Resultant Forces

Question Paper 1

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

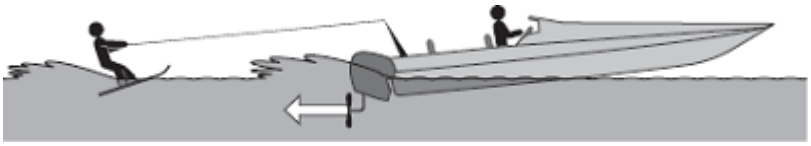
Time Allowed: **53 minutes**

Score: **/53**

Percentage: **/100**

Grade Boundaries:

Q1. 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)

Q2. (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

.....

.....

B

.....

.....

C

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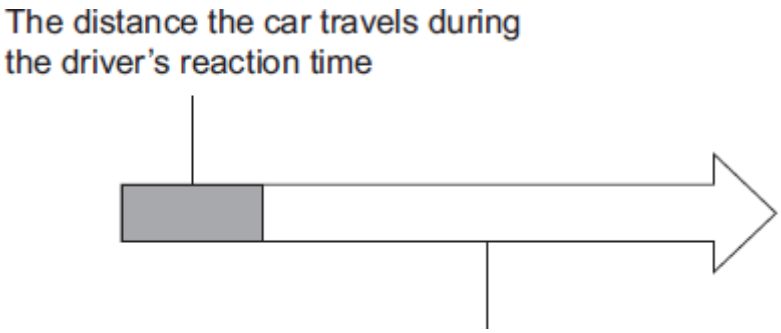
.....

(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.



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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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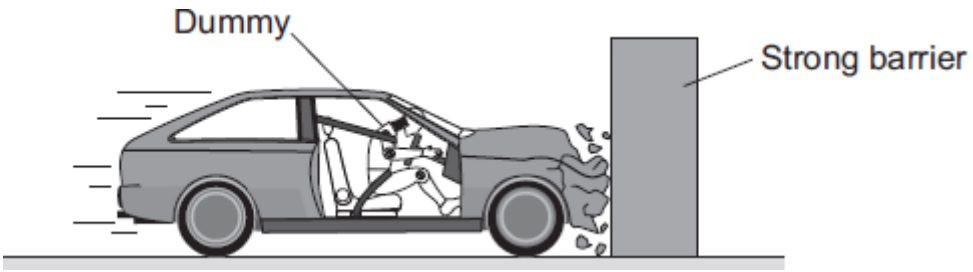
(1)

