

Answer ALL questions.

All multiple choice questions must be answered with a cross in the box for the correct answer and then mark your new answer with a cross

- 1 A particle has a mass of 1 u and a charge of -1.6×10^{-19} C.

- 2 The velocity v of a non-relativistic particle can be expressed in terms of combinations of

(Total for Question 2 = 1 mark)

- 3 A ball is thrown with an initial horizontal component of velocity u and an initial vertical component of velocity v . The effects of air resistance are negligible.

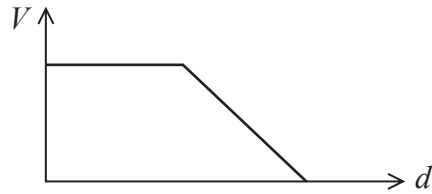
Which of the following statements about the motion of the ball is **not** correct?

- A The magnitude of the acceleration in the vertical plane is g .
- B The horizontal component of velocity is constant.
- C The time taken for the ball to reach its maximum height is equal to $\frac{v}{g}$.
- D The maximum height of the ball depends on the values of u and v .

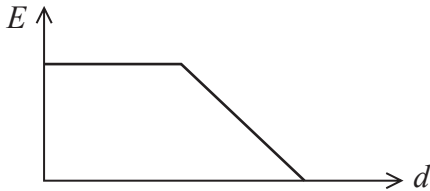
(Total for Question 3 = 1 mark)



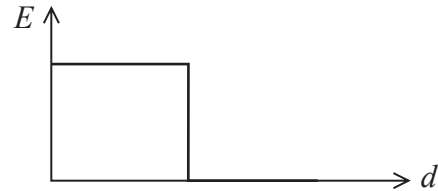
- 6 The graph shows how the potential V varies with distance d in an electric field.



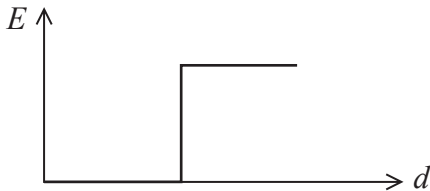
Which of the following shows the corresponding variation in electric field strength E ?



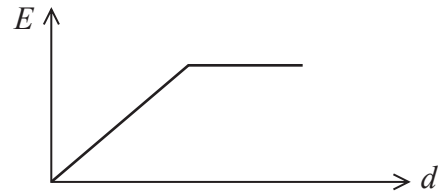
A



B



C



D

(Total for Question 6 = 1 mark)

- 7 Which of the following quantities is a vector?

- A charge
 B mass
 C momentum
 D time

(Total for Question 7 = 1 mark)



11 A student drives a go-kart up a slope.

- (a) The slope is at an angle of 5.7° to the horizontal. The go-kart moves with a constant velocity of 2.8 m s^{-1} .

Calculate the power of the go-kart.

mass of go-kart and driver = 60 kg
resistive force on the go-kart = 18 N

(4)

Power =

- (b) The go-kart is powered by a battery connected to a motor. The rate of thermal energy transfer by the wiring in the motor is 55 W .

Calculate the resistance of the wiring in the motor.

current in motor = 24 A

(2)

Resistance of the wiring in the motor =

(Total for Question 11 = 6 marks)

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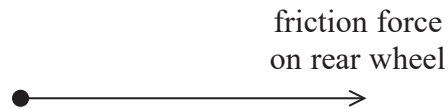


12 The photograph shows a cyclist cycling at a constant velocity on horizontal ground.



- (a) Complete the free-body force diagram to show the four forces acting on the bicycle. Treat the bicycle and cyclist as a single object. One force has been added for you.

(3)



- (b) The cyclist stops pedalling and comes to rest in a time of 5.2 s.

- (i) Sketch a graph to show how the cyclist's velocity changes during this time.

Assume the deceleration is constant.

(2)



(ii) The cyclist travels 7.80 m while coming to rest.

