AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.1.2

Speed

Past-paper questions

Tier	**Higher**
Question groups	**148**
Available paper years	**2003–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

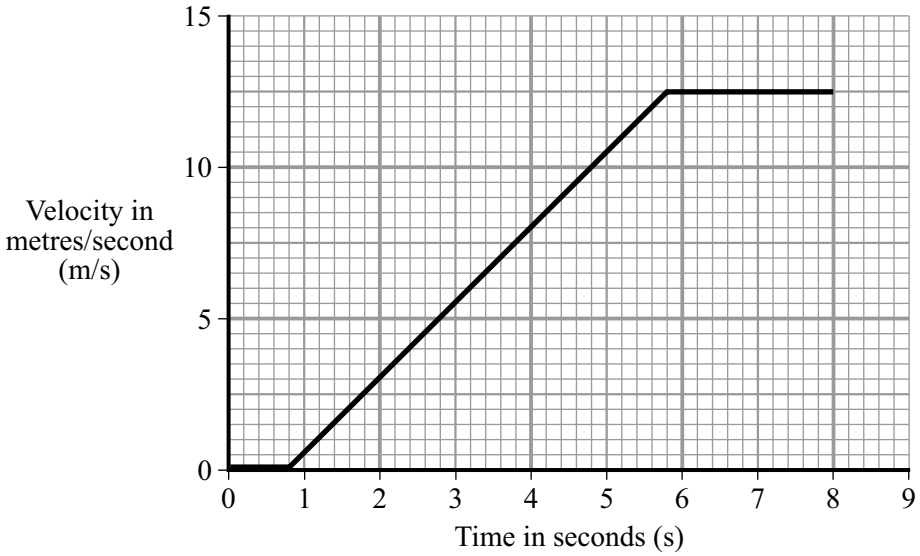
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.6.1.2 Speed

Question 01

June 2003 | 3451H | Original Q10 | Legacy

10 A car travelling along a straight road has to stop and wait at red traffic lights. The graph shows how the velocity of the car changes after the traffic lights turn green.



(a) Between the traffic lights changing to green and the car starting to move there is a time delay. This is called the reaction time. Write down **one** factor that could affect the driver's reaction time.

.....

(1 mark)

(b) Calculate the distance the car travels while accelerating. Show clearly how you work out your answer.

.....

.....

Distance = ...metres

(3 marks)

(c) Calculate the acceleration of the car. Show clearly how you work out your final answer and give the units.

.....

.....

.....

Acceleration = ...

(4 marks)

4.5.6.1.2 Speed

Question 01 · continued

MARGIN
BLANK

(d) The mass of the car is 900 kg.

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

.....

(1 mark)

(ii) Calculate the force used to accelerate the car. Show clearly how you work out your final answer.

.....

.....

Force = ...newtons

(2 marks)

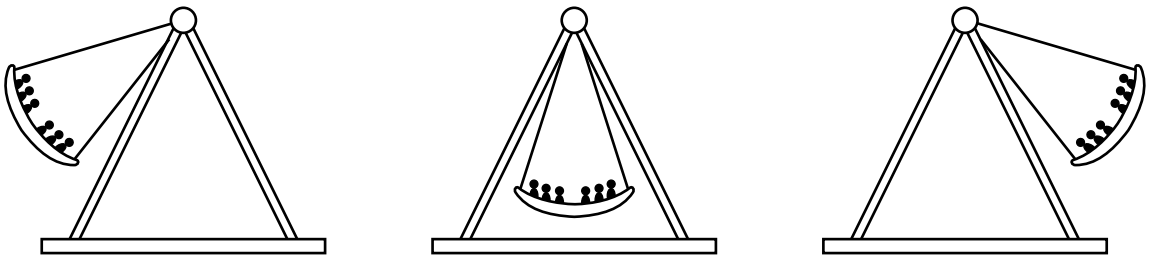
11

4.5.6.1.2 Speed

Question 02

June 2003 | 3451H | Original Q13 | Legacy

13 The Boat is a theme park ride. The Boat swings backwards and forwards. The diagrams show the Boat at the top and bottom of its swing.



A **B** **C**

(a) As the Boat swings from its position in **A** to its position in **B**, a child on the ride gains 5070 joules of kinetic energy. The child has a mass of 60 kg and is sitting at the centre.

(i) Write down the equation which links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the speed of the child as the Boat passes through **B**. Show clearly how you work out your final answer.

.....

.....

.....

Speed = ...m/s

(2 marks)

4.5.6.1.2 Speed

Question 02 · continued

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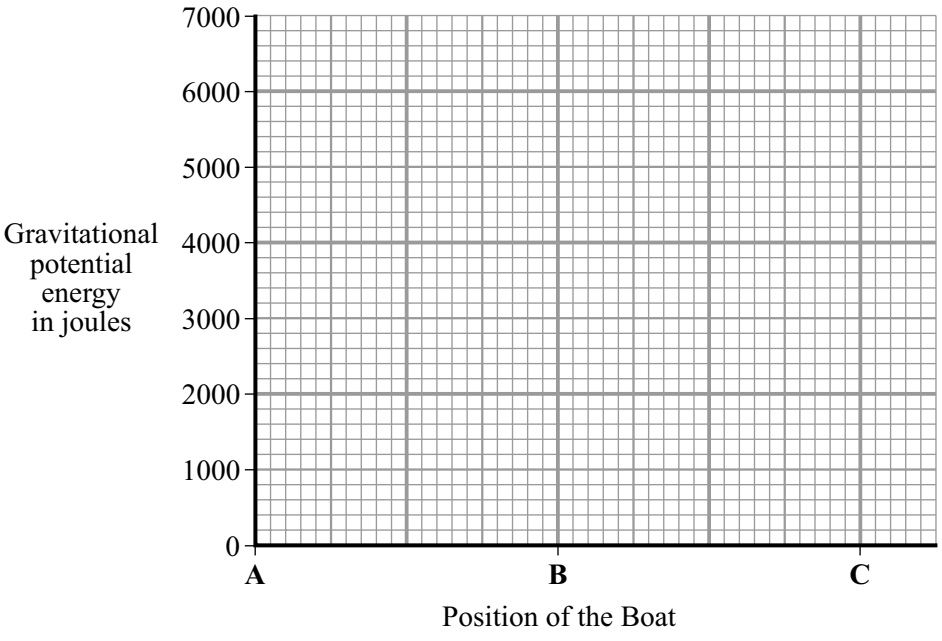
(b) Sketch a graph to show how the gravitational potential energy of the child changes as the Boat swings from **A** to **B** to **C**. The axes have been drawn for you.



(2 marks)

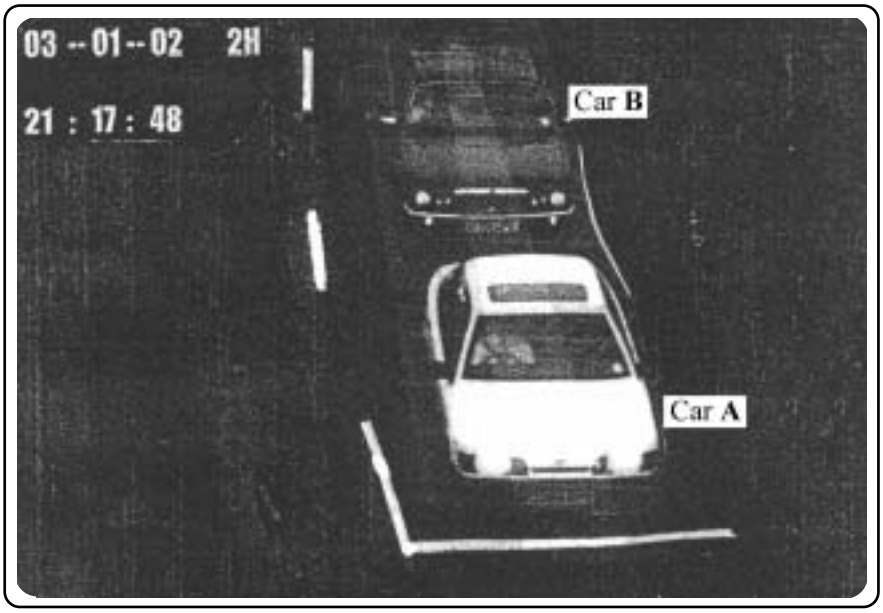
5

4.5.6.1.2 Speed

Question 03

June 2003 | 3451H | Original Q16 | Legacy

16 The roads were very icy. An accident was recorded by a security camera.



Car **A** was waiting at a road junction. Car **B**, travelling at 10 m/s, went into the back of car **A**. This reduced car **B**'s speed to 4 m/s and caused car **A** to move forward.

The total mass of car **A** was 1200 kg and the total mass of car **B** was 1500 kg.

(a) (i) Write down the equation, in words, which you need to use to calculate momentum.

.....

(1 mark)

(ii) Calculate the change in momentum of car **B** in this accident.

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

.....

.....

Change in momentum = ...

(3 marks)

(iii) Use your knowledge of the conservation of momentum to calculate the speed, in m/s, of car **A** when it was moved forward in this accident.

Show clearly how you work out your final answer.

.....

.....

Speed = ...m/s

(3 marks)

4.5.6.1.2 Speed

Question 03 · continued

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(b)



Brian and Susan are talking about the use of security cameras. Brian thinks there are advantages to having them but Susan thinks there are disadvantages.

Apart from the cost of installing and monitoring security cameras, and apart from the use of security cameras in recording traffic accidents, give the reasons which Brian and Susan may have for their views.

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(5 marks)

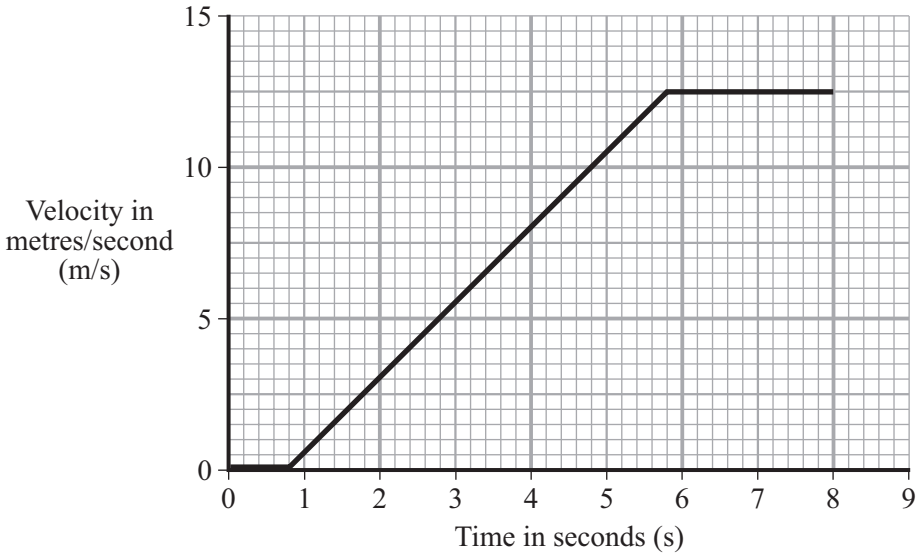
12

4.5.6.1.2 Speed

Question 04

June 2003 | 3462H3 | Original Q8 | Legacy

8 A car travelling along a straight road has to stop and wait at red traffic lights. The graph shows how the velocity of the car changes after the traffic lights turn green.



(a) Between the traffic lights changing to green and the car starting to move there is a time delay. This is called the reaction time. Write down **one** factor that could affect the driver's reaction time.

.....

(1 mark)

(b) Calculate the distance the car travels while accelerating. Show clearly how you work out your answer.

.....

.....

Distance = ...metres

(3 marks)

(c) Calculate the acceleration of the car. Show clearly how you work out your final answer and give the units.

.....

.....

.....

Acceleration = ...

(4 marks)

4.5.6.1.2 Speed

Question 04 · continued

1 /

MARGIN BLANK

(d) The mass of the car is 900 kg.

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

.....

(1 mark)

(ii) Calculate the force used to accelerate the car. Show clearly how you work out your final answer.

.....

.....

Force = ...newtons

(2 marks)

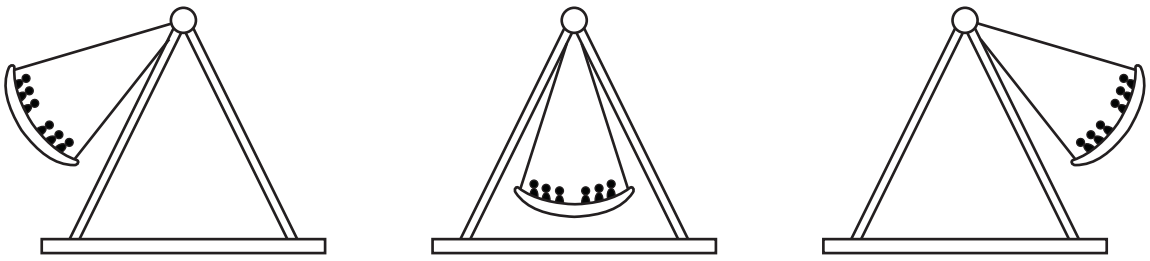
11

4.5.6.1.2 Speed

Question 05

June 2003 | 3462H3 | Original Q11 | Legacy

11 The Boat is a theme park ride. The Boat swings backwards and forwards. The diagrams show the Boat at the top and bottom of its swing.



A **B** **C**

(a) As the Boat swings from its position in **A** to its position in **B**, a child on the ride gains 5070 joules of kinetic energy. The child has a mass of 60 kg and is sitting at the centre.

(i) Write down the equation which links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the speed of the child as the Boat passes through **B**. Show clearly how you work out your final answer.

.....

.....

.....

Speed = ...m/s

(2 marks)

4.5.6.1.2 Speed

Question 05 · continued

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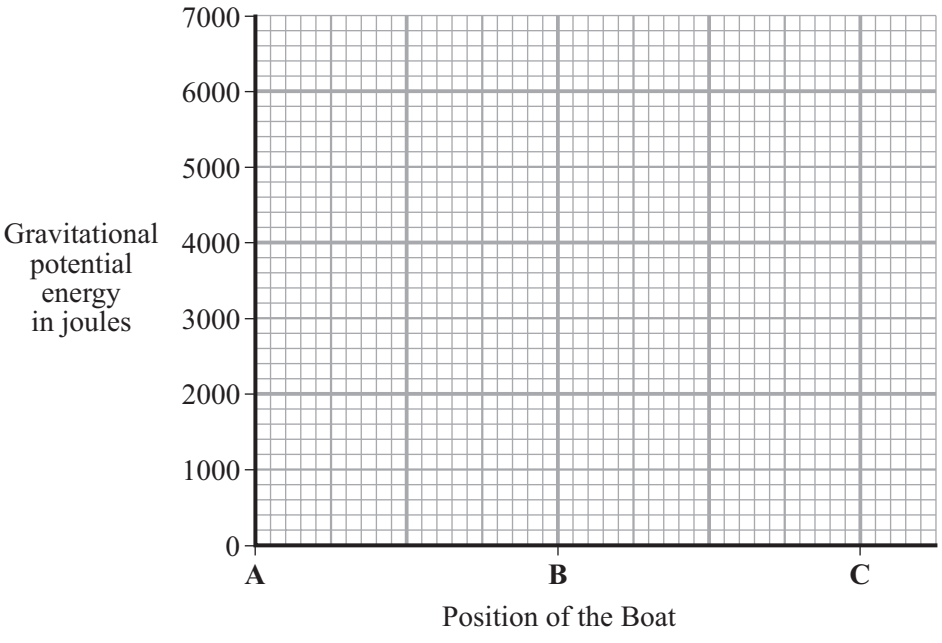
(b) Sketch a graph to show how the gravitational potential energy of the child changes as the Boat swings from **A** to **B** to **C**. The axes have been drawn for you.



(2 marks)

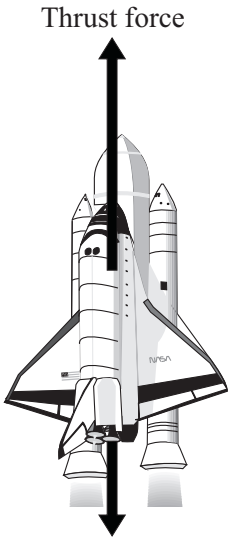
5

4.5.6.1.2 Speed

Question 06

June 2004 | 3451H | Original Q5 | Legacy

5 (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.



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

.....

(1 mark)

(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 mark)

(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 mark)

(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 marks)

4.5.6.1.2 Speed

Question 06 · continued

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

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

.....

(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200ºC.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

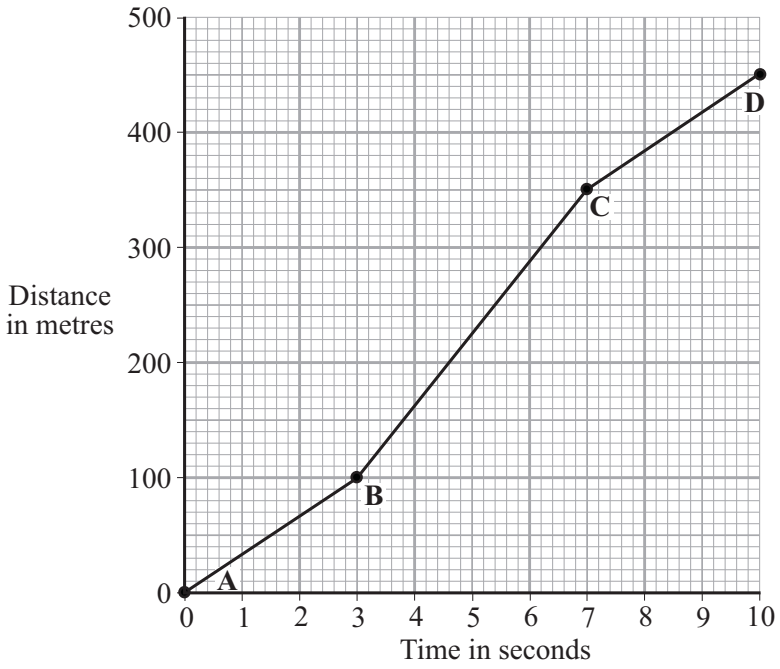
9

4.5.6.1.2 Speed

Question 07

June 2004 | 3451H | Original Q9 | Legacy

9 The distance-time graph represents the motion of a car during a race.



(a) Describe the motion of the car between point **A** and point **D**. You should not carry out any calculations.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

(3 marks)

(b) Calculate the gradient of the graph between point **B** and point **C**. Show clearly how you get your answer.

.....

.....

.....

gradient =.....

(3 marks)

6

4.5.6.1.2 Speed

Question 08

June 2004 | 3451H | Original Q14 | Legacy

14 (a) Use the theory of plate tectonics to explain sea floor spreading.

.....

.....

.....

.....

(2 marks)

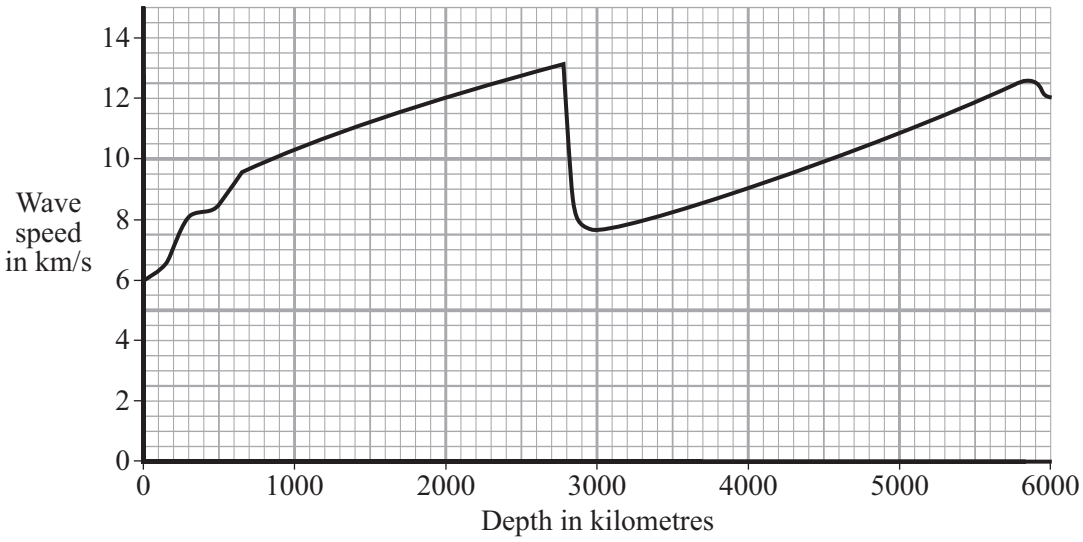
(b) What evidence is there to support the idea of sea floor spreading?

.....

.....

(1 mark)

(c) The diagram shows how the speed of a P-wave produced by an earthquake changes as it travels through the Earth.



(i) Write down the equation that links frequency, wavelength and wave speed.

.....

(1 mark)

(ii) At a depth of 2000 km the P-wave has a wavelength of 24 000 m. Calculate the frequency of the P-wave. Show clearly how you work out your answer.

.....

.....

frequency = ...Hz

(2 marks)

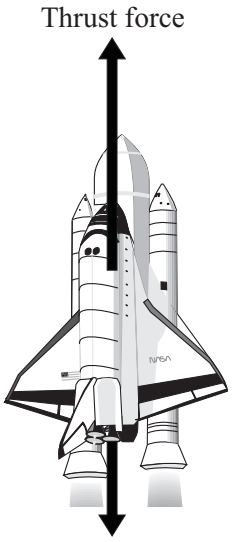
6

4.5.6.1.2 Speed

Question 09

June 2004 | 3462H3 | Original Q5 | Legacy

5 (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.



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

.....

(1 mark)

(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 mark)

(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 mark)

(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 marks)

4.5.6.1.2 Speed

Question 09 · continued

MARGIN BLANK

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

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

.....

(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200ºC.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

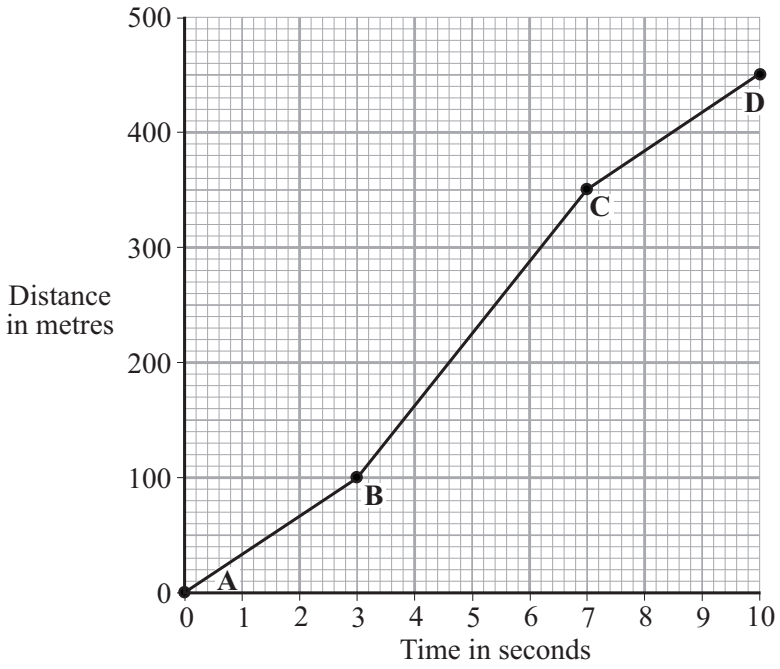
9

4.5.6.1.2 Speed

Question 10

June 2004 | 3462H3 | Original Q7 | Legacy

7 The distance-time graph represents the motion of a car during a race.



(a) Describe the motion of the car between point **A** and point **D**. You should not carry out any calculations.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

(3 marks)

(b) Calculate the gradient of the graph between point **B** and point **C**. Show clearly how you get your answer.

.....

.....

.....

gradient =.....

(3 marks)

6

4.5.6.1.2 Speed

Question 11

June 2004 | 3462H3 | Original Q12 | Legacy

12 (a) Use the theory of plate tectonics to explain sea floor spreading.

.....

.....

.....

.....

(2 marks)

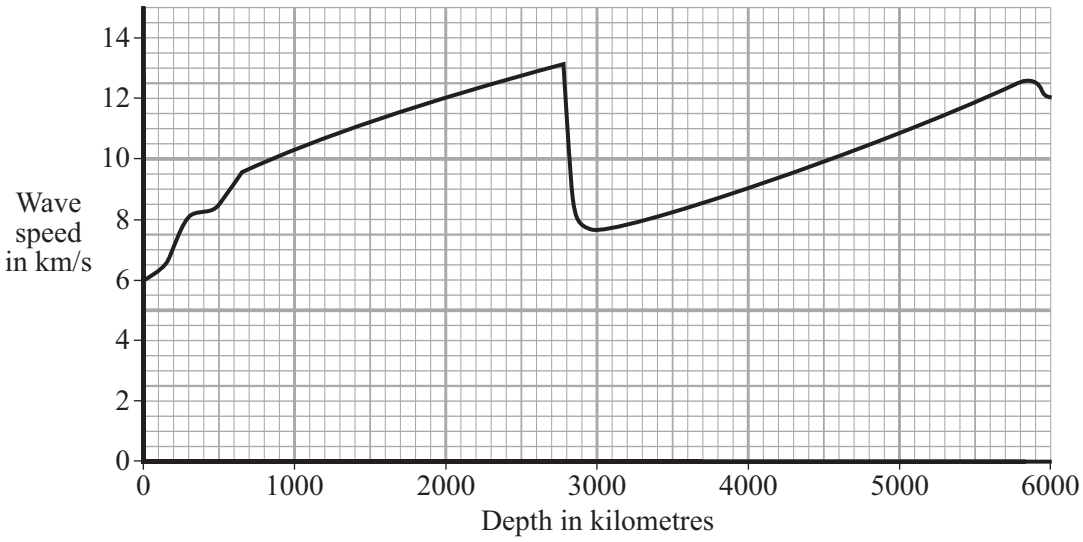
(b) What evidence is there to support the idea of sea floor spreading?

.....

.....

(1 mark)

(c) The diagram shows how the speed of a P-wave produced by an earthquake changes as it travels through the Earth.



(i) Write down the equation that links frequency, wavelength and wave speed.

.....

(1 mark)

(ii) At a depth of 2000 km the P-wave has a wavelength of 24 000 m. Calculate the frequency of the P-wave. Show clearly how you work out your answer.

.....

.....

frequency = ...Hz

(2 marks)

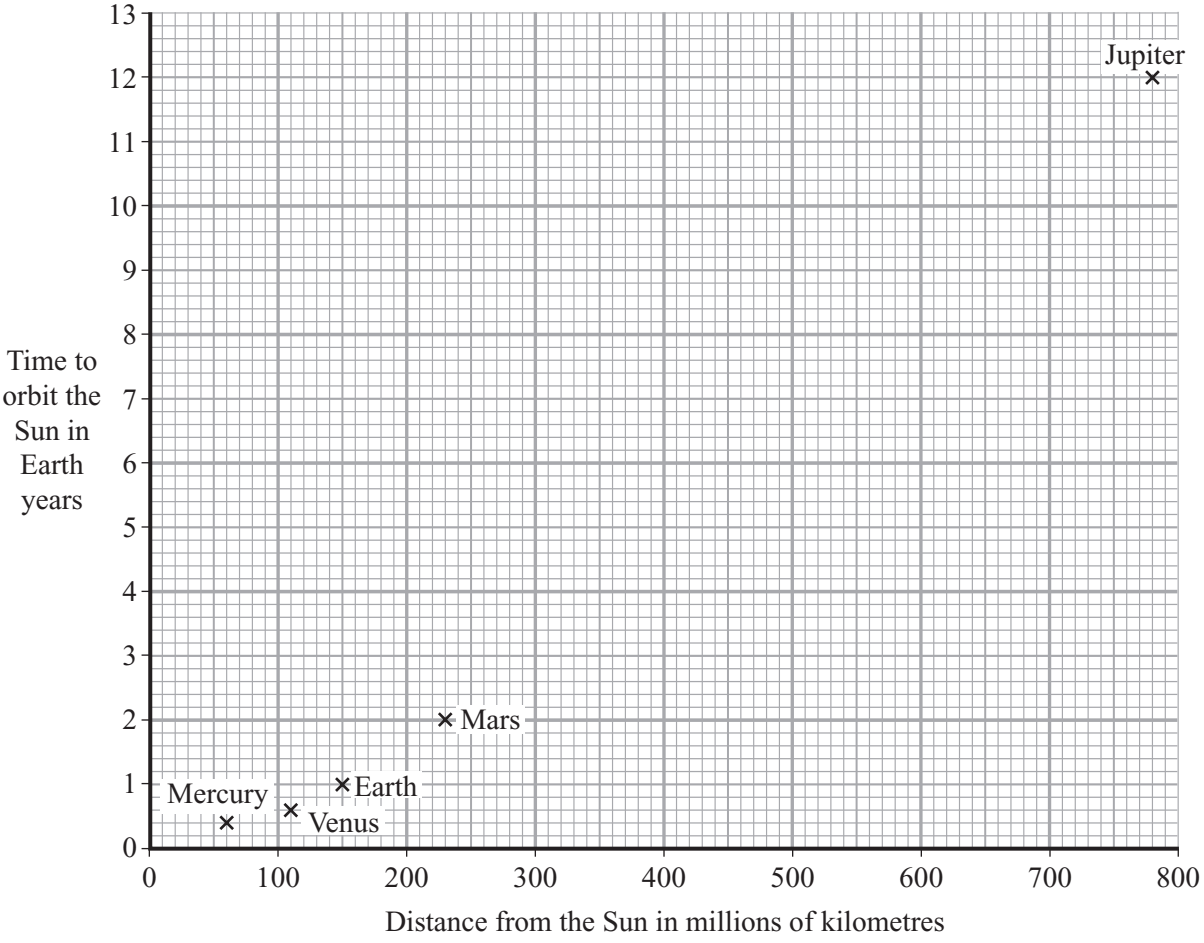
6

4.5.6.1.2 Speed

Question 12

June 2005 | 3451 | Original Q2 | Legacy

2 (a) The chart shows that the time taken by a planet to orbit the Sun depends on its distance from the Sun.



(i) How does the time taken by a planet to orbit the Sun depend on the distance the planet is from the Sun?

.....

.....

(1 mark)

(ii) Asteroids orbit the Sun. One asteroid is 550 million kilometres from the Sun.

Estimate how long this asteroid takes to orbit the Sun.

Time to orbit the Sun = ... Earth years

(1 mark)

4.5.6.1.2 Speed

Question 12 · continued

MARGIN BLANK

(b) The atmosphere on Venus contains a large percentage of a greenhouse gas.

	Mercury	Venus	Earth
Average surface temperature	230 °C	470 °C	20 °C

(i) Which **one** of these gases increases the greenhouse effect? Draw a ring around your answer.

argon **carbon dioxide** **nitrogen** **oxygen**

(1 mark)

(ii) Explain how the information in the table and the chart shows that the atmosphere of Venus produces a greenhouse effect.

.....

.....

.....

.....

(2 marks)

5

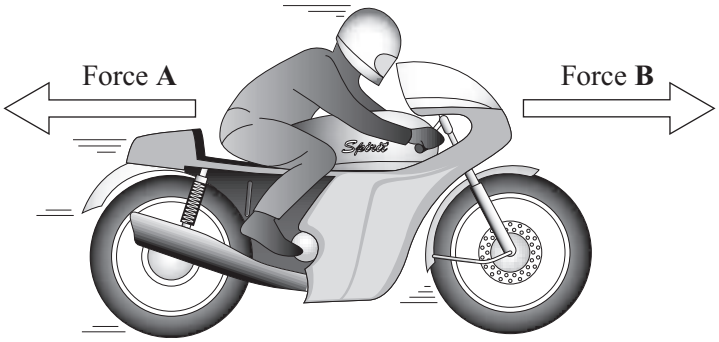
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 13

June 2005 | 3451 | Original Q4 | Legacy

4 (a) The diagram shows the horizontal forces that act on a **moving** motorbike.



(i) Describe the movement of the motorbike when force **A** equals force **B**.

.....

.....

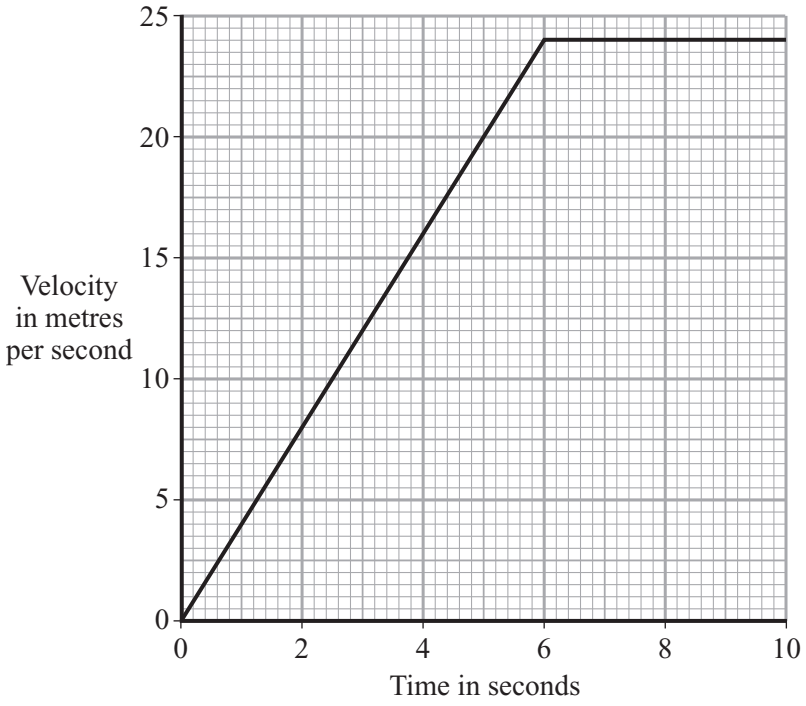
(2 marks)

(ii) What happens to the speed of the motorbike if force **B** becomes smaller than force **A**?

.....

(1 mark)

(b) The graph shows how the velocity of a motorbike changes when it is travelling along a straight road.



4.5.6.1.2 Speed

Question 13 · continued

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(i) What was the change in velocity of the motorbike in the first 5 seconds?

.....

(1 mark)

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

.....

(1 mark)

(iii) Calculate the acceleration of the motorbike during the first 5 seconds. Show clearly how you work out your answer and give the unit.

.....

.....

Acceleration = ...

(3 marks)

(c) A car is travelling on an icy road.

Describe and explain what might happen to the car when the brakes are applied.

.....

.....

.....

.....

(2 marks)

(d) Name **three** factors, other than weather conditions, which would increase the overall stopping distance of a vehicle.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

13

4.5.6.1.2 Speed

Question 14

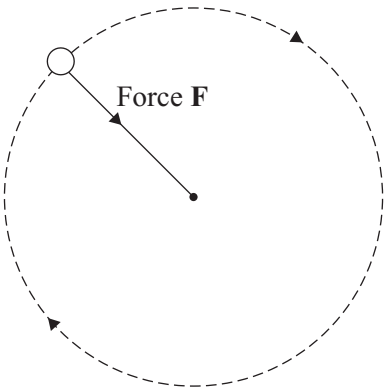
June 2005 | 3451 | Original Q5 | Legacy

5 (a) A student has fastened a ball to a piece of string and is swinging it round in a horizontal circle.



(i) The diagram below shows an overhead view of the movement of the ball.

Add an arrow, from the centre of the ball, to show the direction in which the ball would move if the string broke at this instant.



(1 mark)

(ii) Complete the table to show how force **F** changes if the student changes what he is doing. In each case, all the other factors stay the same.

If the student	Force F needs to
uses a ball with a greater mass	.....
swings the ball at a greater speed	.....
swings the ball with a shorter piece of string	.....

(3 marks)

4.5.6.1.2 Speed

Question 14 · continued

(b) The Moon orbits the Earth in a circular path.

Use words from the box to complete the **three** spaces in the sentence.

direction	resistance	speed	velocity

You may use each word once, more than once or not at all.

The Moon's ..... is constant but its ..... changes because its ..... changes.

(2 marks)

(c) When any object moves in a circular, or nearly circular, path a force must act towards the centre of the circle.

(i) What word is used to describe this force?

.....

(1 mark)

(ii) The Moon orbits the Earth. What provides the force towards the Earth?

.....

(1 mark)

(iii) In an atom, name the particles which are moving in circular paths around the nucleus.

.....

(1 mark)

(iv) In the case of an atom, what word describes the forces which keep these particles moving in circular paths around the nucleus?

.....

(1 mark)

10

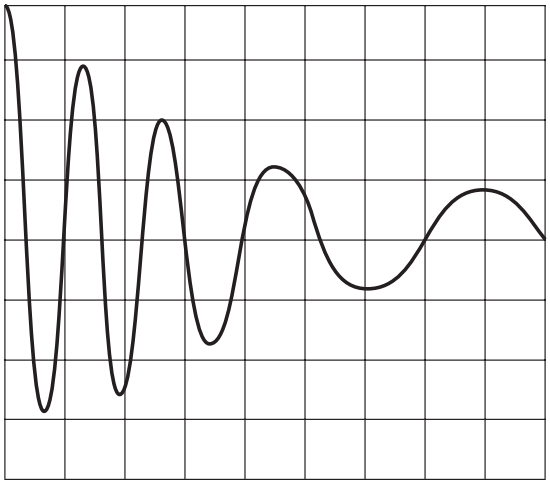
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 15

June 2005 | 3451 | Original Q7 | Legacy

7 (a) A microphone connected to an oscilloscope picks up the sound from a siren. The trace produced on the oscilloscope screen is shown below.



Describe how the wave changes as it goes across the screen from left to right (→).

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

(3 marks)

(b) An African bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.0016 m.

(i) The sound made by the bat is above the limit of human hearing.
What name is given to this type of sound?

.....

(1 mark)

(ii) Write down the equation that links frequency, wavelength and wave speed.

.....

(1 mark)

(iii) Calculate the speed of this sound wave through the air. Show clearly how you work out your final answer.

.....

.....

Wave speed = ... m/s

(3 marks)

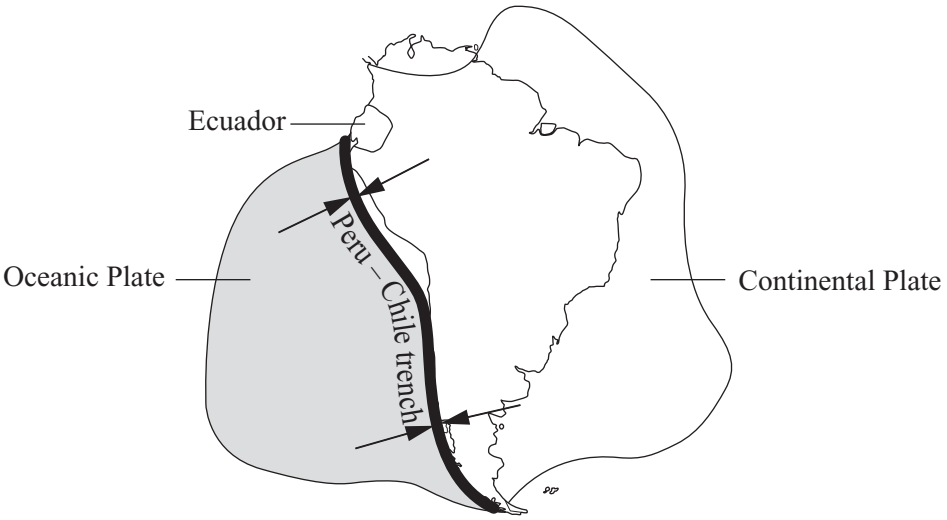
8

4.5.6.1.2 Speed

Question 16

June 2005 | 3451 | Original Q15 | Legacy

15 The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.



Source: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

.....

.....

.....

.....

(2 marks)

4.5.6.1.2 Speed

Question 16 · continued

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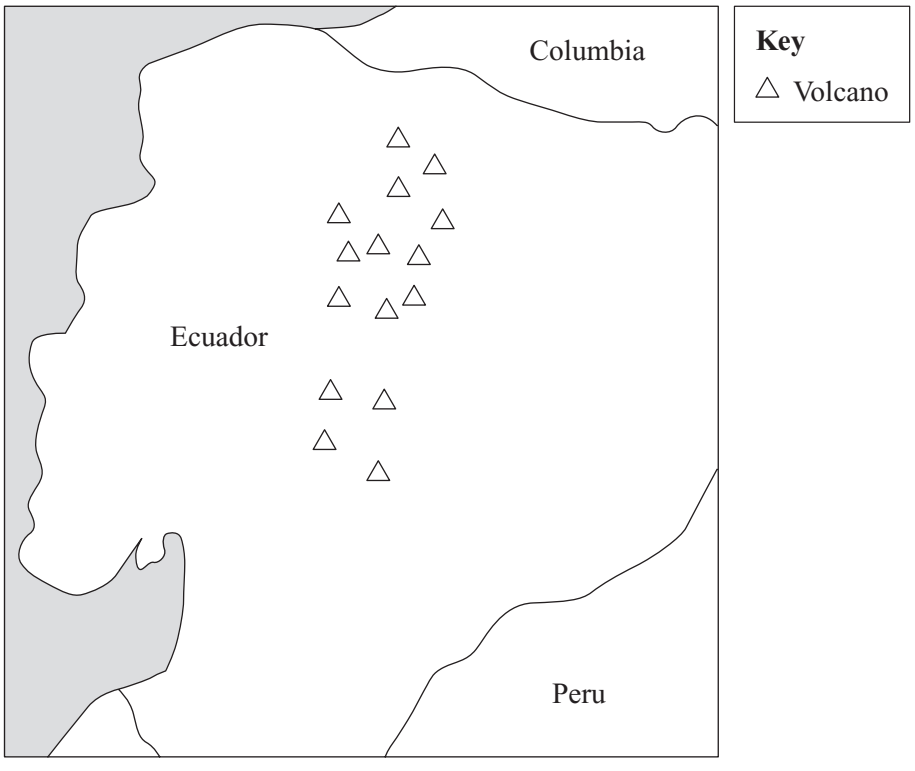
(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.



Explain how the volcanoes were formed.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

(1 mark)

QUESTION 15 CONTINUES ON THE NEXT PAGE

Question 16 · continued

MARGIN BLANK

(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

.....

.....

.....

.....

(2 marks)

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

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

.....

(1 mark)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ... joules
(1 mark)

(e) Read the information in the box and then answer the questions.

> Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.
>
> Potassium-40 decays into argon-40 which is stable.
>
> Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.
>
> A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

(1 mark)

(ii) Calculate the age of the rock.

.....

Age of rock = ... million years
(1 mark)

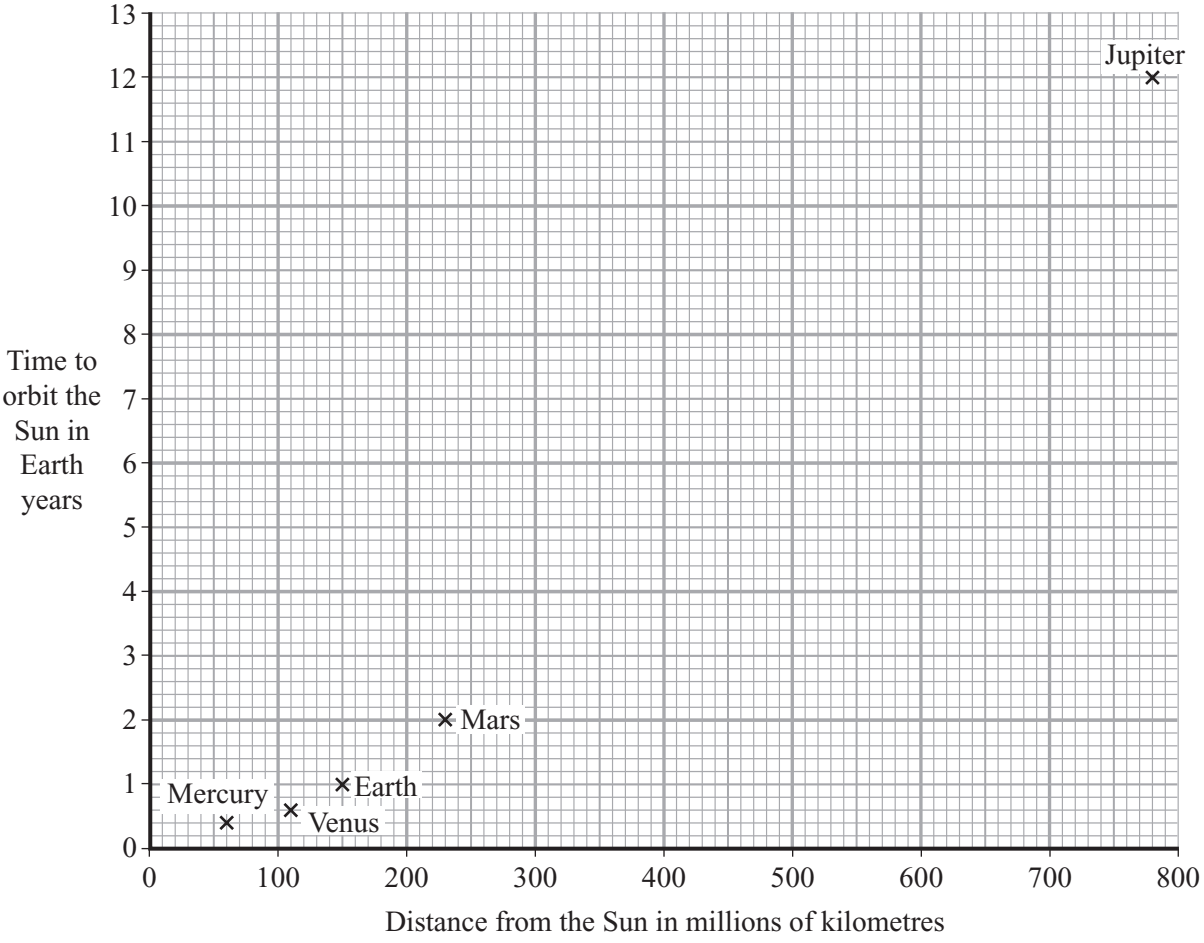
12

4.5.6.1.2 Speed

Question 17

June 2005 | 3462 | Original Q2 | Legacy

2 (a) The chart shows that the time taken by a planet to orbit the Sun depends on its distance from the Sun.



(i) How does the time taken by a planet to orbit the Sun depend on the distance the planet is from the Sun?

.....

.....

(1 mark)

(ii) Asteroids orbit the Sun. One asteroid is 550 million kilometres from the Sun.

Estimate how long this asteroid takes to orbit the Sun.

Time to orbit the Sun = ... Earth years

(1 mark)

4.5.6.1.2 Speed

Question 17 · continued

MARGIN BLANK

(b) The atmosphere on Venus contains a large percentage of a greenhouse gas.

	Mercury	Venus	Earth
Average surface temperature	230 °C	470 °C	20 °C

(i) Which **one** of these gases increases the greenhouse effect? Draw a ring around your answer.

argon **carbon dioxide** **nitrogen** **oxygen**

(1 mark)

(ii) Explain how the information in the table and the chart shows that the atmosphere of Venus produces a greenhouse effect.

.....

.....

.....

.....

(2 marks)

5

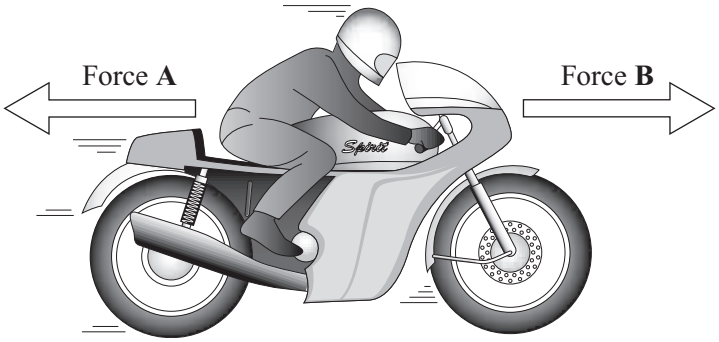
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 18

June 2005 | 3462 | Original Q4 | Legacy

4 (a) The diagram shows the horizontal forces that act on a **moving** motorbike.



(i) Describe the movement of the motorbike when force **A** equals force **B**.

.....

.....

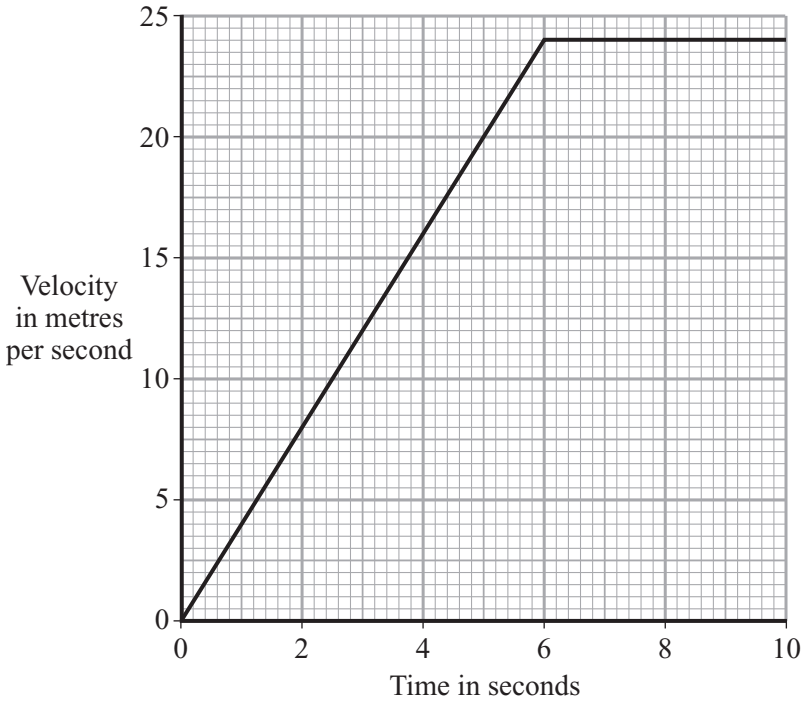
(2 marks)

(ii) What happens to the speed of the motorbike if force **B** becomes smaller than force **A**?

.....

(1 mark)

(b) The graph shows how the velocity of a motorbike changes when it is travelling along a straight road.



4.5.6.1.2 Speed

Question 18 · continued

MARGIN BLANK

(i) What was the change in velocity of the motorbike in the first 5 seconds?

.....

(1 mark)

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

.....

(1 mark)

(iii) Calculate the acceleration of the motorbike during the first 5 seconds. Show clearly how you work out your answer and give the unit.

.....

.....

Acceleration = ...

(3 marks)

(c) A car is travelling on an icy road.

Describe and explain what might happen to the car when the brakes are applied.

.....

.....

.....

.....

(2 marks)

(d) Name **three** factors, other than weather conditions, which would increase the overall stopping distance of a vehicle.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

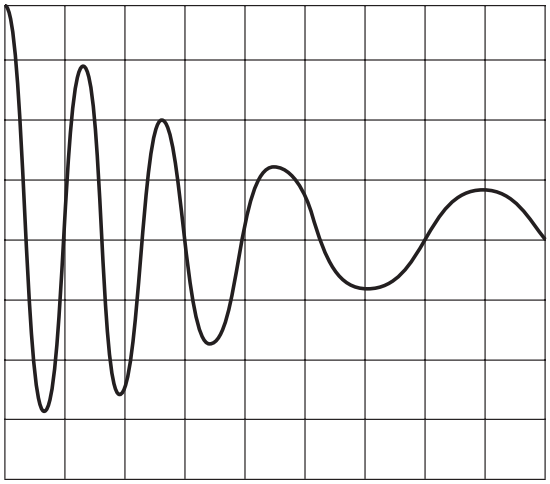
13

4.5.6.1.2 Speed

Question 19

June 2005 | 3462 | Original Q5 | Legacy

5 (a) A microphone connected to an oscilloscope picks up the sound from a siren. The trace produced on the oscilloscope screen is shown below.



Describe how the wave changes as it goes across the screen from left to right (→).

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

(3 marks)

(b) An African bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.0016 m.

(i) The sound made by the bat is above the limit of human hearing.
What name is given to this type of sound?

.....

(1 mark)

(ii) Write down the equation that links frequency, wavelength and wave speed.

.....

(1 mark)

(iii) Calculate the speed of this sound wave through the air. Show clearly how you work out your final answer.

.....

.....

Wave speed = ... m/s

(3 marks)

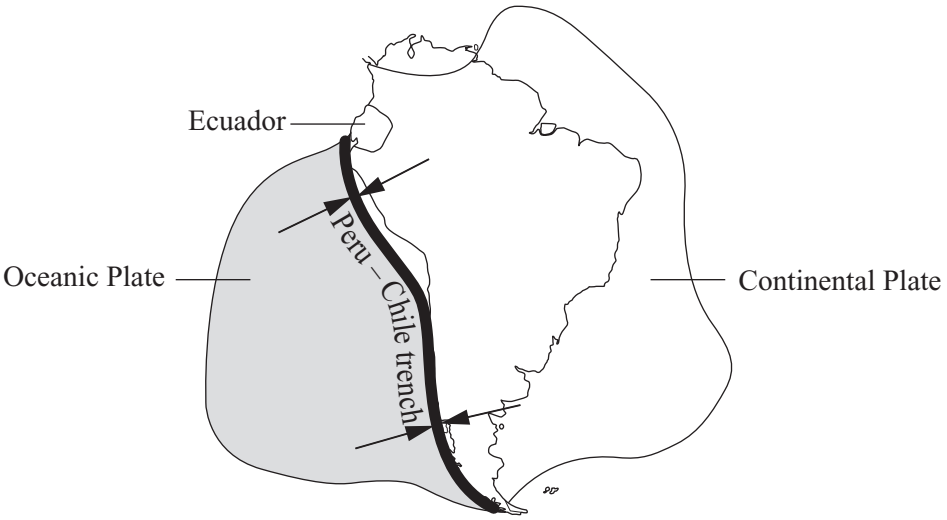
8

4.5.6.1.2 Speed

Question 20

June 2005 | 3462 | Original Q11 | Legacy

11 The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.



Source: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

.....

.....

.....

.....

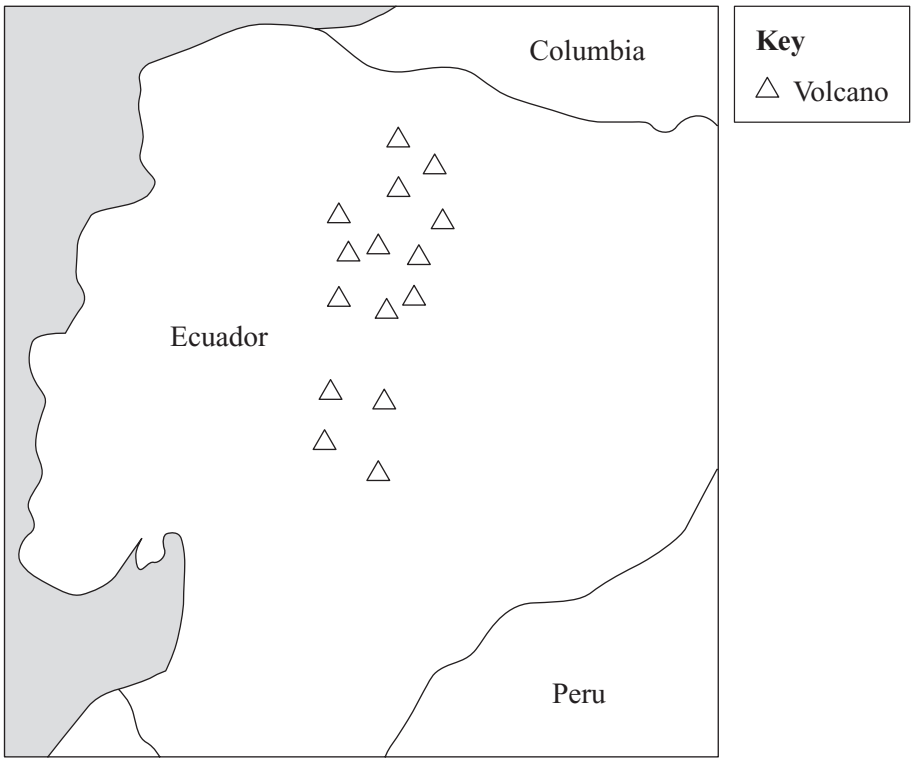
(2 marks)

4.5.6.1.2 Speed

Question 20 · continued

MARGIN
BLANK

(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.



Explain how the volcanoes were formed.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

(1 mark)

QUESTION 11 CONTINUES ON THE NEXT PAGE

Question 20 · continued

(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

.....

.....

.....

.....

(2 marks)

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

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

.....

(1 mark)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ... joules
(1 mark)

(e) Read the information in the box and then answer the questions.

> Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.
>
> Potassium-40 decays into argon-40 which is stable.
>
> Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.
>
> A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

(1 mark)

(ii) Calculate the age of the rock.

.....

Age of rock = ... million years
(1 mark)

12

4.5.6.1.2 Speed

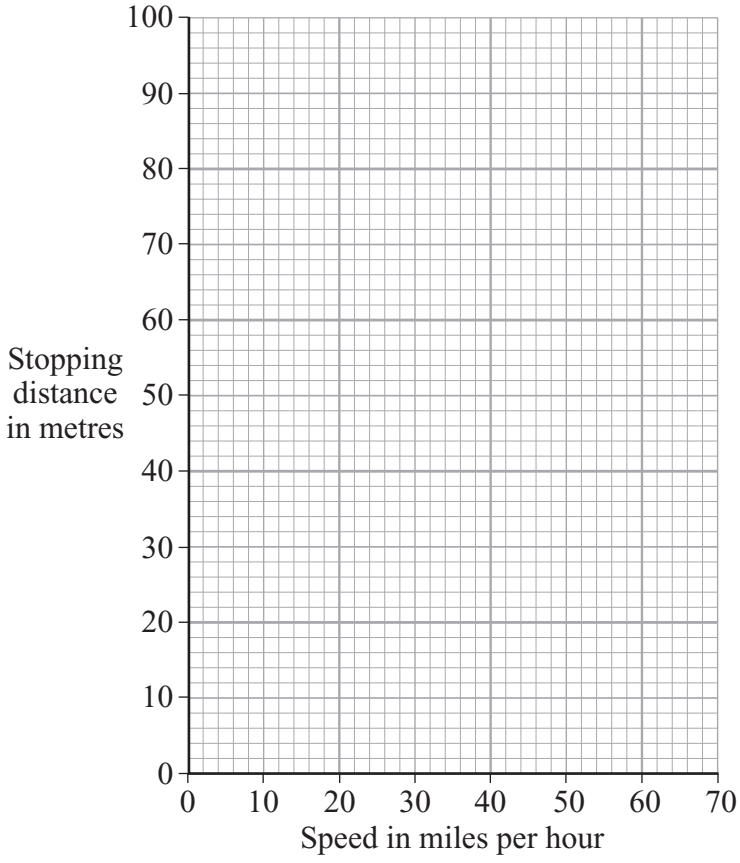
Question 21

June 2006 | 3451 | Original Q4 | Legacy

4 (a) The table shows how the stopping distance of a car, in metres (m), depends on the speed of the car, in miles per hour (mph).

Speed (mph)	20	30	40	50	60	70
Stopping distance (m)	12	23	36	53	73	96

(i) Draw a graph of stopping distance against speed.



(3 marks)

(ii) The speed limit outside a school is 20 mph.

Use the graph to estimate **how much further** a car will travel before it stops when driven at 25 mph instead of 20 mph.

Show clearly how you work out your answer.

.....

.....

