

Understanding collisions

AS Level

9702 AS Ch.6

Chapter 6: Momentum

Lesson 6.3

Sections 6.3

Goal: Tell elastic from inelastic collisions using kinetic energy or relative speeds.

velocity

01 The big picture

Momentum is conserved in every collision, and so is total energy. Kinetic energy is conserved only in a perfectly elastic collision; in an inelastic one some becomes internal energy, sound or deformation.

In a perfectly elastic collision the objects separate as fast as they approached. Objects that stick together have the biggest loss of kinetic energy that conservation of momentum allows.

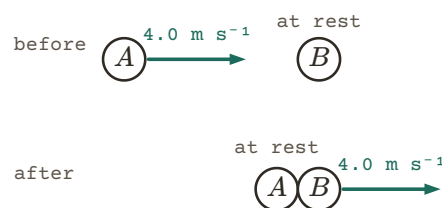
Perfectly elastic [paraphrase]

Total kinetic energy is the same before and after.

Inelastic [paraphrase]

Some kinetic energy is transferred to other forms.

Fig. 1 · Equal masses, perfectly elastic



A stops and B moves off at A's speed: approach speed = separation speed = 4.0 m s^{-1} .

02 Key equations

Kinetic energy

$$E_k = \frac{1}{2}mv^2$$

Perfectly elastic: approach = separation

$$u_1 - u_2 = v_2 - v_1$$

Symbols and units

E_k kinetic energy J u velocity before m s^{-1} v velocity after m s^{-1}

03 Sample problems with solutions

Sample 1 · Is it elastic?

A 2.0 kg trolley at 3.0 m s^{-1} hits a stationary 1.0 kg trolley. They stick together and move at 2.0 m s^{-1} . Show that the collision is inelastic and find the kinetic energy lost.

Step 1. Kinetic energy before and after:

$$E_k = \frac{1}{2}(2.0)(3.0)^2 = 9.0 \text{ J}, \quad E'_k = \frac{1}{2}(3.0)(2.0)^2 = 6.0 \text{ J}$$

Step 2. Kinetic energy fell, so the collision is inelastic:

$$\Delta E_k = 9.0 - 6.0 = 3.0 \text{ J}$$

Answer: Inelastic; 3.0 J of kinetic energy lost

Unit check: $\text{kg} \times (\text{m s}^{-1})^2 = \text{J} \checkmark$

04 Practice problems

P1 Which quantities are conserved in every collision?
Answer: Momentum and total energy

P2 A 0.10 kg ball hits a wall at 8.0 m s^{-1} and rebounds at 6.0 m s^{-1} . Find the kinetic energy lost.
Answer: 1.4 J

P3 Two balls approach at a relative speed of 5.0 m s^{-1} and separate at 3.0 m s^{-1} . Is the collision perfectly elastic?
Answer: No: inelastic

P4 A 1.0 kg ball at 6.0 m s^{-1} hits a stationary 2.0 kg ball elastically. Find both velocities after.
Answer: 1.0 kg : 2.0 m s^{-1} back; 2.0 kg : 4.0 m s^{-1} forwards

05 Other useful information

Common mistakes

- ✗ **Wrong:** Momentum is lost in an inelastic collision.
- ✓ **Right:** Momentum is always conserved; only kinetic energy is lost.

Exam tips

- Elastic problems: use momentum conservation plus approach speed = separation speed.

What the syllabus asks

- 9702 topic 3: elastic and inelastic collisions; relative speeds. Coursebook 6.3.

Explore: [Practice questions for this lesson](#)