Newton's First Law

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.5 Forces
Sub-Topic	Newton's First Law
Difficulty Level	Silver Level
Booklet	Question Paper 1

Time Allowed: **58 minutes**

Score: **/56**

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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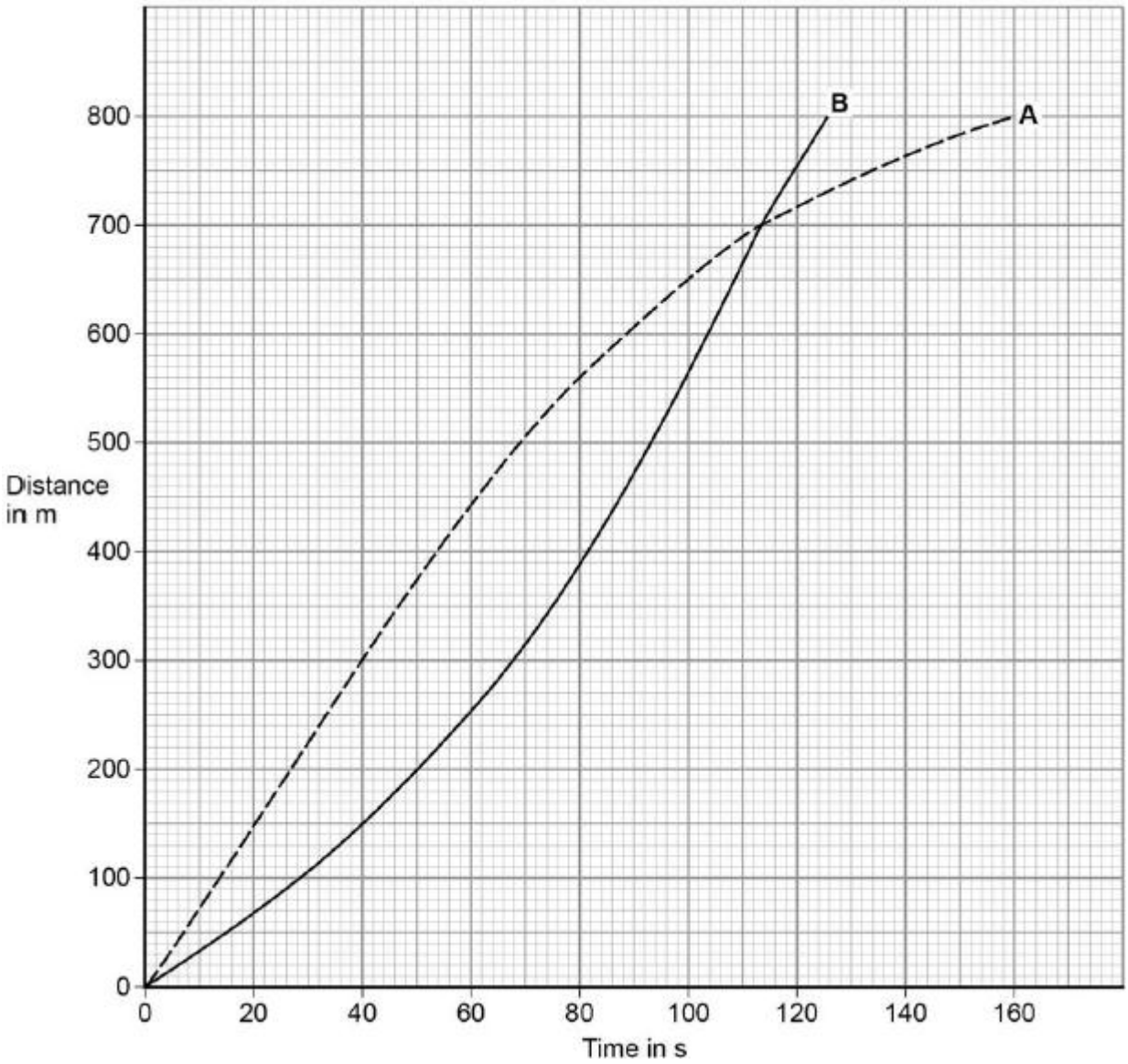
(2)

(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)

(g) Use above **Figure** to determine Girl **B**'s speed at 60 s.

