AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.1.2

Speed

Past-paper questions

Tier	**Foundation**
Question groups	**140**
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:** _____

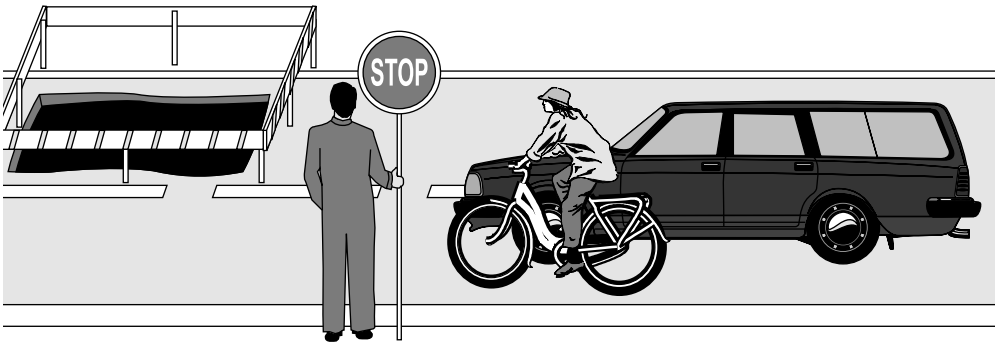
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.6.1.2 Speed

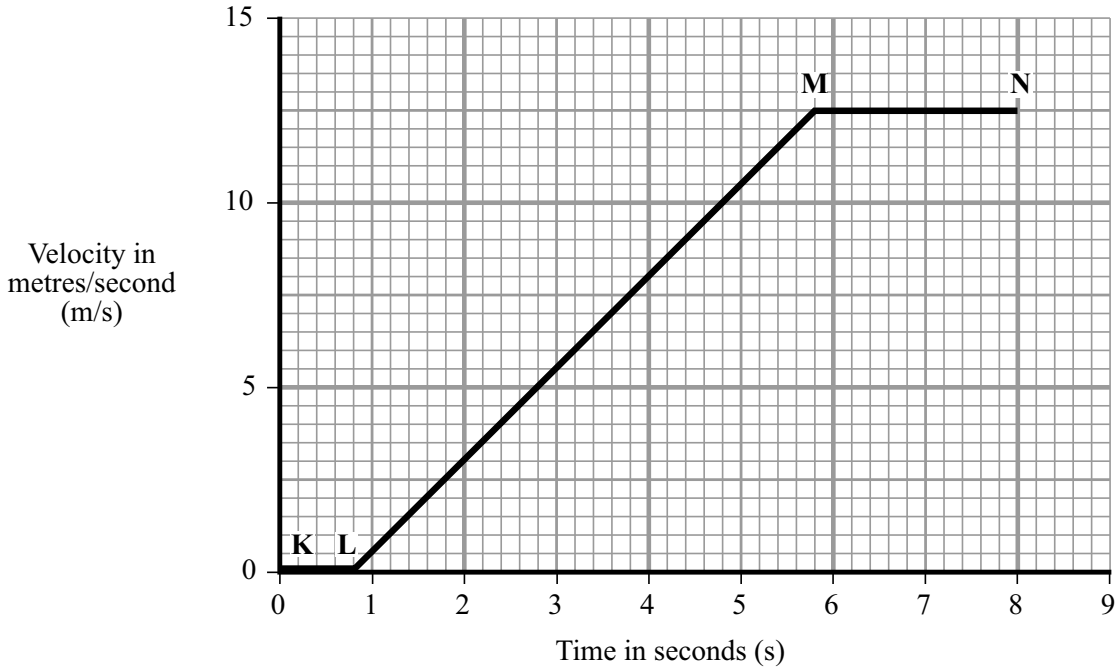
Question 01

June 2003 | 3451F | Original Q5 | Legacy

5 A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



(a) Between which two points on the graph is the car moving at constant velocity?

.....

(1 mark)

(b) Between which two points on the graph is the car accelerating?

.....

(1 mark)

4.5.6.1.2 Speed

Question 01 · continued

MARGIN BLANK

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time = ...seconds
(1 mark)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol ☐

Wet roads ☐

Worn car brakes ☐

(1 mark)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

(2 marks)

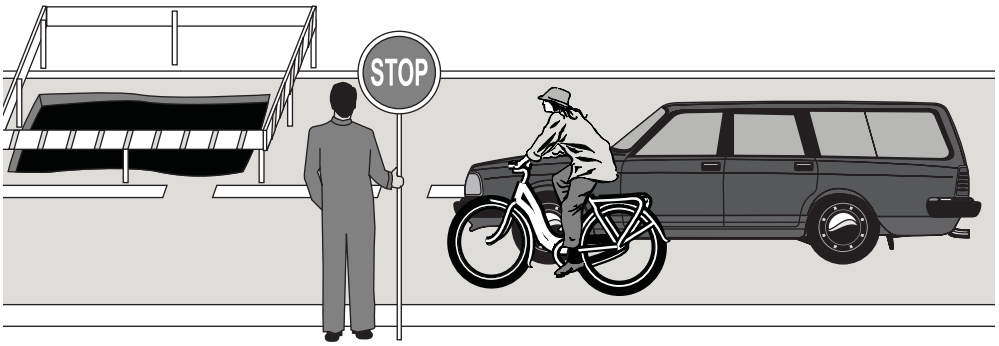
6

4.5.6.1.2 Speed

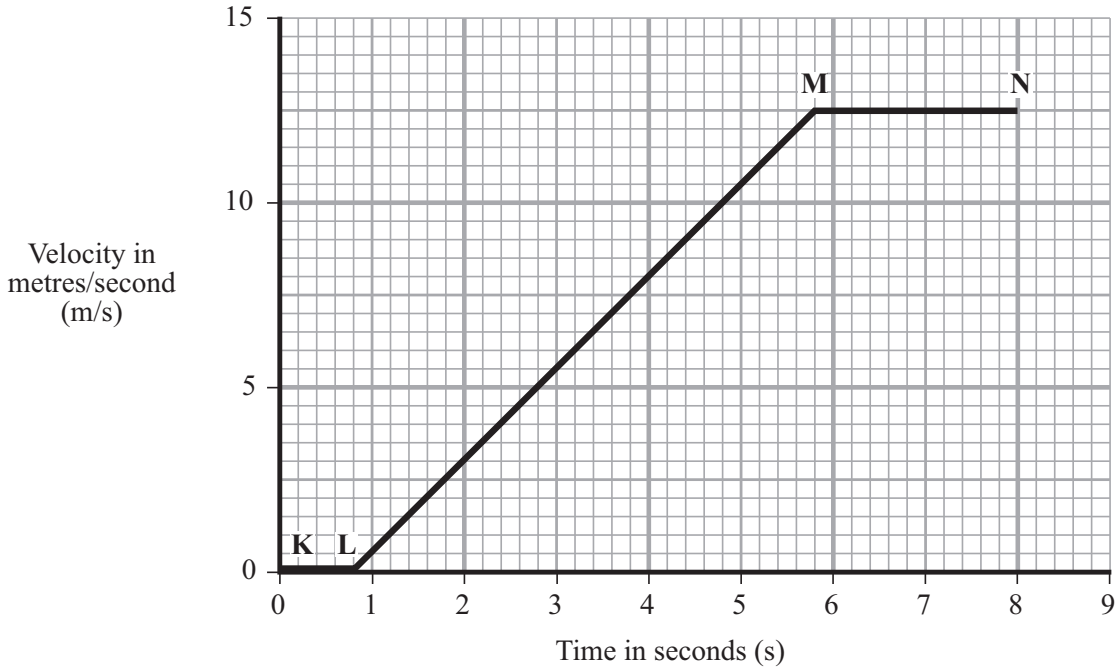
Question 02

June 2003 | 3462F3 | Original Q5 | Legacy

5 A car and a bicycle are travelling along a straight road. They have stopped at road works.



The graph shows how the velocity of the car changes after the sign is changed to GO.



(a) Between which two points on the graph is the car moving at constant velocity?

.....

(1 mark)

(b) Between which two points on the graph is the car accelerating?

.....

(1 mark)

4.5.6.1.2 Speed

Question 02 · continued

MARGIN BLANK

(c) Between the sign changing to GO and the car starting to move, there is a time delay. This is called the reaction time.

(i) What is the reaction time of the car driver?

Reaction time = ...seconds
(1 mark)

(ii) Which **one** of the following could increase the reaction time of a car driver? Tick the box next to your choice.

Drinking alcohol ☐

Wet roads ☐

Worn car brakes ☐

(1 mark)

(d) The cyclist starts to move at the same time as the car. For the first 2 seconds the cyclist's acceleration is constant and is greater than that of the car.

Draw a line on the graph to show how the velocity of the cyclist might change during the first 2 seconds of its motion.

(2 marks)

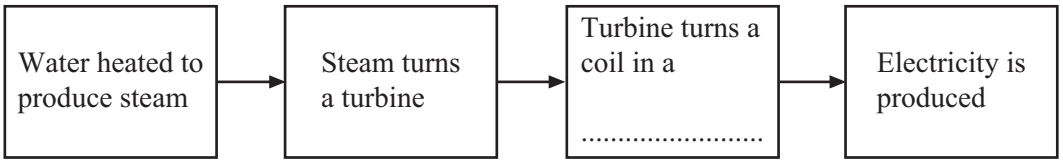
6

4.5.6.1.2 Speed

Question 03

June 2004 | 3451F | Original Q3 | Legacy

3 (a) In Britain most power stations burn fuel to produce heat. The diagram shows the stages by which the heat is transferred into electrical energy.
Complete the diagram by filling in the missing word.



(1 mark)

(b) A fuel burning power station uses 2000 joules of fuel energy to generate 600 joules of electrical energy. The rest of the fuel energy is wasted as heat.

(i) For every 600 joules of electrical energy generated, how much fuel energy is wasted as heat?

.....

(1 mark)

(ii) Use the following equation to calculate the efficiency of the power station.
Show clearly how you work out your answer.

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

.....

.....

efficiency = ...

(2 marks)

(c) List **A** gives three energy resources used to generate electricity.
List **B** gives environmental problems that may be caused by using different energy resources.
Draw a straight line from each energy resource in List **A** to the environmental problem it may cause in List **B**. Draw **three** lines only.

List A **Energy resource**	**List B** **Environmental problem that may be caused**
Wind	Destroys the habitat of wading birds in river estuaries
Tides	Produces a lot of noise
Falling water (hydroelectricity)	Produces the gas sulphur dioxide
	Floods land used for farming or forestry

4.5.6.1.2 Speed

Question 03 · continued

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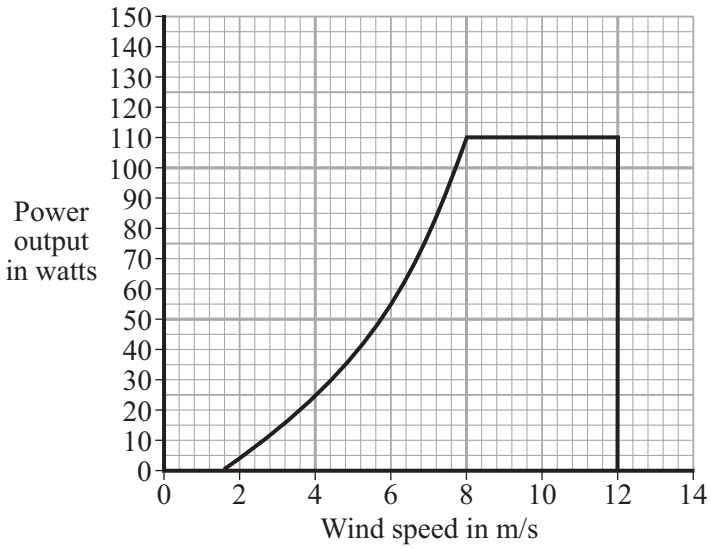
(d) A small wind generator is used to charge a battery. The graph shows the power output of the generator at different wind speeds.



(i) What is the maximum power produced by the generator?

..... watts
(1 mark)

(ii) The generator is designed to stop if the wind speed is too high.

At what wind speed does the generator stop working?

..... m/s
(1 mark)

(iii) Give **one** disadvantage of using a wind generator to charge a battery.

.....

.....
(1 mark)

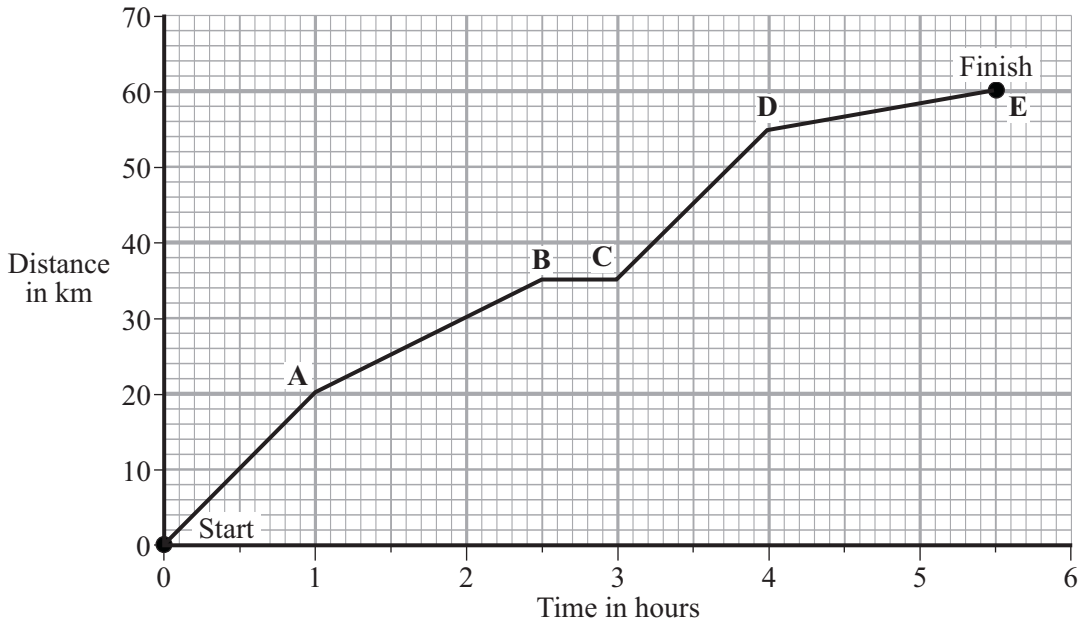
10

4.5.6.1.2 Speed

Question 04

June 2004 | 3451F | Original Q8 | Legacy

8 A horse and rider take part in a long distance race. The graph shows how far the horse and rider travel during the race.



(a) What was the distance of the race?

distance =.....km

(1 mark)

(b) How long did it take the horse and rider to complete the race?

.....

(1 mark)

(c) What distance did the horse and rider travel in the first 2 hours of the race?

distance =.....km

(1 mark)

(d) How long did the horse and rider stop and rest during the race?

.....

(1 mark)

(e) Not counting the time it was resting, between which two points was the horse moving the slowest?

..... and .....

Give a reason for your answer.

.....

.....

(2 marks)

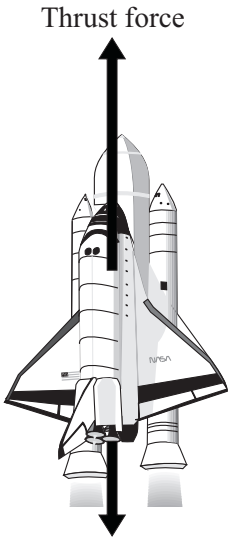
6

4.5.6.1.2 Speed

Question 05

June 2004 | 3451F | Original Q12 | Legacy

12 (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 05 · 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 1200°C.

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

.....

.....

(1 mark)

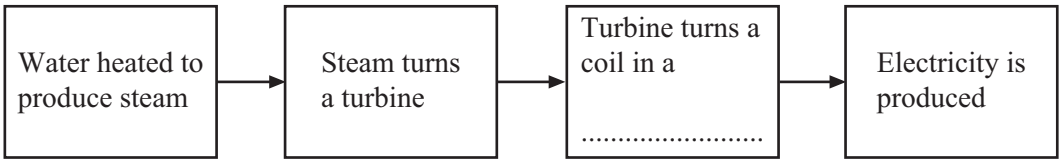
9

4.5.6.1.2 Speed

Question 06

June 2004 | 3462F3 | Original Q3 | Legacy

3 (a) In Britain most power stations burn fuel to produce heat. The diagram shows the stages by which the heat is transferred into electrical energy.
Complete the diagram by filling in the missing word.



(1 mark)

(b) A fuel burning power station uses 2000 joules of fuel energy to generate 600 joules of electrical energy. The rest of the fuel energy is wasted as heat.

(i) For every 600 joules of electrical energy generated, how much fuel energy is wasted as heat?

.....

(1 mark)

(ii) Use the following equation to calculate the efficiency of the power station.
Show clearly how you work out your answer.

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

.....

.....

efficiency = ...

(2 marks)

(c) List **A** gives three energy resources used to generate electricity.
List **B** gives environmental problems that may be caused by using different energy resources.
Draw a straight line from each energy resource in List **A** to the environmental problem it may cause in List **B**. Draw **three** lines only.

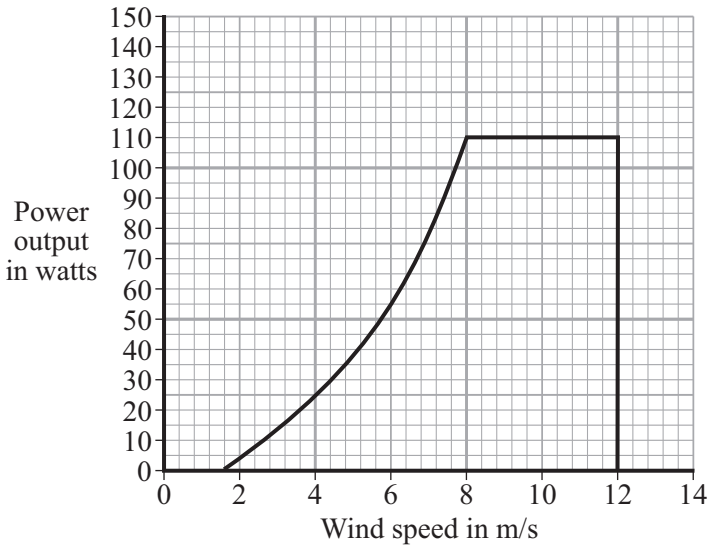
List A **Energy resource**	**List B** **Environmental problem that may be caused**
Wind	Destroys the habitat of wading birds in river estuaries
Tides	Produces a lot of noise
Falling water (hydroelectricity)	Produces the gas sulphur dioxide
	Floods land used for farming or forestry

4.5.6.1.2 Speed

Question 06 · continued

MARGIN BLANK

(d) A small wind generator is used to charge a battery. The graph shows the power output of the generator at different wind speeds.



(i) What is the maximum power produced by the generator?

..... watts
(1 mark)

(ii) The generator is designed to stop if the wind speed is too high.

At what wind speed does the generator stop working?

..... m/s
(1 mark)

(iii) Give **one** disadvantage of using a wind generator to charge a battery.

.....

.....
(1 mark)

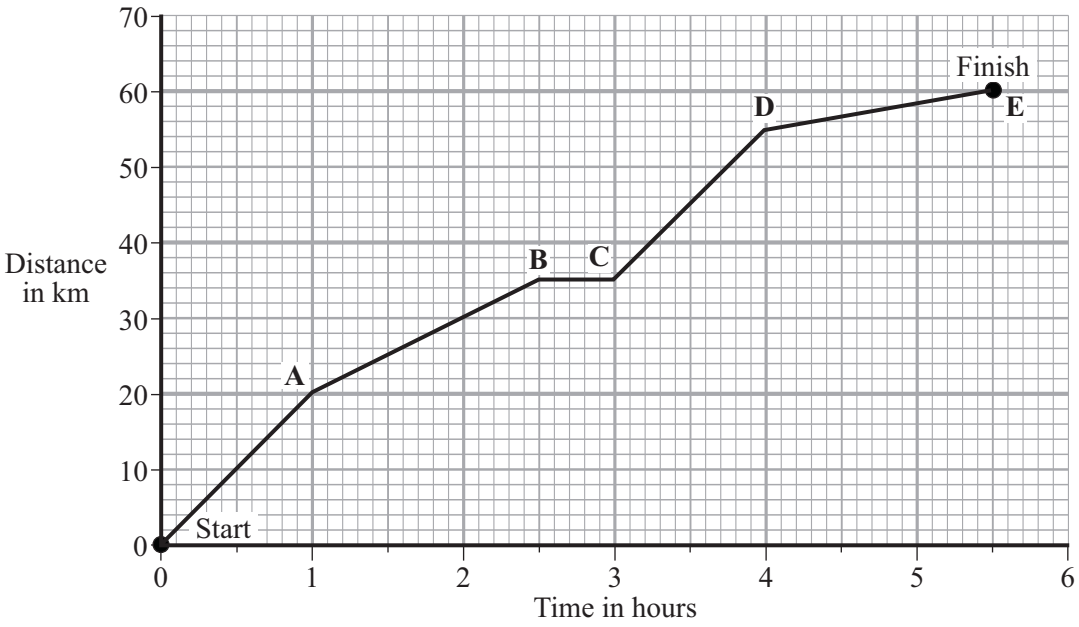
10

4.5.6.1.2 Speed

Question 07

June 2004 | 3462F3 | Original Q6 | Legacy

6 A horse and rider take part in a long distance race. The graph shows how far the horse and rider travel during the race.



(a) What was the distance of the race?

distance =.....km

(1 mark)

(b) How long did it take the horse and rider to complete the race?

.....

(1 mark)

(c) What distance did the horse and rider travel in the first 2 hours of the race?

distance =.....km

(1 mark)

(d) How long did the horse and rider stop and rest during the race?

.....

(1 mark)

(e) Not counting the time it was resting, between which two points was the horse moving the slowest?

..... and .....

Give a reason for your answer.

.....

.....

(2 marks)

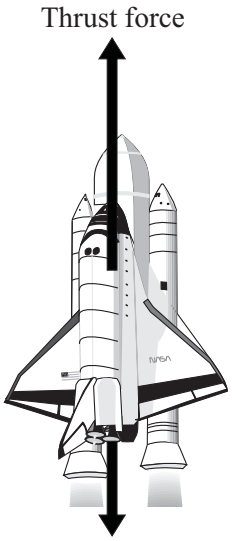
6

4.5.6.1.2 Speed

Question 08

June 2004 | 3462F3 | Original Q10 | Legacy

10 (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 08 · continued

1 /

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 09

June 2005 | 3451 | Original Q3 | Legacy

3 The diagram shows the types of wave that make up the electromagnetic spectrum.

gamma rays	**X-rays**	**ultraviolet**	**light**	**infra red**	**microwaves**	**radio**

(a) Which type of wave:

(i) has the longest wavelength and lowest frequency;

.....

