AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.5.1.1 SCALAR AND VECTOR QUANTITIES (PACK 2)

SCORE	PERCENTAGE
/78	%

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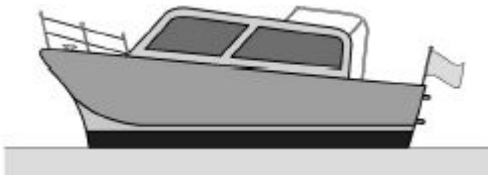
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Q1.

Figure 1 shows a boat floating on the sea. The boat is stationary.

Figure 1



(a) **Figure 2** shows part of the free body diagram for the boat.

Complete the free body diagram for the boat.

Figure 2



(2)

(b) Calculate the mass of the boat.

Use the information given in **Figure 2**.

gravitational field strength = 9.8 N/kg

Give your answer to **two** significant figures.

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_____

_____

_____

_____

Mass = _____ kg

(4)

(c) When the boat propeller pushes water backwards, the boat moves forwards. The force on the water causes an equal and opposite force to act on the boat.

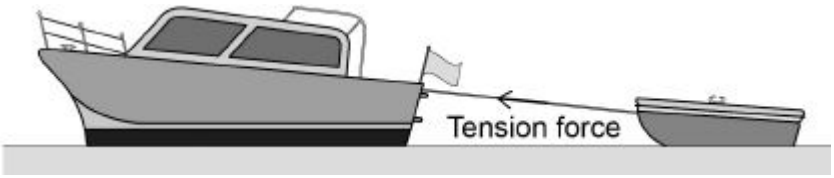
Which law is this an example of?

_____

(1)

(d) **Figure 3** shows the boat towing a small dinghy.

Figure 3



The tension force in the tow rope causes a horizontal force forwards and a vertical force upwards on the dinghy.

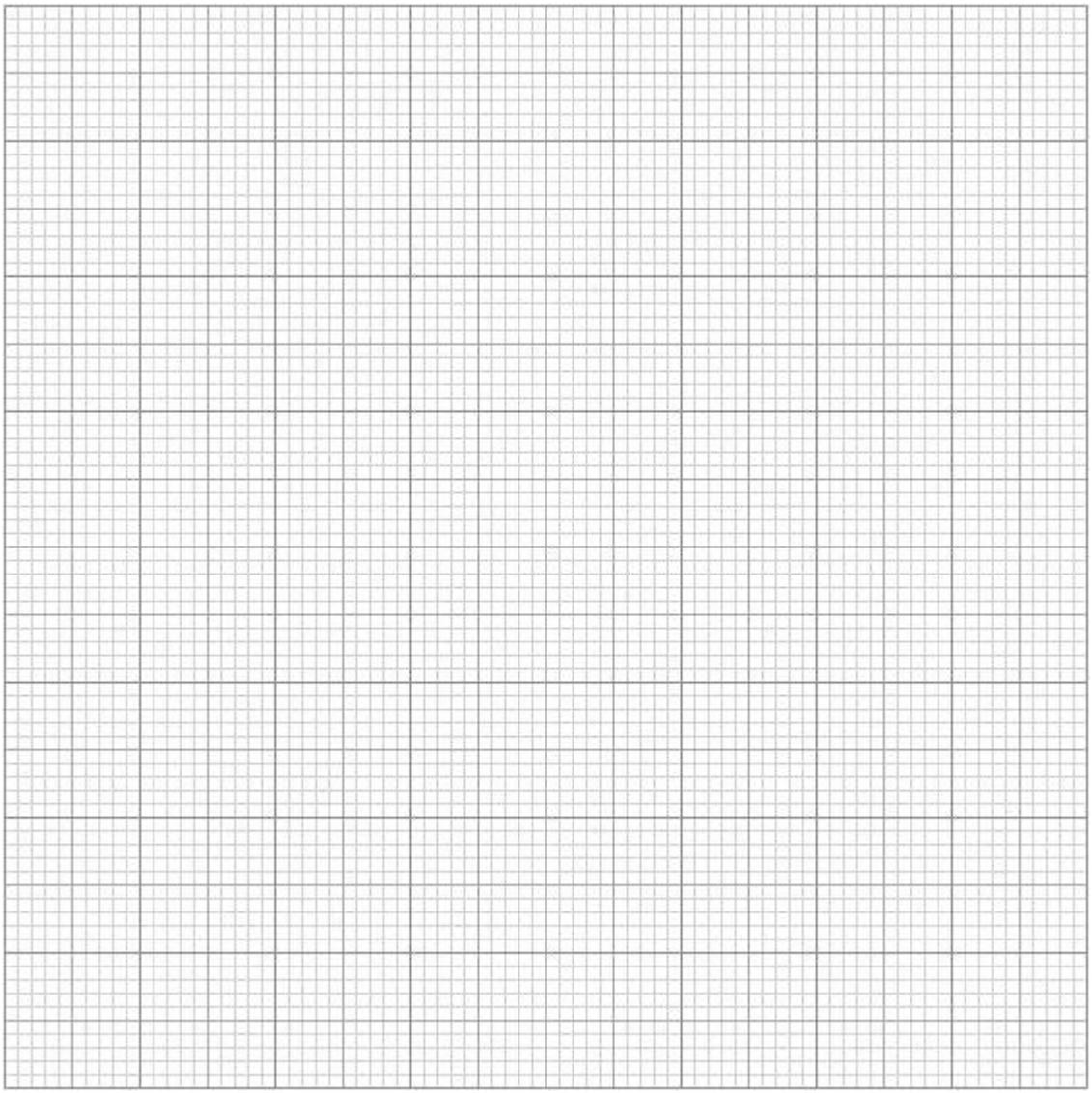
horizontal force forwards = 150 N
vertical force upwards = 50 N