(2 marks)

Question 4 continues on the next page

4.5.6.1.2 Speed

Question 21 · continued

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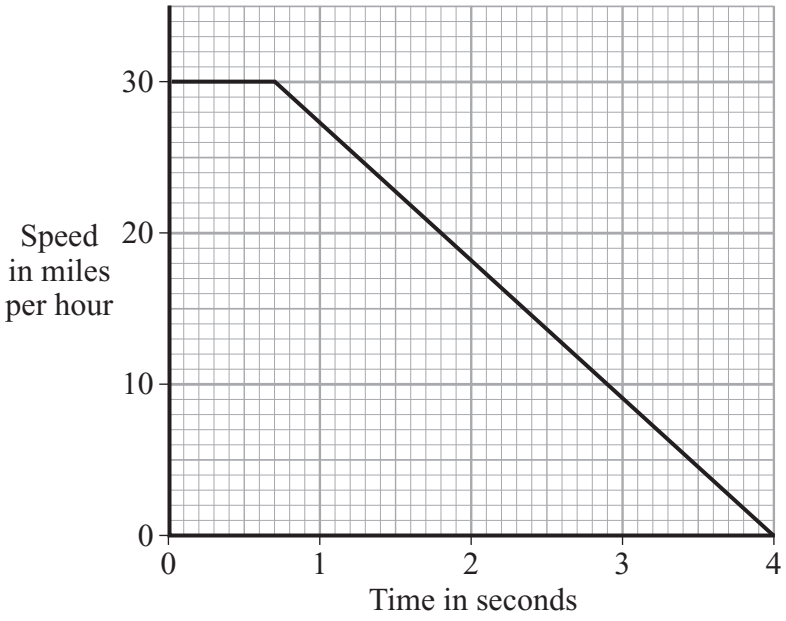
(b) A child ran out in front of a car causing the driver to make an emergency stop. The graph shows how the speed of the car changed from the moment the driver saw the child.



(i) What was the driver's reaction time?

.....

(1 mark)

(ii) Describe the motion of the car during the first 0.5 seconds.

.....

(1 mark)

(iii) How long did it take the car to stop once the brakes were applied?

.....

(1 mark)

(iv) The drug cannabis makes the reactions of a person slower.

Explain how the stopping distance of the car would change if the driver had been smoking cannabis.

.....

.....

.....

.....

(2 marks)

Question 21 · continued

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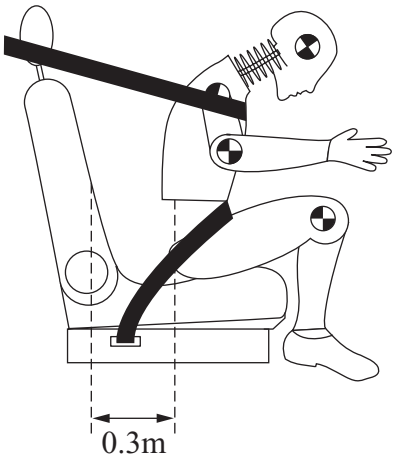
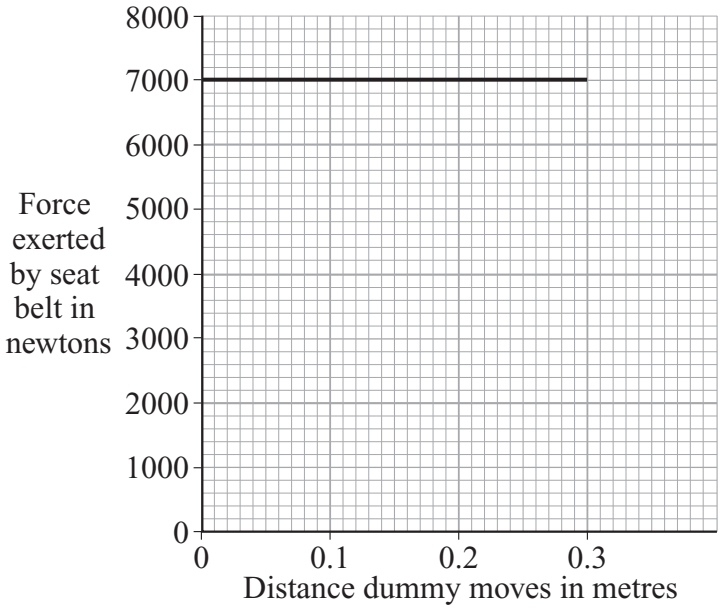
(c) The diagram shows how far a dummy in a car crash test moves before it is stopped by the seat belt. The graph shows the force exerted by the seat belt on the dummy during the crash.





(i) Write down the equation that links distance moved, force applied and work done.

.....

(1 mark)

(ii) Calculate the work done to stop the dummy.

Show clearly how you work out your answer.

.....

.....

.....

Work done = ... joules

(2 marks)

(iii) How much energy is transferred from the dummy during the crash?

.....

(1 mark)

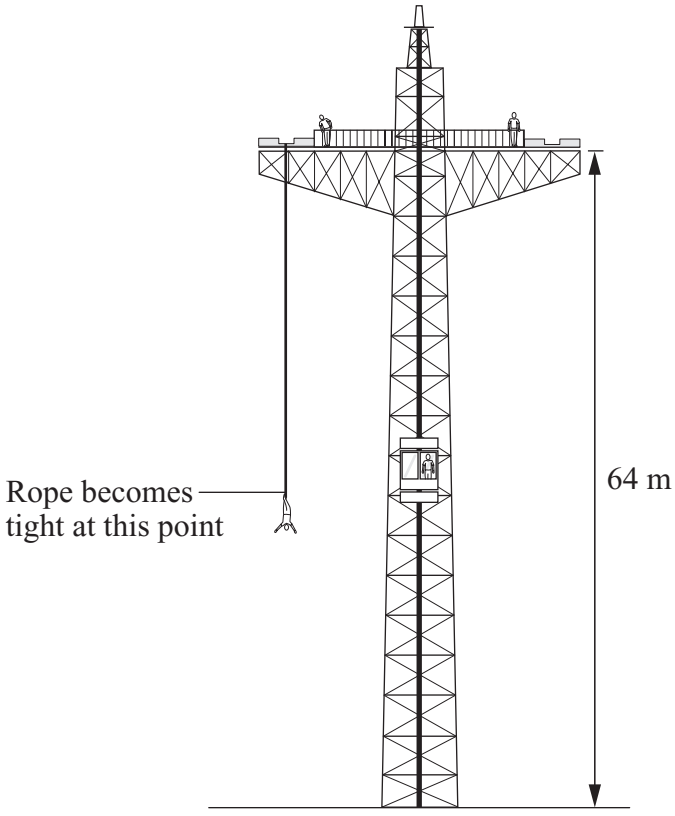
14

4.5.6.1.2 Speed

Question 22

June 2006 | 3451 | Original Q14 | Legacy

14 The diagram shows a tower used for bungee jumping.



(a) A lift takes a person of mass 55 kg, to a platform 64 metres above the ground.

(i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) Calculate the increase in the gravitational potential energy of the person when going from the ground to the platform.

Show clearly how you work out your final answer.
(Gravitational field strength = 10 N/kg)

.....

.....

.....

Increase in gravitational potential energy = ... joules

(2 marks)

4.5.6.1.2 Speed

Question 22 · continued

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(b) The falling bungee jumper reaches a maximum speed when 15 840 joules of gravitational potential energy have been transferred into kinetic energy.

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

.....

(1 mark)

(ii) Calculate the maximum speed of the falling bungee jumper.

Show clearly how you work out your final answer.

.....

.....

.....

Speed = ... m/s

(3 marks)

(c) As the rope stretches the bungee jumper slows down.

Describe fully the energy transfer that happens as the bungee jumper continues to fall towards the ground.

To gain full marks in this question you should write you ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

(3 marks)

10

4.5.6.1.2 Speed

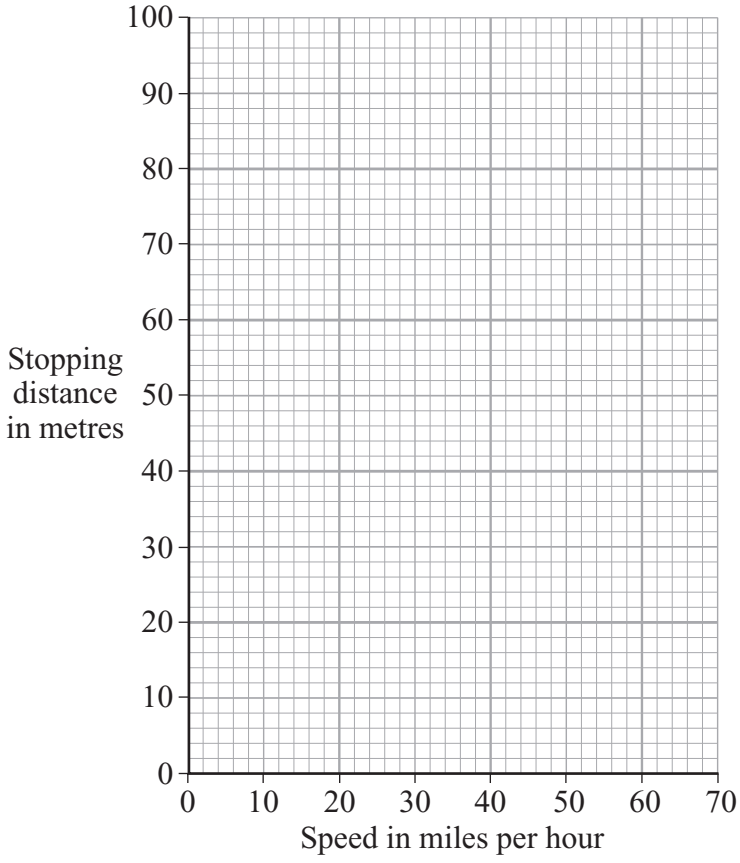
Question 23

June 2006 | 3462 | Original Q4 | Legacy

4 (a) The table shows how the stopping distance of a car, in metres (m), depends on the speed of the car, in miles per hour (mph).

Speed (mph)	20	30	40	50	60	70
Stopping distance (m)	12	23	36	53	73	96

(i) Draw a graph of stopping distance against speed.



(3 marks)

(ii) The speed limit outside a school is 20 mph.

Use the graph to estimate **how much further** a car will travel before it stops when driven at 25 mph instead of 20 mph.

Show clearly how you work out your answer.

.....

.....

(2 marks)

Question 4 continues on the next page

Question 23 · continued

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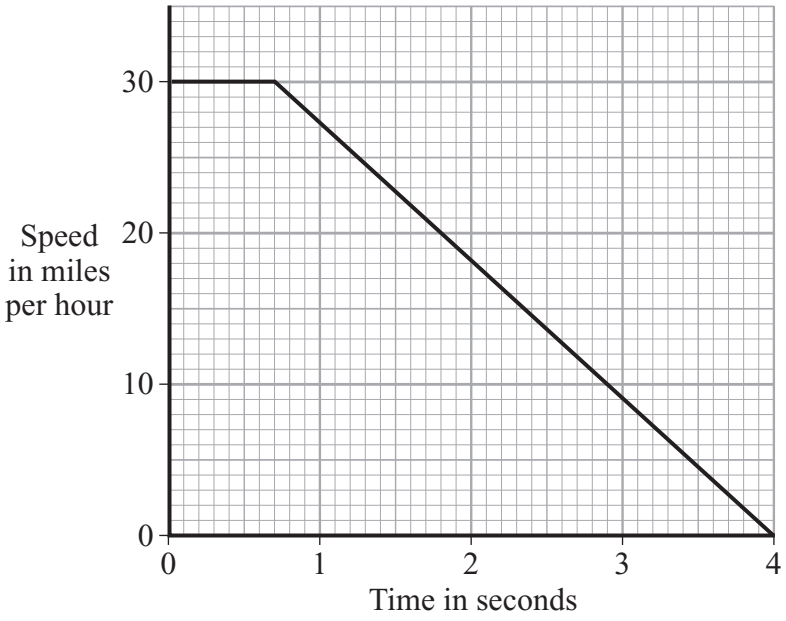
(b) A child ran out in front of a car causing the driver to make an emergency stop. The graph shows how the speed of the car changed from the moment the driver saw the child.



(i) What was the driver's reaction time?

.....

(1 mark)

(ii) Describe the motion of the car during the first 0.5 seconds.

.....

(1 mark)

(iii) How long did it take the car to stop once the brakes were applied?

.....

(1 mark)

(iv) The drug cannabis makes the reactions of a person slower.

Explain how the stopping distance of the car would change if the driver had been smoking cannabis.

.....

.....

.....

.....

(2 marks)

Question 23 · continued

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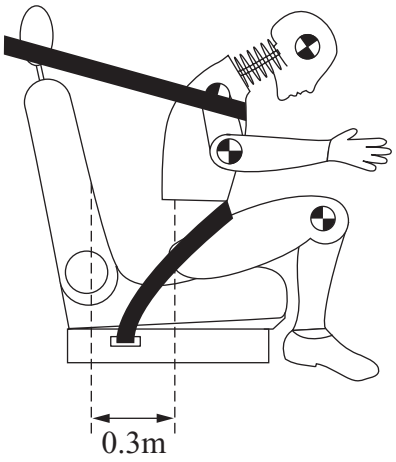
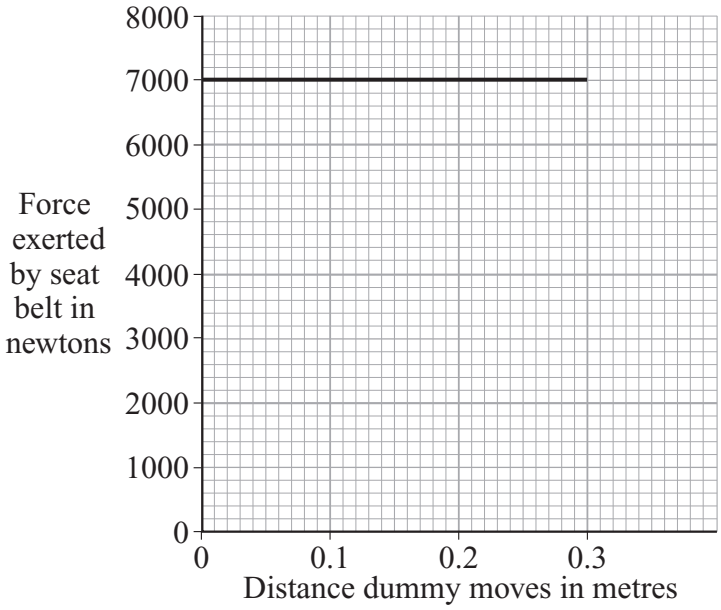
(c) The diagram shows how far a dummy in a car crash test moves before it is stopped by the seat belt. The graph shows the force exerted by the seat belt on the dummy during the crash.





(i) Write down the equation that links distance moved, force applied and work done.

.....

(1 mark)

(ii) Calculate the work done to stop the dummy.

Show clearly how you work out your answer.

.....

.....

.....

Work done = ... joules

(2 marks)

(iii) How much energy is transferred from the dummy during the crash?

.....

(1 mark)

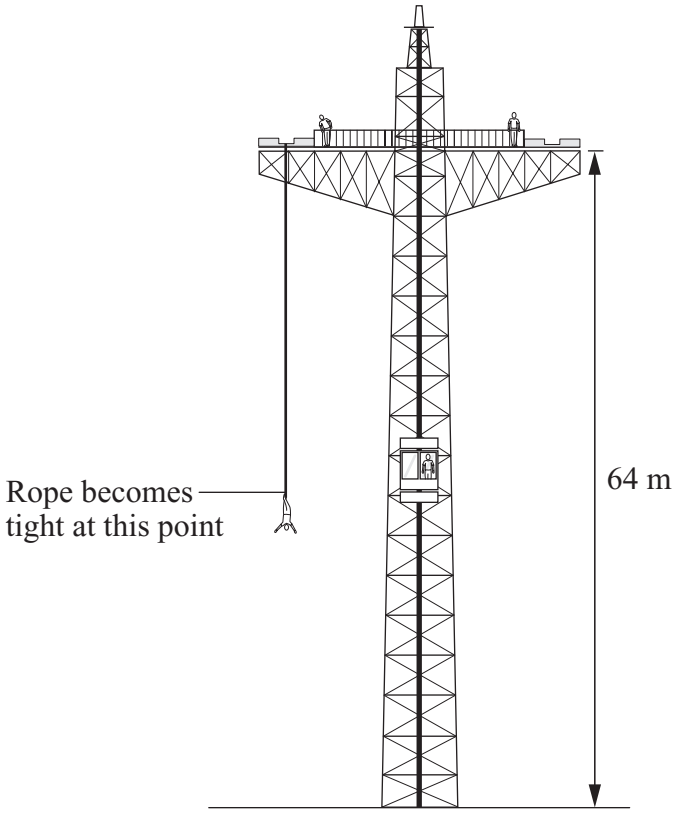
14

4.5.6.1.2 Speed

Question 24

June 2006 | 3462 | Original Q12 | Legacy

12 The diagram shows a tower used for bungee jumping.



(a) A lift takes a person of mass 55 kg, to a platform 64 metres above the ground.

(i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) Calculate the increase in the gravitational potential energy of the person when going from the ground to the platform.

Show clearly how you work out your final answer.
(Gravitational field strength = 10 N/kg)

.....

.....

.....

Increase in gravitational potential energy = ... joules

(2 marks)

4.5.6.1.2 Speed

Question 24 · continued

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(b) The falling bungee jumper reaches a maximum speed when 15 840 joules of gravitational potential energy have been transferred into kinetic energy.

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

.....

(1 mark)

(ii) Calculate the maximum speed of the falling bungee jumper.

Show clearly how you work out your final answer.

.....

.....

.....

Speed = ... m/s

(3 marks)

(c) As the rope stretches the bungee jumper slows down.

Describe fully the energy transfer that happens as the bungee jumper continues to fall towards the ground.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

(3 marks)

10

4.5.6.1.2 Speed

Question 25

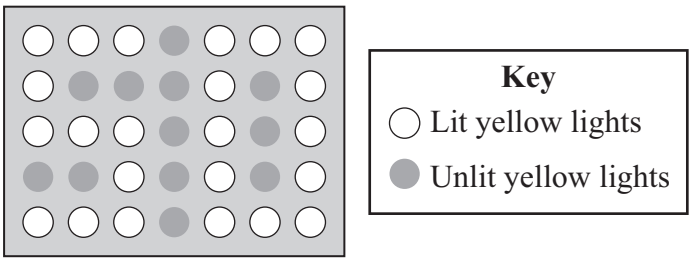
November 2006 | PHY1B | Original Q3 | Legacy

QUESTION THREE

Vehicles on motorways often travel at high speeds. It is important that clear warning signs are used.

Tests were carried out to find the most suitable colour for the lights in the warning sign.

The drawing shows a sign which has yellow lights.



3A Suggest why yellow light is used for the sign.

1 It has a higher frequency than all other colours.

2 It has a longer wavelength than all other colours.

3 It is easier to see than all other colours.

4 It travels faster than all other colours.

3B What determines the colour of the light from the display?

1 its brightness

2 its frequency

3 its power

4 its speed in a vacuum

4.5.6.1.2 Speed

Question 25 · continued

3C The wavelength of red light is 700 nm and the wavelength of violet light is 300 nm.

What is the likely value of the wavelength of the yellow light from the sign?

1 350 nm

2 450 nm

3 600 nm

4 750 nm

3D The warning sign is switched on by sending a radio signal. The frequency of the signal is 2 000 000 hertz and its wavelength is 150 metres.

Calculate the wave speed of the signal in metres/second.

wave speed = **frequency** × **wavelength**

1 13 333 m/s

2 1 333 333 m/s

3 300 000 000 m/s

4 3 000 000 000 m/s

4.5.6.1.2 Speed

Question 26

November 2006 | PHY1B | Original Q8 | Legacy

QUESTION EIGHT

Scientists have observed light from different galaxies. They have evidence for a red-shift in the light.

8A What change has occurred to the speed and wavelength of the light to cause the red-shift?

	Speed	Wavelength
1	decreased	stayed the same
2	increased	stayed the same
3	stayed the same	decreased
4	stayed the same	increased

8B Light from a galaxy with a very large red-shift would indicate that the galaxy was . . .

1 close and moving towards the Earth.

2 close and moving away from the Earth.

3 distant and moving towards the Earth.

4 distant and moving away from the Earth.

8C Many scientists support the 'big bang' theory.

This theory states that . . .

1 the galaxies are in fixed positions in space.

2 the galaxies rotate around a central point.

3 the stars are formed when planets collide.

4 the Universe began from a small initial point.

4.5.6.1.2 Speed

Question 26 · continued

8D Observations are taken by satellites in space.

The information is sent back to Earth using . . .

1 gamma rays.

2 microwaves.

3 ultraviolet rays.

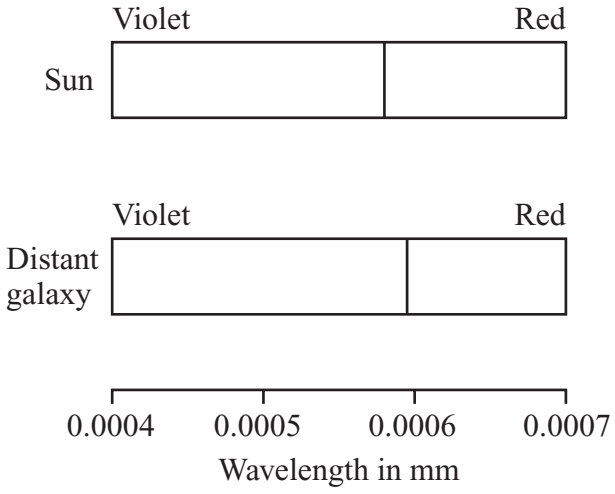
4 X-rays.

Turn over for the next question

4.5.6.1.2 Speed

Question 27

3 The visible part of the electromagnetic spectrum from a star includes a dark line. This line is at a specific wavelength. The diagram shows the position of the dark line in the spectrum from the Sun and in the spectrum from a distant galaxy.



(a) Explain how the spectrum 'shift' of the dark line supports the theory that the Universe began from a very small point.

.....

.....

.....

.....

.....

.....

(3 marks)

Question 3 continues on the next page

Question 27 · continued

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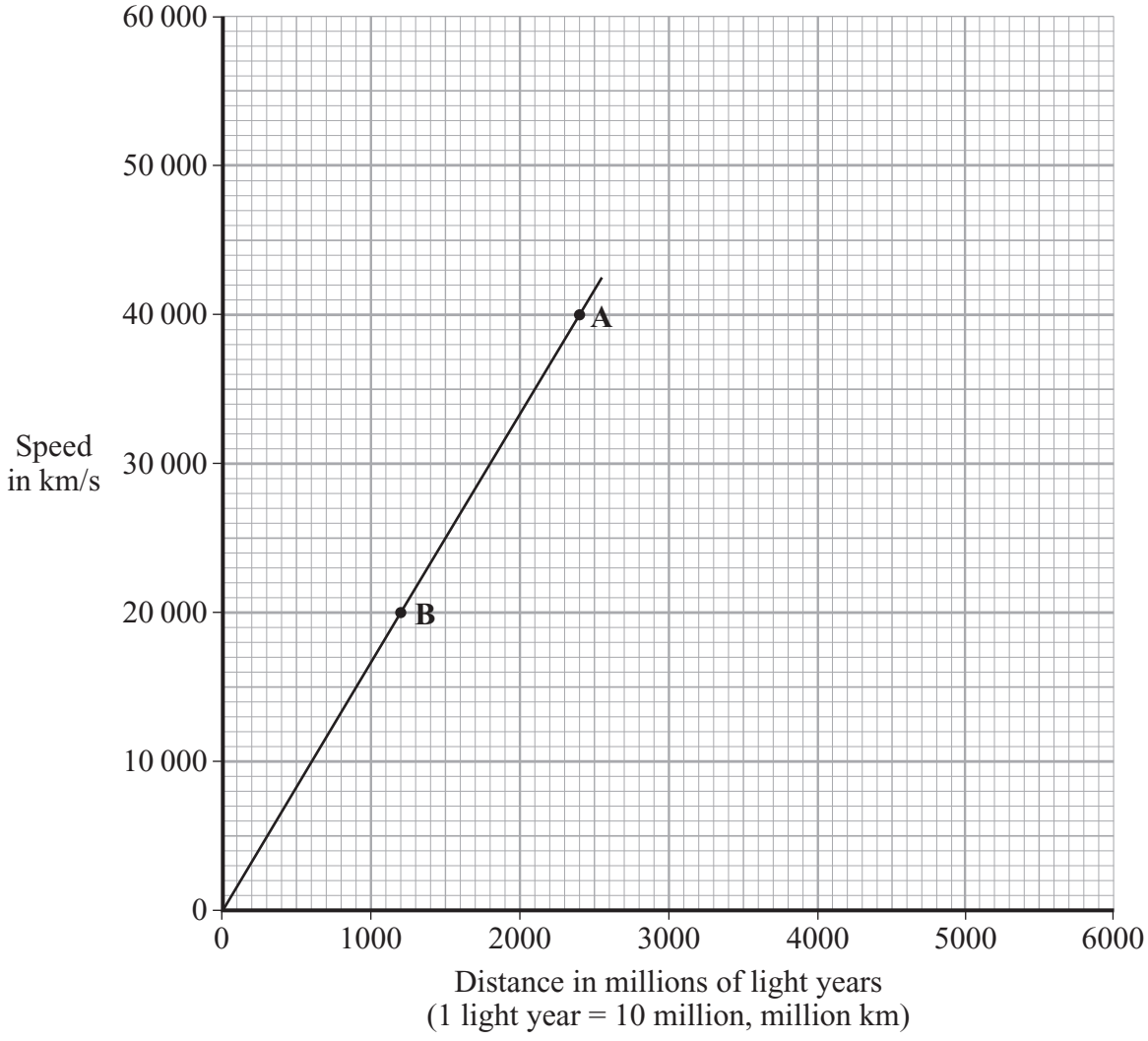
(b) From data collected, a graph can be drawn that links the speed of a galaxy with the distance of the galaxy from the Earth.



(i) How does the visible light spectrum from galaxy **A** look different from the visible light spectrum from galaxy **B**?

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 27 · continued

BLANK

(ii) A third galaxy, **C**, seems to be travelling away from the Earth at about 60 000 km/s.

Estimate how far galaxy **C** might be from the Earth, showing how you use the graph to do this.

.....

.....

Distance between galaxy **C** and the Earth = ... million light years

(2 marks)

(c) Astronomers use telescopes to observe distant galaxies. Since 1990 the Hubble optical telescope has been in orbit around the Earth.

Explain why an optical telescope in space allows astronomers to see further and more clearly than an optical telescope on Earth.

.....

.....

.....

.....

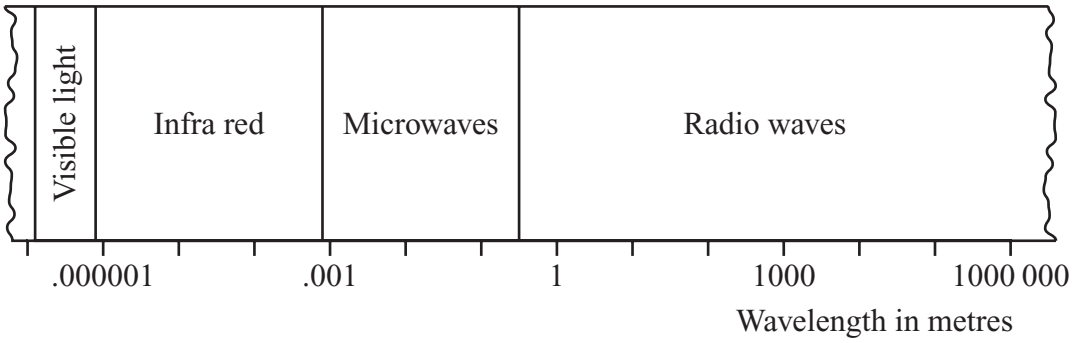
(2 marks)

8

4.5.6.1.2 Speed

Question 28

5 (a) The diagram represents part of the electromagnetic spectrum.



(i) Visible light travels through air at 300 000 000 m/s.

Why can we assume that radio waves travel through air at the same speed as light?

.....

(1 mark)

(ii) A radio station broadcasts at a frequency of 200 kHz.

Use the following equation to calculate the wavelength of the waves broadcast by this radio station. Show clearly how you work out your answer.

wave speed = frequency × wavelength

.....

.....

Wavelength = ... m

(2 marks)

(iii) Draw a vertical line on the diagram above to show the position of this radio wave in the electromagnetic spectrum.

(1 mark)

(b) Many radio stations now broadcast digital signals instead of *analogue* signals.

(i) What is an *analogue* signal?

.....

(1 mark)

4.5.6.1.2 Speed

Question 28 · continued

BLANK

(ii) Give **one** reason why a radio station would broadcast digital signals instead of analogue signals.

.....

.....

(1 mark)

(c) A student thinks that because energy cannot be destroyed it is not possible to waste energy. So he leaves his radio, TV and computer on all the time, even when there is no one in the house.

Explain why he is wrong about not being able to waste energy.

.....

.....

.....

.....

(2 marks)

8

4.5.6.1.2 Speed

Question 29

March 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

Use the equation to answer parts of this question.

wave speed	=	frequency	×	wavelength
(metres/second, m/s)		(hertz, Hz)		(metres, m)

7A A radio signal is broadcast at a frequency of 1500 kilohertz (kHz) and its speed is 300 million m/s.

What is its wavelength?

1 2 m

2 200 m

3 20 000 m

4 200 000 m

7B A microwave has a wavelength of 10 cm and its speed is 300 million m/s.

What is its frequency?

1 3 million Hz

2 30 million Hz

3 300 million Hz

4 3000 million Hz

7C Infra red signals can be sent through optical fibres.

This is because they are . . .

1 bent by a magnetic field in the optical fibre.

2 diffused through the optical fibre.

3 reflected from the inside surface of the optical fibre.

4 trapped in the centre of the optical fibre.

4.5.6.1.2 Speed

7D Which statement is true of radio waves?

1 They are mostly absorbed by soft tissue.

2 They do not include television signals.

3 They are not affected by the Earth's atmosphere.

4 They can create an alternating current in an electrical conductor.

Turn over for the next question

4.5.6.1.2 Speed

Question 30

June 2007 | PHY1B | Original Q3 | Legacy

QUESTION THREE

Pills are often kept in bottles made from brown plastic. The brown plastic absorbs ultraviolet (UV) radiation which may cause chemical changes to take place in the pills.

A scientist carried out an investigation to compare the amount of UV radiation absorbed by four different pill bottles. Each bottle was made from a different type of plastic.

Instead of pills, she used UV-sensitive beads. The beads were white when kept in the dark. They changed to a red colour when exposed to UV radiation.

- She put twenty beads into each of the bottles.
- She then placed the bottles at equal distances from a UV lamp.
- She then measured the time it took for all of the beads in each bottle to change from white to red.

The table shows her results.

Bottle	Time taken, in minutes, for beads to turn red
W	19
X	37
Y	56
Z	24

3A What kind of variable was the type of pill bottle?

1 categoric

2 continuous

3 discrete

4 ordered

4.5.6.1.2 Speed

Question 30 · continued

3B Which of these was **not** a control variable in this investigation?

1 the number of beads

2 the distance of the bottle from the UV radiation

3 the intensity of the UV lamp

4 the type of plastic used for the bottle

3C Which bottle would be best for storing pills?

1 **W**

2 **X**

3 **Y**

4 **Z**

3D The best way of displaying the data from this investigation would be in the form of a . . .

1 bar chart.

2 line graph.

3 pie chart.

4 scattergram.

4.5.6.1.2 Speed

Question 31

June 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

This question is about the transmission of light by optical fibres.

7A Optical fibres can bend light around corners without loss of signal.

This is because . . .

1 absorption of the signal occurs in the optical fibre.

2 following signals push the signals around the corners.

3 reflection of the signal occurs inside the optical fibre.

4 light signals are digital signals.

7B Infra red and visible light are used to send signals along optical fibres.

Compared with other electromagnetic radiations, infra red and visible light . . .

1 have similar frequencies and wavelengths.

2 have very high frequencies and very high wavelengths.

3 have very low frequencies and very low wavelengths.

4 travel at different speeds.

7C Communication by electromagnetic radiation may be by analogue signals.

Which row of the table correctly describes the characteristics of these analogue signals?

	Speed	Signal type
1	constant	continuously varying
2	constant	only on or off
3	varies	continuously varying
4	varies	only on or off

4.5.6.1.2 Speed

Question 31 · continued

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

7D An infra red wave has a wavelength of 0.001 m and a wave speed of 300 000 000 m/s.

The frequency of this wave is:

1 3 Hz

2 30 Hz

3 30 000 Hz

4 300 000 000 000 Hz

Turn over for the next question

4.5.6.1.2 Speed

Question 32

June 2007 | PHY1H | Original Q5 | Legacy

5 (a) The new Tetra communications system to be used by the police transmits *digital signals* using microwaves of wavelength 75 cm.
The signals travel through the air at 300 000 000 m/s.

(i) What is a *digital signal*?

.....

(1 mark)

(ii) Use the following equation to calculate the frequency of the microwaves used by the Tetra system. Show clearly how you work out your answer.

wave speed = frequency × wavelength

.....

.....

Frequency = ... hertz
(2 marks)

(b) Read the following extract from a newspaper and then answer the questions that follow.

> Residents of Stag Hill Court, a luxury block of flats, are shocked at the plans to site a mobile phone mast on the roof of the flats. They oppose the mast on health grounds, quoting research in Germany that has found a possible increase in cases of cancer around mobile phone masts.
>
> A spokesperson for the telecoms company said, 'The residents should not worry. The research carried out by our own scientists has found no link between ill health and mobile phone masts'.
>
> This has not reassured the residents, who argue that new independent research is urgently needed.

(i) Explain why living near a mobile phone mast could cause ill health.

.....

.....

.....

.....

.....

.....
(3 marks)

4.5.6.1.2 Speed

Question 32 · continued

BLANK

(ii) Suggest **two** reasons why the residents have **not** been reassured by the research carried out by the telecoms company.

1 .....

.....

2 .....

.....

(2 marks)

8

Turn over for the next question

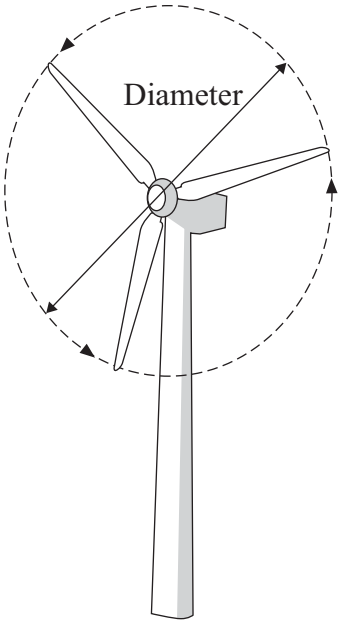
4.5.6.1.2 Speed

Question 33

November 2007 | PHY1A | Original Q7 | Legacy

QUESTION SEVEN

The electrical power output from a wind turbine depends on the diameter of the turbine and on the wind speed.



Turbine diameter in metres	Electrical power output in watts for a wind speed of 6 metres per second
2	60
3	135
4	240
5	375
6	540

7A Which conclusion about the electrical power output is correct for this data?

1 It increases in direct proportion to the diameter.

2 It increases in inverse proportion to the diameter.

3 It increases in inverse proportion to the radius.

4 It increases in direct proportion to the square of the diameter.

4.5.6.1.2 Speed

Question 33 · continued

7B The power output of a wind turbine . . .

1 is constant all the year round.

2 is greater in summer than winter.

3 varies on a monthly cycle.

4 varies throughout the year.

7C An advantage of wind turbines compared with a hydroelectric power station is that . . .

1 their dismantling cost is low.

2 there is no output of polluting gases during their construction.

3 they have no visual impact on their surroundings.

4 they work equally well in any location.

7D A disadvantage of wind turbines compared with a hydroelectric power station is that . . .

1 many hundreds are needed to produce the same power output.

2 their total atmospheric pollution in use is greater.

3 their total fuel costs are higher.

4 they use a non-renewable energy source.

4.5.6.1.2 Speed

Question 34

5 (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave? .....

(1 mark)

(b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

wave speed = frequency × wavelength

Show clearly how you work out your answer.

.....

.....

Wavelength = ... m

(2 marks)

(c) What happens when a metal aerial absorbs radio waves?

.....

.....

.....

.....

(2 marks)

4.5.6.1.2 Speed

Question 34 · continued

BLANK

(d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth not be able to detect X-rays emitted from distant stars?

.....

.....

(1 mark)

6

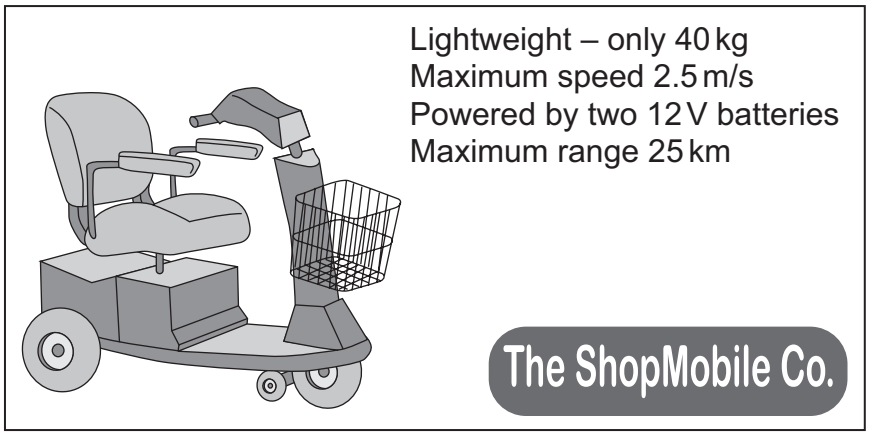
Turn over for the next question

4.5.6.1.2 Speed

Question 35

January 2008 | PHY2H | Original Q3 | Legacy

3 The picture shows an advert for an electric mobility scooter.



(a) The batteries are joined in series.

(i) What is the potential difference provided by the batteries to the motor?

.....

(1 mark)

(ii) The batteries supply a *direct current (d.c.)*.

What is a *direct current (d.c.)*?

.....

.....

(1 mark)

(b) At 2.5 m/s on flat ground, the motor takes a current of 3.0 A from the batteries.

(i) Explain why a bigger current is taken from the batteries when the scooter is going uphill at 2.5 m/s.

.....

.....

.....

.....

(2 marks)

4.5.6.1.2 Speed

Question 35 · continued

BLANK

(ii) What effect does travelling uphill have on the range of the scooter?

.....

(1 mark)

(c) The mass of the scooter driver is 80 kg.

Use the equation in the box to calculate the kinetic energy of the scooter **and** driver when they are travelling at maximum speed.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ... J

(2 marks)

(d) A battery which has run down is recharged in 8 hours. The average current delivered by the battery charger is 1.5 A.

Use the equation in the box to calculate the maximum charge stored by **both** batteries.

$$\text{charge} = \text{current} \times \text{time}$$

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

.....

.....

Charge stored = ...

(3 marks)

10

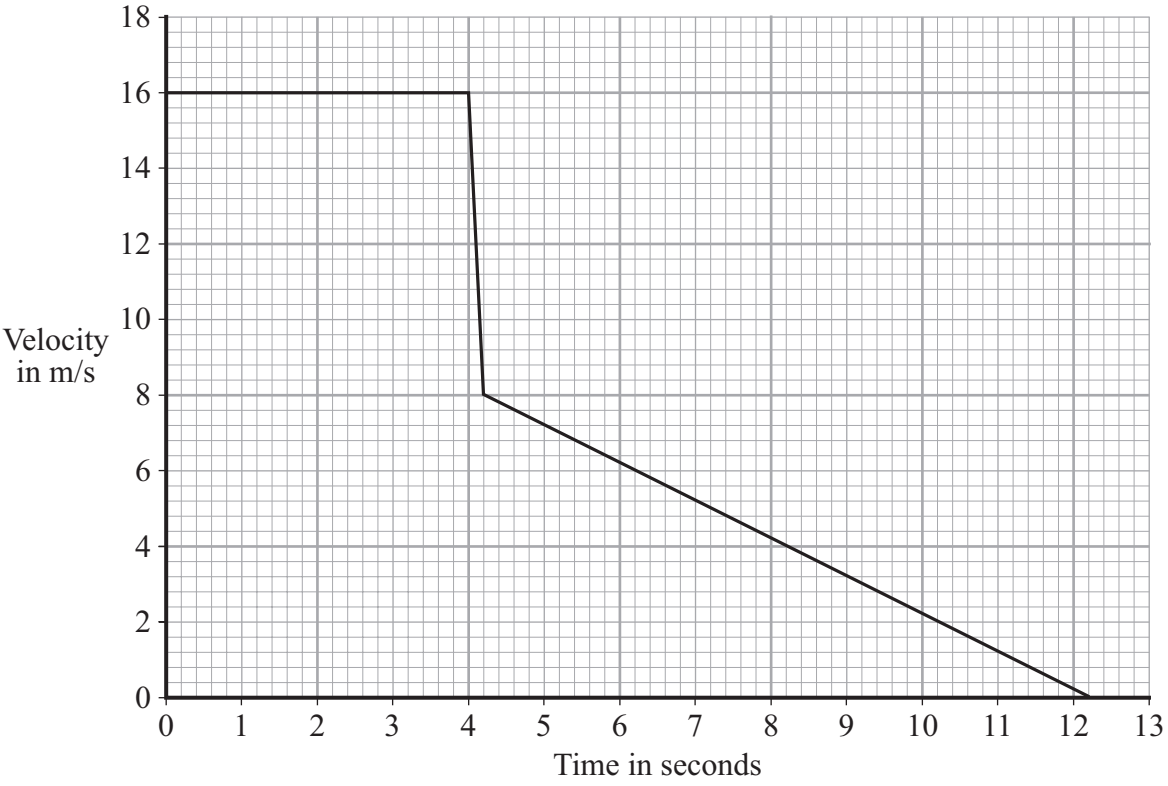
4.5.6.1.2 Speed

Question 36

January 2008 | PHY2H | Original Q6 | Legacy

6 In an experiment at an accident research laboratory, a car driven by remote control was crashed into the back of an identical stationary car. On impact the two cars joined together and moved in a straight line.

(a) The graph shows how the *velocity* of the remote-controlled car changed during the experiment.



(i) How is the *velocity* of a car different from the speed of a car?

.....

(1 mark)

(ii) Use the graph to calculate the distance travelled by the remote-controlled car before the collision.

Show clearly how you work out your answer.

.....

.....

Distance = ... m

(2 marks)

4.5.6.1.2 Speed

Question 36 · continued

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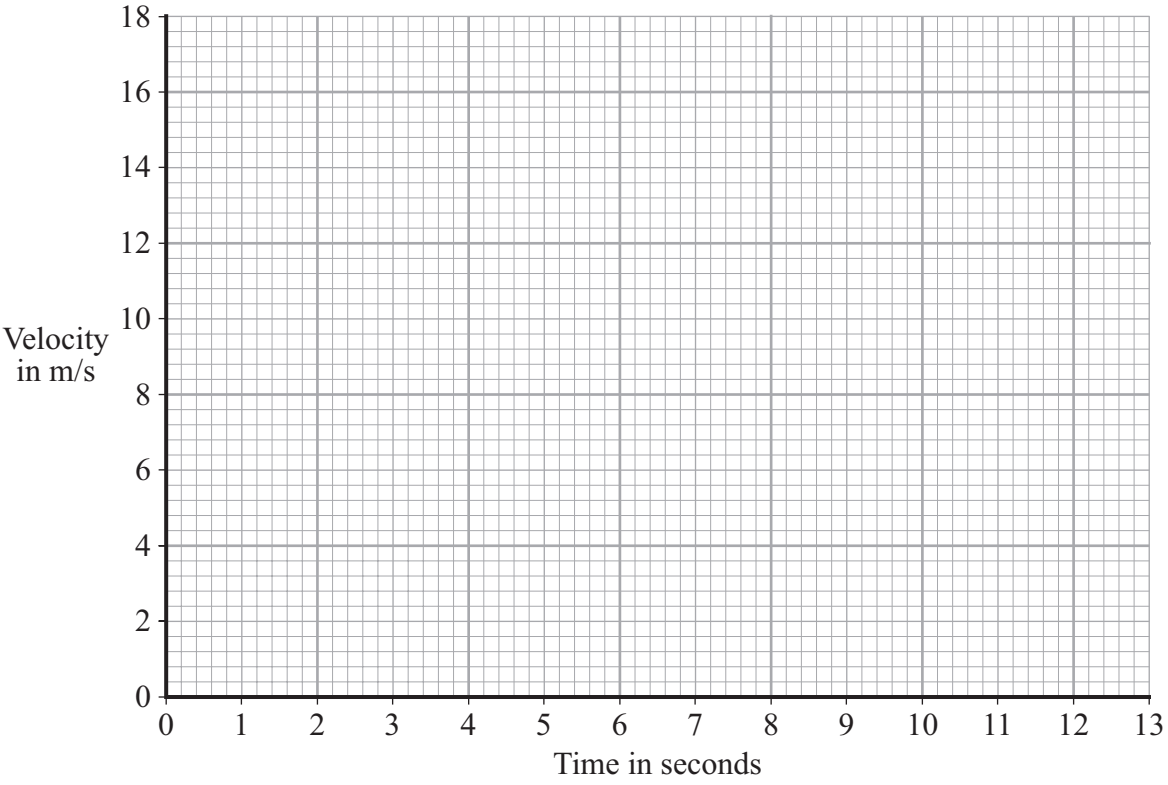
(iii) Draw, on the grid below, a graph to show how the velocity of the second car changed during the experiment.



(2 marks)

(iv) The total momentum of the two cars was not conserved.

What does this statement mean?

.....

.....

(1 mark)

Question 6 continues on the next page

4.5.6.1.2 Speed

Question 36 · continued

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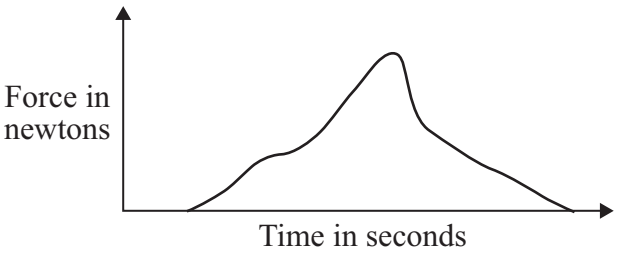
(b) The graph line shows how the force from a seat belt on a car driver changes during a collision.



Scientists at the accident research laboratory want to develop a seat belt that produces a constant force throughout a collision.

Use the idea of momentum to explain why this type of seat belt would be better for a car driver.

.....

.....

.....

.....

(2 marks)

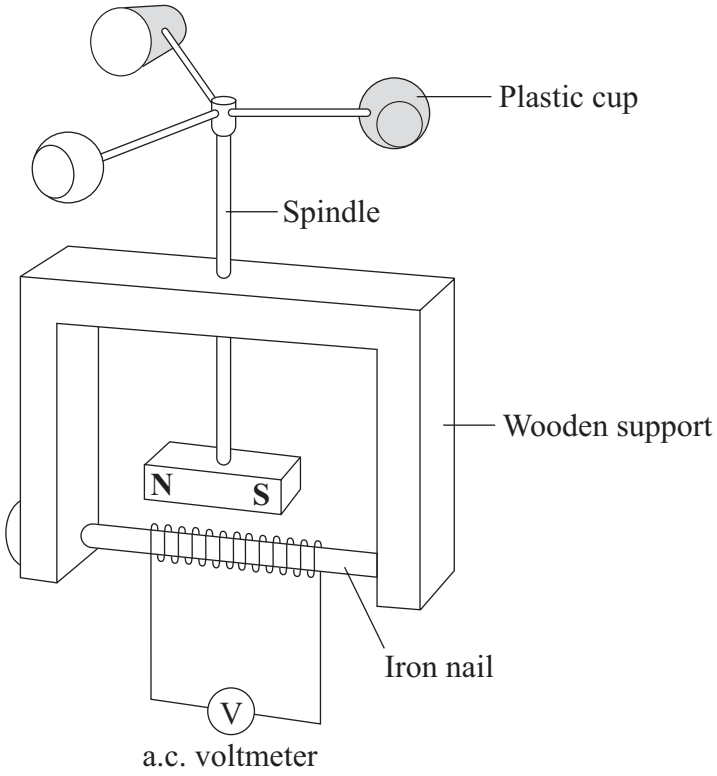
8

4.5.6.1.2 Speed

Question 37

January 2008 | PHY3H | Original Q7 | Legacy

7 The diagram shows a student's design for a simple wind speed gauge.



(a) Explain why the wind causes the a.c. voltmeter to give a reading. The explanation has been started for you.

The wind causes the plastic cups to turn. This causes the spindle and magnet to turn.

.....

.....

.....

.....

(2 marks)

(b) The gauge is not sensitive enough to measure light winds.

Suggest **one** way that the design can be modified to make the gauge more sensitive.

.....

.....

(1 mark)

3

4.5.6.1.2 Speed

Question 38

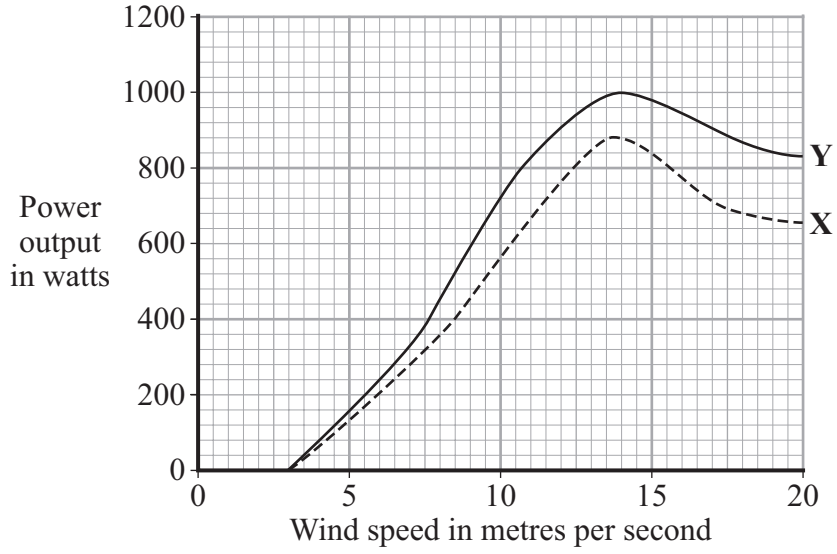
March 2008 | PHY1AP | Original Q4 | Legacy

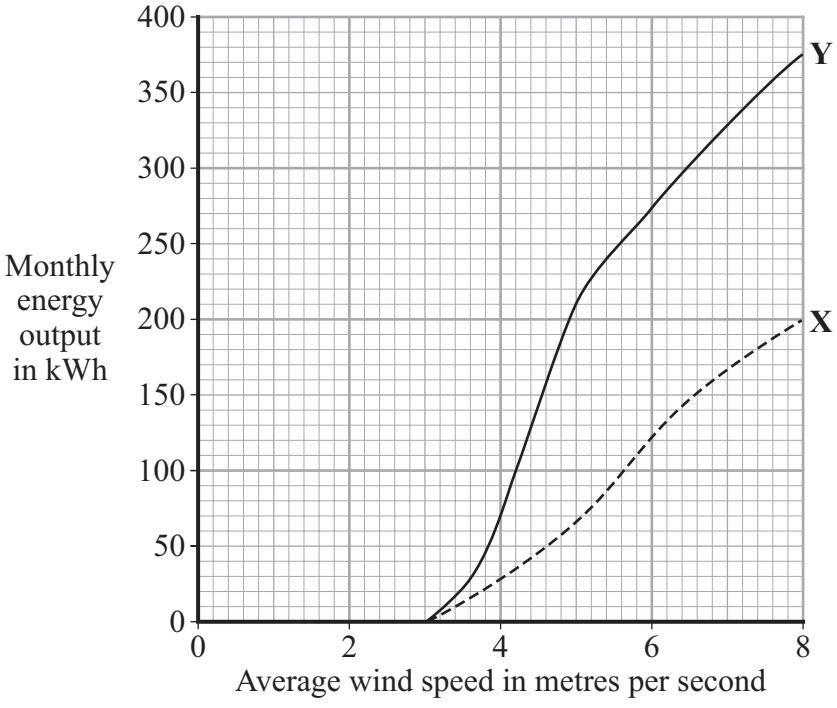
QUESTION FOUR

Many people are now installing wind turbines at their homes to produce electricity.

A customer has to decide which turbine to install.

The graphs show the performance of two models of wind turbine, **X** and **Y**.





4A How much greater is the maximum power produced by turbine **Y** than that produced by turbine **X**?

1 80 W

2 120 W

3 880 W

4 1000 W

4.5.6.1.2 Speed

Question 38 · continued March 2008 | PHY1AP | Original Q4 | Legacy

4B Which one of the following statements about the relationship between average wind speed and monthly energy output by turbine **X** is true?

1 An increase in average wind speed always causes an increase in monthly energy output.

2 As average wind speed doubles, monthly energy output doubles.

3 Above a certain average wind speed, monthly energy output falls.

4 At average wind speeds below 2 m/s, a 10 % increase in wind speed has no effect on monthly energy output.

4C Turbine **X** can be bought and installed for £750; turbine **Y** can be bought and installed for £1500.

A person lives in an area where the maximum wind speed is 10 m/s and the average annual wind speed is 3.5 m/s. A salesman advises the person to buy turbine **Y** because it produces more power.

Is the advice given by the salesman the best advice?

1 Yes, because turbine **Y** always produces more power than turbine **X**.

2 Yes, because as wind speed increases above 3 m/s, power output increases more rapidly from turbine **Y** than from turbine **X**.

3 No, because there is very little difference between the monthly energy output of the two turbines where the person lives.

4 No, because turbine **Y** will never pay for itself.

4D A neighbour objects to planning permission being given for the turbine.

The most likely reason for this objection is that the neighbour thinks that . . .

1 the turbine may cause a decrease in property prices in the area.

2 the turbine is a health risk.

3 the turbine will cause air pollution.

4 having a turbine is a status symbol.

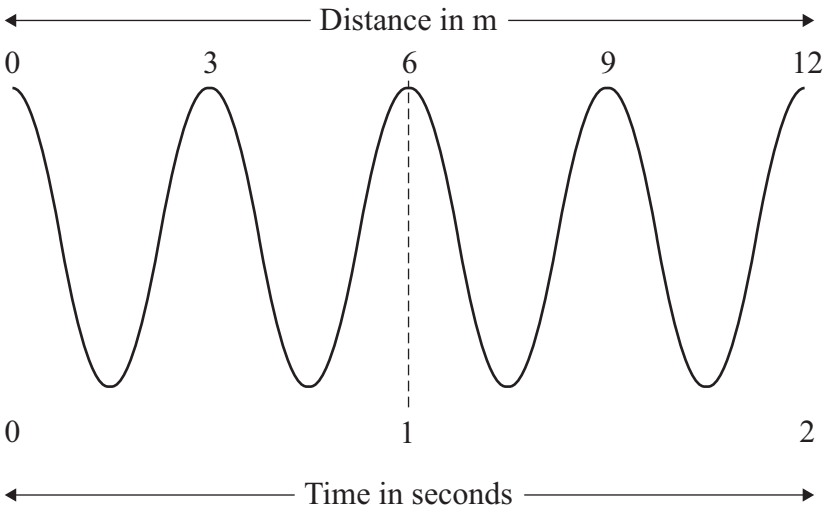
4.5.6.1.2 Speed

Question 39

March 2008 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

The diagram shows a wave.



wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

4.5.6.1.2 Speed

Question 39 · continued

Match figures, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A 2

B 3

C 4

D 6

1	the number of complete waves shown in the diagram
2	the wavelength in metres
3	the frequency in hertz
4	the speed of the wave in metres per second

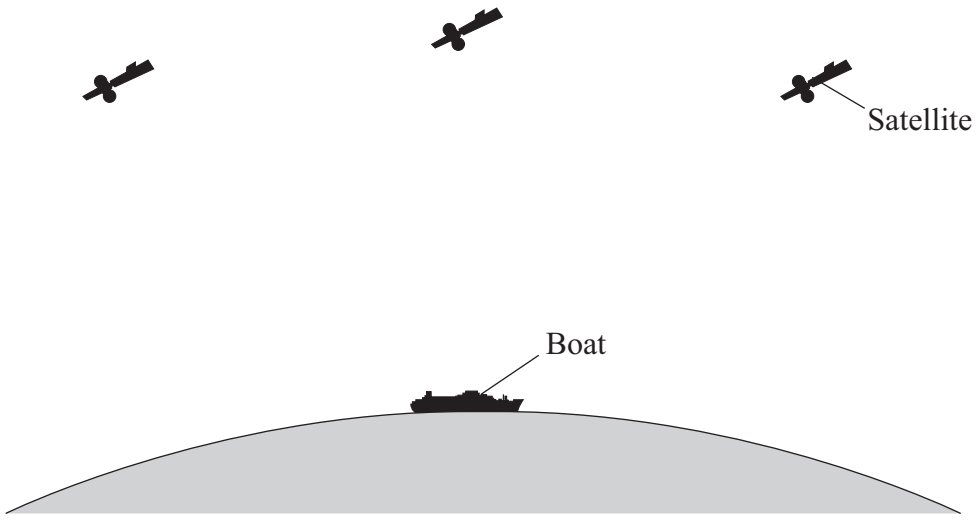
4.5.6.1.2 Speed

Question 40

March 2008 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Geostationary satellites can be used for navigation. These satellites remain in the same position above the Earth as the Earth spins on its axis. For accurate navigation, the signals from three satellites are needed.



6A Electromagnetic radiation is used to communicate with the satellites.

Here are two statements about electromagnetic radiation.

X All electromagnetic radiation travels as waves.

Y All forms of electromagnetic radiation travel at the same speed through space.

The correct statements are . . .

1 **X** only.

2 **Y** only.

3 both **X** and **Y**.

4 neither **X** nor **Y**.

Question 40 · continued March 2008 | PHY1BP | Original Q6 | Legacy

6B What effect will signals from the satellite have on the metal aerial on the boat?

1 heat up the metal and destroy some of its atoms

2 heat up the metal and set up an alternating electric current

3 produce microwaves which carry the information to be displayed

4 produce microwaves which set up an alternating electrical current

6C The electromagnetic radiation has a speed of 300 000 000 m/s and a wavelength of 0.1 m.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

What is its frequency?

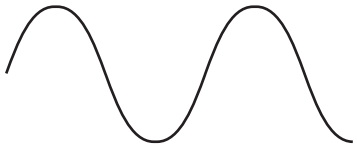
1 3.33 Hz

2 30 000 000 Hz

3 33 000 000 Hz

4 3 000 000 000 Hz

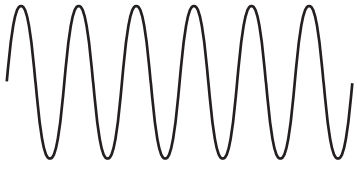
6D Which of these signals could be processed by a computer within the navigation system?



1



2



3



4

4.5.6.1.2 Speed

Question 41

June 2008 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

In 1927, the Belgian priest Georges Lemaitre proposed that the universe began with an explosion. His proposal came after astronomers had observed red-shift in light from distant galaxies.

7A Red-shift is . . .

1 a decrease in wavelength of the light due to a galaxy moving away from the Earth.

2 an increase in wavelength of the light due to a galaxy moving away from the Earth.

3 a decrease in wavelength of the light due to a galaxy moving towards the Earth.

4 an increase in the wavelength of the light due to a galaxy moving towards the Earth.

7B In 1929, Edwin Hubble found experimental evidence that distant galaxies are moving away from us with speeds that are proportional to their distance from the Earth.