Calculate the average resistive force on the cyclist and bicycle.

mass of cyclist and bicycle = 28.0 kg

(4)

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Average resistive force =

(Total for Question 12 = 9 marks)

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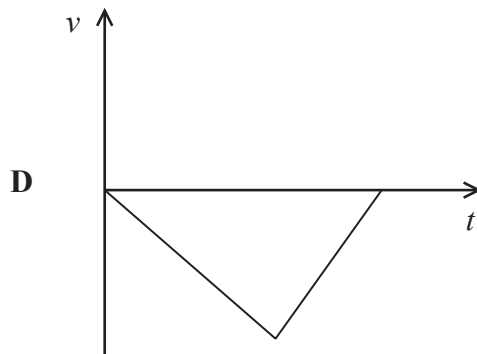
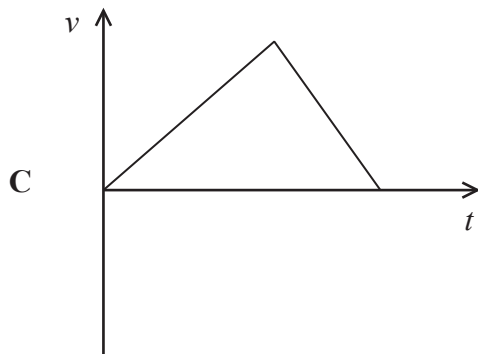
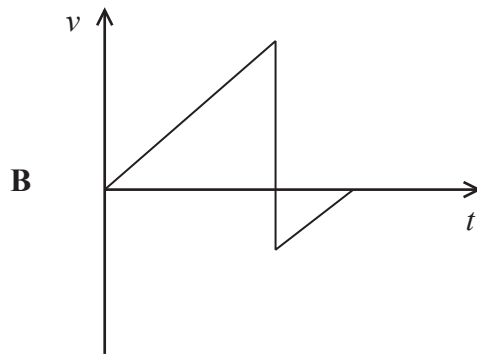
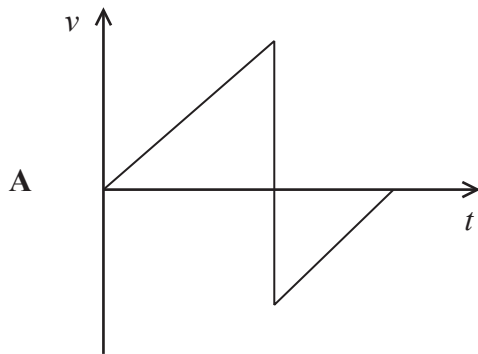
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P 6 9 3 0 6 A 0 9 2 8

- 3 A ball was dropped from rest, from a height above the ground. The ball bounced back up to about half its initial height.

Which graph shows how the velocity v of the ball varied with time t ?