(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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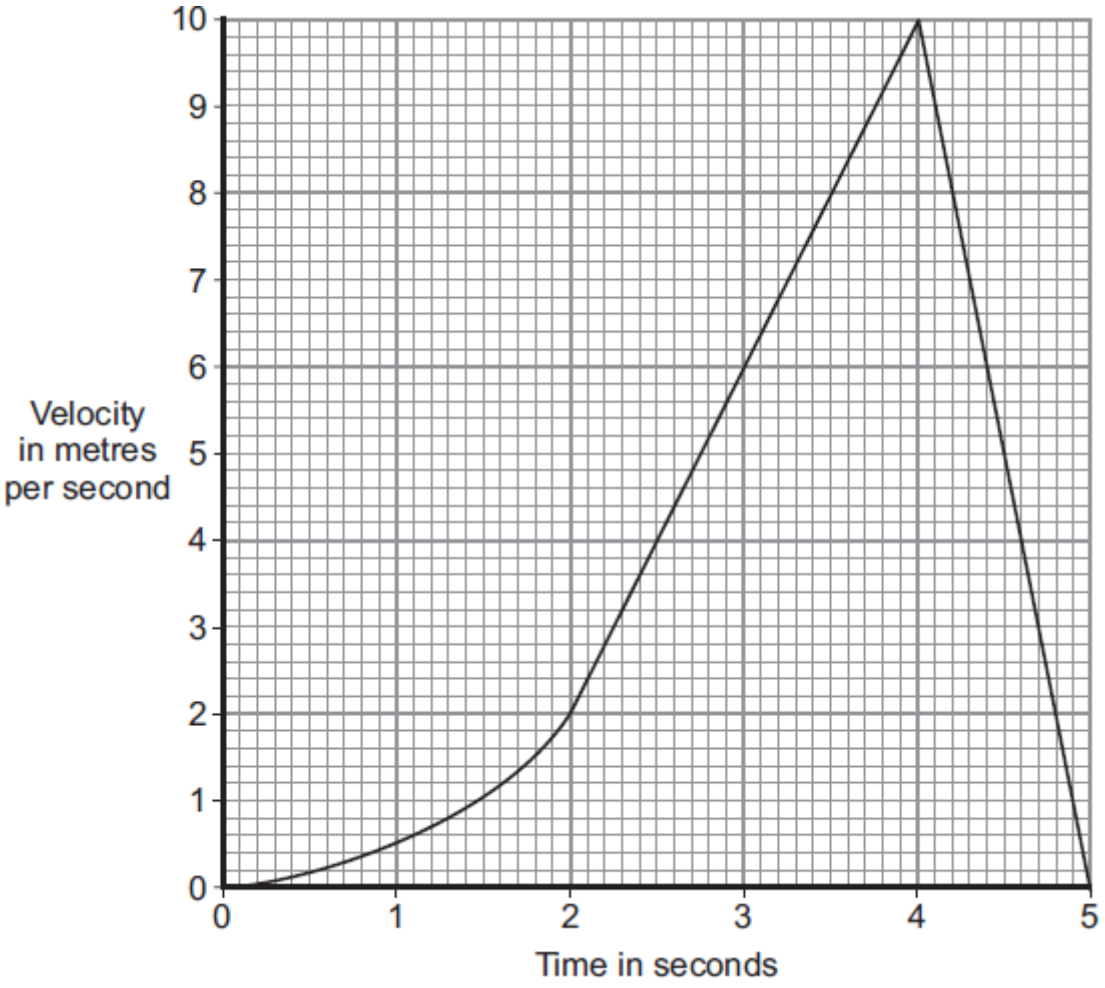
(1)

(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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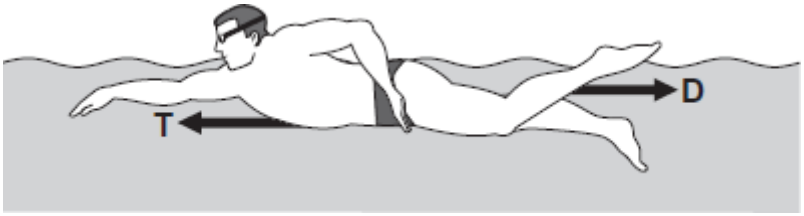
Acceleration = ...

(3)
(Total 10 marks)

Q3. (a) The diagram shows the horizontal forces acting on a swimmer.



(i) The swimmer is moving at constant speed.
Force **T** is 120 N.

What is the size of force **D**?

..... N

(1)

(ii) By increasing force **T** to 140 N, the swimmer accelerates to a higher speed.

Calculate the size of the initial resultant force acting on the swimmer.

.....

.....

Initial resultant force = ... N

(1)

(iii) Even though the swimmer keeps the force **T** constant at 140 N, the resultant force on the swimmer decreases to zero.

Explain why.