This suggests that . . .

1 the universe is contracting.

2 the universe started from a small initial point.

3 the universe has always been the same.

4 the galaxies are getting slower.

7C Later, in 1948, it was suggested that if the universe started with an explosion there should still be cosmic (microwave) background radiation in space left over from the explosion. This microwave radiation was discovered in 1964.

Its discovery . . .

1 proves that the universe started with a ‘big bang’.

2 proves that the universe is expanding.

3 provides strong evidence that the universe started with a ‘big bang’.

4 finally disproves all other theories of the origin of the universe.

4.5.6.1.2 Speed

Question 41 · continued

7D According to the latest theory, the universe was created 13.7 billion years ago.

This figure . . .

1 is both accurate and precise.

2 is a guess.

3 is an estimate based on reliable data.

4 is an estimate based on unreliable data.

Turn over for the next question

4.5.6.1.2 Speed

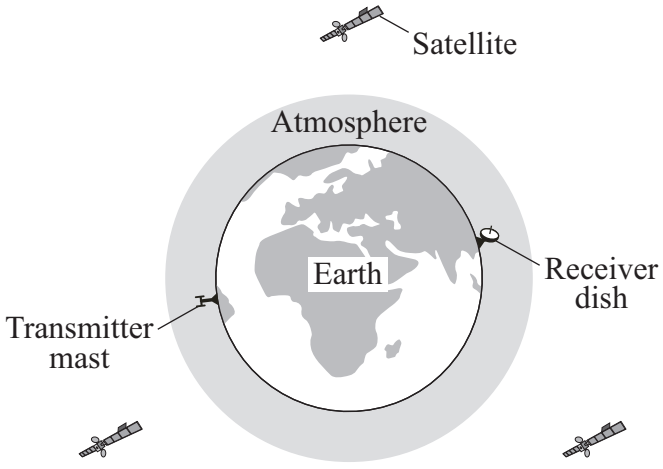
Question 42

June 2008 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Satellite television broadcasts are transmitted as microwaves. In a vacuum, the microwaves travel at 300 million metres per second.

Television stations are changing the transmission method from analogue signals to digital signals. In a few years' time there will be no analogue television transmissions.



9A Microwaves are used for transmissions to and from satellites because they . . .

1 are never affected by interference.

2 are regarded as 100% safe by scientists.

3 cannot be seen by the human eye.

4 pass through the Earth's atmosphere easily.

9B Digital signals are better than analogue signals for transmitting satellite television programmes because digital signals . . .

1 can only be ON or OFF and so are less prone to distortion by interference.

2 do not need the use of a computer to process them.

3 pass through clouds and are not affected by weather.

4 travel at a higher speed in a vacuum.

4.5.6.1.2 Speed

Question 42 · continued

9C It is necessary to transmit from the transmitter mast to the receiver dish via a satellite because . . .

1 microwaves will not travel far.

2 microwaves do not travel in a curved path.

3 the Earth is rotating.

4 the waves spread out from the transmitter in all directions into space.

9D A new television channel will transmit via satellites using microwaves with a wavelength of 400 millimetres.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

1 MHz = 1 000 000 Hz

The frequency of the microwaves will be . . .

1 0.75 Hz

2 750 Hz

3 0.75 MHz

4 750 MHz

END OF TEST

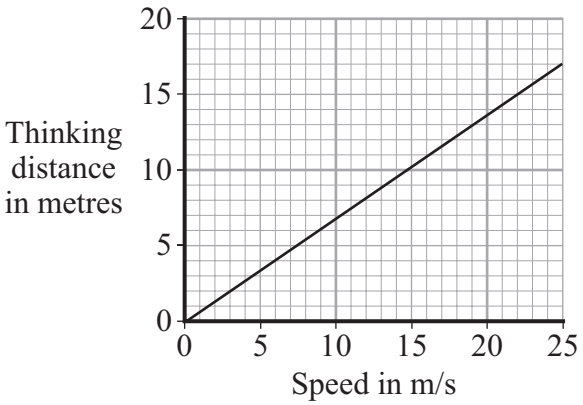
4.5.6.1.2 Speed

Question 43

June 2008 | PHY2H | Original Q3 | Legacy

3 (a) A car driver takes a short time to react to an emergency before applying the brakes. The distance the car will travel during this time is called the 'thinking distance'.

The graph shows how the thinking distance of a driver depends on the speed of the car.



3 (a) (i) What is the connection between thinking distance and speed?

.....

(1 mark)

3 (a) (ii) Many people drive while they are tired.

Draw a new line on the graph to show how thinking distance changes with speed for a tired driver.

(1 mark)

3 (a) (iii) The graph was drawn using data given in the Highway Code.

Do you think that the data given in the Highway Code is likely to be reliable?

Draw a ring around your answer.

Yes **No** **Maybe**

Give a reason for your answer.

.....

.....

(1 mark)

Question 3 continues on the next page

4.5.6.1.2 Speed

Question 43 · continued

for mark

3 (b) The distance a car travels once the brakes are applied is called the 'braking distance'.

3 (b) (i) What is the relationship between thinking distance, braking distance and stopping distance?

.....

(1 mark)

3 (b) (ii) State **two** factors that could increase the braking distance of a car at a speed of 15 m/s.

1 .....

2 .....

(2 marks)

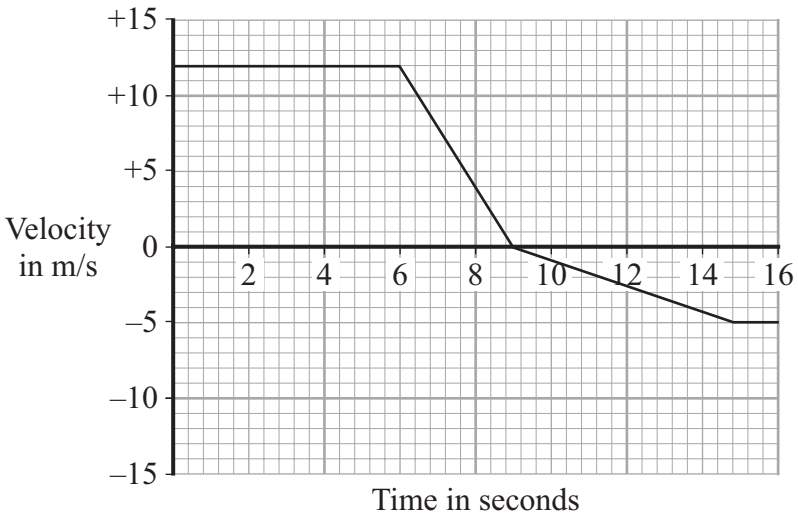
6

4.5.6.1.2 Speed

Question 44

June 2008 | PHY2H | Original Q5 | Legacy

5 A car is driven along a straight road. The graph shows how the velocity of the car changes during part of the journey.



5 (a) Use the graph to calculate the deceleration of the car between 6 and 9 seconds.

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

.....

.....

.....

Deceleration = ...

(3 marks)

5 (b) At what time did the car change direction?

..... seconds

(1 mark)

4

4.5.6.1.2 Speed

Question 45

June 2008 | PHY3H | Original Q8 | Legacy

8 The London Eye is the largest observation wheel in the world.



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

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

.....

.....

.....

(2 marks)

8 (b) In which direction does each capsule accelerate?

.....

(1 mark)

8 (c) What is the name of the resultant force that causes the capsules to accelerate?

.....

(1mark)

4.5.6.1.2 Speed

Question 45 · continued

for mark

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

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 mark)

5

4.5.6.1.2 Speed

Question 46

November 2008 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

This question is about the electromagnetic spectrum and its use in communications.

5A Which one of the following types of electromagnetic wave would **not** be suitable for communications?

1 infra red

2 microwave

3 gamma

4 visible light

5B Which types of electromagnetic waves can be used to send signals along optical fibres?

1 infra red and ultraviolet

2 infra red and visible light

3 infra red, ultraviolet and visible light

4 ultraviolet and visible light

5C By 2012, all TV signals in the UK will be digital.

This will be an improvement over analogue signals because . . .

1 digital signals are less prone to interference.

2 digital signals pick up interference and amplify it.

3 in an analogue signal, interference is treated as part of the original signal.

4 when analogue signals are amplified, interference is amplified.

4.5.6.1.2 Speed

Question 46 · continued

5D Electromagnetic waves travel at a speed of 300 000 km/s.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

A radio station transmits signals at a wavelength of 1.5 km.

The frequency of the waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

Turn over for the next question

4.5.6.1.2 Speed

Question 47

November 2008 | PHY1BP | Original Q9 | Legacy

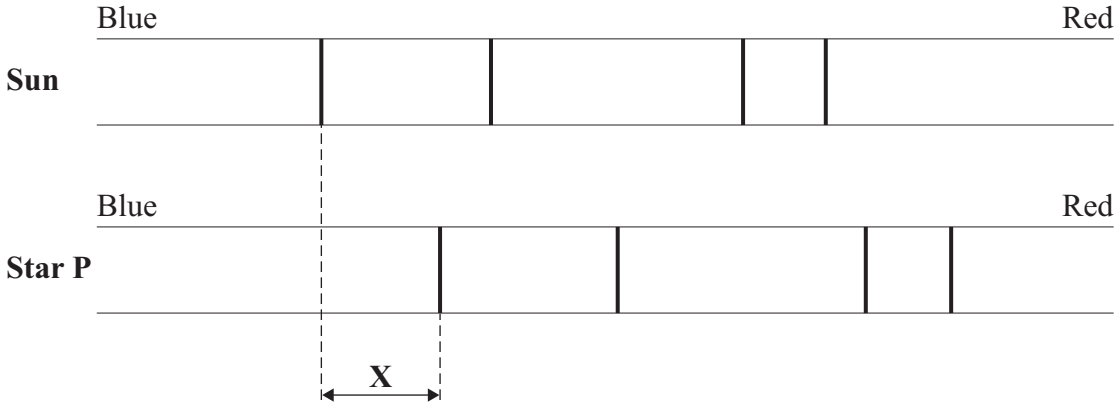
QUESTION NINE

The visible part of the electromagnetic spectrum from a star includes dark lines. These lines are at specific wavelengths.

The diagrams show the positions of the dark lines in the spectrum from the Sun and in the spectrum from a distant star, **P**.

Star **P** is moving away from the observer.

The dark lines in **P**'s spectrum are shown to be displaced.



9A The displacement marked **X** in the diagram is called the red-shift.

What change has occurred to the speed and frequency of the light to cause red-shift?

	Speed	Frequency
1	decreased	stayed the same
2	increased	stayed the same
3	stayed the same	decreased
4	stayed the same	increased

Question 47 · continued

9B Another star, **Q**, is further away from the observer than star **P** and is also moving away from the observer.

The displacement **X** in **Q**'s spectrum, compared with that in **P**'s is . . .

1 smaller and in the opposite direction.

2 bigger and in the opposite direction.

3 smaller and in the same direction.

4 bigger and in the same direction.

9C Edwin Hubble made measurements on the dark lines in the spectra from distant galaxies.

His observations led to the idea that the universe is expanding.

He observed that . . .

1 the further away the galaxy, the smaller the red-shift.

2 the further away the galaxy, the bigger the red-shift.

3 the most distant galaxies show a blue-shift.

4 the red-shift does not change with distance.

9D Scientists are interested in how the universe began.

Which one of the following statements is correct?

1 We now definitely know that the universe began with a 'big bang'.

2 There is no evidence about how the universe began.

3 The current evidence suggests that the universe began at a small point.

4 We now know that the galaxies will continue to get further apart.

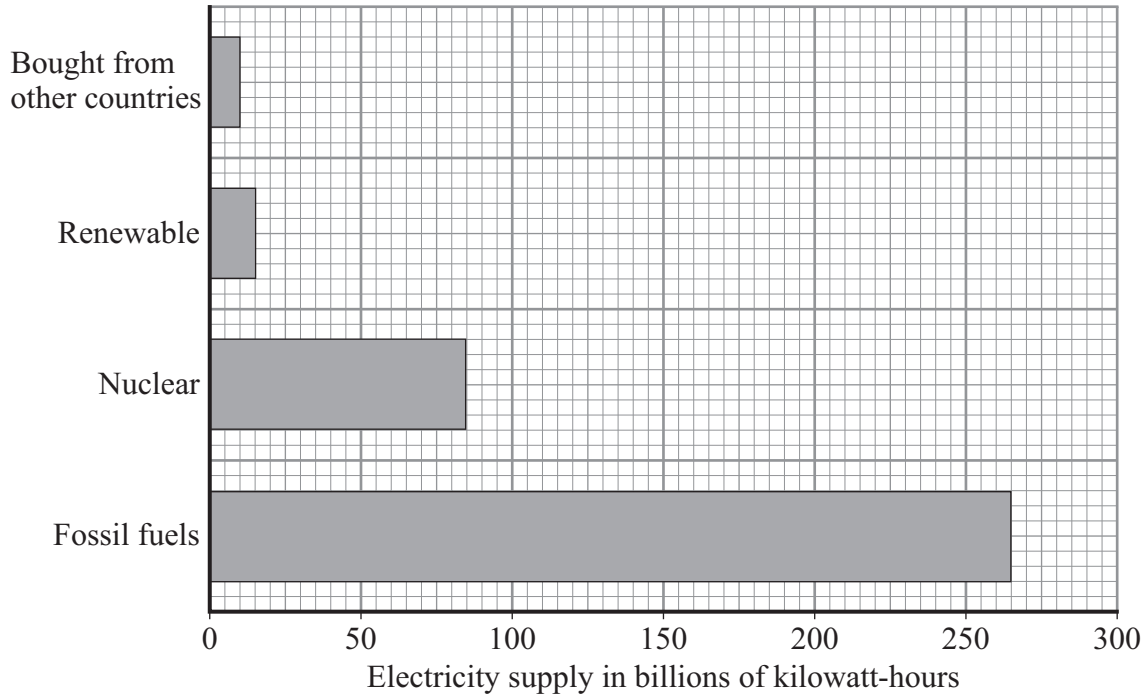
END OF TEST

4.5.6.1.2 Speed

Question 48

January 2009 | PHY1H | Original Q3 | Legacy

3 The bar chart shows how the UK's electricity demands in 2007 were met.



3 (a) What proportion of electricity was generated using renewable energy sources?

Show clearly how you work out your answer.

.....

.....

.....

.....

(2 marks)

4.5.6.1.2 Speed

Question 48 · continued

for mark

3 (b) By 2020, most of the UK's nuclear reactors and one-third of coal-fired power stations are due to close, yet the demand for electricity is expected to increase.

Four students, **A**, **B**, **C** and **D**, were asked how a demand of 380 billion kilowatt-hours could be met. They made the suggestions given in the table.

Student	Fossil fuels	Nuclear	Renewable	Bought from other countries
A	200	100	40	40
B	80	240	40	20
C	160	80	100	40
D	280	0	100	0

3 (b) (i) Which student has made the suggestion most likely to result in the lowest carbon dioxide emissions?

.....

Give a reason for your answer.

.....

.....

(2 marks)

3 (b) (ii) Suggest **one** realistic way in which a householder could help to reduce the annual electricity demand.

.....

.....

(1 mark)

Question 3 continues on the next page

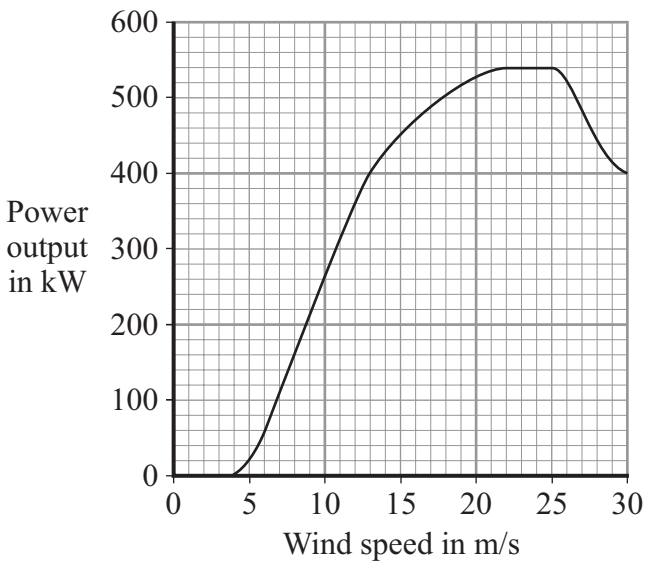
4.5.6.1.2 Speed

Question 48 · continued

for mark

3 (c) To increase the amount of electricity generated using renewable energy resources would probably involve erecting many new wind turbines.

The graph shows the power curve of a wind turbine.



3 (c) (i) Describe, in detail, how the power output of the turbine varies with the wind speed.

.....

.....

.....

.....

.....

.....

(3 marks)

3 (c) (ii) Give **one** disadvantage of using wind turbines to generate a high proportion of the electricity required in the UK.

.....

.....

(1 mark)

9

4.5.6.1.2 Speed

Question 49

January 2009 | PHY1H | Original Q5 | Legacy

5 (a) Microwaves are one type of electromagnetic wave.

5 (a) (i) Which type of electromagnetic wave has a lower frequency than microwaves?

.....

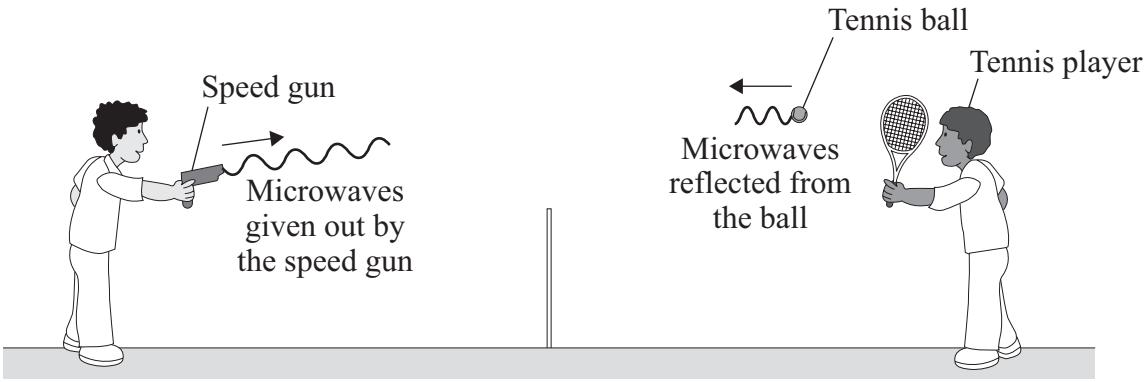
(1 mark)

5 (a) (ii) What do all types of electromagnetic wave transfer from one place to another?

.....

(1 mark)

5 (b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



5 (b) (i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the microwaves emitted from the speed gun.

wave speed = frequency × wavelength

Show clearly how you work out your answer.

.....

.....

Wavelength = ... m

(2 marks)

4.5.6.1.2 Speed

Question 49 · continued

for mark

5 (b) (ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

.....

.....

(1 mark)

5 (b) (iii) Some of the microwaves transmitted by the speed gun are reflected from the moving ball back towards the speed gun.

Describe how the wavelength and frequency of the microwaves change as they are reflected from the moving ball.

.....

.....

.....

.....

(2 marks)

Question 5 continues on the next page

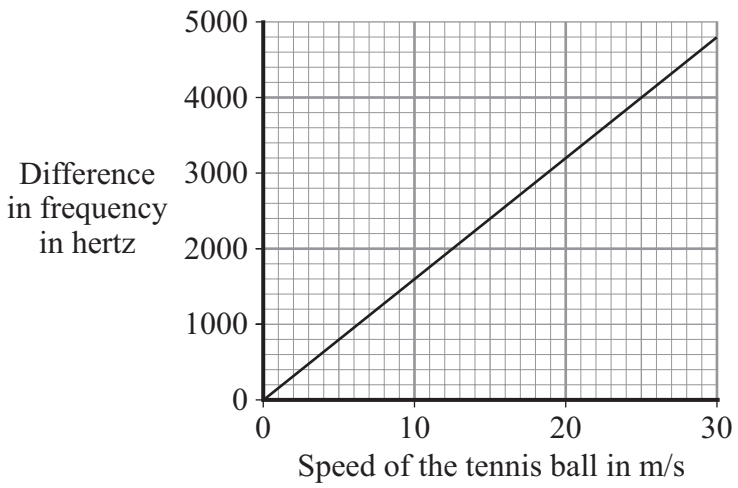
4.5.6.1.2 Speed

Question 49 · continued

for mark

5 (c) The difference in frequency between the transmitted and reflected waves is detected by the speed gun. This data is processed by a computer chip inside the speed gun, and then displayed as a speed.

5 (c) (i) The graph shows that the difference in frequency between the transmitted and reflected waves is directly proportional to the speed of the moving ball.



Why has a line graph been used to display the data?

.....

.....

(1 mark)

5 (c) (ii) Is it better to transfer the data to the computer as an analogue signal or as a digital signal?

.....

Give a reason for your answer.

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 49 · continued

for mark

5 (c) (iii) What is the difference between an analogue signal and a digital signal?

You may draw a labelled diagram to help you with your answer.

.....

.....

.....

.....

(2 marks)

11

4.5.6.1.2 Speed

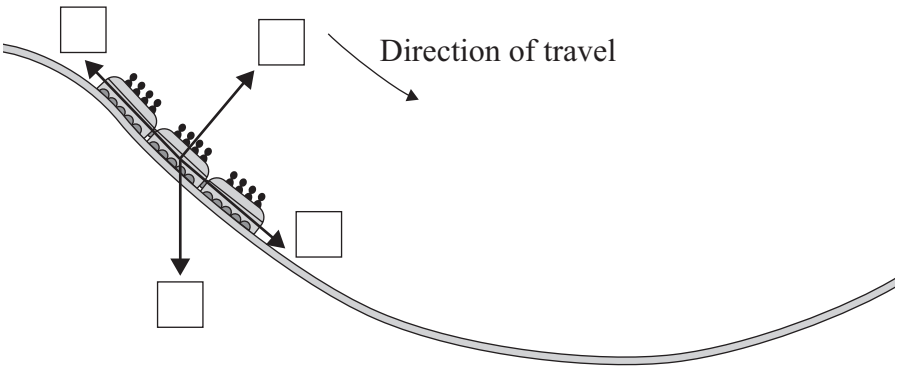
Question 50

January 2009 | PHY2H | Original Q1 | Legacy

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

1 (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 mark)

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?

.....

.....

(1 mark)

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 = 10 N/kg

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

.....

.....

Maximum gravitational field strength = ... N/kg

(1 mark)

4.5.6.1.2 Speed

Question 50 · continued

for mark

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

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

weight = mass × gravitational field strength

Show clearly how you work out your answer.

.....

.....

Maximum weight = ... N
(2 marks)

5

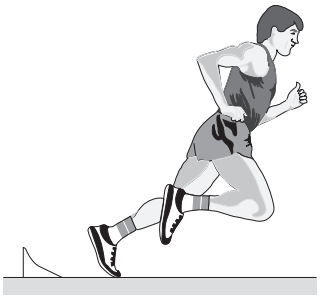
Turn over for the next question

4.5.6.1.2 Speed

Question 51

January 2009 | PHY2H | Original Q2 | Legacy

2 (a) The diagram shows an athlete at the start of a race. The race is along a straight track.



In the first 2 seconds, the athlete accelerates constantly and reaches a speed of 9 m/s.

2 (a) (i) Use the equation in the box to calculate the acceleration of the athlete.

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

Show clearly how you work out your answer.

.....

.....

.....

Acceleration = ...

(2 marks)

2 (a) (ii) Which **one** of the following is the unit for acceleration?

Draw a ring around your answer.

J/s **m/s** **m/s^2** **Nm**

(1 mark)

4.5.6.1.2 Speed

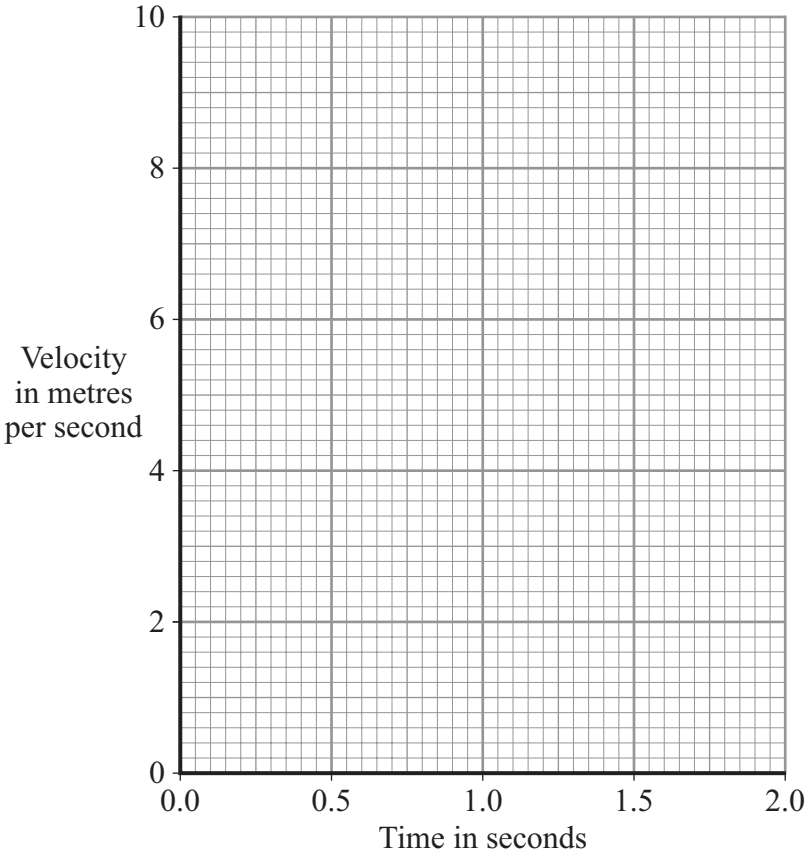
Question 51 · continued

for mark

2 (a) (iii) Complete the following sentence.

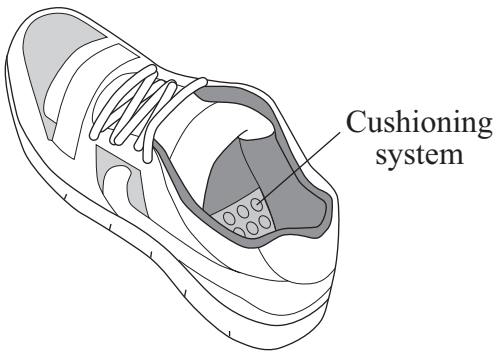
The velocity of the athlete is the ..... of the athlete in a given direction. *(1 mark)*

2 (a) (iv) Complete the graph to show how the velocity of the athlete changes during the first 2 seconds of the race.



(2 marks)

2 (b) Many running shoes have a cushioning system. This reduces the impact force on the athlete as the heel of the running shoe hits the ground.

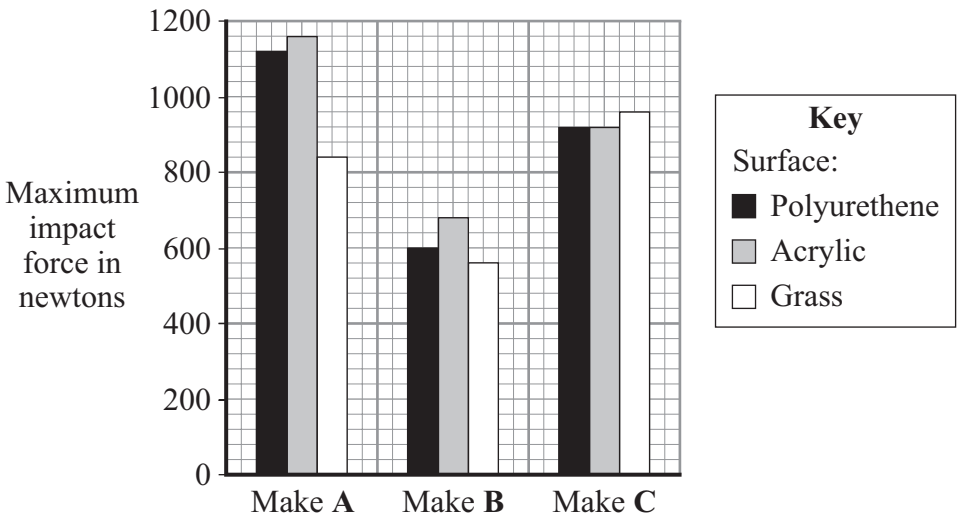


Question 2 continues on the next page

Question 51 · continued

for mark

The bar chart shows the maximum impact force for three different makes of running shoe used on three different types of surface.



2 (b) (i) Which **one** of the three makes of running shoe, **A**, **B** or **C**, has the best cushioning system?

.....

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

2 (b) (ii) The data needed to draw the bar chart was obtained using a robotic athlete fitted with electronic sensors.

Why is this data likely to be more reliable than data obtained using human athletes?

.....

.....

(1 mark)

10

4.5.6.1.2 Speed

Question 52

5 The table gives data on the Solar System.

Name of planet	Average distance from the Sun in millions of kilometres	Average orbital speed in kilometres per second
Mercury	60	48
Venus	108	35
Earth	150	30
Mars	228	24
Jupiter	778	13
Saturn	1430	9.6
Uranus	2860	6.8

5 (a) A student studies this data and comes to the following conclusion.

> For the planets in the table, the average orbital speed is very nearly inversely proportional to the planet's average distance from the Sun.

5 (a) (i) This conclusion is **not** correct.

Use the data for Saturn and Uranus to explain how the student's conclusion is not correct.

.....

.....

.....

.....

(2 marks)

4.5.6.1.2 Speed

Question 52 · continued

for mark

5 (a) (ii) For all the listed planets, write a correct conclusion for the connection between the average distance from the Sun and the orbital speed.

.....

.....

.....

.....

(2 marks)

5 (b) The student knows the following:

> The planets all move in ellipses (slightly squashed circles).

What is the connection between this statement and the headings in the table?

.....

.....

.....

.....

(2 marks)

6

4.5.6.1.2 Speed

Question 53

March 2009 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

This question is about the behaviour of waves as the source of the wave moves, and what this can tell us about the universe.

7A At an air show, an aircraft flies at a steady speed in a straight line over the crowd of spectators.

As the aircraft approaches, how do the wavelength and frequency of the sound wave heard by the spectators differ from the sound emitted by the aircraft?

	Wavelength	Frequency
1	shorter	higher
2	longer	lower
3	longer	the same
4	the same	lower

7B Scientists observing the Andromeda galaxy see that its light is undergoing a blue-shift.

What does this tell them about the wavelength of light arriving on Earth from this galaxy and the movement of Andromeda relative to Earth?

	Wavelength	Movement relative to Earth
1	decreasing	moving away
2	decreasing	moving towards
3	increasing	moving away
4	increasing	moving towards

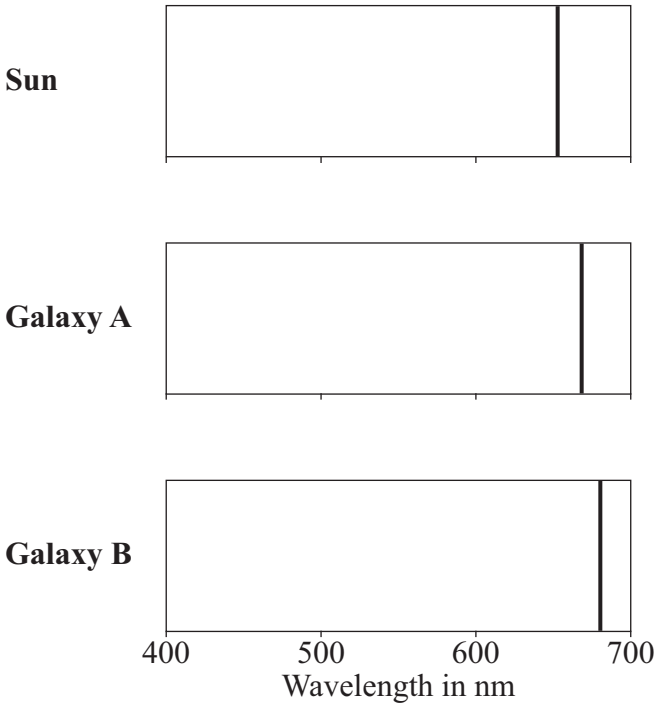
4.5.6.1.2 Speed

Question 53 · continued March 2009 | PHY1BP | Original Q7 | Legacy

The visible part of the electromagnetic spectrum from stars includes dark lines. They correspond to chemical elements in the stars and occur at specific wavelengths.

The line in the spectra shown below, from three different sources, represents hydrogen which is found in the Sun's spectrum at a wavelength of 656.3 nm.

1 nanometre, 1 nm = 0.000 000 001 metre



7C What does this indicate about galaxies **A** and **B**?

1 Galaxy **A** is colder than galaxy **B**.

2 Galaxy **A** is further away from Earth than galaxy **B**.

3 Galaxy **B** is colder than galaxy **A**.

4 Galaxy **B** is further away from Earth than galaxy **A**.

7D Which of the following theories about the universe does red-shift information support?

1 The universe began from a small initial point and has been expanding ever since.

2 The universe expanded initially, but is now contracting.

3 The universe has always been the size it is now.

4 The universe will eventually run out of energy and collapse.

4.5.6.1.2 Speed

Question 54

June 2009 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Mobile phones make use of microwaves.

Microwave ovens use microwaves of a similar wavelength. These microwaves are absorbed by the water molecules in food.

Human and animal body tissues contain a lot of water molecules. Some people are worried that using mobile phones for long periods of time could lead to some form of brain damage.

Scientists have investigated this worry by exposing laboratory mice to mobile phone radiation and monitoring the mice for signs of brain abnormality.

6A Electromagnetic waves travel at a speed of 300 000 km/s. Some microwaves have a wavelength of 10 cm.

What is the frequency of these microwaves?

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

1 30 000 000 Hz

2 300 000 000 Hz

3 3 000 000 000 Hz

4 30 000 000 000 Hz

6B Electromagnetic waves that ionise may cause cancer. The higher the frequency of a wave, the more ionising the radiation.

Which type of radiation is most likely to cause cancer?

1 microwaves

2 infra red

3 ultraviolet

4 X-rays

4.5.6.1.2 Speed

Question 54 · continued

6C The power output of a microwave oven is at least 500 W.

The power output of mobile phones is limited to 2 W.

What is the most likely reason why this power limit was introduced?

1 to reduce interference between phones

2 to reduce heating effects on the brain

3 to allow phones to use the GPS (Global Positioning System)

4 to allow phones to use a digital signal

6D The tests on mice showed no evidence of brain abnormalities in the mice.

From this, the public can conclude that . . .

1 the results are not accurate because the tests were not carried out on humans.

2 as there is no evidence of danger to mice, there is probably no danger to humans.

3 as there is no evidence of danger to mice, there is no danger to humans.

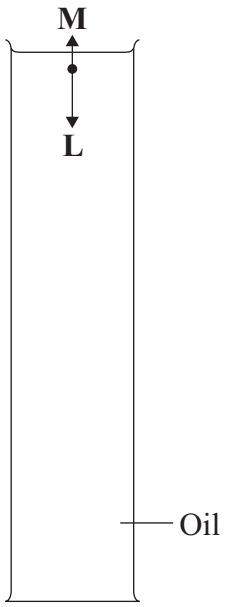
4 the tests were not sensitive enough to record any evidence.

4.5.6.1.2 Speed

Question 55

June 2009 | PHY2H | Original Q3 | Legacy

3 (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**?

.....

(1 mark)

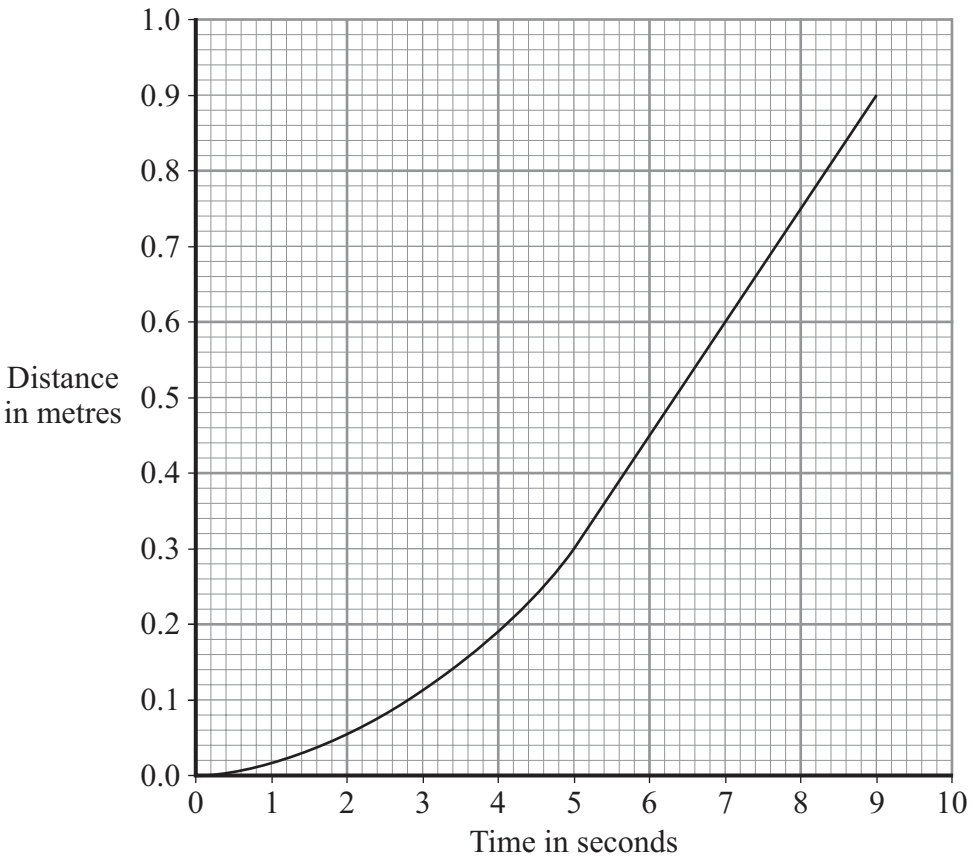
Question 3 continues on the next page

4.5.6.1.2 Speed

Question 55 · continued

for mark

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



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

.....

.....

.....

.....

.....

.....

(3 marks)

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

.....

(1 mark)

4.5.6.1.2 Speed

Question 55 · continued

for mark

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

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

.....

.....

.....

Speed = ... m/s

(2 marks)

7

Turn over for the next question

4.5.6.1.2 Speed

Question 56

June 2009 | PHY2H | Original Q4 | Legacy

4 The diagram shows a child on a playground swing.
The playground has a rubber safety surface.



4 (a) The child, with a mass of 35 kg, falls off the swing and hits the ground at a speed of 6 m/s.

4 (a) (i) Use the equation in the box to calculate the momentum of the child as it hits the ground.

momentum = mass × velocity

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

.....

.....

.....

Momentum = ...

(3 marks)

Question 56 · continued

for mark

4 (a) (ii) After hitting the ground, the child slows down and stops in 0.25 s.
Use the equation in the box to calculate the force exerted by the ground on the child.

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

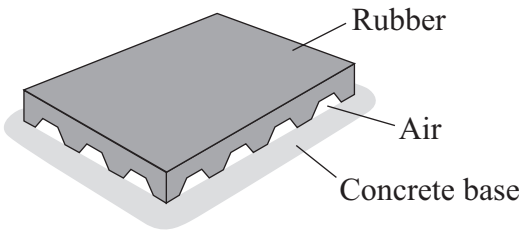
.....

.....

Force = ... N

(2 marks)

4 (b) The diagram shows the type of rubber tile used to cover the playground surface.



Explain how the rubber tiles reduce the risk of children being seriously injured when they fall off the playground equipment.

.....

.....

.....

.....

.....

.....

(3 marks)

Question 4 continues on the next page

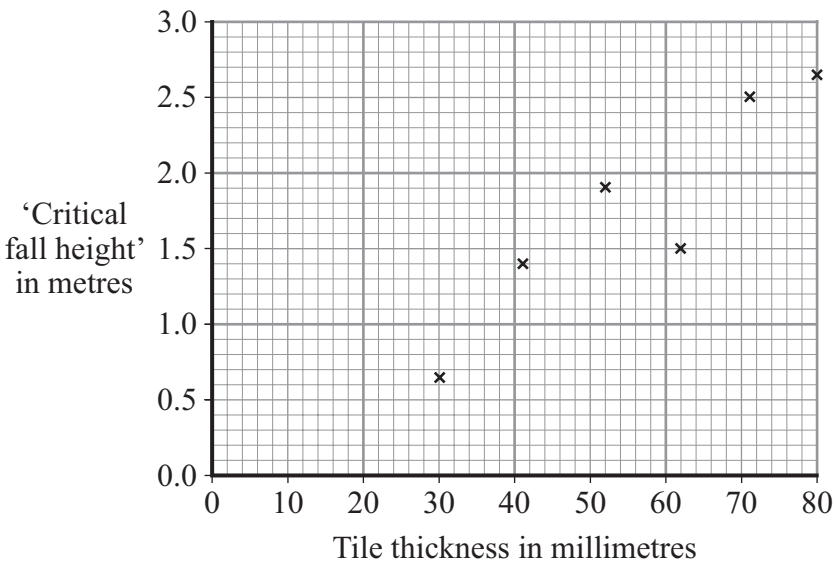
4.5.6.1.2 Speed

Question 56 · continued

for mark

4 (c) The 'critical fall height' is the height that a child can fall and **not** be expected to sustain a life-threatening head injury.
A new type of tile, made in a range of different thicknesses, was tested in a laboratory using test dummies and the 'critical fall height' measured. Only one test was completed on each tile.

The results are shown in the graph.



The 'critical fall height' for playground equipment varies from 0.5 m to 3.0 m.

Suggest **two** reasons why more tests are needed before this new type of tile can be used in a playground.

1.....

.....

2.....

.....

(2 marks)

4 (d) Developments in technology allow manufacturers to make rubber tiles from scrap car tyres.

Suggest why this process may benefit the environment.

.....

.....

(1 mark)

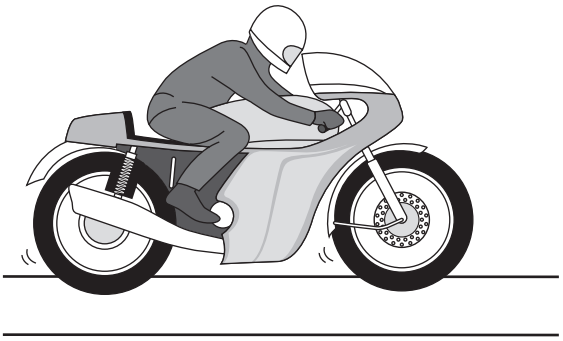
11

4.5.6.1.2 Speed

Question 57

June 2009 | PHY2H | Original Q5 | Legacy

5 The diagram shows a motorbike of mass 300 kg being ridden along a straight road.



The rider sees a traffic queue ahead. He applies the brakes and reduces the speed of the motorbike from 18 m/s to 3 m/s.

5 (a) Use the equation in the box to calculate the kinetic energy lost by the motorbike.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

.....

.....

Kinetic energy lost = ... J

(2 marks)

5 (b) (i) How much work is done on the motorbike by the braking force?

.....

(1 mark)

5 (b) (ii) What happens to the kinetic energy lost by the motorbike?

.....

(1 mark)

4

4.5.6.1.2 Speed

Question 58

November 2009 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

There are two types of radio wave that carry television signals, VHF and UHF.

7A Some UHF waves have a frequency that is ten times bigger than some VHF waves.

The wavelength of these UHF waves, in comparison to the VHF ones, is . . .

1 ten times as big because they travel faster.

2 one tenth as big because they travel faster.

3 ten times as big because they travel at the same speed.

4 one tenth as big because they travel at the same speed.

7B One television channel transmits using waves of frequency 1000 MHz.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

Speed of electromagnetic waves in a vacuum = 300 000 km/s

1 MHz = 1 million hertz

What is the wavelength of these waves?

1 0.3 m

2 3.0 m

3 0.3 km

4 3.0 km

4.5.6.1.2 Speed

Question 58 · continued

7C All television transmitters in the UK are going to be switched from analogue to digital signals.

Which row in the table is correct?

	Analogue signals	Digital signals
1	continuously varying	more prone to interference and cannot be processed by a computer
2	less prone to interference and can be easily processed by a computer	discrete values only, generally on and off
3	continuously varying	less prone to interference and can be easily processed by a computer
4	discrete values only, generally on and off	continuously varying

7D An aerial receives television signals.

The energy transferred by an electromagnetic wave carrying the television signal . . .

1 makes the aerial hotter so that it can detect the signal.

2 makes the aerial colder so that it can detect the signal.

3 creates an alternating current in the aerial with the same frequency as the wave.

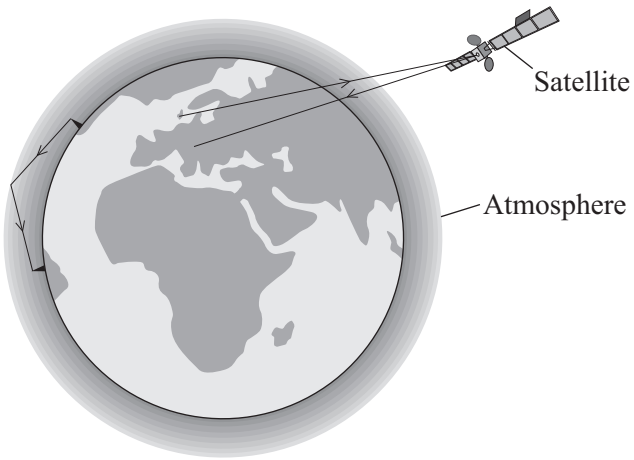
4 creates a direct current in the aerial with the same frequency as the wave.

4.5.6.1.2 Speed

Question 59

January 2010 | PHY1H | Original Q3 | Legacy

3 (a) Electromagnetic waves have many uses. The diagram shows two ways of sending information using electromagnetic waves.



3 (a) (i) What type of wave is used to send information to and from satellites?

.....

(1 mark)

3 (a) (ii) What property of this type of wave makes it suitable for satellite communications?

.....

(1 mark)

3 (b) The diagram shows two types of signal that can be used to send information. One of the signals is an analogue signal. The other is a digital signal.



Describe the differences between an analogue signal and a digital signal.

.....

.....

.....

.....

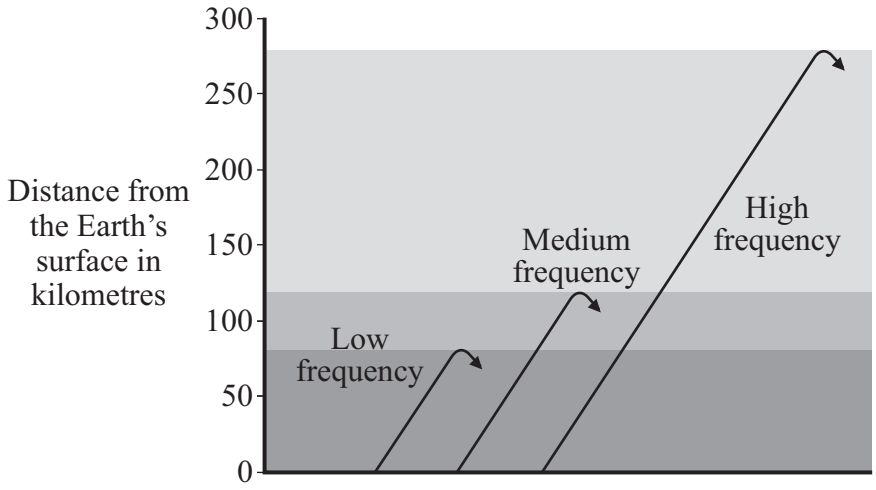
(2 marks)

4.5.6.1.2 Speed

Question 59 · continued

for mark

3 (c) Different frequency radio waves travel different distances through the atmosphere before being reflected.



Use the information in the diagram to describe the connection between the frequency of a radio wave and the distance the radio wave travels through the atmosphere before it is reflected.

.....

.....

(1 mark)

3 (d) Electromagnetic waves travel at a speed of 300 000 000 m/s.

A radio station transmits waves with a wavelength of 20 metres.

Use the equation in the box to calculate the frequency, in kilohertz (kHz), of these waves.

wave speed = frequency × wavelength

Show clearly how you work out your answer.

.....

.....

.....

Frequency = ... kHz

(2 marks)

7

4.5.6.1.2 Speed

Question 60

1 A cyclist travelling along a straight level road accelerates at 1.2 m/s^2 for 5 seconds. The mass of the cyclist and the bicycle is 80 kg.

1 (a) Use the equation in the box to calculate the resultant force needed to produce this acceleration.

resultant force = mass × acceleration

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

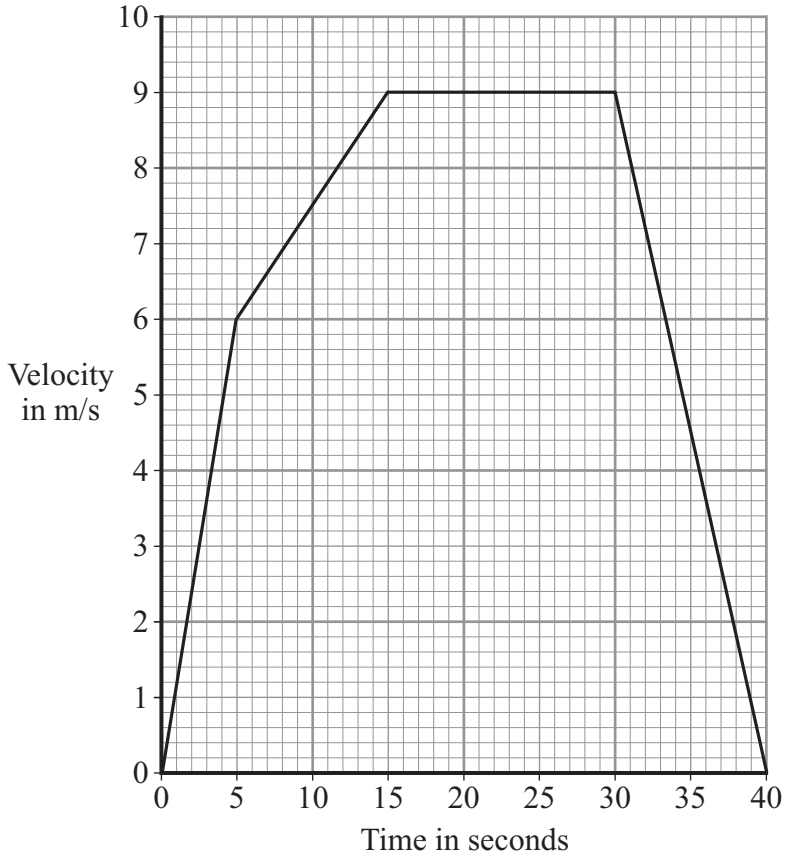
.....

.....

Resultant force = ...

(3 marks)

1 (b) The graph shows how the velocity of the cyclist changes with time.



4.5.6.1.2 Speed

Question 60 · continued

for mark

1 (b) (i) Complete the following sentence.

The velocity includes both the speed and the ..... of the cyclist.

(1 mark)

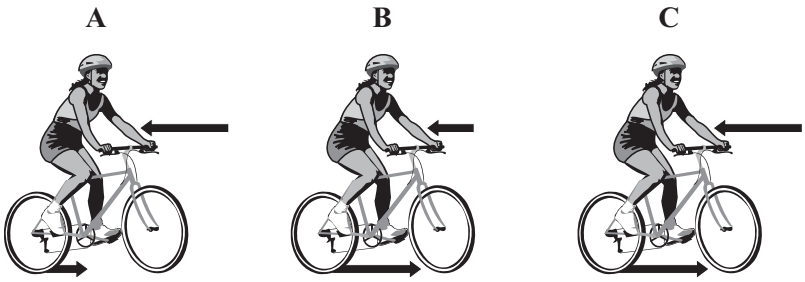
1 (b) (ii) Why has the data for the cyclist been shown as a line graph instead of a bar chart?

.....

.....

(1 mark)

1 (b) (iii) The diagrams show the horizontal forces acting on the cyclist at three different speeds. The length of an arrow represents the size of the force.



Which **one** of the diagrams, **A**, **B** or **C**, represents the forces acting when the cyclist is travelling at a constant 9 m/s?

.....

Explain the reason for your choice.

.....

.....

.....

.....

.....

.....

(3 marks)

8

4.5.6.1.2 Speed

Question 61

January 2010 | PHY3H | Original Q1 | Legacy

1 A student collects data from the Internet about planets in the solar system.
She arranges the data into a table.

Name of the planet	Distance from the Sun in millions of kilometres	Time taken for one orbit of the Sun in years	Time taken to spin on its axis in hours	Average temperature on the side facing the Sun in °C
Mercury	60	0.24	1400	+430
Venus	110	0.60	5800	+470
Earth	150	1	24	+20
Mars	230	2	25	–20
Jupiter	780	12	10	–150
Saturn	1400	30	10	–180
Uranus	2900	84	17	–220
Neptune	4500	160	16	–230

1 (a) Name the **two** variables in the student's table which **always** have the relationship:

As one increases, so does the other.

..... and .....

(1 mark)

1 (b) (i) Give an example of **two** variables in the student's table which **generally** have the relationship:

As one increases, the other decreases.

..... and .....

(1 mark)

4.5.6.1.2 Speed

Question 61 · continued

for mark

1 (b) (ii) Which piece of data does not seem to fit the relationship in (b)(i)?

.....

(1 mark)

1 (c) Scientists plan to launch a satellite which will orbit Mars above its equator.
It will be a geostationary satellite.

How many hours will it take to orbit Mars?

..... hours

(1 mark)

1 (d) Mars has two moons.

Neither of them is in a geostationary orbit and they both take different times to orbit the planet.

Which **one** of these statements is correct.
Put a tick (✓) in the box next to your answer.

The two moons will always be above the same point on the surface of Mars. ☐

The two moons will be in different positions at different times. ☐

You can never see both moons at the same time. ☐

(1 mark)

1 (e) Use words from the box to complete the **three** spaces in the passage.

circular	**direction**	**friction**	**gravitational**	**speed**	**universal**

The moons of the planet Neptune move in circular paths around the planet.

They continuously accelerate towards the centre of Neptune.

The acceleration changes the ..... of each moon but does not change its ..... . The force causing the acceleration is a ..... force.

(2 marks)

7

4.5.6.1.2 Speed

Question 62

March 2010 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

There are two types of communication signal: analogue and digital.

4A Which pair of diagrams correctly shows the patterns for digital and analogue signals?

	Digital signal pattern	Analogue signal pattern
1		
2		
3		
4		

4B One reason for using digital signals rather than analogue signals for communication is that . . .

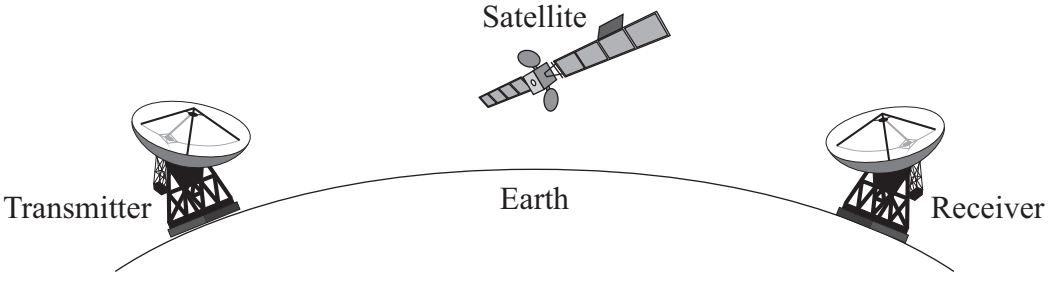
1 analogue signals are less prone to interference.

2 analogue signals can have only two values.

3 digital signals are continuously variable.

4 digital signals can be easily processed by computers.

4C Satellites in orbit around the Earth receive and transmit microwave signals for international telephone communication.



Microwaves are used because . . .

1 they are the only type of electromagnetic wave that can travel through a vacuum.

2 they are not absorbed by the Earth's atmosphere.

3 they follow the curvature of the Earth.

4 they travel faster than radio waves.

4.5.6.1.2 Speed

Question 62 · continued March 2010 | PHY1BP | Original Q4 | Legacy

4D Properties of waves are often demonstrated in schools using waves on water.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

A wave generator with a frequency of 50 Hz produces water waves with a wavelength of 2 cm.

At what speed do the waves travel?

1 1 m/s

2 25 m/s

3 100 m/s

4 2500 m/s

Turn over for the next question

4.5.6.1.2 Speed

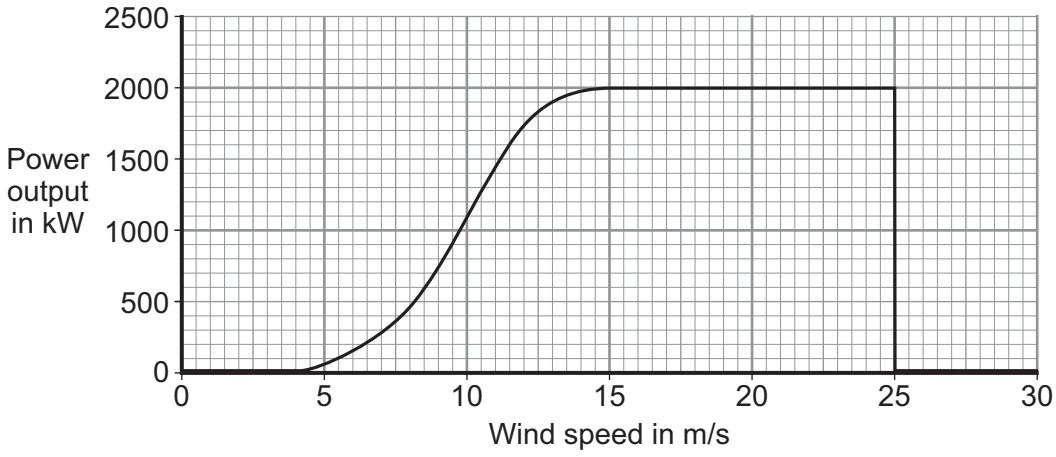
Question 63

June 2010 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

A wind turbine can be used to produce electricity.

The graph shows how the power output of a particular turbine varies with wind speed.



The turbine is designed to operate best at a minimum wind speed of 15 m/s. This is called the rated wind speed.

7A How much energy would be transferred if the turbine operated at its rated wind speed for 2 hours?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 2 kWh

2 4 kWh

3 2000 kWh

4 4000 kWh

7B The turbine will work only when the wind speed is above a value called the cut-in wind speed. The turbine shuts down when the wind speed reaches a certain value.

Which row in the table gives the correct wind speeds?

	Cut-in wind speed	Shut-down wind speed
1	4 m/s	15 m/s
2	9 m/s	20 m/s
3	4 m/s	25 m/s
4	13 m/s	25 m/s

4.5.6.1.2 Speed

Question 63 · continued

7C What happens to the energy of the wind at speeds lower than the cut-in speed and higher than the shut-down speed?

1 It will all be transformed into heat.

2 It will all be transformed into sound.

3 It will be stored in the turbine for future use.

4 It will stay as kinetic energy of moving air.

7D The efficiency of this turbine is 0.7

How many kilowatt-hours of wind energy would be needed to produce 10 kilowatt-hours of electrical energy?