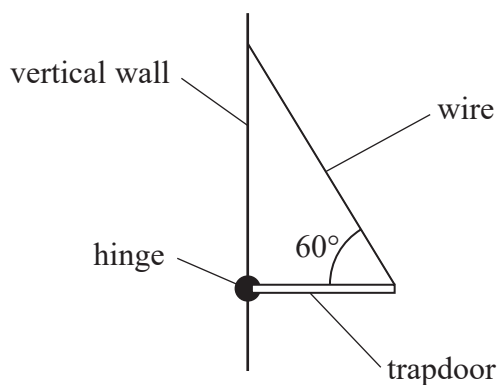


- A
- B
- C
- D

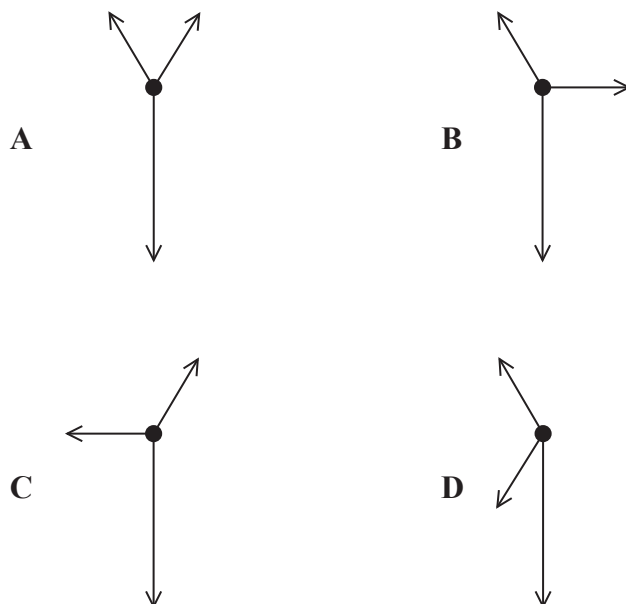
(Total for Question 3 = 1 mark)



- 6 A trapdoor is fixed to a vertical wall with a hinge. A wire is attached to the other end of the trapdoor and inclined at an angle of 60° , as shown. The wire holds the trapdoor horizontal.



Which of the following shows the free-body force diagram for the trapdoor?



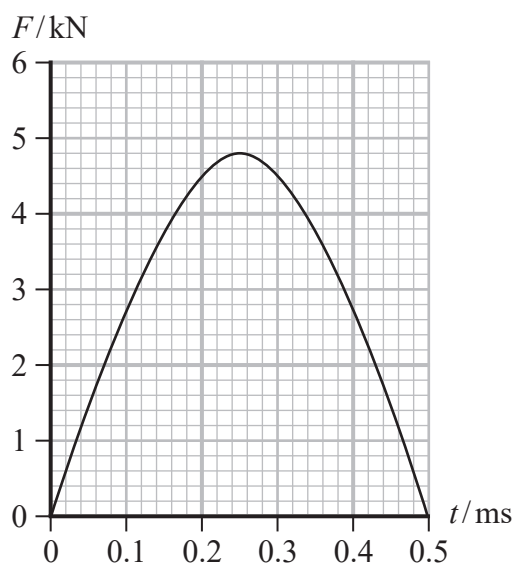
- A
- B
- C
- D

(Total for Question 6 = 1 mark)



- 12 In the game of golf a stationary ball is hit by a club. One of the aims of the game is to land the ball on a patch of ground called the green.

The graph shows how the force F exerted by the club on the ball varies with time t as the ball is hit.



- (a) State why the area under the graph represents impulse.

(1)

- (b) (i) Show that the velocity of the ball is about 30 m s^{-1} immediately after it is hit by the club.

mass of ball = 0.046 kg

(3)

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Answer All questions.

All multiple choice questions must be answered with a cross in the box for the correct answer from A to D. If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

1 Which of the following is an example of a scalar quantity?

- A displacement
- B energy
- C momentum
- D velocity

(Total for Question 1 = 1 mark)

2 Which row of the table summarises the mass and charge of an antineutron?

3 The distance between a proton and an electron is r . The electrostatic force is F .

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4 Which of the following is a base SI unit?

- A ampere
- B coulomb
- C joule
- D newton

(Total for Question 4 = 1 mark)



- 10 Two gliders, X and Y, are placed on an air track. The gliders are pushed towards each other as shown.



The gliders collide and continue to move after the collision.

Which row of the table could show the velocities of X and Y, in ms^{-1} , after the collision?

	X	Y
<input type="checkbox"/> A	-1.0	0.5
<input type="checkbox"/> B	-1.0	-0.5
<input type="checkbox"/> C	-2.0	-1.0
<input type="checkbox"/> D	-2.0	2.0

(Total for Question 10 = 1 mark)

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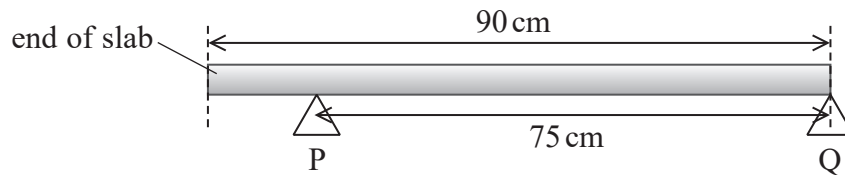


11 A uniform paving slab is to be used as a garden step.

(a) State what is meant by the centre of gravity of an extended body.

