

Elastic and inelastic collisions with centre of mass

AP Physics 1 (algebra-based) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test lasts 45 minutes and counts for 20 points. Show every substitution, give units, and write the sign of each velocity. No data sheet is given beyond the formulae you learned in the lesson; write clearly so that the marker can follow your reasoning.

Level: AP Physics 1 (algebra-based) · **Curriculum:** AP P1 Unit 4

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Core ideas (2 marks)

- State the condition for the total momentum of a system to be conserved. (1 mark)
- Define the centre of mass of a two-object system and give its velocity formula. (1 mark)

Question 2 Classify the events (2 marks)

- A ball of putty hits a wall and stays on it. (1 mark)
- Two air-track gliders with spring bumpers rebound with no loss of kinetic energy. (1 mark)

Question 3 Trolleys that couple (3 marks)

A 0.60 kg lab cart moves at 2.0 m/s towards a 0.90 kg cart moving the same way at 0.50 m/s. They couple.

- Calculate the speed after coupling. (2 marks)
- Calculate the kinetic energy transformed. (1 mark)

Question 4 An elastic collision (3 marks)

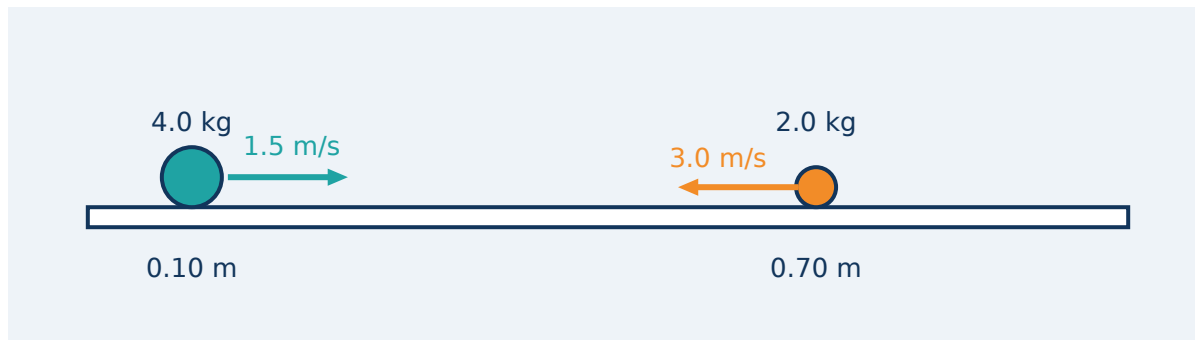
A 0.30 kg block at 4.0 m/s collides elastically and head-on with a stationary 0.10 kg block on a frictionless surface.

- Calculate the velocity of each block afterwards. (2 marks)

- b. Show that kinetic energy is conserved. (1 mark)

Question 5 Centre of mass (3 marks)

Two masses are on a metre rule.



Masses on a rule, positions measured from the left end.

- Calculate the position of the centre of mass. (2 marks)
- Calculate the velocity of the centre of mass. (1 mark)

Question 6 Third law and conservation (2 marks)

Explain, using Newton's third law, why the momentum gained by one object in a collision equals the momentum lost by the other.

Question 7 Identify the collision (3 marks)

In a collision a 1.5 kg cart at +2.0 m/s hits a 1.0 kg cart at -1.0 m/s. Afterwards the 1.5 kg cart moves at +0.20 m/s.

- Calculate the velocity of the 1.0 kg cart afterwards. (1 mark)
- Calculate the kinetic energy before and after. (1 mark)
- Classify the collision. (1 mark)

Question 8 Paragraph argument (2 marks)

A student states that kinetic energy lost in a collision means that momentum was not conserved. Write a short argument that evaluates this statement.