(1 mark)

(ii) can be used to kill harmful bacteria in food;

.....

(1 mark)

(iii) is used in sunbeds to give a sun-tan;

.....

(1 mark)

(iv) is used to send information between mobile phones?

.....

(1 mark)

(b) Complete the following sentence by crossing out the **two** lines in the box that are wrong.

The speed of light rays through space is

faster than
the same as
slower than

the speed of radio waves through space.

(1 mark)

4.5.6.1.2 Speed

Question 09 · continued

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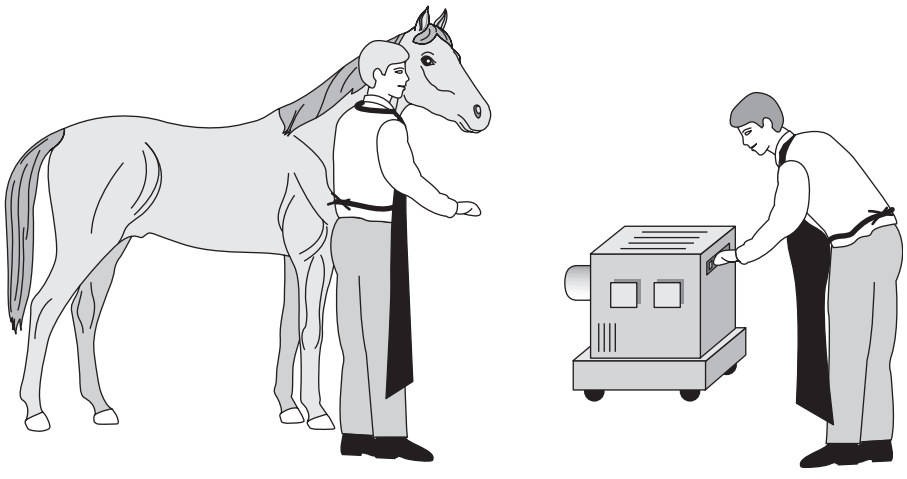
(c) The picture shows a horse being prepared for an X-ray.



The person who will take the X-ray and the person holding the horse are wearing special aprons. These aprons have a lead lining.

Explain why the lead lining is important.

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)

8

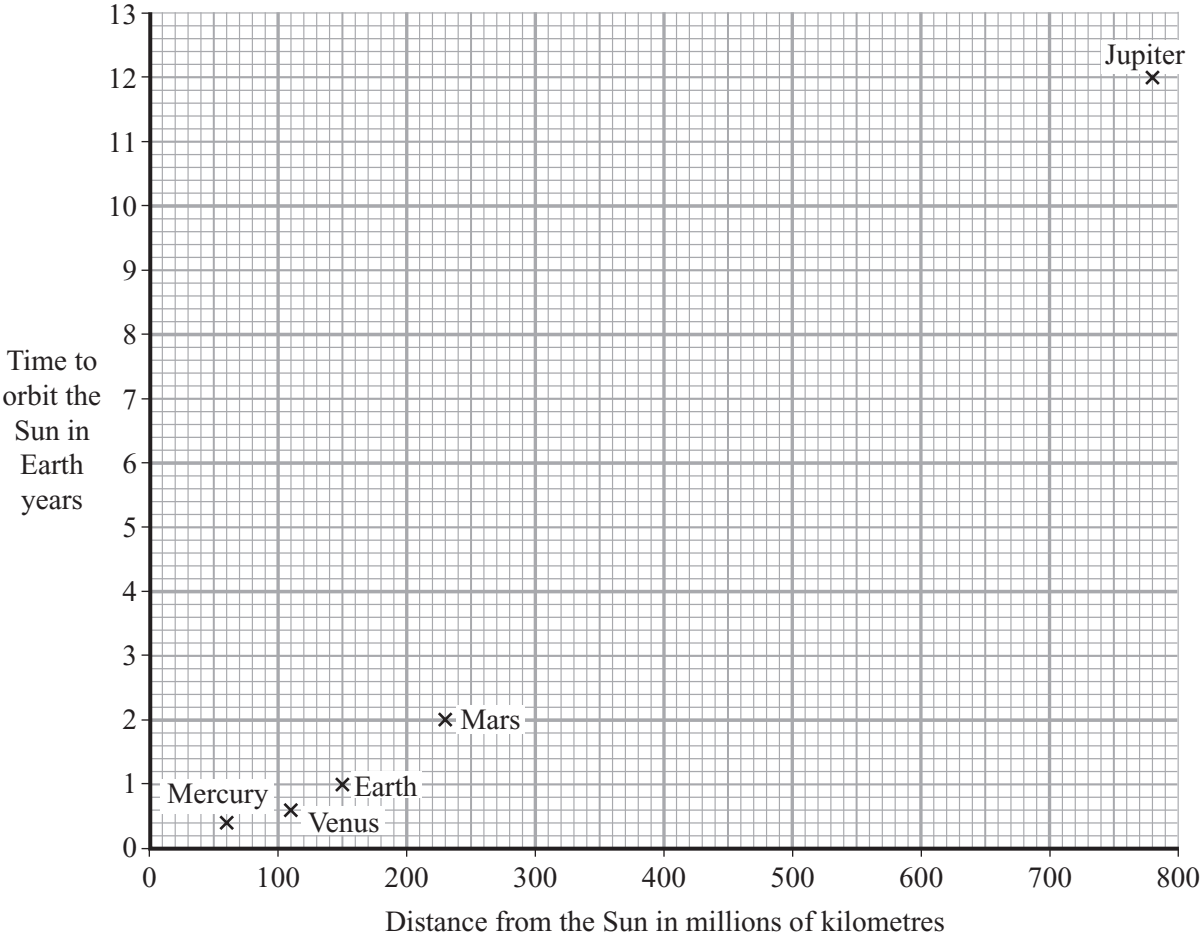
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 10

June 2005 | 3451 | Original Q12 | Legacy

12 (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 10 · 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

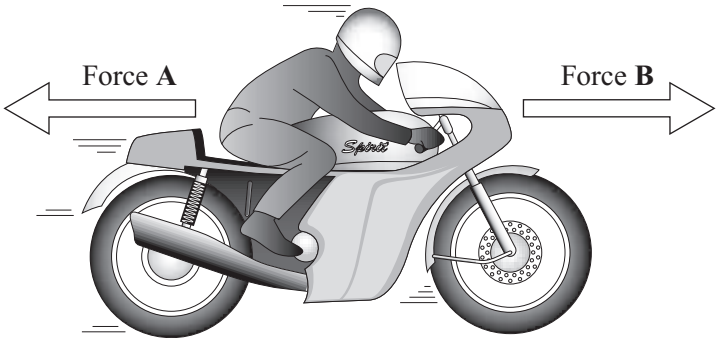
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 11

June 2005 | 3451 | Original Q14 | Legacy

14 (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**.

.....

.....

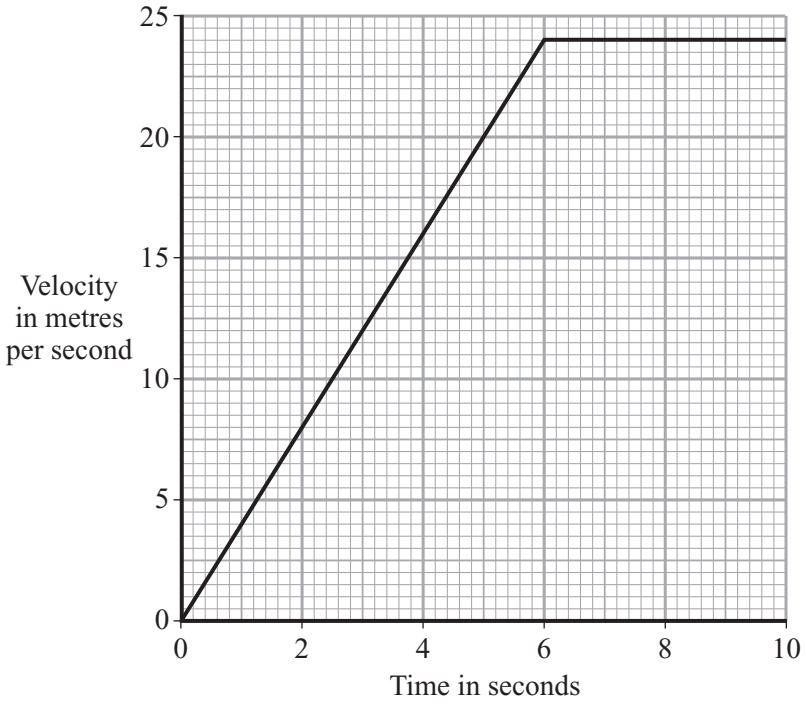
(2 marks)

(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 11 · 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 12

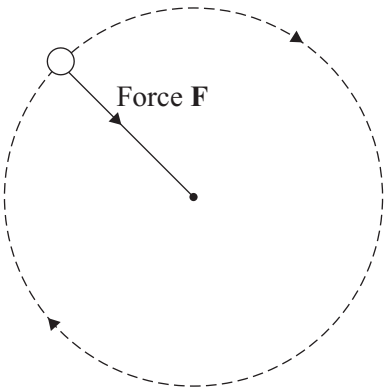
June 2005 | 3451 | Original Q15 | Legacy

15 (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 12 · continued

MARGIN BLANK

(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

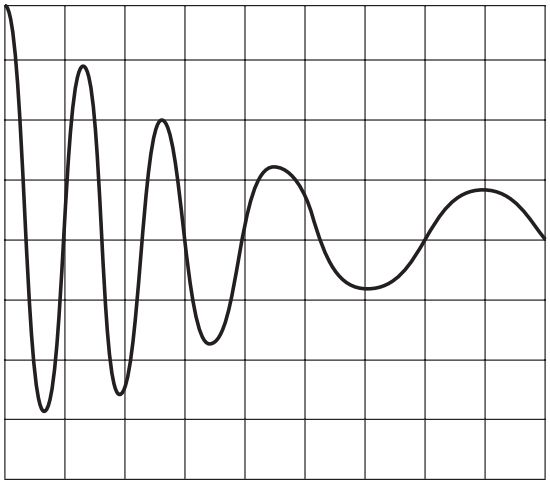
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 13

June 2005 | 3451 | Original Q17 | Legacy

17 (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 14

June 2005 | 3462 | Original Q3 | Legacy

3 The diagram shows the types of wave that make up the electromagnetic spectrum.

gamma rays	**X-rays**	**ultraviolet**	**light**	**infra red**	**microwaves**	**radio**

(a) Which type of wave:

(i) has the longest wavelength and lowest frequency;

.....

(1 mark)

(ii) can be used to kill harmful bacteria in food;

.....

(1 mark)

(iii) is used in sunbeds to give a sun-tan;

.....

(1 mark)

(iv) is used to send information between mobile phones?

.....

(1 mark)

(b) Complete the following sentence by crossing out the **two** lines in the box that are wrong.

The speed of light rays through space is

faster than
the same as
slower than

the speed of radio waves through space.

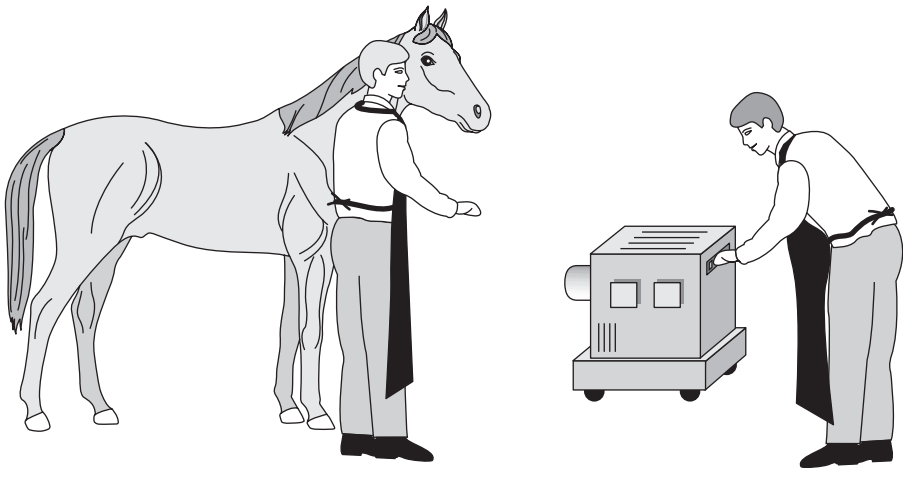
(1 mark)

4.5.6.1.2 Speed

Question 14 · continued

MARGIN BLANK

(c) The picture shows a horse being prepared for an X-ray.



The person who will take the X-ray and the person holding the horse are wearing special aprons. These aprons have a lead lining.

Explain why the lead lining is important.

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)

8

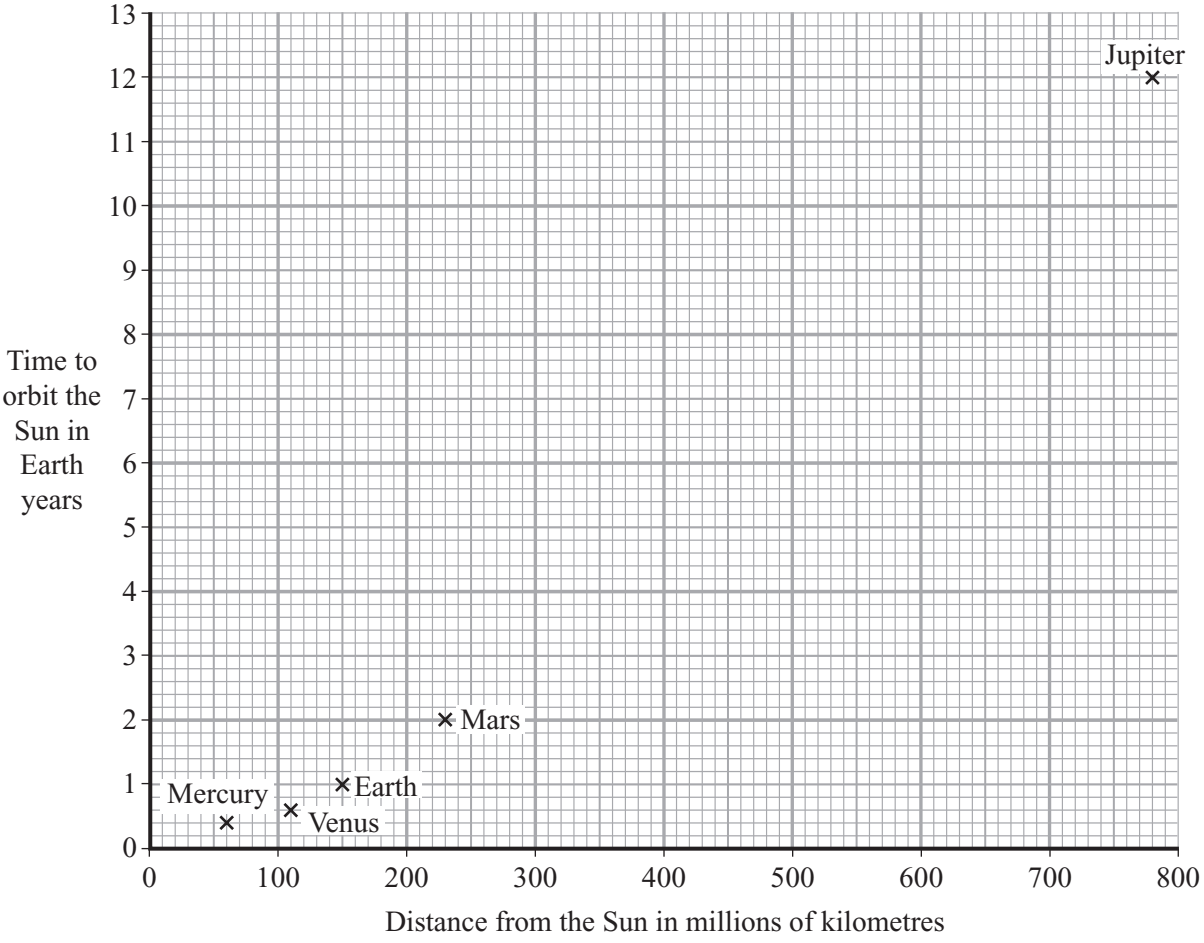
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 15

June 2005 | 3462 | Original Q10 | Legacy

10 (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 15 · 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

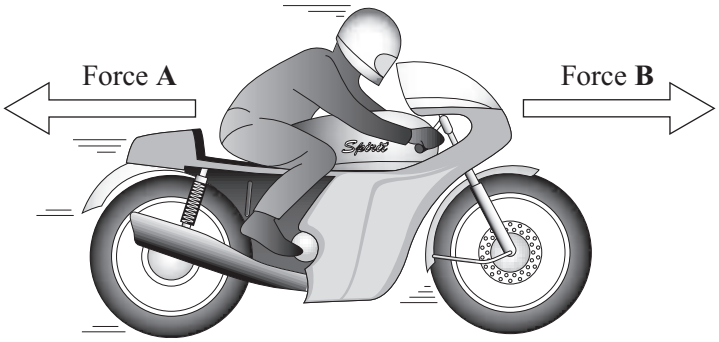
TURN OVER FOR THE NEXT QUESTION

4.5.6.1.2 Speed

Question 16

June 2005 | 3462 | Original Q12 | Legacy

12 (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**.

.....

.....

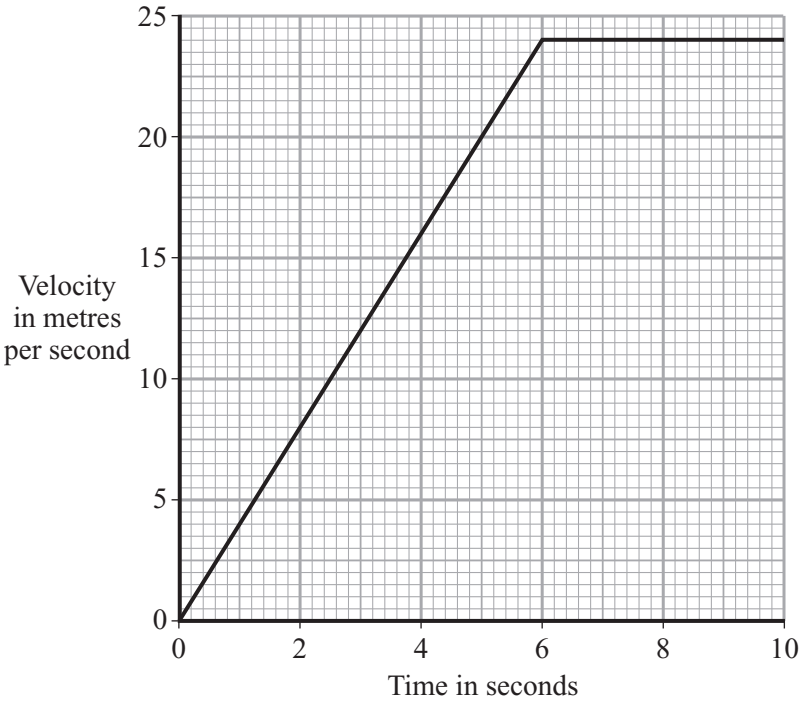
(2 marks)

(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 16 · 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)

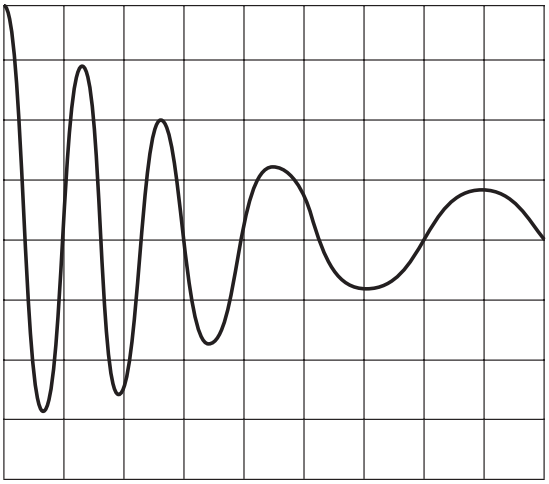
13

4.5.6.1.2 Speed

Question 17

June 2005 | 3462 | Original Q13 | Legacy

13 (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)

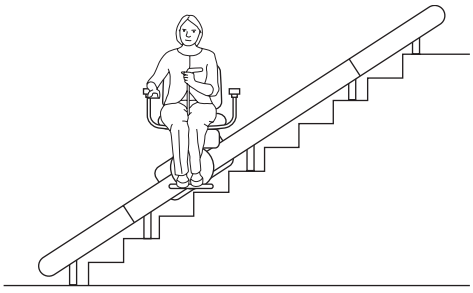
8

4.5.6.1.2 Speed

Question 18

June 2006 | 3451 | Original Q7 | Legacy

7 A person uses a stairlift to go upstairs. The stairlift is worked by an electric motor.



(a) Complete the sentences by choosing the correct words from the box.

Each word may be used once or not at all.

chemical	**electrical**	**heat**	**kinetic**	**light**	**sound**

(i) The electric motor is designed to transfer .....

energy to ..... energy.

(2 marks)

(ii) When the electric motor is working, the main energy wastages are

..... and ..... .

(2 marks)

Question 18 · continued

BLANK

(b) To lift the person and the chair, the electric motor does 2880 joules of work in 8 seconds.

(i) Use the following equation to calculate the useful power output of the electric motor. Show clearly how you work out your answer.

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

.....

.....

Power = ... J/s

(2 marks)

(ii) The answer to part (b)(i) is in J/s; this is not the usual unit for power. Which **one** of the following units is usually used for power?

Draw a ring around your answer.

coulomb (C) **joule (J)** **newton (N)** **watt (W)**

(1 mark)

(c) The forces on the stairlift are balanced.

Put a tick (✓) in the boxes next to the **two** statements that describe what the stairlift could be doing.

The stairlift is not moving. ☐

The stairlift is moving at a constant speed. ☐

The stairlift is speeding up. ☐

The stairlift is slowing down. ☐

(1 mark)

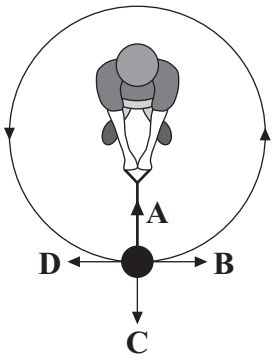
8

4.5.6.1.2 Speed

Question 19

June 2006 | 3451 | Original Q11 | Legacy

11 (a) The diagram shows an overhead view of an athlete who is about to throw a hammer.
The hammer is a metal mass joined to a strong wire.
The athlete swings the mass round in a circular path.



(i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act? .....
(1 mark)

(ii) The athlete lets go of the wire.
In which direction, **A**, **B**, **C** or **D**, does the mass move? .....
(1 mark)

(iii) Complete the sentences by ticking (✓) the correct ending.

