

6.4 Conservation of Angular Momentum

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS angular momentum 角动量 • conserved 守恒

Objective

Build the skills to answer exam questions on **conservation of angular momentum**.

You must be able to:

- state that **angular momentum** 角动量 is conserved when the net external torque is zero
- explain the spinning-skater example (I down, ω up)
- apply conservation of angular momentum to collisions and to a changing rotational inertia

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Conservation of angular momentum

When the net external torque is zero, $I_i\omega_i = I_f\omega_f$.

■ The spinning skater

Pulling the arms in **reduces** I ; since $L = I\omega$ stays constant, ω **increases**. Halving I doubles ω .

■ Adding mass to a turntable

A lump landing on a spinning disc raises I (by mr^2), so ω drops — but L is unchanged.

2 Practice

2.1 State the condition for the angular momentum of a system to be conserved. [1]

2.2 A skater with $I = 4.0 \text{ kg m}^2$ spins at 2.0 rad s^{-1} , then pulls in to $I = 1.0 \text{ kg m}^2$. Find the new angular velocity. [2]

2.3 Using $L = I\omega$, explain why the skater speeds up. [2]

3 Exam-style questions

3.1 Angular momentum is conserved when [1]

A	B
C	D

- A** kinetic energy is constant
- B** the net external torque is zero
- C** the angular velocity is constant
- D** there is no friction anywhere

3.2 A spinning skater pulls in their arms. Their angular speed [1]

A	B
C	D

- A** increases
- B** decreases
- C** stays the same
- D** reverses

3.3 A turntable of $I = 0.10 \text{ kg m}^2$ spins freely at 6.0 rad s^{-1} . A 0.20 kg lump of clay drops onto it 0.30 m from the axis.

(a) Find the rotational inertia added by the clay ($I = mr^2$). [1]

(b) Find the new angular speed. [3]