Show how you use the graph to obtain your answer.

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Speed = ... m / s

(3)

(Total 15 marks)

Q2. 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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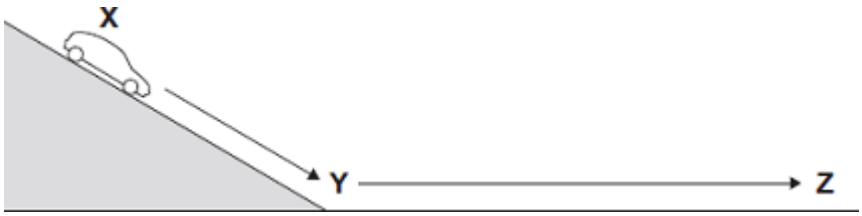
(4)
(Total 10 marks)

Q3.(a) The diagram shows a car at position **X**.



The handbrake is released and the car rolls down the slope to **Y**.
The car continues to roll along a horizontal surface before stopping at **Z**.
The brakes have **not** been used during this time.

(i) What type of energy does the car have at **X**?

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(1)

(ii) What type of energy does the car have at **Y**?

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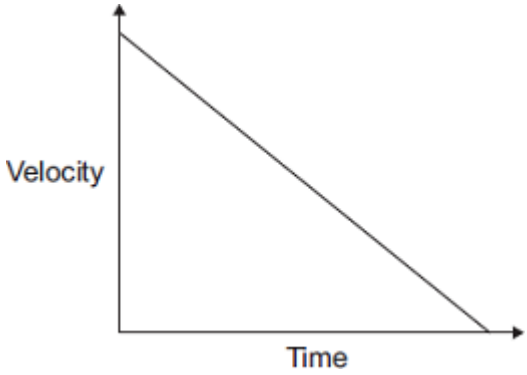
(1)

(b) The graph shows how the velocity of the car changes with time between **Y** and **Z**.



(i) Which feature of the graph represents the negative acceleration between **Y** and **Z**?

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(1)

(ii) Which feature of the graph represents the distance travelled between **Y** and **Z**?

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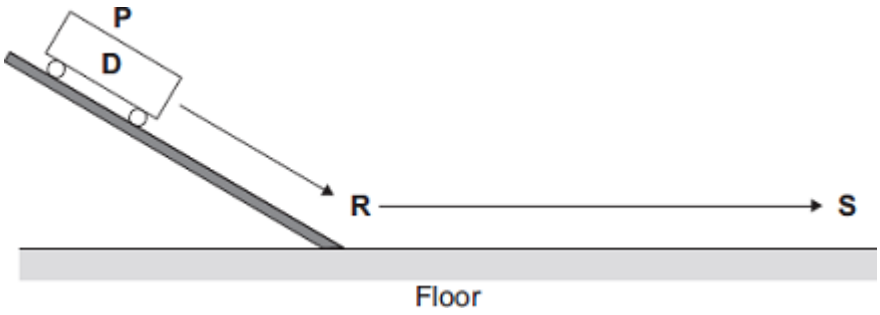
(1)

(iii) The car starts again at position **X** and rolls down the slope as before. This time the brakes are applied lightly at **Y** until the car stops.

Draw on the graph another straight line to show the motion of the car between **Y** and **Z**.

(2)

(c) Three students carry out an investigation. The students put trolley **D** at position **P** on a slope. They release the trolley. The trolley rolls down the slope and along the floor as shown in the diagram.



