The Distance-Time Relationship

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.5 Forces
Sub-Topic	The Distance-Time Relationship
Difficulty Level	Silver Level
Booklet	Question Paper 1

Time Allowed: **60 minutes**

Score: **/57**

Percentage: **/100**

Grade Boundaries:

Q1. Four students tested their reaction times using a computer program.

When a green light appeared on the screen the students had to press a key.

Table 1 shows their results.

Table 1

Student	Reaction time in s			Mean reaction time in s
	Test 1	Test 2	Test 3	
Boy 1	0.28	0.27	0.26	0.27
Boy 2	0.28	0.47	0.22	0.29
Girl 1	0.31	0.29	0.27	0.29
Girl 2	0.32	0.30	0.29	0.30

(a) What is meant by 'reaction time' in this experiment?

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(1)

(b) Boy 2 had an anomalous result in **Test 2**.

Suggest a reason why.

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(1)

(c) Give **one** conclusion that can be made from the results in **Table 1**.

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(1)

(d) Suggest further evidence that you could collect to support your conclusion.

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(1)

(e) Reaction time is important at the start of a race.

Table 2 shows the time taken by a boy to run different distances.

Table 2

Distance in m	Time in s
100	12.74
200	25.63
800	139.46

Reaction time is more important in a 100 m race than in an 800 m race.

Explain why.

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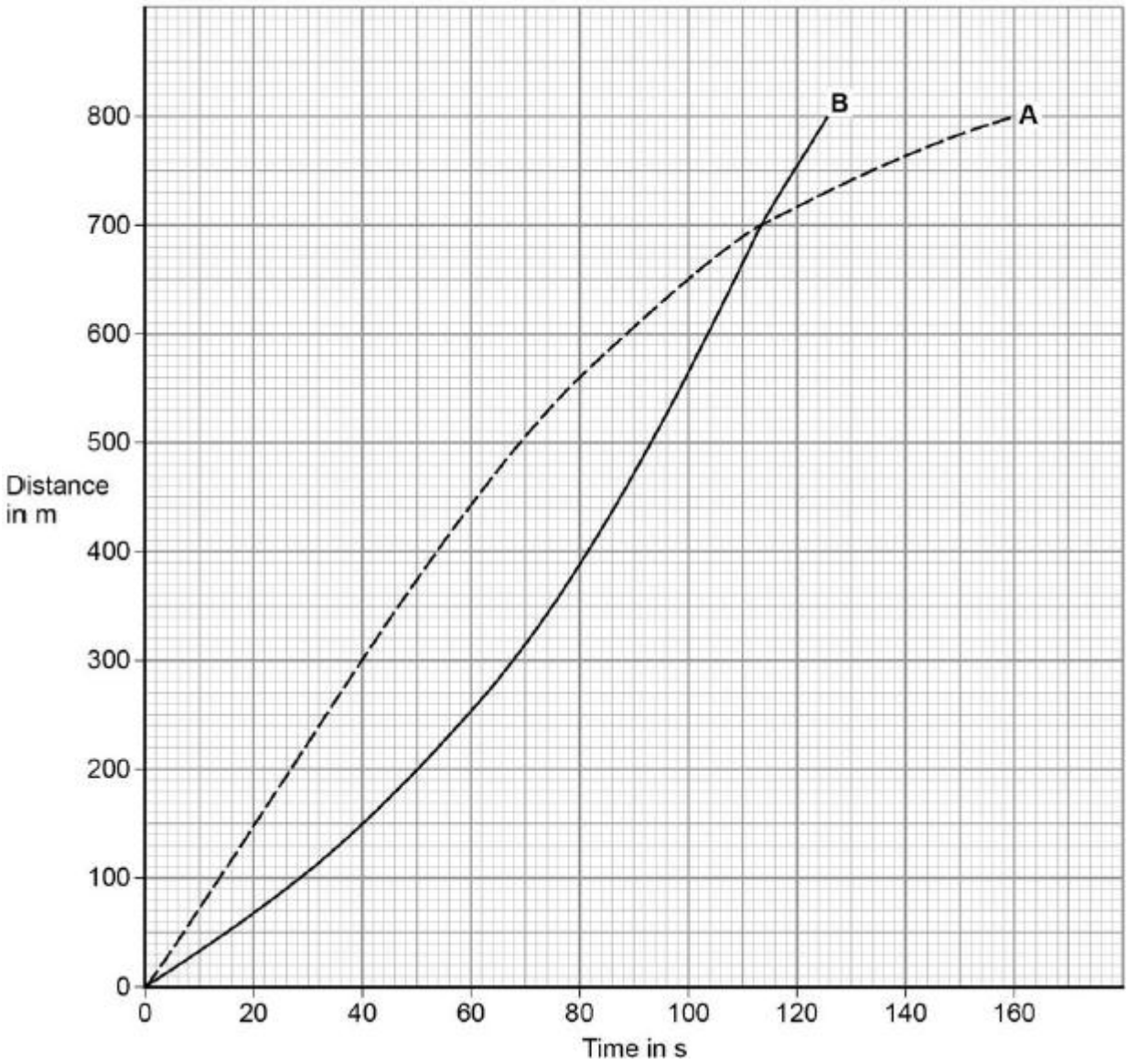
(2)