Figure 4 shows a grid.

Draw a vector diagram to determine the magnitude of the tension force in the tow rope and the direction of the force this causes on the dinghy.

Figure 4

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Magnitude of the tension force in the tow rope = _____ N

Direction of the force on the dinghy caused by the tension force in the tow rope = _____

(4)

(Total 11 marks)

Q2.

Momentum is a vector quantity.

(a) How is a vector quantity different to a scalar quantity?

_____

_____

(1)

(b) Name another vector quantity.

_____

(1)

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(c) Give the definition of momentum.

_____

_____

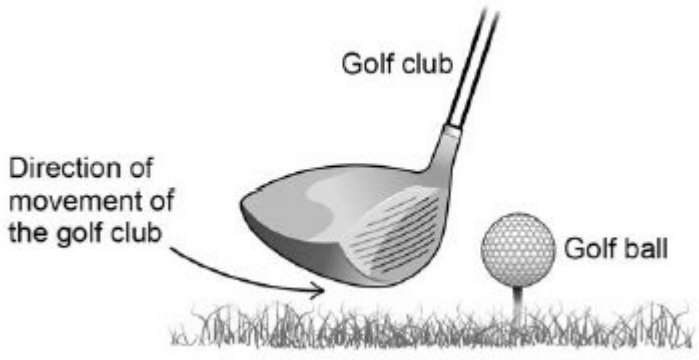
(1)

(d) What is the unit of momentum?

_____

(1)

(e) The image shows a golf club about to hit a stationary golf ball.



The golf club is in contact with the golf ball for 1.8 ms and exerts a force of 1500 N on the golf ball.

The mass of the golf ball is 0.045kg

Calculate the velocity of the golf ball as it leaves the golf club.

_____

_____

_____

_____

_____

_____

_____

Velocity = _____ m/s

(4)

(f) When hitting the golf ball the golfer swings the golf club to keep it in contact with the golf ball for as long as possible.

The force acting on the golf ball is constant during this time.

Explain the effect that the time of contact between the golf club and the golf ball has on the distance the golf ball travels.

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_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 12 marks)

Q3.

(a) **Figure 1** shows an aircraft flying at a constant velocity and at a constant height above the ground.

Figure 1



Complete the free body diagram in **Figure 2** to show the other two forces acting on the aircraft.