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

1 7.0

2 9.3

3 10.7

4 14.3

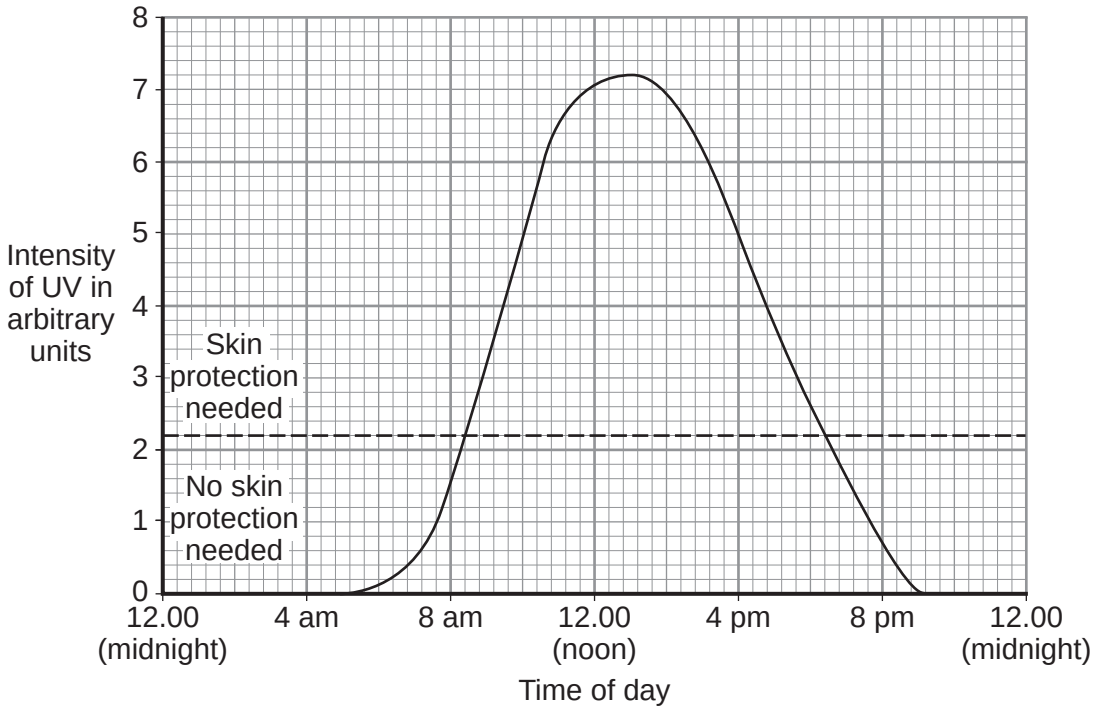
4.5.6.1.2 Speed

Question 64

June 2010 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

The graph shows how the intensity of ultraviolet (UV) radiation changes during a typical day in June in the UK.



3A The intensity of UV radiation reaches a maximum at . . .

1 9.30 am

2 12.00 noon

3 1.00 pm

4 5.00 pm

4.5.6.1.2 Speed

Question 64 · continued

3B The dashed line (– – – –) on the graph shows the intensity above which you should protect your skin from UV radiation by using sunscreen cream.

For approximately how long is the intensity of UV radiation high enough to suggest that protection is needed?

1 0 hours

2 7 hours

3 10 hours

4 16 hours

3C For a typical day in December in the UK, how would you expect the graph to be different?

	Peak	Area under the graph
1	higher	the same
2	lower	the same
3	higher	bigger
4	lower	smaller

3D UV radiation travels as an electromagnetic wave.

Which row in the table below correctly shows the speed and frequency of UV compared with the speed and frequency of visible light?

	Speed of UV compared with visible light	Frequency of UV compared with visible light
1	slower	lower
2	same	higher
3	faster	higher
4	same	lower

4.5.6.1.2 Speed

Question 65

June 2010 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Radio and television programmes are transmitted through the air over long distances.

The information is carried by electromagnetic waves.

6A Compared with light waves, radio waves . . .

1 have a shorter wavelength and a higher speed.

2 have a lower frequency and the same speed.

3 have a longer wavelength and a lower speed.

4 have a higher frequency and the same speed.

6B A radio programme is broadcast on a wavelength of 1500 metres. The speed of the wave is 300 000 000 m/s.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

The frequency of these waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

6C Over the next few years, all television signals will be changed from analogue to digital.

One advantage to television broadcasters of using digital signals instead of analogue signals is that . . .

1 they are easier to generate.

2 they are less prone to interference.

3 they can travel faster.

4 they can travel further.

4.5.6.1.2 Speed

Question 65 · continued

6D Some people are worried about the effects of living close to a powerful radio transmitter.

Close to one transmitter, it was found that the number of children with leukaemia was slightly higher than normal. Leukaemia is a type of cancer of the blood.

What conclusion could you make from this observation?

1 Radio waves cause leukaemia.

2 There may be a connection between radio waves and leukaemia.

3 Adults are less likely than children to develop leukaemia.

4 Children should not be allowed to live near a radio transmitter.

Turn over for the next question

4.5.6.1.2 Speed

Question 66

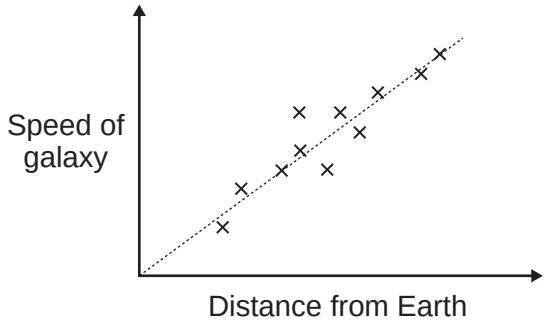
June 2010 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

Red-shift measurements can be used to calculate the speed at which a galaxy is moving relative to the Earth.

Astronomers have also measured the distance of some galaxies from the Earth.

They have drawn their results on a graph.



8A The graph shows that . . .

1 all galaxies have the same speed.

2 distant galaxies are moving faster than nearer galaxies.

3 nearer galaxies are moving faster than more distant galaxies.

4 there is no relationship between how far galaxies are from the Earth and how fast they move.

8B Which of the following is the best description of red-shift? . . .

1 The light from galaxies is coloured red.

2 The light from galaxies is mainly at the red end of the spectrum.

3 The wavelength of light from galaxies shows a movement away from the red end of the spectrum.

4 The wavelength of light from galaxies shows a movement towards the red end of the spectrum.

8C Red-shift is described as . . .

1 the increased speed of the electromagnetic radiation as it travels from the galaxy.

2 the observed increase in frequency of the electromagnetic radiation leaving the galaxy.

3 the observed increase in wavelength of the electromagnetic radiation leaving the galaxy.

4 the decreased speed of the electromagnetic radiation as it travels from the galaxy.

4.5.6.1.2 Speed

Question 66 · continued

8D The observation of red-shift gives evidence to support the ‘big bang’ theory.

This theory states that . . .

1 the stars in each galaxy are moving further apart.

2 galaxies started to rotate after the ‘big bang’.

3 new galaxies are created by an explosion in space.

4 the universe started from a single initial point.

Turn over for the next question

4.5.6.1.2 Speed

Question 67

June 2010 | PHY1H | Original Q4 | Legacy

4 (a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

4 (a) (i) Give **two** properties that are common to both visible light and microwaves.

1 .....

.....

2 .....

.....

(2 marks)

4 (a) (ii) Name **two** more types of electromagnetic wave that can be used for communications.

..... and .....

(1 mark)

4 (b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the frequency of the microwaves used to link the computer to the router.

wave speed = frequency × wavelength

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

.....

.....

.....

Frequency = ...

(3 marks)

4.5.6.1.2 Speed

Question 67 · continued

4 (c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.

A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

4 (c) (i) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

.....

.....

(1 mark)

4 (c) (ii) Why did the group of scientists suggest that there is a need for further research?

.....

.....

(1 mark)

8

4.5.6.1.2 Speed

Question 68

June 2010 | PHY1H | Original Q6 | Legacy

6 (a) In 1929, the astronomer Edwin Hubble observed that the light from galaxies that are moving away from the Earth showed a *red-shift*.

What is *red-shift*?

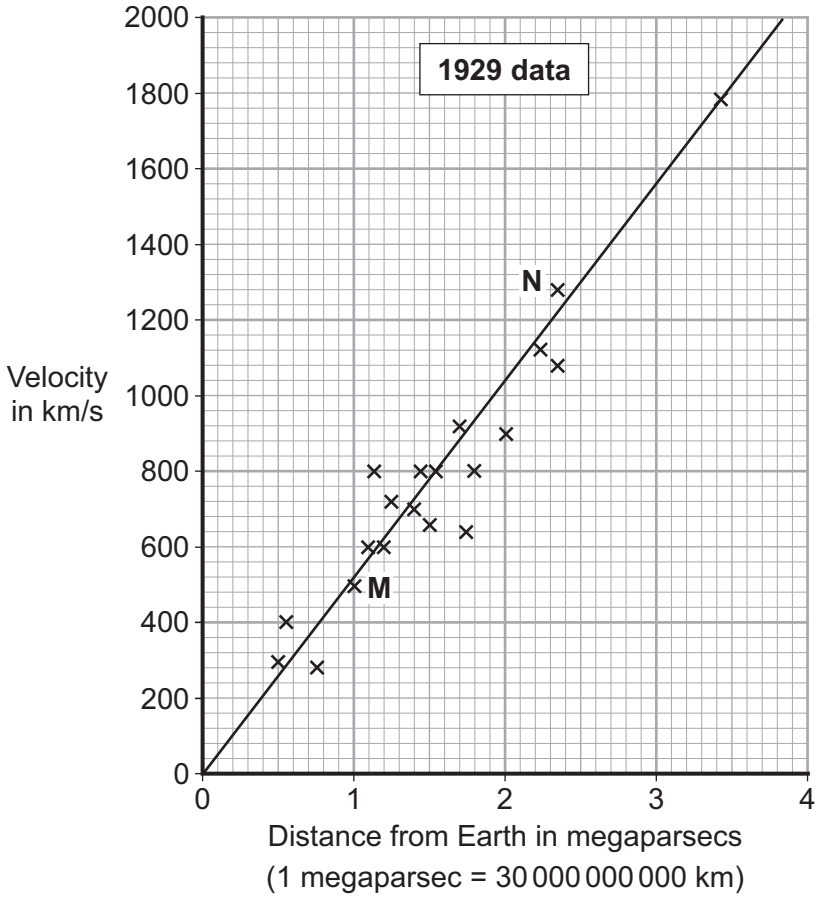
.....

.....

(1 mark)

6 (b) By measuring the red-shift, Hubble was able to calculate the speed at which the galaxies are moving away from the Earth. He was also able to calculate the distance of these galaxies from the Earth.

The graph shows some of the data calculated by Hubble.



4.5.6.1.2 Speed

Question 68 · continued

6 (b) (i) The data from two galaxies, **M** and **N**, has been included in the graph. The light from galaxy **M** has a smaller red-shift than the light from galaxy **N**.

What does the difference in red-shift tell scientists about the two galaxies, **M** and **N**?

.....

.....

.....

(2 marks)

6 (b) (ii) The gradient of the line drawn on the graph gives a number known as the Hubble constant. The Hubble constant can be used to estimate when the universe began.

Use the graph to calculate the value of the Hubble constant.

Show clearly how you obtained your answer.

.....

.....

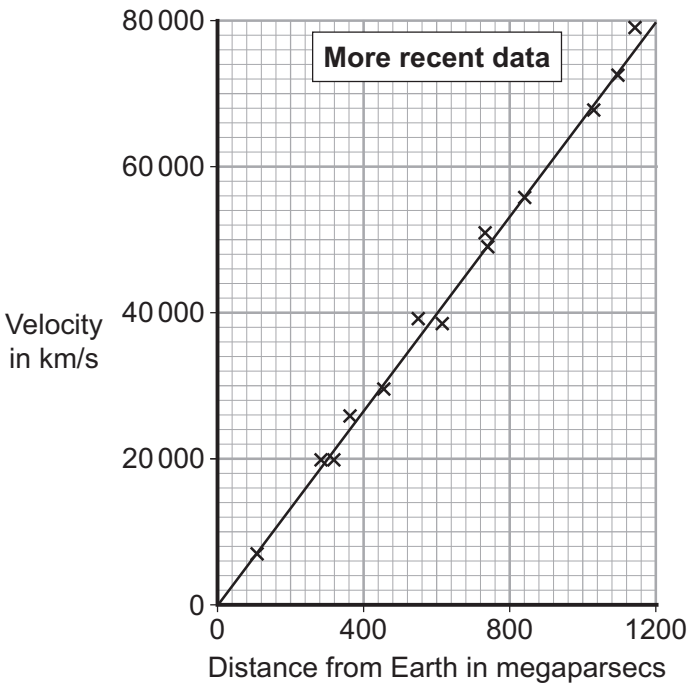
Hubble constant = ... km/s per megaparsec

(2 marks)

Question 6 continues on the next page

Question 68 · continued

6 (b) (iii) More recently, data has been obtained from more distant galaxies.



The results from the more recent data give a totally different value for the Hubble constant to the one calculated from the 1929 data.

Which set of data, the 1929 or the more recent, is most likely to give the value closest to the true value for the Hubble constant?

Draw a ring around your answer.

1929 **more recent**

Give a reason for your answer.

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 68 · continued

6 (c) The Andromeda galaxy is not moving away from the Earth. It is actually moving towards the Earth. This means that the light from Andromeda shows a blue-shift.

How do the wavelength and frequency of the light from Andromeda seem to have changed when viewed from the Earth?

.....

.....

.....

.....

(2 marks)

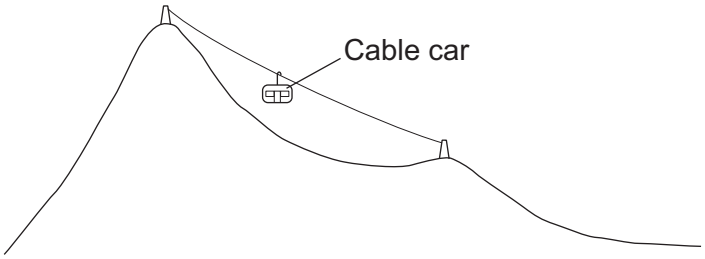
8

4.5.6.1.2 Speed

Question 69

June 2010 | PHY2H | Original Q1 | Legacy

1 (a) The diagram shows a cable car used to take skiers to the top of a mountain.



1 (a) (i) The total mass of the cable car and skiers is 7500 kg.

Use the equation in the box to calculate the weight of the cable car and skiers.

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

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

.....

.....

Weight = ...

(3 marks)

4.5.6.1.2 Speed

Question 69 · continued

1 (a) (ii) The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Use the following equation to calculate the work done to lift the cable car and skiers.

work done = force applied × distance moved in the direction of force

Show clearly how you work out your answer.

.....

.....

Work done = ... J

(2 marks)

1 (b) The diagram shows a skier who is accelerating down a steep ski slope.



1 (b) (i) Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

(1 mark)

1 (b) (ii) How and why does the kinetic energy of the skier change?

.....

.....

.....

.....

(2 marks)

Question 1 continues on the next page

4.5.6.1.2 Speed

Question 69 · continued

1 (c) Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet. However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

.....

.....

(1 mark)

9

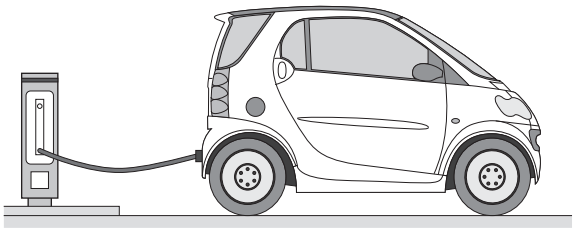
4.5.6.1.2 Speed

Question 70

November 2010 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

A manufacturer is producing a new electric car. Batteries in the car store the energy needed for driving. These batteries need to be charged for 6 hours every night.



The manufacturer carried out four tests to find out how far the car can be driven after the batteries had been charged for 6 hours. All the tests were carried out under the same conditions, with the car being driven at the same speed.

3A Four tests were carried out. The distances travelled were measured and a mean was calculated.

Why is this better than simply carrying out a single test?

1 It decreases the validity of the results.

2 It makes the results more precise.

3 It makes sure that the results will be true for all road conditions.

4 It minimises the effect of random errors.

3B The table shows the results of the four tests.

Test number	Distance travelled in km
1	31
2	57
3	61
4	62

Which one of the results, **1**, **2**, **3** or **4**, appears to be anomalous?

4.5.6.1.2 Speed

Question 70 · continued

3C How should the mean of the measurements be calculated?

1 Add all four results together and divide by four.

2 Add the highest and the lowest together and divide by two.

3 Ignore the anomalous result, add the other three results together and divide by three.

4 Ignore the anomalous result and take the middle value of the other three results.

3D A person who bought the car found that the distance the car could travel on a single charge was a lot less than that stated by the manufacturer.

What could be the reason for this?

1 The batteries had been left on charge for more than 6 hours.

2 The distance recorder on the car lacked precision.

3 The meter that records the total distance travelled had not been set to zero.

4 The owner did not control the same variables as the manufacturer.

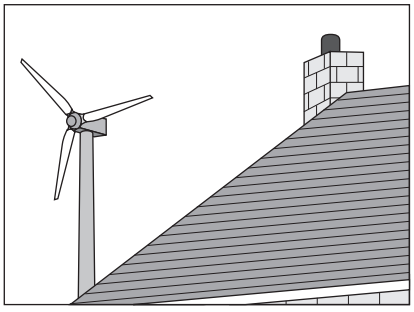
4.5.6.1.2 Speed

Question 71

November 2010 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

A householder is thinking about buying and installing a wind turbine on his roof.
The turbine costs £3000 to buy and install.



4A The householder estimates that the wind turbine would generate electricity worth an average of £1.50 each day.

What would be the pay-back time?

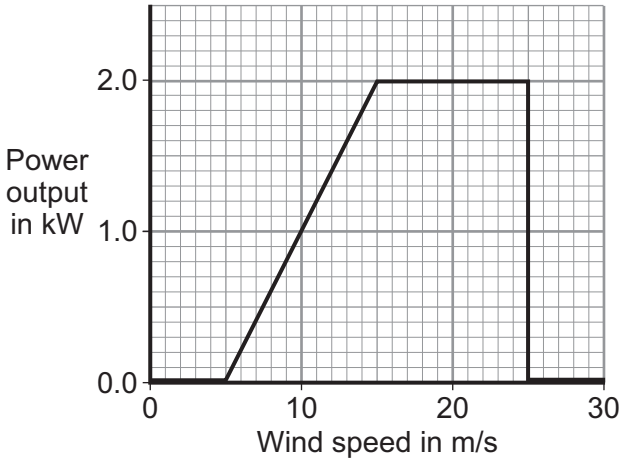
1 1000 days

2 2000 days

3 3000 days

4 4000 days

The graph shows how the power produced by the wind turbine changes with the wind speed.
The wind turbine shuts down at high wind speeds.



4B The maximum power output occurs when the wind speed reaches . . .

1 5 m/s

2 10 m/s

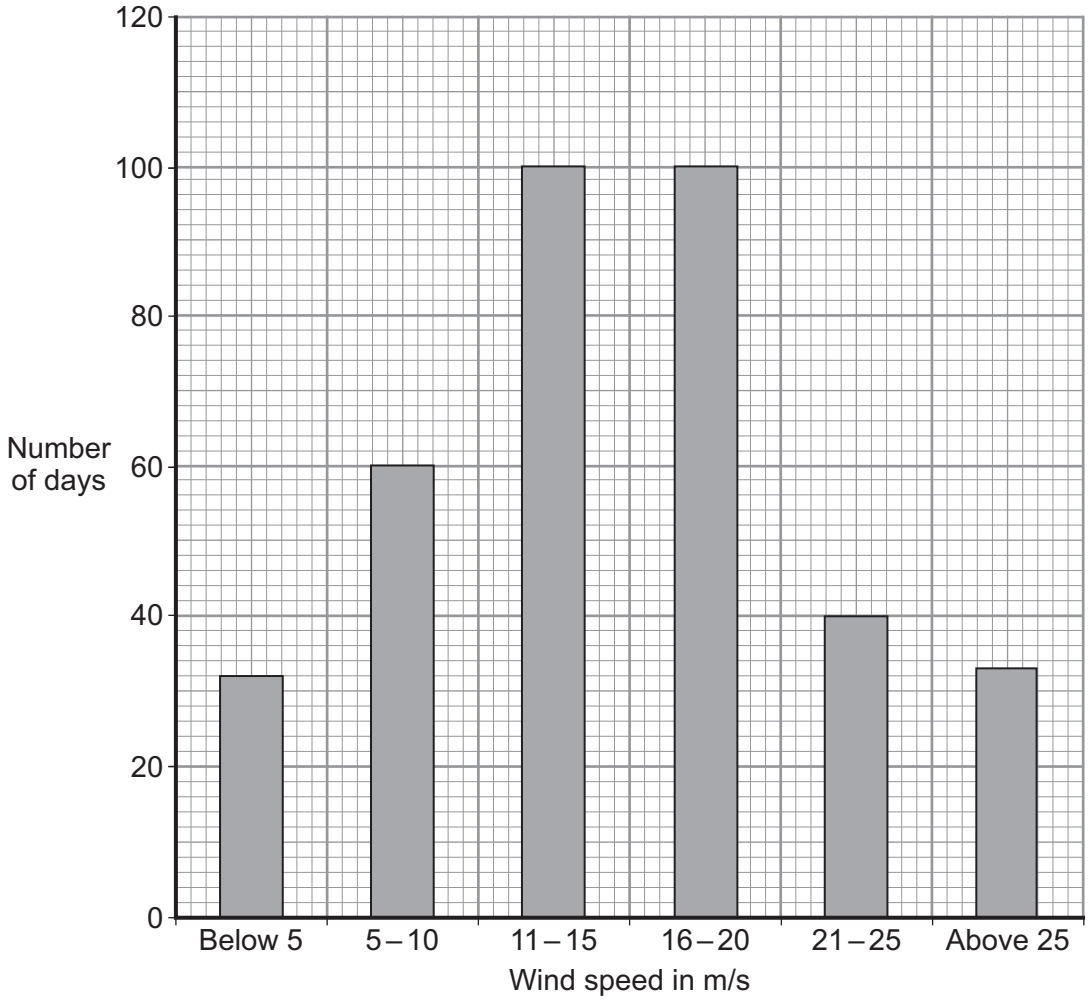
3 15 m/s

4 20 m/s

4.5.6.1.2 Speed

Question 71 · continued

4C The bar chart shows the wind speed at the house and the number of days in the year on which the wind has that speed.



For how many days in the year could the householder get some energy from the wind turbine?

1 160

2 260

3 300

4 330

4D The householder decides not to buy the wind turbine.

The most likely reason for his decision is that the wind turbine . . .

1 has fuel costs that are too high.

2 produces no greenhouse gases.

3 uses a non-renewable energy source.

4 uses an unreliable energy source.

4.5.6.1.2 Speed

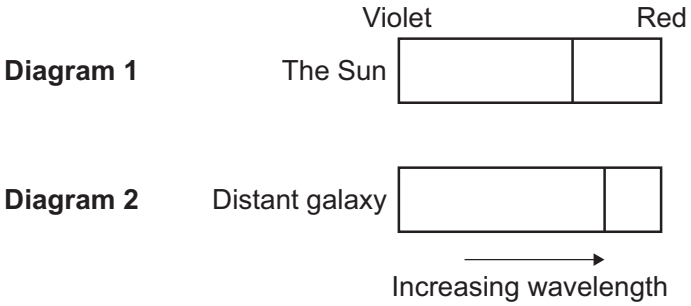
Question 72

November 2010 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

Diagram 1 shows the spectrum of light from the Sun. There is a black line in the spectrum.

Diagram 2 shows the spectrum of light from a distant galaxy. This spectrum has the same black line.



Match words, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A decreased

B increased

C shifted

D not changed

Edwin Hubble compared the spectrum of light from this distant galaxy to the spectrum of light from the Sun.

Hubble found that the position of the black line had . . . **1** . . . .

This was because the wavelength of the observed light had . . . **2** . . . .

The frequency of the observed light had . . . **3** . . . .

The speed of the light had . . . **4** . . . .

4.5.6.1.2 Speed

Question 73

November 2010 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

Fluorescers are substances that are used to make objects look brighter. Fluorescers absorb ultraviolet radiation and re-emit it as visible light. This makes the object glow when exposed to ultraviolet radiation.

- Laundry detergents contain fluorescers to make 'white look even whiter'.
- Dental compounds contain fluorescers to make teeth look brighter.
- Since 1950, fluorescers have been added to white paper to brighten it.

5A A white shirt has been washed in detergent containing a fluorescer.

The white shirt will . . .

1 be much cleaner.

2 glow in the dark.

3 look cleaner.

4 stay cleaner for longer.

5B A dentist paints someone's teeth with enamel containing a fluorescer.

The enamel absorbs ultraviolet radiation from sunlight and then emits light with . . .

1 a higher frequency and a longer wavelength.

2 a higher frequency and a shorter wavelength.

3 a lower frequency and a longer wavelength.

4 a lower frequency and a shorter wavelength.

5C A document is dated 1805. The document glows when it is viewed in ultraviolet light.

The document is likely to . . .

1 be a forgery.

2 have been printed before 1805.

3 have a dull surface.

4 have a shiny surface.

4.5.6.1.2 Speed

Question 73 · continued

5D The ultraviolet radiation used to view the document has a wavelength of 0.000 000 1 metres.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

Speed of electromagnetic waves = 300 000 000 m/s

What is the frequency of ultraviolet radiation of wavelength 0.000 000 1 metres?

1 30 Hz

2 3 000 000 Hz

3 3 000 000 000 Hz

4 3 000 000 000 000 000 Hz

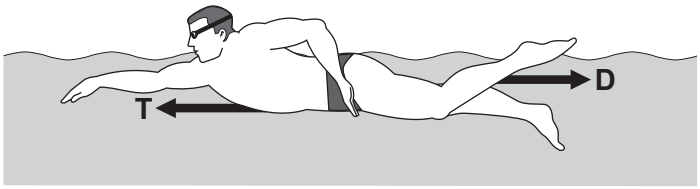
Turn over for the next question

4.5.6.1.2 Speed

Question 74

January 2011 | PHY2H | Original Q1 | Legacy

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



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

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

..... N
(1 mark)

1 (a) (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 mark)

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

Explain why.

.....

.....

.....

.....

.....

.....

(3 marks)

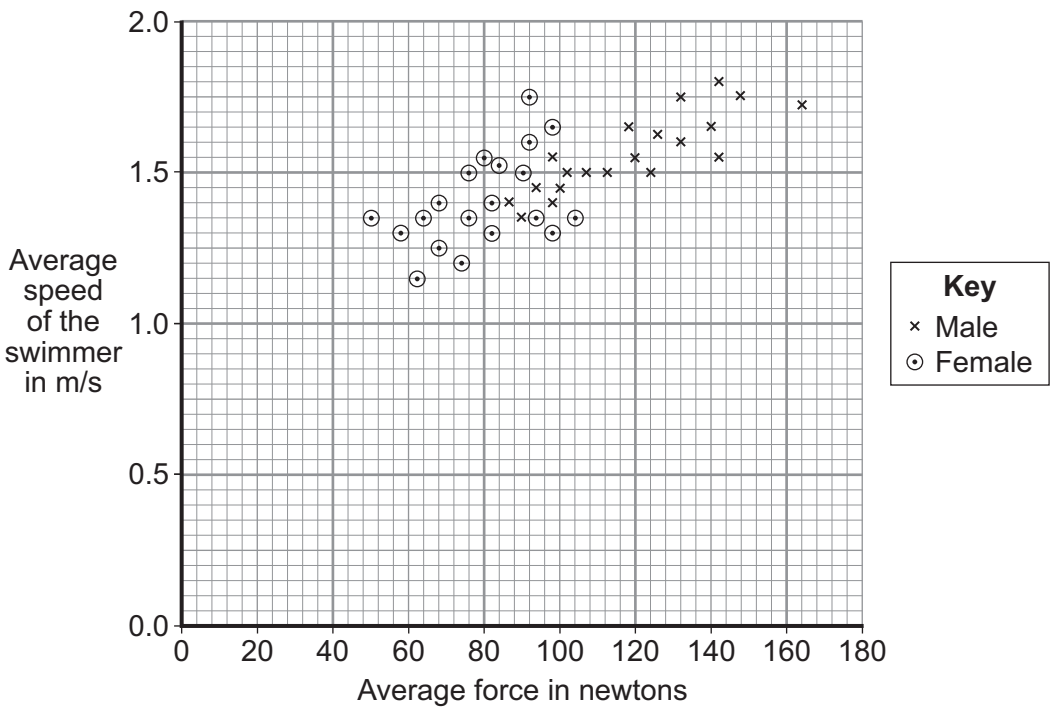
Question 1 continues on the next page

4.5.6.1.2 Speed

Question 74 · continued

1 (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.



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

.....

(1 mark)

1 (b) (ii) Explain **one** advantage of measuring the force 85 times every second rather than just once or twice every second.

.....

.....

.....

.....

(2 marks)

4.5.6.1.2 Speed

Question 74 · continued

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

10

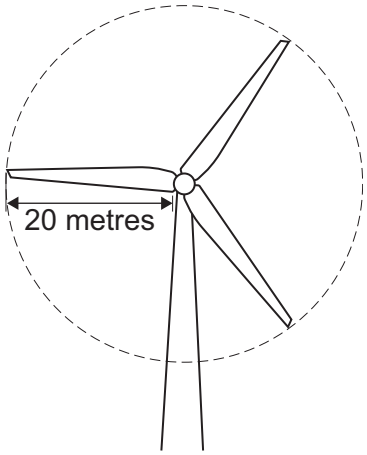
Turn over for the next question

4.5.6.1.2 Speed

Question 75

January 2011 | PHY2H | Original Q4 | Legacy

4 The diagram shows a wind turbine.



4 (a) The blades of the turbine are 20 metres long. On average, 15 000 kg of air, moving at a speed of 12 m/s, hit the blades every second.

Use the equation in the box to calculate the kinetic energy of the air hitting the blades every second.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

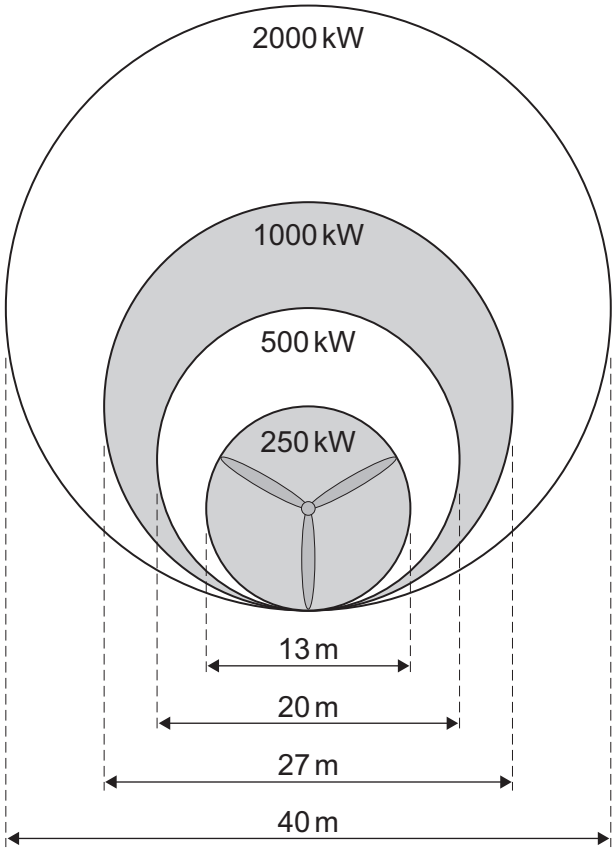
Kinetic energy = ... J

(2 marks)

4.5.6.1.2 Speed

Question 75 · continued

4 (b) Part of the kinetic energy of the wind is transformed into electrical energy.
The diagram shows that, for the same wind speed, the power output of a turbine, in kilowatts, depends on the length of the turbine blades.



Give a reason why doubling the diameter of the blades more than doubles the power output of a turbine.

.....

.....

(1 mark)

3

4.5.6.1.2 Speed

Question 76

March 2011 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

A 'hybrid' car can run on petrol stored in a tank or on electricity stored in a rechargeable battery.

5A When the battery is completely 'flat', it has no energy stored in it. The battery of car **X** is connected to the mains electrical supply and receives energy at a rate of 2000 W. It takes 6 hours to fully charge the battery.

How much electrical energy is needed to fully charge the battery of car **X**?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 3 kWh

2 12 kWh

3 333 kWh

4 12 000 kWh

5B A different hybrid car, **Y**, needs a different amount of electrical energy to charge its battery. The total cost of this electrical energy is £3.

Mains electricity costs 15 pence per kWh.

How much electrical energy is needed to fully charge the battery of car **Y**?

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

1 0.2 kWh

2 12 kWh

3 20 kWh

4 45 kWh

5C When the battery of car **Y** is fully charged, it can travel 100 km using the energy stored in its battery. Travelling the same distance using its petrol engine would require five times as much energy.

What does this tell you about the efficiency of the two methods of propelling car **Y**?

1 The electric motor is more efficient than the petrol engine.

2 The petrol engine is more efficient than the electric motor.

3 The petrol engine and the electric motor have the same efficiency.

4 It is impossible to compare the efficiency.

4.5.6.1.2 Speed

Question 76 · continued

5D Some cars are all electric and have no petrol engine fitted.

Which statement about these cars is true?

1 They are not responsible for producing any atmospheric pollution.

2 They produce more atmospheric pollution than petrol-engine cars.

3 They produce no atmospheric pollution while being driven.

4 They produce no atmospheric pollution but a lot of noise pollution.

Turn over for the next question

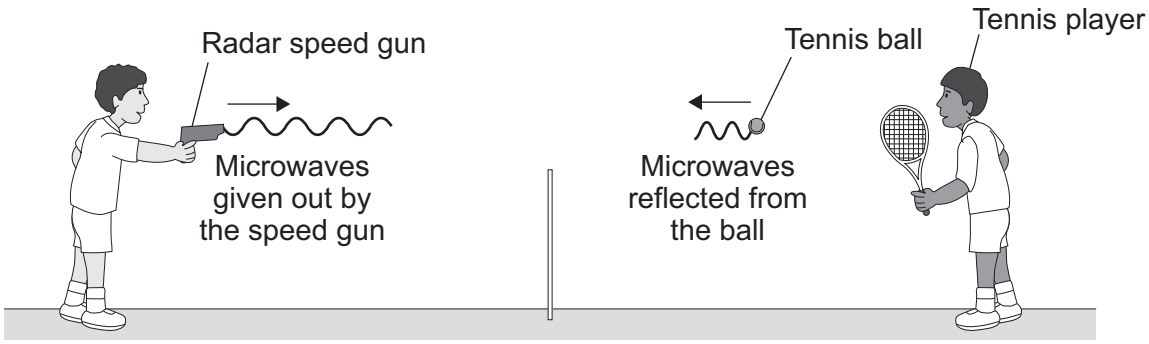
4.5.6.1.2 Speed

Question 77

March 2011 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

The picture shows a radar speed gun being used to measure how fast a tennis player hits the ball.



Some of the microwaves from the radar speed gun are absorbed by the ball and some are reflected by the ball.

3A What effect will the absorbed microwaves have on the ball?

1 The temperature of the ball will increase slightly.

2 The ball will go faster.

3 The temperature of the ball will decrease slightly.

4 The ball will go slower.

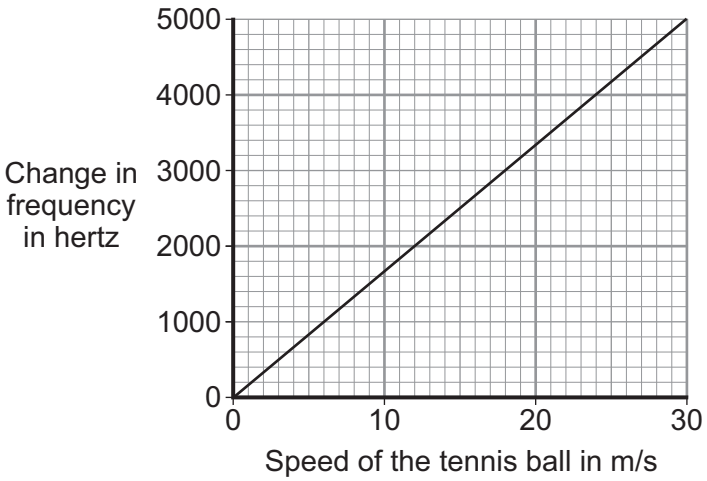
3B Which row in the table describes how the frequency and wavelength of the reflected microwaves are different from the microwaves given out by the speed gun?

	Frequency of reflected waves	Wavelength of reflected waves
1	higher	longer
2	lower	shorter
3	higher	shorter
4	lower	longer

4.5.6.1.2 Speed

Question 77 · continued March 2011 | PHY1BP | Original Q3 | Legacy

The graph shows how the change in frequency of the microwaves depends on the speed of the ball.



3C The data has been drawn as a line graph because . . .

1 frequency and speed are both categoric variables.

2 frequency and speed are both continuous variables.

3 frequency is a categoric variable and speed is a continuous variable.

4 frequency is a continuous variable and speed is a categoric variable.

3D The speed gun measures the change in frequency as 3000 Hz.

What is the speed of the ball?

1 18 m/s

2 20 m/s

3 21 m/s

4 22 m/s

4.5.6.1.2 Speed

Question 78

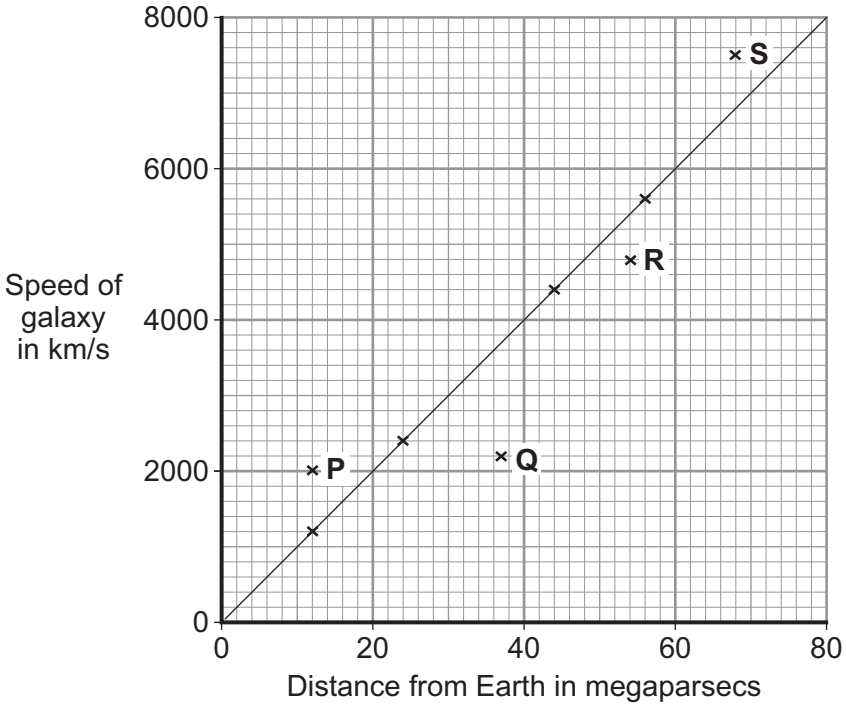
March 2011 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

In the early part of the twentieth century, Edwin Hubble made the discovery that distant galaxies are moving away from Earth.

He calculated the speeds at which the galaxies are moving away from Earth and their distances from Earth.

The graph shows Hubble's results.



A megaparsec is a unit of distance

5A Which one of the following statements describes what the graph shows?

1 All galaxies have different but constant speeds.

2 Galaxies will eventually reach a maximum speed.

3 Nearer galaxies have the highest speeds.

4 The speed of a galaxy is directly proportional to its distance from Earth.

5B What is the approximate speed, in km/s, of a galaxy 120 megaparsecs away from Earth?

1 10 000

2 11 000

3 12 000

4 13 000

4.5.6.1.2 Speed

Question 78 · continued

5C The light from four galaxies, **P**, **Q**, **R** and **S**, is examined for red-shift.

Which one of the following statements about the amount of red-shift is correct?

1 **P** produces the biggest red-shift.

2 **P**, **Q**, **R** and **S** produce the same red-shift.

3 **Q** and **R** produce the smallest red-shift.

4 **S** produces the biggest red-shift.

5D Some galaxies show a blue-shift.

These galaxies . . .

1 are the most distant galaxies from the Earth.

2 are stationary.

3 are moving towards the Earth.

4 have only just been formed.

4.5.6.1.2 Speed

Question 79

June 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

A source of sound waves is moving away from an observer.

Match words, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A frequency

B red-shift

C wavelength

D wave speed

Compared with the sound that the source emits, the observer hears a sound with a bigger . . . **1** . . . and a smaller . . . **2** . . . .

There is no change in the . . . **3** . . . .

A similar effect is seen with the light from a distant galaxy. This is called . . . **4** . . . .

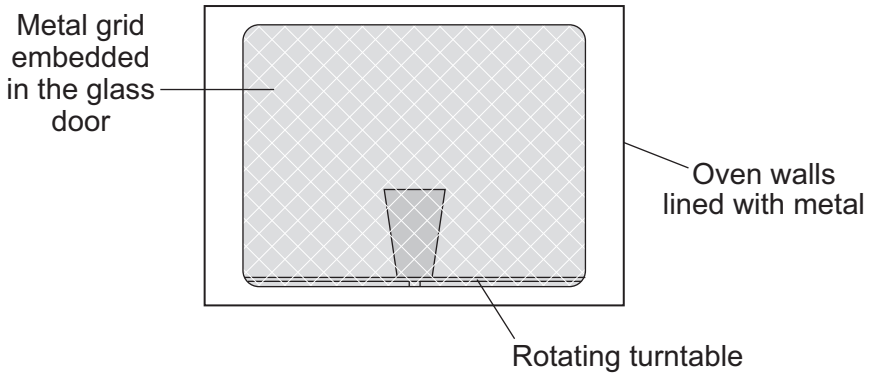
4.5.6.1.2 Speed

Question 80

June 2011 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows a microwave oven.



The microwaves have a frequency of 2500 MHz.

1 MHz = 1 000 000 Hz

5A The wave speed of the microwaves is 300 000 000 m/s.

What is the wavelength of the microwaves?

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

1 0.12 m

2 1.2 m

3 7.5 m

4 8.3 m

5B Which one of the following statements about electromagnetic radiations best explains why food can be heated by microwaves?

1 All electromagnetic radiations are disturbances in an electric field.

2 All electromagnetic radiations travel through a vacuum at the same speed.

3 All electromagnetic radiations travel as waves.

4 All electromagnetic radiations move energy from one place to another.

4.5.6.1.2 Speed

Question 80 · continued

5C The inside walls of the microwave oven are lined with metal. The door has a metal grid embedded in the glass.

The reason for using metal is that . . .

1 microwaves create an alternating current in the metal.

2 microwaves reflect off metal surfaces.

3 microwaves are absorbed by metals.

4 microwaves are transmitted by metals.

5D Microwaves are dangerous to living creatures. Microwaves can also affect radio and television reception.

Which feature of the oven shown in the diagram makes sure that microwaves do not escape through the door?

1 the rotating turntable

2 the metal lining

3 the embedded metal grid

4 the glass

4.5.6.1.2 Speed

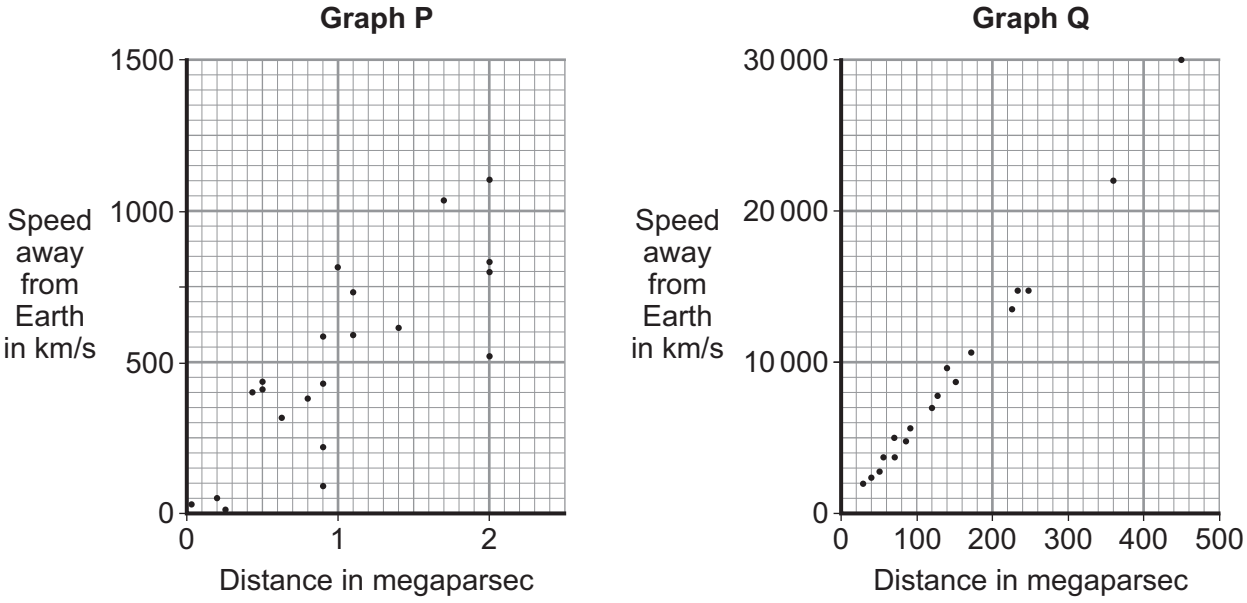
Question 81

June 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Edwin Hubble investigated the relationship between the speed of a galaxy moving away from the Earth and its distance from the Earth.

Graph P shows his results.



A megaparsec is a very large unit of distance used by astronomers.

Other astronomers have confirmed Hubble's results by surveying other galaxies. **Graph Q** shows the other astronomers' results.

9A The data in **Graph P** suggests that . . .

1 there is no relationship between the speed of a galaxy and its distance from Earth.

2 the galaxies closest to Earth move fastest.

3 the further away a galaxy is from Earth, the slower it is moving.

4 the further away a galaxy is from Earth, the faster it is moving.

4.5.6.1.2 Speed

The gradient (slope) of the line of best fit is called the Hubble constant. Astronomers have used the value of the Hubble constant to calculate the age of the universe.

9B The value of the Hubble constant obtained from **Graph Q** is thought to be more accurate than Hubble's original value.

This is because . . .

1 the data includes galaxies moving towards the Earth.

2 the data gives a line of best fit passing through the origin, (0,0).

3 the data was obtained from a wide range of galaxies.

4 the data was obtained from only very distant galaxies.

9C From the data in **Graph Q**, an approximate value for the Hubble constant in km/s per megaparsec is . . .

1 0.0017

2 0.017

3 60

4 600

9D A teacher used a balloon to model an expanding universe. Some dots were marked on the balloon, which was then inflated.

Which of the following is **not** a reason for using models in science?

1 They prove a theory is correct.

2 They help us to understand a theory.

3 They give similar results to the real experiment.

4 It is easier to take measurements from a model.

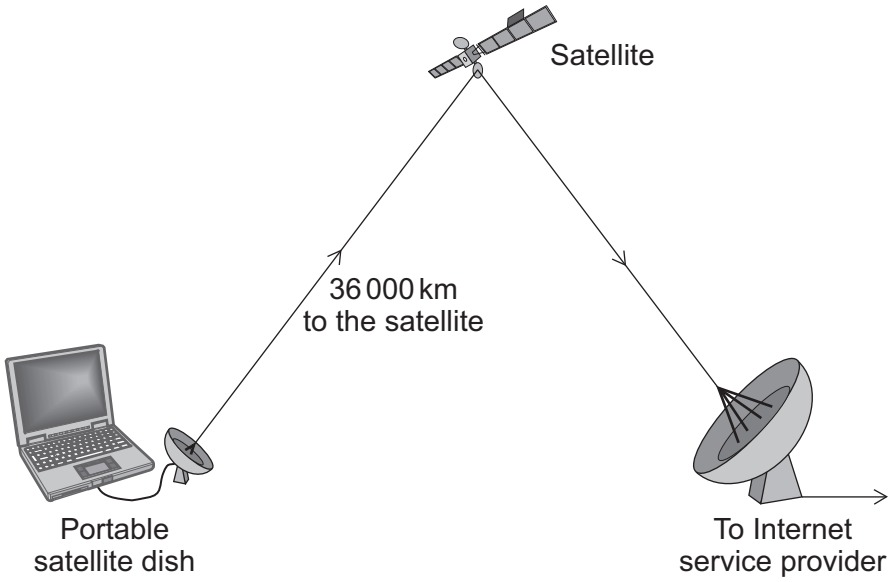
END OF TEST

4.5.6.1.2 Speed

Question 82

June 2011 | PHY1H | Original Q3 | Legacy

3 (a) The diagram shows a computer connected to the Internet using a satellite link.



3 (a) (i) Name the type of electromagnetic wave used to send information to and from the satellite.

.....

(1 mark)

3 (a) (ii) The information is sent to and from the satellite using a *digital signal*.

Describe a *digital signal*.

You may draw a diagram to help you answer.

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 82 · continued

3 (a) (iii) Give **one** advantage of sending information as a digital signal rather than as an analogue signal.

.....

.....

(1 mark)

3 (b) Electromagnetic waves travel at a speed of 300 000 000 m/s.
The waves travelling to and from the satellite have a wavelength of 15 cm.

Use the equation in the box to calculate the frequency of these waves.

wave speed = frequency × wavelength

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

.....

.....

Frequency = ...

(3 marks)

3 (c) In 2009, parts of the African country Kenya, were linked to the Internet by a super-fast optical fibre. Before that, all Internet connections had to be made via a satellite link.

3 (c) (i) Complete the following sentence.

Signals can be sent along an optical fibre using either visible light or

..... .

(1 mark)

3 (c) (ii) Suggest a reason why signals sent through the optical fibre arrive faster than signals sent via a satellite link.

.....

.....

(1 mark)

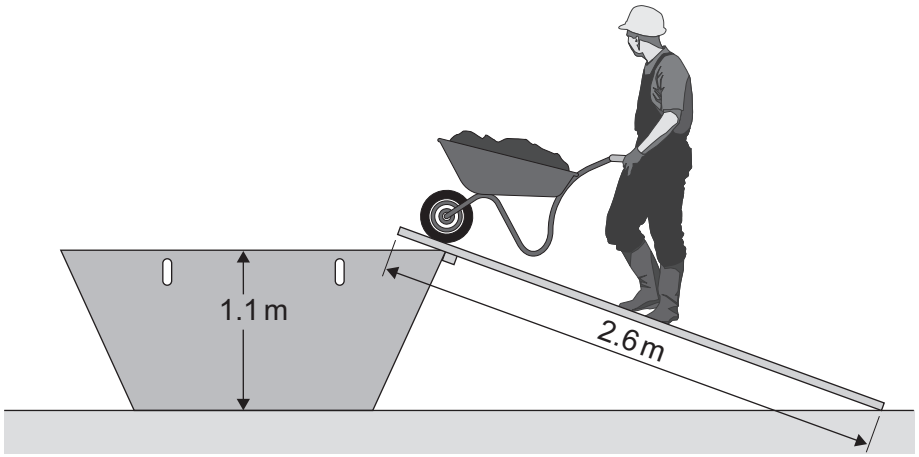
8

4.5.6.1.2 Speed

Question 83

June 2011 | PHY2H | Original Q2 | Legacy

2 (a) The diagram shows a builder using a plank to help load rubble into a skip.



The builder uses a force of 220 N to push the wheelbarrow up the plank.

Use information from the diagram and the equation in the box to calculate the work done to push the wheelbarrow up the plank to the skip.

work done = force applied × distance moved in the direction of force

Show clearly how you work out your answer.

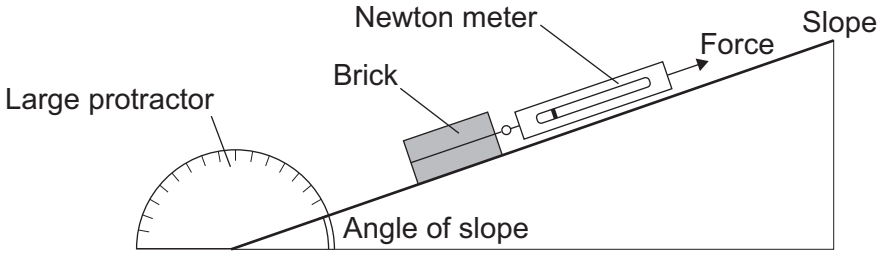
.....

.....

Work done = ... J

(2 marks)

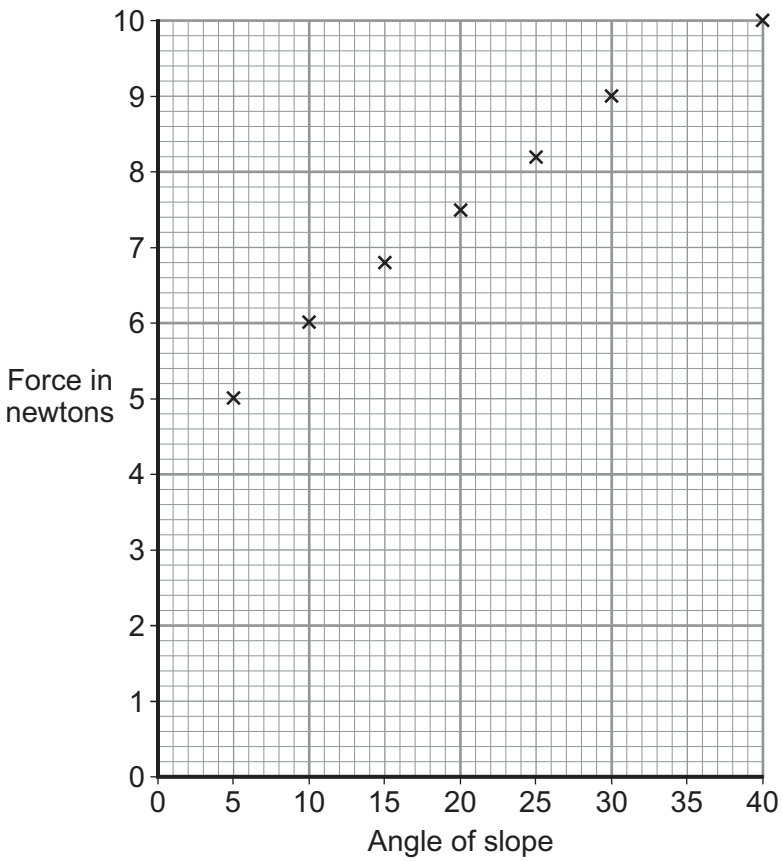
2 (b) A student investigated how the force needed to pull a brick up a slope, at a steady speed, depends on the angle of the slope.
The apparatus used by the student is shown in the diagram.



The student used the results from the investigation to plot the points for a graph of force used against the angle of the slope.

4.5.6.1.2 Speed

Question 83 · continued



2 (b) (i) Draw a line of best fit for these points. *(1 mark)*

2 (b) (ii) How does the force used to pull the brick up the slope change as the angle of the slope increases?

.....

.....

(1 mark)

2 (b) (iii) Consider the results from this experiment.
Should the student recommend that the builder use a long plank or a short plank to help load the skip?

Draw a ring around your answer.

long plank **short plank**

Explain the reason for your answer.

.....

.....

.....

.....

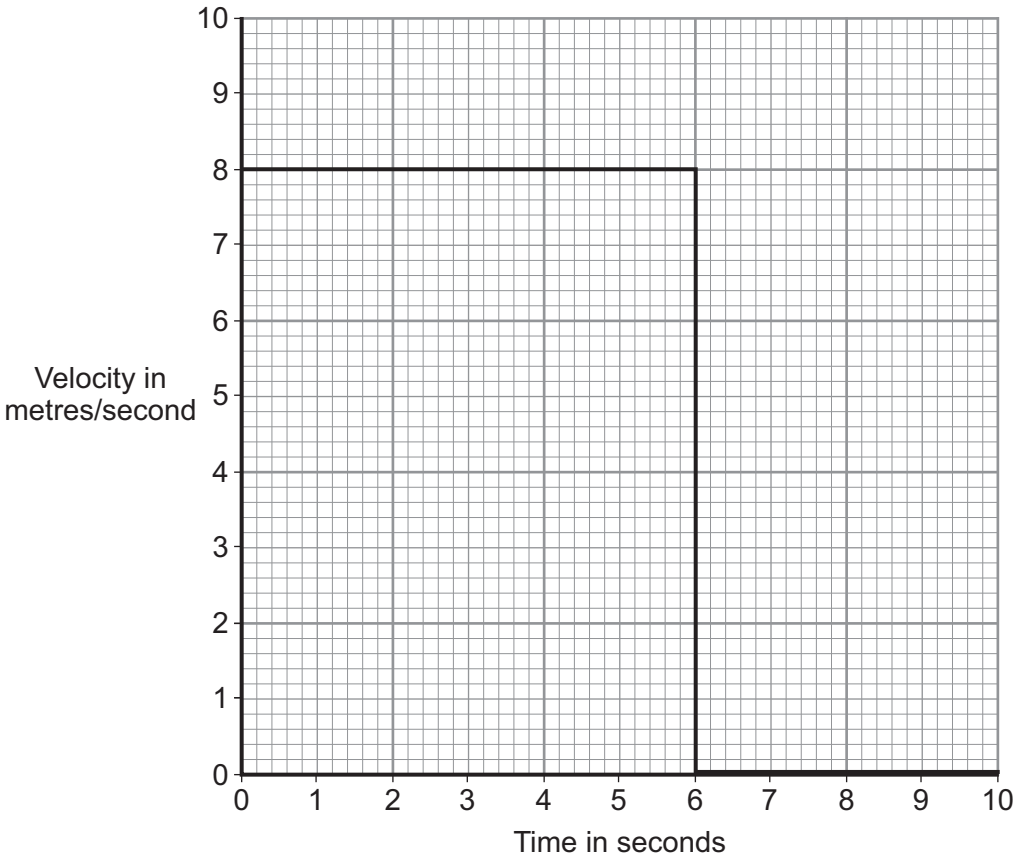
(2 marks)

6

4.5.6.1.2 Speed

Question 84

5 The diagram shows the velocity-time graph for an object over a 10 second period.



5 (a) Use the graph to calculate the distance travelled by the object in 10 seconds.

Show clearly how you work out your answer.

.....

.....