(1)

(b) The paving slab has a weight of 310 N and a length of 90 cm and will be supported at two points, P and Q, as shown. The distance between P and Q will be 75 cm.



This might be unsafe because a person who places all their weight at the end of the slab might tip the slab.

A person of mass 70 kg stands at the end of the slab.

Deduce whether the slab will tip.

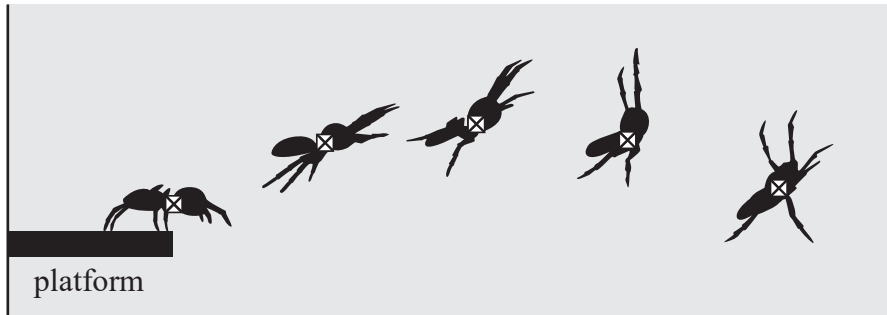
(4)

(Total for Question 11 = 5 marks)



16 Scientists have been studying a type of jumping spider that can jump up to six times its body length.

- (a) The scientists photographed a spider at 0.02s intervals, during a jump. The picture is taken from the photograph and is shown actual size.



- (i) Deduce whether the images show that the motion in the x -direction is independent of the motion in the y -direction. You should take measurements using the cross marking the centre of gravity of the spider.

(4)

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(ii) Show that the initial velocity of the spider at the start of the jump is about 1 m s^{-1} .
You should take measurements using the cross marking the centre of gravity of the spider.

(5)

(iii) The spider achieves this jump by extending its two back legs by 3.0 mm.

Calculate the average force the spider exerts in each leg to achieve the jump.

mass of spider = 150 mg

(3)

Average force =

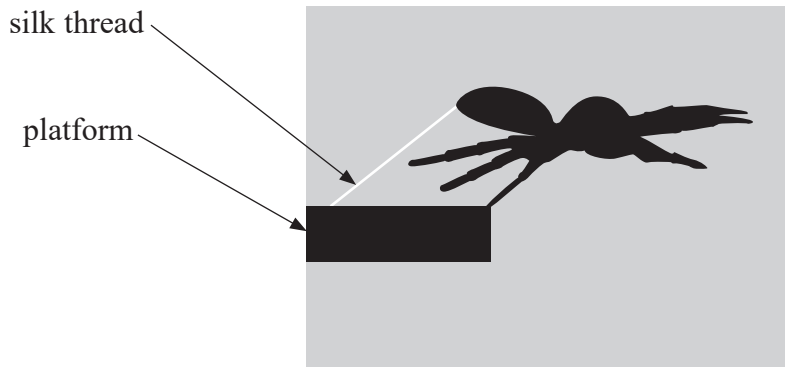
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(b) Just as the spider starts the jump, it fixes a silk thread to the platform. It is thought that the thread acts as a safety line in case the spider falls.



A student makes the comment:

‘If the silk thread can withstand a tension equal to the weight of the spider then this safety system should work.’

Deduce whether this statement is correct.

(2)

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(Total for Question 16 = 14 marks)

