

4.4 Elastic and Inelastic Collisions

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

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

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

Now apply the methods above.

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

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

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

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

3 Exam-style questions

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

3.2 Two balls collide and stick together. This collision is [1]

- A** elastic
- B** perfectly inelastic
- C** frictionless
- D** impossible

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 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

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) $50 - 32 = 18 \text{ J}$ lost, converted to heat/sound/deformation.

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