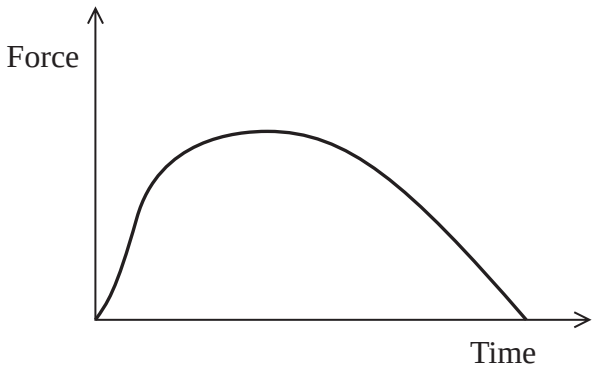
1 A student throws a ball horizontally. The graph shows how the force from the student's hand on the ball varies with time during the throw.



Which of the following quantities is given by the area under the graph?

☒ **A** acceleration

☒ **B** change in momentum

☒ **C** change in velocity

☒ **D** rate of change of momentum

(Total for Question = 1 mark)

2 Particle A of mass m has kinetic energy E_k. Particle B of mass $3m$ has kinetic energy $2E_k$. The ratio of the momentum of particle A to the momentum of particle B is given by

☒ **A** $\frac{1}{6}$

☒ **B** $\frac{1}{\sqrt{6}}$

☒ **C** $\sqrt{6}$

☒ **D** 6

(Total for Question = 1 mark)

3 A particle of mass m, has a velocity v and momentum p.

Which of the following is correct for this particle?

☒ **A** $mv^2/2 = p^2$

☒ **B** $m^2v^2/2 = p^2$

☒ **C** $m^2v^2 = p^2/m$

☒ **D** $mv^2 = p^2/m$

(Total for Question = 1 mark)

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

☒ **A** kg m s^{-2}

☒ **B** kg m s^{-1}

☒ **C** N s^{-1}

☒ **D** N s

(Total for Question = 1 mark)

5 A footballer kicks a football from the penalty spot. A graph of force on the ball against time is drawn.

The area under the force-time graph represents

☒ **A** acceleration

☒ **B** change in kinetic energy

☒ **C** change in momentum

☒ **D** displacement

(Total for Question = 1 mark)

6 Select the row of the table which correctly identifies the quantities conserved in an inelastic collision.

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

(Total for Question = 1 mark)

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

☒ **A** kg m s^{-1}

☒ **B** kg m s^{-2}

☒ **C** N s

☒ **D** N s^{-1}

(Total for Question = 1 mark)

8 A correct re-statement of the equation $E_k = p^2/2m$ is

☒ **A** $\frac{1}{2}mv^2 = p^2$

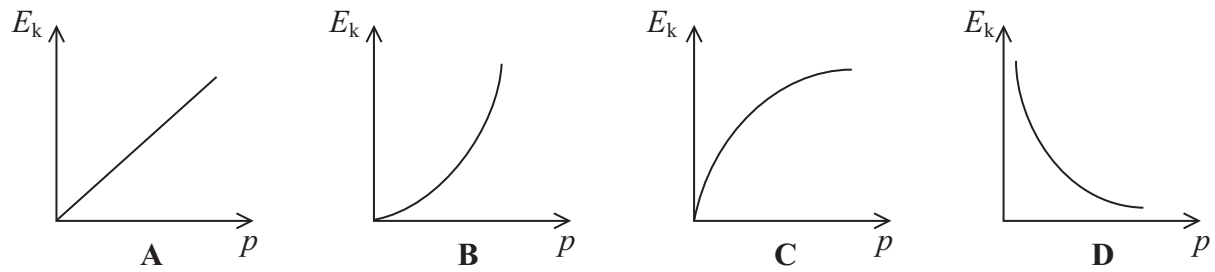
☒ **B** $p^2 = m^2v^2$

☒ **C** $p^2/m = 2v^2$

☒ **D** $mv^2 = \frac{1}{2}p^2$

(Total for Question = 1 mark)

9 A car is accelerated from rest. Which graph correctly shows how the kinetic energy E_k varies with momentum p?



☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 1 mark)

10 An inelastic collision is one in which

☒ **A** momentum is not conserved.