Figure 2



(2)

(b) A small aircraft accelerated down a runway at 4.0 m/s^2

The aircraft started from rest and reached a speed of 34 m/s just before take-off.

Calculate the distance the aircraft travelled while accelerating.

Give your answer to 2 significant figures.

_____

_____

_____

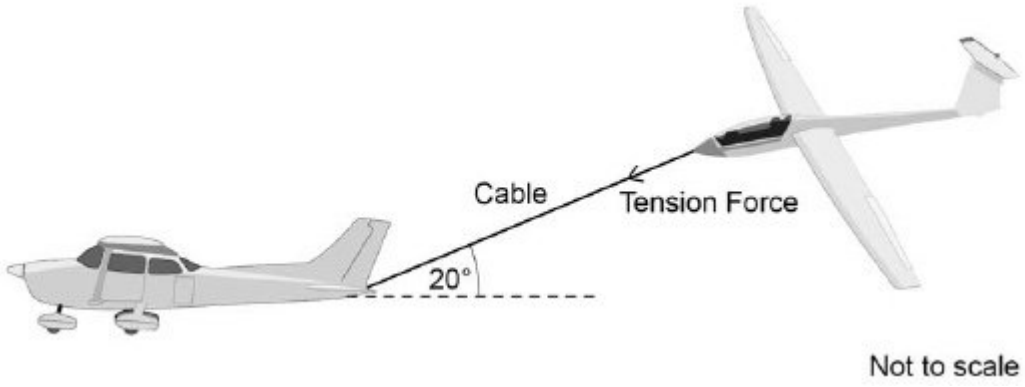
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Distance = _____ m

(4)

(c) **Figure 3** shows the small aircraft being used to tow a glider.

Figure 3



The tension force in the cable can be resolved into a horizontal component and a vertical component.

The tension in the cable is 2000 N

The cable makes an angle of 20° with the horizontal.

Draw a vector diagram to determine the magnitude of the two components of the tension force in the cable.

Magnitude of the horizontal component = _____ N

Magnitude of the vertical component = _____ N

(1)

(Total 10 marks)

Q4.

Quantities in physics are either scalars or vectors.

(a) Use the correct answers from the box to complete the sentence.

acceleration	**direction**	**distance**	**speed**	**time**

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Velocity is _____ in a given _____ .

(2)

(b) Complete the table to show which quantities are scalars and which quantities are vectors.

Put **one** tick (✓) in each row.

The first row has been completed for you.

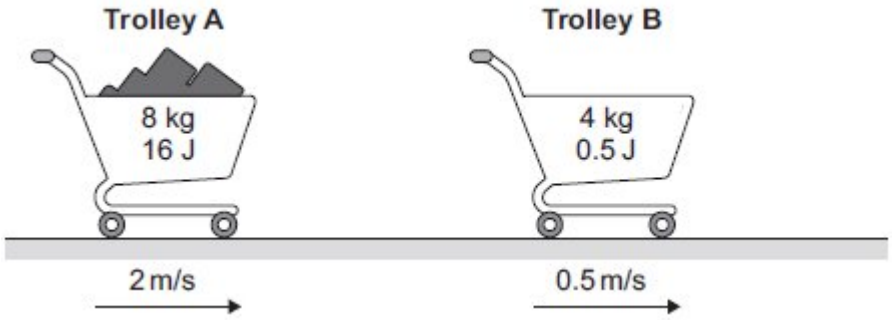
Quantity	**Scalar**	**Vector**
Momentum		✓
Acceleration		
Distance		
Force		
Time		

(3)

(c) The diagram shows two supermarket trolleys moving in the same direction.

Trolley **A** is full of shopping, has a total mass of 8 kg and is moving at a velocity of 2 m / s with a kinetic energy of 16 J.

Trolley **B** is empty, has a mass of 4 kg and is moving at a velocity of 0.5 m / s with a kinetic energy of 0.5 J.



(i) Calculate the momentum of both trolley **A** and trolley **B**.

Give the unit.

_____

_____

Momentum of trolley **A** = _____

Momentum of trolley **B** = _____

Unit _____

(4)

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(ii) The trolleys in the diagram collide and join together. They move off together.