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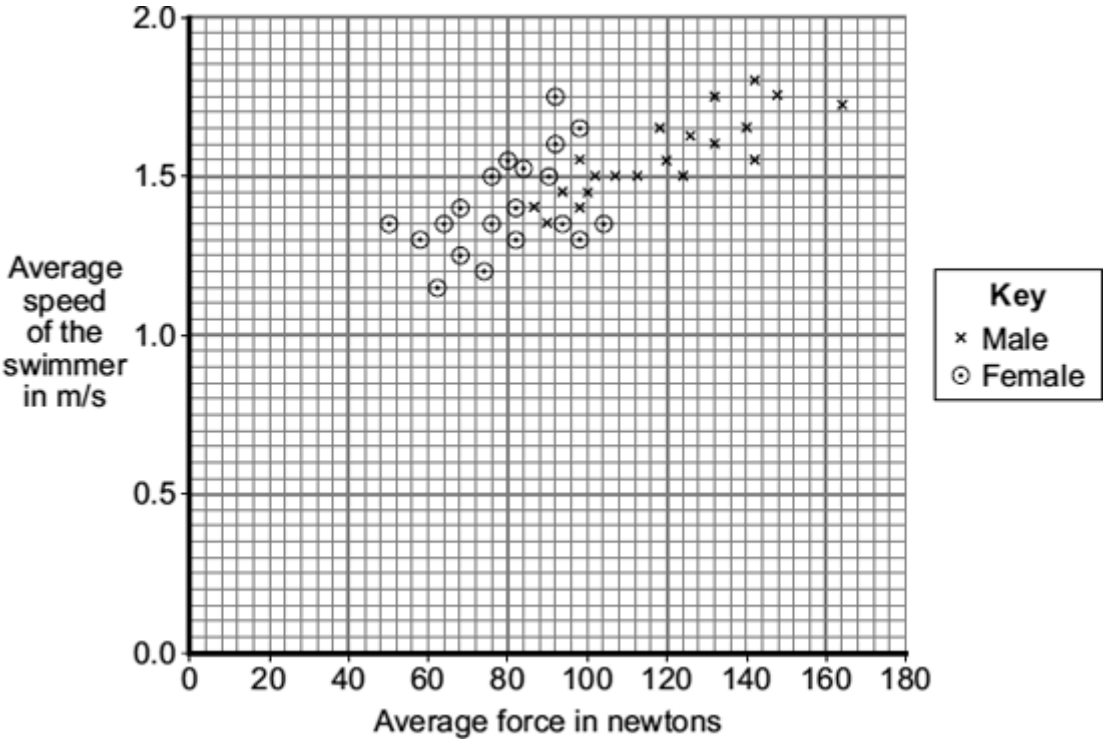
(3)

(b) A sports scientist investigated how the force exerted by a swimmer's hands against the water affects the swimmer's speed.
The investigation involved 20 males and 20 females swimming a fixed distance.
Sensors placed on each swimmer's hands measured the force 85 times every second over the last 10 metres of the swim.
The measurements were used to calculate an average force.
The average speed of each swimmer over the last 10 metres of the swim was also measured.

The data from the investigation is displayed in the graph.



(i) What was the dependent variable in this investigation?

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(1)

(ii) Explain **one** advantage of measuring the force 85 times every second rather

than just once or twice every second.

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(2)

(iii) Give **one** way in which the data for the male swimmers is different from the data for the female swimmers.

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(1)

(iv) Considering only the data from this investigation, what advice should a swimming coach give to swimmers who want to increase their average speed?

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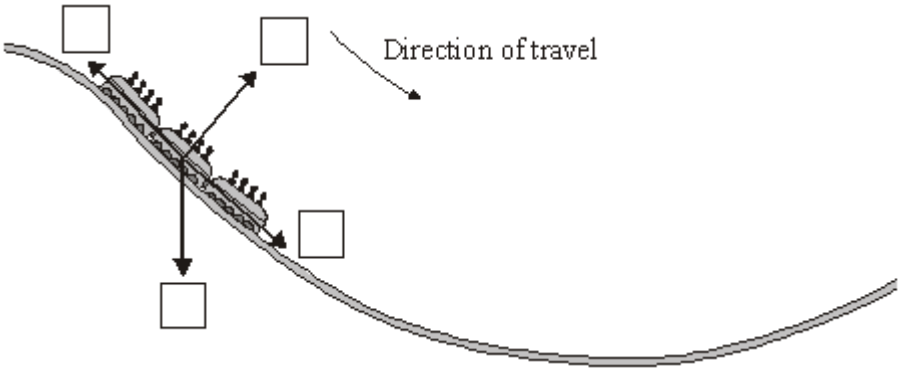
(1)
(Total 10 marks)

Q4. The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train?