When the mass moves in a circle at a steady speed the centripetal force is larger

if the

mass is larger	
mass is smaller	
speed decreases	
weight is smaller	

.

(1 mark)

When the mass moves in a circle at a steady speed the centripetal force is larger

if the

speed decreases	
weight is smaller	
wire is longer	
wire is shorter	

.

(1 mark)

(b) The following equation is used to calculate the turning effect of a force.

Choose **two** words from the box to complete the equation.

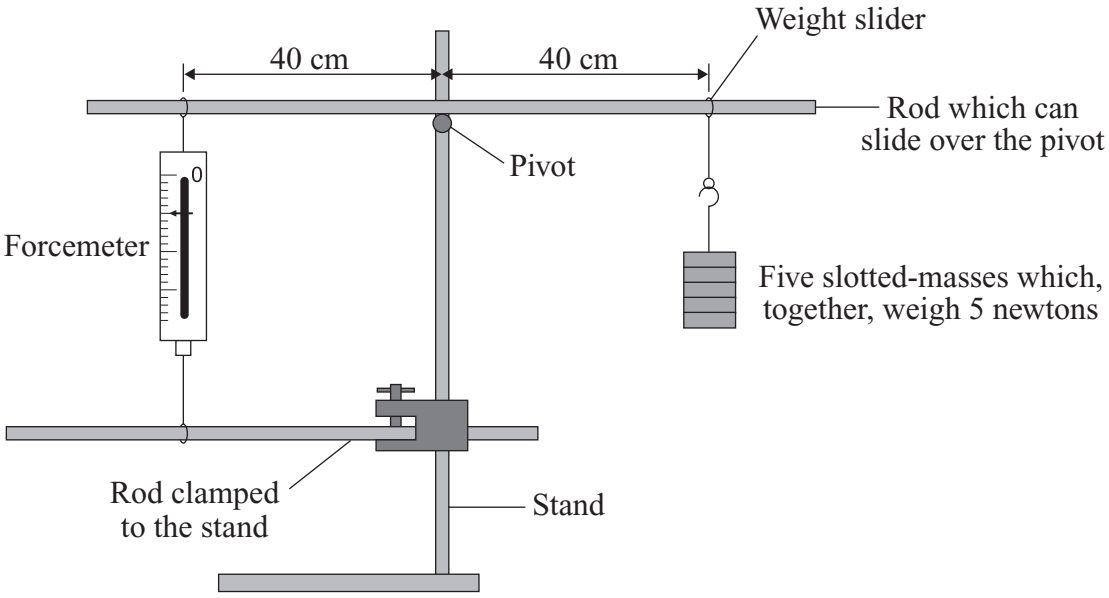
distance	**energy**	**mass**	**moment**	**weight**

..... = force × perpendicular ..... between line of action and pivot.
(2 marks)

Question 19 · continued

BLANK

(c) A student investigates turning effects.
The equipment she uses is shown below.



(i) What is the weight, in newtons, of each of the slotted masses? ..... N
(1 mark)

(ii) What will the reading be, in newtons, on the forcemeter? ..... N
(1 mark)

(iii) Briefly describe **two** different ways to adjust the apparatus so that the reading on the forcemeter is **less** than the weight of the slotted masses.

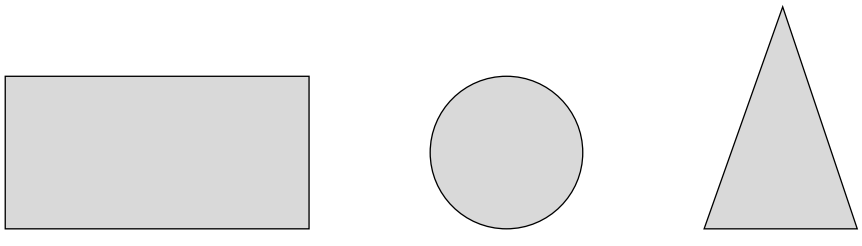
1.....

.....

2.....

.....
(2 marks)

(d) The diagrams show three thin sheets of plastic.
Label the centre of mass of each sheet with an **X**.



(3 marks)

13

4.5.6.1.2 Speed

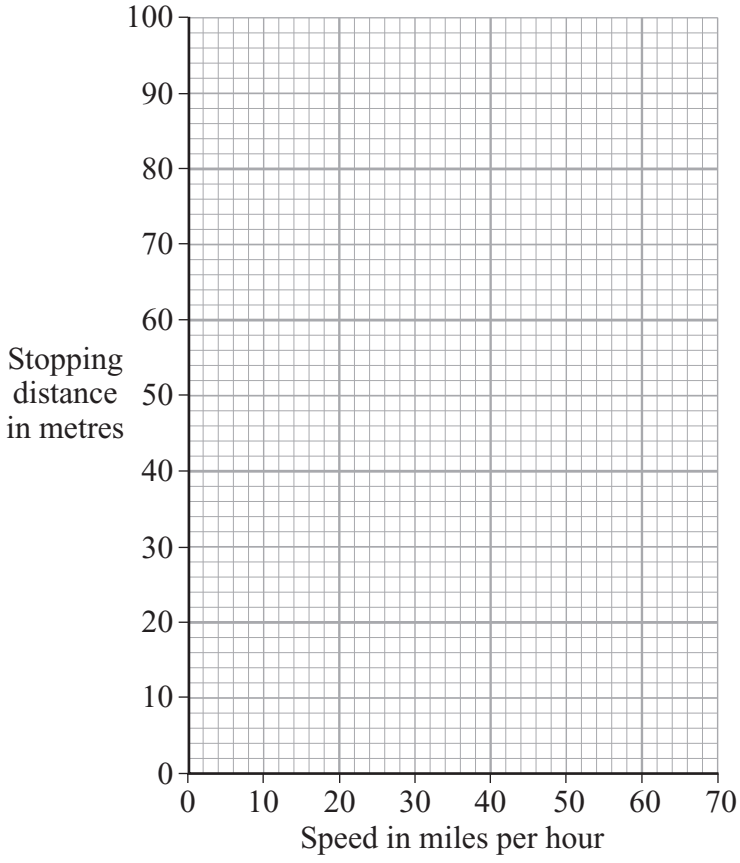
Question 20

June 2006 | 3451 | Original Q15 | Legacy

15 (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 15 continues on the next page

Question 20 · continued

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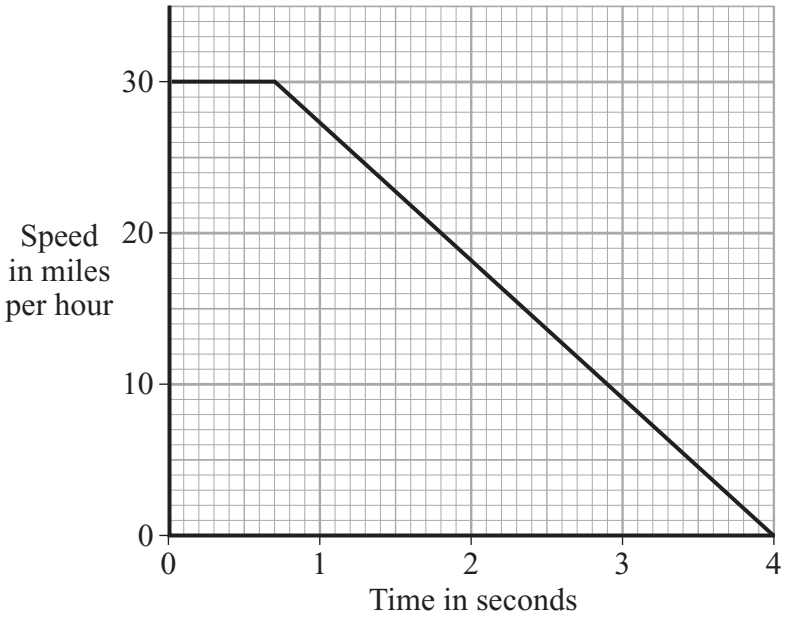
(b) A child ran out in front of a car causing the driver to make an emergency stop. The graph shows how the speed of the car changed from the moment the driver saw the child.



(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 20 · continued

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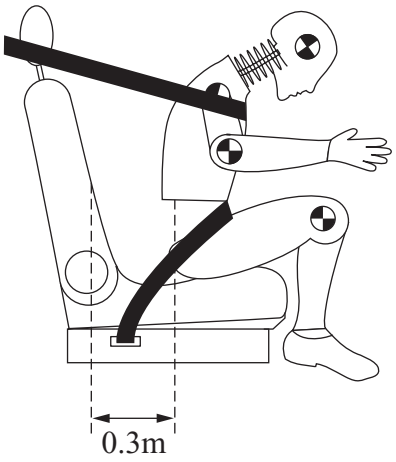
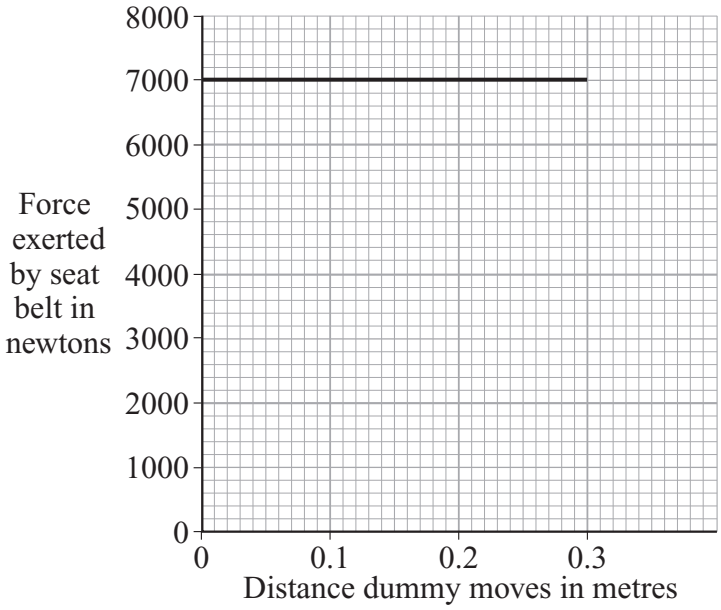
(c) The diagram shows how far a dummy in a car crash test moves before it is stopped by the seat belt. The graph shows the force exerted by the seat belt on the dummy during the crash.





(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)

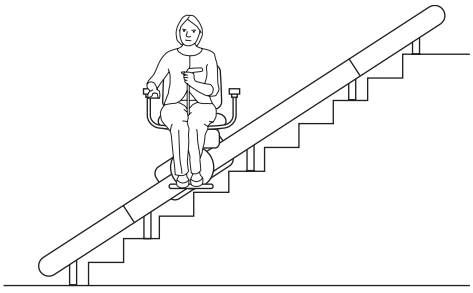
14

4.5.6.1.2 Speed

Question 21

June 2006 | 3462 | Original Q7 | Legacy

7 A person uses a stairlift to go upstairs. The stairlift is worked by an electric motor.



(a) Complete the sentences by choosing the correct words from the box.

Each word may be used once or not at all.

chemical	**electrical**	**heat**	**kinetic**	**light**	**sound**

(i) The electric motor is designed to transfer .....

energy to ..... energy.

(2 marks)

(ii) When the electric motor is working, the main energy wastages are

..... and ..... .

(2 marks)

Question 21 · continued

BLANK

(b) To lift the person and the chair, the electric motor does 2880 joules of work in 8 seconds.

(i) Use the following equation to calculate the useful power output of the electric motor. Show clearly how you work out your answer.

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

.....

.....

Power = ... J/s

(2 marks)

(ii) The answer to part (b)(i) is in J/s; this is not the usual unit for power. Which **one** of the following units is usually used for power?

Draw a ring around your answer.

coulomb (C) **joule (J)** **newton (N)** **watt (W)**

(1 mark)

(c) The forces on the stairlift are balanced.

Put a tick (✓) in the boxes next to the **two** statements that describe what the stairlift could be doing.

The stairlift is not moving. ☐

The stairlift is moving at a constant speed. ☐

The stairlift is speeding up. ☐

The stairlift is slowing down. ☐

(1 mark)

8

4.5.6.1.2 Speed

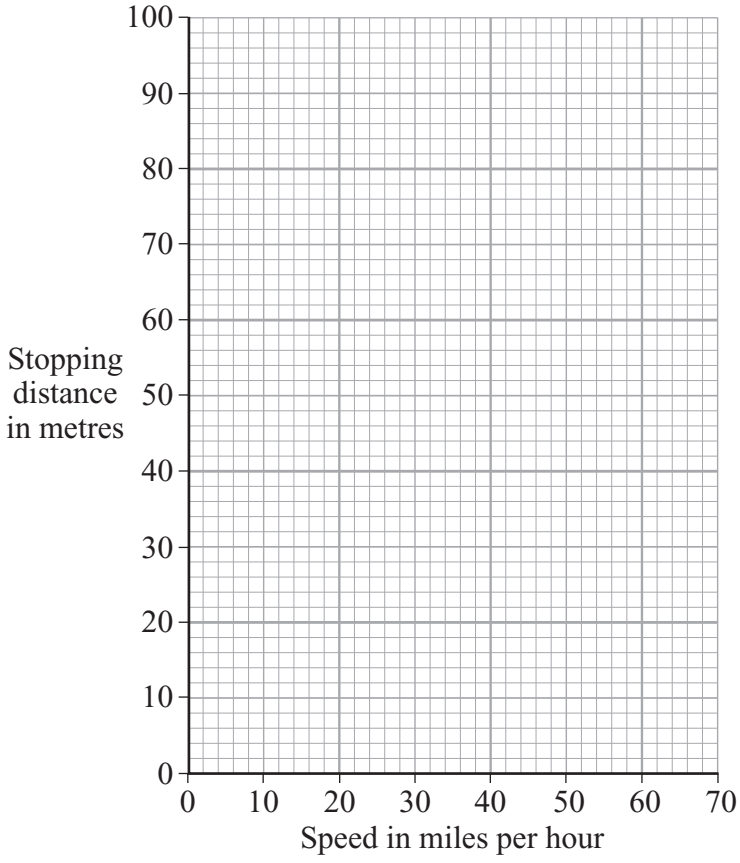
Question 22

June 2006 | 3462 | Original Q13 | Legacy

13 (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 13 continues on the next page

Question 22 · continued

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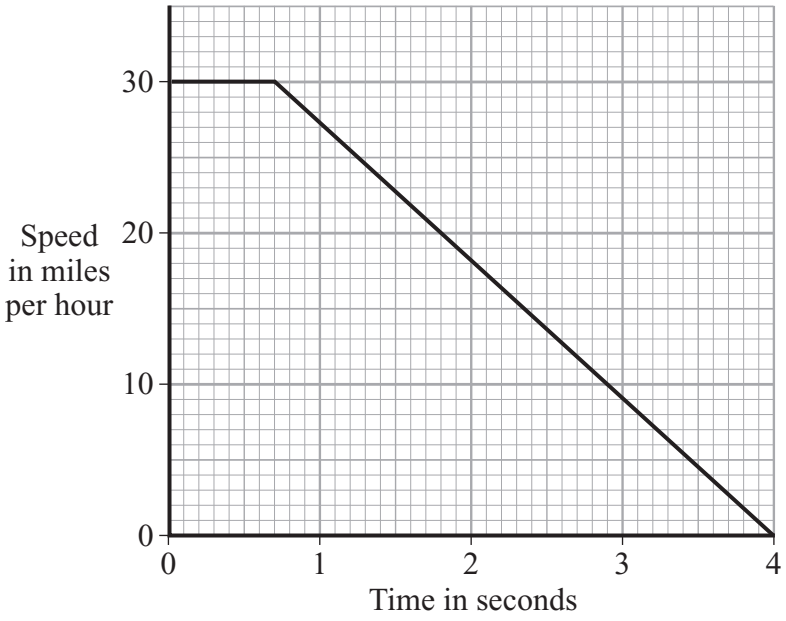
(b) A child ran out in front of a car causing the driver to make an emergency stop. The graph shows how the speed of the car changed from the moment the driver saw the child.



(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 22 · continued

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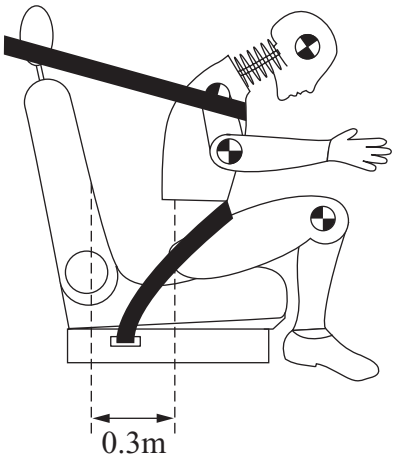
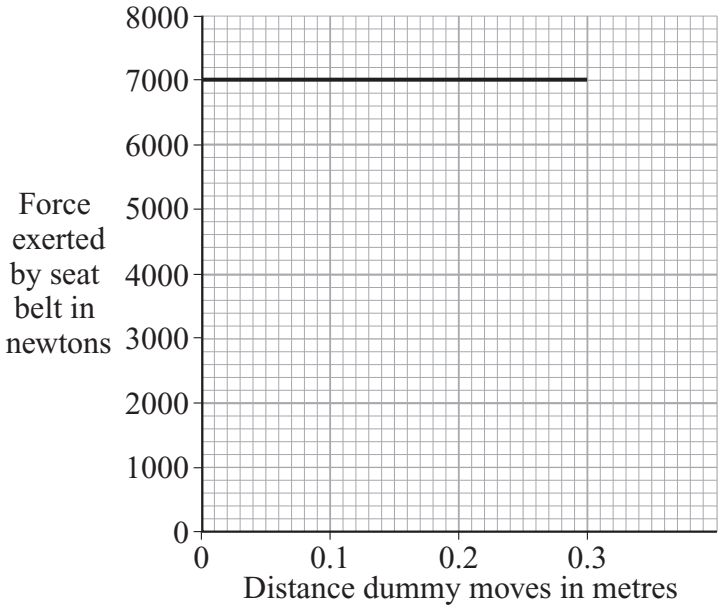
(c) The diagram shows how far a dummy in a car crash test moves before it is stopped by the seat belt. The graph shows the force exerted by the seat belt on the dummy during the crash.





(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 23

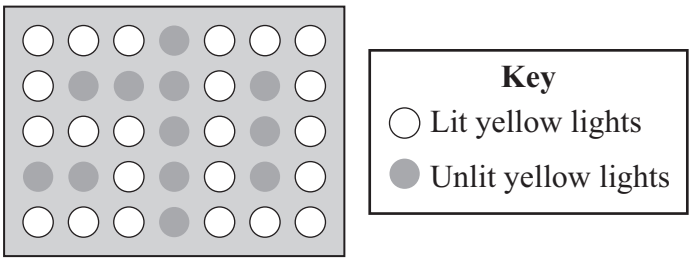
November 2006 | PHY1B | Original Q8 | Legacy

QUESTION EIGHT

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.



8A 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.

8B 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

8C 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?

1 250 nm

2 350 nm

3 600 nm

4 750 nm

4.5.6.1.2 Speed

Question 23 · continued

8D 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

Turn over for the next question

4.5.6.1.2 Speed

Question 24

March 2007 | PHY1B | Original Q4 | Legacy

QUESTION FOUR

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

A away from

B beyond

C furthest

D towards

The light that reaches us from distant galaxies shows a shift . . . **1** . . . the red end of the electromagnetic spectrum. This is evidence that these galaxies are moving . . . **2** . . . us at a very high speed.

Telescopes orbiting outside the Earth's atmosphere can detect infra red radiation from the . . . **3** . . . galaxies. This is . . . **4** . . . the capability of telescopes on the Earth's surface.

4.5.6.1.2 Speed

Question 25

June 2007 | PHY1B | Original Q8 | Legacy

QUESTION EIGHT

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

8A 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 25 · continued

8B 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

8C Which bottle would be best for storing pills?

1 **W**

2 **X**

3 **Y**

4 **Z**

8D 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 26

June 2007 | PHY1F | Original Q4 | Legacy

4 (a) Ultraviolet and visible light are both electromagnetic waves.

(i) Name **one** other type of electromagnetic wave.

.....

(1 mark)

(ii) Which **one** of the following statements is true for electromagnetic waves travelling through a vacuum?

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

All the waves have the same frequency. ☐

All the waves have the same wavelength. ☐

All the waves travel at the same speed. ☐

(1mark)

4.5.6.1.2 Speed

Question 26 · continued

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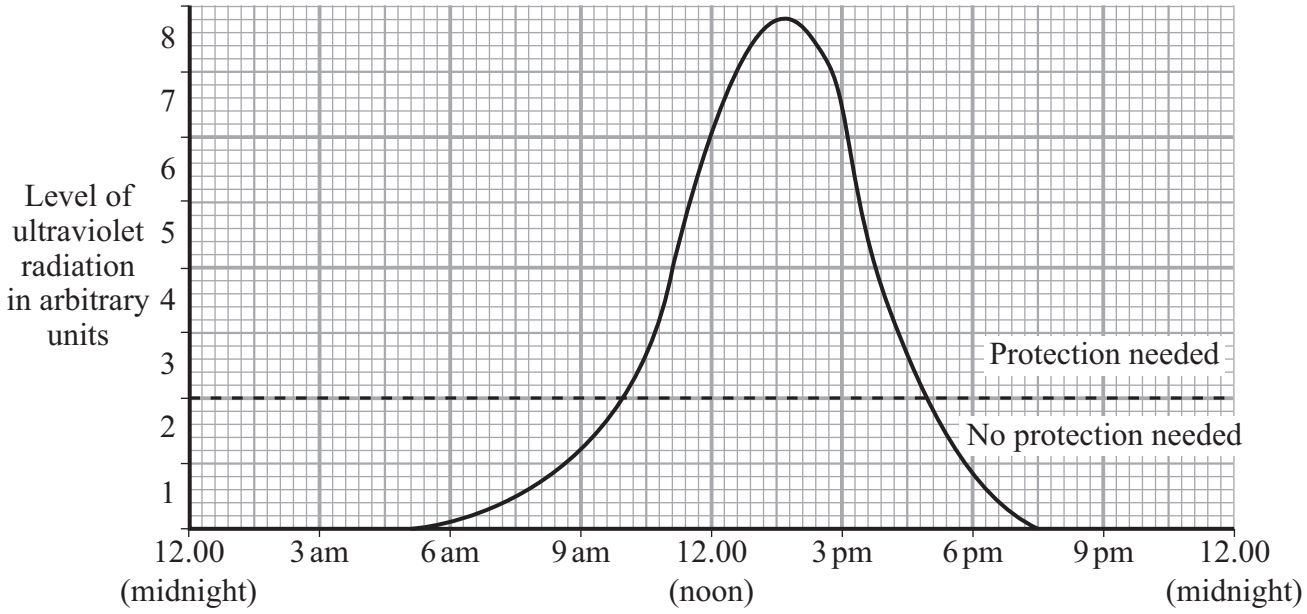
(b) The graph shows how the level of ultraviolet radiation changed during a summer day in England.



