]

(b) Explain why, in terms of mass distribution. [2]