

Exercise walk-through

Elastic and Inelastic Collisions ■ 4.4

eXercise

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

Method — 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).

Method — Perfectly inelastic

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

Method — 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.

Practice 2.1 ■ 1 mark

State what is conserved in **every** collision.

Solution 2.1

Worked steps

Momentum **B1**.

Practice 2.2 ■ 1 mark

State the extra quantity conserved in an elastic collision.

Solution 2.2

Worked steps

Kinetic energy **B1**.

Practice 2.3 ■ 1 mark

In a perfectly inelastic collision, what do the objects do?

Solution 2.3

Method: Perfectly inelastic

Worked steps

They stick together and move as one **B1**.

Practice 2.4 ■ 1 mark

In an inelastic collision, where does the lost kinetic energy go?

Solution 2.4

Worked steps

Into heat, sound, and deformation **B1**.

Exam-style 3.1 ■ 1 mark

In an inelastic collision, which is conserved?

- A** kinetic energy only
- B** momentum only
- C** both momentum and kinetic energy
- D** neither

Solution 3.1

- A kinetic energy only
- B momentum only
- C both momentum and kinetic energy
- D neither



Worked steps

B — momentum only (kinetic energy is lost).

Exam-style 3.2 ■ 1 mark

Two balls collide and stick together. This collision is

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

Solution 3.2

Method: Perfectly inelastic

A elastic

B perfectly inelastic



C frictionless

D impossible

Worked steps

B — sticking together is perfectly inelastic.

Exam-style 3.3 ■ 1 mark

Before a collision the total KE is 50 J; after, it is 32 J.

- (a) State whether the collision is elastic or inelastic.
- (b) State how much kinetic energy was lost, and where it went.

Solution 3.3

Method: Checking the type

Worked steps

(a) Inelastic (KE decreased) **B1**. (b) $50 - 32 = 18$ J lost, converted to heat/sound/deformation **M1** **A1**.

Exam-style 3.4 ■ 2 marks

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

Solution 3.4

Worked steps

(a) $2(6) = 12 = 4v \Rightarrow v = 3 \text{ m s}^{-1}$ **M1** **A1**. (b) Before: $\frac{1}{2}(2)(6)^2 = 36 \text{ J}$; after: $\frac{1}{2}(4)(3)^2 = 18 \text{ J}$ — not conserved **M1** **A1**.