Momentum

Question Paper

Level	International A Level
Subject	Physics
Exam Board	Edexcel
Topic	Physics on the move
Sub Topic	Momentum
Booklet	Question Paper

Time Allowed: **52 minutes**

Score: **/43**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Which of the following is a possible unit for rate of change of momentum?

- ☒ **A** kg m s
- ☒ **B** kg m s^{-1}
- ☒ **C** kg m s^{-2}
- ☒ **D** kg m s^{-3}

(Total for Question 1 = 1 mark)

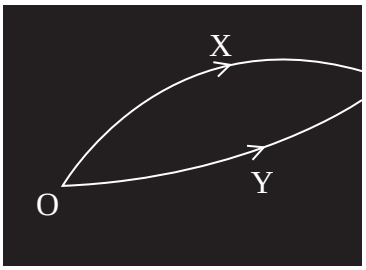
---

2 An electron has a momentum of 1.9×10^{-24} kg m s^{-1}.
The kinetic energy of the electron is

- ☒ **A** 1.1×10^{-21} J
- ☒ **B** 2.0×10^{-18} J
- ☒ **C** 4.0×10^{-18} J
- ☒ **D** 1.0×10^{6} J

(Total for Question 2 = 1 mark)

Question 3 refer to the diagram which shows tracks from a particle detector.



Two particles X and Y were created by the decay of a lambda particle at O.

The diagram shows the tracks of particles X and Y.

3 Which of the following is a correct statement about momentum?

☒ **A** The momentum of X is equal to that of Y.

☒ **B** The total momentum of the system is zero.

☒ **C** The vector sum of the momenta of X and Y must equal that of the lambda particle.

☒ **D** The vector sum of the momenta of X and Y must equal zero.

(Total for Question 3 = 1 mark)

4 Select the row of the table that correctly identifies what happens in an elastic collision.

	Momentum	**Total energy**	**Kinetic energy**
☒ **A**	conserved	conserved	conserved
☒ **B**	conserved	conserved	conserved
☒ **C**	conserved	not conserved	conserved
☒ **D**	not conserved	conserved	not conserved

(Total for Question 4 = 1 mark)

5 A particle Z has kinetic energy E and momentum p. A second particle X has twice the mass and half the momentum of particle Z.

The kinetic energy of X is

☒ **A** $2E$

☒ **B** $\frac{E}{4}$

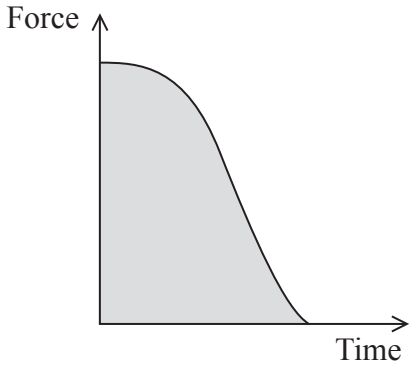
☒ **C** $\frac{E}{8}$

☒ **D** $\frac{E}{16}$

(Total for Question 5 = 1 mark)

---

6 The graph shows how the force on a stone being fired from a catapult varies with time.



Which quantity is represented by the shaded area?

☒ **A** the acceleration of the stone

☒ **B** the work done on the stone

☒ **C** the change in momentum of the stone

☒ **D** the displacement of the stone

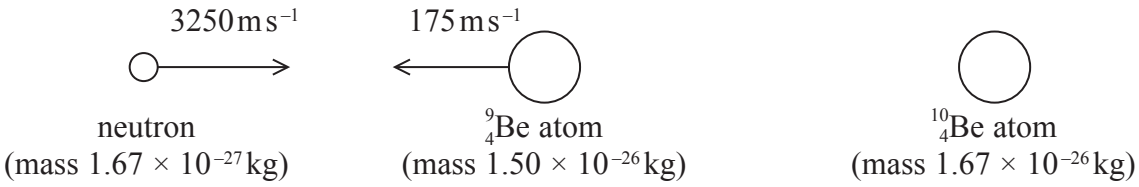
(Total for Question 6 = 1 mark)

---

7 (a) State the principle of conservation of momentum.

(2)

(b) A head-on collision occurs between a neutron and a beryllium atom $^{9}_{4}Be$. The nucleus of the beryllium atom absorbs the neutron to form the isotope $^{10}_{4}Be$.



(i) Calculate the velocity of the $^{10}_{4}Be$ atom, indicating its direction by adding an arrow to the diagram.

(4)

Velocity = ...