(f) Two girls, **A** and **B**, ran an 800 m race.

The figure below shows how the distance changed with time.



Compare the motion of runners **A** and **B**.

Include data from the figure above.

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(6)
(Total 12 marks)

Q2. This question is about speed.

(a) What is a typical value for the speed of sound?

Tick **one** box.

3.3 m / s ☐

3.3×10^2 m / s ☐

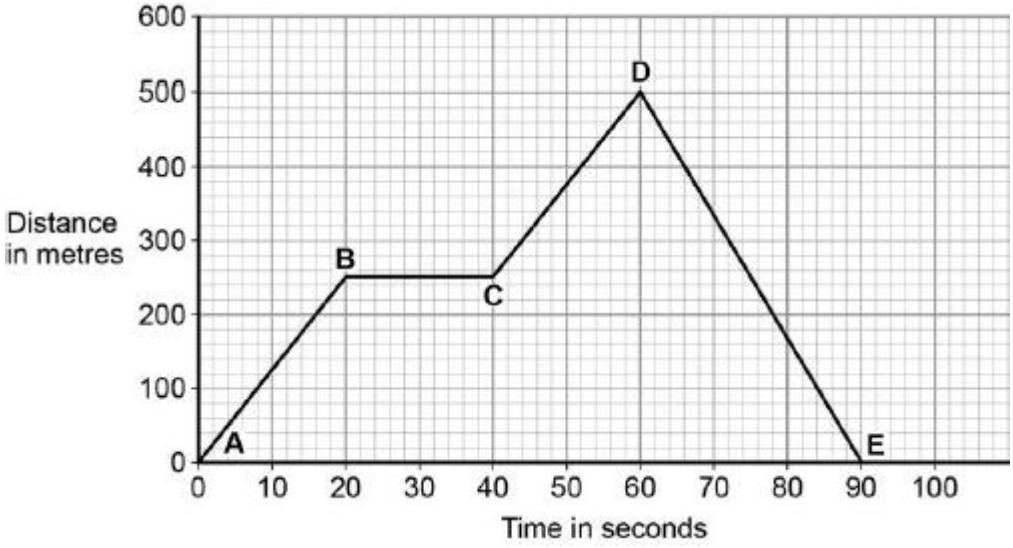
3.3×10^3 m / s ☐

3.3×10^6 m / s ☐

(1)

(b) **Figure 1** shows a distance–time graph of a car.

Figure 1



Explain what **Figure 1** shows about the motion of the car between point **A** and point **E**.