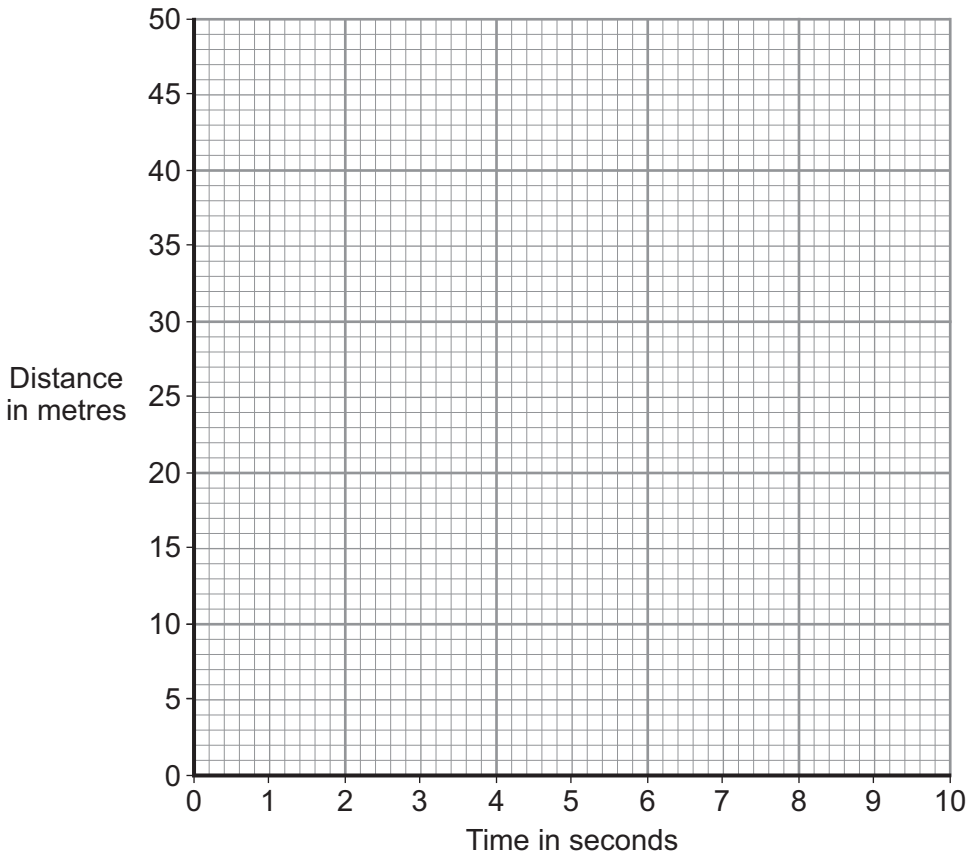
Distance = ... m

(2 marks)

4.5.6.1.2 Speed

Question 84 · continued

5 (b) Complete the distance-time graph for the object over the same 10 seconds.



(2 marks)

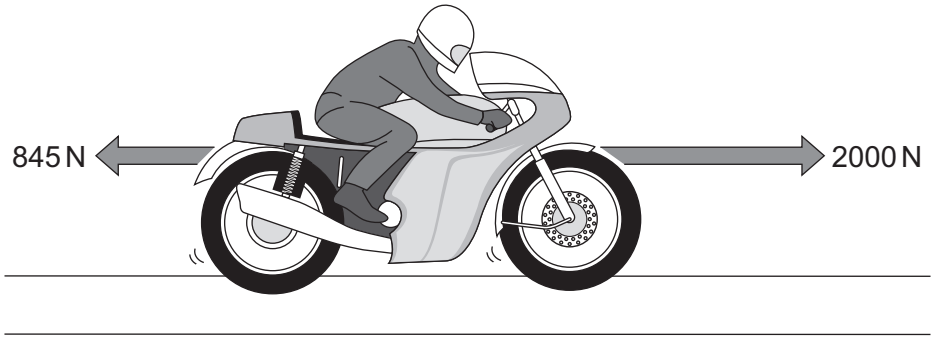
4

4.5.6.1.2 Speed

Question 85

June 2011 | PHY2H | Original Q7 | Legacy

7 The arrows in the diagram represent the horizontal forces acting on a motorbike at one moment in time.



7 (a) The mass of the motorbike and rider is 275 kg.

Use the equation in the box to calculate the acceleration of the motorbike at this moment in time.

resultant force = mass × acceleration

Show clearly how you work out your answer.

.....

.....

.....

.....

.....

Acceleration = ... m/s^2

(3 marks)

4.5.6.1.2 Speed

Question 85 · continued

7 (b) A road safety organisation has investigated the causes of motorbike accidents.

The main aim of the investigation was to find out whether there was any evidence that young, inexperienced riders were more likely to be involved in an accident than older, experienced riders.

Data obtained by the organisation from a sample of 1800 police files involving motorbike accidents, is summarised in the table.

Size of motorbike engine	Percentage of all motorbikes sold	Total number in the sample of 1800 accident files
up to 125 cc	36	774
126 to 350 cc	7	126
351 to 500 cc	7	162
over 500 cc	50	738

Most of the motorbikes with engines up to 125 cc were ridden by young people. The motorbikes with engines over 500 cc were ridden by older, more experienced riders.

7 (b) (i) In terms of the main aim of the investigation, is this data valid?

Draw a ring around your answer. **NO** **YES**

Explain the reason for your answer.

.....

.....

.....

.....

(2 marks)

Question 7 continues on the next page

4.5.6.1.2 Speed

Question 85 · continued

7 (b) (ii) The organisation concluded that:

"Young, inexperienced riders are more likely to be involved in a motorbike accident than older, experienced riders".

Explain how the data supports this conclusion.

.....

.....

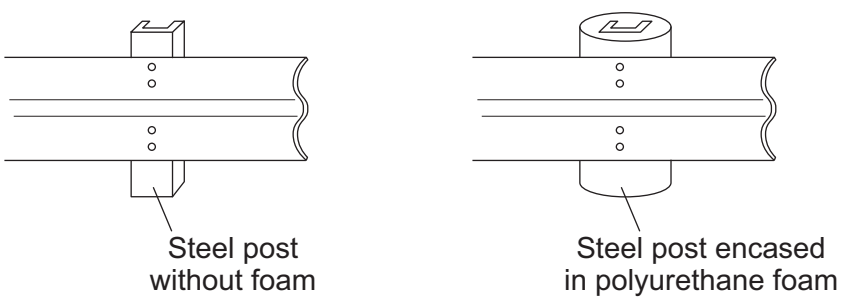
.....

.....

(2 marks)

7 (c) Of particular concern to motorbike riders is the design of steel crash barriers. Riders falling off and sliding at high speed into a steel support post are often seriously injured.

One way to reduce the risk of serious injury is to cover the post in a thick layer of high impact polyurethane foam.



7 (c) (i) Use the ideas of momentum to explain how the layer of foam reduces the risk of serious injury to a motorbike rider sliding at high speed into the support post.

.....

.....

.....

.....

.....

(3 marks)

4.5.6.1.2 Speed

Question 85 · continued

7 (c) (ii) Crash barrier tests use dummies that collide at 17 m/s with the barrier. Each test costs about £12 000. New safety devices for crash barriers are tested many times to make sure that they will improve safety.

Do you think that the cost of developing the new safety devices is justified?

Draw a ring around your answer. **NO** **YES**

Give a reason for your answer.

.....

.....

(1 mark)

11

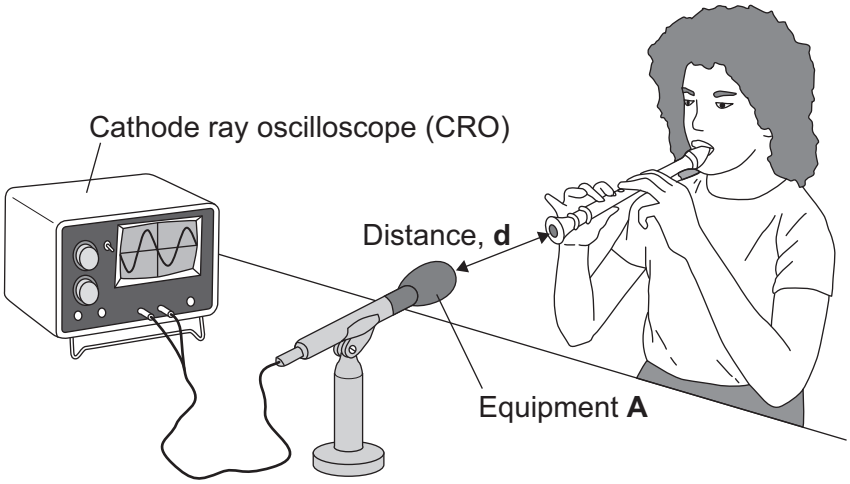
4.5.6.1.2 Speed

Question 86

June 2011 | PHY3H | Original Q1 | Legacy

1 A group of students investigates sound waves.

The diagram shows part of their investigation.



1 (a) Identify the equipment labelled **A**.

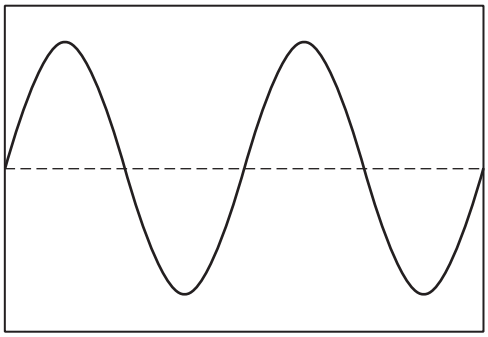
.....

(1 mark)

1 (b) The student plays the same note in the same way at different distances from equipment **A**.

Another student records the amplitude of the wave shown on the cathode ray oscilloscope (CRO).

1 (b) (i) Label this wave to show its amplitude.



(1 mark)

1 (b) (ii) Complete the sentence.

Increasing the amplitude of a sound wave will increase the .....

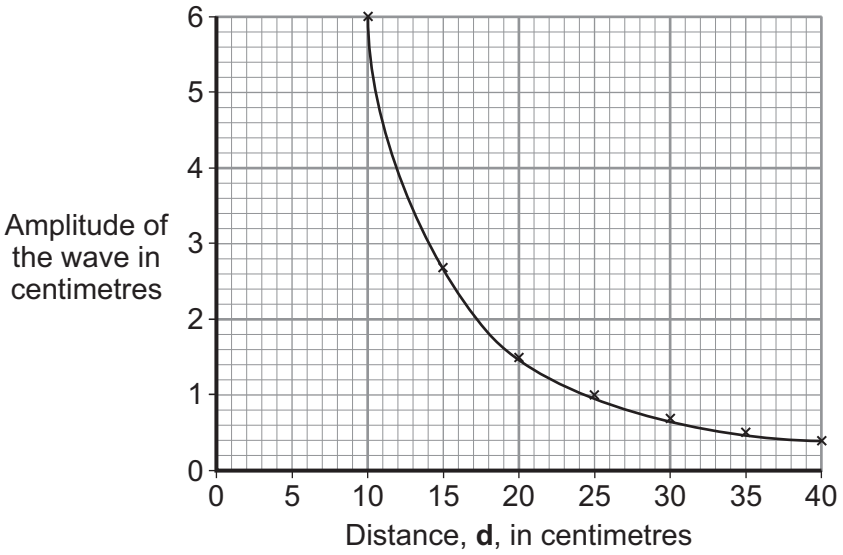
of the sound.

(1 mark)

4.5.6.1.2 Speed

Question 86 · continued

1 (c) The graph shows the students' average results from several sets of measurements.



Use the graph to find the distance, **d**, in centimetres, at which the average amplitude is likely to be 2 centimetres.

Distance = ... cm.

(1 mark)

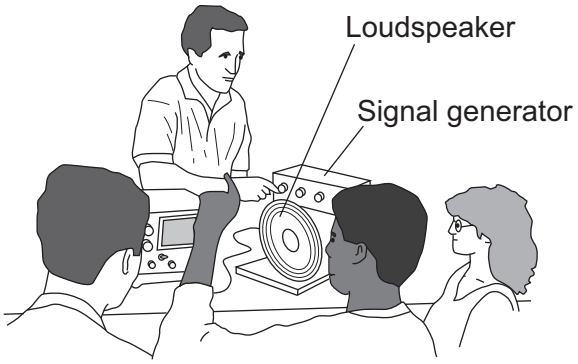
1 (d) Write a conclusion for this investigation.

.....

.....

(1 mark)

1 (e) A physics teacher uses a signal generator and a loudspeaker to demonstrate the range of hearing of a group of students.



What is the range of frequencies most humans can hear?

Most humans can hear from ..... Hz to ..... Hz.

(2 marks)

7

4.5.6.1.2 Speed

Question 87

June 2011 | PHY3H | Original Q2 | Legacy

2 (a) A student investigates the moment of a force.

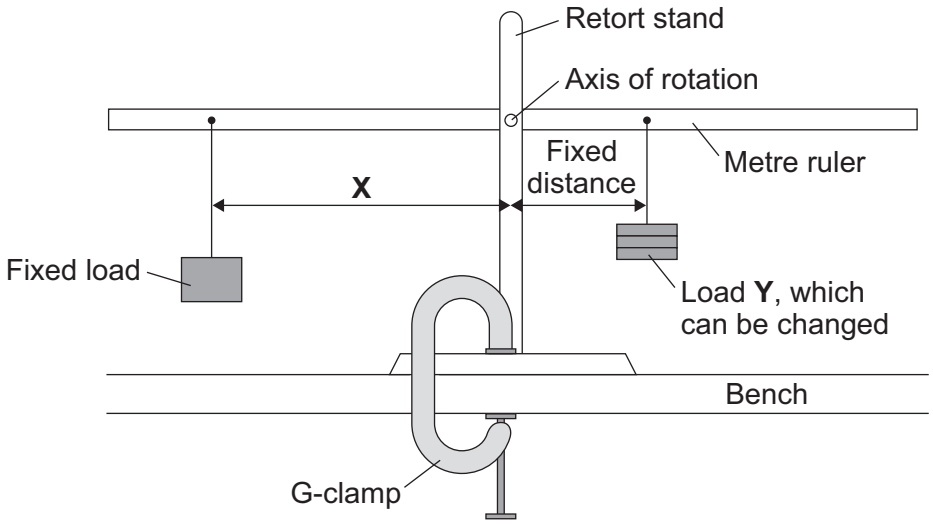
2 (a) (i) What does the word *moment* mean in this sentence?

.....

.....

(1 mark)

2 (a) (ii) The diagram shows how she sets up her apparatus.



Suggest the purpose of the G-clamp.

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 87 · continued

2 (a) (iii) A horizontal rod fits into a hole at the centre of the metre ruler. This is the axis of rotation. The student changes the load **Y** and adjusts the distance **X** until the metre ruler is horizontal. She takes six pairs of measurements which are shown in the table.

Load Y in newtons	Distance X in centimetres
1	7
2	14
3	21
4	28
5	35
6	42

Explain fully how distance **X** varies with load **Y**.

.....

.....

.....

.....

.....

(2 marks)

2 (a) (iv) The weight of the ruler can be ignored in this experiment.

Which statement gives the reason why?

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

The weight of the ruler is so small it is negligible. ☐

The centre of mass of the ruler is at the axis of rotation. ☐

The ruler is a symmetrical object. ☐

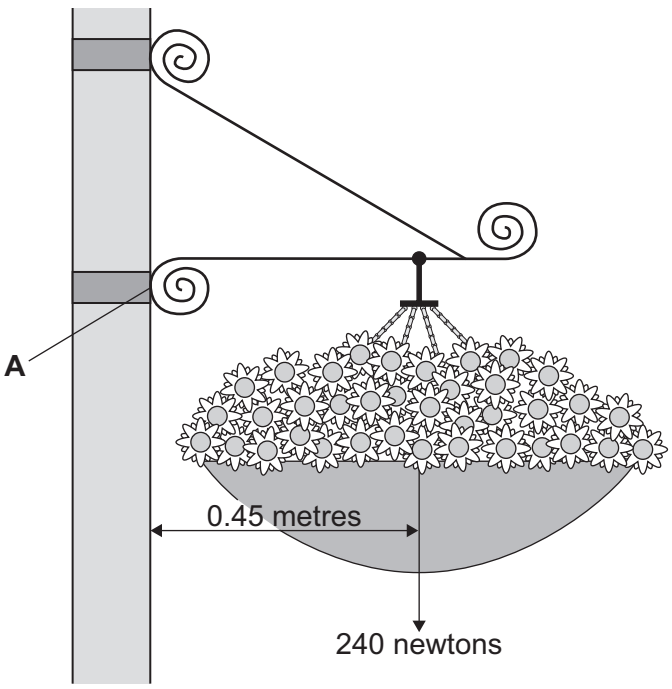
(1 mark)

Question 2 continues on the next page

4.5.6.1.2 Speed

Question 87 · continued

2 (b) In the summer, a town council fits hanging baskets to some of its lamp posts.



Use the information in the diagram and the equation in the box to calculate the moment produced by the weight of the hanging basket about an axis through point **A**.

moment = force × perpendicular distance from the line of action of the force to the axis of rotation

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

.....

.....

.....

.....

Moment =.....

(3 marks)

8

4.5.6.1.2 Speed

Question 88

3 Jupiter is the largest planet in the solar system. It has over sixty moons. The four largest moons were observed by Galileo using his telescope over four hundred years ago.

The table displays some of the data on these four largest moons which is now known to scientists.

Name	Distance from Jupiter in kilometres	Time to orbit Jupiter in days	Diameter in kilometres	Mass in quintillion tonnes
Callisto	1 883 000	16.9	4806	108
Europa	671 000	3.6	3130	48
Ganymede	1 070 000	7.2	5268	148
Io	422 000	1.8	3630	89

1 quintillion tonne = 1 000 000 000 000 000 000 tonnes

3 (a) A centripetal force acts on each of these moons.

State clearly what provides the centripetal force.

.....

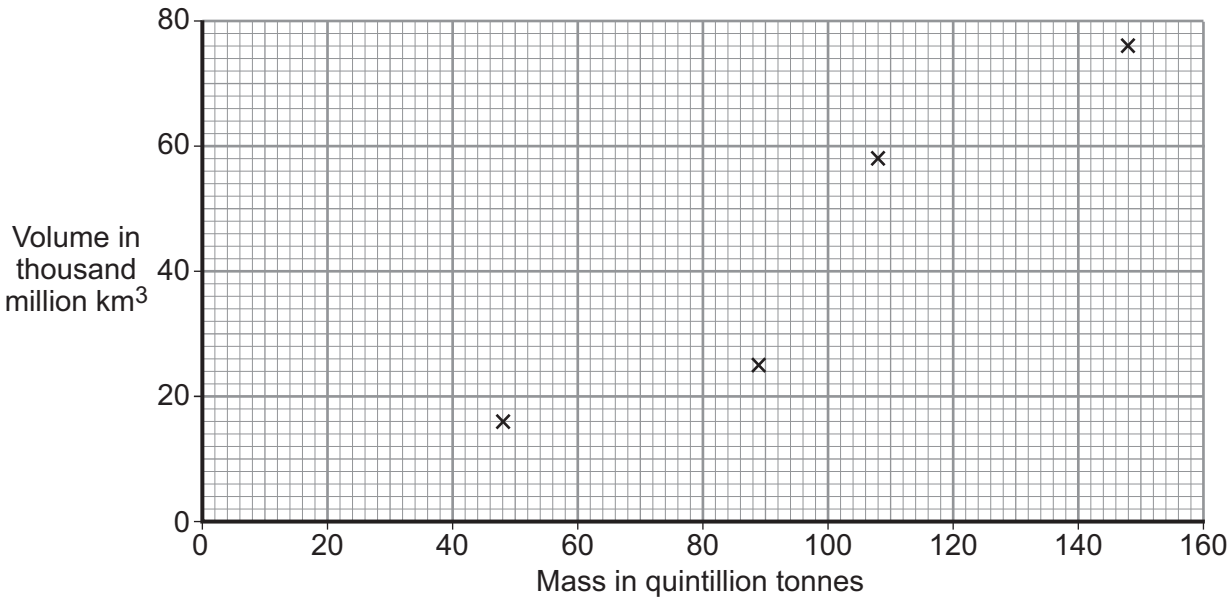
.....

(1 mark)

4.5.6.1.2 Speed

Question 88 · continued

3 (b) The graph shows the volume against mass for these large moons.



Use the graph to estimate the volume of a moon with a mass of 20 quintillion tonnes.

Show clearly on the graph how you used it to get to your estimate.

Estimated volume of moon = ... thousand million km^3

(2 marks)

3 (c) For these large moons, what is the relationship, if any, between the moon's *distance* from Jupiter and the *time* it takes for the moon to orbit Jupiter?

.....

.....

(1 mark)

3 (d) One reason why astronomers now have more data on the moons of Jupiter is that present-day astronomers have telescopes which are much more powerful than Galileo's telescope.

Give **one** other reason.

.....

.....

(1 mark)

5

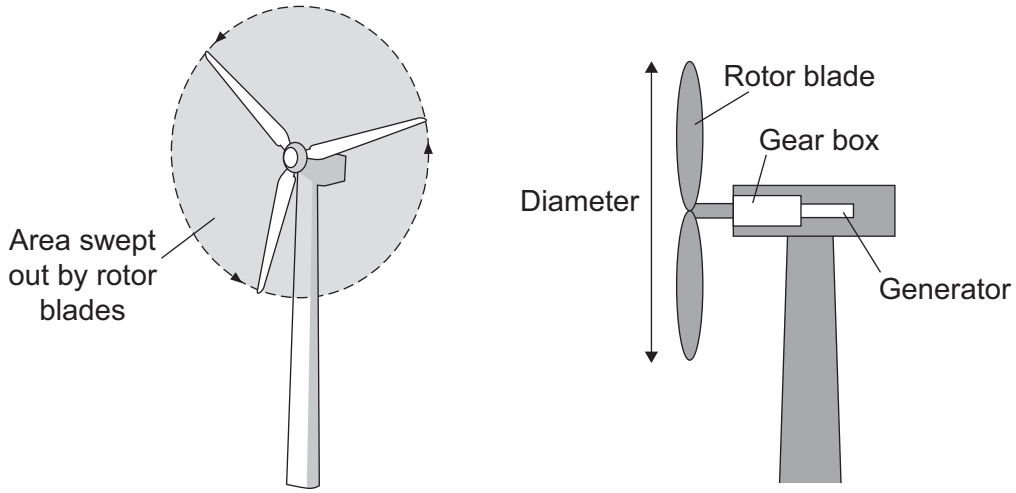
4.5.6.1.2 Speed

Question 89

November 2011 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

A wind turbine is an electrical generator. The rotor blades are connected to the generator through a gear box.



8A Which is the correct energy transformation for the wind turbine generator?

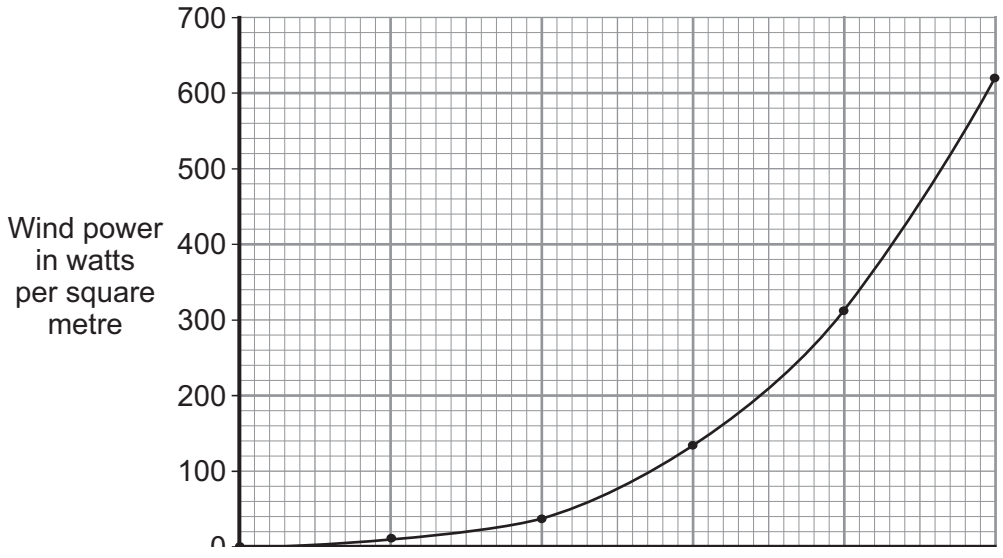
1 potential → electrical, thermal and sound

2 potential → kinetic, electrical and thermal

3 kinetic → electrical, thermal and sound

4 kinetic → chemical, electrical and thermal

8B The graph shows the power developed by the wind at different wind speeds. The power is measured in watts per square metre of area swept out by the rotor blades.



Question 89 · continued November 2011 | PHY1AP | Original Q8 | Legacy

What wind power is developed by a wind speed of 5.5 metres per second when the rotor blades sweep out an area of 5 square metres?

1 20 W

2 27.5 W

3 100 W

4 500 W

8C The table shows how the power output of a wind turbine changes with the diameter of the rotor blade.

Rotor blade diameter in metres (m)	Power output in kilowatts (kW)
1	0.4
2	1.6
3	3.6
4	6.4
6	14.4
8	25.6
10	40.0

Which of the following statements is correct?

1 decrease the rotor blade diameter and the power output increases

2 double the rotor blade diameter and the power output doubles

3 double the rotor blade diameter and the power output trebles

4 double the rotor blade diameter and the power output quadruples

8D A small wind turbine on the roof of a house has an average power output of 1 kW. The average demand for a household is 10 kW.

Large wind farms can produce an average power output of 5 MW.

One of the **disadvantages** of using wind farms to provide all the electricity for a large city is that . . .

1 wind farms develop far too much power for a large city.

2 large numbers of turbines are needed, taking up a lot of land.

3 large numbers of turbines will produce a lot of carbon dioxide.

4 wind farms produce a lot of noise that is very harmful to birds.

4.5.6.1.2 Speed

Question 90

November 2011 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

The light given out by distant galaxies has the same features as light from a very hot gas in a laboratory. However, the light from distant galaxies is shifted to longer wavelengths. This is called red-shift.

8A Red-shift occurs because . . .

1 the frequency of light increases as it travels through space.

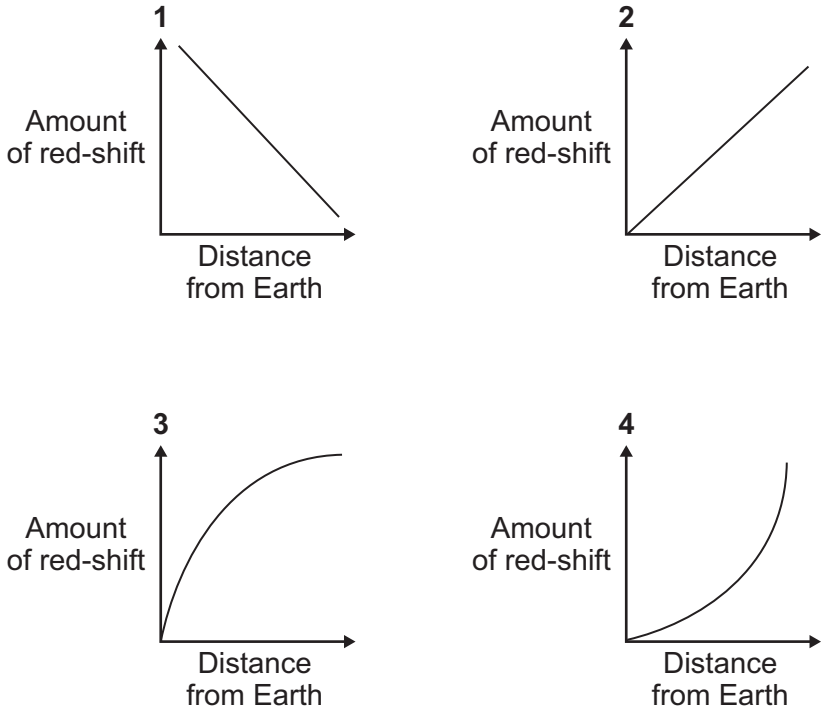
2 the speed of light from galaxies decreases as it travels through space.

3 distant galaxies have a relative movement away from the Earth.

4 distant galaxies have a relative movement towards the Earth.

8B Distant galaxies show an amount of red-shift which is directly proportional to their distance from the Earth.

Which graph shows this relationship?



4.5.6.1.2 Speed

Question 90 · continued

8C The amount of red-shift can be used to estimate the speed of a galaxy relative to Earth.

This led to the discovery that distant galaxies are . . .

1 moving faster than nearer galaxies and the universe is contracting.

2 moving faster than nearer galaxies and the universe is expanding.

3 moving slower than nearer galaxies and the universe is contracting.

4 moving slower than nearer galaxies and the universe is expanding.

8D There are some galaxies close to the Earth that are moving towards the Earth.

Light from these galaxies has . . .

1 an observable decrease in its frequency.

2 an observable decrease in its wavelength.

3 smaller red-shifts than distant galaxies.

4 no change in its wavelength.

4.5.6.1.2 Speed

Question 91

June 2012 | PH1HP | Original Q5 | Legacy

5 Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

5 (a) Give **two** more properties that are the same for both radio waves and microwaves.

1 .....

.....

2 .....

.....

(2 marks)

5 (b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

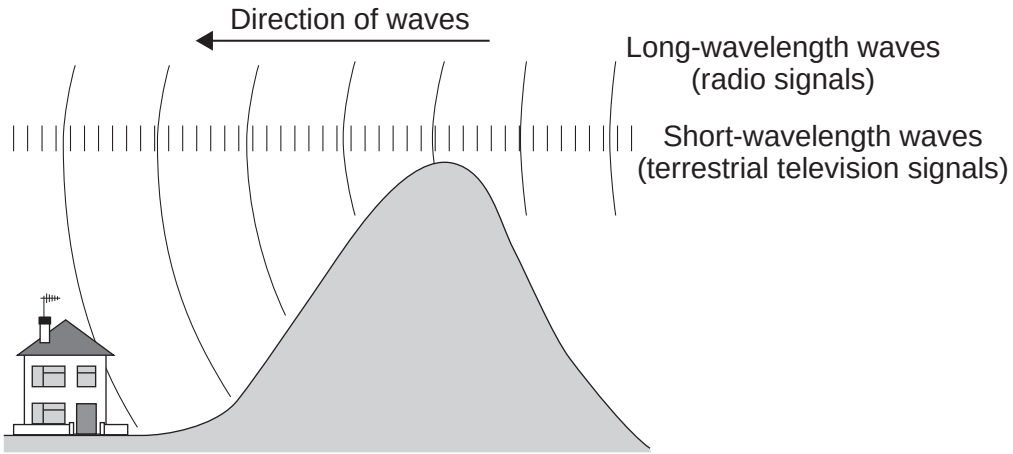
.....

.....

(1 mark)

5 (c) Terrestrial television does not use satellites.

Terrestrial television signals and radio signals both use radio waves.
Radio signals are transmitted at a longer wavelength than terrestrial television signals.



4.5.6.1.2 Speed

Question 91 · continued

In hilly areas it may be possible to receive radio signals but not receive terrestrial television signals.

Explain why.

.....

.....

.....

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.....

.....

(3 marks)

5 (d) Electromagnetic waves travel at a speed of 3.0×10^8 m/s.
A radio station transmits waves with a wavelength of 2.5×10^2 m.

Calculate the frequency of the radio waves.

Use the correct equation from the Physics Equations Sheet.

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

.....

.....

.....

Frequency = ...

(3 marks)

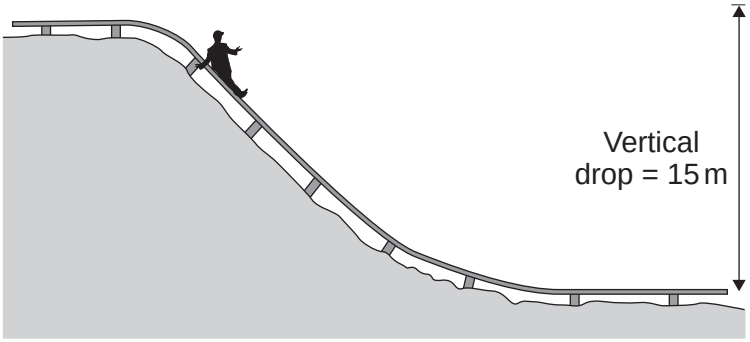
9

4.5.6.1.2 Speed

Question 92

June 2012 | PH2HP | Original Q4 | Legacy

4 The miners working in a salt mine use smooth wooden slides to move quickly from one level to another.



4 (a) A miner of mass 90 kg travels down the slide.

Calculate the change in gravitational potential energy of the miner when he moves 15m vertically downwards.

gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Change in gravitational potential energy = ... J

(2 marks)

4.5.6.1.2 Speed

Question 92 · continued

4 (b) Calculate the **maximum** possible speed that the miner could reach at the bottom of the slide.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Give your answer to an appropriate number of significant figures.

.....

.....

.....

.....

Maximum possible speed = ... m/s

(3 marks)

4 (c) The speed of the miner at the bottom of the slide is much less than the calculated maximum possible speed.

Explain why.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

8

4.5.6.1.2 Speed

Question 93

5 Galaxies emit all types of electromagnetic wave.

5 (a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1 mark)

5 (a) (ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1 mark)

5 (b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Frequency = ...

(3 marks)

5 (c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part **(b)** as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

5 (c) (i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 93 · continued

5 (c) (ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....

.....

.....

.....

(2 marks)

5 (c) (iii) What does the observation of red-shift suggest is happening to the Universe?

.....

.....

(1 mark)

9

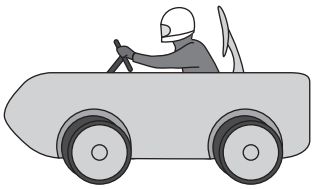
4.5.6.1.2 Speed

Question 94

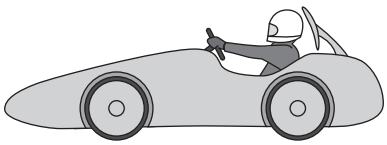
January 2013 | PH2HP | Original Q5 | Legacy

5 (a) Some students have designed and built an electric-powered go-kart. After testing, the students decided to make changes to the design of their go-kart.

First design **X**



Final design **Y**



The go-kart always had the same mass and used the same motor.

The change in shape from the first design (**X**) to the final design (**Y**) will affect the top speed of the go-kart.

Explain why.

.....

.....

.....

.....

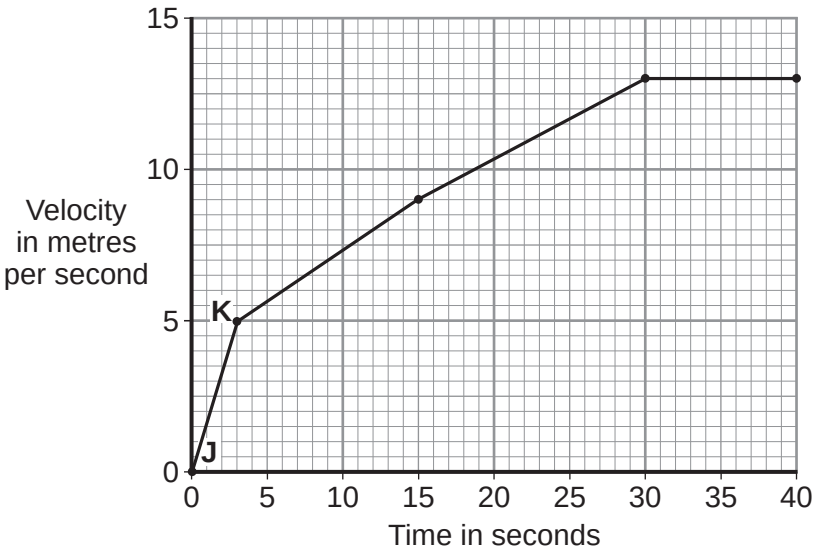
.....

.....

(3 marks)

5 (b) The final design go-kart, **Y**, is entered into a race.

The graph shows how the velocity of the go-kart changes during the first 40 seconds of the race.



4.5.6.1.2 Speed

Question 94 · continued

5 (b) (i) Use the graph to calculate the acceleration of the go-kart between points **J** and **K**.

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

.....

.....

.....

Acceleration = ... m/s^2

(2 marks)

5 (b) (ii) Use the graph to calculate the distance the go-kart travels between points **J** and **K**.

.....

.....

.....

Distance = ... m

(2 marks)

5 (b) (iii) What causes most of the resistive forces acting on the go-kart?

.....

(1 mark)

8

4.5.6.1.2 Speed

Question 95

June 2013 | PH1HP | Original Q7 | Legacy

7 (a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

10^{-15} metres to 10^{4} metres ☐

10^{-4} metres to 10^{15} metres ☐

10^{-6} metres to 10^{6} metres ☐

(1 mark)

7 (b) Infrared waves and microwaves are used for communications.

7 (b) (i) Give **one** example of infrared waves being used for communication.

.....

.....

(1 mark)

7 (b) (ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of 1.8×10^{9} Hz and travel at a speed of 3.0×10^{8} m/s.

Calculate the wavelength of the microwaves.

Use the correct equation from the Physics Equations Sheet.

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

.....

.....

.....

Wavelength = ... m

(3 marks)

4.5.6.1.2 Speed

Question 95 · continued

7 (c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	Sperm count in millions of sperm cells per cm^3 of semen
0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

.....

(1 mark)

6

4.5.6.1.2 Speed

Question 96

June 2013 | PH2HP | Original Q4 | Legacy

4 (a) The stopping distance of a vehicle is made up of two parts, the thinking distance and the braking distance.

4 (a) (i) What is meant by *thinking distance*?

.....

.....

(1 mark)

4 (a) (ii) State **two** factors that affect thinking distance.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) A car is travelling at a speed of 20 m/s when the driver applies the brakes. The car decelerates at a constant rate and stops.

4 (b) (i) The mass of the car and driver is 1600 kg.

Calculate the kinetic energy of the car and driver before the brakes are applied.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Kinetic energy = ... J

(2 marks)

4 (b) (ii) How much work is done by the braking force to stop the car and driver?

Work done = ... J

(1 mark)

4.5.6.1.2 Speed

Question 96 · continued

4 (b) (iii) The braking force used to stop the car and driver was 8000 N.

Calculate the braking distance of the car.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Braking distance = ... m

(2 marks)

4 (b) (iv) The braking distance of a car depends on the speed of the car and the braking force applied.

State **one** other factor that affects braking distance.

.....

.....

(1 mark)

4 (b) (v) Applying the brakes of the car causes the temperature of the brakes to increase.

Explain why.

.....

.....

.....

.....

(2 marks)

Question 4 continues on the next page

4.5.6.1.2 Speed

Question 96 · continued

4 (c) Hybrid cars have an electric engine and a petrol engine. This type of car is often fitted with a regenerative braking system. A regenerative braking system not only slows a car down but at the same time causes a generator to charge the car's battery.

State and explain the benefit of a hybrid car being fitted with a regenerative braking system.

.....

.....

.....

.....

.....

.....

(3 marks)

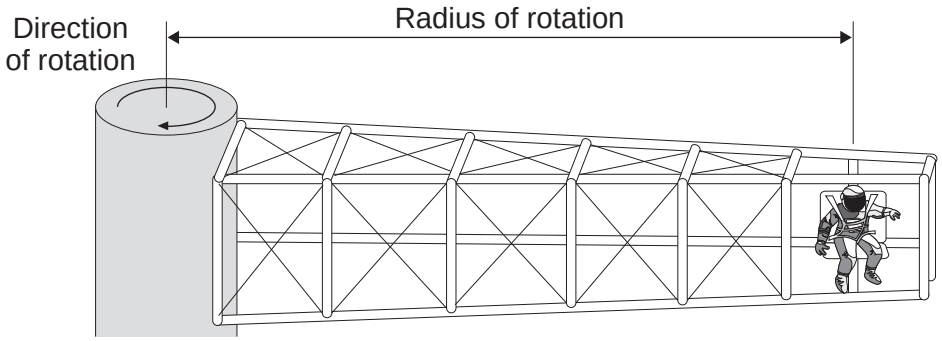
14

4.5.6.1.2 Speed

Question 97

June 2013 | PH3HP | Original Q5 | Legacy

5 The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



The G-machine moves the astronaut in a horizontal circle.

5 (a) When the G-machine is rotating at constant speed, the astronaut is accelerating.

State the name and direction of the force causing the astronaut to accelerate.

Name of force .....

Direction of force .....

.....

(2 marks)

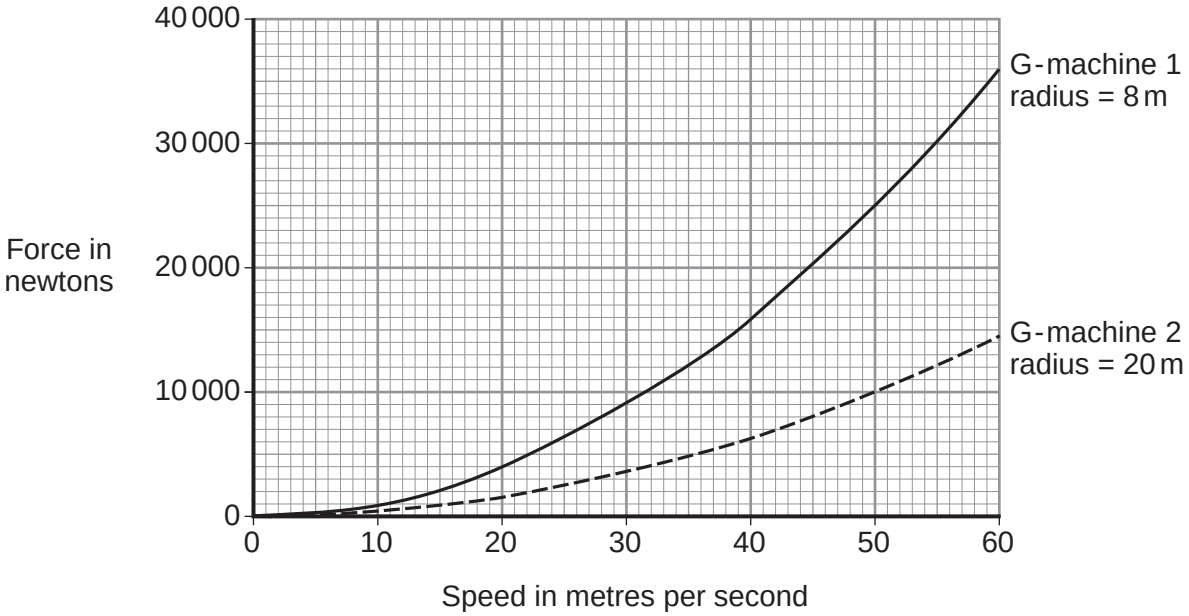
4.5.6.1.2 Speed

Question 97 · continued June 2013 | PH3HP | Original Q5 | Legacy

5 (b) The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.



5 (b) (i) State **three** conclusions that can be made from the graph.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

5 (b) (ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

Determine the change in force on the astronaut.

.....

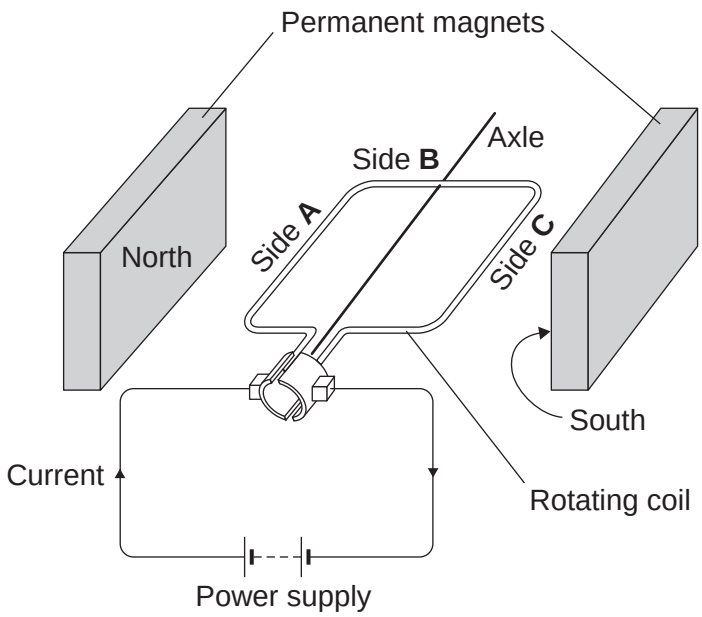
Change in force = ... N

(1 mark)

4.5.6.1.2 Speed

Question 97 · continued

5 (c) Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.



5 (c) (i) A current flows through the coil of the motor.

Explain why side **A** of the coil experiences a force.

.....

.....

.....

.....

(2 marks)

5 (c) (ii) Draw arrows on the diagram to show the direction of the forces acting on side **A** of the coil and side **C** of the coil.

(1 mark)

5 (c) (iii) When horizontal, side **B** experiences no force.

Give the reason why.

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 97 · continued

5 (d) While a G-machine is rotating, the operators want to increase its speed.

What can the operators do to make the G-machine rotate faster?

.....

.....

(1 mark)

5 (e) The exploration of space has cost a lot of money.

Do you think spending lots of money on space exploration has been a good thing?

Draw a ring around your answer.

Yes **No**

Give a reason for your answer.

.....

.....

(1 mark)

12

4.5.6.1.2 Speed

Question 98

June 2014 | PH1HP | Original Q3 | Legacy

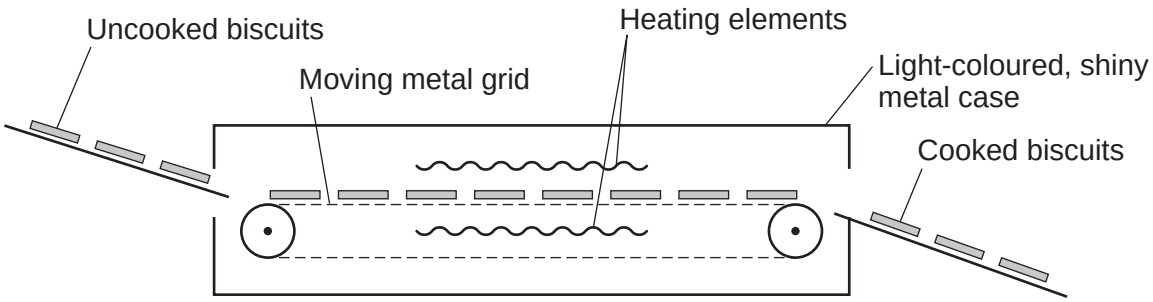
3 **Figure 1** shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

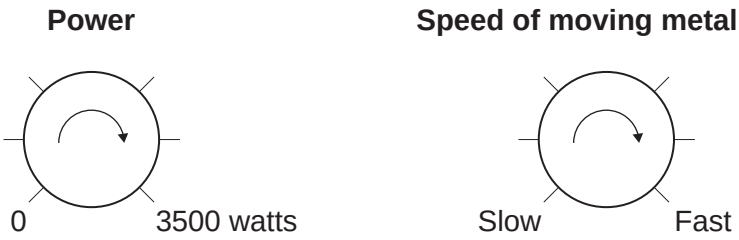
The biscuits turn brown as they cook.

Figure 1



The oven has two control knobs, as shown in **Figure 2**.

Figure 2



3 (a) Which type of electromagnetic radiation makes the biscuits turn brown?

[1 mark]

.....

3 (b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

[2 marks]

1 .....

.....

2 .....

.....

4.5.6.1.2 Speed

Question 98 · continued

3 (c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

6

Turn over for the next question

4.5.6.1.2 Speed

Question 99

June 2014 | PH1HP | Original Q4 | Legacy

4 A note was played on an electric keyboard.

The frequency of the note was 440 Hz.

4 (a) (i) What does a frequency of 440 Hz mean?

[1 mark]

.....

.....

4 (a) (ii) The sound waves produced by the keyboard travel at a speed of 340 m/s.

Calculate the wavelength of the note.

Use the correct equation from the Physics Equations Sheet.

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

[3 marks]

.....

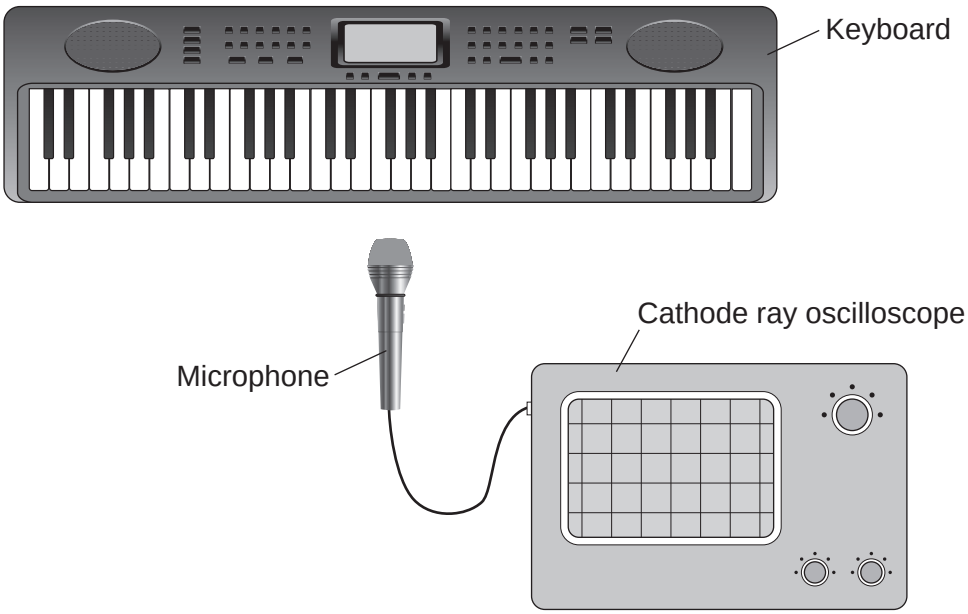
.....

.....

Wavelength = ... metres

4 (b) **Figure 3** shows a microphone connected to a cathode ray oscilloscope (CRO) being used to detect the note produced by the keyboard.

Figure 3

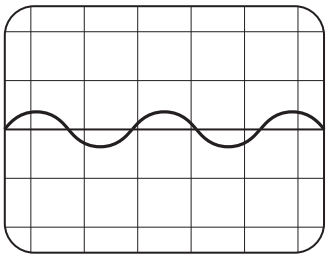


4.5.6.1.2 Speed

Question 99 · continued

Figure 4 shows the trace produced by the sound wave on the CRO.

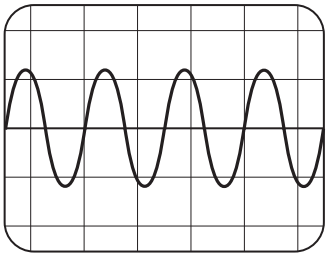
Figure 4



A second note, of different wavelength, was played on the keyboard.

Figure 5 shows the trace produced by the sound wave of the second note on the CRO.

Figure 5



The settings on the CRO were unchanged.

What **two** conclusions should be made about the **second** sound wave produced by the keyboard compared with the **first** sound wave?

Give a reason for each conclusion.

[4 marks]

Conclusion 1 .....

.....

Reason .....

.....

Conclusion 2 .....

.....

Reason .....

.....

8

4.5.6.1.2 Speed

Question 100

June 2014 | PH3HP | Original Q1 | Legacy

1 (a) What is ultrasound?

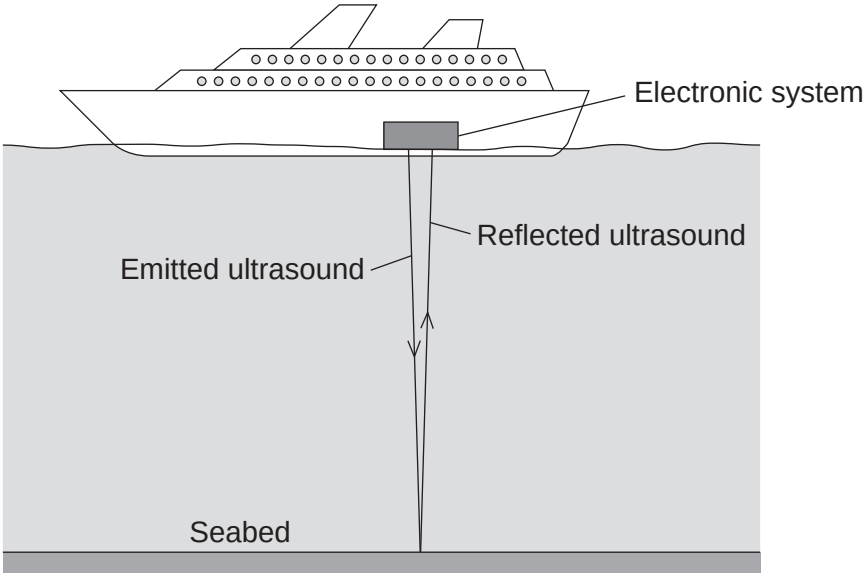
[1 mark]

.....

.....

1 (b) **Figure 1** shows how ultrasound is used to measure the depth of water below a ship.

Figure 1



A pulse of ultrasound is sent out from an electronic system on-board the ship.

It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.

Calculate the depth of the water.

Speed of ultrasound in water = 1600 m/s

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

Depth of water = ... metres

4.5.6.1.2 Speed

Question 100 · continued

1 (c) Ultrasound can be used in medicine for scanning.

State **one** medical use of ultrasound scanning.

[1 mark]

.....

1 (d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 2** uses X-rays to produce these images.

Figure 2



State **one** advantage and **one** disadvantage of using a CT scanner, compared with ultrasound scanning, for forming images of the inside of the human body.

[2 marks]

Advantage of CT scanning .....

.....

.....

Disadvantage of CT scanning .....

.....

.....

7

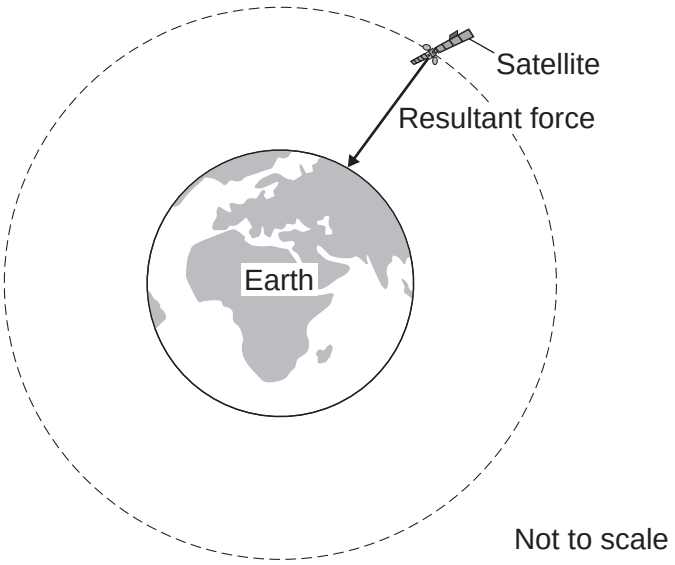
4.5.6.1.2 Speed

Question 101

June 2014 | PH3HP | Original Q2 | Legacy

2 Man-made satellites can orbit the Earth, as shown in **Figure 3**.

Figure 3



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force.

2 (a) What provides the centripetal force on the satellite?

[1 mark]

.....

2 (b) State **two** factors that determine the size of the centripetal force on the satellite.

[2 marks]

1 .....

2 .....

4.5.6.1.2 Speed

Question 101 · continued

2 (c) **Table 1** gives data for five different satellites orbiting the Earth.

Table 1

Satellite	Average height above Earth's surface in kilometres	Time taken to orbit Earth once in minutes	Mass of satellite in kilograms
A	370	93	419 000
B	697	99	280
C	827	103	630
D	5 900	228	400
E	35 800	1440	2 030

2 (c) (i) State the relationship, if any, between the height of the satellite above the Earth's surface and the time taken for the satellite to orbit the Earth once.

[1 mark]

.....

.....

2 (c) (ii) State the relationship, if any, between the time taken for the satellite to orbit the Earth once and the satellite's mass.

[1 mark]

.....

.....

Question 2 continues on the next page

4.5.6.1.2 Speed

Question 101 · continued

2 (d) Over 300 years ago, the famous scientist Isaac Newton proposed, with a 'thought experiment', the idea of satellites.

Newton suggested that if an object was fired at the right speed from the top of a high mountain, it would circle the Earth.

Why did many people accept Isaac Newton's idea as being possible?

Tick (✓) **one** box.

[1 mark]

Isaac Newton was a respected scientist who had made new discoveries before. ☐

Isaac Newton went to university. ☐

It was a new idea that nobody else had thought of before. ☐

6

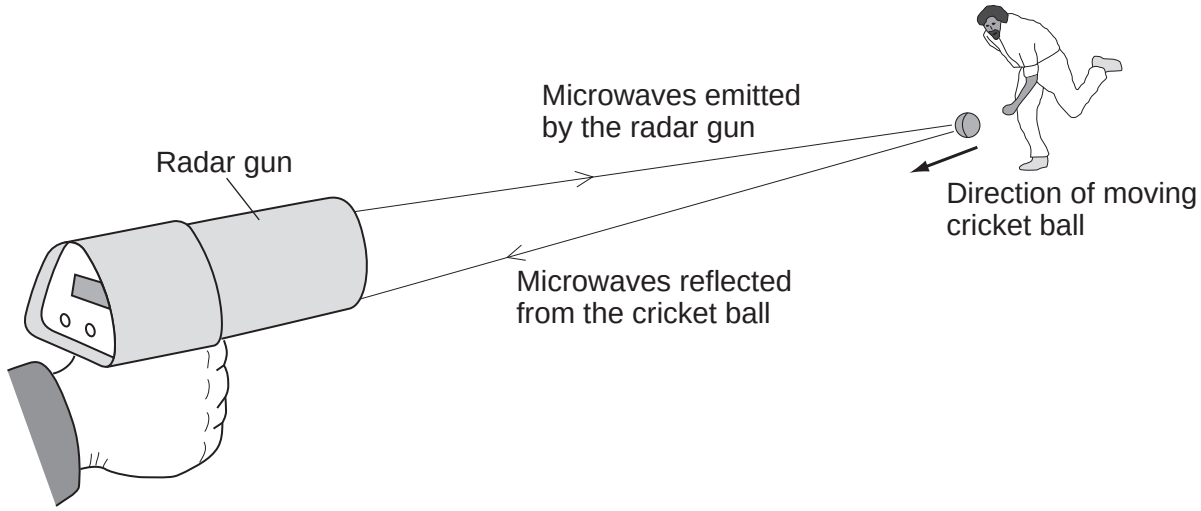
4.5.6.1.2 Speed

Question 102

June 2015 | PH1HP | Original Q6 | Legacy

6 A radar gun is used to determine the speed of a cricket ball during a cricket match. The radar gun emits a beam of microwaves. The microwaves are reflected from the moving ball, as shown in **Figure 6**.

Figure 6



Comparing the microwaves emitted by the radar gun with the microwaves reflected from the cricket ball enables the speed of the ball to be determined.

6 (a) What is the name given to the effect used to determine the speed of the cricket ball?

[1 mark]

.....

6 (b) Compare the wavelength, frequency and speed of the **reflected** microwaves with the wavelength, frequency and speed of the microwaves emitted by the radar gun.

[3 marks]

.....

.....

.....

.....

.....

.....

4

4.5.6.1.2 Speed

Question 103

June 2015 | PH2HP | Original Q4 | Legacy

4 (a) A car driver sees the traffic in front is not moving and brakes to stop his car.

The stopping distance of a car is the thinking distance plus the braking distance.

4 (a) (i) What is meant by the 'braking distance'?

[1 mark]

.....

.....

4 (a) (ii) The braking distance of a car depends on the speed of the car and the braking force.

State **one** other factor that affects braking distance.

[1 mark]

.....

.....

4 (a) (iii) How does the braking force needed to stop a car in a particular distance depend on the speed of the car?

[1 mark]

.....

.....

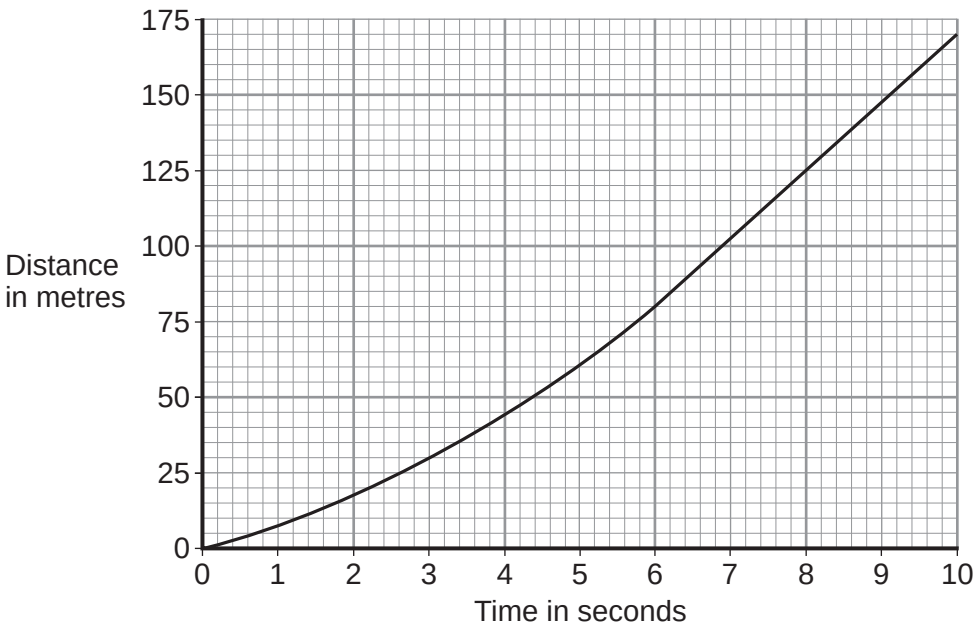
Question 4 continues on the next page

4.5.6.1.2 Speed

Question 103 · continued

4 (b) **Figure 4** shows the distance–time graph for the car in the 10 seconds before the driver applied the brakes.