Calculate the velocity with which they move off together.

_____

_____

_____

_____

Velocity = _____ m / s

(3)

(iii) In a different situation, the trolleys in the digram move at the same speeds as before but now move towards each other.

Calculate the total momentum and the total kinetic energy of the two trolleys before they collide.

_____

_____

Total momentum = _____

_____

_____

Total kinetic energy = _____ J

(2)

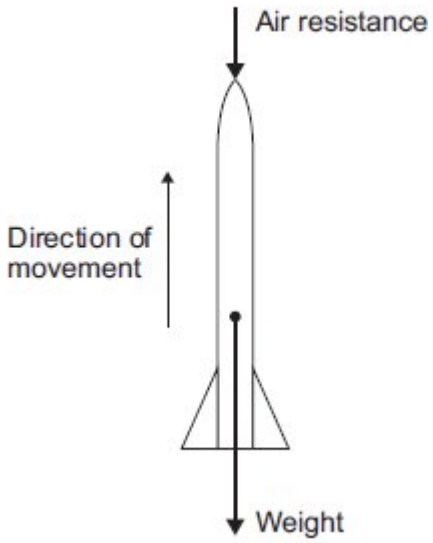
(Total 14 marks)

Q5.

(a) **Figure 1** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

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Figure 1



(i) How does the velocity of the rocket change as the rocket moves **upwards**?

_____

Give a reason for your answer.

_____

_____

(2)

(ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

_____

_____

_____

(1)

(b) The speed of the rocket just after being launched is 12 m / s.
The mass of the rocket is 0.05 kg.

(i) Calculate the kinetic energy of the rocket just after being launched.

_____

_____

_____

Kinetic energy = _____ J

(2)

(ii) As the rocket moves upwards, it gains gravitational potential energy.

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State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

Maximum gravitational potential energy = _____ J

(1)

(iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

_____

_____

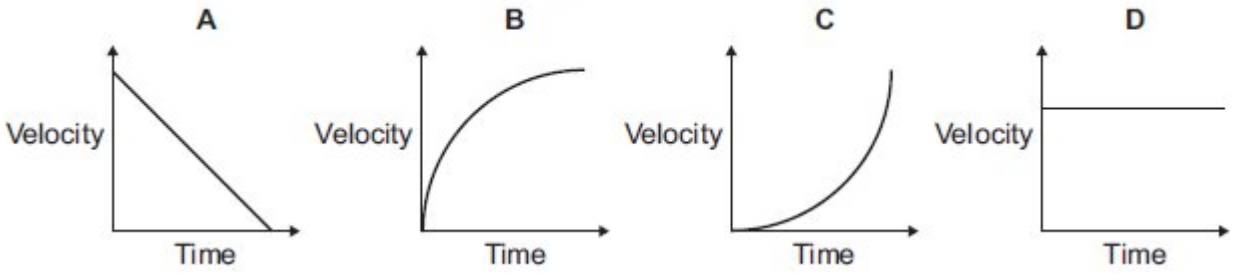
_____

Maximum height = _____ m

(2)

(iv) **Figure 2** shows four velocity−time graphs.