You should use values from **Figure 1** in your answer.

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(4)

(c) The kinetic energy of a moving car depends on the car's mass and speed.

Write down the equation that links kinetic energy, mass and speed.

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(1)

(d) A car has a mass of 1 650 kg.

The table below shows the kinetic energy of the car moving at 11 m / s.

Mass of car in kg	Speed in m / s	Kinetic energy in J
1 650	11	99 825
1 650	30	

Calculate the missing value in the table above.

Give your answer in kilojoules (kJ).

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Kinetic energy = ... kJ

(2)

(e) A man is driving his car at a constant speed on a wet road.

He sees a fallen tree on the wet road and tries to stop quickly to prevent an accident.

Figure 2

Explain why the man may not be able to stop in time.

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(6)
(Total 14 marks)

Q3. The figure below shows an ice skater standing on the ice.

Mass
70 kg

(a) Write down the equation that links acceleration, change in velocity and time.

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(1)

(b) As the skater pushes away across the ice there is a small frictional force.

After pushing, the skater starts to move with a velocity of 5 m / s.

He slows to 3 m / s in 6 seconds.

Calculate the acceleration of the skater.

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Acceleration = ... m / s^2

(2)

(c) Write down the equation that links acceleration, force and mass.

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(1)

(d) Friction reduces the speed of the skater.

Calculate the frictional force acting on the skater to slow him down.

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Frictional force = ... N

(2)

(e) The skater stands still on the ice.

He throws his bag to a friend.

As he throws his bag forwards, the skater moves backwards across the ice.

Use the idea of conservation of momentum to explain why he moves backwards.

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(4)
(Total 10 marks)

Q4. (a) The diagram shows the forces acting on a parachutist in free fall.

The parachutist has a mass of 75 kg.

Calculate the weight of the parachutist.

gravitational field strength = 10 N/kg

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

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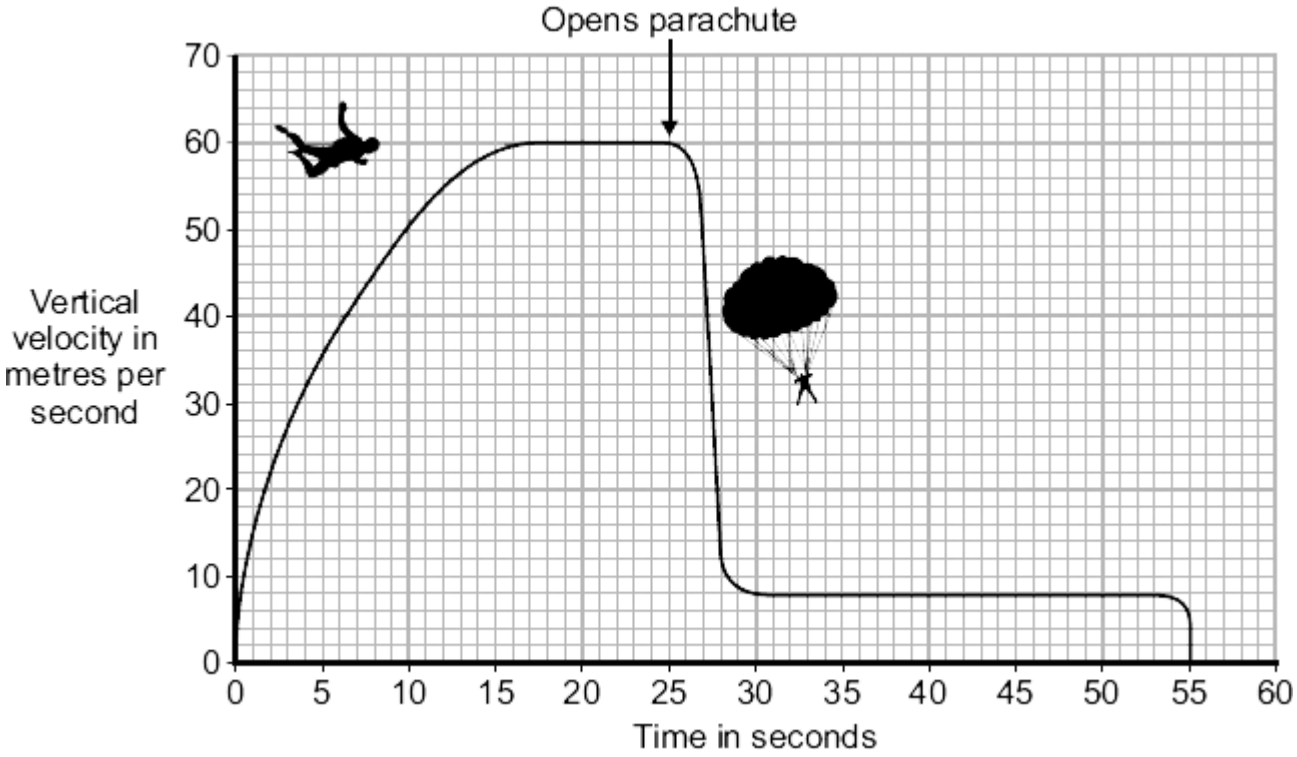
Weight = ...