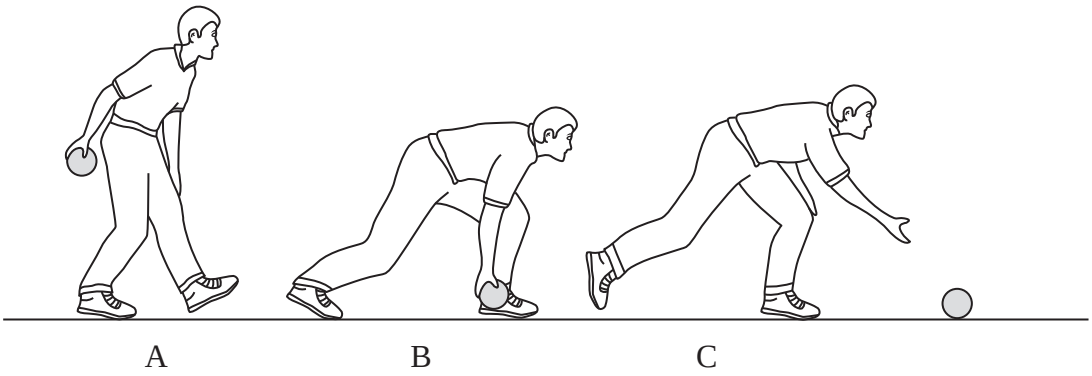
(ii) Using a suitable calculation, determine whether the collision was elastic or inelastic.

(2)

(Total for Question 7 = 8 marks)

8 In a bowling game, a player rolls a small ball along the ground. The diagram shows the action of the player as he starts to swing his arm forward at A, to the point when the ball is rolling along the ground at C.

The player exerts a forward force on the ball between A and B.



(a) (i) State how the motion of the ball at C differs from that at B.

(2)

.....

.....

.....

.....

(ii) The player applies a forward force for 0.20 s and the ball leaves the player's hand at a speed of 3.0 m s^{-1}.

Calculate the average forward force that the player applies to the ball.

mass of ball, m_1 = 1.5 kg

(2)

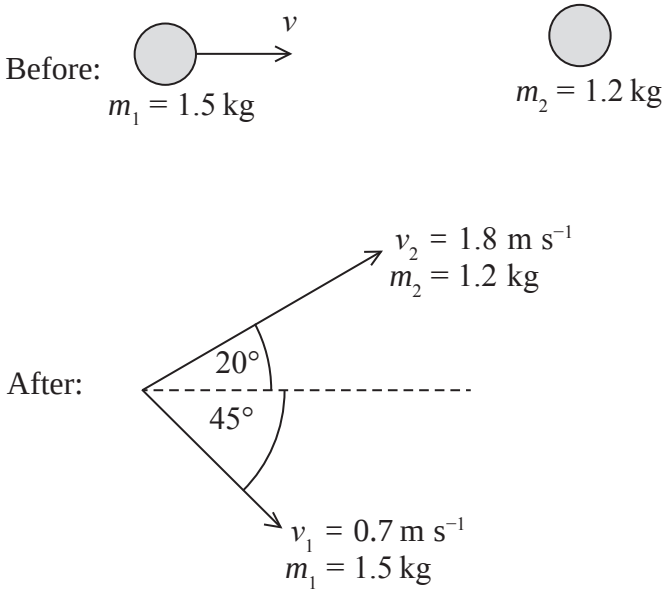
.....

.....

.....

Average forward force = ...

(b) The ball rolls along the ground until it collides with a stationary ball of mass 1.2 kg. After the collision both balls roll off at an angle to the original direction of the moving ball as shown in the diagrams.



After the collision:

- the 1.5 kg ball travels at 0.7 m s^{-1} at an angle of 45° to its original direction
- the 1.2 kg ball travels at 1.8 m s^{-1} at an angle of 20° to the original direction of the moving ball.

(i) Show that the velocity v of the first ball as it collides with the second ball is about 2 m s^{-1}.

(3)

(ii) By means of a suitable calculation, show that the collision is inelastic.

(2)

.....

.....

.....

.....

(Total for Question 8 = 9 marks)

9 (a) State the principle of conservation of momentum.

(2)

(b) State the relationship between the resultant force acting on an object and momentum of the object.

(1)

(c) A car is travelling due east with a velocity of 12 m s^{-1}. The driver of the car changes direction to travel due north with a velocity of 15 m s^{-1}.

(i) The initial velocity is shown in the diagram.
Complete the vector diagram to represent the change in velocity. You do not need to draw it exactly to scale.

(2)

(ii) Determine the change in velocity of the car.

(3)

.....

.....

.....

.....

Magnitude of change of velocity = ...

Direction of change of velocity = ...

(iii) The mass of the car is 1500 kg and the change in velocity took 4.0 s.

Calculate the average force that was needed.

(2)

.....

.....