Figure 4



Use **Figure 4** to calculate the maximum speed the car was travelling at.
Show clearly how you work out your answer.

[2 marks]

.....

.....

Maximum speed = ... m/s

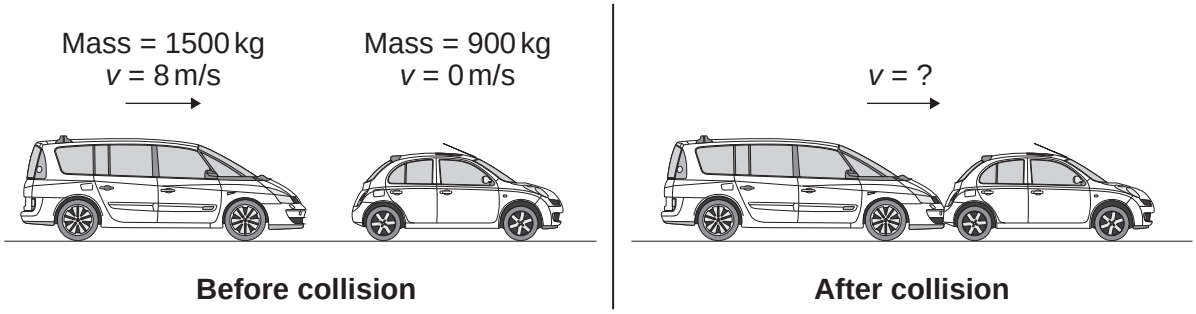
4.5.6.1.2 Speed

Question 103 · continued

4 (c) The car did not stop in time. It collided with the stationary car in front, joining the two cars together.

Figure 5 shows both cars, just before and just after the collision.

Figure 5



Before collision **After collision**

4 (c) (i) The momentum of the two cars was conserved.

What is meant by the statement 'momentum is conserved'?

[1 mark]

.....

.....

4 (c) (ii) Calculate the velocity of the two joined cars immediately after the collision.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

.....

Velocity = ... m/s

Question 4 continues on the next page

4.5.6.1.2 Speed

Question 103 · continued

4 (d) Since 1965, all cars manufactured for use in the UK must have seat belts.

It is safer for a car driver to be wearing a seat belt, compared with not wearing a seat belt, if the car is involved in a collision.

Explain why.

[4 marks]

.....

.....

.....

.....

.....

.....

.....

.....

13

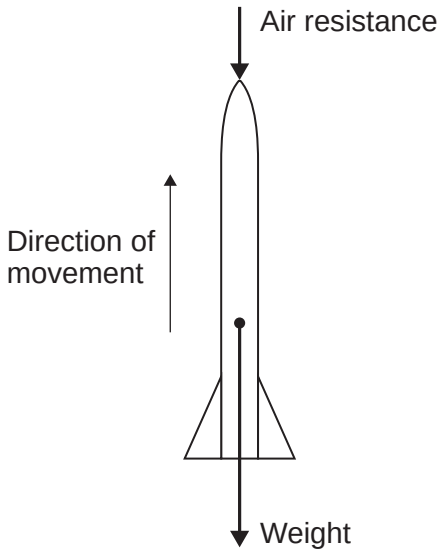
4.5.6.1.2 Speed

Question 104

June 2015 | PH2HP | Original Q6 | Legacy

6 (a) **Figure 7** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 7



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

[2 marks]

.....

Give a reason for your answer.

.....

.....

6 (a) (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 mark]

.....

.....

.....

4.5.6.1.2 Speed

Question 104 · continued

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

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

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Kinetic energy = ... J

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

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

[1 mark]

Maximum gravitational potential energy = ... J

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

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Maximum height = ... m

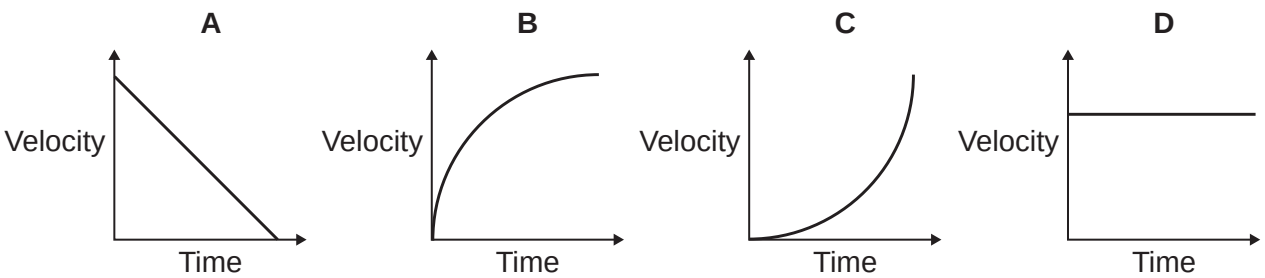
Question 6 continues on the next page

4.5.6.1.2 Speed

Question 104 · continued

6 (b) (iv) **Figure 8** shows four velocity–time graphs.

Figure 8



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?

[1 mark]

Write the correct answer in the box.

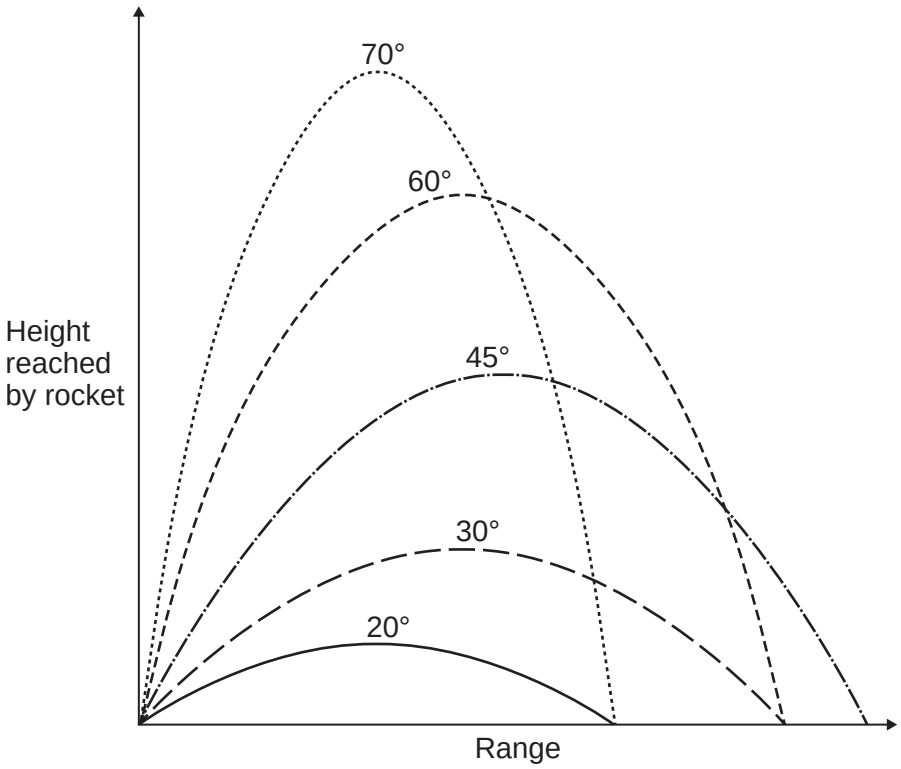
4.5.6.1.2 Speed

Question 104 · continued

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

Figure 9 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 9



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

[2 marks]

.....

.....

.....

.....

11

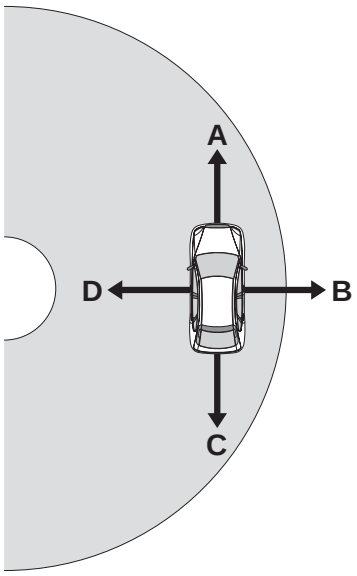
4.5.6.1.2 Speed

Question 105

June 2015 | PH3HP | Original Q2 | Legacy

2 (a) **Figure 3** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 3



There is a resultant force acting on the car. This resultant force is called the centripetal force.

2 (a) (i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the car?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

2 (a) (ii) State the name of the force that provides the centripetal force.

[1 mark]

.....

4.5.6.1.2 Speed

Question 105 · continued

2 (a) (iii) State **two** factors that affect the size of the centripetal force acting on the car.

[2 marks]

1 .....

2 .....

2 (b) **Figure 4** shows a racing car.

Figure 4



The racing car should not roll over when racing.

State **two** features of the car that make it difficult for the car to roll over.

[2 marks]

1 .....

.....

2 .....

.....

6

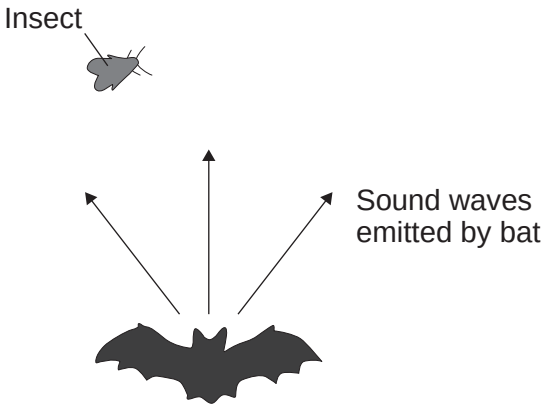
4.5.6.1.2 Speed

Question 106

June 2016 | PH1HP | Original Q1 | Legacy

1 Bats use the reflection of high pitched sound waves to determine the position of objects. **Figure 1** shows a bat and an insect flying in front of the bat.

Figure 1



1 (a) What determines the pitch of a sound wave?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
amplitude	
frequency	
speed	

1 (b) State the name given to reflected sound waves.

[1 mark]

_____

4.5.6.1.2 Speed

Question 106 · continued

1 (c) The bat emits sound waves with a range of wavelengths.

Some of the sound waves will be diffracted by the insect.

Complete the following sentences to explain why.

[2 marks]

Diffraction is caused by the sound waves _____ as they pass the insect.

The most diffraction happens when the wavelength of the sound wave is

_____ the size of the insect.

1 (d) The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.

Calculate the speed of this sound wave.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Speed = _____ m/s

1 (e) Sound waves are longitudinal. Describe a longitudinal sound wave.

[2 marks]

_____

_____

_____

_____

8

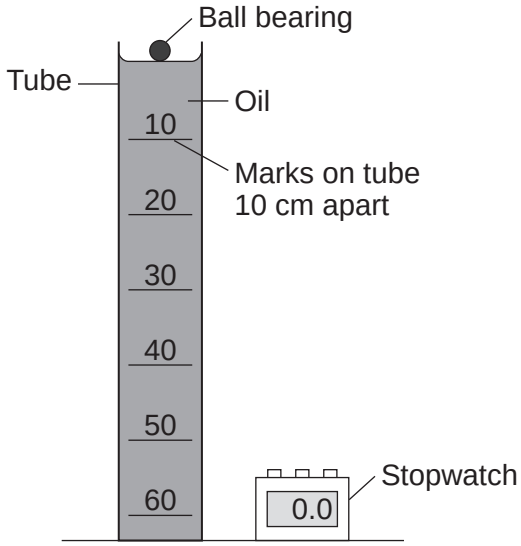
4.5.6.1.2 Speed

Question 107

June 2016 | PH2HP | Original Q1 | Legacy

1 A student investigated how the speed of a ball bearing changes as the ball bearing falls through a tube of oil.
Figure 1 shows the equipment the student used.

Figure 1



The student measured the time taken for the ball bearing to fall different distances.
Each distance was measured from the top of the oil.

1 (a) What is likely to have been the main source of error in this investigation?

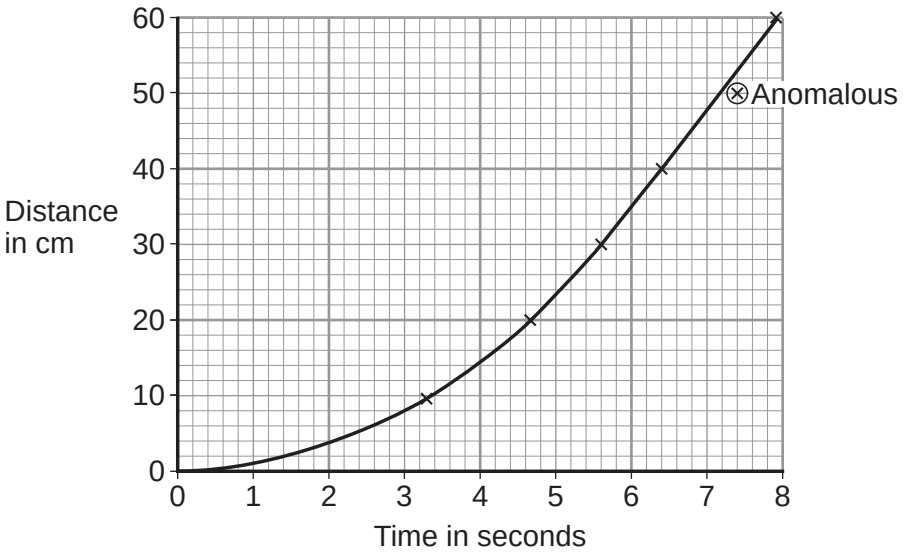
[1 mark]

4.5.6.1.2 Speed

Question 107 · continued

1 (b) **Figure 2** shows the student's results plotted as a graph.

Figure 2



1 (b) (i) The student has identified one of the results as being anomalous.

Use the correct answer from the box to complete the sentence.

[1 mark]

after	as	before

The anomalous result was caused by the stopwatch being started _____ the ball bearing was released.

1 (b) (ii) What can you conclude from the graph about the speed of the ball bearing during the first four seconds?

[1 mark]

_____

_____

1 (b) (iii) The graph shows that the ball bearing reached its terminal velocity.

Describe how the graph would be used to calculate the terminal velocity of the ball bearing.

[1 mark]

_____

_____

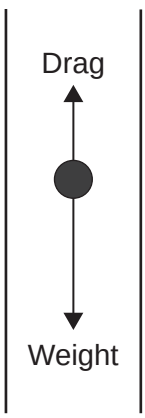
Question 1 continues on the next page

4.5.6.1.2 Speed

Question 107 · continued

1 (b) (iv) The directions of the two forces acting on the ball bearing as it falls through the oil are shown in **Figure 3**.

Figure 3



Explain, in terms of the forces shown in **Figure 3**, why the ball bearing reaches its terminal velocity.

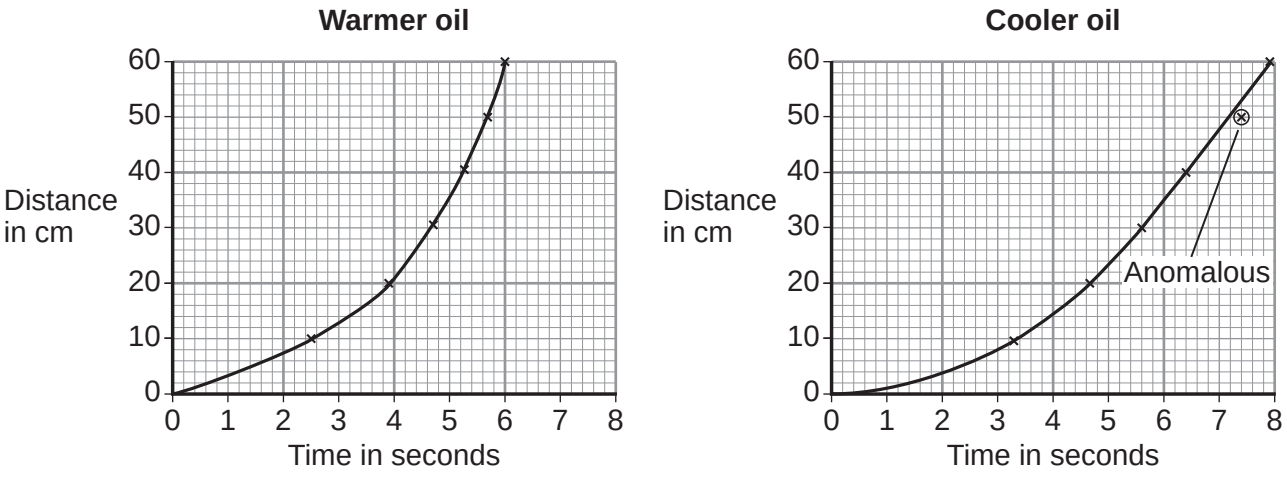
[2 marks]

Question 107 · continued

1 (c) The student repeated the investigation using warmer oil.

Figure 4 shows the set of results using the warmer oil **and** the set of results using the cooler oil.

Figure 4



Compare the two graphs in **Figure 4**.

Use the correct phrase from the box to complete the sentence.

[3 marks]

less than	**equal to**	**greater than**

After falling 40 cm, the drag force on the ball bearing in the warmer oil is

_____ the drag force on the ball bearing in the cooler oil.

Explain the reason for your answer.

_____

_____

_____

_____

9

4.5.6.1.2 Speed

Question 108

June 2016 | PH3HP | Original Q3 | Legacy

3 X-rays and ultrasound can both be used for scanning internal organs.

3 (a) Ultrasound is used to scan unborn babies but X-rays are **not** used to scan unborn babies.

Explain why.

[3 marks]

3 (b) The behaviour of ultrasound waves when they meet a boundary between two different materials is used to produce an image.

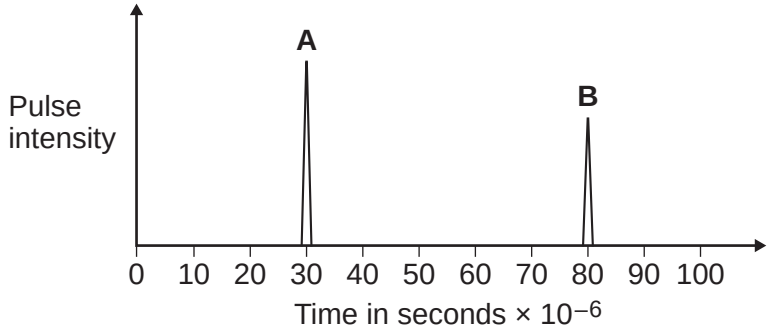
Describe how.

[2 marks]

Question 108 · continued

3 (c) **Figure 4** shows two pulses from a scan of an unborn baby. The emitted pulse is labelled **A**. The returning pulse picked up by the receiver is labelled **B**.

Figure 4



The closest distance between the unborn baby and the mother's skin is 4.0 cm.
Use information from **Figure 4** to calculate the average speed of the pulse.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Average speed = _____ m/s

Question 3 continues on the next page

4.5.6.1.2 Speed

Question 108 · continued

3 (d) **Figure 5** shows an X-ray of an arm with a broken bone.

Figure 5



3 (d) (i) Describe how X-rays are able to produce an image of bones.

[3 marks]

_____

_____

_____

_____

_____

_____

3 (d) (ii) Complete the following sentence.

X-rays are able to produce detailed images because their wavelength

is very _____ .

[1 mark]

12

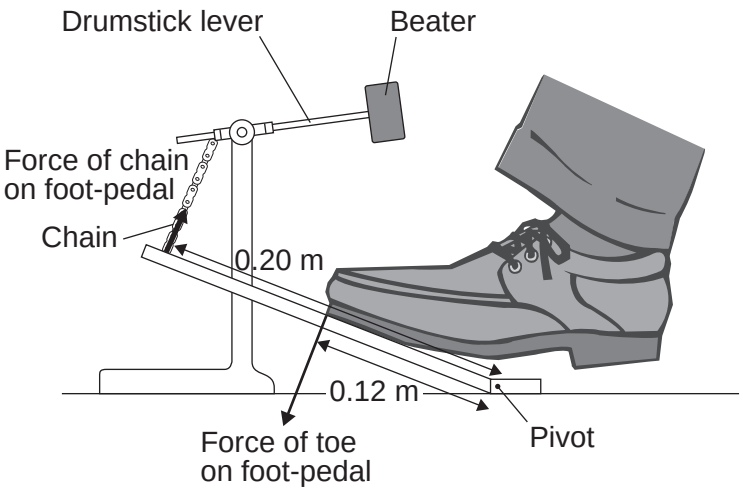
4.5.6.1.2 Speed

Question 109

June 2016 | PH3HP | Original Q5 | Legacy

5 A drum is hit by a beater attached to a drumstick lever. The drumstick lever is attached to a foot-pedal by a chain, as shown in **Figure 9**.

Figure 9



5 (a) When the toe is pushed down the force creates a moment on the foot-pedal.

5 (a) (i) State what is meant by the moment of a force.

[1 mark]

5 (a) (ii) The foot-pedal is pushed halfway down and held stationary. The toe and the chain both exert a force on the foot-pedal.

Compare the sizes and directions of the moments caused by the force of the toe and the force of the chain on the foot-pedal.

[1 mark]

4.5.6.1.2 Speed

Question 109 · continued

5 (a) (iii) The drummer's toe pushes with a 1.5 N force on the foot-pedal.
The perpendicular distance from the pivot to the force is 0.12 m.
The perpendicular distance from the pivot to the chain is 0.20 m.

Calculate the force of the chain acting on the foot-pedal.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Force = _____ N

Question 5 continues on the next page

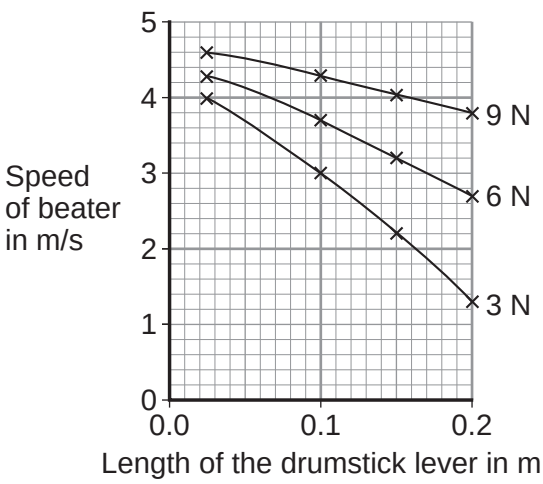
Question 109 · continued

5 (b) The foot-pedal is pushed with different forces to make the beater move at different speeds.

The higher the speed at which the beater hits the drum, the louder the sound the drum makes.

Figure 10 shows how the length of the drumstick lever affects the speed of the beater for three different forces.

Figure 10



The drummer needs to be able to sometimes play the drum quietly and sometimes loudly.

How does the **length** of the drumstick lever affect the variation in loudness of the sound from the drum when applying:

[2 marks]

a force of 3 N? _____

_____

a range of forces from 3 N to 9 N? _____

_____

7

4.5.6.1.2 Speed

Question 110

June 2017 | PH1HP | Original Q1 | Legacy

1 A laser emits light waves in the visible region of the electromagnetic spectrum.

1 (a) What type of wave are all electromagnetic waves?

[1 mark]

_____

1 (b) The light from a laser has a wavelength of 6.5×10^{-7} m

The speed of light is 3.0×10^{8} m/s

Calculate the frequency of the light from the laser.

Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

Frequency = _____ Hz

1 (c) What is the approximate range of wavelengths of the electromagnetic spectrum?

Tick (✓) **one** box.

[1 mark]

Range of wavelengths in metres	**Tick (✓)**
10^{-10} to 10^{8}	
10^{-8} to 10^{6}	
10^{-15} to 10^{4}	

5

4.5.6.1.2 Speed

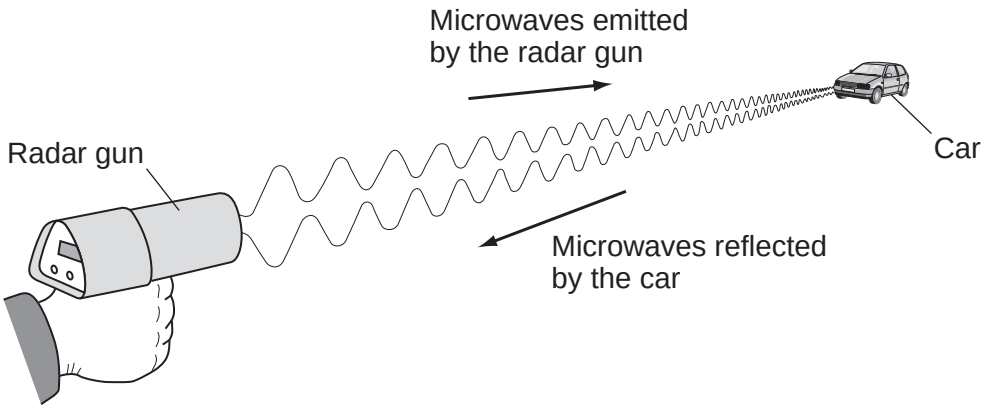
Question 111

June 2017 | PH1HP | Original Q4 | Legacy

4 A radar gun can be used to measure the speed of a car.

Microwaves are emitted by the radar gun and reflected by the car, as shown in **Figure 4**.

Figure 4



4 (a) The microwaves reflected by the moving car have a different frequency from the microwaves emitted by the radar gun.

What is the name of the effect causing this change in frequency?

[1 mark]

_____

4 (b) The data in **Table 2** are measurements taken from three different cars on the same piece of road.

Table 2

Car	Frequency of emitted microwaves in kHz	Frequency of reflected microwaves in kHz
A	27 000 000	27 000 002
B	27 000 000	27 000 000
C	27 000 000	26 999 997

4.5.6.1.2 Speed

Question 111 · continued

4 (b) (i) State which car in **Table 2** is moving towards the radar gun. Give a reason for your answer.

[2 marks]

Car _____

Reason _____

_____

4 (b) (ii) State which car in **Table 2** is moving the fastest. Give a reason for your answer.

[2 marks]

Car _____

Reason _____

_____

5

Turn over for the next question

4.5.6.1.2 Speed

Question 112

June 2017 | PH2HP | Original Q4 | Legacy

4 A lorry driver sees the traffic lights at a road junction change to red.
The driver applies the brakes to stop the lorry.

The stopping distance is the thinking distance plus the braking distance.

4 (a) (i) Which statement describes the thinking distance?

[1 mark]

Tick (✓) **one** box.

The time it takes for the lorry to stop after the brakes are applied. ☐

The time it takes the driver to react and apply the brakes. ☐

The distance the lorry travels once the brakes are applied. ☐

The distance the lorry travels during the driver's reaction time. ☐

4 (a) (ii) How does thinking distance depend on the speed of the lorry?

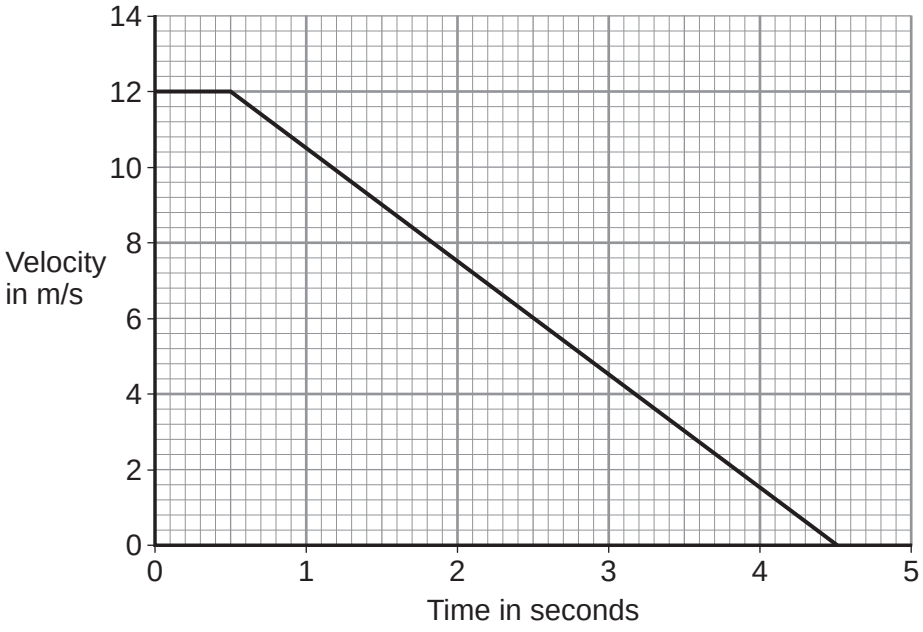
[1 mark]

_____

_____

4 (b) **Figure 3** shows how the velocity of the lorry changes from just after the driver sees the traffic lights change to red.

Figure 3



4.5.6.1.2 Speed

Question 112 · continued

4 (b) (i) Calculate the braking distance of the lorry.

Show how you used **Figure 3** to obtain your answer.

[2 marks]

Distance = _____ m

4 (b) (ii) The work done to stop the lorry is 360 kJ

Calculate the braking force used to stop the lorry.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Braking force = _____ N

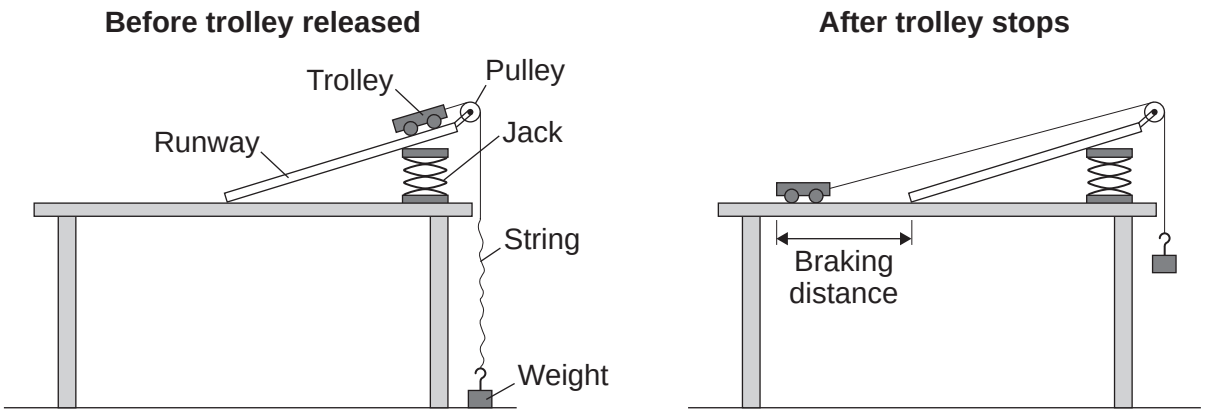
Question 4 continues on the next page

4.5.6.1.2 Speed

Question 112 · continued

4 (c) A student investigated how braking distance depends on braking force. The student used the apparatus shown in **Figure 4**.

Figure 4



The student released the trolley from the top of the runway. When the trolley reached the bottom of the runway the string became taut and the trolley started to lift a weight from the floor. The weight being lifted was equal to the braking force on the trolley.

The student changed the weight being lifted and measured the new braking distance.

4 (c) (i) State **one** control variable in this investigation.

[1 mark]

4 (c) (ii) **Figure 4** shows the braking distance measured by the student.

What else could the student have measured that would also have given the braking distance?

[1 mark]

4.5.6.1.2 Speed

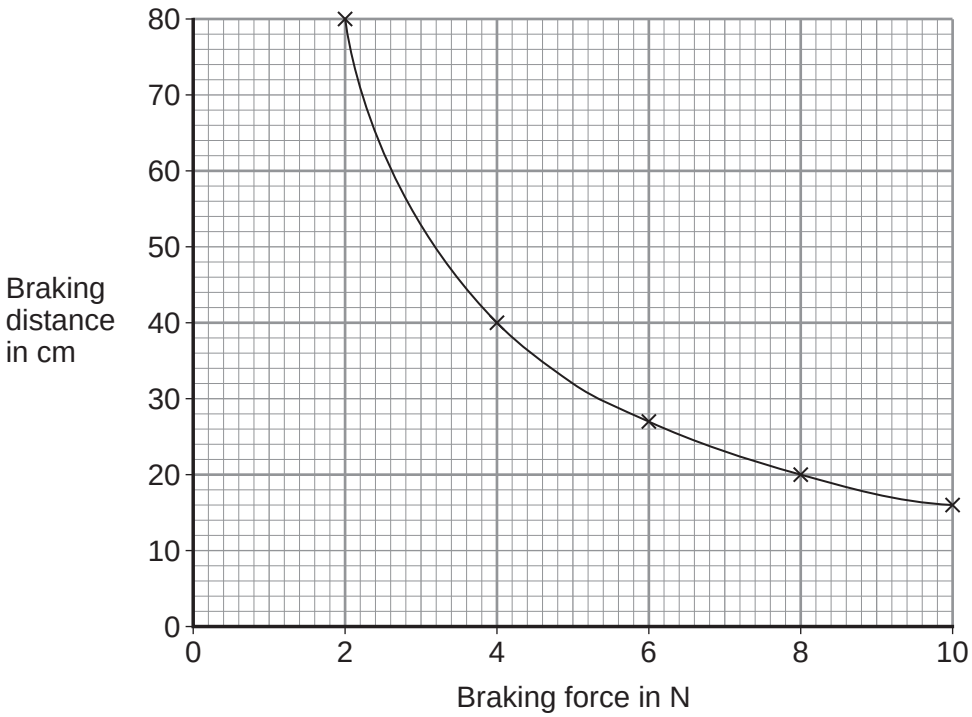
Question 112 · continued

4 (c) (iii) Measuring each braking distance at least twice would improve the investigation. Suggest why.

[2 marks]

4 (c) (iv) The results of the investigation are plotted as a graph in **Figure 5**.

Figure 5



What conclusions should be made from this investigation about the relationship between braking distance and braking force?

Use data from **Figure 5** to justify your conclusion.

[2 marks]

12

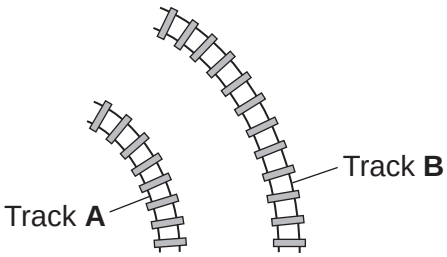
4.5.6.1.2 Speed

Question 113

June 2017 | PH3HP | Original Q8 | Legacy

8 **Figure 7** shows two train tracks, **A** and **B**.

Figure 7



8 (a) (i) A train moves at constant speed along track **A**.

Explain how the train can be accelerating while travelling at a constant speed.

[3 marks]

8 (a) (ii) Two identical trains travel on the tracks, one on track **A** and one on track **B**.

Explain which train can travel at the highest maximum speed.

[2 marks]

4.5.6.1.2 Speed

Question 113 · continued

8 (b) One type of train is designed to tilt as it goes around bends. Tilting the train more increases the centripetal force that acts on the train.

8 (b) (i) Suggest **one** advantage of creating a train which can vary the amount it tilts as it goes around bends.

[1 mark]

_____

_____

8 (b) (ii) The tilting train is designed so that the line of action of the weight of the train always lies between the two rails.

State why the train does not topple.

[1 mark]

_____

_____

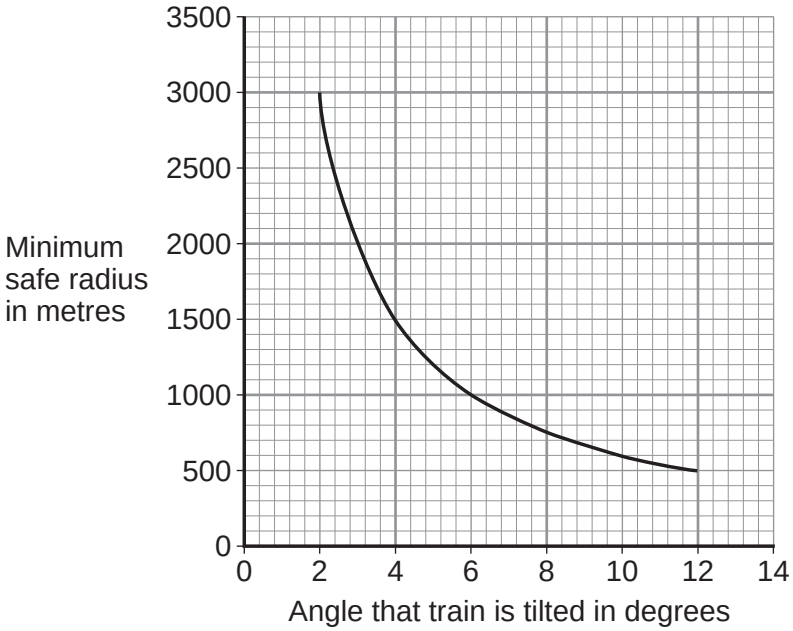
Question 8 continues on the next page

4.5.6.1.2 Speed

Question 113 · continued

8 (c) An engineer built a small scale model to predict the minimum safe radius of curved track that the tilted train could safely go round at 250 km/hour. The results predicted using the small scale model are shown in **Figure 8**.

Figure 8



8 (c) (i) The engineer described the relationship between the angle that the train tilted and the minimum safe radius at 250 km/hour as inversely proportional.

Use data from the graph to explain why the engineer is correct.

[2 marks]

8 (c) (ii) The engineer also created a computer simulation of the tilting train.

Suggest **one** benefit of using a computer simulation over using a small scale model.

[1 mark]

10

4.5.6.1.2 Speed

Question 114

June 2018 | 8463/1H | Original Q4

0 4 **Figure 5** shows a cyclist riding along a straight, level road at a constant speed.

Figure 5



0 4 . 1 Complete the sentences.

[2 marks]

As the cyclist rides along the road, the _____ energy store in the cyclist's body decreases.

The speed of the cyclist is constant when the work done by the cyclist is _____ the work done against air resistance.

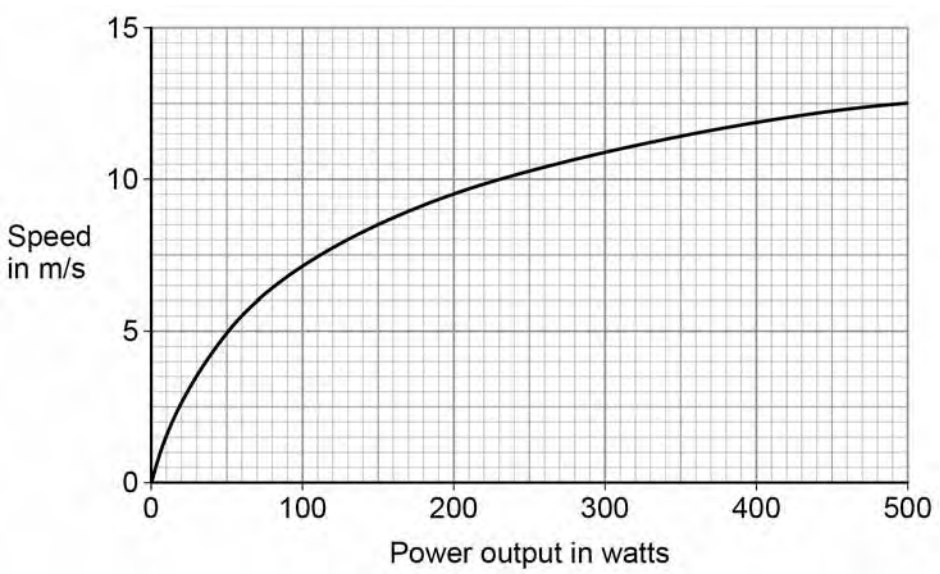
Question 4 continues on the next page

4.5.6.1.2 Speed

Question 114 · continued

Figure 6 shows how the speed changes as the power output of the cyclist changes.

Figure 6



0 4 . 2 Write down the equation that links power, time and work done.

[1 mark]

0 4 . 3 Calculate the work done by the cyclist when his power output is 200 W for 1800 seconds.

[3 marks]

Work done = _____ J

4.5.6.1.2 Speed

Question 114 · continued

0 4 . 4 Calculate the percentage increase in speed of the cyclist when the power output changes from 200 W to 300 W.

[2 marks]

Percentage increase in speed = _____

0 4 . 5 The maximum speed this cyclist can travel on a level road is 14 m/s.

How does cycling uphill affect the maximum speed of this cyclist?

Explain your answer.

[3 marks]

11

4.5.6.1.2 Speed

Question 115

June 2018 | 8463/1H | Original Q10

1 0 **Figure 16** shows a wind turbine.

Figure 16



1 0 . 1 At a particular wind speed, a volume of 2.3×10^4 m^3 of air passes the blades each second.

The density of air is 1.2 kg/m^3.

Calculate the mass of air passing the blades per second.

[3 marks]

Mass of air per second = _____ kg

1 0 . 2 The power output of the turbine is directly proportional to the kinetic energy of the air passing the blades each second.

Describe the effect on the power output when the wind speed is halved.

[3 marks]

4.5.6.1.2 Speed

Question 115 · continued

1 0 . 3 At a different wind speed, the wind turbine has a power output of 388 kW.

The mass of air passing the wind turbine each second is 13 800 kg.

Calculate the speed of the air passing the blades each second.

Assume that the process is 100% efficient.

[3 marks]

Speed of air = _____ m/s

9

4.5.6.1.2 Speed

Question 116

June 2018 | 8463/2H | Original Q3

0 3 P-waves and S-waves are two types of seismic wave caused by earthquakes.

0 3 . 1 Which **one** of the statements about P-waves and S-waves is correct?

Tick **one** box.

[1 mark]

P-waves and S-waves are transverse. ☐

P-waves and S-waves are longitudinal. ☐

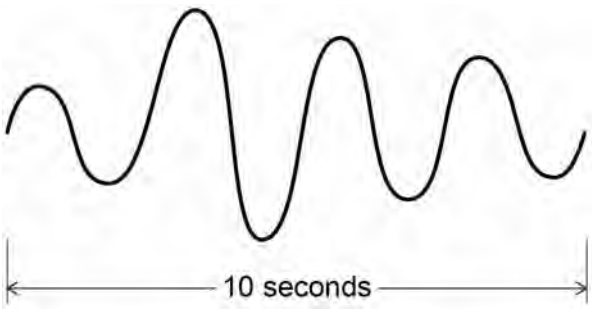
P-waves are transverse and S-waves are longitudinal. ☐

P-waves are longitudinal and S-waves are transverse. ☐

Seismometers on the Earth's surface record the vibrations caused by seismic waves.

Figure 3 shows the vibration recorded by a seismometer for one P-wave.

Figure 3



0 3 . 2 Calculate the frequency of the P-wave shown in **Figure 3**.

[1 mark]

Frequency = _____ Hz

4.5.6.1.2 Speed

Question 116 · continued

0 3 . 3 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

0 3 . 4 The P-wave shown in **Figure 3** is travelling at 7200 m/s.

Calculate the wavelength of the P-wave.

[3 marks]

Wavelength = _____ m

0 3 . 5 Explain why the study of seismic waves provides evidence for the structure of the Earth's core.

[2 marks]

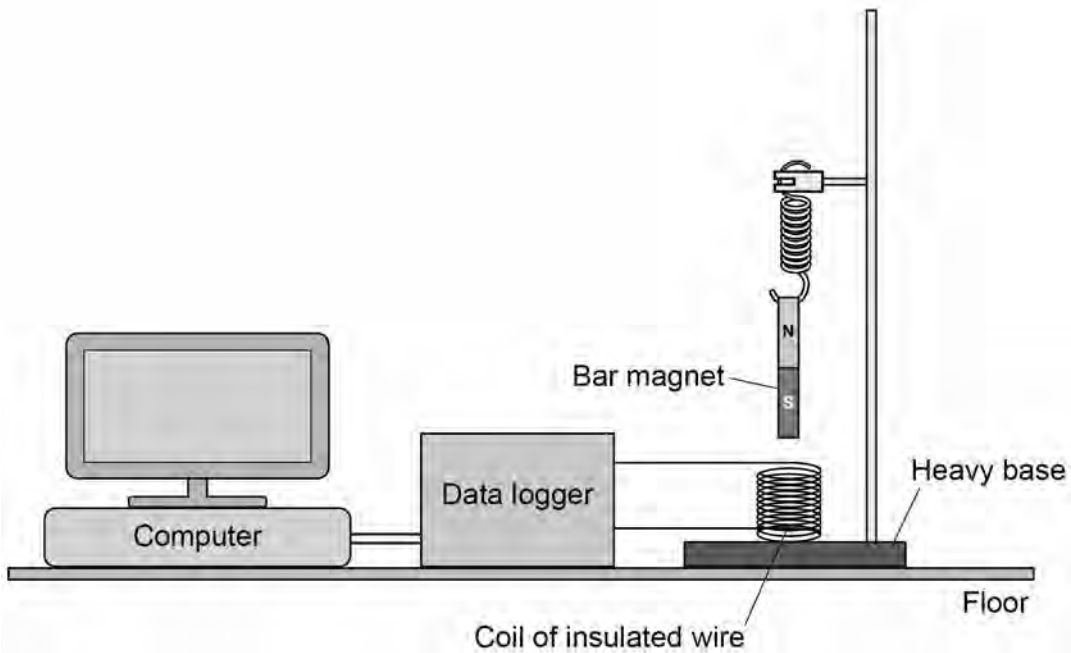
Question 3 continues on the next page

4.5.6.1.2 Speed

Question 116 · continued

Figure 4 shows a simple seismometer made by a student.

Figure 4



To test that the seismometer works, the student pushes the bar magnet into the coil and then releases the bar magnet.

0 3 . 6 Why does the movement of the bar magnet induce a potential difference across the coil?

[1 mark]

0 3 . 7 Why is the induced potential difference across the coil alternating?

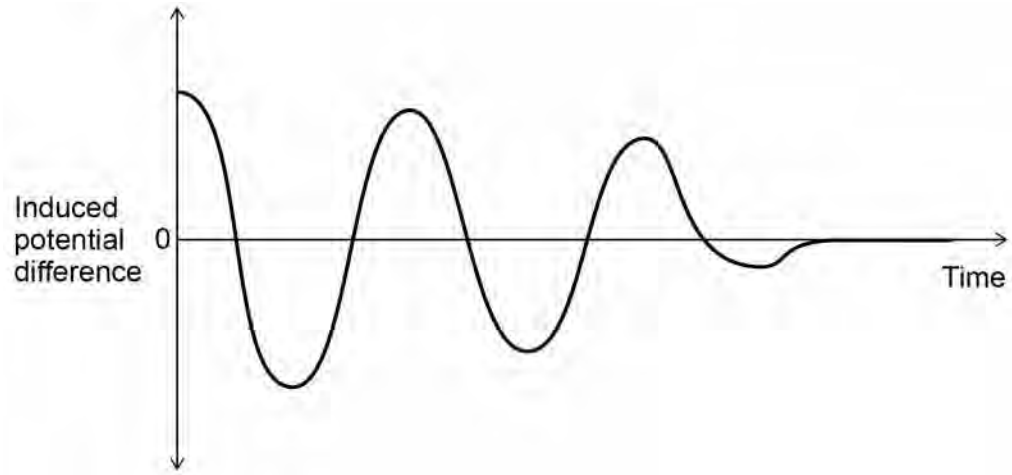
[1 mark]

4.5.6.1.2 Speed

Question 116 · continued

0 3 . 8 **Figure 5** shows how the potential difference induced across the coil varies after the bar magnet has been released.

Figure 5



Which statement describes the movement of the magnet when the induced potential difference is zero?

Tick **one** box.

[1 mark]

Accelerating upwards. ☐

Constant speed upwards. ☐

Decelerating downwards. ☐

Stationary. ☐

0 3 . 9 The seismometer cannot detect small vibrations.

Suggest **two** changes to the design of the seismometer that would make it more sensitive to small vibrations.

[2 marks]

1 _____

_____

2 _____

_____

13

4.5.6.1.2 Speed

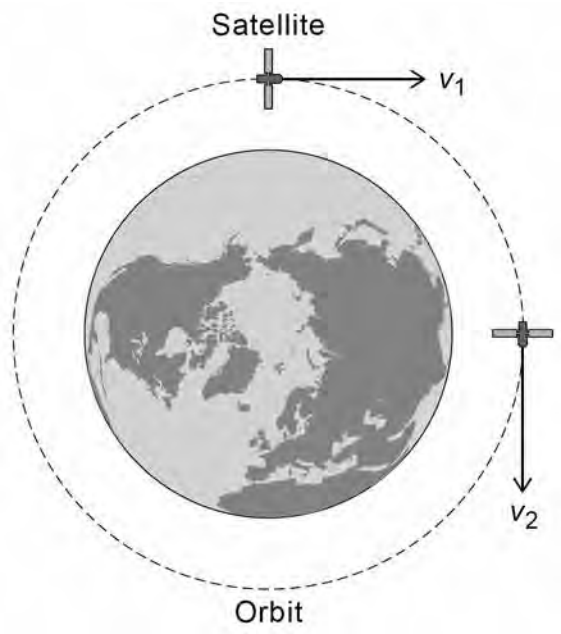
Question 117

June 2018 | 8463/2H | Original Q8

0 8 A satellite is in a circular orbit around the Earth.

Figure 14 shows the velocity of the satellite at two different positions in the orbit.

Figure 14



0 8 . 1 Explain why the velocity of the satellite changes as it orbits the Earth.

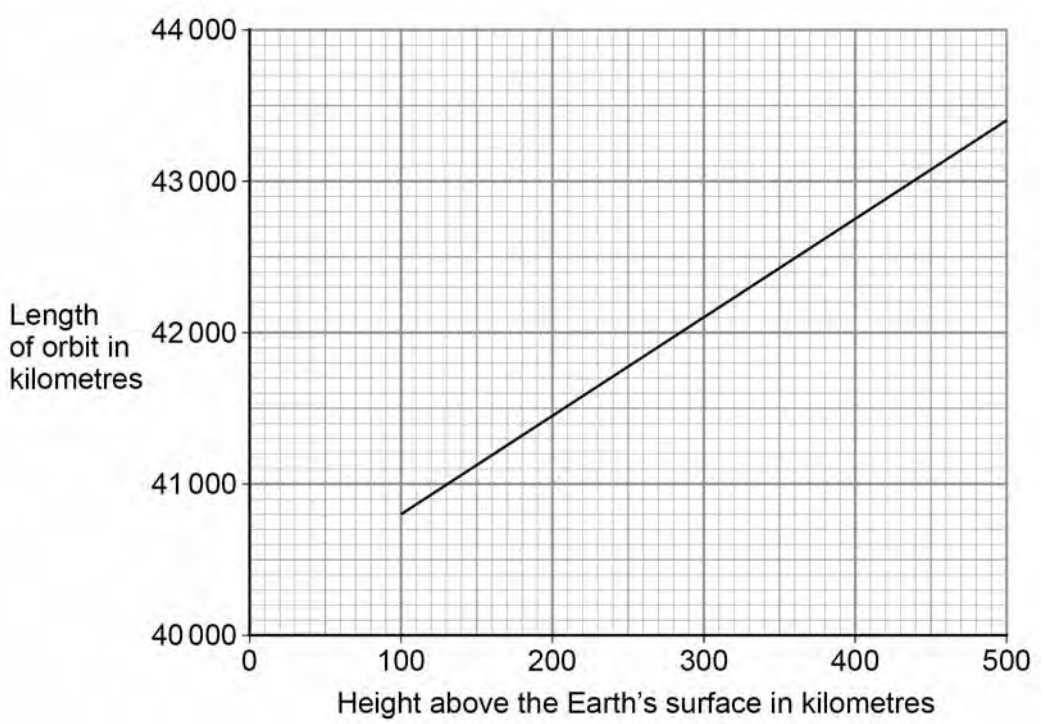
[3 marks]

Question 8 continues on the next page

Question 117 · continued

0 8 . 2 **Figure 15** shows how the length of a satellite orbit depends on the height of the satellite above the Earth's surface.

Figure 15



A satellite orbits 300 km above the Earth's surface at a speed of 7.73 km/s.

Calculate how many complete orbits of the Earth the satellite will make in 24 hours.

[5 marks]

Number of complete orbits = _____

4.5.6.1.2 Speed

Question 117 · continued

In 1772, an astronomer called J Bode developed an equation to predict the orbital radii of the planets around the Sun.

Table 3 shows Bode's predicted orbital radii and the actual orbital radii for the planets that were known in 1772.

Table 3

Planet	Predicted orbital radius in millions of kilometres	Actual orbital radius in millions of kilometres
Mercury	60	58
Venus	105	108
Earth	150	150
Mars	240	228
Jupiter	780	778
Saturn	1500	1430

0 8 . 3 The predicted data can be considered to be accurate.

Give the reason why.

[1 mark]

0 8 . 4 J Bode used his equation to predict the existence of a planet with an orbital radius of 2940 million kilometres.

The planet Uranus was discovered in 1781.

Uranus has an orbital radius of 2875 million kilometres.

Explain why the discovery of Uranus was important.

[2 marks]

11

4.5.6.1.2 Speed

Question 118

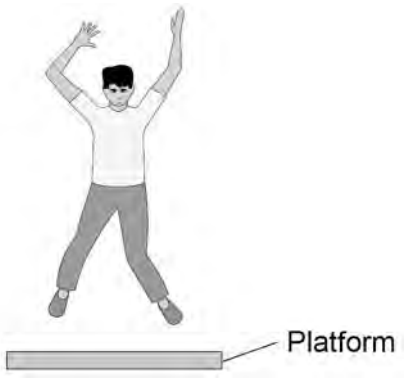
June 2019 | 8463/1H | Original Q3

0 3 A scientist investigated how the maximum muscle power of humans varies with age and gender.

The scientist asked volunteers to stand on a platform and to jump as high as they could.

Figure 4 shows a volunteer taking part in the experiment.

Figure 4



An electronic timer measured the time that the volunteer was in the air.

0 3 . 1 The muscle power in watts per kg is calculated using the following equation:

$$\text{muscle power} = \frac{9.8 \times \text{jump height}}{\text{time}}$$

One volunteer has a muscle power of 41 W/kg

He was in the air for 0.12 s

Calculate his jump height.

[3 marks]

Jump height = _____ m

4.5.6.1.2 Speed

Question 118 · continued

0 3 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

0 3 . 3 One volunteer had a kinetic energy of 270 J and a speed of 3.0 m/s at the moment he left the ground.

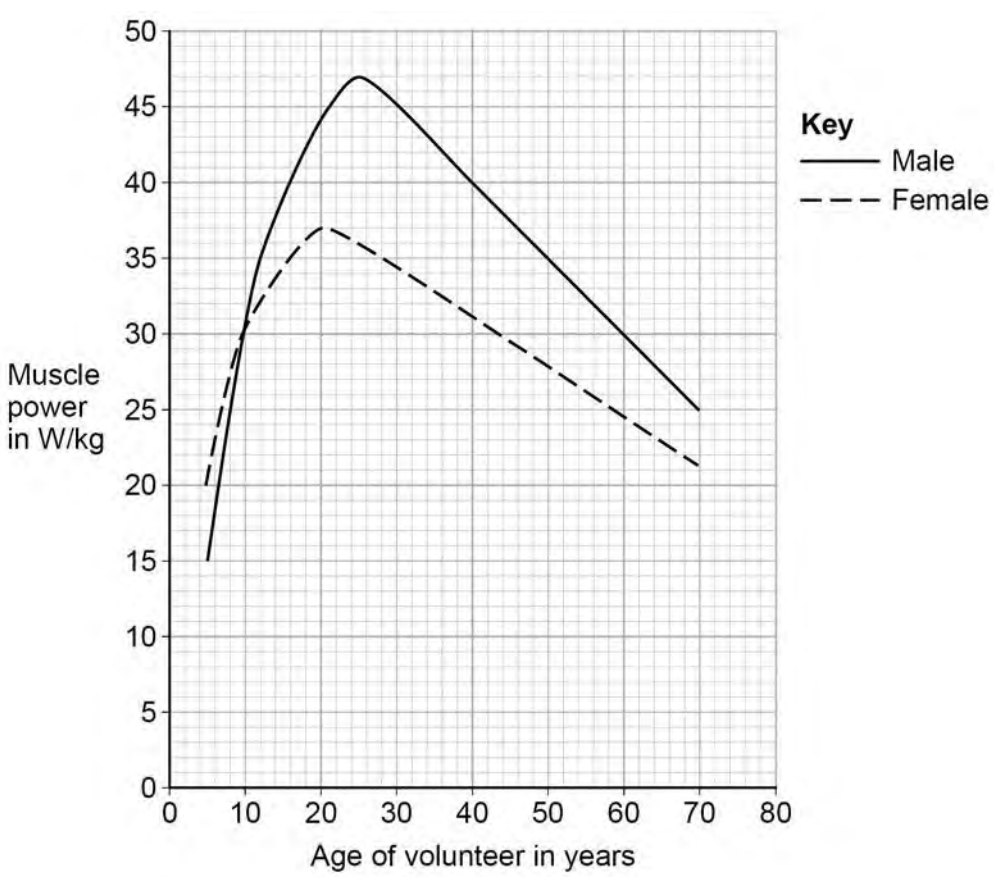
Calculate his mass.

[3 marks]

Mass = _____ kg

Figure 5 shows the scientist's results.

Figure 5



4.5.6.1.2 Speed

Question 118 · continued

0 3 . 4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 5** in your answer.

[4 marks]

0 3 . 5 The muscle power of each volunteer was measured five times.

The highest muscle power reading was recorded instead of calculating an average.

Suggest **one** reason why.

[1 mark]

12

4.5.6.1.2 Speed

Question 119

0 4 Electric cars have motors that are powered by a battery.

Diesel cars have engines that are powered by diesel fuel.

Table 2 compares one type of electric car with one type of diesel car.

Table 2

Power source	Energy density in MJ / kg	Mass of power source in kg	Total mass of car in kg	Time to recharge battery or refill fuel tank in minutes
Battery	0.95	280	1600	40
Diesel fuel	45	51	1500	3

0 4 . 1 The electric car has a range of 400 km with a fully charged battery.

The diesel car has a range of 1120 km with a full tank of diesel.

Explain the difference in the time needed to complete a 500 km journey using the electric car compared with the diesel car.

Assume both cars travel at the same speed.

[2 marks]

4.5.6.1.2 Speed

Question 119 · continued

0 4 . 2 Energy density is the amount of energy stored per kilogram of the energy source.

Show why the diesel car has a greater range than the electric car.

Use data from **Table 2**.

Assume the efficiency of the two cars is the same.

Include calculations in your answer.