(3)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The graph shows how the vertical velocity of a parachutist changes from the moment the parachutist jumps from the aircraft until landing on the ground.



Using the idea of forces, explain why the parachutist reaches a terminal velocity and why opening the parachute reduces the terminal velocity.

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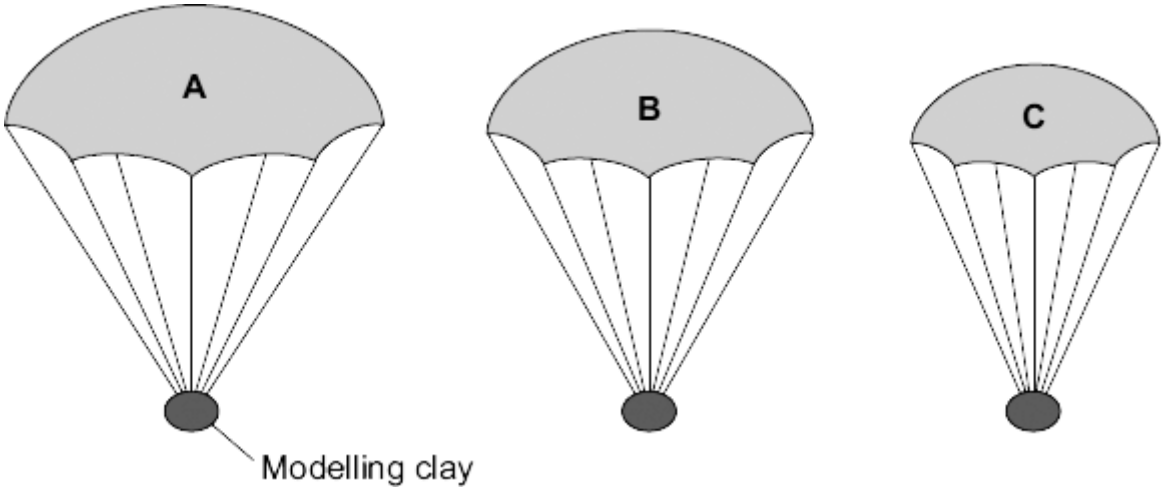
(6)

(c) A student wrote the following hypothesis.

'*The larger the area of a parachute, the slower a parachutist falls.*'

To test this hypothesis the student made three model parachutes, **A**, **B** and **C**, from one large plastic bag. The student dropped each parachute from the same height and timed how long each parachute took to fall to the ground.



(i) The height that the student dropped the parachute from was a control variable.

Name **one** other control variable in this experiment.