(i) What serious health problem can be caused by exposure to the ultraviolet radiation from the Sun?

.....

(1 mark)

(ii) Explain why it would be sensible to stay out of the Sun between 10 am and 4 pm in the summer.

.....

.....

.....

.....

(2 marks)

5

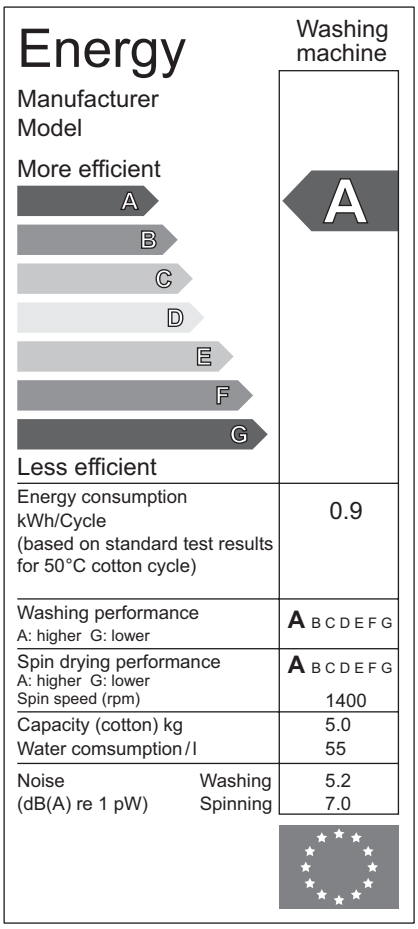
4.5.6.1.2 Speed

Question 27

November 2007 | PHY1A | Original Q7 | Legacy

QUESTION SEVEN

The energy label gives information about a washing machine.



7A The energy label states that this washing machine has an efficiency rating of **A**.

Another washing machine has an efficiency rating of **C**.

This means that the washing machine described by this label . . .

1 uses less energy for each wash cycle than the C-rated washing machine.

2 uses more energy for each wash cycle than the C-rated washing machine.

3 wastes more energy for each wash cycle than the C-rated washing machine.

4 wastes less energy for each wash cycle than the C-rated washing machine.

4.5.6.1.2 Speed

Question 27 · continued

7B Washing machines do **not** transfer all of the supplied energy into useful forms.

Information on the energy label suggests that energy is wasted as . . .

1 heat.

2 light.

3 kinetic energy.

4 sound.

7C The A-rated washing machine is used for 300 standard washing cycles per year.

How much energy does this number of cycles transfer?

1 270 kWh

2 1500 kWh

3 2700 kWh

4 3600 kWh

7D

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

A large family uses the A-rated washing machine for 500 standard washing cycles in a year.

1 kilowatt-hour of electricity costs 12 p.

How much does the washing machine cost to run each year?

1 £40

2 £41.60

3 £54

4 £60

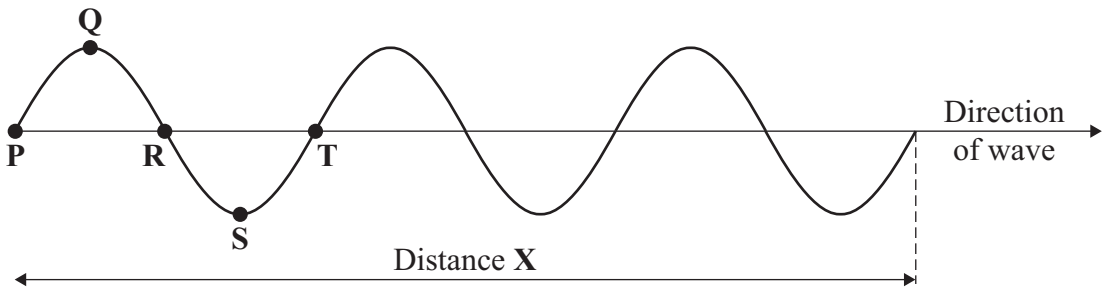
4.5.6.1.2 Speed

Question 28

November 2007 | PHY1B | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows part of a wave.



7A The wavelength of this wave is . . .

1 **PR**

2 **PT**

3 **RT**

4 **QS**

7B The wave travels distance **X** in 1 second.

The frequency of the wave is . . .

1 1 Hz

2 2 Hz

3 3 Hz

4 6 Hz

4.5.6.1.2 Speed

Question 28 · continued

7C The spectrum of light from a source of white light moving away at high speed shows . . .

1 a ‘shift’ towards the red end of the spectrum.

2 an increase in the intensity of the ultraviolet radiation.

3 that light travels in straight lines.

4 that red light travels more slowly than blue light in a vacuum.

7D Scientists have analysed light from distant galaxies.

Their conclusion is that . . .

1 our solar system and distant galaxies are moving apart at high speed.

2 galaxies are moving towards each other at high speed.

3 galaxies are stationary.

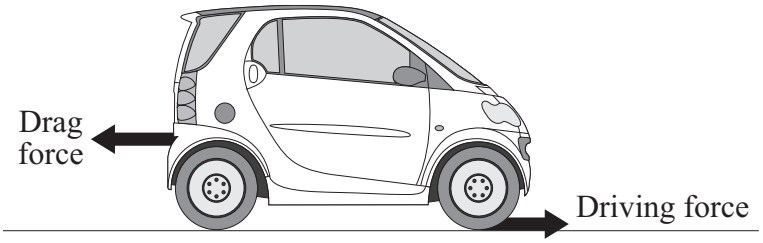
4 the planets in our solar system are moving away from the Sun at high speed.

4.5.6.1.2 Speed

Question 29

January 2008 | PHY2F | Original Q3 | Legacy

3 The diagram shows the horizontal forces acting on a car travelling along a straight road.



(a) Complete the following sentences by drawing a ring around the correct word in each box.

(i) When the driving force equals the drag force, the speed of the car is

decreasing
constant
increasing

.

(1 mark)

(ii) Putting the brakes on transforms the car's kinetic energy mainly into

heat
light
sound

.

(1 mark)

4.5.6.1.2 Speed

Question 29 · continued

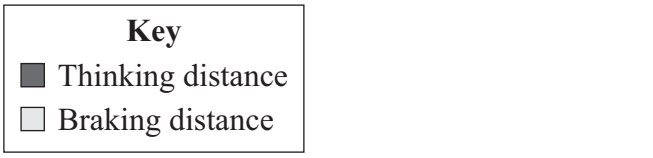
BLANK

(b) The charts, **A**, **B** and **C** give the thinking distance and the braking distance for a car driven under different conditions.

(i) Draw straight lines to match each chart to the correct conditions.

Draw only **three** lines.

Conditions	Charts
Speed = 22 m/s driver wide awake	A
Speed = 13 m/s driver wide awake	B
Speed = 13 m/s driver very tired	C



(2 marks)

(ii) The three charts above all apply to dry road conditions.

How would the braking distances be different if the road were wet?

.....

.....

(1 mark)

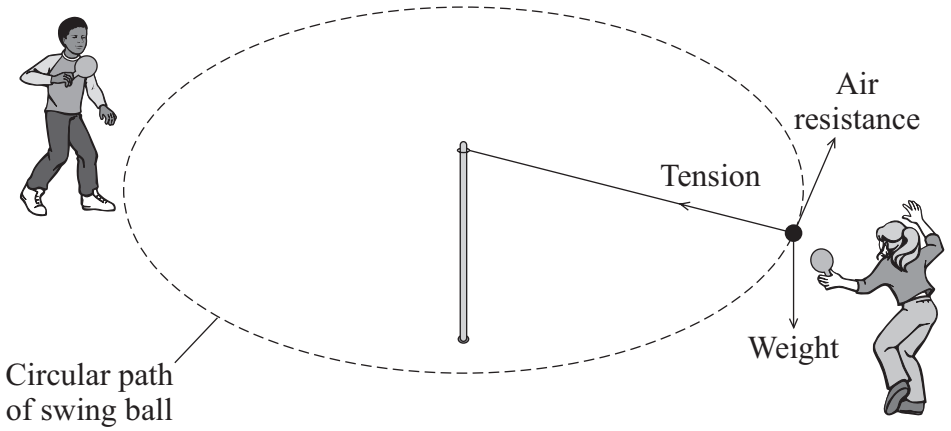
5

4.5.6.1.2 Speed

Question 30

January 2008 | PHY3F | Original Q3 | Legacy

3 The diagram shows two children playing with a toy called a swing ball. The ball is joined to a pole by a strong string. The children hit the ball so that it goes round in a circular path.



(a) Which force causes the ball to move in a circle?

Draw a ring around your answer.

air resistance **tension** **weight**

(1 mark)

(b) Complete the sentences by ticking (✓) the correct ending.

(i) The force needed to make the ball move in a circular path is larger if

the speed of the ball is increased. ☐

the speed of the ball is decreased. ☐

the string is made longer. ☐

(1 mark)

(ii) The continuous acceleration of a ball moving in a circular path changes

the speed of the ball. ☐

the direction of the ball. ☐

the weight of the ball. ☐

(1 mark)

4.5.6.1.2 Speed

Question 30 · continued

BLANK

(c) Which of the following words is used to describe any force that causes an object to move in a circular path?

Draw a ring around your answer.

centripetal **frictional** **gravitational** **universal**

(1 mark)

4

Turn over for the next question

4.5.6.1.2 Speed

Question 31

January 2008 | PHY3F | Original Q5 | Legacy

5 Two students collect data from the Internet about planets in the Solar System.

The table shows the data that they collect about the first six planets.

Name of planet	Distance from the Sun in arbitrary units	Time for one orbit of the Sun in years	Mean surface temperature of the planet in ºC
Mercury	0.4	0.2	+ 125
Venus	0.7	0.6	+ 465
Earth	1.0	1.0	+ 22
Mars	1.5	1.9	– 48
Jupiter	5.2	11.9	
Saturn	9.6	29.5	– 180

(a) One student says that the mean surface temperature of planets gets less the further they are from the Sun. The other student agrees but says that one planet does not fit the pattern.

Which planet does not fit the pattern?

.....

(1 mark)

(b) Estimate a value for the mean surface temperature of Jupiter.

Mean surface temperature of Jupiter = ... ºC

(1 mark)

(c) Use words from the box to complete the following conclusion reached using the data in the table.

You can use the words once, more than once or not at all.

decreases	increases	stays the same

As the distance from the Sun to a planet .....

the time taken for the planet to orbit the Sun ..... .

(1 mark)

4.5.6.1.2 Speed

Question 31 · continued

BLANK

(d) Hundreds of years ago, some scientists thought that Mars was a hot planet because it has a reddish colour.

Which **one** of the following statements gives the reason why scientists no longer think this?

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

Hundreds of years ago, scientists got everything wrong. ☐

Today's scientists have new evidence about Mars. ☐

All scientific ideas change every one hundred years. ☐

(1 mark)

4

Turn over for the next question

4.5.6.1.2 Speed

Question 32

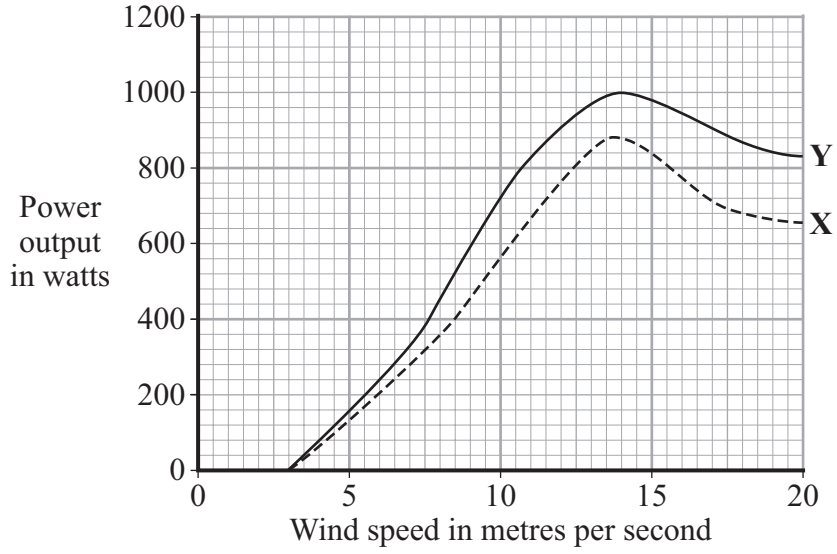
March 2008 | PHY1AP | Original Q9 | Legacy

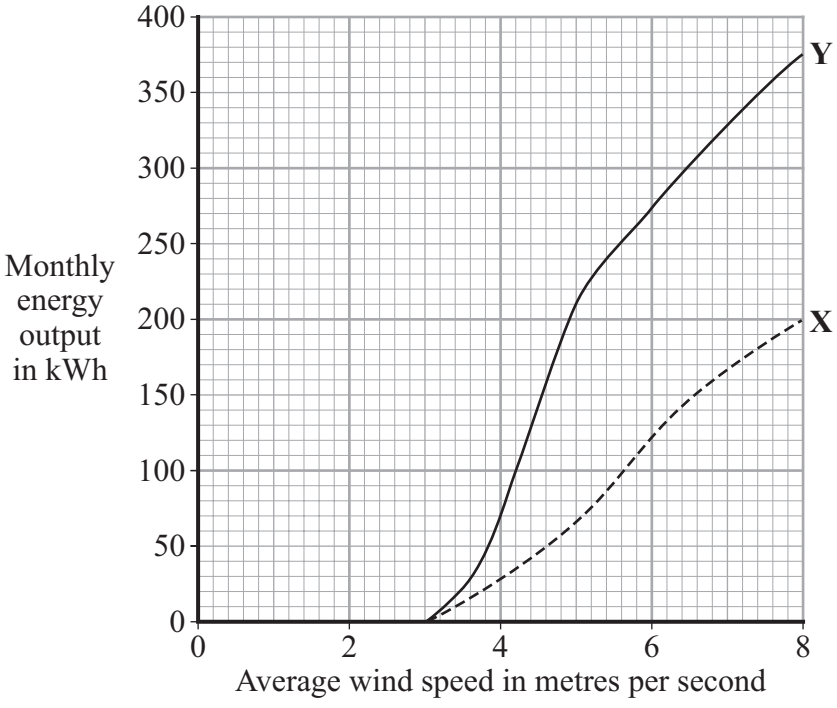
QUESTION NINE

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**.





9A 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

Question 32 · continued

9B 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.

9C 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.

9D 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.

END OF TEST

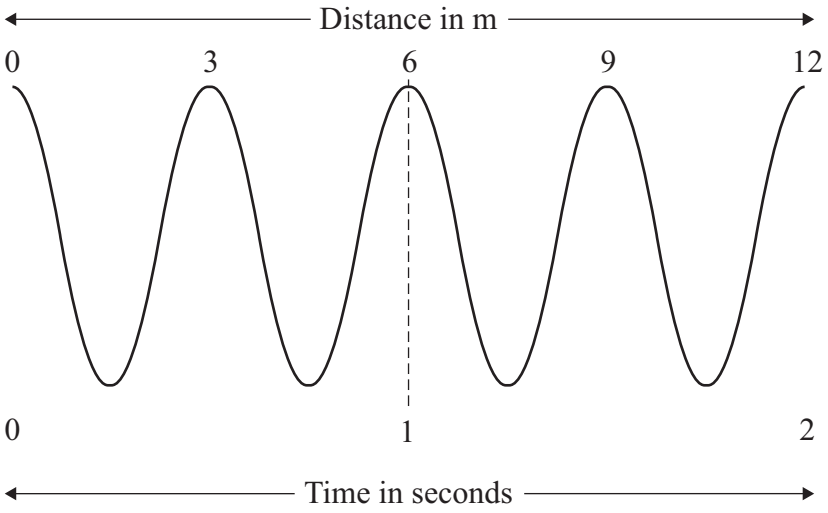
4.5.6.1.2 Speed

Question 33

March 2008 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

The diagram shows a wave.



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

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

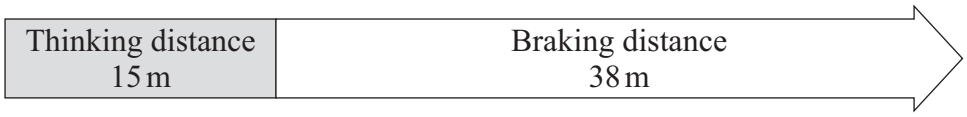
4.5.6.1.2 Speed

Question 34

June 2008 | PHY2F | Original Q1 | Legacy

1 (a) A car driver makes an emergency stop.

The chart shows the 'thinking distance' and the 'braking distance' needed to stop the car.



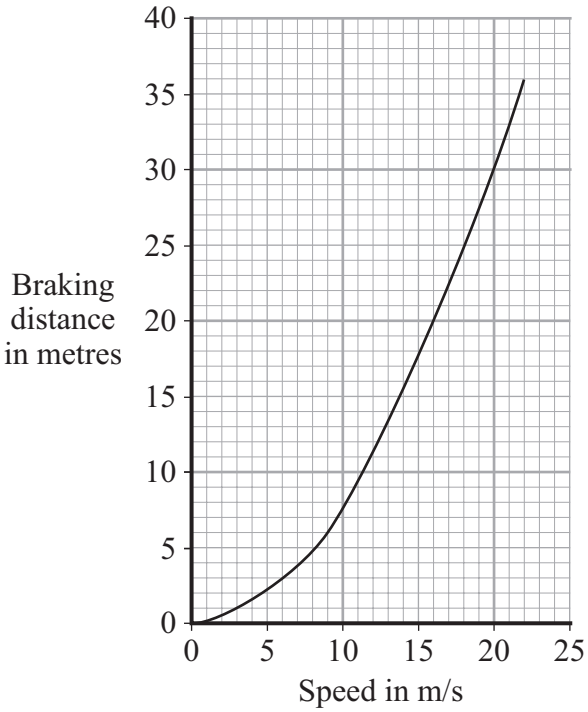
Calculate the total stopping distance of the car.

.....

Stopping distance = ... m

(1 mark)

1 (b) The graph shows how the braking distance of a car driven on a dry road changes with the car's speed.



The braking distance of the car on an icy road is longer than the braking distance of the car on a dry road.

1 (b) (i) Draw a new line on the graph to show how the braking distance of the car on an icy road changes with speed.

(2 marks)

Question 1 continues on the next page

4.5.6.1.2 Speed

Question 34 · continued

for mark

1 (b) (ii) Which **two** of the following would also increase the braking distance of the car?

Put a tick (✓) in the box next to each of your answers.

rain on the road ☐

the driver having drunk alcohol ☐

car brakes in bad condition ☐

the driver having taken drugs ☐

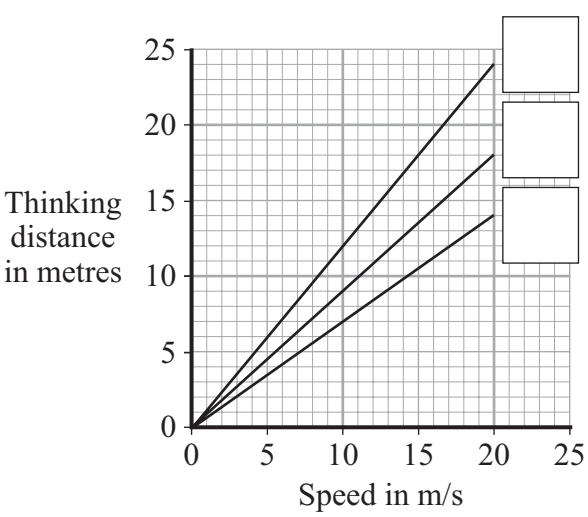
(2 marks)

1 (c) The thinking distance depends on the driver's reaction time.

The table shows the reaction times of three people driving under different conditions.

Car driver	Condition	Reaction time in seconds
A	Wide awake with no distractions	0.7
B	Using a hands-free mobile phone	0.9
C	Very tired and listening to music	1.2

The graph lines show how the thinking distance for the three drivers, **A**, **B** and **C**, depends on how fast they are driving the car.



1 (c) (i) Match each graph line to the correct driver by writing **A**, **B** or **C** in the box next to the correct line.

(2 marks)

4.5.6.1.2 Speed

Question 34 · continued

for mark

1 (c) (ii) The information in the table cannot be used to tell if driver **C**'s reaction time is increased by being tired **or** by listening to music.

Explain why.

.....

.....

.....

.....

(2 marks)

9

Turn over for the next question

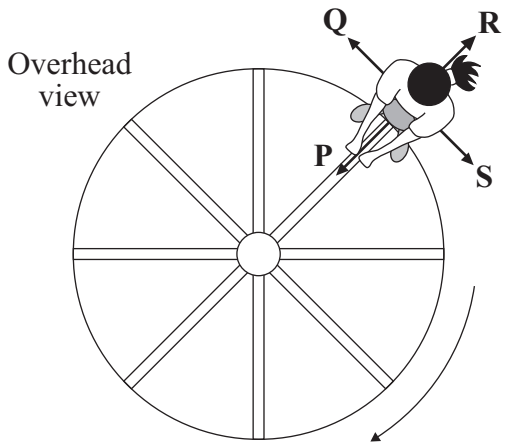
4.5.6.1.2 Speed

Question 35

June 2008 | PHY3F | Original Q5 | Legacy

5 A girl and her father visit a children's playground.

5 (a) The diagram shows the girl holding on to a roundabout which is turning.



A centripetal force must act because the girl moves in a circular path.

5 (a) (i) In which direction, **P**, **Q**, **R** or **S**, does the centripetal force act?

Direction ..... *(1 mark)*

5 (a) (ii) What provides this centripetal force?

.....

.....

(1 mark)

5 (a) (iii) Her father pushes the roundabout so that it turns faster. The girl continues to stand on the same part of the roundabout.

Complete the following sentence by drawing a ring around the correct line in the box.

The centripetal force on the girl

decreases
does not change
increases

.

(1 mark)

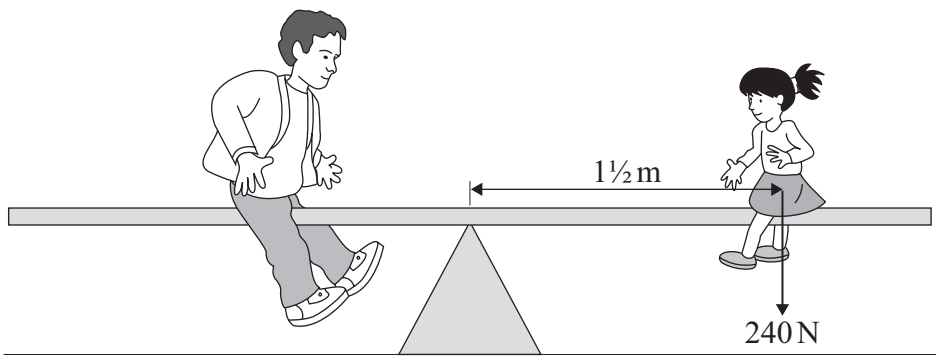
Question 5 continues on the next page

4.5.6.1.2 Speed

Question 35 · continued

for mark

5 (b) The diagram shows the girl and her father on a see-saw.