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



(1)

(b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

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.....

(1)

(c) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 9.8 N/kg

(i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ... N/kg

(1)

(ii) One of the passengers has a mass of 80 kg.

Calculate the maximum weight this passenger seems to have during the ride.

Show clearly how you work out your answer.

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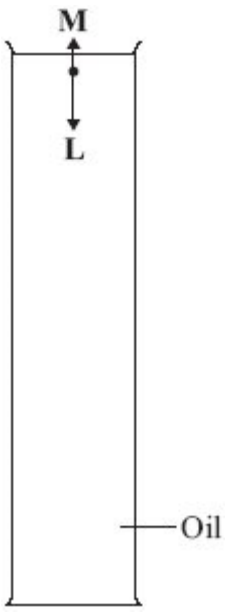
.....

Maximum weight = ... N

(2)

(Total 5 marks)

Q5. (a) The diagram shows a steel ball-bearing falling through a tube of oil. The forces, **L** and **M**, act on the ball-bearing.



What causes force **L**?

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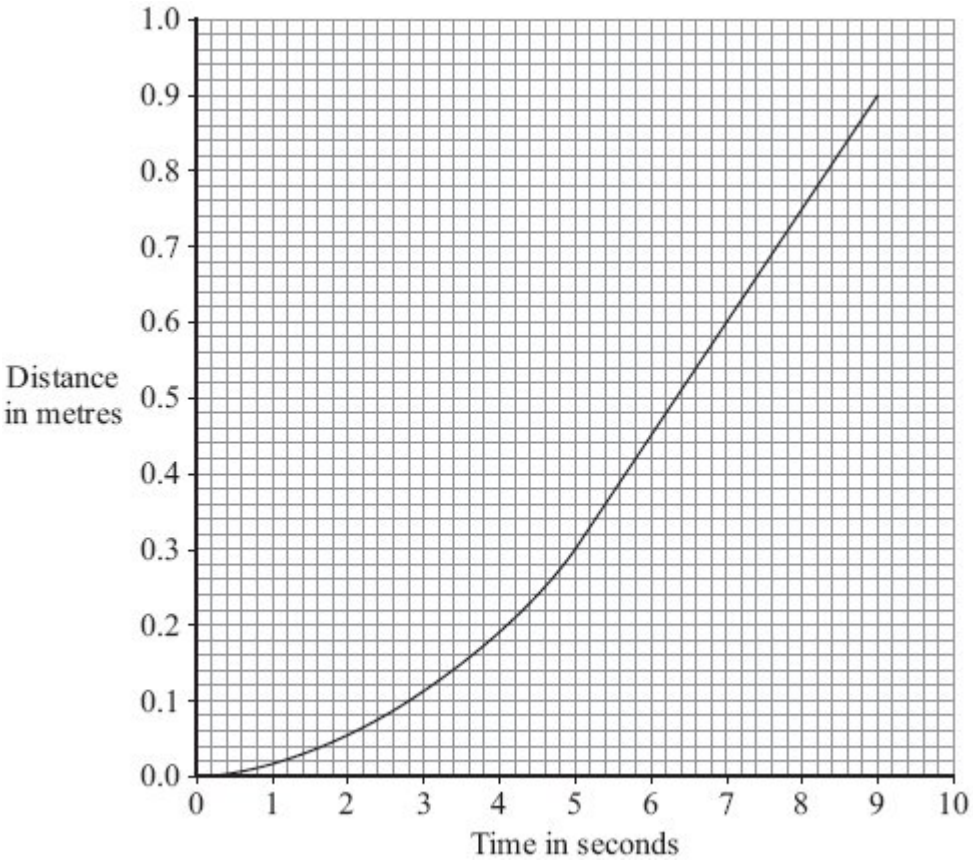
(1)

(b) The distance – time graph represents the motion of the ball-bearing as it falls through the oil.