[3 marks]

Question 4 continues on the next page

4.5.6.1.2 Speed

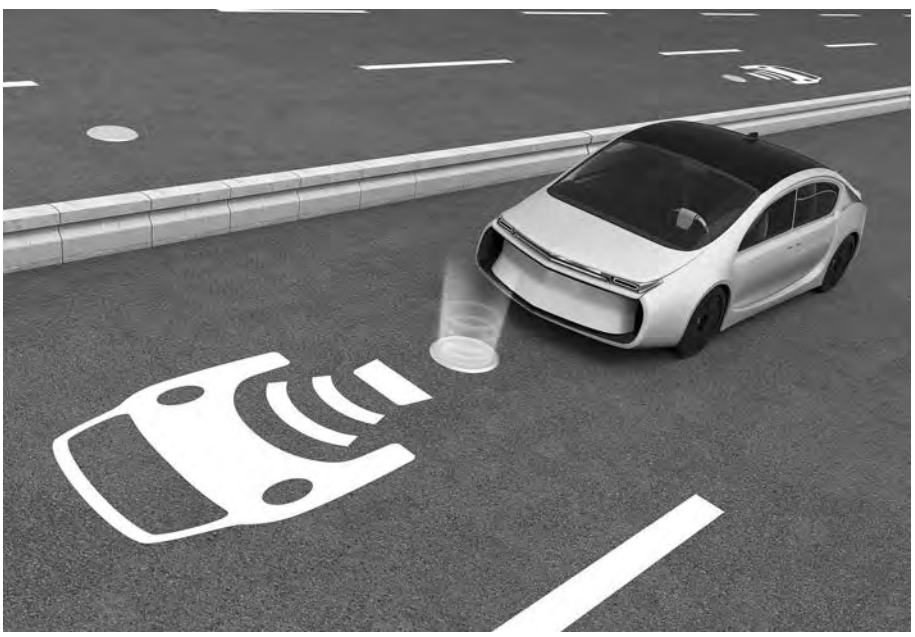
Question 119 · continued

Engineers have developed a way of charging electric cars while they are driving along the road.

Coils of wire buried under the road transfer energy to the car's battery as the car is passing over the coils.

Figure 6 shows a charging lane on a motorway.

Figure 6



0 4 . 3 Suggest **two** advantages of using this method to charge electric cars compared with plugging them into the mains electricity supply.

[2 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

4.5.6.1.2 Speed

Question 119 · continued

0 4 . 4 When electric cars are not being driven, energy stored in their batteries could be used to meet sudden peaks in electricity demand.

Suggest how.

[2 marks]

9

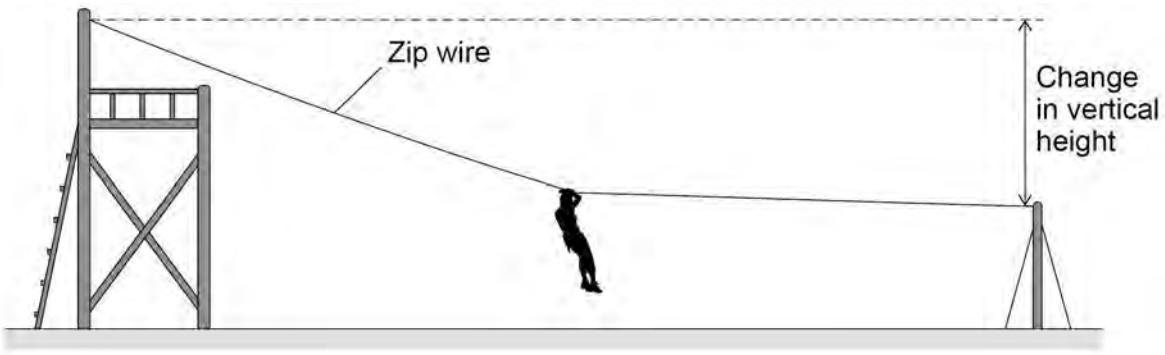
4.5.6.1.2 Speed

Question 120

June 2019 | 8463/1H | Original Q7

0 7 **Figure 9** shows a person sliding down a zip wire.

Figure 9



0 7 . 1 As the person slides down the zip wire, the change in the gravitational potential energy of the person is 1.47 kJ

The mass of the person is 60 kg

gravitational field strength = 9.8 N/kg

Calculate the change in vertical height of the person.

[3 marks]

Change in vertical height = _____ m

4.5.6.1.2 Speed

Question 120 · continued

0 7 . 2 As the person moves down the zip wire her increase in kinetic energy is less than her decrease in gravitational potential energy.

Explain why.

[2 marks]

0 7 . 3 Different people have different speeds at the end of the zip wire.

Explain why.

[2 marks]

7

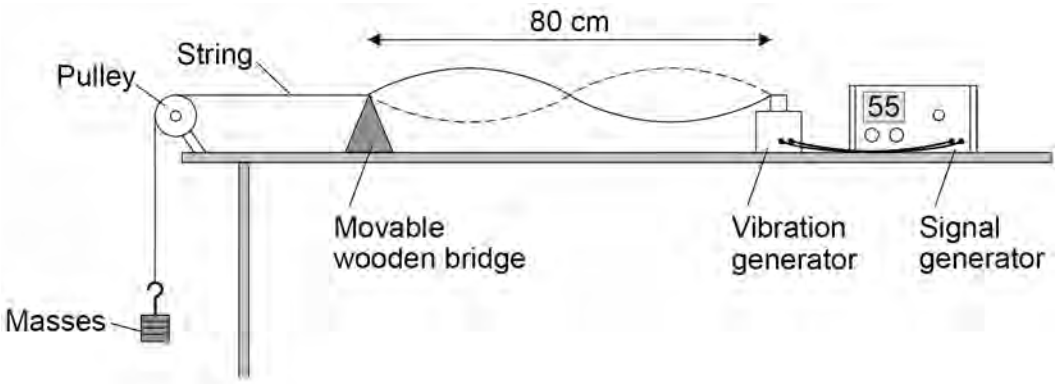
4.5.6.1.2 Speed

Question 121

June 2019 | 8463/2H | Original Q2

0 2 **Figure 4** shows the apparatus used to investigate the waves in a stretched string.

Figure 4



The frequency of the signal generator is adjusted so that the wave shown in **Figure 4** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 4**.

0 2 . 1 The wavelength of the wave shown in **Figure 4** was measured as 80 cm

What piece of apparatus would have been suitable for measuring this wavelength?

[1 mark]

0 2 . 2 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

0 2 . 3 The string in **Figure 4** vibrates at 55 Hz

Calculate the wave speed of the wave shown in **Figure 4**.

Use data given in **Figure 4**.

[3 marks]

Wave speed = _____ m/s

4.5.6.1.2 Speed

Question 121 · continued

0 2 . 4 The frequency of the signal generator is increased.

This makes the wavelength of the wave change.

The wave speed stays the same.

Describe how the apparatus could be adjusted to show one complete wave without reducing the frequency.

[2 marks]

0 2 . 5 A student wants to investigate how the speed of a wave on a stretched string depends on the tension in the string.

The student uses the apparatus in **Figure 4**.

Describe a method the student could use for this investigation.

[4 marks]

11

4.5.6.1.2 Speed

Question 122

June 2019 | 8463/2H | Original Q5

0 5 . 1 The light from distant galaxies shows red-shift.

Complete the sentence.

[1 mark]

The term red-shift describes the observed increase

in the _____ of the light from a distant galaxy.

0 5 . 2 The Big Bang theory is one model used to explain the origin of the universe.

How does the Big Bang theory describe the universe when it began?

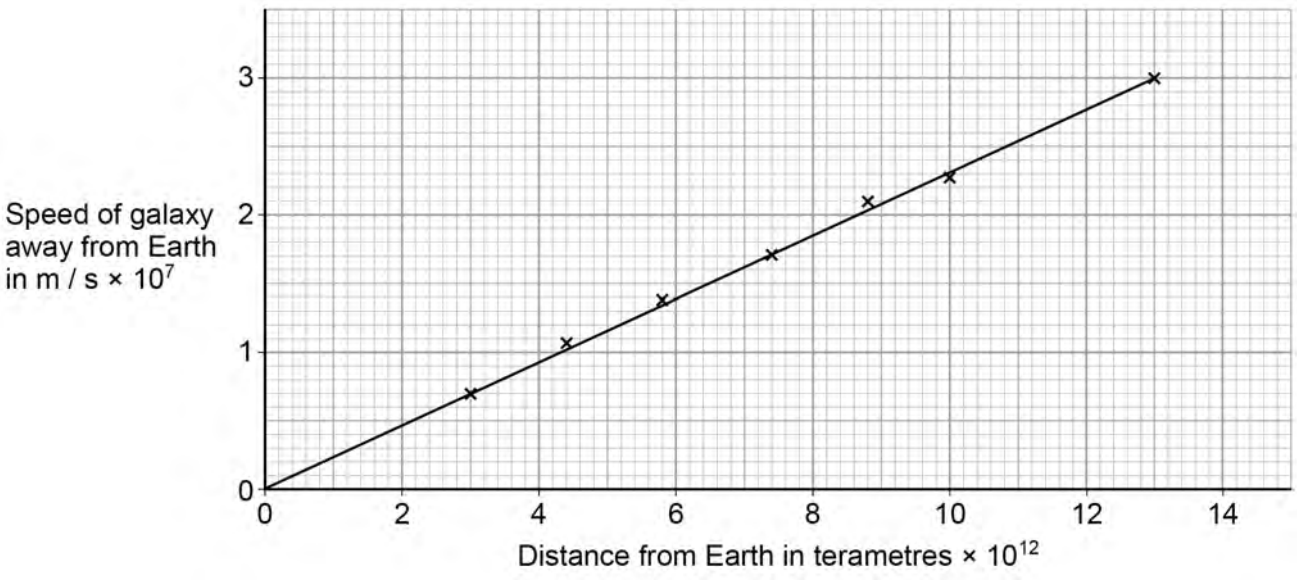
[1 mark]

_____

_____

Figure 9 shows data scientists have calculated from measurements of red-shift.

Figure 9



4.5.6.1.2 Speed

Question 122 · continued

0 5 . 3 Describe the relationship between the speed of a galaxy and the distance the galaxy is from the Earth.

[1 mark]

0 5 . 4 Which of the following is the same as 6×10^{12} terametres?

[1 mark]

Tick (✓) **one** box.

6×10^{15} m ☐

6×10^{18} m ☐

6×10^{21} m ☐

6×10^{24} m ☐

0 5 . 5 Explain how the data in **Figure 9** supports the suggestion that the universe began from a very small region.

[2 marks]

Question 5 continues on the next page

4.5.6.1.2 Speed

Question 122 · continued

0 5 . 6 The Big Bang theory suggested that gravity would slow the rate at which galaxies move away from the Earth.

New observations suggest that distant galaxies are moving away from the Earth at an increasingly fast rate.

What do the new observations suggest is happening to the universe?

[1 mark]

0 5 . 7 New observations and data that do not fit existing theories should undergo peer review.

Give **one** reason why peer review is an important process.

[1 mark]

0 5 . 8 The Andromeda galaxy is moving towards the Earth.

Describe how the wavelength and frequency of the light from Andromeda seem to have changed when viewed from the Earth.

[2 marks]

10

4.5.6.1.2 Speed

Question 123

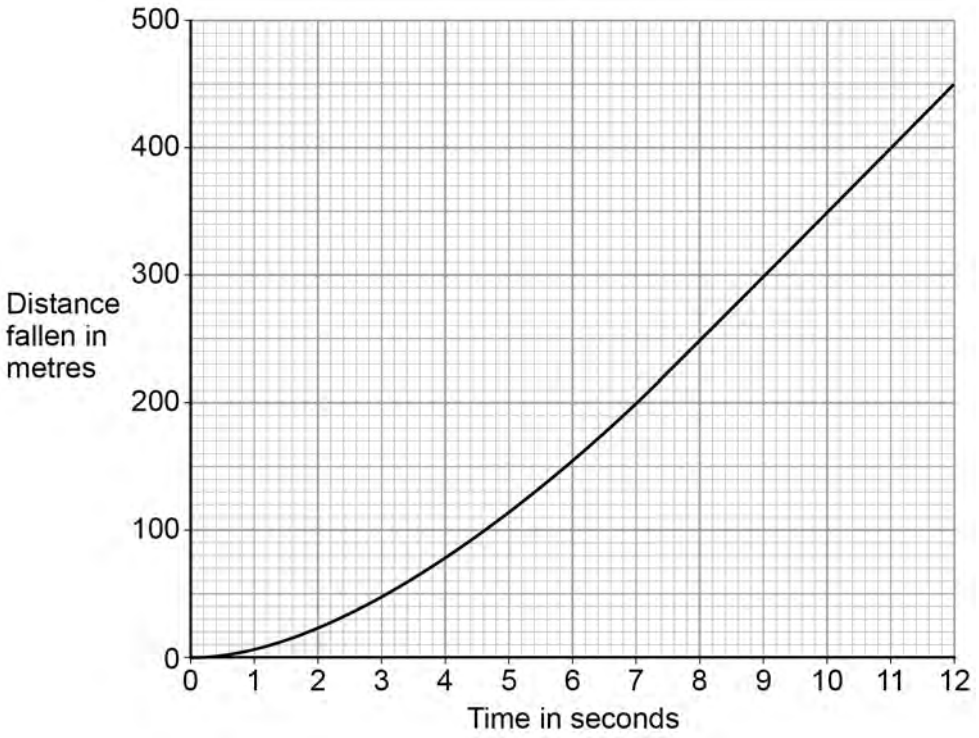
June 2019 | 8463/2H | Original Q8

0 8 An aeroplane is 4000 m above the Earth's surface.

A skydiver jumps from the aeroplane and falls vertically.

Figure 15 shows the distance the skydiver falls during the first 12 seconds after jumping.

Figure 15

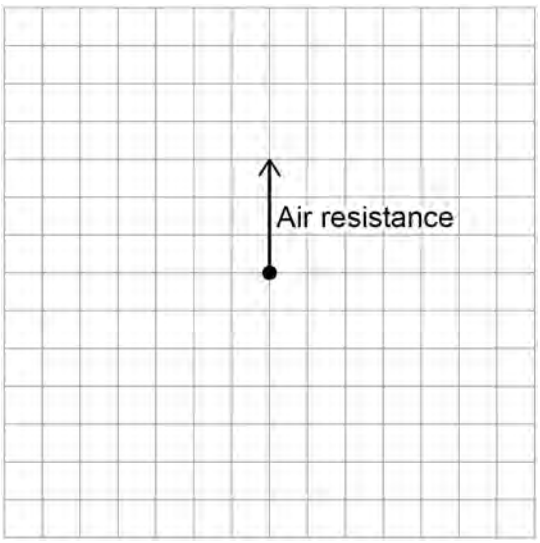


0 8 . 1 **Figure 16** shows part of the free body diagram for the skydiver three seconds after jumping.

Complete the free body diagram for the skydiver.

[2 marks]

Figure 16



4.5.6.1.2 Speed

Question 123 · continued

0 8 . 2 Explain the changing motion of the skydiver in terms of the forces acting on the skydiver.

[4 marks]

0 8 . 3 Use **Figure 15** to determine the speed of the skydiver between 7 seconds and 12 seconds.

[3 marks]

Speed = _____ m/s

Question 8 continues on the next page

4.5.6.1.2 Speed

Question 123 · continued

June 2019 | 8463/2H | Original Q8

0 8 . 4 In 2012 a skydiver jumped from a helium balloon 39 000 metres above the Earth's surface. The skydiver reached a maximum speed of 377 m/s

Jumping from 39 000 metres allowed the skydiver to reach a much higher speed than a skydiver jumping from 4000 metres.

Explain why.

[3 marks]

12

4.5.6.1.2 Speed

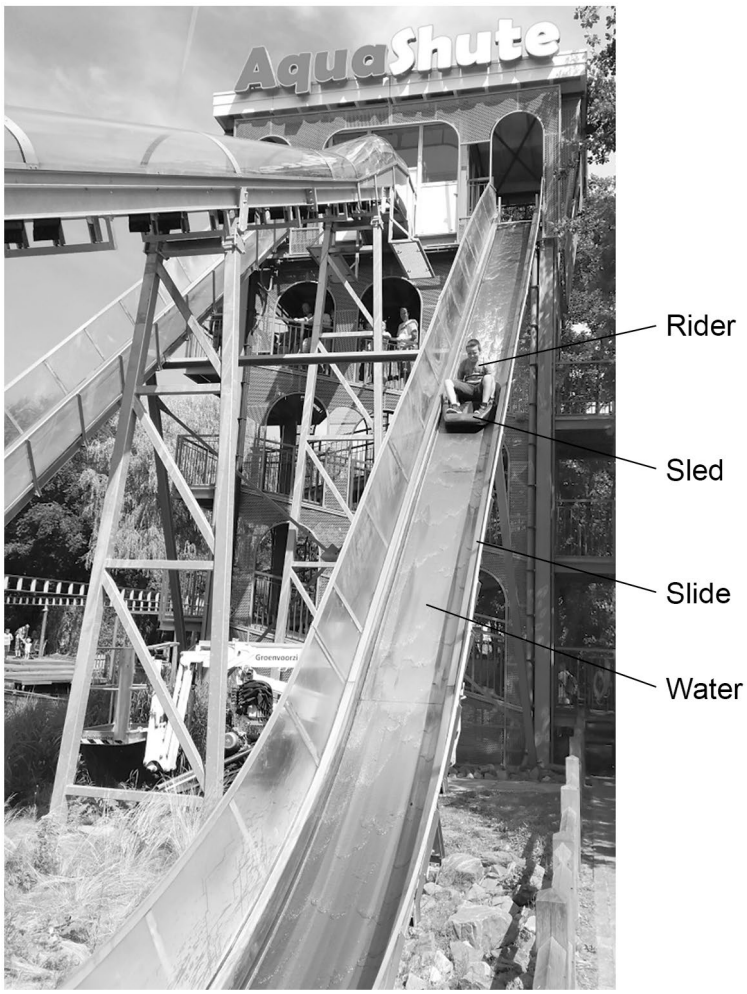
Question 124

November 2020 | 8463/1H | Original Q6

0 6 **Figure 9** shows a theme park ride called AquaShute.

Riders of the AquaShute sit on a sled and move down a slide.

Figure 9



0 6 . 1 A light gate and data logger can be used to determine the speed of each rider and sled.

What two measurements are needed to determine the speed of a rider and sled?

[2 marks]

Tick (✓) **two** boxes.

- Gravitational field strength ☐
- Length of sled ☐
- Mass of rider and sled ☐
- Temperature of surroundings ☐
- Time for sled to pass light gate ☐

4.5.6.1.2 Speed

Question 124 · continued

0 6 . 2 The decrease in gravitational potential energy of one rider on the slide was 8.33 kJ.

The rider moved through a vertical height of 17.0 m.

gravitational field strength = 9.8 N/kg

Calculate the mass of the rider.

[4 marks]

Mass of rider = _____ kg

0 6 . 3 At the bottom of the slide, all riders and their sleds have approximately the same speed.

Explain why.

[4 marks]

10

4.5.6.1.2 Speed

Question 125

November 2020 | 8463/2H | Original Q2

0 2 . 1 Complete the sentences.

[2 marks]

The Sun is a stable star. This is because the forces pulling inwards caused by _____ are in equilibrium with the forces pushing outwards caused by the energy released by nuclear _____.

0 2 . 2 Write down the equation that links distance travelled (s), speed (v) and time (t).

[1 mark]

_____

0 2 . 3 The mean distance between the Sun and the Earth is 1.5×10^{11} m.

Light travels at a speed of 3.0×10^{8} m/s.

Calculate the time taken for light from the Sun to reach the Earth.

[3 marks]

_____

_____

_____

_____

_____

Time = _____ s

4.5.6.1.2 Speed

Question 125 · continued

0 2 . 4 Some stars are much more massive than the Sun.

Describe the life cycle of stars much more massive than the Sun, including the formation of new elements.

[6 marks]

Question 2 continues on the next page

4.5.6.1.2 Speed

Question 125 · continued

0 2 . 5 Stars emit radiation with a range of wavelengths.

Which property of a star does the range of wavelengths depend on?

[1 mark]

Tick (✓) **one** box.

- Density ☐
- Mass ☐
- Temperature ☐
- Volume ☐

13

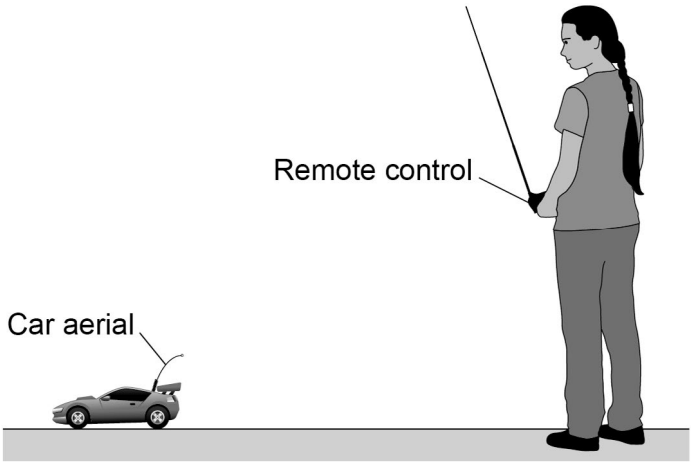
4.5.6.1.2 Speed

Question 126

November 2020 | 8463/2H | Original Q6

0 6 **Figure 8** shows a student playing with a remote-controlled car.

Figure 8



0 6 . 1 The remote control transmits radio waves to the car aerial.

The transmitted radio waves have a frequency of 320 MHz.

speed of radio waves = 3.0×10^8 m/s

Calculate the wavelength of the radio waves.

Give the unit.

[5 marks]

Wavelength = _____ Unit _____

4.5.6.1.2 Speed

Question 126 · continued

0 6 . 2 The car aerial is connected to an electrical circuit in the car.

Describe what happens in the electrical circuit when the car aerial absorbs radio waves.

[2 marks]

0 6 . 3 The car produces sound waves.

Give **two** ways in which radio waves are different to sound waves.

[2 marks]

1

2

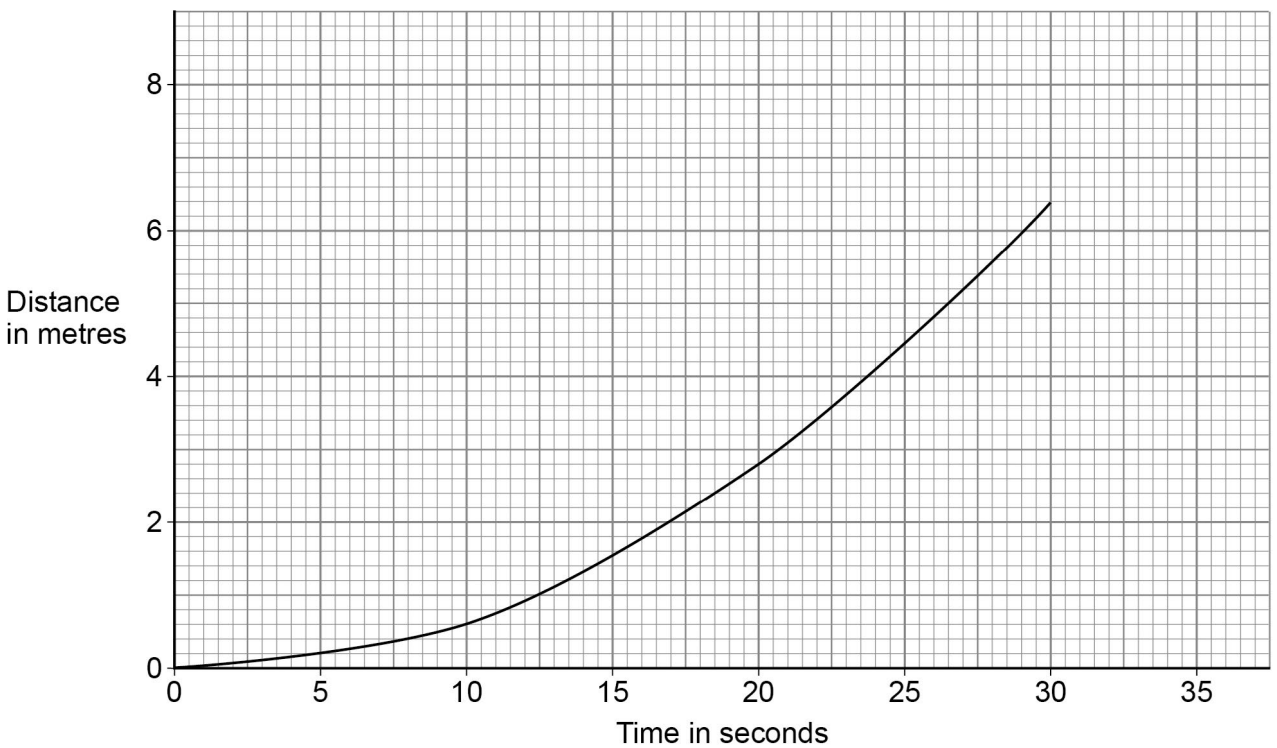
Question 6 continues on the next page

4.5.6.1.2 Speed

Question 126 · continued

Figure 9 shows the distance-time graph for the first 30 seconds of the car's motion.

Figure 9



0 6 . 4 Describe the motion of the car during the first 30 seconds.

[1 mark]

0 6 . 5 Determine the speed of the car 20 seconds after it started to move.

[4 marks]

Speed = _____ m/s

4.5.6.1.2 Speed

Question 126 · continued

0 6 . 6 A different car accelerated from 0.12 m/s to 0.52 m/s.

The acceleration of the car was 0.040 m/s^2.

The work done to accelerate the car was 0.48 J.

Calculate the resultant force needed to accelerate the car.

[6 marks]

Resultant force = _____ N

0 6 . 7 Explain why the car has a maximum speed.

[4 marks]

24

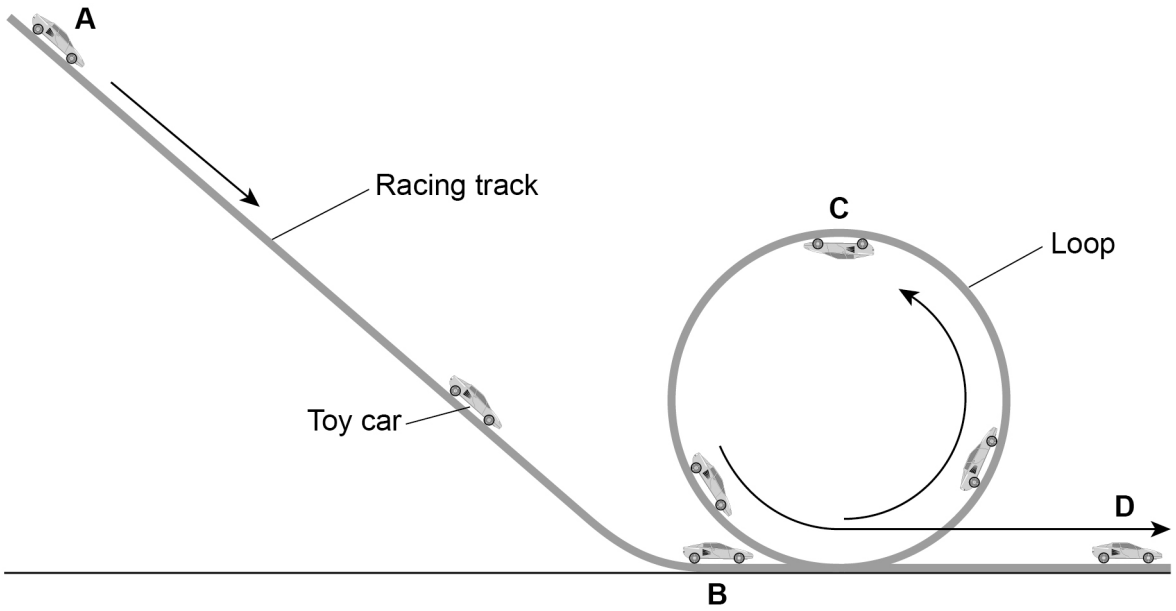
4.5.6.1.2 Speed

Question 127

November 2021 | 8463/1H | Original Q8

0 8 **Figure 11** shows a toy car in different positions on a racing track.

Figure 11



0 8 . 1 The toy car and racing track can be modelled as a closed system.

Why can the toy car and racing track be considered 'a closed system'?

[1 mark]

Tick (✓) **one** box.

The racing track and the car both have gravitational potential energy. ☐

The racing track and the car are always in contact with each other. ☐

The total energy of the racing track and the car is constant. ☐

4.5.6.1.2 Speed

Question 127 · continued

0 8 . 2 The car is released from rest at position **A** and accelerates due to gravity down the track to position **B**.

mass of toy car = 0.040 kg

vertical height between position **A** and position **B** = 90 cm

gravitational field strength = 9.8 N/kg

Calculate the maximum possible speed of the toy car when it reaches position **B**.

[5 marks]

Speed = _____ m/s

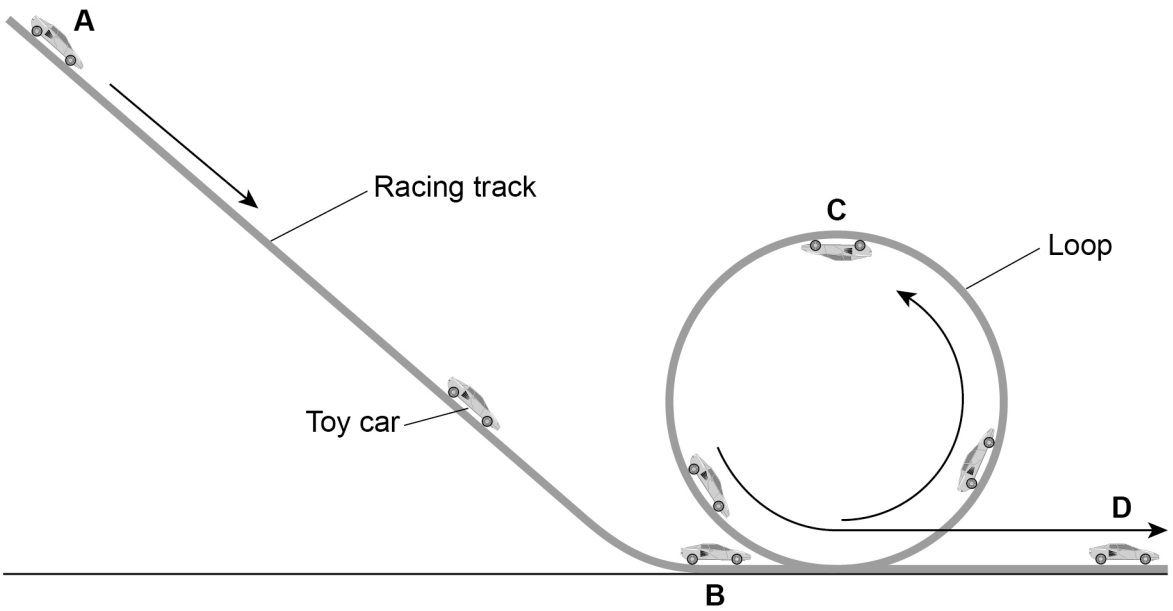
Question 8 continues on the next page

4.5.6.1.2 Speed

Question 127 · continued

Figure 11 is repeated below.

Figure 11



0 8 . 3 At position **C** the car's gravitational potential energy is 0.20 J greater than at position **B**.

How much kinetic energy does the car need at position **B** to complete the loop of the track?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Less than 0.20 J ☐

Exactly 0.20 J ☐

More than 0.20 J ☐

Reason _____

_____

_____

8

4.5.6.1.2 Speed

Question 128

November 2021 | 8463/2H | Original Q1

0 1 The thinking distance and braking distance for a car vary with the speed of the car.

0 1 . 1 Explain the effect of **two** other factors on the **braking** distance of a car.

Do **not** refer to speed in your answer.

[4 marks]

Question 1 continues on the next page

4.5.6.1.2 Speed

Question 128 · continued

0 1 . 2 Which equation links acceleration (a), mass (m) and resultant force (F).

[1 mark]

Tick (✓) **one** box.

resultant force = mass × acceleration ☐

resultant force = mass × acceleration^2 ☐

resultant force = $\frac{\text{mass}}{\text{acceleration}^2}$ ☐

resultant force = $\frac{\text{mass}}{\text{acceleration}}$ ☐

0 1 . 3 The mean braking force on a car is 7200 N.

The car has a mass of 1600 kg.

Calculate the deceleration of the car.

[3 marks]

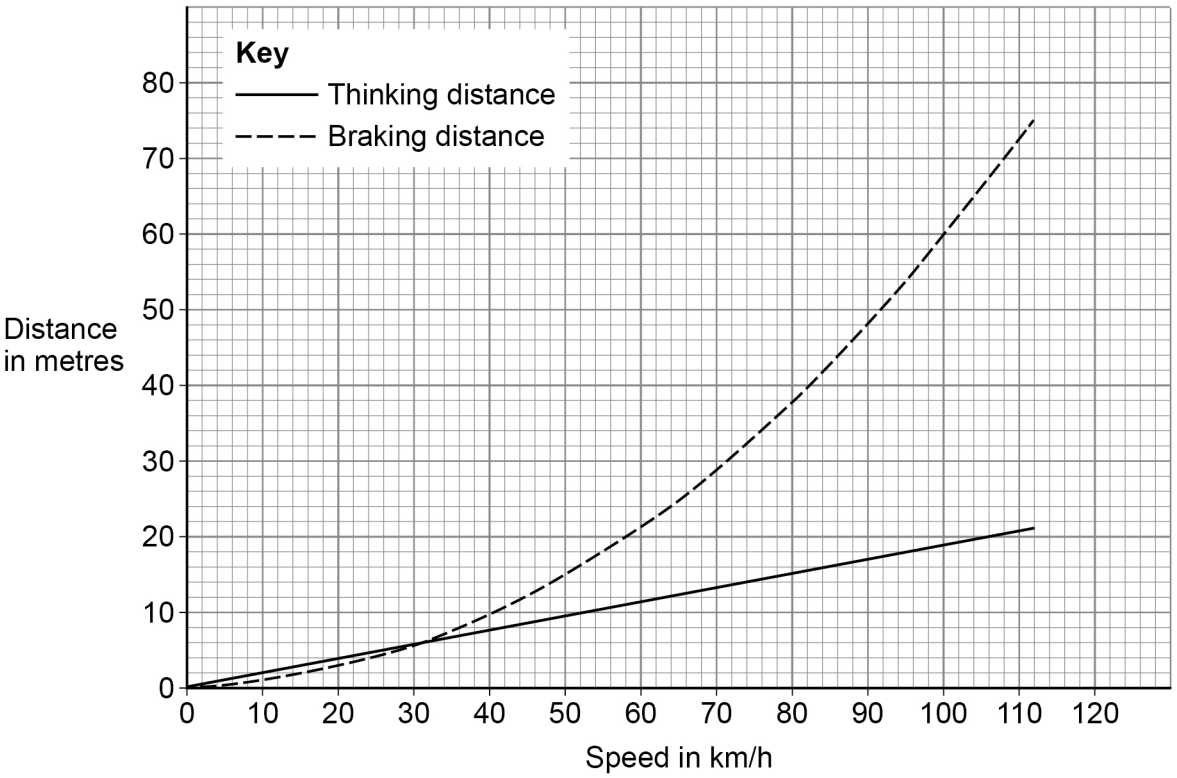
Deceleration = _____ m/s^2

4.5.6.1.2 Speed

Question 128 · continued

0 1 . 4 **Figure 1** shows how the thinking distance and braking distance for a car vary with the speed of the car.

Figure 1



Determine the stopping distance when the car is travelling at 80 km/h.

[2 marks]

Stopping distance = _____ m

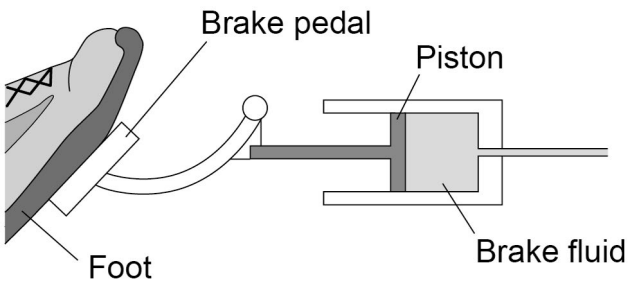
Question 1 continues on the next page

4.5.6.1.2 Speed

Question 128 · continued

Figure 2 shows part of the braking system for a car.

Figure 2



0 1 . 5 Which equation links area of a surface (A), the force normal to that surface (F) and pressure (p).

[1 mark]

Tick (✓) **one** box.

$p = F \times A$ ☐

$p = F \times A^2$ ☐

$p = \frac{F}{A}$ ☐

$p = \frac{A}{F}$ ☐

4.5.6.1.2 Speed

Question 128 · continued

0 1 . 6 When the brake pedal is pressed, a force of 60 N is applied to the piston.

The pressure in the brake fluid is 120 000 Pa.

Calculate the surface area of the piston.

Give your answer in standard form.

Give the unit.

[5 marks]

Surface area (in standard form) = _____ Unit _____

16

4.5.6.1.2 Speed

Question 129

November 2021 | 8463/2H | Original Q3

0 3 A main sequence star in a distant galaxy is the same size and mass as the Sun.

0 3 . 1 Explain why the star is stable while it is in the main sequence stage of its life cycle.

[2 marks]

0 3 . 2 Describe what will happen to the star between the main sequence stage and the end of the star's life cycle.

You should include the names of the stages in the life cycle of the star.

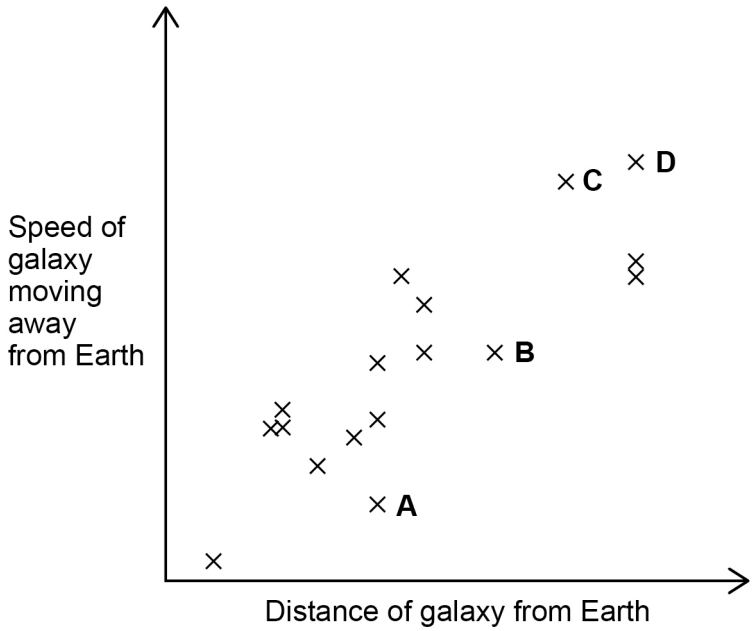
[3 marks]

4.5.6.1.2 Speed

Question 129 · continued

0 3 . 3 **Figure 5** shows how the speed of galaxies moving away from Earth varies with the distance of the galaxies from Earth.

Figure 5



Which galaxy would show the smallest observed change in the wavelength of visible light?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Reason _____

_____

7

4.5.6.1.2 Speed

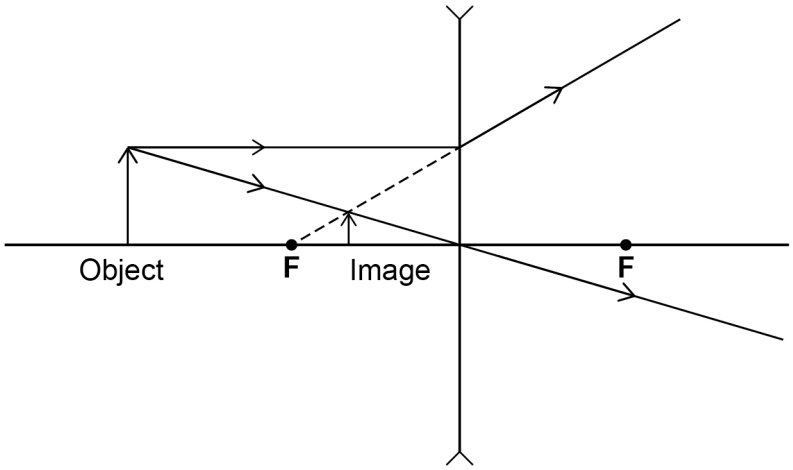
Question 130

November 2021 | 8463/2H | Original Q4

0 4 Lenses are used to form images of objects.

0 4 . 1 **Figure 6** shows how a concave lens forms an image of an object.

Figure 6



The image of the object in **Figure 6** is upright.

Give **two** other words that describe the image.

[1 mark]

1 _____

2 _____

4.5.6.1.2 Speed

Question 130 · continued

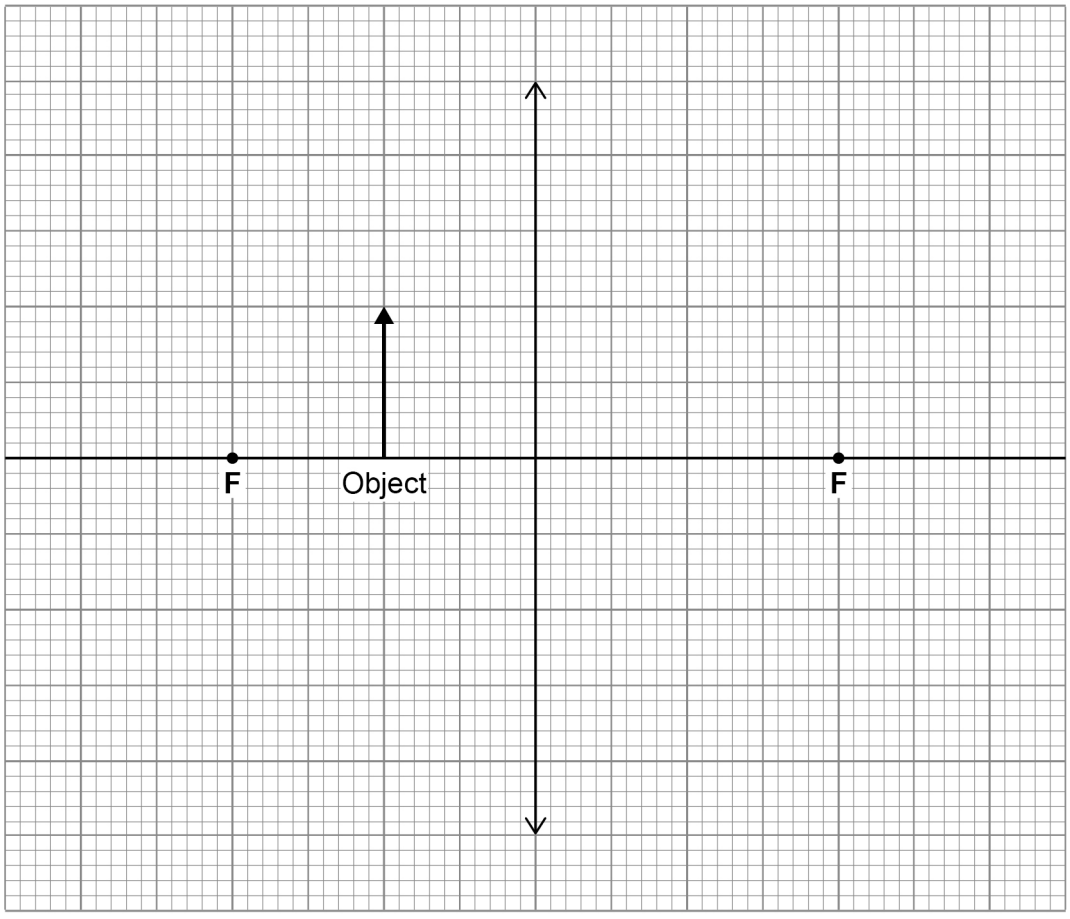
0 4 . 2 **Figure 7** shows an object near to a **convex** lens.

Complete the ray diagram to show how the image is formed.

Use an arrow to represent the image.

[3 marks]

Figure 7



Question 4 continues on the next page

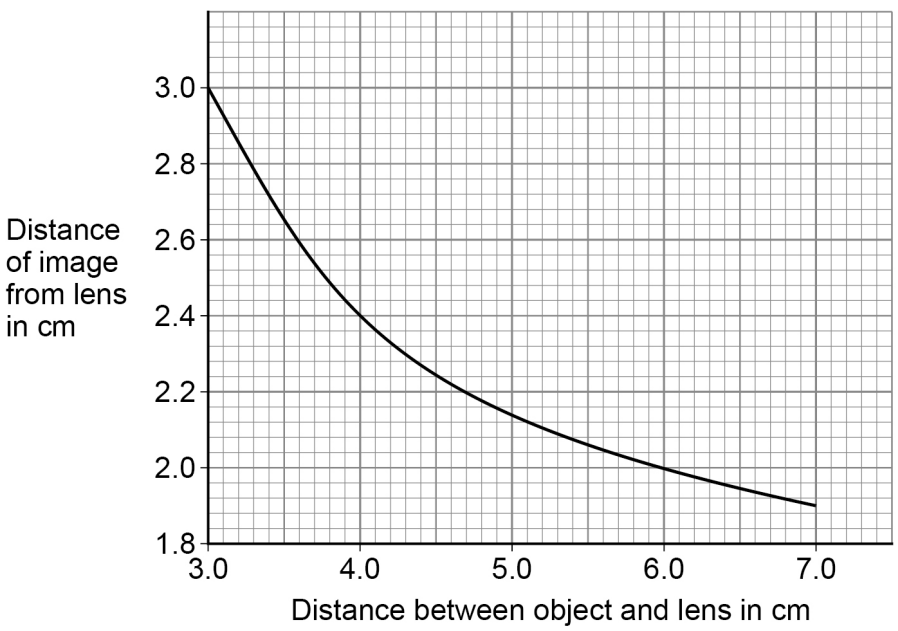
4.5.6.1.2 Speed

Question 130 · continued

The position of an image formed by a convex lens varies with the distance between the object and the lens.

Figure 8 shows the results of a student's investigation using a convex lens.

Figure 8



0 4 . 3 Describe how the distance of the image from the lens decreases as the distance between the object and the lens increases.

[1 mark]

4.5.6.1.2 Speed

Question 130 · continued

0 4 . 4 The student measured the distance from the image to the lens four times.

The distance between the object and the lens did not change.

The 4 measurements from the image to the lens were:

1.9 cm 1.7 cm 2.2 cm 1.4 cm

Calculate the uncertainty in the measurements.

[2 marks]

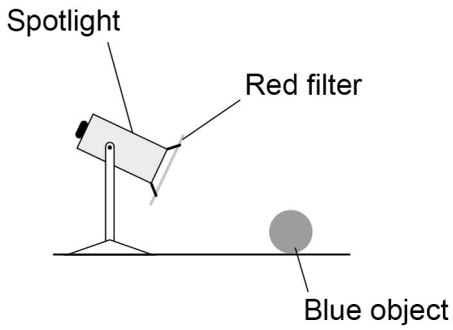
Uncertainty = ± _____ cm

0 4 . 5 **Figure 9** shows a spotlight containing a convex lens.

A red filter is placed in front of the spotlight.

The spotlight is directed at a blue object.

Figure 9



Explain why the blue object appears black.

[3 marks]

10

4.5.6.1.2 Speed

Question 131

November 2021 | 8463/2H | Original Q5

0 5 Ultraviolet is a type of electromagnetic wave.

0 5 . 1 Give **one** use of ultraviolet.

[1 mark]

_____

0 5 . 2 An ultraviolet wave has a wavelength of 300 nanometres.

Which of the following is equal to 300 nanometres?

[1 mark]

Tick (✓) **one** box.

3×10^{7} m ☐

3×10^{-7} m ☐

3×10^{9} m ☐

3×10^{-9} m ☐

0 5 . 3 The speed of ultraviolet waves is 3×10^{8} m/s.

Calculate the frequency of the ultraviolet wave.

Use your answer to Question **05.2**

[3 marks]

_____

_____

_____

_____

_____

Frequency = _____ Hz

Question 131 · continued

0 5 . 4 **Table 1** gives the wavelength of an ultraviolet wave and three other electromagnetic waves.

Table 1

	Ultraviolet	Wave E	Wave F	Wave G
Wavelength in nanometres	300	0.1	600	100 000

Draw **one** line from each wave to the name of the wave.

[1 mark]

Wave	Name
Wave E	Infrared
Wave F	Visible light
Wave G	X-rays

0 5 . 5 Electromagnetic waves are transverse.

Some other types of wave are longitudinal.

Describe the difference between transverse and longitudinal waves.

[2 marks]

8

4.5.6.1.2 Speed

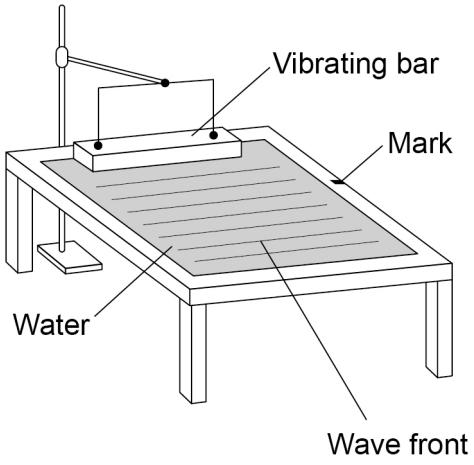
Question 132

November 2021 | 8463/2H | Original Q6

0 6 A teacher demonstrated some features of waves using a ripple tank.

Figure 10 shows the ripple tank.

Figure 10



0 6 . 1 The teacher measured the time taken for 10 wave fronts to pass the mark.

The teacher repeated this measurement three times and calculated the mean.

What is the advantage of repeating measurements and calculating a mean?

[1 mark]

Question 132 · continued

0 6 . 2 The teacher's measurements for the time taken for 10 wave fronts to pass the mark were:

8.4 s 7.8 s 8.1 s

Calculate the mean frequency of the wave.

Give your answer to 2 significant figures.

[5 marks]

Mean frequency (2 significant figures) = _____ Hz

0 6 . 3 In a different investigation, the teacher wanted to determine the speed of water waves in the ripple tank.

The teacher did **not** measure the wavelength of the wave.

Explain how the teacher could determine the speed of the wave.

[3 marks]

9

4.5.6.1.2 Speed

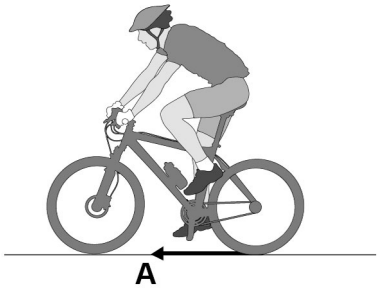
Question 133

November 2021 | 8463/2H | Original Q7

0 7 **Figure 11** shows a cyclist riding a bicycle.

Force **A** causes the bicycle to accelerate forwards.

Figure 11

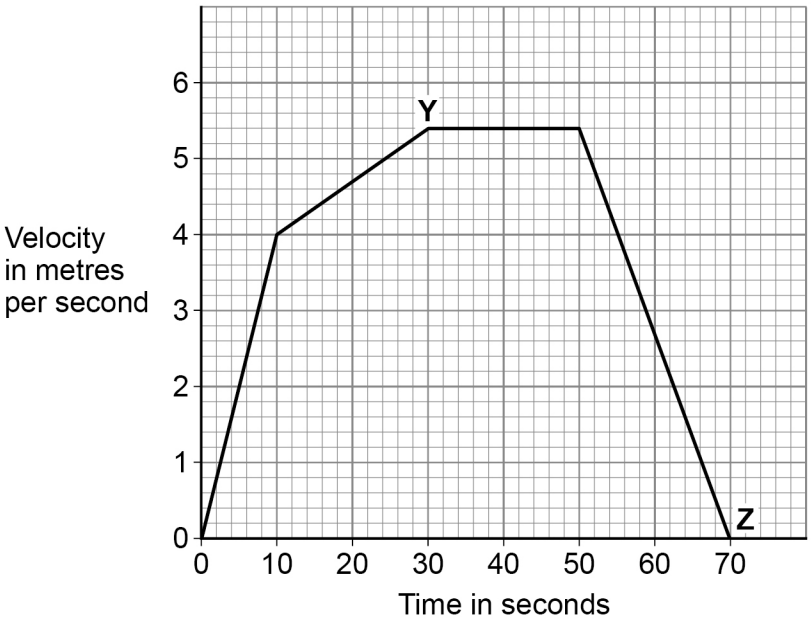


0 7 . 1 What name is given to force **A**?

[1 mark]

Figure 12 shows how the velocity of the cyclist changes during a short journey.

Figure 12



4.5.6.1.2 Speed

Question 133 · continued

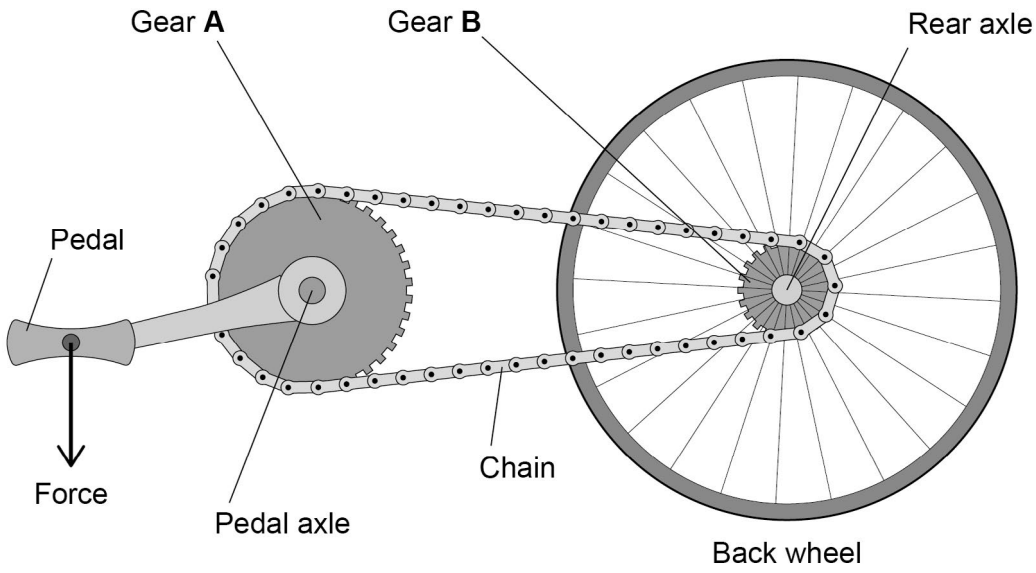
0 7 . 2 Determine the distance travelled by the cyclist between **Y** and **Z**.

[3 marks]

Distance travelled by the cyclist between **Y** and **Z** = _____ m

0 7 . 3 **Figure 13** shows the gears on the bicycle.

Figure 13



Describe how the force on the pedal causes a moment about the rear axle.

[2 marks]

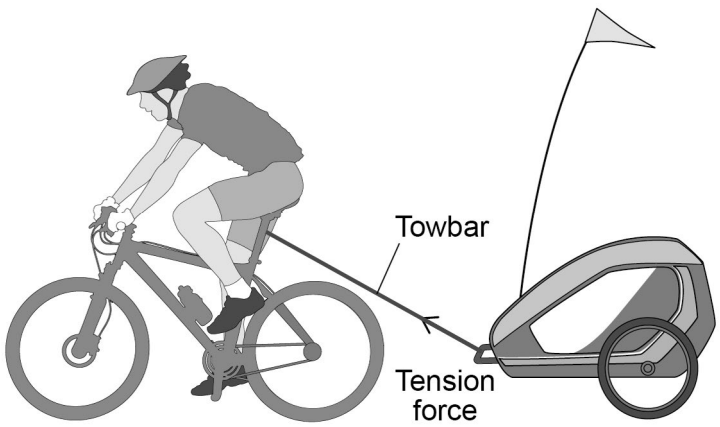
Question 7 continues on the next page

4.5.6.1.2 Speed

Question 133 · continued

Figure 14 shows a different cyclist towing a trailer.

Figure 14



0 7 . 4 The speed of the cyclist and trailer increased uniformly from 0 m/s to 2.4 m/s.

The cyclist travelled 0.018 km while accelerating.

Calculate the initial acceleration of the cyclist.

[3 marks]

Acceleration = _____ m/s^2

4.5.6.1.2 Speed

Question 133 · continued

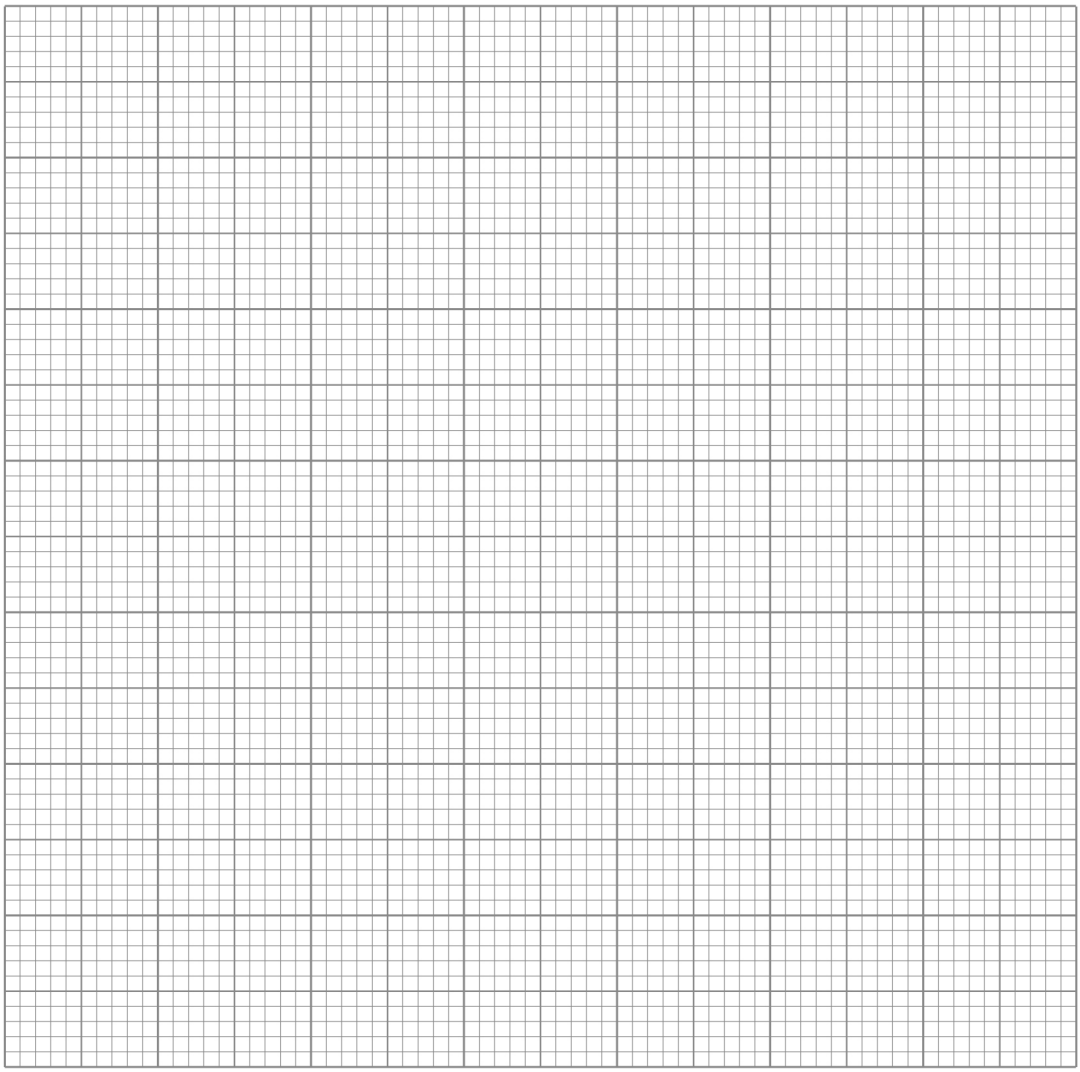
0 7 . 5 The resultant force of the towbar on the trailer has a horizontal component and a vertical component.

horizontal force = 200 N

vertical force = 75 N

Determine the magnitude and direction of the resultant force of the towbar on the trailer by drawing a vector diagram.

