

4.4 Elastic and Inelastic Collisions

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS elastic collision 弹性碰撞 • inelastic collision 非弹性碰撞
 • perfectly inelastic collision 完全非弹性碰撞 • collisions 碰撞 • conserved 守恒

Objective

Build the skills to answer exam questions on **elastic and inelastic collisions**.

You must be able to:

- distinguish an **elastic collision** 弹性碰撞 (kinetic energy conserved) from an **inelastic collision** 非弹性碰撞
- describe a **perfectly inelastic collision** 完全非弹性碰撞 (objects stick and move with a common velocity)
- apply **conservation of momentum** to find final velocities
- check whether **kinetic energy** is conserved

1 Worked examples

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

■ Momentum is always conserved; energy is not

In **every** collision (no external force), momentum is conserved. Kinetic energy is conserved only in an **elastic** collision; in an inelastic one, some becomes thermal energy.

■ Perfectly inelastic collision

The objects stick: $m_1u_1 + m_2u_2 = (m_1 + m_2)v$.

■ Example

A 2.0 kg cart at 3.0 m s^{-1} sticks to a stationary 2.0 kg cart: $v = \frac{2.0(3.0)}{4.0} = 1.5 \text{ m s}^{-1}$.
 KE before = 9.0 J, after = $\frac{1}{2}(4.0)(1.5)^2 = 4.5 \text{ J} \rightarrow 4.5 \text{ J lost to heat (inelastic)}$.

2 Practice

2.1 State what is conserved in (a) an elastic collision and (b) an inelastic collision. [2]

2.2 A 1.0 kg ball at 6.0 m s^{-1} strikes a stationary 2.0 kg ball and they stick together. Find their common speed. [2]

2.3 For the collision in 2.2, find the kinetic energy lost. [2]

3 Exam-style questions

3.1 In a perfectly inelastic collision, the objects [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** bounce apart
B stick together
C conserve kinetic energy
D reverse direction

3.2 Kinetic energy is conserved in [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** all collisions
B elastic collisions only
C inelastic collisions only
D explosions only

3.3 A 0.50 kg cart at 4.0 m s^{-1} hits a stationary 0.50 kg cart, and they move off together.

(a) Find their common velocity. [2]

(b) By calculating the kinetic energy before and after, state whether the collision is elastic. [2]