☒ **B** momentum and kinetic energy are not conserved.

☒ **C** momentum and kinetic energy are conserved.

☒ **D** kinetic energy is not conserved.

(Total for Question 1 mark)

11 A body is falling freely under gravity. The rate at which the body's momentum is changing is equal to its

☒ **A** acceleration.

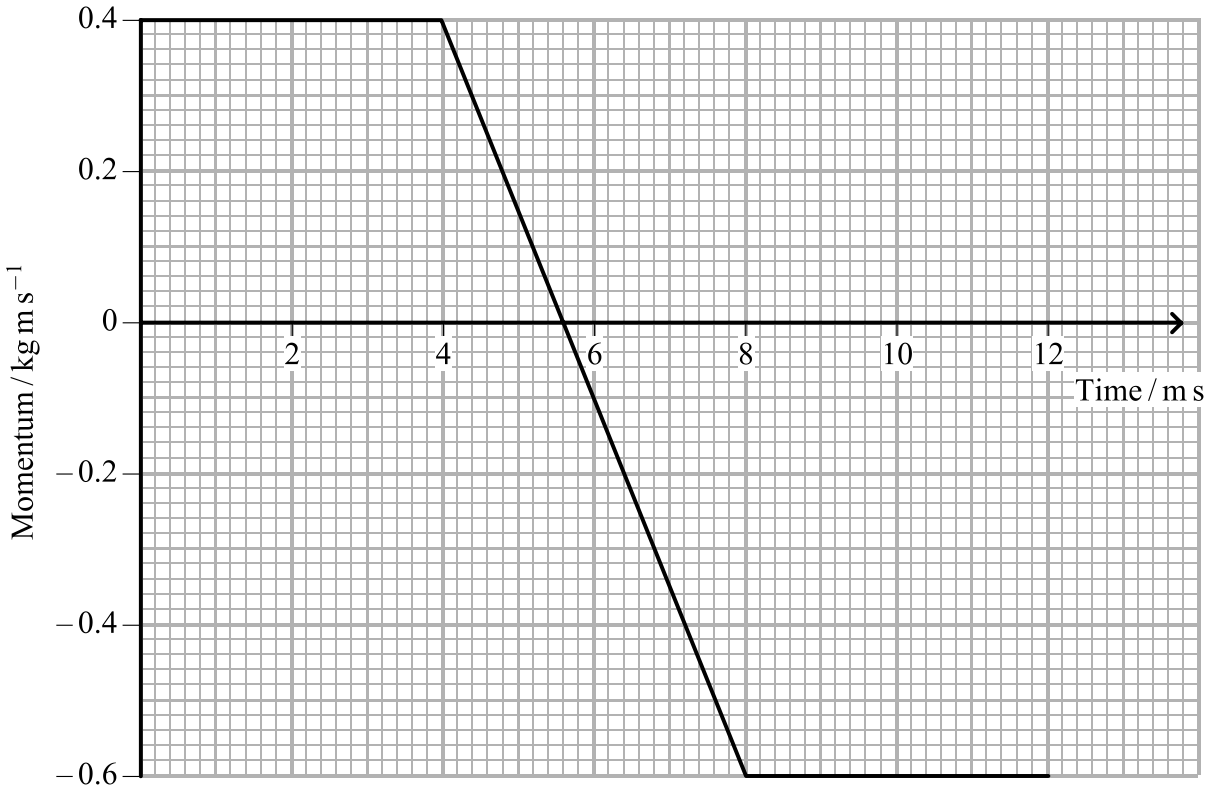
☒ **B** kinetic energy.

☒ **C** potential energy.

☒ **D** weight.