The students measure the distance from **R** at the bottom of the slope to **S** where the trolley stops. They also measure the time taken for the trolley to travel the distance **RS**.
They repeat the investigation with another trolley, **E**.

Their results are shown in the table.

Trolley	Distance RS in centimetres	Time taken in seconds	Average velocity in centimetres per second
D	65	2.1	
E	80	2.6	

(i) Calculate the average velocity, in centimetres per second, between **R** and **S** for trolleys **D** and **E**. Write your answers in the table.

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(3)

(ii) Before the investigation, each student made a prediction.

- Student **1** predicted that the two trolleys would travel the same distance.
- Student **2** predicted that the average velocity of the two trolleys would be the same.

- Student **3** predicted that the negative acceleration of the two trolleys would be the same.

Is each prediction correct?

Justify your answers.

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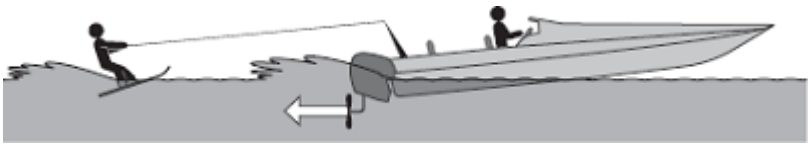
(3)
(Total 12 marks)

Q4. The diagram shows a boat pulling a water skier.



(a) The arrow represents the force on the water produced by the engine propeller. This force causes the boat to move.

Explain why.

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(2)

(b) The boat accelerates at a constant rate in a straight line. This causes the velocity of the water skier to increase from 4.0 m/s to 16.0 m/s in 8.0 seconds.

(i) Calculate the acceleration of the water skier and give the unit.

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Acceleration = ...

(3)

(ii) The water skier has a mass of 68 kg.

Calculate the resultant force acting on the water skier while accelerating.

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Resultant force = ... N

(2)

(iii) Draw a ring around the correct answer to complete the sentence.

The force from the boat pulling the water skier forwards

will be | less than / the same as / greater than | the answer to part **(b)(ii)**.

Give the reason for your answer.

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(2)
(Total 9 marks)

Q5. (a) A car is being driven along a straight road. The diagrams, **A**, **B** and **C**, show the horizontal forces acting on the moving car at three different points along the road.

Describe the motion of the car at each of the points, **A**, **B** and **C**.

A .....

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B .....

.....

C .....

.....

(3)

(b) The diagram below shows the stopping distance for a family car, in good condition, driven at 22 m/s on a dry road. The stopping distance has two parts.

(i) Complete the diagram below by adding an appropriate label to the second part of the stopping distance.

The distance the car travels during the driver's reaction time

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(1)

(ii) State **one** factor that changes both the first part **and** the second part of the stopping distance.

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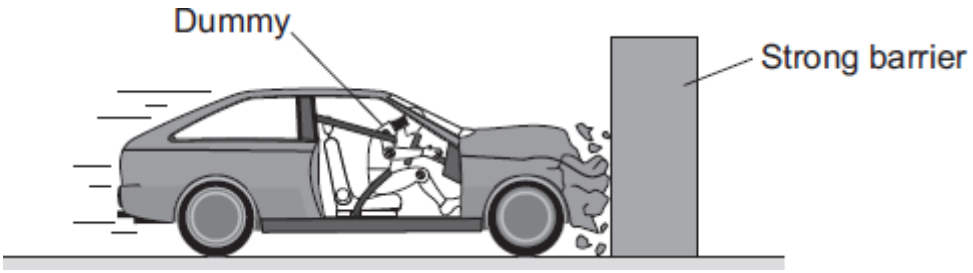
(1)

(c) 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 the dummy inside the car.



(i) At the point of collision, the car exerts a force of 5000 N on the barrier.

State the size and direction of the force exerted by the barrier on the car.

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(1)

(ii) Suggest why the dummy is fitted with electronic sensors.