5 (b) (i) Use the equation in the box to calculate the moment of the girl.

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.

.....

.....

Moment of the girl = ... Nm

(2 marks)

5 (b) (ii) What must her father do to increase his moment?

.....

.....

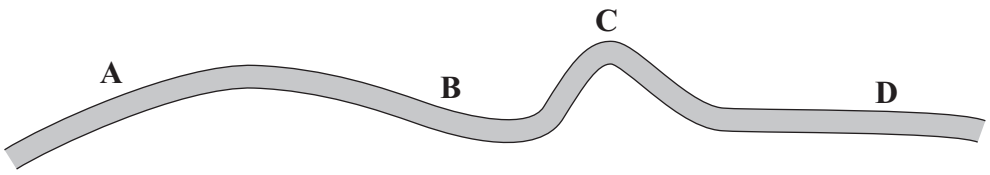
(1 mark)

4.5.6.1.2 Speed

Question 35 · continued

for mark

5 (c) The diagram shows part of a level road that they take when they drive home. They drive at a steady speed.



5 (c) (i) At which point, **A**, **B**, **C** or **D**, will the centripetal force on the car be greatest?

Centripetal force is greatest at ..... .

(1 mark)

5 (c) (ii) What provides the centripetal force when the car goes round a bend?

.....

.....

(1 mark)

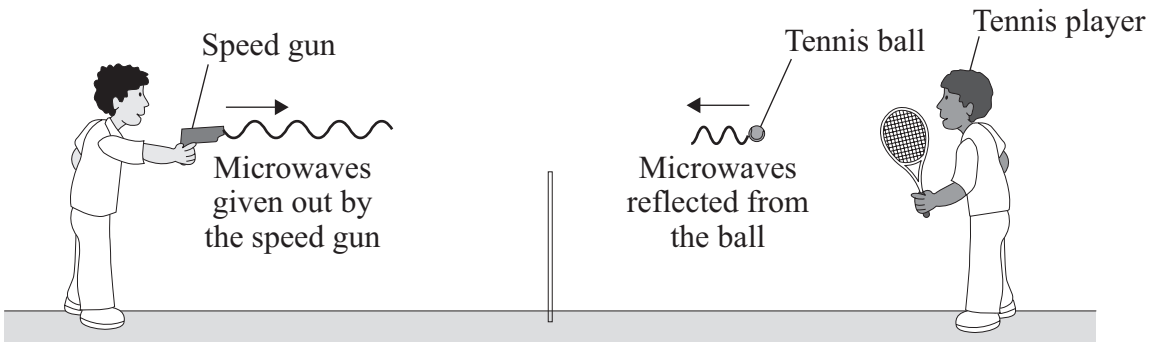
8

4.5.6.1.2 Speed

Question 36

January 2009 | PHY1F | Original Q2 | Legacy

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



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

2 (a) (i) Complete the following sentence by choosing **one** of the phrases from the box.

longer than	**the same as**	**shorter than**

The wavelength of the microwaves reflected from the ball are

..... the wavelength of the microwaves from the speed gun.

(1 mark)

2 (a) (ii) Complete the following sentence by drawing a ring around the correct line in the box.

When the ball absorbs microwaves, its temperature will

decrease slightly
not change
increase slightly

.

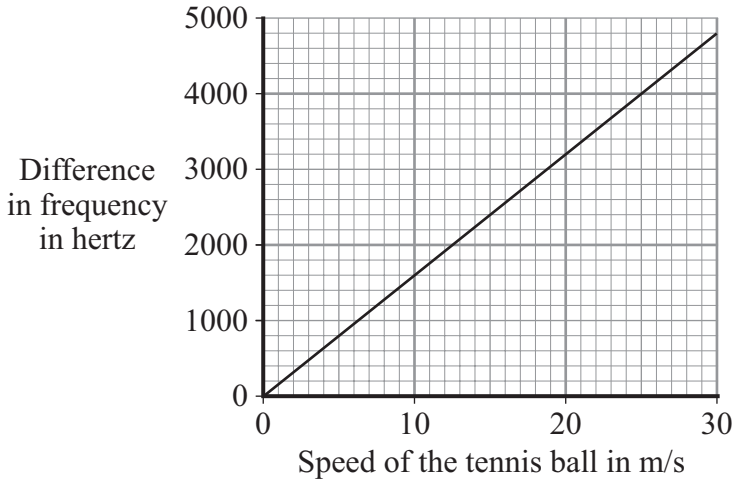
(1 mark)

4.5.6.1.2 Speed

Question 36 · continued

for mark

2 (b) The microwaves reflected from the ball have a higher frequency than the microwaves from the speed gun.
The graph shows how the difference between the two frequencies depends on the speed of the ball.



2 (b) (i) Describe the pattern that links the difference between the two frequencies and the speed of the ball.

.....

.....

(1 mark)

2 (b) (ii) The speed gun measures the difference between the two frequencies as 3200 Hz.

Use the graph to find the speed of the tennis ball.
Show clearly on the graph how you obtain your answer.

Speed of the tennis ball = ... m/s

(2 marks)

2 (b) (iii) Which **one** of the following gives the reason why the data has been shown as a line graph and **not** as a bar chart?

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

Frequency and speed are both categoric variables. ☐

Frequency and speed are both continuous variables. ☐

Speed is a continuous variable and frequency is a categoric variable. ☐

(1 mark)

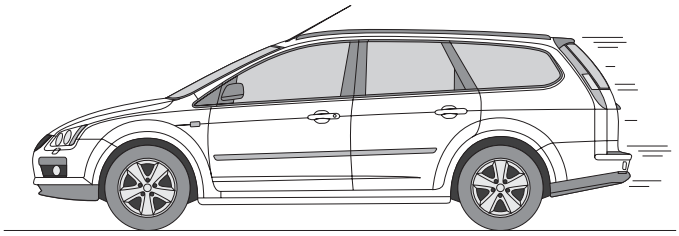
6

4.5.6.1.2 Speed

Question 37

January 2009 | PHY2F | Original Q6 | Legacy

6 (a) The diagram shows a car travelling at a speed of 12 m/s along a straight road.



6 (a) (i) Use the equation in the box to calculate the momentum of the car.

momentum = mass × velocity

Mass of the car = 900 kg

Show clearly how you work out your answer.

.....

.....

.....

.....

Momentum = ... kg m/s

(2 marks)

6 (a) (ii) Momentum has direction.

Draw an arrow on the diagram to show the direction of the car's momentum.

(1 mark)

4.5.6.1.2 Speed

Question 37 · continued

for mark

6 (b) The car stops at a set of traffic lights.

How much momentum does the car have when it is stopped at the traffic lights?

.....

Give a reason for your answer.

.....

.....

.....

.....

(2 marks)

5

Turn over for the next question

4.5.6.1.2 Speed

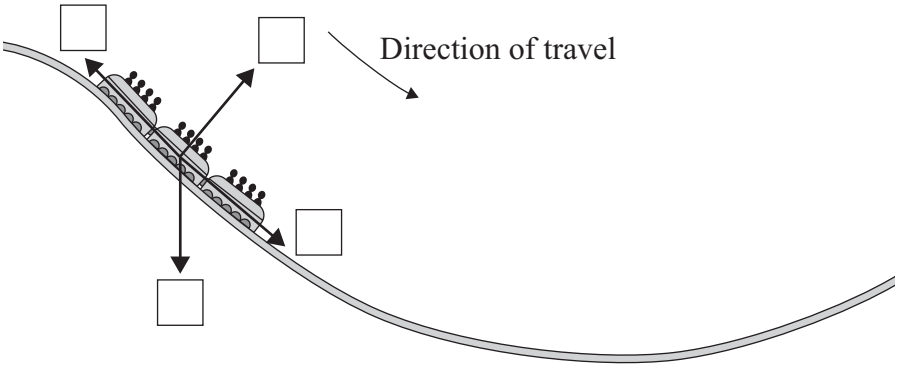
Question 38

January 2009 | PHY2F | Original Q7 | Legacy

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

7 (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)

7 (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)

7 (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

7 (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 38 · continued

for mark

7 (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

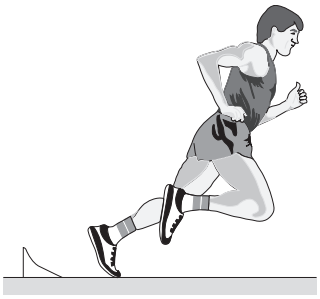
Turn over for the next question

4.5.6.1.2 Speed

Question 39

January 2009 | PHY2F | Original Q8 | Legacy

8 (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.

8 (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)

8 (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

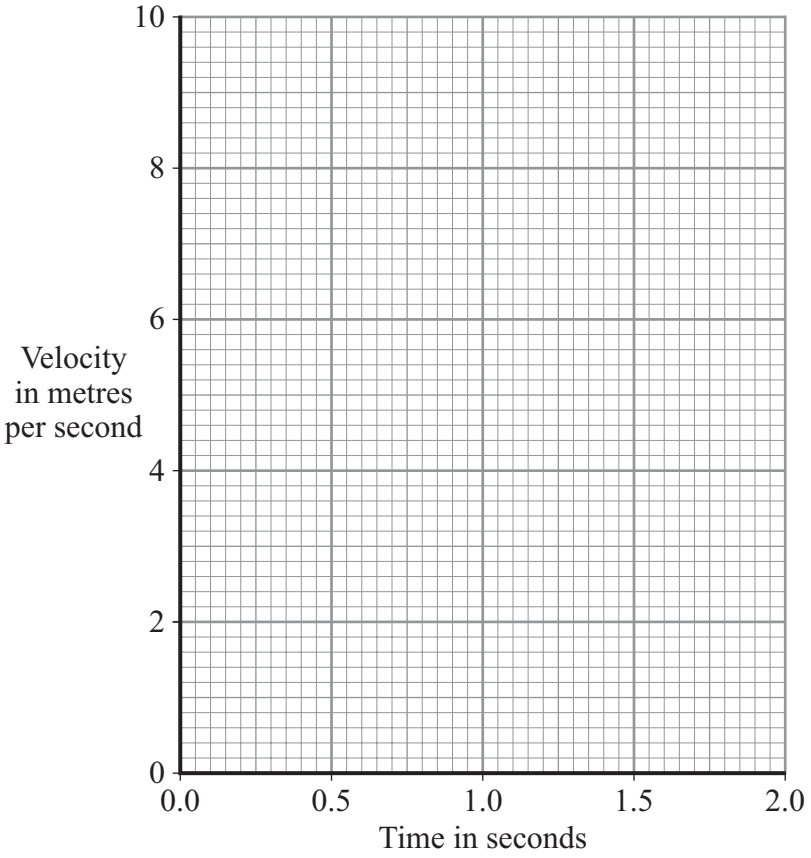
Question 39 · continued

for mark

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

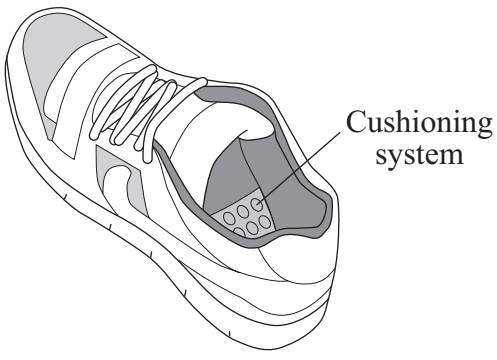
The velocity of the athlete is the ..... of the athlete in a given direction. *(1 mark)*

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



(2 marks)

8 (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.



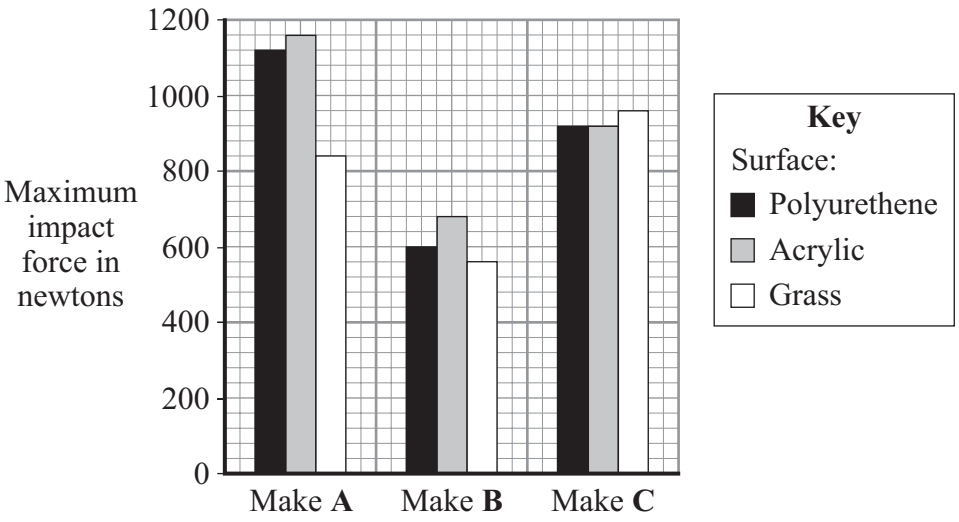
Question 8 continues on the next page

4.5.6.1.2 Speed

Question 39 · 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.



8 (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)

8 (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)

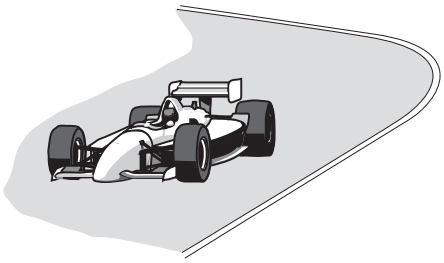
10

4.5.6.1.2 Speed

Question 40

January 2009 | PHY3F | Original Q3 | Legacy

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



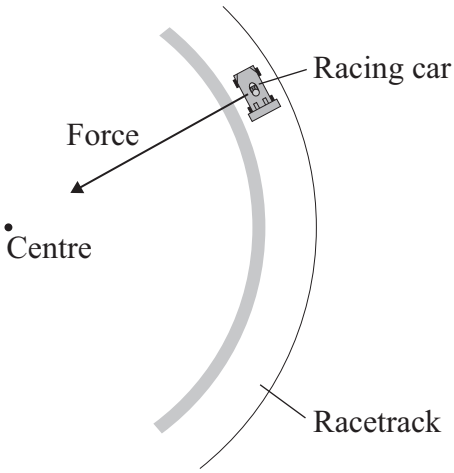
A racing car can accelerate by changing

its direction only
its speed only
either its direction or its speed

.

(1 mark)

3 (b) A racing car moves round a circular part of a racetrack.



A force acts on the racing car. The force is towards the centre of the circular part of the racetrack.

4.5.6.1.2 Speed

Question 40 · continued

for mark

Complete the following sentences by drawing a ring around the correct line in each of the boxes.

3 (b) (i) The force is caused by

electrostatics
friction
gravity

.

(1 mark)

3 (b) (ii) The force is a

centripetal force
circular force
perpendicular force

.

(1 mark)

3 (b) (iii) If another racing car has a greater mass and travels at the same speed around the same racetrack, then the force will need to

decrease
stay the same
increase

.

(1 mark)

3 (b) (iv) When the racing car goes faster, the force will need to

decrease
stay the same
increase

.

(1 mark)

Question 3 continues on the next page

4.5.6.1.2 Speed

Question 40 · continued

for mark

3 (c) This is an item from a newspaper.

No to racetrack plan

At last night's meeting, one local resident said, "The racetrack will be noisy but motor racing leads to safety improvements in all our cars."

"We'll need better brakes. Motor racing encourages speeding and leads to more accidents", said another.

Most of the residents were against the plan to build a racetrack.

Do you agree with most of the residents?

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

Yes ☐ No ☐ Not sure ☐

.....

.....

.....

.....

(2 marks)

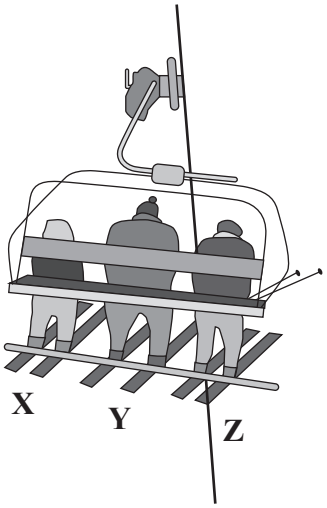
7

4.5.6.1.2 Speed

Question 41

June 2009 | PHY2F | Original Q2 | Legacy

2 (a) The diagram shows three skiers, **X**, **Y** and **Z**, on a moving chairlift.
The mass of each skier is given in the table.



Skier	Mass in kg
X	65
Y	90
Z	80

Which **one** of the skiers, **X**, **Y** or **Z**, has the most momentum?

.....

Give the reason for your answer.

.....

.....

(2 marks)

2 (b) At one point in the journey, the chairlift accelerates to a higher speed.

What happens to the momentum of the three skiers as the chairlift accelerates?

.....

(1 mark)

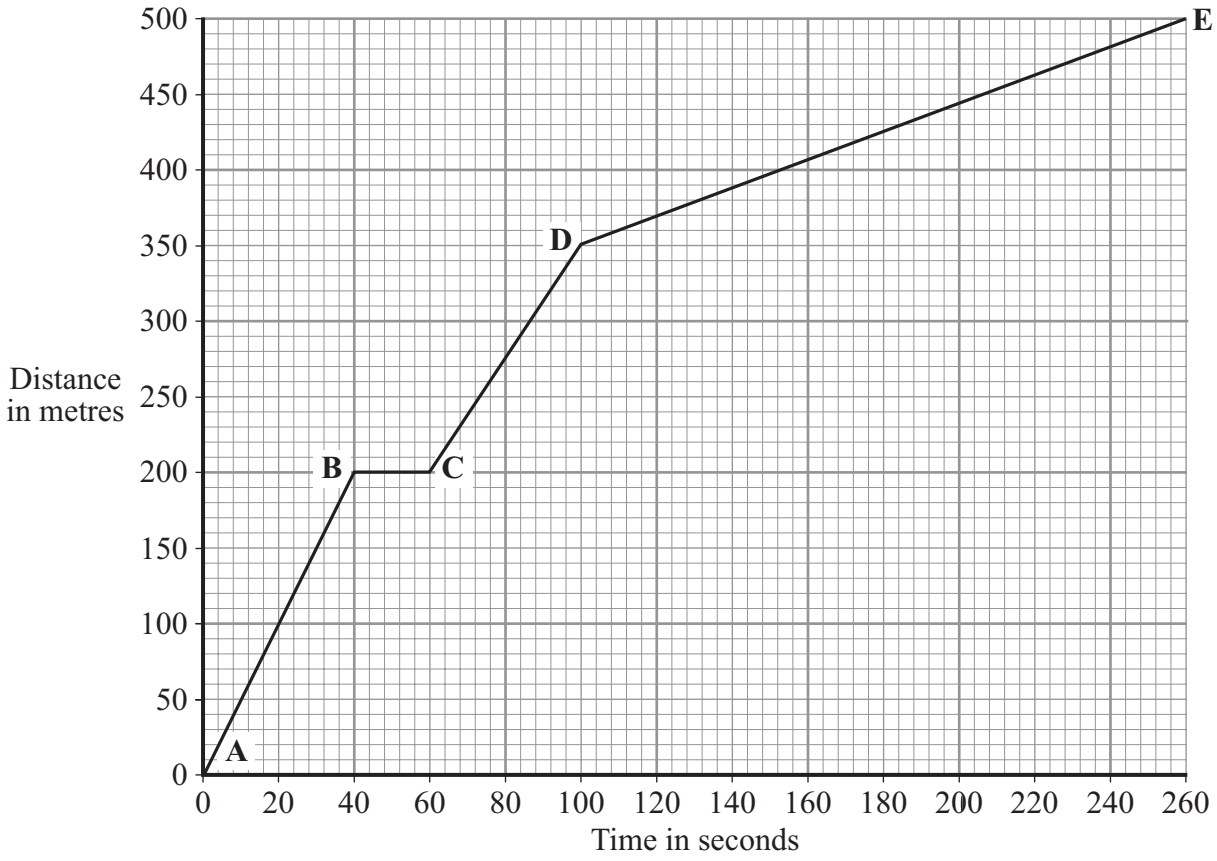
3

4.5.6.1.2 Speed

Question 42

June 2009 | PHY2F | Original Q3 | Legacy

3 Part of a bus route is along a high street.
The distance–time graph shows how far the bus travelled along the high street and how long it took.



3 (a) The bus travels the **slowest** between points **D** and **E**.

How can you tell this from the graph?

.....

.....

(1 mark)

3 (b) Between which two points was the bus travelling the **fastest**?

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

Points	
A–B	
B–C	
C–D	

(1 mark)

4.5.6.1.2 Speed

Question 42 · continued

for mark

3 (c) There is a bus stop in the high street.
This is marked as point **B** on the graph.

3 (c) (i) What is the distance between point **A** on the graph and the bus stop?

Distance ..... metres
(1 mark)

3 (c) (ii) How long did the bus stop at the bus stop?
Show clearly how you work out your answer.

.....

Time = ... seconds
(2 marks)

3 (d) A cyclist made the same journey along the high street.
The cyclist started at the same time as the bus and completed the journey in 200 seconds. The cyclist travelled the whole distance at a constant speed.

3 (d) (i) Draw a line on the graph to show the cyclist's journey. *(2 marks)*

3 (d) (ii) After how many seconds did the cyclist overtake the bus?

The cyclist overtook the bus after ..... seconds.
(1 mark)

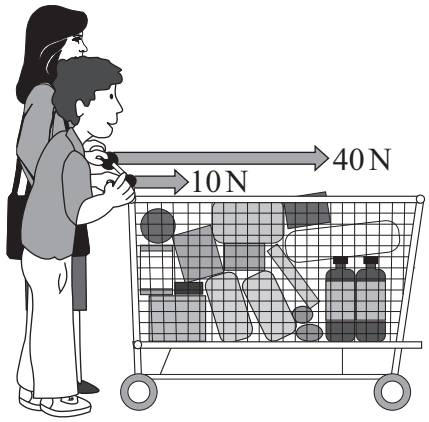
8

4.5.6.1.2 Speed

Question 43

June 2009 | PHY2F | Original Q5 | Legacy

5 The diagram shows an adult and a child pushing a loaded shopping trolley.



5 (a) (i) What is the *total force* on the trolley due to the adult and child?