Figure 2



Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

Write the correct answer in the box. ☐

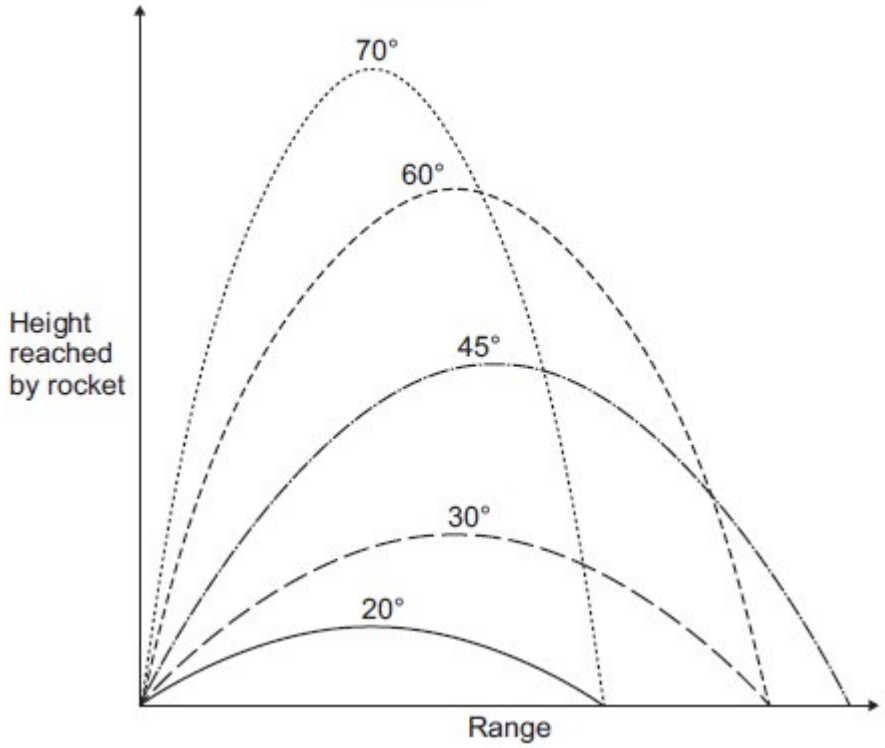
(1)

(c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 3 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

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Figure 3



What pattern links the angle at which the rocket is launched and the range of the rocket?

_____

_____

_____

_____

(2)

(Total 11 marks)

Q6.

The London Eye is one of the largest observation wheels in the world.

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The passengers ride in capsules. Each capsule moves in a circular path and accelerates.

(a) Explain how the wheel can move at a steady speed and the capsules accelerate at the same time.

_____

_____

_____

(2)

(b) In which direction is the resultant force on each capsule?

_____

(1)

(c) The designers of the London Eye had to consider **three** factors which affect the resultant force described in part (b).

Two factors that increase the resultant force are:

- an increase in the speed of rotation
- an increase in the total mass of the wheel, the capsules and the passengers.

Name the other factor that affects the resultant force and state what effect it has on the resultant force.

_____

_____

(1)

(Total 4 marks)

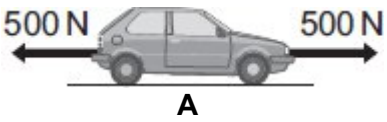
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Q7.

(a) The diagrams, **A**, **B** and **C**, show the horizontal forces acting on a **moving** car.

Draw a line to link each diagram to the description of the car's motion at the moment when the forces act.

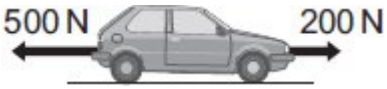
Draw only **three** lines.



A



B

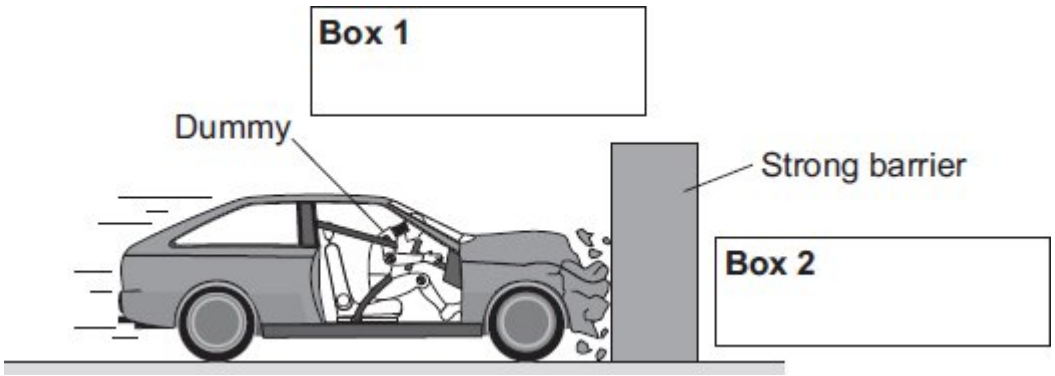


C

stationary
constant speed
slowing down
accelerating forwards

(3)

(b) The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to a dummy inside the car.



