

Momentum conservation, impulse and collision types

Physics grades 11-12 (A Level · IB · Class 11-12) · Test

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

This test lasts 45 minutes and is worth 20 marks. Calculators are allowed. Take $g = 9.81 \text{ N/kg}$, define a positive direction in every collision and show all your working with units.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB A.2

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

Question 1 Definitions (2 marks)

- Define impulse. (1 mark)
- State the principle of conservation of momentum. (1 mark)

Question 2 Hammer and nail (3 marks)

A hammer of mass 2.0 kg strikes a nail at 5.0 m/s and stops in 4.0 ms .

- Calculate the change in momentum of the hammer. (1 mark)
- Calculate the average force on the nail. (2 marks)

Question 3 Pucks sticking together (3 marks)

A puck of mass 0.30 kg slides at 4.0 m/s and sticks to a stationary puck of mass 0.60 kg .

- Calculate the speed of the pair. (2 marks)
- Calculate the kinetic energy lost. (1 mark)

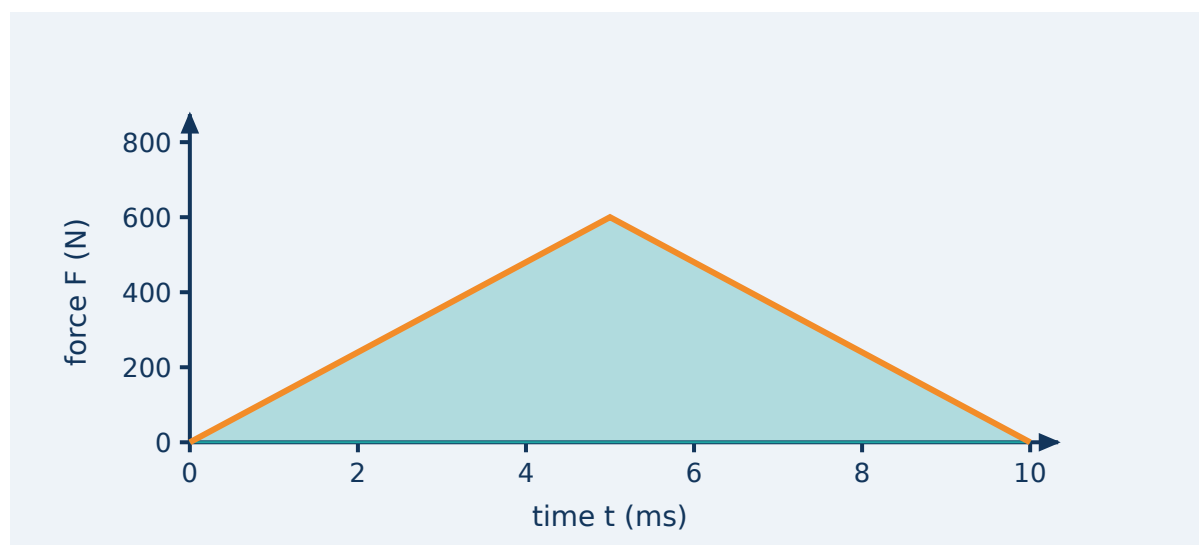
Question 4 Elastic collision (3 marks)

A ball of mass 3.0 kg moving at 4.0 m/s hits a stationary ball of mass 1.0 kg in a head-on elastic collision. The final velocities are 2.0 m/s and 6.0 m/s in the original direction.

- Show that momentum is conserved. (1 mark)
- Show that the relative speeds of approach and separation are equal. (1 mark)
- Show that kinetic energy is conserved. (1 mark)

Question 5 Force-time graph (3 marks)

A ball of mass 0.50 kg is at rest and is struck. The graph shows the force on it.



Contact force on a ball of mass 0.50 kg.

- Calculate the impulse. (1 mark)
- Calculate the speed of the ball afterwards. (1 mark)
- Calculate the average force. (1 mark)

Question 6 Rocket in space (2 marks)

Explain how a rocket accelerates in empty space where there is no air to push against.

Question 7 Pucks at right angles (3 marks)

Puck A (0.20 kg) moves east at 3.0 m/s and puck B (0.20 kg) moves north at 4.0 m/s. They collide and stick together.

- Calculate the magnitude of the total momentum. (1 mark)
- Calculate the speed of the pair. (1 mark)
- Calculate their direction north of east. (1 mark)

Question 8 Kinetic energy and sticking (1 mark)

State whether kinetic energy is conserved when two objects stick together, and give a reason.