(i) Explain, in terms of the forces, **L** and **M**, why the ball-bearing accelerates at first but then falls at constant speed.

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(3)

(ii) What name is given to the constant speed reached by the falling ball-bearing?

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(1)

(iii) Calculate the constant speed reached by the ball-bearing.

Show clearly how you use the graph to work out your answer.

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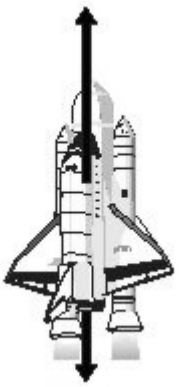
Speed = ... m/s

(2)
(Total 7 marks)

Q6. (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.

Thrust force



Weight of shuttle, fuel tanks and booster rockets plus air resistance

(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

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

.....

(1)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration = ... m/s^2

(2)

(iii) How is the velocity of an object different from the speed of an object?

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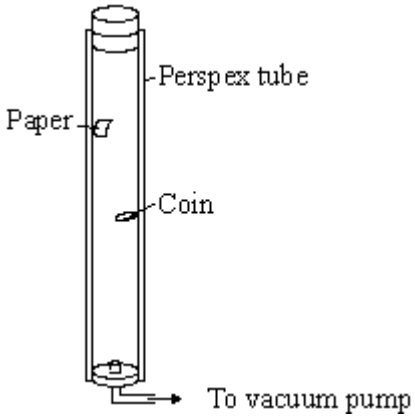
(1)

(Total 6 marks)

Q7. The apparatus shown is used to compare the motion of a coin with the motion of a piece of paper as they both fall.



(a) When the tube is filled with air the coin falls faster than the piece of paper. Why?

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(1)

(b) The air in the tube is removed by the vacuum pump. The tube is turned upside down.
State **two** ways in which the motion of the coin and piece of paper will change compared to when there was air in the tube.

1 .....

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2 .....

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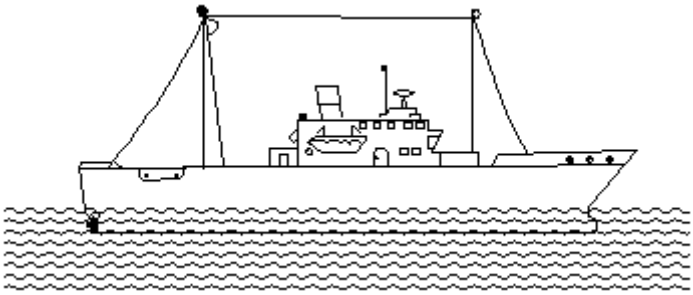
(2)
(Total 3 marks)

Q8. The diagram below shows an empty cargo ship. It is not moving.



(a) The water exerts a force on the ship. In which direction does this force act?

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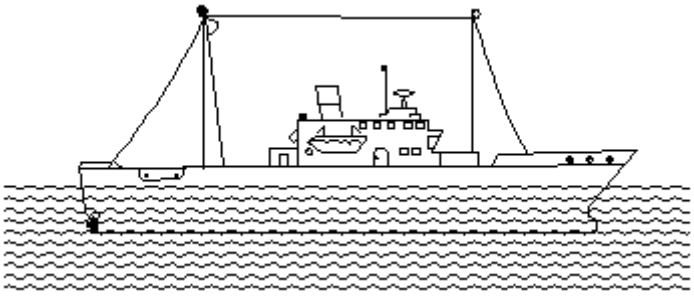
(1)

(b) The diagram below shows the same cargo ship. This time it has a full load of cargo.



(i) How does the force exerted by the water on the ship change as the ship is loaded?

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(1)

(ii) Why has the force exerted by the water changed?

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(1)

(Total 3 marks)