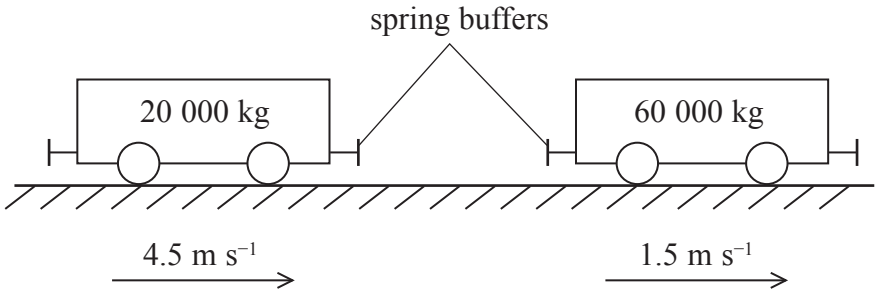
.....

.....

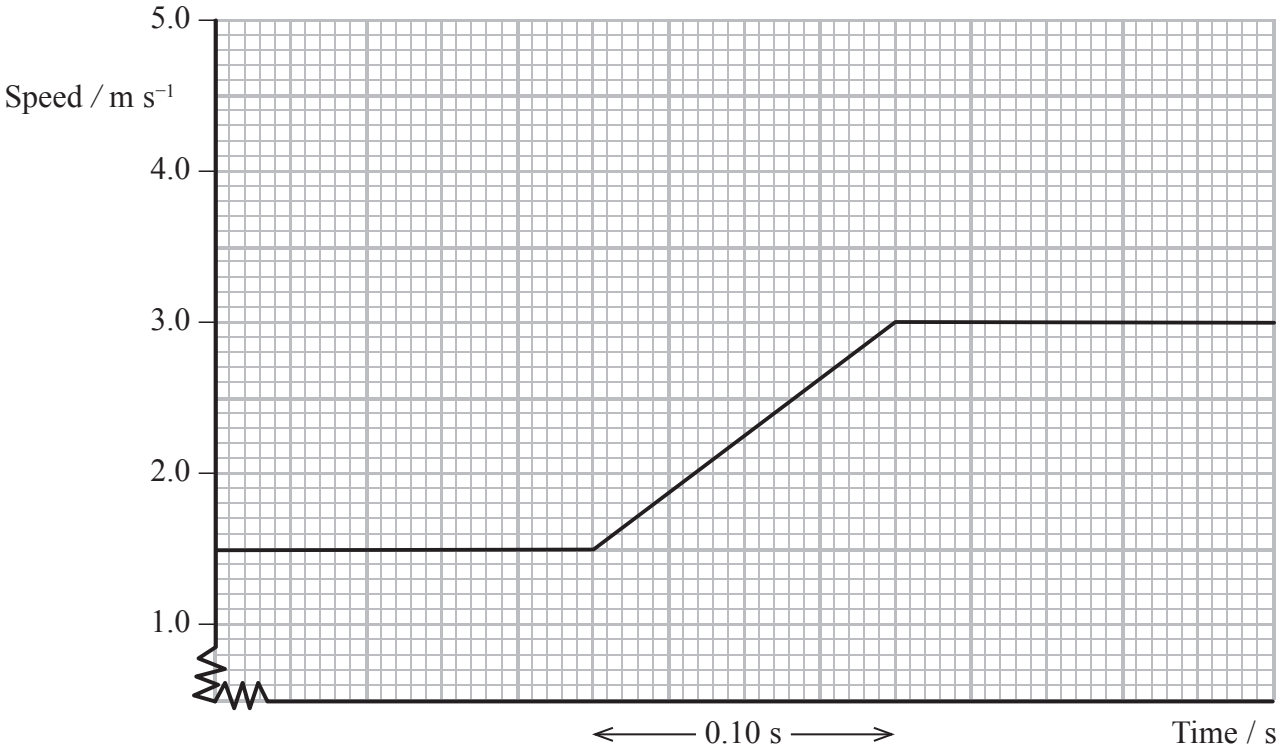
Force = ...

(Total for Question 9 = 10 marks)

10 A railway truck of mass 20 000 kg is moving at a speed of 4.5 m s^{-1}. It catches up and collides with a loaded truck of total mass 60 000 kg which is moving in the same direction at 1.5 m s^{-1}.



The graph shows the speed of the heavier truck before, during and after the collision.



(a) (i) By means of a calculation, show that the speed of the lighter truck after the collision will be zero.

(2)

(ii) Add a second line to the graph to show the speed of the lighter truck before, during and after the collision.

(1)

(iii) Calculate the force that each truck exerts on the other truck.

(2)

Force = ...

(b) The collision between the railway trucks is elastic.

(i) State what is meant by an elastic collision.

(1)

(ii) Show that the total kinetic energy halfway through the collision is less than the total kinetic energy after the collision.

(3)

(iii) Suggest a reason for this.

(1)

(Total for Question 10 = 10 marks)