[4 marks]



Magnitude of force = _____ N

Direction of force = _____ degrees

13

4.5.6.1.2 Speed

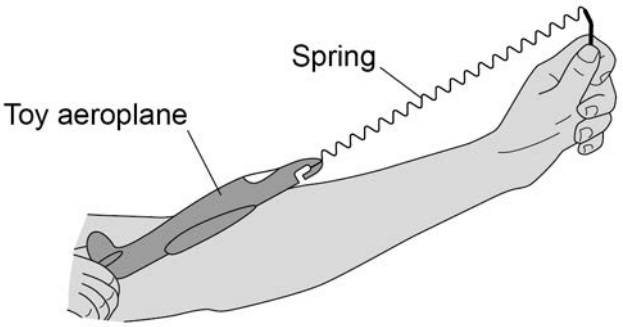
Question 134

June 2022 | 8463/1H | Original Q10

1 0 **Figure 11** shows a student launching a toy aeroplane.

To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.

Figure 11



1 0 . 1 Just before the toy aeroplane is released, the spring has an extension of 0.12 m.

mass of aeroplane = 0.020 kg

spring constant of the spring = 50 N/m

Calculate the maximum speed of the toy aeroplane just after it is launched.

Use the Physics Equations Sheet.

Give the unit.

[6 marks]

Speed = _____ Unit _____

4.5.6.1.2 Speed

Question 134 · continued

1 0 . 2 Complete the sentence.

[1 mark]

As the aeroplane moves upwards through the air there is a decrease

in the _____ energy of the aeroplane.

1 0 . 3 Give **one** factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

[1 mark]

_____

_____

8

Turn over for the next question

4.5.6.1.2 Speed

Question 135

June 2022 | 8463/2HR | Original Q1

0 1 **Figure 1** shows an electric super-car.

Figure 1



0 1 . 1 The battery in an electric car needs to be recharged.

Suggest **two** factors that affect the distance an electric car can travel before the battery needs to be recharged.

[2 marks]

1 _____

2 _____

4.5.6.1.2 Speed

Question 135 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 1 . 3 The maximum acceleration of the car is 20 m/s^2.

Calculate the time taken for the speed of the car to change from 0 m/s to 28 m/s at its maximum acceleration.

[3 marks]

Time taken = _____ s

Question 1 continues on the next page

4.5.6.1.2 Speed

Question 135 · continued

0 1 . 4 In a trial run, the car accelerates at 10 m/s^2 until it reaches its final velocity.

distance travelled by the car = 605 m

initial velocity of the car = 0 m/s

Calculate the final velocity of the car.

Use the Physics Equations Sheet.

[3 marks]

Final velocity = _____ m/s

4.5.6.1.2 Speed

Question 135 · continued

Use the Physics Equations Sheet to answer questions **01.5** and **01.6**.

0 1 . 5 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 1 . 6 When travelling at its maximum speed the air resistance acting on the car is 4000 N.

Calculate the work done against air resistance when the car travels a distance of 7.5 km at its maximum speed.

[3 marks]

Work done = _____ J

13

4.5.6.1.2 Speed

Question 136

June 2022 | 8463/2HR | Original Q3

0 3 Speed limits on roads increase safety.

0 3 . 1 The braking distance of a car increases as the speed of the car increases.

Give two **other** factors that **increase** the braking distance of a car.

[2 marks]

1 _____

2 _____

0 3 . 2 Explain why the driver's reaction time affects the thinking distance of a car.

[2 marks]

_____

_____

_____

_____

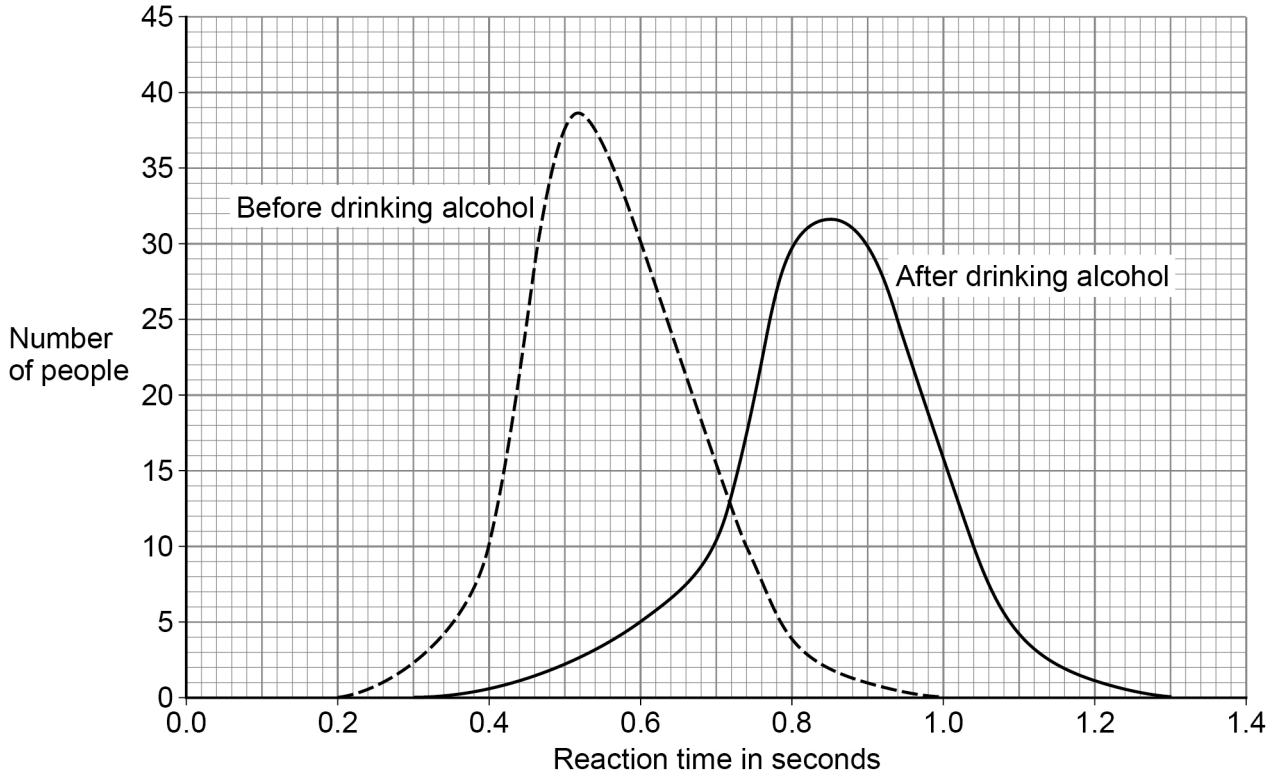
4.5.6.1.2 Speed

Question 136 · continued

0 3 . 3 Scientists have investigated how drinking alcohol affects a person's reaction time.

Figure 5 shows the results of the investigation.

Figure 5



Which of the following conclusions can be made using **Figure 5**?

[2 marks]

Tick (✓) **two** boxes.

- Every person's reaction time increases after drinking alcohol. ☐
- Mean reaction time increases after drinking alcohol. ☐
- Some people's reaction time is not affected by drinking alcohol. ☐
- The change in reaction time is not the same for all people after drinking alcohol. ☐
- There is a smaller range of reaction times after drinking alcohol. ☐

Question 3 continues on the next page

4.5.6.1.2 Speed

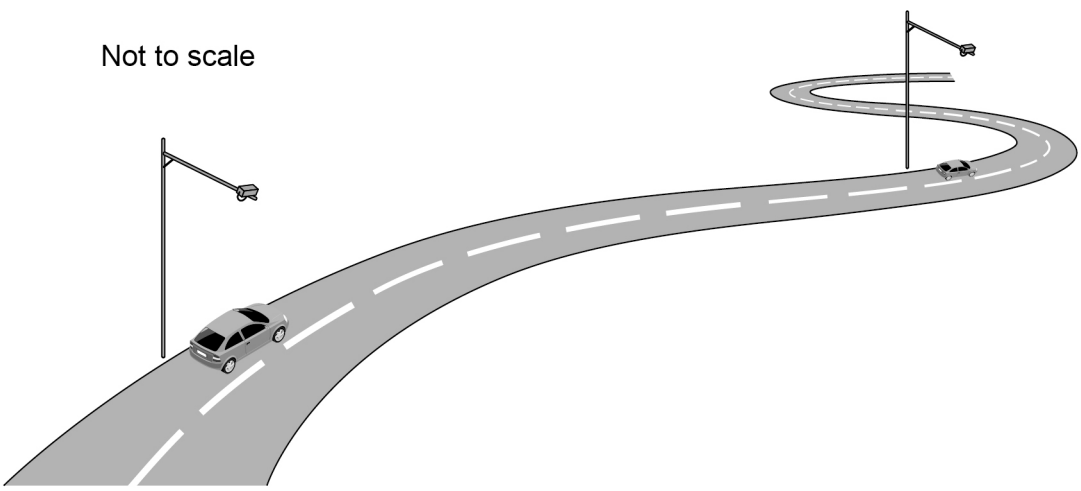
Question 136 · continued

Figure 6 shows some speed cameras on a road.

The speed cameras determine the average speed of cars on the road.

Figure 6

Not to scale



0 3 . 4 The speed limit on the road in **Figure 6** is 20 m/s.

The cameras in **Figure 6** are 1.5 km apart.

Calculate the minimum time it takes to travel 1.5 km without breaking the speed limit.

Use the Physics Equations Sheet.

[4 marks]

Minimum time = _____ s

4.5.6.1.2 Speed

Question 136 · continued

0 3 . 5 The average speed of a car between the cameras and the average velocity of the car between the cameras are different.

Explain why.

[3 marks]

13

4.5.6.1.2 Speed

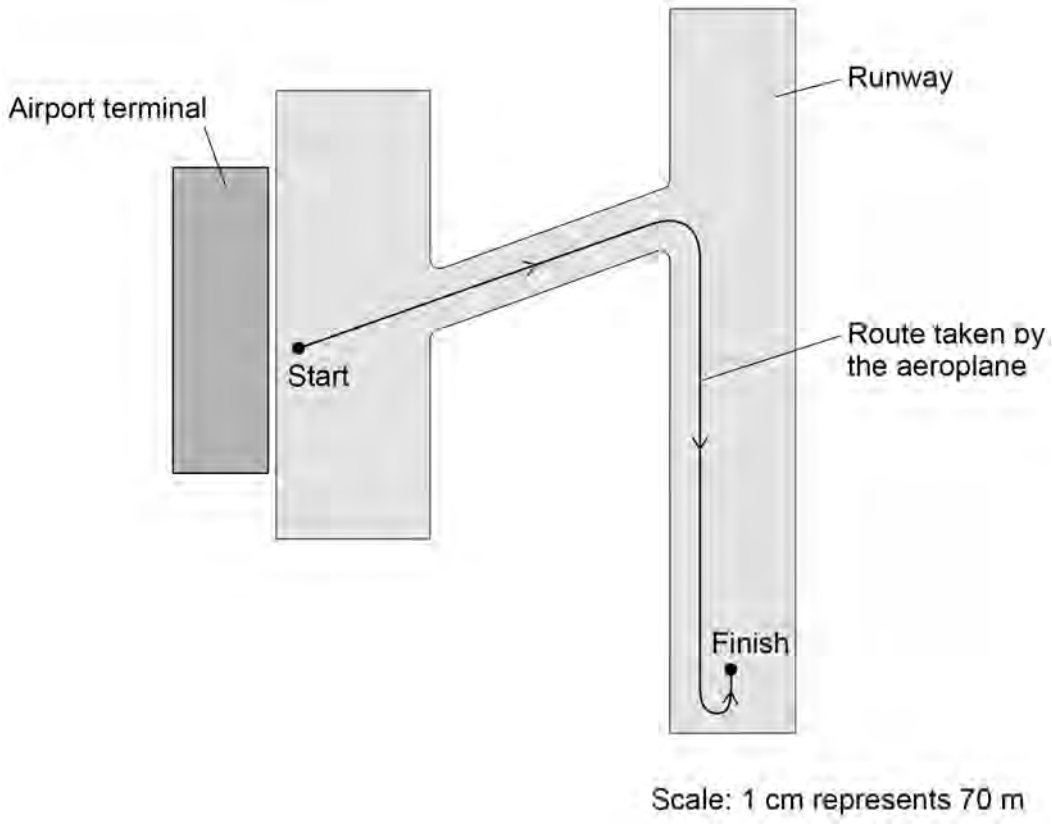
Question 137

June 2023 | 8463/2H | Original Q2

0 2 **Figure 3** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 3 has been drawn to scale.

Figure 3



0 2 . 1 Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 3**.

[2 marks]

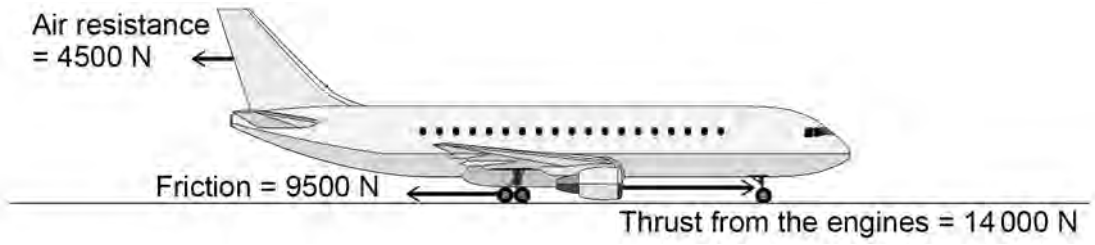
Displacement = _____ m

4.5.6.1.2 Speed

Question 137 · continued

Figure 4 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 4



0 2 . 2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = _____ N

0 2 . 3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

0 2 . 4 Air resistance and friction are contact forces.

Give **one** other example of a contact force.

[1 mark]

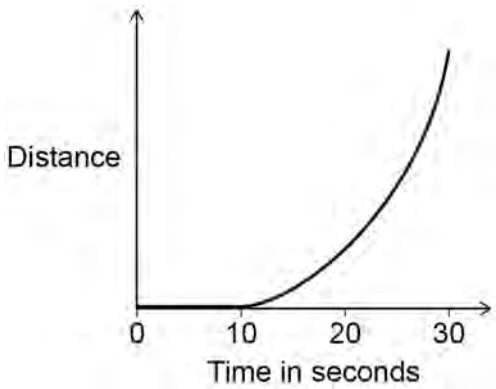
4.5.6.1.2 Speed

Question 137 · continued

0 2 . 5 The aeroplane stops for a short time and then accelerates along the runway.

Figure 5 shows a distance–time sketch-graph for this stage of the journey.

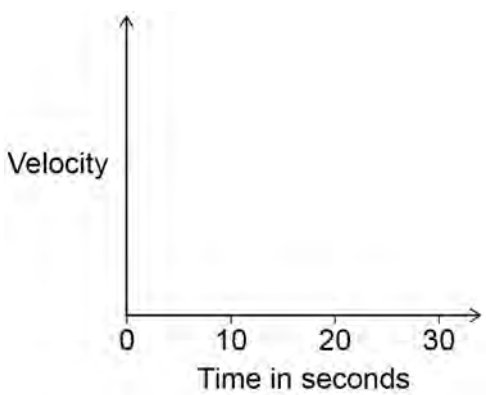
Figure 5



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 6**.

[2 marks]

Figure 6



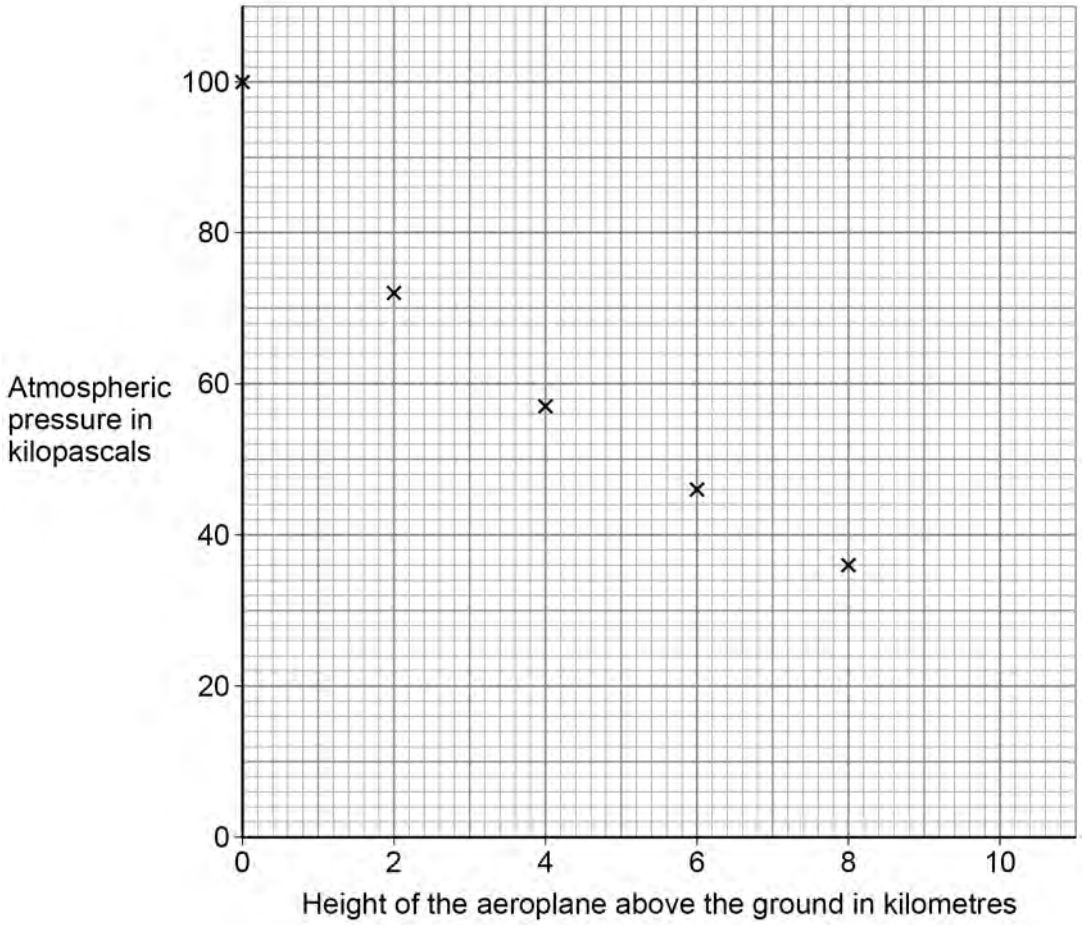
4.5.6.1.2 Speed

Question 137 · continued

0 2 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 7 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 7



Estimate the atmospheric pressure when the height of the aeroplane above the ground is 10 km.

[2 marks]

Atmospheric pressure = _____ kPa

Question 2 continues on the next page

4.5.6.1.2 Speed

Question 137 · continued

0 2 . 7 What happens to the air surrounding the aeroplane as the height of the aeroplane above the ground increases?

[1 mark]

Tick (✓) **one** box.

- The average density of the air above the aeroplane decreases. ☐
- The mass of air above the aeroplane increases. ☐
- The temperature of the air increases. ☐
- The volume of air below the aeroplane decreases. ☐

10

4.5.6.1.2 Speed

Question 138

June 2023 | 8463/2H | Original Q5

0 5 **Figure 14** shows some bumper cars.

Bumper cars are designed to withstand collisions at low speeds.

Figure 14



0 5 . 1 During a collision between a bumper car and the barrier, the bumper car and barrier act as a closed system.

What is meant by a 'closed system'?

[1 mark]

4.5.6.1.2 Speed

Question 138 · continued

0 5 . 2 How does Newton's Third Law of motion apply to the collision between the bumper car and the barrier?

[1 mark]

0 5 . 3 During the collision, the change in momentum of the bumper car is 700 kg m/s.

The time taken for the collision is 0.28 s.

Calculate the force on the bumper car during the collision.

Use the Physics Equations Sheet.

[2 marks]

Force = _____ N

Question 5 continues on the next page

4.5.6.1.2 Speed

Question 138 · continued

0 5 . 4 The bumper car has a flexible bumper.

Explain how the flexible bumper reduces the risk of injury to the people in the bumper car during the collision.

[3 marks]

0 5 . 5 A bumper car moved with an initial constant velocity and then accelerated at 2.0 m/s^2.

While accelerating, the bumper car travelled a distance of 1.5 m.

The final velocity of the bumper car was 2.5 m/s.

Calculate the initial constant velocity of the bumper car.

Use the Physics Equations Sheet.

[3 marks]

Initial constant velocity = _____ m/s

10

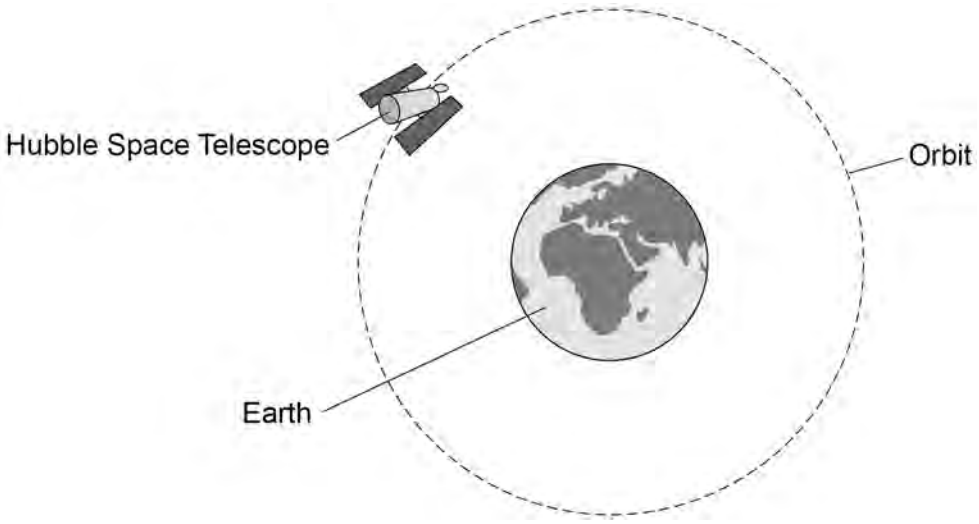
4.5.6.1.2 Speed

Question 139

June 2023 | 8463/2H | Original Q6

0 6 **Figure 15** shows the Hubble Space Telescope orbiting the Earth.

Figure 15



0 6 . 1 What name is given to objects that orbit a planet?

[1 mark]

Question 6 continues on the next page

4.5.6.1.2 Speed

Question 139 · continued

0 6 . 2 A space telescope uses microwaves to communicate with the Earth.

A microwave has a wavelength of 12.5 cm.

The speed of microwaves through space is 3.0×10^8 m/s.

Calculate the frequency of the microwave.

Use the Physics Equations Sheet.

Give your answer in standard form.

[5 marks]

Frequency (in standard form) = _____ Hz

0 6 . 3 Explain the effect of the Earth's gravitational force on the motion of the Hubble Space Telescope.

[3 marks]

4.5.6.1.2 Speed

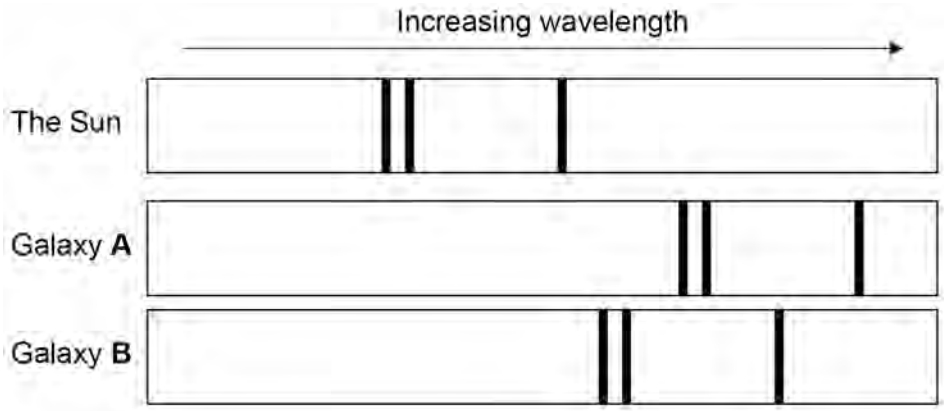
Question 139 · continued

0 6 . 4 The Hubble Space Telescope can detect visible light from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

Figure 16 shows the visible light spectra from the Sun and two galaxies.

Figure 16



Explain what conclusions can be made about galaxies **A** and **B**.

[3 marks]

12

4.5.6.1.2 Speed

Question 140

0 2 **Figure 5** shows a young child using a baby walker.

Figure 5



0 2 . 1 The child is standing still.

What is the resultant **vertical** force on the child?

Give a reason for your answer.

[2 marks]

Resultant vertical force = _____ N

Reason _____

_____

4.5.6.1.2 Speed

Question 140 · continued

Use the Physics Equations Sheet to answer questions **02.2** and **02.3**.

0 2 . 2 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 2 . 3 The child pushed the baby walker 2.8 m across a horizontal floor.

The work done by the child was 35 J.

Calculate the horizontal force the child applied to the baby walker.

[3 marks]

Horizontal force = _____ N

0 2 . 4 The child pushed the baby walker from a carpet onto a hard floor.

The child applied the same horizontal force to the baby walker.

Explain why the speed of the baby walker increased.

[2 marks]

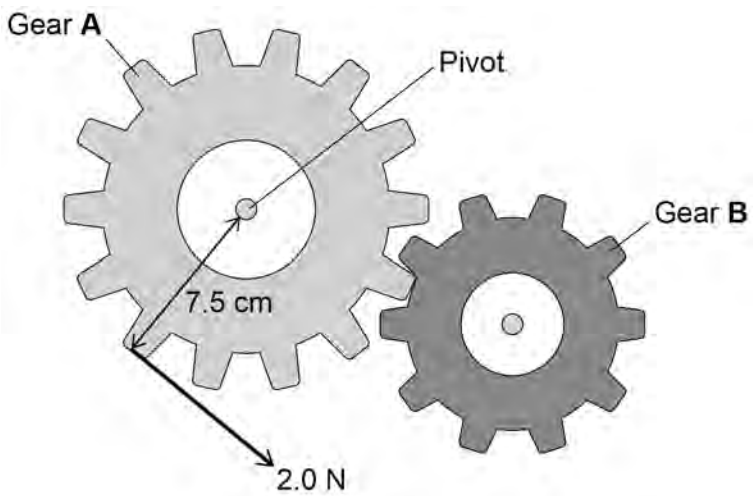
4.5.6.1.2 Speed

Question 140 · continued

There are some toy gears on the front of the baby walker.

Figure 6 shows the gears.

Figure 6



The child applies a force to gear **A**.

This causes a moment about the pivot, so gear **A** rotates.

4.5.6.1.2 Speed

Question 140 · continued

Use the Physics Equations Sheet to answer questions **02.5** and **02.6**.

0 2 . 5 Write down the equation which links distance (*d*), force (*F*) and moment of a force (*M*).

[1 mark]

0 2 . 6 The child applies a force of 2.0 N on gear **A**.

The perpendicular distance between the force and the pivot is 7.5 cm.

Calculate the moment of the force about the pivot.

[3 marks]

Moment of force = _____ N m

0 2 . 7 Explain what happens to gear **B** when the child applies the force to gear **A**.

[2 marks]

14

4.5.6.1.2 Speed

Question 141

0 3 The Universe contains many stars.

0 3 . 1 The Sun is the star at the centre of our solar system.

Give **three** other types of object that form our solar system.

[3 marks]

1 _____

2 _____

3 _____

Some main sequence stars will eventually form black holes.

Table 3 gives the mass of four stars.

Table 3

Star	Mass in kg
Arcturus	2.2×10^{30}
Betelgeuse	2.2×10^{31}
Cygni A	1.4×10^{30}
The Sun	2.0×10^{30}

0 3 . 2 Which star in **Table 3** is most likely to form a black hole?

[1 mark]

_____

4.5.6.1.2 Speed

Question 141 · continued

0 3 . 3 The distance from Cygni A to the Earth is 1.1×10^8 gigametres.

Which distance is the same as 1.1×10^8 gigametres?

[1 mark]

Tick (✓) **one** box.

1.1×10^{11} m ☐

1.1×10^{14} m ☐

1.1×10^{17} m ☐

1.1×10^{20} m ☐

Question 3 continues on the next page

4.5.6.1.2 Speed

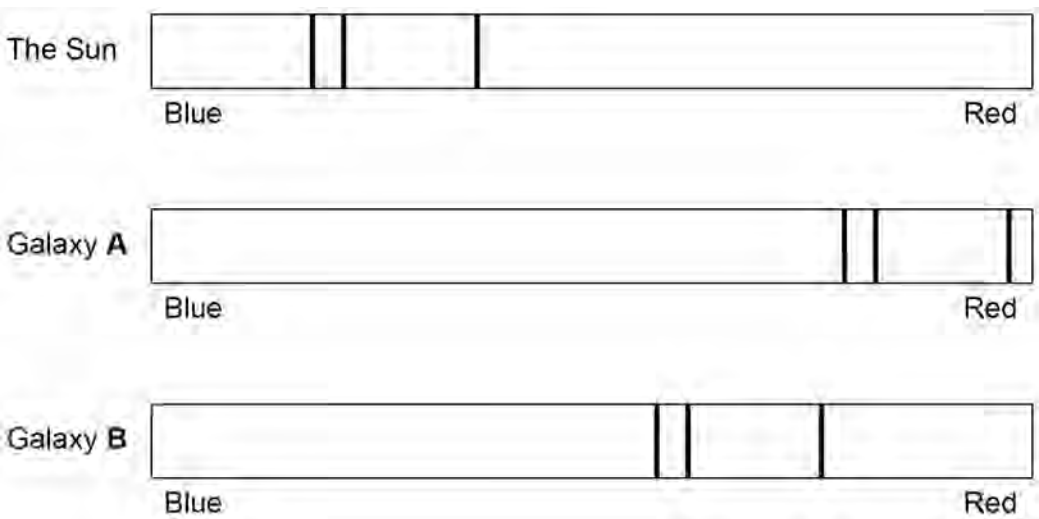
Question 141 · continued

0 3 . 4 The light spectrum from every galaxy includes dark lines.

The lines have the same pattern.

Figure 7 shows the position of dark lines in the visible spectra of light from the Sun and from two distant galaxies.

Figure 7



Explain what these light spectra tell us about the velocities of galaxy **A** and galaxy **B**.

[3 marks]

4.5.6.1.2 Speed

Question 141 · continued

0 3 . 5 The distance between Arcturus and the Earth is 3.6×10^{14} km.

speed of light = 3.0×10^{8} m/s

Calculate the time taken for light from Arcturus to reach the Earth.

Use the Physics Equations Sheet.

[4 marks]

Time taken = _____ s

0 3 . 6 When stars are formed, they contain mostly hydrogen.

Describe how stars produce all other naturally occurring elements.

[4 marks]

16

4.5.6.1.2 Speed

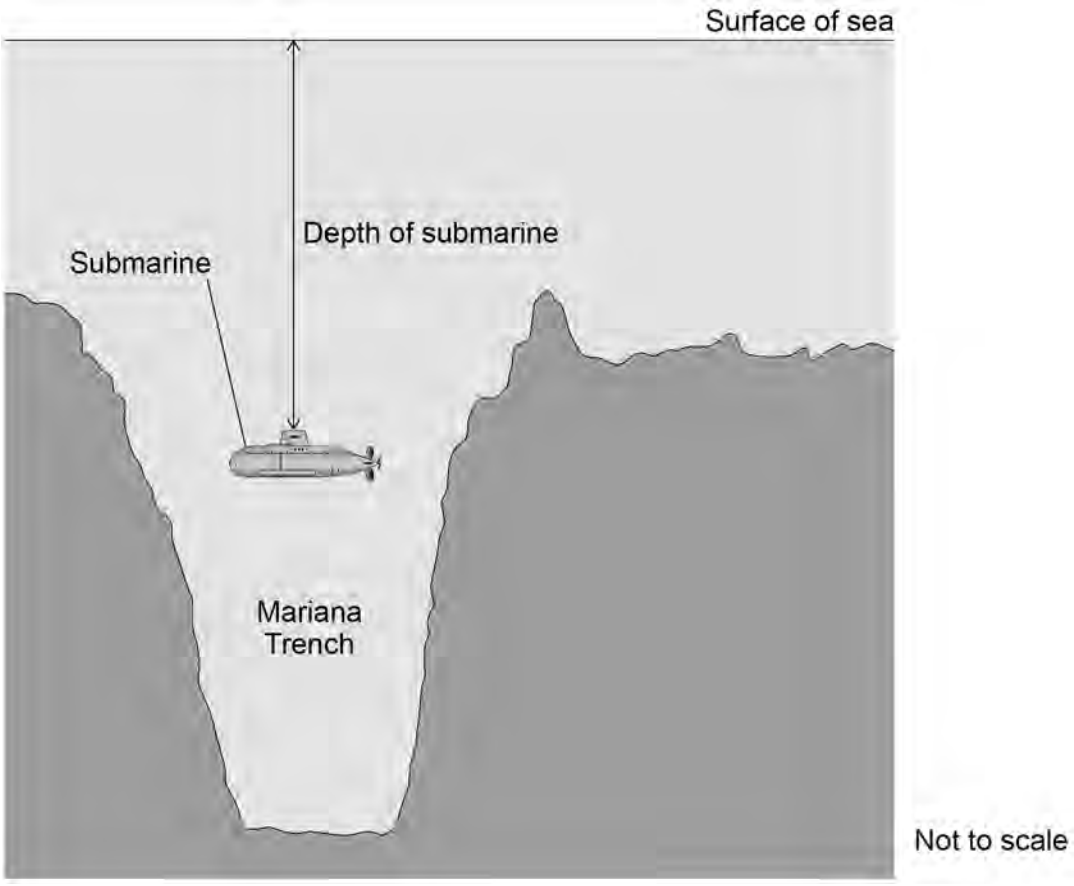
Question 142

June 2024 | 8463/2H | Original Q4

0 4 The Mariana Trench is the deepest part of the Pacific Ocean.

Figure 8 shows a submarine going to the bottom of the Mariana Trench.

Figure 8



0 4 . 1 The depth of the submarine increases.

Explain what happens to the pressure on the submarine.

[2 marks]

4.5.6.1.2 Speed

Question 142 · continued

0 4 . 2 The submarine moved from the surface of the water to the bottom of the Mariana Trench.

The change in pressure was 110 000 kPa.

mean density of sea water = 1026 kg/m^3

gravitational field strength = 9.8 N/kg

Calculate the depth of the Mariana Trench.

Use the Physics Equations Sheet.

[4 marks]

Depth = _____ m

Question 4 continues on the next page

4.5.6.1.2 Speed

Question 142 · continued

Earthquakes often occur at the Mariana Trench.

P-waves and S-waves are produced by earthquakes.

0 4 . 3 Which statement describes P-waves and S-waves?

[1 mark]

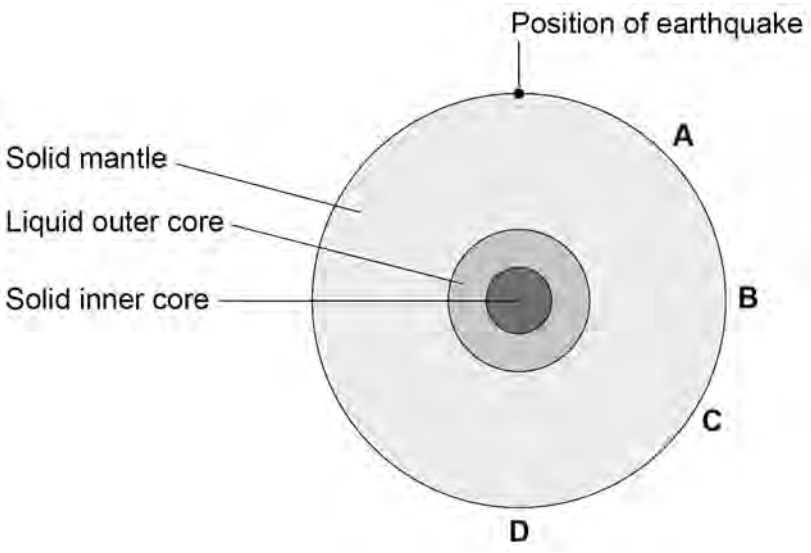
Tick (✓) **one** box.

- Both P-waves and S-waves are longitudinal. ☐
- Both P-waves and S-waves are transverse. ☐
- P-waves are longitudinal and S-waves are transverse. ☐
- P-waves are transverse and S-waves are longitudinal. ☐

0 4 . 4 **Figure 9** shows the layers inside the Earth.

An earthquake occurs at the position shown.

Figure 9



Which letter shows the position where **only** P-waves will be detected?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Reason _____

_____

Question 4 continues on the next page

4.5.6.1.2 Speed

Question 142 · continued

0 4 . 5 An S-wave has a frequency of 3.6 Hz.

The S-wave has a speed of 4.5 km/s.

Calculate the wavelength of this S-wave.

Use the Physics Equations Sheet.

[3 marks]

Wavelength = _____ m

0 4 . 6 A seismometer is a device that detects earthquakes.

P-waves travel at a known speed between an earthquake and a seismometer.

S-waves travel at a slower speed than P-waves.

A P-wave and an S-wave from the earthquake arrive at the seismometer at different times.

Describe the relationship between the distance from the earthquake to the seismometer and the time between the P-wave and the S-wave arriving.

[2 marks]

14

4.5.6.1.2 Speed

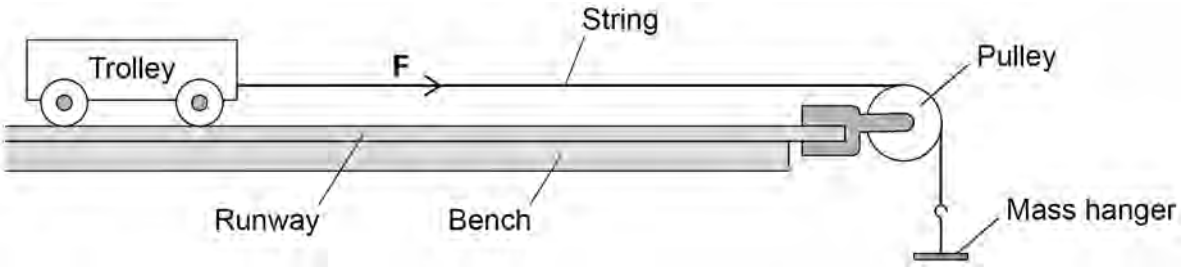
Question 143

June 2024 | 8463/2H | Original Q5

0 5 A student investigated how the acceleration of a trolley varies with the resultant force on the trolley.

Figure 10 shows some of the equipment used.

Figure 10



0 5 . 1 **Figure 10** shows the force **F** which acts through the string.

What name is given to force **F**?

[1 mark]

0 5 . 2 Give **one** variable that should have been a control variable in this investigation.

[1 mark]

Question 5 continues on the next page

Question 143 · continued

0 5 . 3 The student held the trolley stationary and then released it.

The trolley moved along the runway with a constant acceleration.

The student recorded the time taken for the trolley to travel a measured distance along the runway.

Describe how the acceleration of the trolley can be calculated using the time taken and distance travelled by the trolley.

[3 marks]

For one set of results, the force acting through the string was 2.0 N.

0 5 . 4 The student released the trolley three times and determined the following values for acceleration:

1.36 m/s^2 1.39 m/s^2 1.33 m/s^2

Calculate the uncertainty in the values of acceleration.

[2 marks]

Uncertainty = ± _____ m/s^2

4.5.6.1.2 Speed

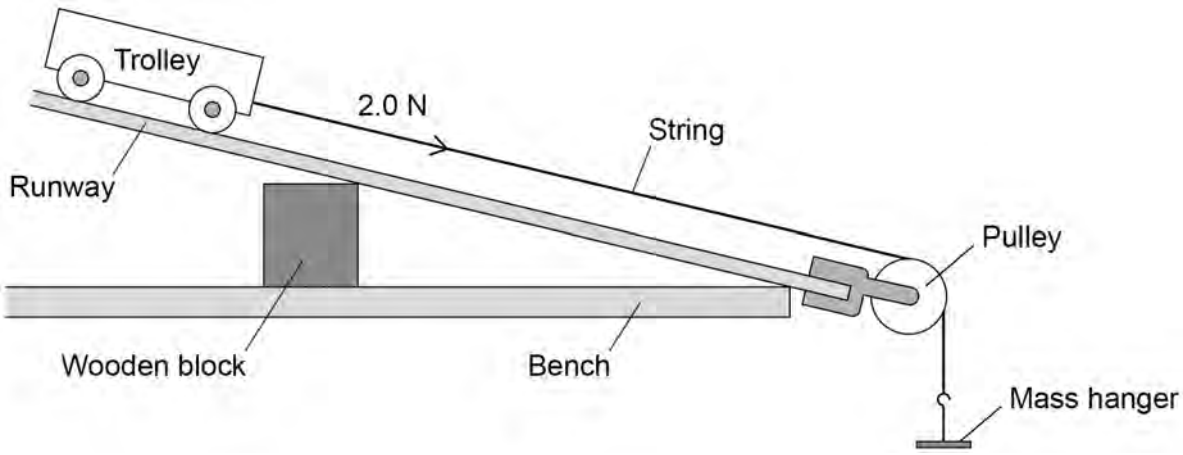
Question 143 · continued

0 5 . 5 The runway was then raised at one end.

The force acting through the string remained the same.

Figure 11 shows this.

Figure 11



Explain how the acceleration was affected by raising the end of the runway.

[2 marks]

9

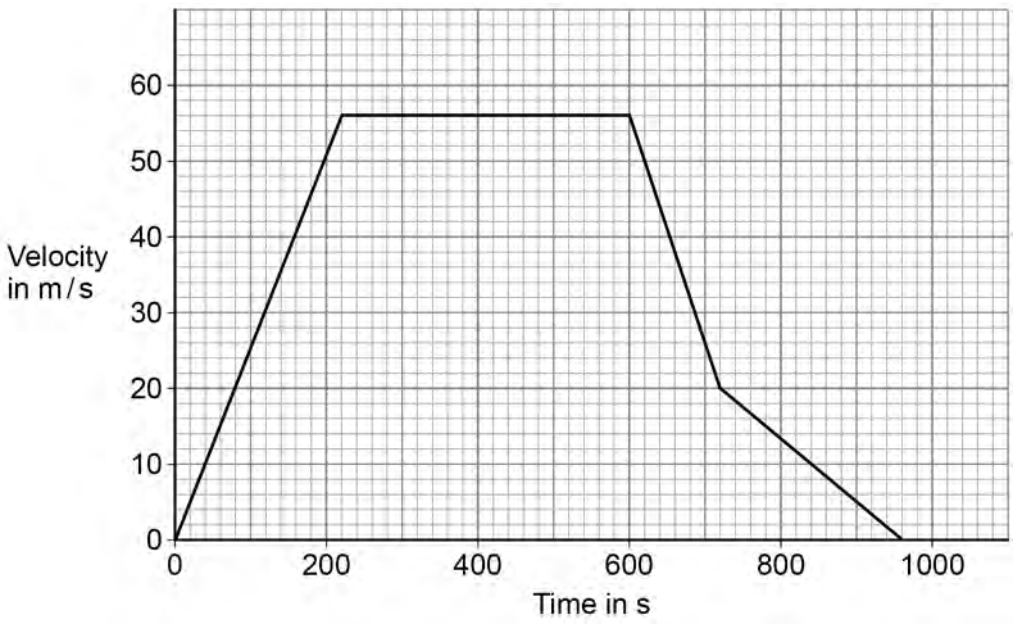
4.5.6.1.2 Speed

Question 144

June 2024 | 8463/2H | Original Q7

0 7 **Figure 12** shows a velocity–time graph for a train travelling between two stations.

Figure 12



0 7 . 1 Determine the distance travelled by the train in the first 600 s of the journey.

[3 marks]

Distance = _____ m

4.5.6.1.2 Speed

Question 144 · continued

0 7 . 2 Explain what happens to the braking force as the train decelerates.

Use information from **Figure 12**.

[3 marks]

0 7 . 3 Determine the maximum deceleration of the train.

[3 marks]

Deceleration = _____ m/s^2

Question 7 continues on the next page

4.5.6.1.2 Speed

Question 144 · continued

0 7 . 4 Another train travels at a speed of 60 m/s.

A constant braking force of 270 000 N causes the train to decelerate and stop.

mass of train = 240 000 kg

Calculate the distance travelled while the braking force is applied.

Use the Physics Equations Sheet.

[6 marks]

Distance travelled = _____ m

4.5.6.1.2 Speed

Question 144 · continued

0 7 . 5 It is illegal for train drivers to drink alcohol before driving a train.

Explain how drinking alcohol would affect the stopping distance of a train.

[3 marks]

18

Turn over for the next question

4.5.6.1.2 Speed

Question 145

June 2025 | 8463/1H | Original Q1

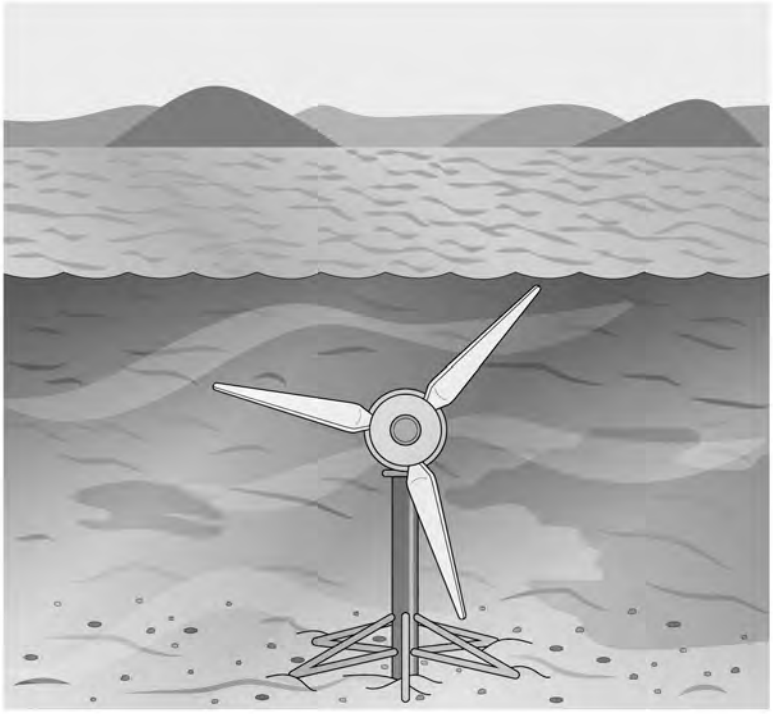
0 1 Tides and wind are two renewable energy resources.

0 1 . 1 Describe the difference between renewable energy resources and non-renewable energy resources.

[2 marks]

Figure 1 shows a new design of tidal turbine to generate electricity using the tides.

Figure 1



4.5.6.1.2 Speed

Question 145 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 1 . 3 The mass of seawater passing through the tidal turbine each second is 824 000 kg.

The density of seawater is 1030 kg/m^3.

Calculate the volume of seawater passing through the tidal turbine each second.

[3 marks]

Volume = _____ m^3

Question 1 continues on the next page

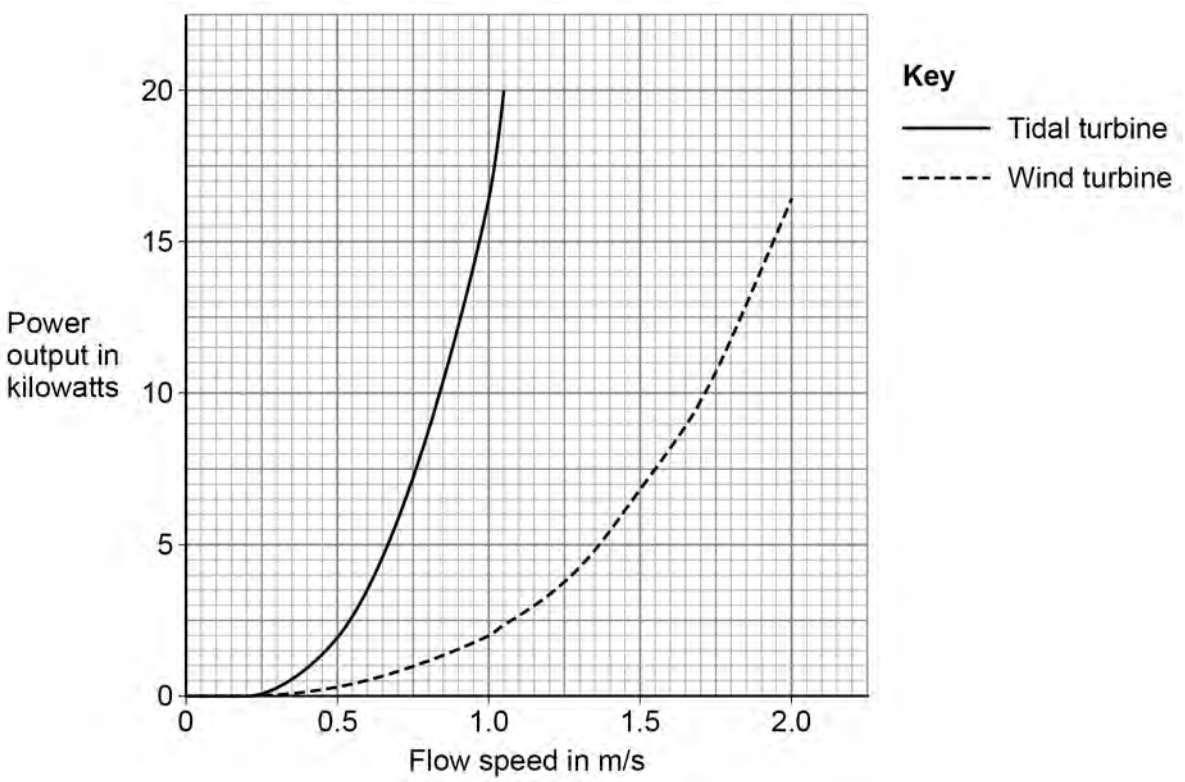
4.5.6.1.2 Speed

Question 145 · continued

The speed of the tide or the speed of the wind past a turbine is called the 'flow speed'.

Figure 2 shows how the power output of a tidal turbine compares with a wind turbine for different flow speeds.

Figure 2



0 1 . 4 As flow speed increases, power output increases.

Give **two** other conclusions that can be made using information from **Figure 2**.

[2 marks]

1 _____

_____

2 _____

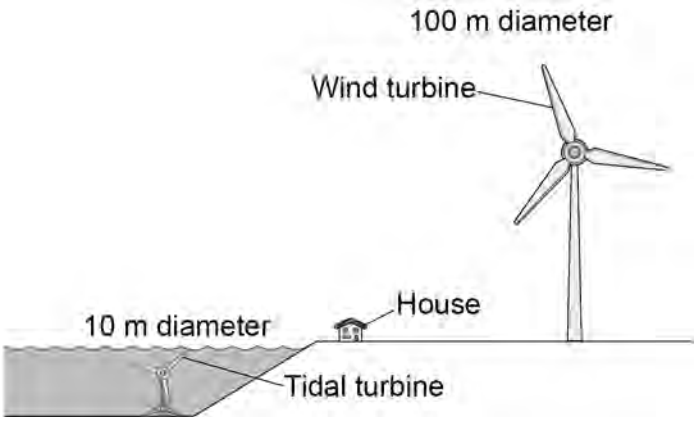
_____

4.5.6.1.2 Speed

Question 145 · continued

0 1 . 5 **Figure 3** shows the turbines used to obtain the data for **Figure 2**.

Figure 3



Compare the environmental impacts of the wind turbine and the tidal turbine in **Figure 3**.

[4 marks]

12

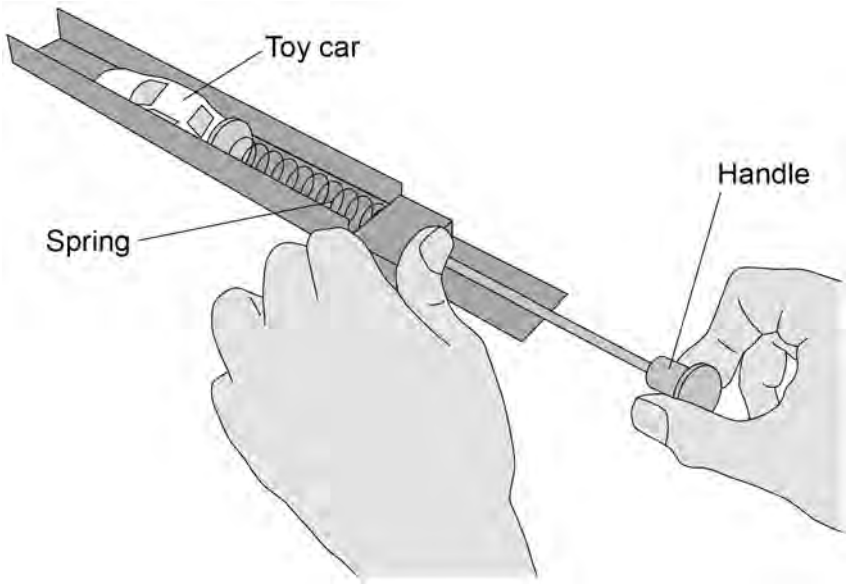
4.5.6.1.2 Speed

Question 146

June 2025 | 8463/1H | Original Q10

1 0 **Figure 12** shows a device that accelerates a toy car at the start of a race track.

Figure 12



4.5.6.1.2 Speed

Question 146 · continued

1 0 . 1 Pulling the handle compresses the spring in the device by 0.075 m.

When the handle is released, the energy stored in the compressed spring is transferred to the toy car.

spring constant = 64 N/m

mass of toy car = 0.052 kg

Calculate the maximum possible speed of the toy car just after the car starts to move.

Use the Physics Equations Sheet.

Give your answer to **2** significant figures.

[6 marks]

Maximum possible speed (2 significant figures) = _____ m/s

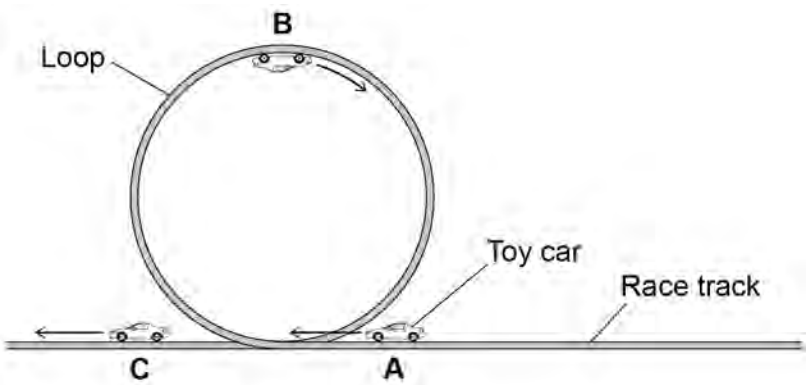
Question 10 continues on the next page

4.5.6.1.2 Speed

Question 146 · continued

10.2 **Figure 13** shows the path of the toy car along a loop section of the race track.

Figure 13



The car moves along the track from position **A** to position **B** and then to position **C**.

Describe how the energy stores of the car change as the car moves along the track from position **A** to position **C**.

Ignore the effects of friction and air resistance.

[3 marks]

4.5.6.1.2 Speed

Question 146 · continued

10.3 At the end of the race track, the toy car passes through a light gate that measures the speed of the car.

Which **two** measurements are needed to determine the speed of the car?

[2 marks]

Tick (✓) **two** boxes.

- Length of the toy car ☐
- Mass of the toy car ☐
- Temperature of the room ☐
- Time for the toy car to pass the light gate ☐
- Total length of the race track ☐

11

4.5.6.1.2 Speed

Question 147

June 2025 | 8463/2H | Original Q1

0 1 In a thunderstorm, lightning produces visible light waves and sound waves.

0 1 . 1 Describe the similarities and differences between visible light waves and sound waves.

[6 marks]

4.5.6.1.2 Speed

Question 147 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Which equation links distance (*s*), speed (*v*) and time (*t*)?

[1 mark]

Tick (✓) **one** box.

speed = distance × time ☐

speed = $\frac{\text{distance}}{\text{time}}$ ☐

speed = $\frac{\text{time}}{\text{distance}}$ ☐

0 1 . 3 Lightning strikes the ground 13 200 m from a student.

The speed of sound in air is 330 m/s.

Calculate the time taken for the sound created by the lightning strike to reach the student.

[3 marks]

Time = _____ s

10

4.5.6.1.2 Speed

Question 148

June 2025 | 8463/2H | Original Q4

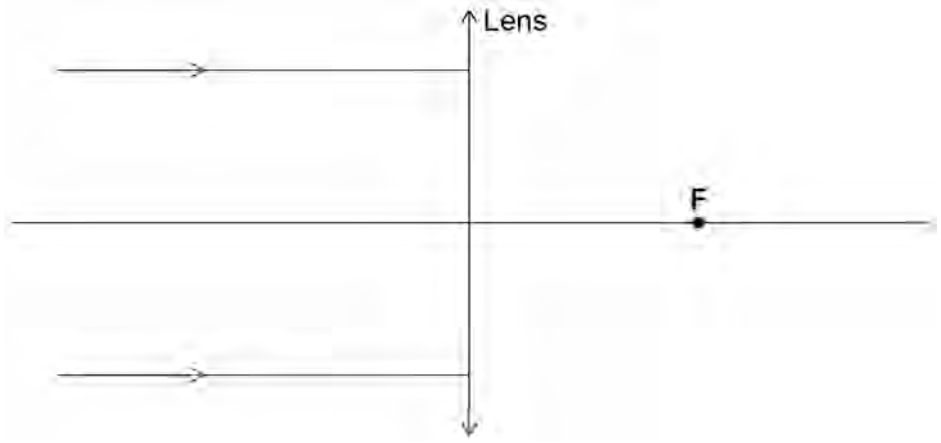
0 4 Telescopes are used to look at distant objects.

Some telescopes use lenses to form an image.

Figure 5 shows two parallel rays of light incident on a lens in a telescope.

The principal focus of the lens is labelled **F**.

Figure 5



0 4 . 1 What type of lens is shown in **Figure 5**?

[1 mark]

0 4 . 2 Complete the ray diagram in **Figure 5**.

[2 marks]

Question 4 continues on the next page

4.5.6.1.2 Speed

Question 148 · continued

The James Webb Space Telescope can detect electromagnetic radiation beyond the visible spectrum.

0 4 . 3 The shortest wavelength of electromagnetic radiation that can be detected by the James Webb Space Telescope is 0.60 μm.

speed of electromagnetic radiation = 3.0×10^8 m/s

Calculate the frequency of electromagnetic radiation that has a wavelength of 0.60 μm.

Use the Physics Equations Sheet.

[4 marks]

Frequency = _____ Hz

0 4 . 4 Complete the sentence.

[1 mark]

Electromagnetic radiation detected from distant galaxies is red-shifted.

This means that the electromagnetic radiation shows an increase in

_____.

4.5.6.1.2 Speed

Question 148 · continued

0 4 . 5 Why is the electromagnetic radiation from distant galaxies red-shifted?

[1 mark]

Tick (✓) **one** box.

All observed light from distant galaxies appears red. ☐

Distant galaxies are moving away from our galaxy. ☐

Distant galaxies are moving at the speed of light. ☐

0 4 . 6 The James Webb Space Telescope has detected electromagnetic radiation from many different galaxies.

Electromagnetic radiation from one of the galaxies detected shows the greatest red-shift ever observed.

What conclusion can be made about the distance to this galaxy?

[1 mark]

0 4 . 7 The James Webb Space Telescope is an artificial satellite that orbits the Sun at a constant speed.

Explain why the velocity of the satellite changes as it orbits the Sun.

[3 marks]

13