(i) Draw an arrow in **Box 1** to show the direction of the force that the car exerts on the barrier.

(1)

(ii) Draw an arrow in **Box 2** to show the direction of the force that the barrier exerts on the car.

(1)

(iii) Complete the following by drawing a ring around the correct line in the box.

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The car exerts a force of 5000 N on the barrier. The barrier does not move.

The force exerted by the barrier on the car will be

more than
equal to
less than

5000 N.

(1)

(iv) Which **one** of the following gives the most likely reason for attaching electronic sensors to the dummy?

Put a tick (✓) in the box next to your answer.

To measure the speed of the car just before the impact. ☐

To measure the forces exerted on the dummy during the impact. ☐

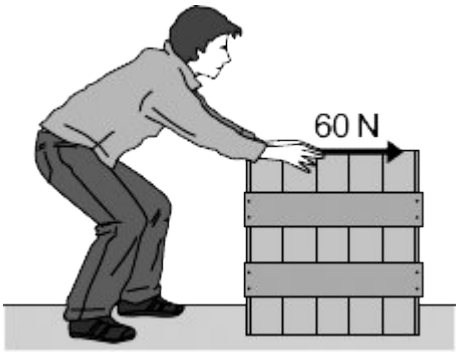
To measure the distance the car travels during the impact. ☐

(1)

(Total 7 marks)

Q8.

The diagram shows a worker using a constant force of 60 N to push a crate across the floor.



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Steve Witney, © Philip Allan UK

(a) The crate moves at a constant speed in a straight line

(i) Draw an arrow on the diagram to show the direction of the friction force acting on the moving crate.

(1)

(ii) State the size of the friction force acting on the moving crate.

_____ N

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Give the reason for your answer.

_____

_____

(2)

(b) Calculate the work done by the worker to push the crate 28 metres.

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

joule **newton** **watt**

_____

_____

Work done = _____

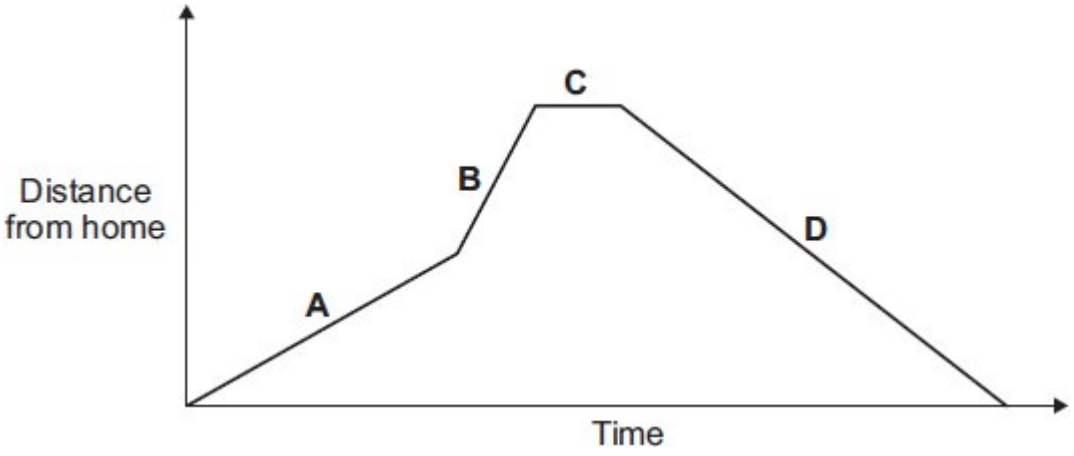
(3)

(Total 6 marks)

Q9.

(a) A person takes their dog for a walk.

The graph shows how the distance from their home changes with time.



Which part of the graph, **A**, **B**, **C** or **D**, shows them walking the fastest?

Write your answer in the box. ☐

Give the reason for your answer.

_____

_____

(2)

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(b) During the walk, both the speed and the velocity of the person and the dog change.

How is *velocity* different from *speed*?

_____

_____

(1)

(Total 3 marks)

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