(Total for Question = 1 mark)

12 A tennis ball is travelling horizontally with a momentum of 0.4 kg m s^{-1} just before it is hit with a tennis racket. It rebounds horizontally from the tennis racket with a momentum of –0.6 kg m s^{-1}. The graph shows the variation in the momentum of the ball during this process.



The force exerted by the tennis ball on the racket is

☒ **A** 12 N

☒ **B** 100 N

☒ **C** 250 N

☒ **D** 1000 N

(Total for Question = 1 mark)

13 A body, initially at rest, explodes into two masses M_1 and M_2. These masses move apart with speeds v_1 and v_2 respectively.

The ratio v_1/v_2 is equal to

☒ **A** $\frac{M_1}{M_2}$

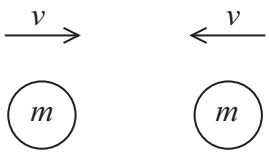
☒ **B** $\frac{M_2}{M_1}$

☒ **C** $\frac{\sqrt{M_1}}{\sqrt{M_2}}$

☒ **D** $\frac{\sqrt{M_2}}{\sqrt{M_1}}$

(Total for Question 1 mark)

14 Two identical spheres of mass m are both travelling with a speed v towards each other.



The spheres collide head-on.

Which of the following statements **must** be true after the collision?

☒ **A** total momentum $2mv$

☒ **B** total momentum 0

☒ **C** total kinetic energy mv^2

☒ **D** total kinetic energy 0

(Total for Question 1 mark)

15 A cyclist travels along a straight horizontal road at a steady speed. A net force of 20 N is then applied for 6 s. The change in momentum of the cyclist is

☒ **A** 3.3 kg m s ^{1}

☒ **B** 26 kg m s ^{1}

☒ **C** 120 kg m s ^{1}

☒ **D** 720 kg m s ^{1}

(Total for Question 1 mark)

16 The momentum of a particle is p. The kinetic energy of the particle is doubled.

The momentum is now

☒ **A** $\sqrt{2}p$

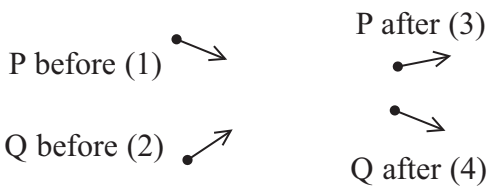
☒ **B** $2p$

☒ **C** $4p$

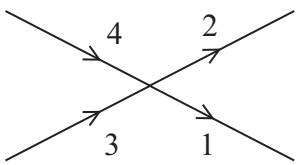
☒ **D** $8p$

(Total for Question 1 mark)

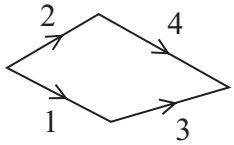
17 The diagram represents the collision between two sub-atomic particles P and Q moving with momenta 1 and 2 respectively. After the collision they have momenta 3 and 4 respectively.



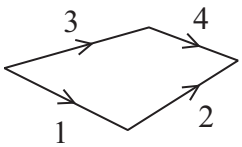
Which vector diagram best shows the correct relationship for the momenta of P and Q?



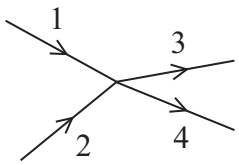
A



B



C



D

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 1 mark)

18 The area under a force-time graph represents

☒ **A** acceleration.

☒ **B** change in momentum.

☒ **C** displacement.