.....

(1 mark)

5 (a) (ii) Which **one** of the terms in the box means the same as *total force*?

Draw a ring around your answer.

answer force	**mean force**	**resultant force**

(1 mark)

5 (a) (iii) The trolley is pushed at a constant speed for 80 metres.

Use the equation in the box to calculate the work done to push the trolley 80 metres.

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

Show clearly how you work out your answer.

.....

.....

Work done = ...

(2 marks)

4.5.6.1.2 Speed

Question 43 · continued

for mark

5 (b) Complete the following sentences by drawing a ring around the correct word in each of the boxes.

5 (b) (i) The unit of work done is the | joule / newton / watt | .

(1 mark)

5 (b) (ii) Most of the work done to push the trolley is transformed into | heat / light / sound | .

(1 mark)

6

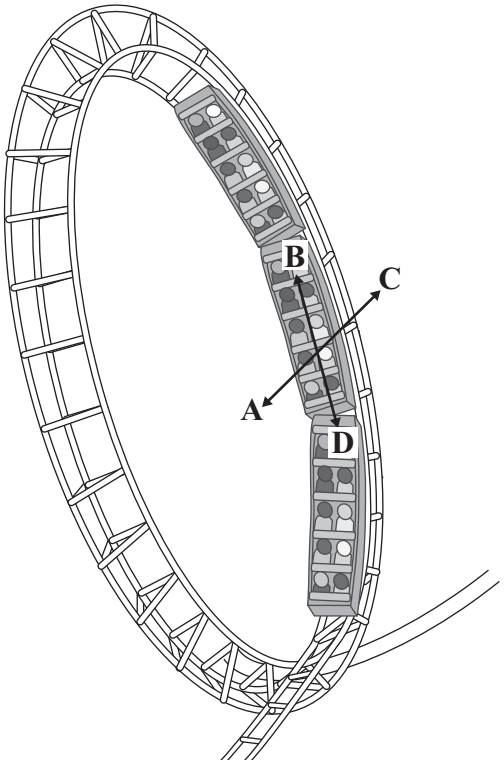
Turn over for the next question

4.5.6.1.2 Speed

Question 44

June 2009 | PHY3F | Original Q2 | Legacy

2 The drawing shows a set of carriages on a roller coaster.
The carriages are moving upwards in a nearly circular path at a constant speed.



2 (a) Complete the following sentences by drawing a ring around the correct line in each box.

2 (a) (i) The carriages will accelerate because of a change in their

direction
mass
speed

.

(1 mark)

2 (a) (ii) The resultant force which causes the carriages to accelerate is the

circular
centripetal
gravity

force.

(1 mark)

4.5.6.1.2 Speed

Question 44 · continued

for mark

2 (b) In which direction, **A**, **B**, **C** or **D**, does the resultant force act?

Write your answer in the box. ☐

(1 mark)

2 (c) Complete the following sentence by drawing a ring around the correct line in the box.

The resultant force will need to be greater if the

mass of the passengers is greater
radius of the circle is greater
speed of the carriages is less

.

(1 mark)

4

Turn over for the next question

4.5.6.1.2 Speed

Question 45

November 2009 | PHY1BP | Original Q3 | Legacy

QUESTION THREE

This question is about a radioactive isotope that emits alpha particles.

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

A count rate

B half-life

C penetrating power

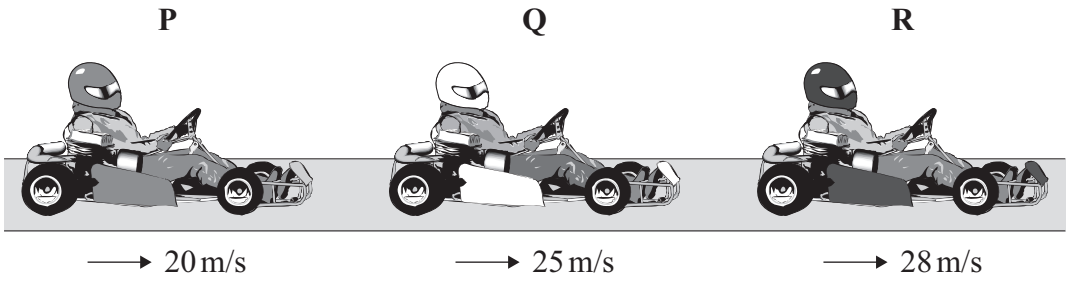
D range

	Description
1	the number of alpha particles detected per second
2	the distance the alpha particles travel before being fully absorbed
3	the time it takes for half of the nuclei of the isotope to decay
4	the ability of the alpha particles to pass through matter

4.5.6.1.2 Speed

Question 46

3 (a) The diagram shows three identical go-karts, **P**, **Q** and **R**, travelling at different speeds along the straight part of an outdoor racetrack.



Which **go-kart**, **P**, **Q** or **R**, has the greatest momentum?

.....

Give the reason for your answer.

.....

.....

(2 marks)

3 (b) The total mass of go-kart **Q** and the driver is 130 kg.

3 (b) (i) Use the equation in the box to calculate the total momentum of go-kart **Q** and the driver.

momentum = mass × velocity

Show clearly how you work out your answer.

.....

.....

Momentum = ...

(2 marks)

3 (b) (ii) Which of the following is the unit of momentum?

Draw a ring around your answer.

J/s	**kg m/s**	**Nm**

(1 mark)

4.5.6.1.2 Speed

Question 46 · continued

for mark

3 (c) To race safely at high speed, a go-kart driver must have fast reaction times and the outdoor racetrack should be dry.

3 (c) (i) How would being tired affect a driver's reaction time?

.....

(1 mark)

3 (c) (ii) How would a wet track affect the braking distance of a go-kart?

.....

(1 mark)

7

Turn over for the next question

4.5.6.1.2 Speed

Question 47

6 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.

6 (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.

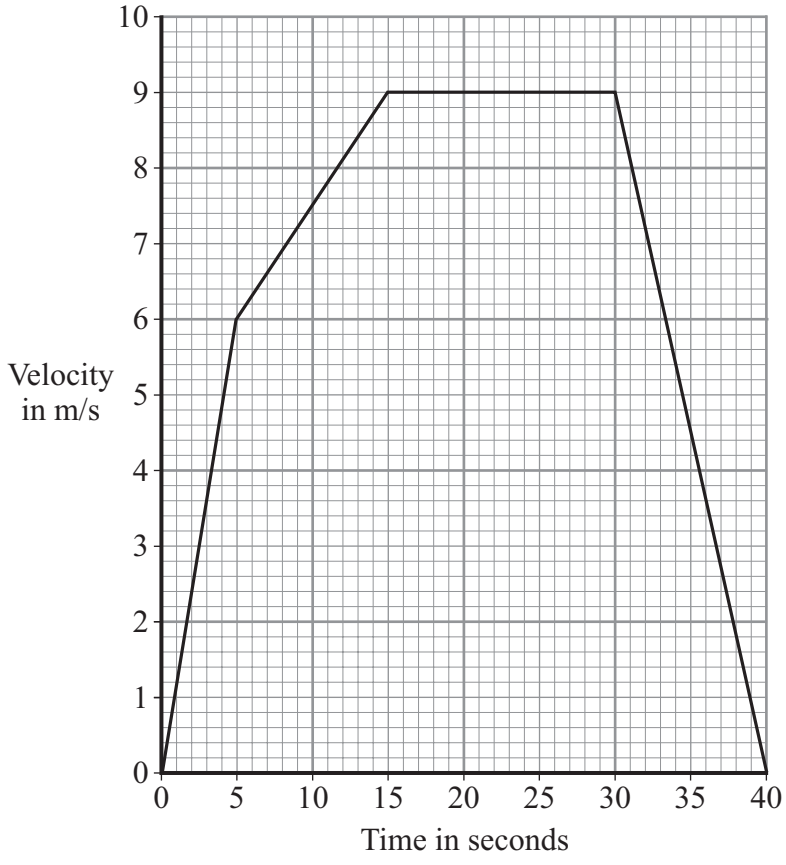
.....

.....

Resultant force = ...

(3 marks)

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



4.5.6.1.2 Speed

Question 47 · continued

for mark

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

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

(1 mark)

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

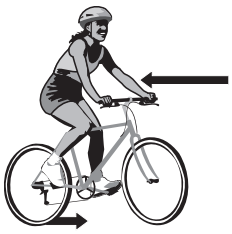
.....

.....

(1 mark)

6 (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.

A



B



C



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 48

7 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

7 (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)

7 (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)

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

.....

(1 mark)

4.5.6.1.2 Speed

Question 48 · continued

for mark

7 (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)

7 (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)

7 (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 49

March 2010 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

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

9A Which pair of diagrams correctly shows the patterns for digital and analogue signals?

	Digital signal pattern	Analogue signal pattern
1		
2		
3		
4		

9B One reason for using digital signals rather than analogue signals for communication is that . . .

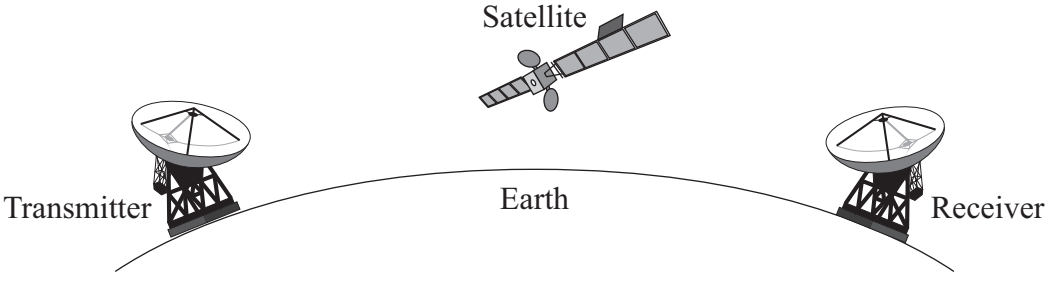
1 analogue signals are less prone to interference.

2 analogue signals can have only two values.

3 digital signals are continuously variable.

4 digital signals can be easily processed by computers.

9C 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 49 · continued

9D 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

END OF TEST

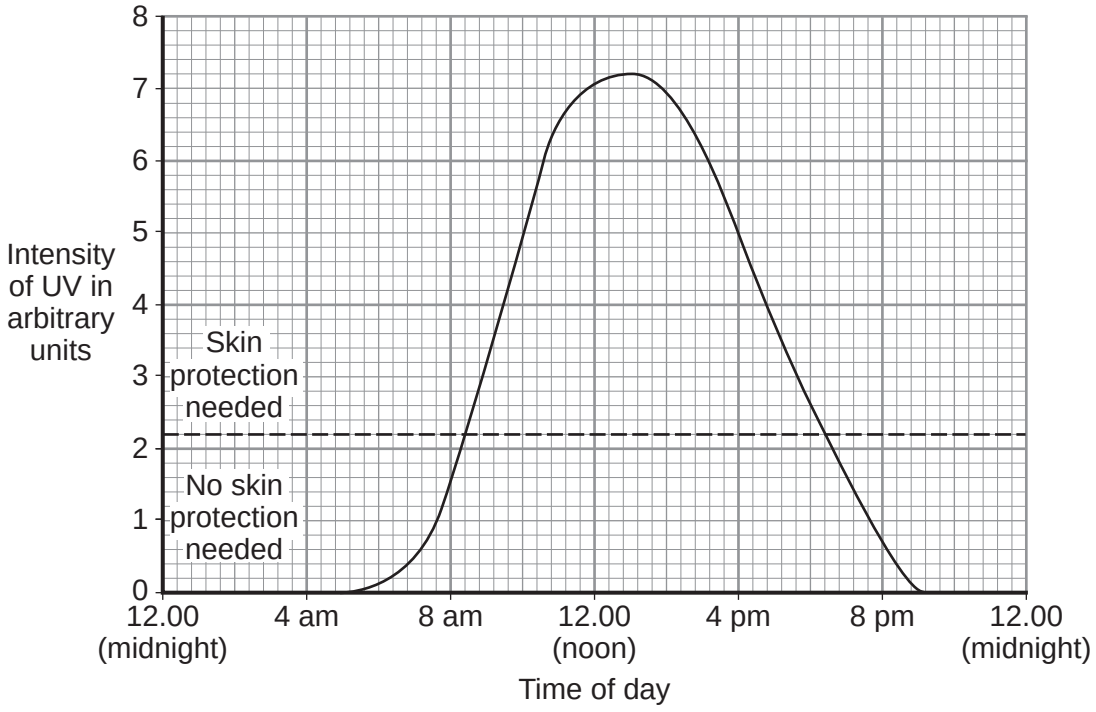
4.5.6.1.2 Speed

Question 50

June 2010 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

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



8A 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

8B 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

4.5.6.1.2 Speed

Question 50 · continued

8C 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

8D 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 51

June 2010 | PHY1F | Original Q5 | Legacy

5 (a) Scientists use telescopes to observe stars and galaxies.
Some telescopes are on Earth, but some are on satellites in space.

Why do telescopes in space give better images than telescopes on the Earth?

.....

.....

(1 mark)

5 (b) Scientists have observed that the wavelengths of the light given out from galaxies that are moving away from the Earth are longer than expected.

5 (b) (i) What name is given to this observation?

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

blue-shift ☐

green-shift ☐

red-shift ☐

(1 mark)

5 (b) (ii) Complete the following sentence by drawing a ring around the correct line in the box.

This observation gives evidence for the idea that the universe is

shrinking.

not changing.

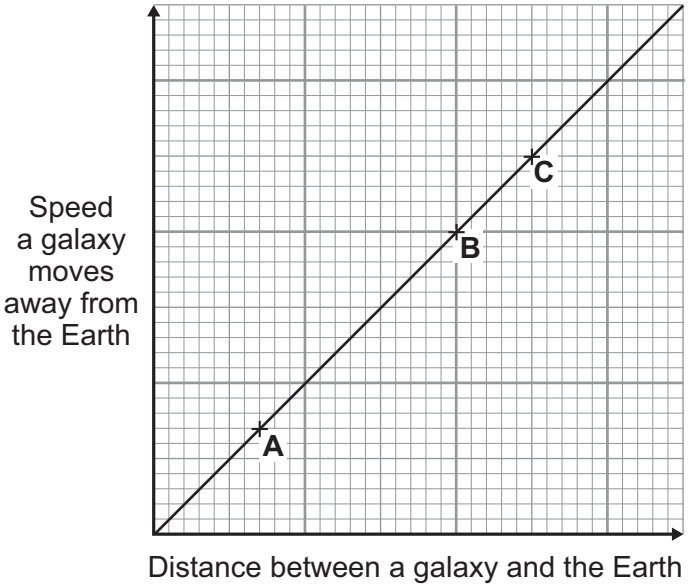
expanding.

(1 mark)

4.5.6.1.2 Speed

Question 51 · continued

5 (c) Use the graph to answer the following questions.



5 (c) (i) What is the link between the speed that a galaxy moves away from the Earth and the distance between the galaxy and the Earth?

.....

.....

(1 mark)

5 (c) (ii) The positions of three galaxies, **A**, **B** and **C**, are marked on the graph.

From which galaxy, **A**, **B** or **C**, would the wavelength of the light reaching the Earth seem to have changed the most?

Galaxy .....

Give a reason for your answer.

.....

.....

.....

.....

(2 marks)

6

4.5.6.1.2 Speed

Question 52

June 2010 | PHY2F | Original Q3 | Legacy

3 (a) The total stopping distance of a car has two parts. One part is the distance the car travels during the driver's reaction time. This distance is often called the 'thinking distance'.

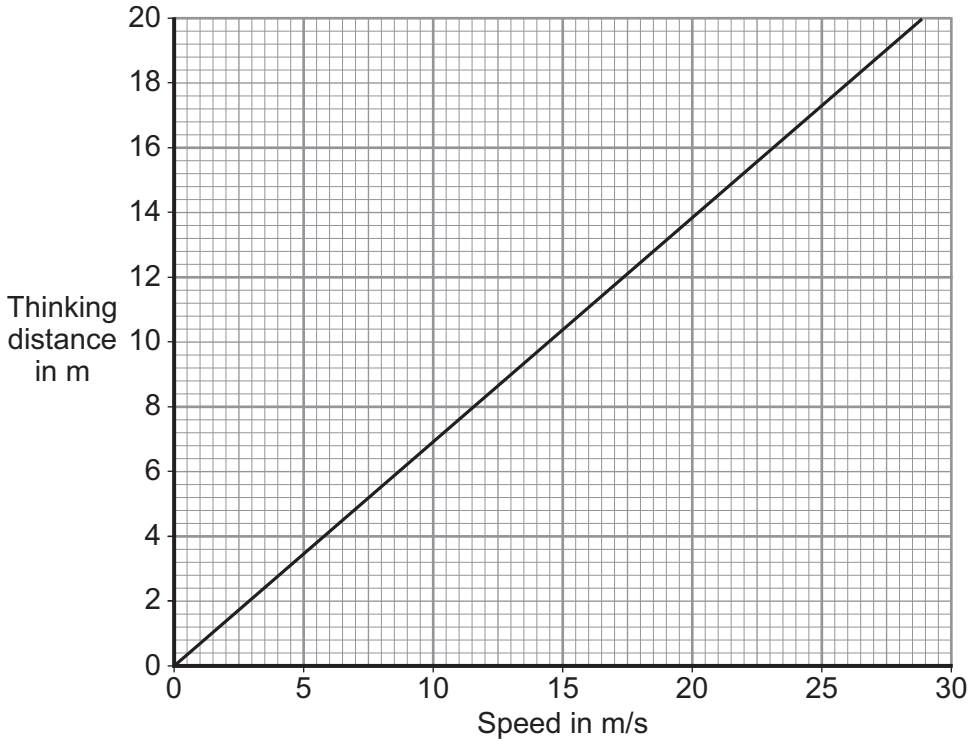
What distance is added to the 'thinking distance' to give the total stopping distance?

.....

.....

(1 mark)

3 (b) The graph shows the relationship between the speed of a car and the thinking distance.



Describe the relationship between speed and thinking distance.

.....

.....

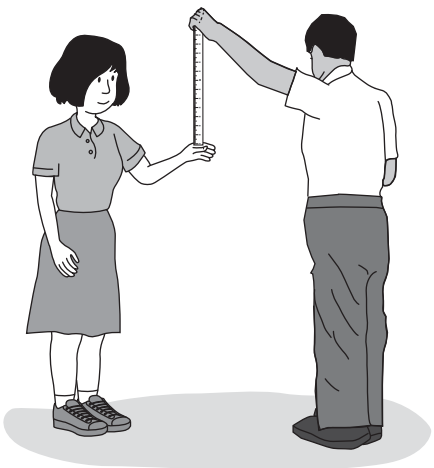
(2 marks)

Question 3 continues on the next page

4.5.6.1.2 Speed

Question 52 · continued

3 (c) The diagram shows two students investigating reaction time.



One student holds a 30 cm ruler, then lets go. As soon as the second student sees the ruler fall, she closes her hand, stopping the ruler. The further the ruler falls before being stopped, the slower her reaction time.

3 (c) (i) One student always holds the ruler the same distance above the other student's hand. In this experiment, what type of variable is this?

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

independent variable ☐

dependent variable ☐

control variable ☐

(1 mark)

3 (c) (ii) Describe how this experiment could be used to find out whether listening to music affects reaction time.

.....

.....

.....

.....

(2 marks)

4.5.6.1.2 Speed

Question 52 · continued

3 (d) The following information is written on the label of some cough medicine.

WARNING: Causes drowsiness.
Do not drive or operate machinery.

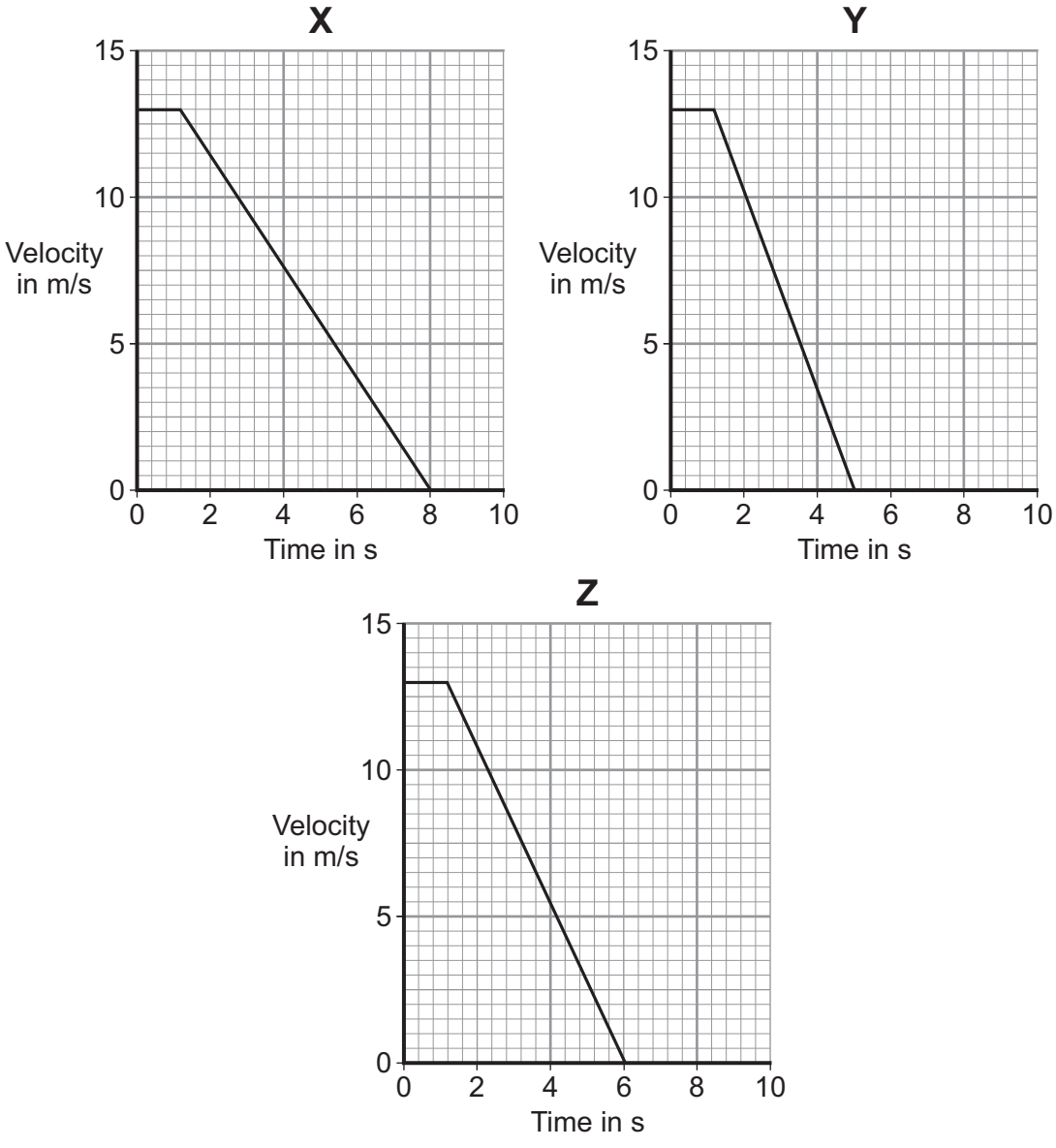
How is feeling drowsy (sleepy) likely to affect a driver's reaction time?

