

## 4.4 Elastic and Inelastic Collisions

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Total: 13 marks**

**KEY WORDS** inelastic 非弹性 • elastic collision 弹性碰撞 • inelastic collision 非弹性碰撞 • deformation 形变  
• perfectly inelastic collision 完全非弹性碰撞

### Objective

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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** 非弹性 one
- state that momentum is conserved in **both** kinds of collision
- identify a **perfectly inelastic** collision (objects stick together)
- reason about where the lost kinetic energy goes

### 1 Worked examples

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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.

#### ■ Momentum always, kinetic energy sometimes

- **Elastic:** momentum **and** kinetic energy are both conserved.
- **Inelastic:** momentum is conserved, but some kinetic energy is lost (to heat, sound, deformation).

#### ■ Perfectly inelastic

The objects stick together and move as one. This loses the most kinetic energy of any collision that conserves momentum.

#### ■ Checking the type

Compute the total kinetic energy before and after. If it is the same, the collision is elastic; if less, it is inelastic.

## 2 Practice

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Now apply the methods above.

**2.1** State what is conserved in **every** collision. [1]

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**2.2** State the extra quantity conserved in an elastic collision. [1]

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**2.3** In a perfectly inelastic collision, what do the objects do? [1]

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**2.4** In an inelastic collision, where does the lost kinetic energy go? [1]

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## 3 Exam-style questions

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**3.1** In an inelastic collision, which is conserved? [1]

- **A** kinetic energy only
  - **B** momentum only
  - **C** both momentum and kinetic energy
  - **D** neither
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**3.2** Two balls collide and stick together. This collision is [1]

- **A** elastic
  - **B** perfectly inelastic
  - **C** frictionless
  - **D** impossible
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**3.3** Before a collision the total KE is 50 J; after, it is 32 J.

(a) State whether the collision is elastic or inelastic. [1]

- (b) State how much kinetic energy was lost, and where it went. [2]

**3.4** A 2 kg ball at  $6 \text{ m s}^{-1}$  hits a stationary 2 kg ball and they stick.

- (a) Find the speed after (momentum conservation). [2]

- (b) Show that kinetic energy is not conserved. [2]

## Solutions

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**2.1** Momentum.

**2.2** Kinetic energy.

**2.3** They stick together and move as one.

**2.4** Into heat, sound, and deformation.

**3.1 B** — momentum only (kinetic energy is lost).

**3.2 B** — sticking together is perfectly inelastic.

**3.3** (a) Inelastic (KE decreased). (b)  $50 - 32 = 18$  J lost, converted to heat/sound/deformation.

**3.4** (a)  $2(6) = 12 = 4v \Rightarrow v = 3 \text{ m s}^{-1}$ . (b) Before:  $\frac{1}{2}(2)(6)^2 = 36$  J; after:  $\frac{1}{2}(4)(3)^2 = 18$  J — not conserved.