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(1)

(ii) Use the student's hypothesis to predict which parachute, **A**, **B** or **C**, will hit the ground first.

Write your answer in the box. ☐

Give a reason for your answer.

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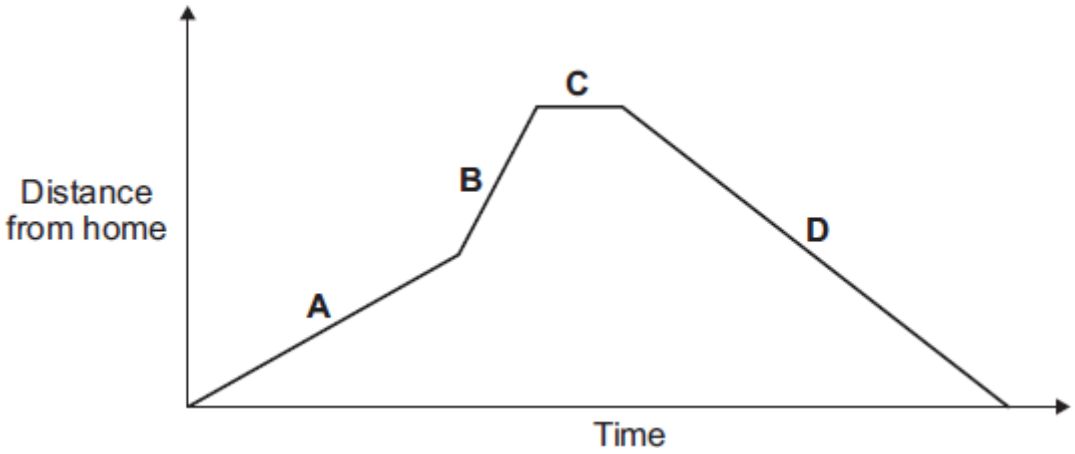
(2)
(Total 12 marks)

Q5. (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.

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(2)

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

How is *velocity* different from *speed*?

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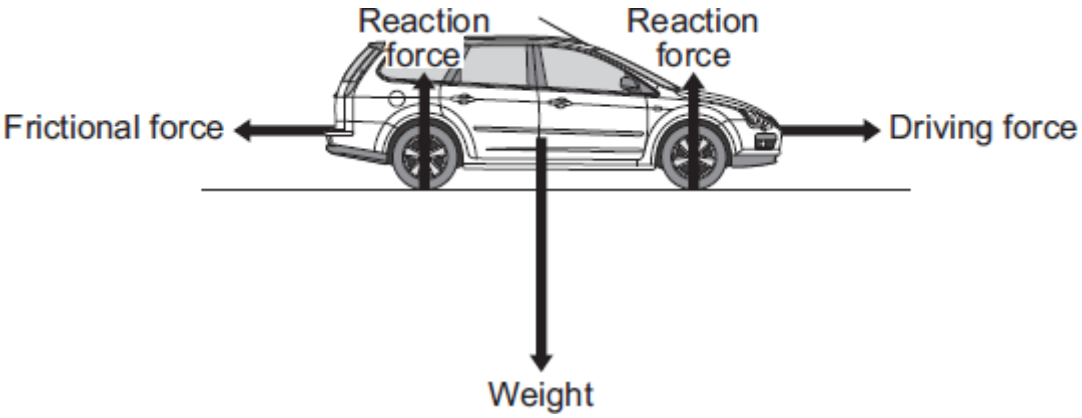
(1)
(Total 3 marks)

Q6. The diagram shows the forces acting on a car. The car is being driven along a straight, level road at a constant speed of 12 m/s.



(a) The driver then accelerates the car to 23 m/s in 4 seconds.

Use the equation in the box to calculate the acceleration of the car.

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken for change}}$$

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

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Acceleration = ...

(3)

(b) Describe how the horizontal forces acting on the car change during the first **two** seconds of the acceleration.

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(3)
(Total 6 marks)