.....

.....

(1 mark)

3 (e) Three cars, **X**, **Y** and **Z**, are being driven along a straight road towards a set of traffic lights. The graphs show how the velocity of each car changes once the driver sees that the traffic light has turned to red.



Which one of the cars, **X**, **Y** or **Z**, stops in the shortest distance?

.....

(1 mark)

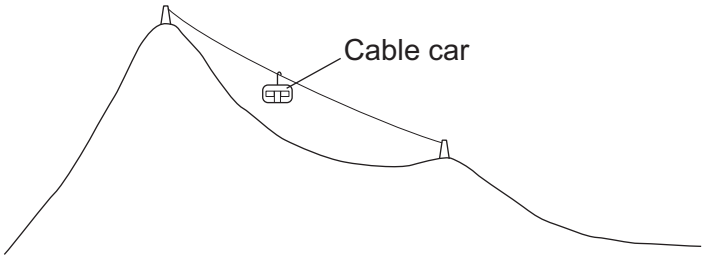
8

4.5.6.1.2 Speed

Question 53

June 2010 | PHY2F | Original Q6 | Legacy

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



6 (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 53 · continued

6 (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)

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



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

(1 mark)

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

.....

.....

.....

.....

(2 marks)

Question 6 continues on the next page

4.5.6.1.2 Speed

Question 53 · continued

6 (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

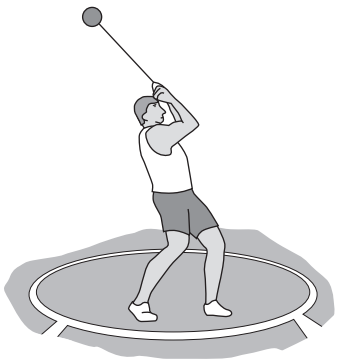
4.5.6.1.2 Speed

Question 54

June 2010 | PHY3F | Original Q3 | Legacy

3 The hammer throw is an athletic event.

The athlete throws a heavy metal ball attached by a wire to a handle.



3 (a) The hammer thrower swings the hammer round in a circle before letting go.

He swings the hammer slowly at first and then faster.

Complete the following sentence by drawing a ring around the correct word or line in the box.

As the speed of the swing increases, the centripetal force on the

hammer

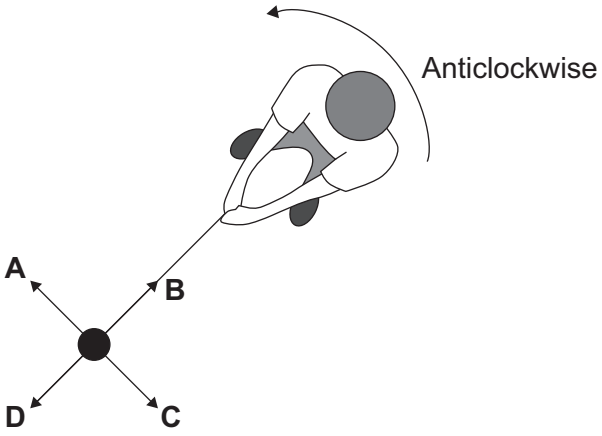
decreases.
does not change.
increases.

(1 mark)

4.5.6.1.2 Speed

Question 54 · continued

3 (b) The diagram shows an overhead view of a hammer thrower swinging the hammer anticlockwise in a circle.



3 (b) (i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the hammer?

(1 mark)

3 (b) (ii) Complete the following sentence by drawing a ring around the correct line in the box.

The centripetal force is provided by the

air resistance.
gravitational force.
tension in the wire.

(1 mark)

3 (b) (iii) At the instant shown in the diagram above, the athlete lets go of the handle.

In which direction, **A**, **B**, **C** or **D**, does the hammer move?

(1 mark)

4

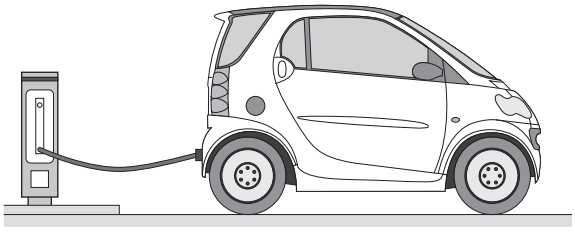
4.5.6.1.2 Speed

Question 55

November 2010 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

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.

8A 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.

8B 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?

8C 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.

4.5.6.1.2 Speed

8D 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.

Turn over for the next question

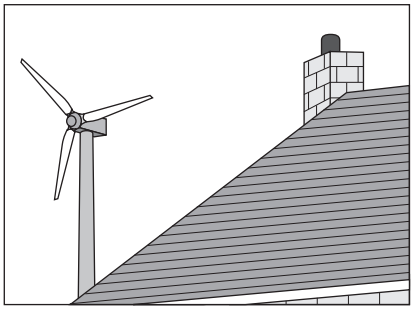
4.5.6.1.2 Speed

Question 56

November 2010 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

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



9A 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?

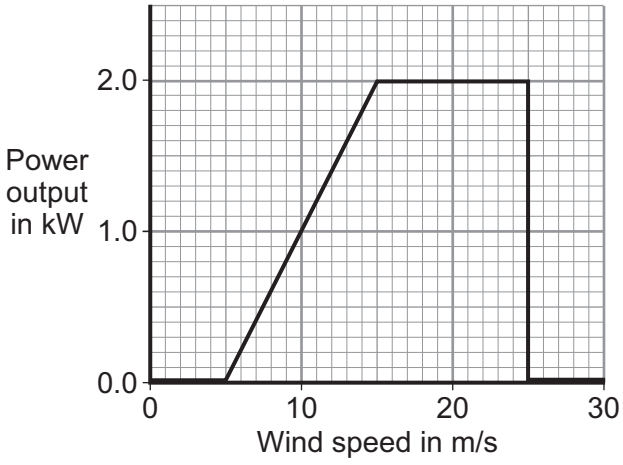
1 1000 days

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.



9B The maximum power output occurs when the wind speed reaches . . .

1 5 m/s

2 10 m/s

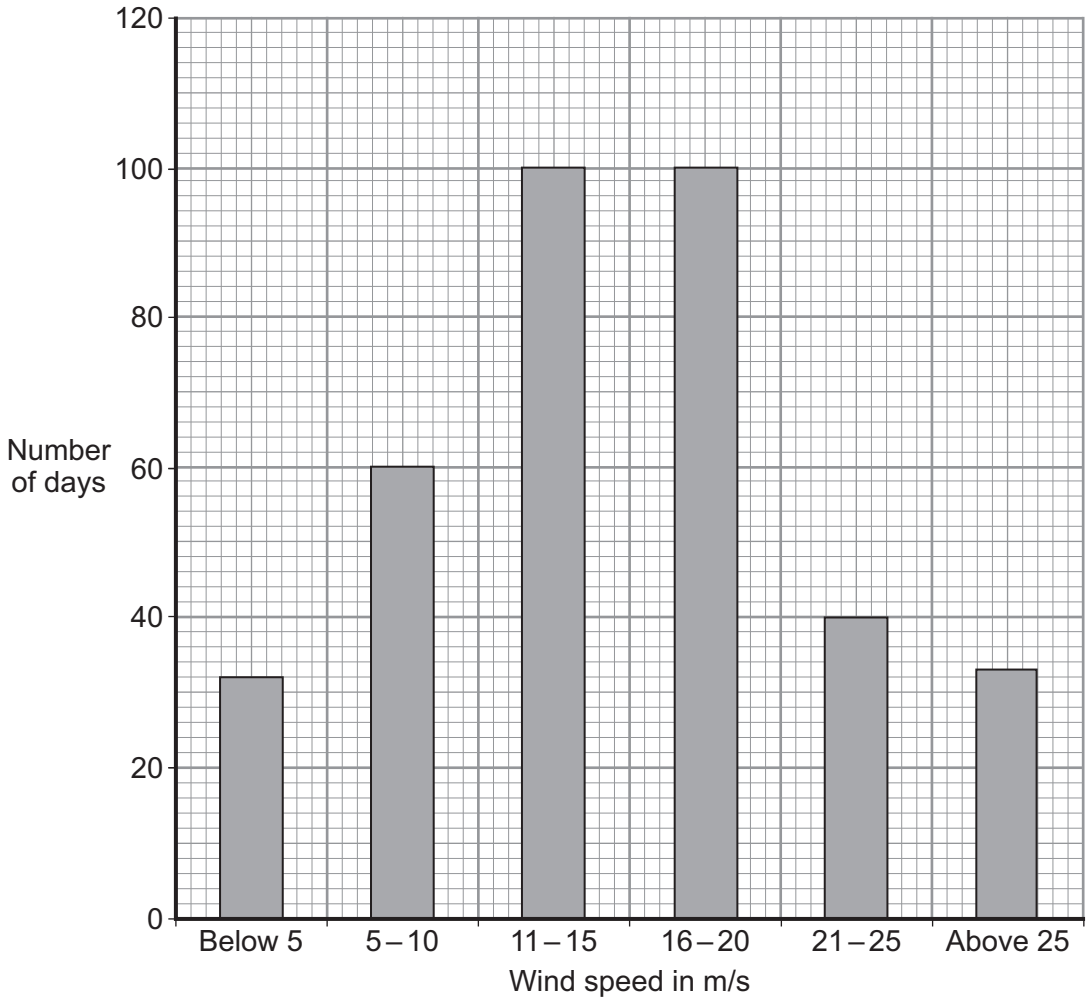
3 15 m/s

4 20 m/s

4.5.6.1.2 Speed

Question 56 · continued

9C 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

9D 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.

END OF TEST

4.5.6.1.2 Speed

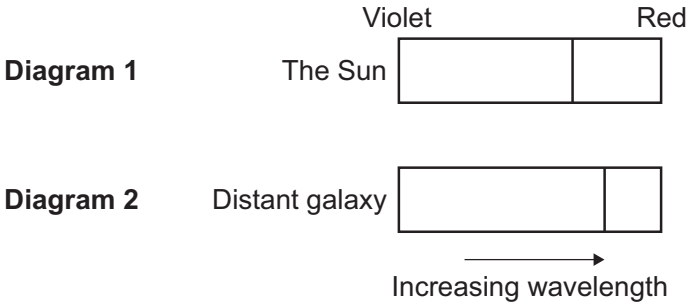
Question 57

November 2010 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

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 58

3 A high-speed train accelerates at a constant rate in a straight line.
The velocity of the train increases from 30 m/s to 42 m/s in 60 seconds.

3 (a) (i) Calculate the change in the velocity of the train.

.....

Change in velocity = ... m/s
(1 mark)

3 (a) (ii) Use the equation in the box to calculate the acceleration of the train.

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

Show clearly how you work out your answer and give the unit.
Choose the unit from the list below.

m/s **m/s^2** **N/kg** **Nm**

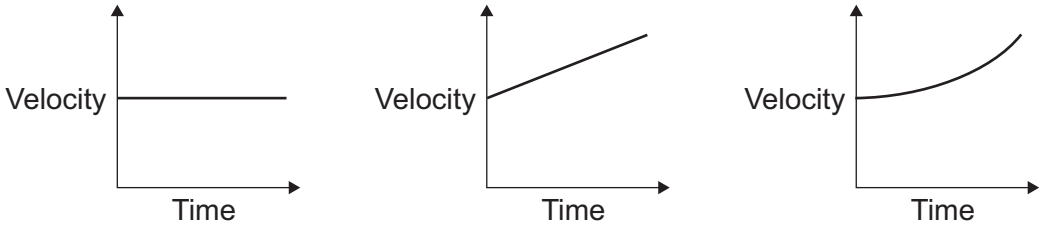
.....

.....

Acceleration = ...
(2 marks)

3 (b) Which **one** of the graphs, **A**, **B** or **C**, shows how the velocity of the train changes as it accelerates?

Write your answer, **A**, **B** or **C**, in the box.



A **B** **C**

Graph ☐

(1 mark)

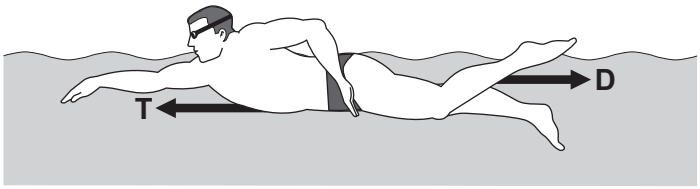
4

4.5.6.1.2 Speed

Question 59

January 2011 | PHY2F | Original Q7 | Legacy

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



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

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

..... N
(1 mark)

7 (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)

7 (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.

.....

.....

.....

.....

.....

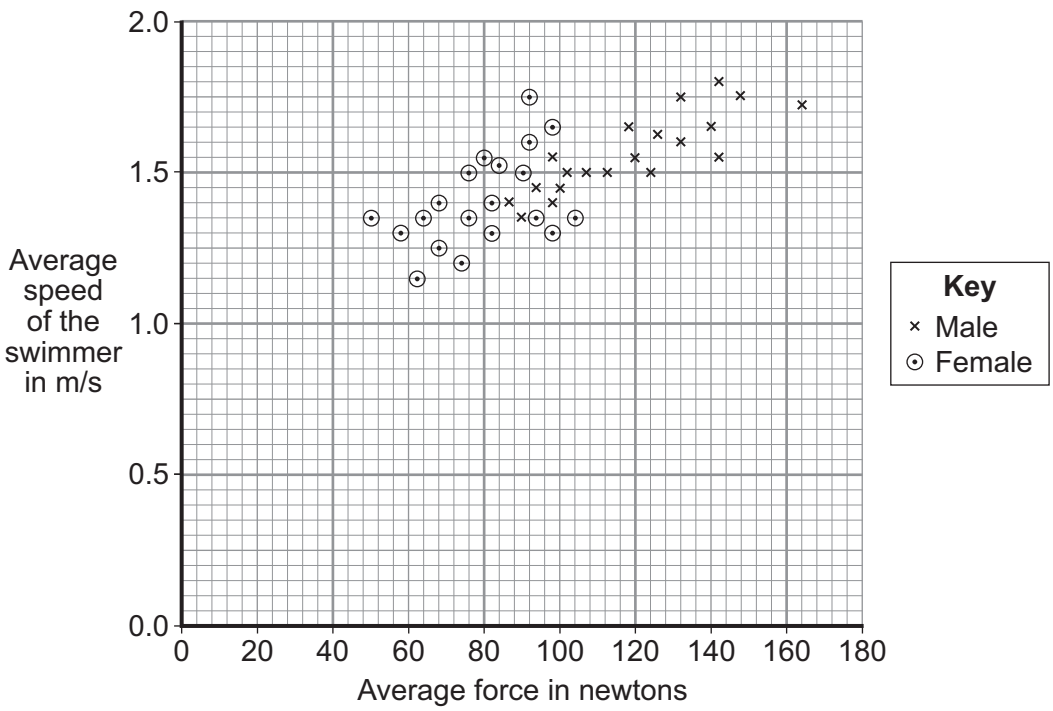
.....
(3 marks)

Question 7 continues on the next page

Question 59 · continued

7 (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.



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

.....

(1 mark)

7 (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 59 · continued

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

.....

.....

(1 mark)

7 (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

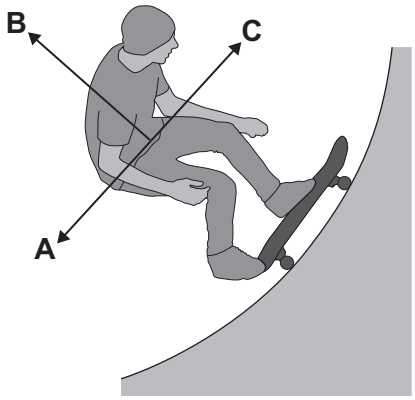
4.5.6.1.2 Speed

Question 60

January 2011 | PHY3F | Original Q2 | Legacy

2 The drawing shows a skateboarder moving in a circular path.

• Centre of circular path



2 (a) (i) What is the name of the resultant force which allows the skateboarder to move in a circular path?

Draw a ring around your answer.

centripetal force **gravitational force** **weight**

(1 mark)

2 (a) (ii) In which direction, **A**, **B** or **C**, does this resultant force act on the skateboarder?

Write your answer, **A**, **B** or **C**, in the box. ☐

(1 mark)

2 (b) Another skateboarder has a smaller mass.

Complete the following sentences by drawing a ring around the correct line in each box.

2 (b) (i) She uses the same part of the ramp at the same speed.

The force which allows her to move in a circular path will need

to

decrease.
stay the same.
increase.

(1 mark)

4.5.6.1.2 Speed

Question 60 · continued

2 (b) (ii) If she goes faster, this resultant force will need to

decrease.
stay the same.
increase.

(1 mark)

2 (c) On their website, the managers of a skateboard park give the following information about some of the ramps where skateboarders move in a circular path.

Name of ramp	Inside radius of the ramp in metres
Bull pit	6
Dragon's den	11
Tiger cage	8
Witch's cauldron	7

A skateboarder uses each ramp at the same speed.

Name the ramp where the resultant force on the skateboarder will need to be the greatest.

.....

Explain the reason for your answer.

.....

.....

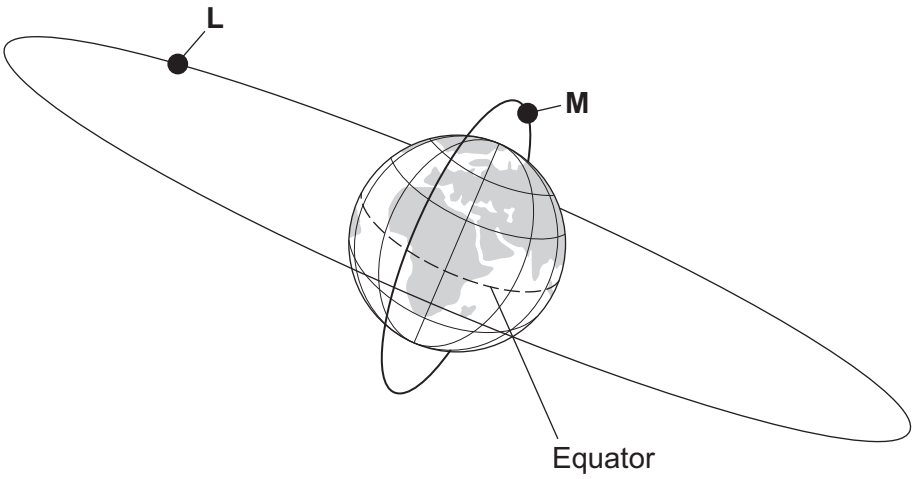
(2 marks)

6

4.5.6.1.2 Speed

Question 61

4 The diagram, which is not to scale, shows two satellites, **L** and **M**, orbiting the Earth.



4 (a) Complete the following table.

Each letter, **L** or **M**, may be used once, more than once or not at all.

Statement about the satellite	Letter for the satellite
It is used as a monitoring satellite.	
It is a geostationary satellite.	
It takes 24 hours to complete its orbit.	

(2 marks)

4 (b) Complete the following sentence.

To stay in its present orbit around the Earth, each satellite must move at a particular ..... .

(1 mark)

4.5.6.1.2 Speed

Question 61 · continued

4 (c) Thousands of satellites are now in orbit around the Earth. A student used the Internet to collect information about some of them.

Name of satellite	Average distance from the centre of the Earth in kilometres	Speed in kilometres per second	Time taken to orbit the Earth
The Moon	391 400	1.01	28 days
GEO	42 200	3.07	1 day
Navstar	26 600	3.87	12 hours
Lageos	12 300	5.70	3.8 hours
HST	7 000	7.56	97 mins
ISS	6 700	7.68	92 mins

4 (c) (i) The Moon takes a longer time than any of the other satellites to orbit the Earth.

Give **one** other way in which the Moon is different from the other satellites in the table.

.....

.....

(1 mark)

4 (c) (ii) What conclusion on the relationship between the *average distance* and *speed* can the student come to on the basis of this data?

.....

.....

(1 mark)

4 (c) (iii) What conclusion on the relationship between the *speed* and the *time taken to orbit the Earth* can the student come to on the basis of this data?

.....

.....

(1 mark)

6

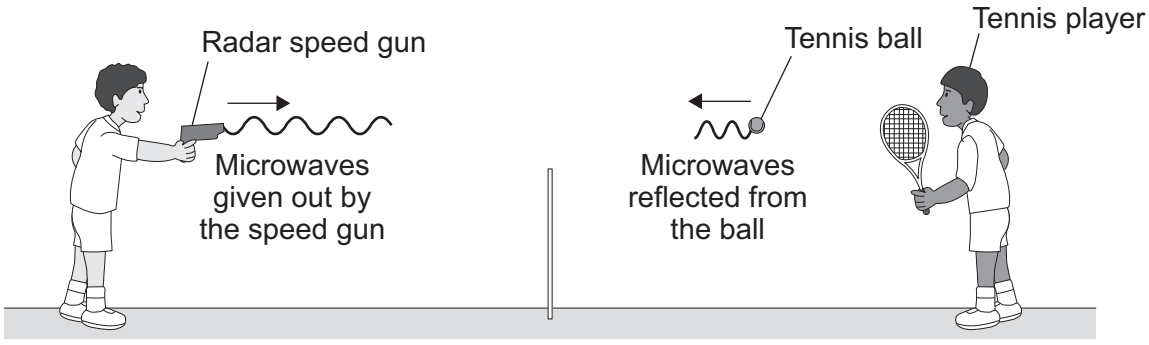
4.5.6.1.2 Speed

Question 62

March 2011 | PHY1BP | Original Q8 | Legacy

QUESTION EIGHT

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.

8A 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.

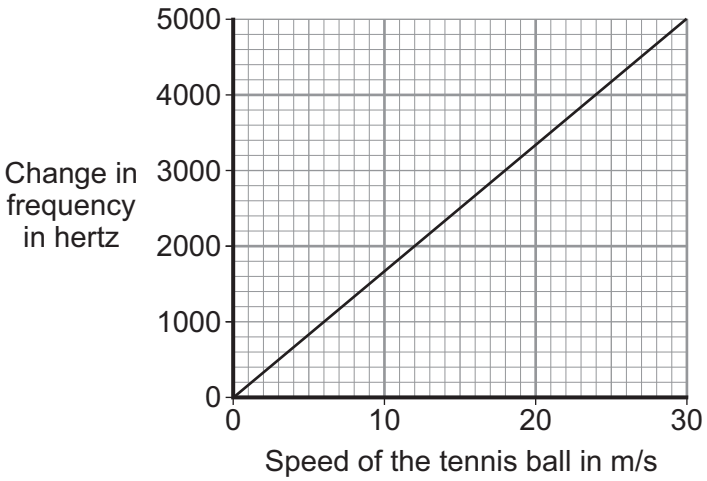
8B Which row in the table describes how the frequency and wavelength of the reflected microwaves are different from the microwaves given out by the speed gun?