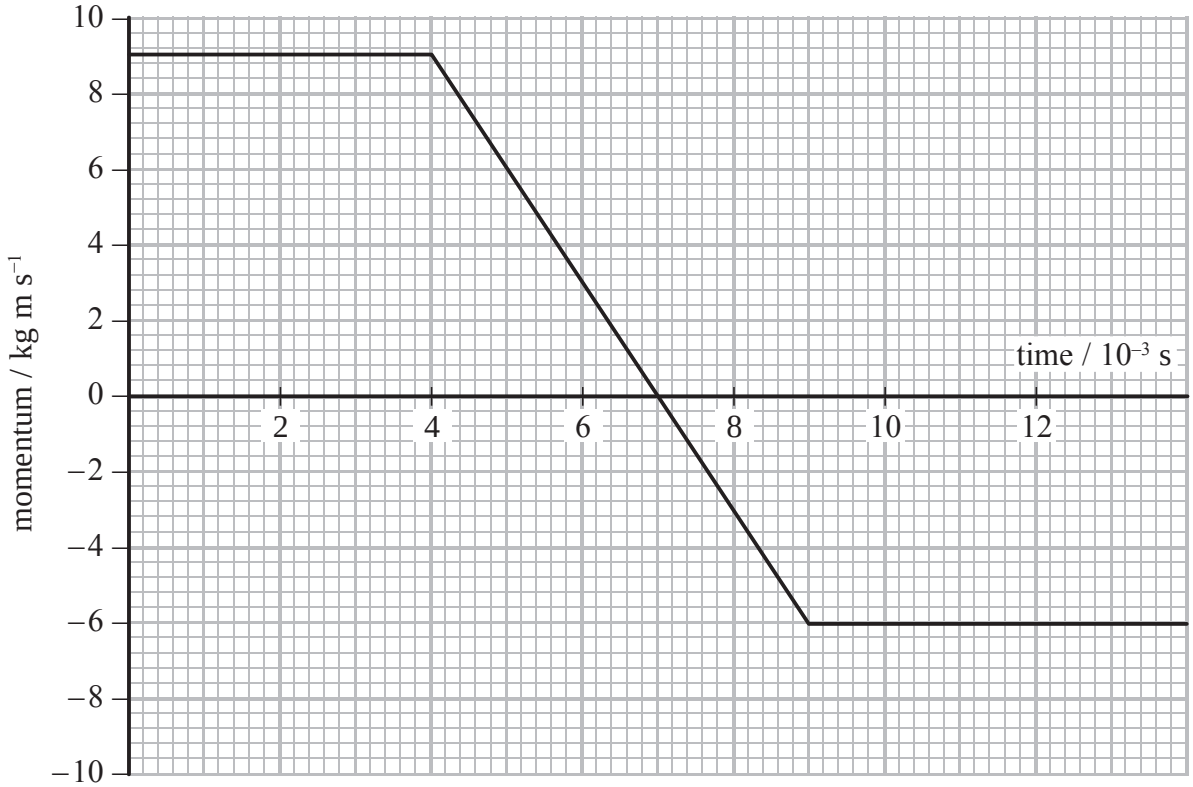
☒ **D** kinetic energy.

(Total for Question 1 mark)

19 A football is kicked horizontally to hit a wall. Its momentum just before it hits the wall is

9.0 kg m s^{-1}.

The graph shows how the momentum of the football varies during the impact with the wall.



The force exerted by the wall on the football is

☒ **A** 3.0 N

☒ **B** 15 N

☒ **C** 600 N

☒ **D** 3000 N

(Total for Question = 1 mark)

20 Which of the following statements is always true for an inelastic collision?

☒ **A** Both momentum and kinetic energy are conserved.

☒ **B** Neither momentum nor kinetic energy is conserved.

☒ **C** Kinetic energy is not conserved.

☒ **D** Momentum is not conserved.

(Total for Question = 1 mark)

21 A gymnast of mass 40 kg falls vertically onto a trampoline with a speed of 5 m s^{-1} and rebounds with the same speed.

She is in contact with the trampoline for 0.2 s. The average force exerted on the gymnast by the trampoline during this period is

☒ **A** 10 N

☒ **B** 20 N

☒ **C** 1000 N

☒ **D** 2000 N

(Total for Question = 1 mark)

22 Select the row in the table that correctly identifies what happens in an inelastic collision.

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

(Total for Question = 1 mark)