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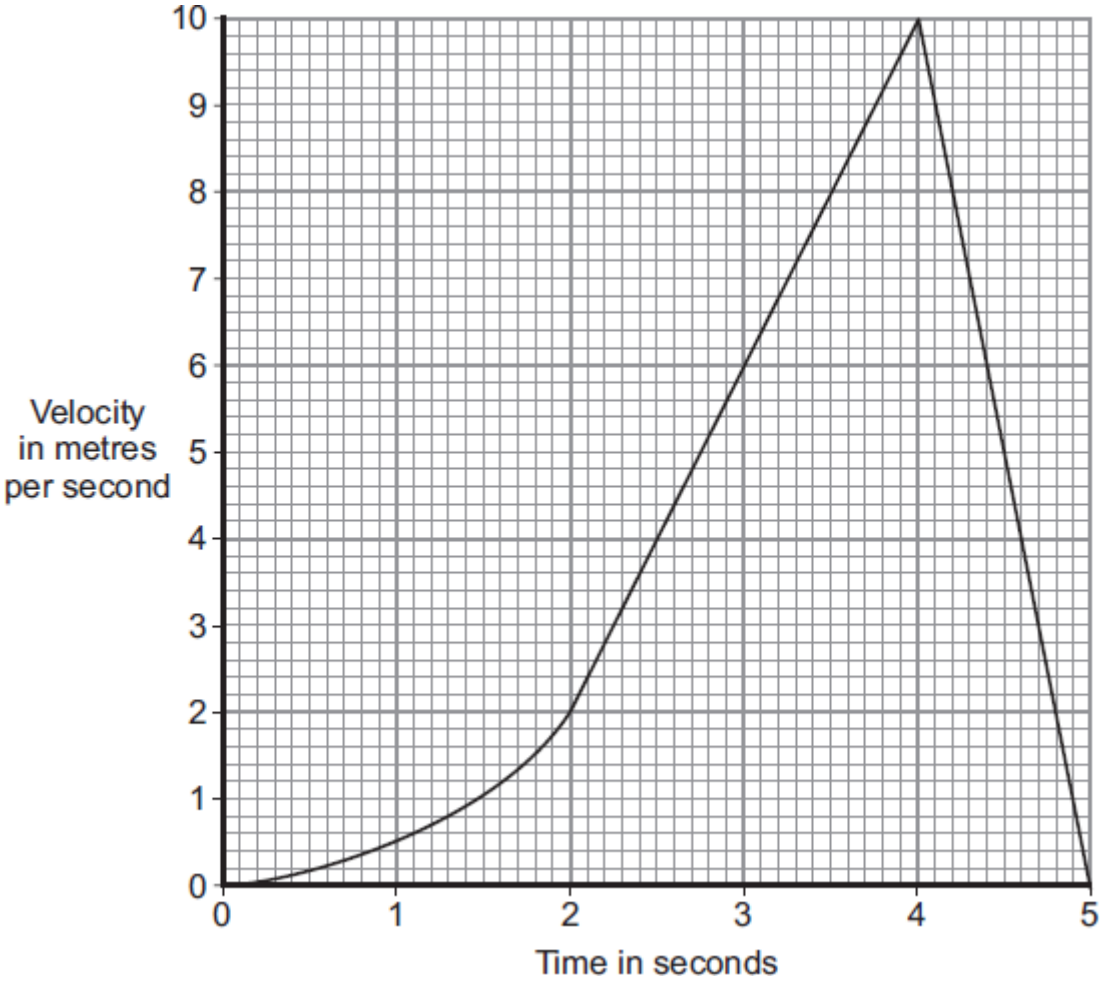
(1)

(iii) The graph shows how the velocity of the car changes during the test.



Use the graph to calculate the acceleration of the car just before the collision with the barrier.

Show clearly how you work out your answer, including how you use the graph, and give the unit.

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Acceleration = ...

(3)

(Total 10 marks)