	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 62 · continued

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



8C 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.

8D 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 63

June 2011 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

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** . . . .

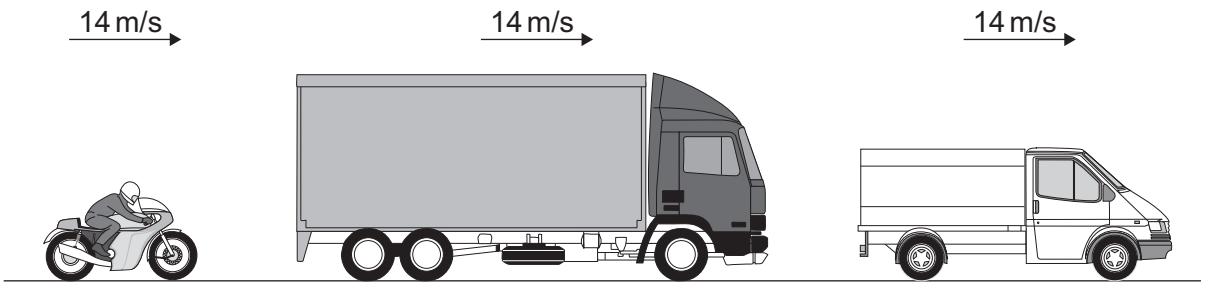
A similar effect is seen with the light from a distant galaxy. This is called . . . **4** . . . .

4.5.6.1.2 Speed

Question 64

June 2011 | PHY2F | Original Q3 | Legacy

3 (a) (i) The diagram shows three vehicles travelling along a straight road at 14 m/s.



Motorbike
Mass = 175 kg

Lorry
Mass = 10 000 kg

Van
Mass = 3000 kg

Which vehicle has the greatest momentum?

.....

Give the reason for your answer.

.....

.....

.....

(2 marks)

3 (a) (ii) Use the equation in the box to calculate the momentum of the motorbike when it travels at 14 m/s.

momentum = mass × velocity

Show clearly how you work out your answer.

.....

.....

Momentum = ...kg m/s

(2 marks)

4.5.6.1.2 Speed

Question 64 · continued

3 (b) The motorbike follows the lorry for a short time, and then accelerates to overtake both the lorry and van.

3 (b) (i) Complete the following sentence by drawing a ring around the correct line in the box.

When the motorbike starts to overtake, the kinetic energy

of the motorbike

decreases.
stays the same.
increases.

(1 mark)

3 (b) (ii) Give a reason for your answer to part (b)(i).

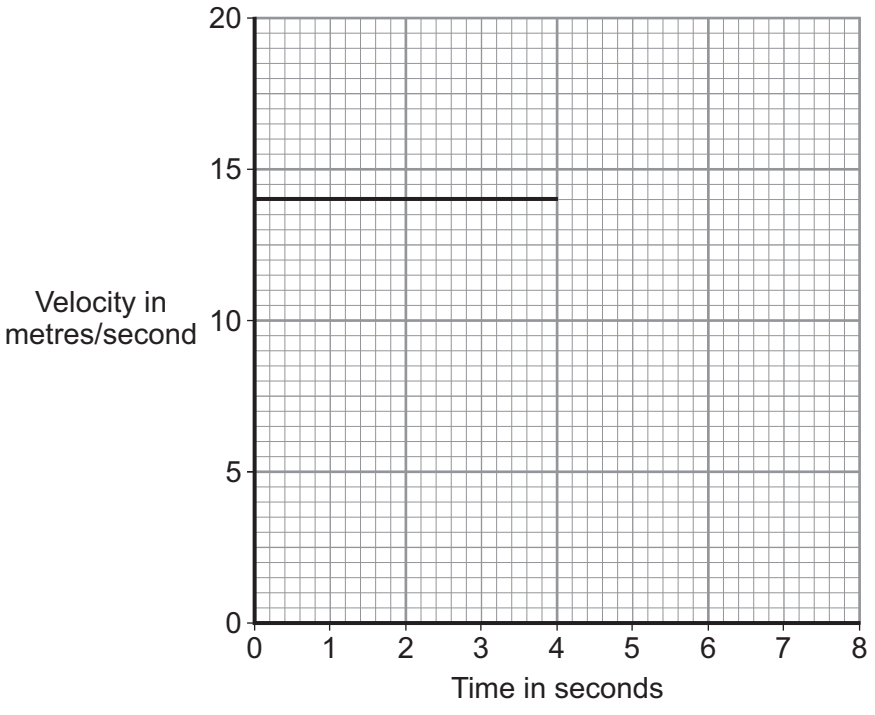
.....

.....

(1 mark)

3 (b) (iii) The graph shows the velocity of the motorbike up to the time when it starts to accelerate. The motorbike accelerates constantly, going from a speed of 14 m/s to a speed of 20 m/s in a time of 2 seconds. The motorbike then stays at 20 m/s.

Complete the graph to show the motion of the motorbike over the next 4 seconds.



(3 marks)

9

4.5.6.1.2 Speed

Question 65

June 2011 | PHY2F | Original Q5 | Legacy

5 Motorway accidents have many causes.

5 (a) Which **one** of the following is most likely to increase the chance of a car being in an accident?

Tick (✓) the box next to your answer.

The car has just had new tyres fitted. ☐

The driver has been drinking alcohol. ☐

A road surface in dry conditions ☐

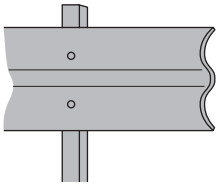
Give a reason for your answer.

.....

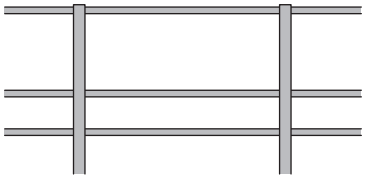
.....

(2 marks)

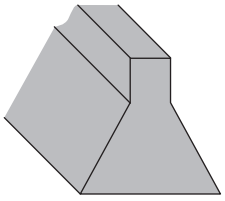
5 (b) The diagram shows three designs of motorway crash barriers.



Steel sheets



Steel 'ropes'



Solid concrete

Before a new design of barrier is used, it must be tested.
A car of mass 1500 kg is driven at 30 m/s to hit the barrier at an angle of 20 degrees.
This barrier must slow the car down and must not break.

4.5.6.1.2 Speed

Question 65 · continued

Explain why the mass of the car, the speed of the car and the angle at which the car hits the barrier must be the same in every test.

.....

.....

.....

.....

.....

(2 marks)

5 (c) A group of scientists has suggested that new designs of crash barriers should be first tested using computer simulations.

Which **two** statements give sensible reasons for testing new barrier designs using a computer simulation?

Put a tick (✓) in the box next to each of your answers.

The design of the barrier can be changed easily. ☐

Data for different conditions can be obtained quickly. ☐

Simulations are more realistic than using cars and barriers. ☐

(1 mark)

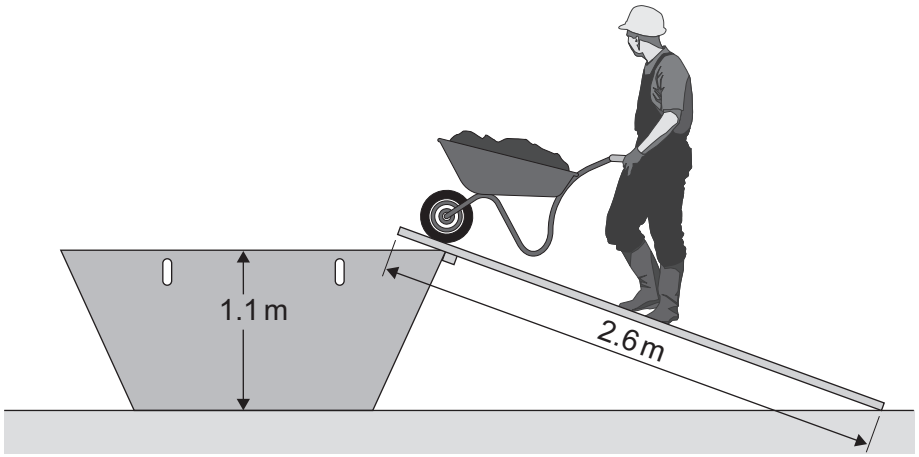
5

4.5.6.1.2 Speed

Question 66

June 2011 | PHY2F | Original Q7 | Legacy

7 (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.

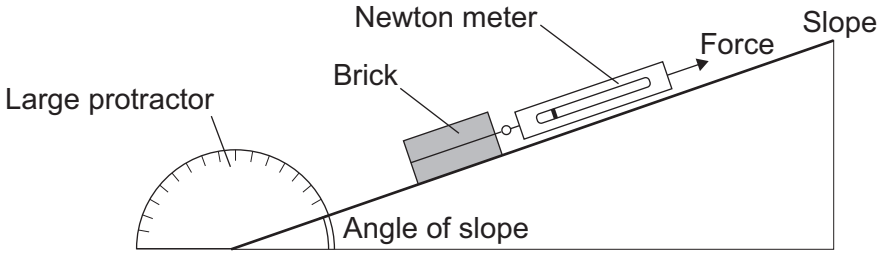
.....

.....

Work done = ... J

(2 marks)

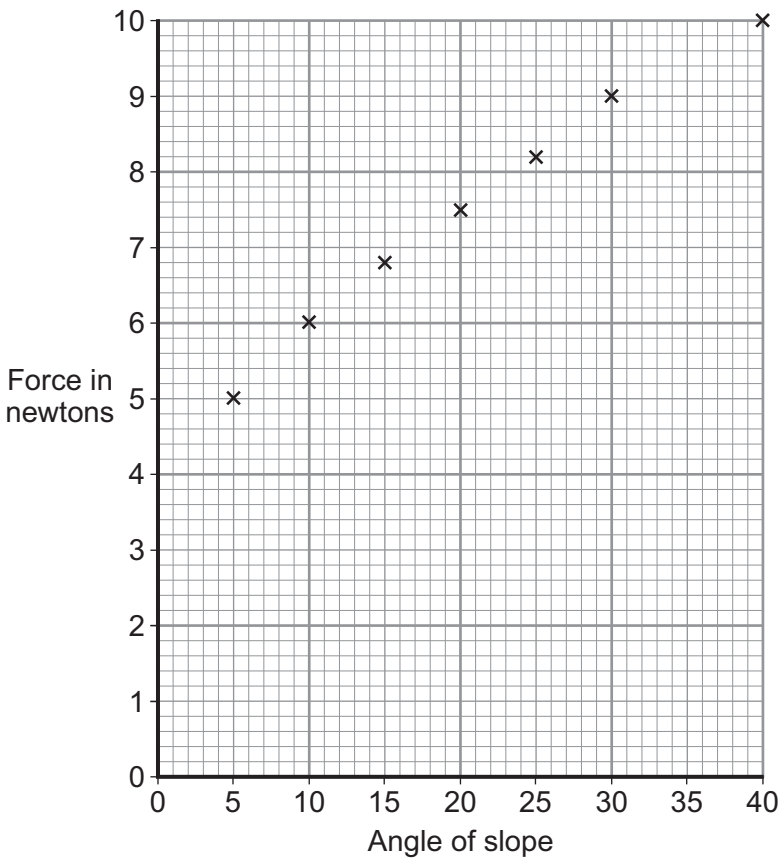
7 (b) A student investigated how the force needed to pull a brick up a slope, at a steady speed, depends on the angle of the slope.
The apparatus used by the student is shown in the diagram.



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 66 · continued



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

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

.....

.....

(1 mark)

7 (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

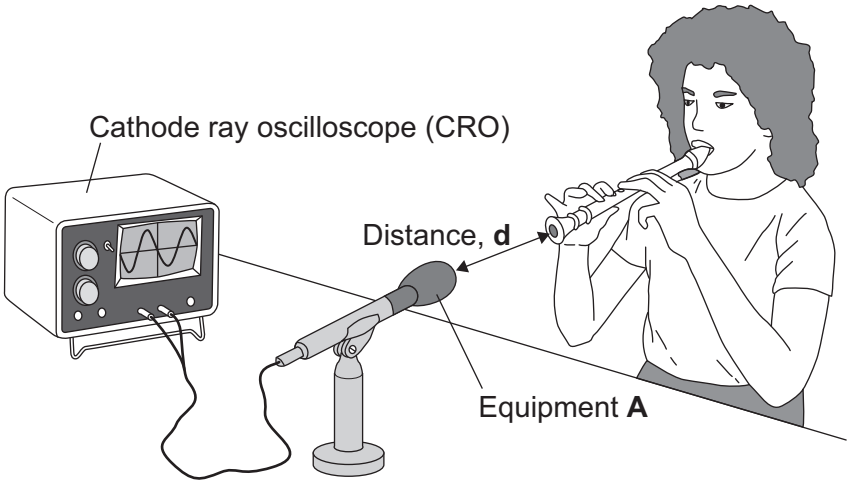
4.5.6.1.2 Speed

Question 67

June 2011 | PHY3F | Original Q7 | Legacy

7 A group of students investigates sound waves.

The diagram shows part of their investigation.



7 (a) Identify the equipment labelled **A**.

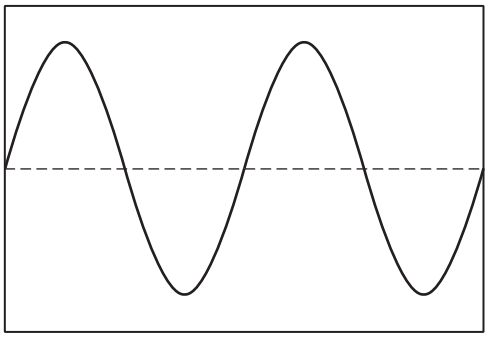
.....

(1 mark)

7 (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).

7 (b) (i) Label this wave to show its amplitude.



(1 mark)

7 (b) (ii) Complete the sentence.

Increasing the amplitude of a sound wave will increase the .....

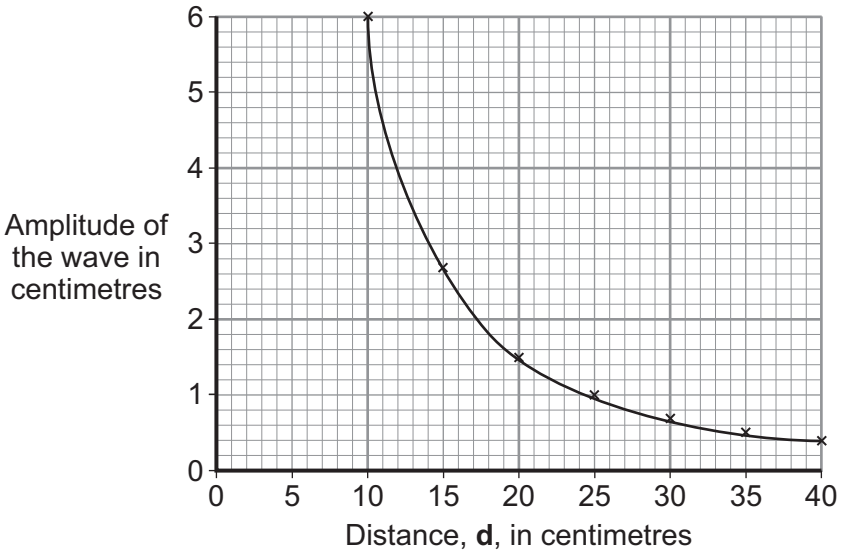
of the sound.

(1 mark)

4.5.6.1.2 Speed

Question 67 · continued

7 (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)

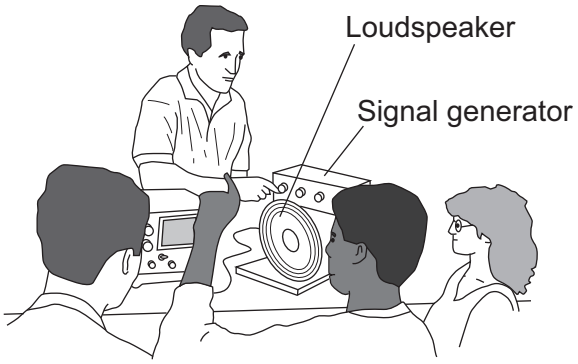
7 (d) Write a conclusion for this investigation.

.....

.....

(1 mark)

7 (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 68

June 2011 | PHY3F | Original Q8 | Legacy

8 (a) A student investigates the moment of a force.

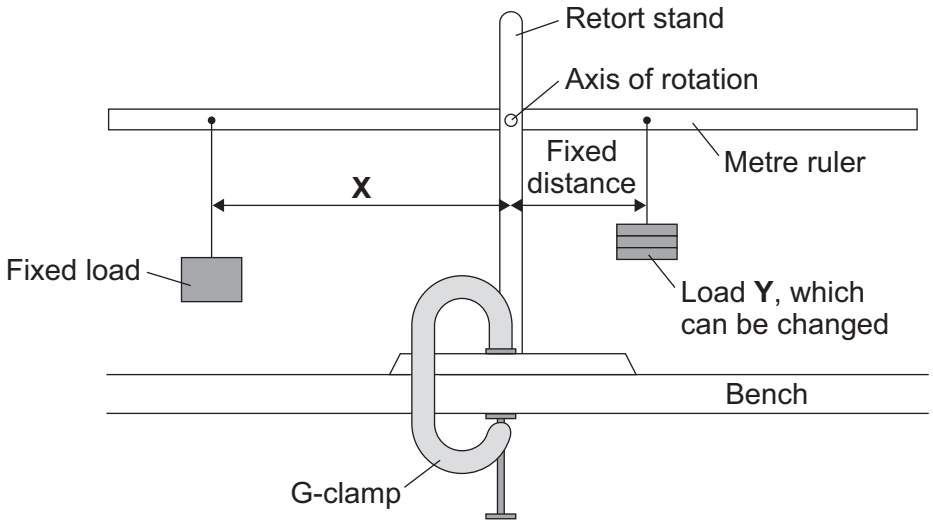
8 (a) (i) What does the word *moment* mean in this sentence?

.....

.....

(1 mark)

8 (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 68 · continued

8 (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)

8 (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. ☐

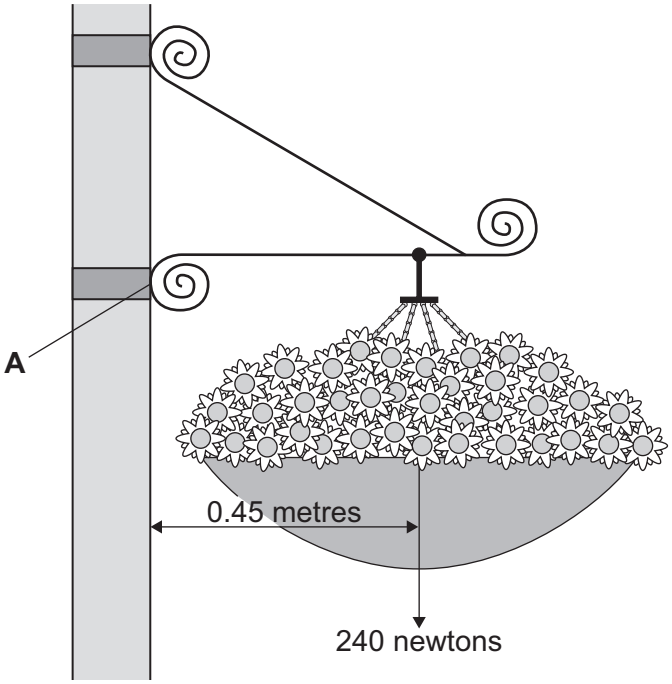
(1 mark)

Question 8 continues on the next page

4.5.6.1.2 Speed

Question 68 · continued

8 (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 69

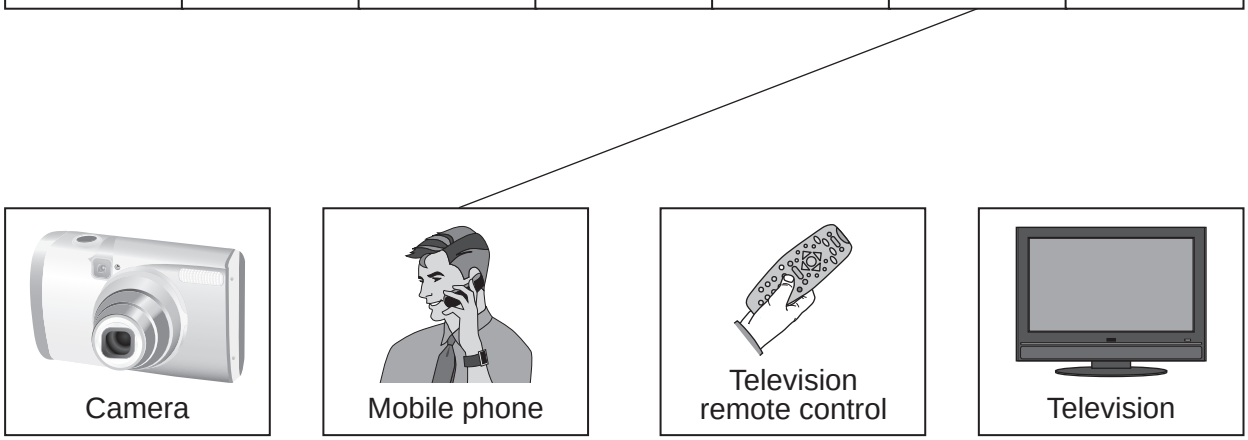
June 2012 | PH1FP | Original Q2 | Legacy

2 (a) The diagram shows the electromagnetic spectrum.

The pictures show four devices. Each device uses a different type of electromagnetic wave.

Draw **one** line from each device to the type of electromagnetic wave the device uses. One line has been drawn for you.

Gamma rays	X-rays	Ultraviolet waves	Visible light waves	Infrared waves	Microwaves	Radio waves



(3 marks)

2 (b) Visible light waves travel through space at a speed of 300 000 km/s.

How fast do infrared waves travel through space?

.....

(1 mark)

2 (c) Draw a ring around the correct answer in the box to complete the sentence.

Infrared waves have

a longer wavelength than
the same wavelength as
a shorter wavelength than

visible light waves.

(1 mark)

4.5.6.1.2 Speed

Question 69 · continued

2 (d) The two diagrams, **A** and **B**, show a light ray travelling into a glass block.

Diagram A

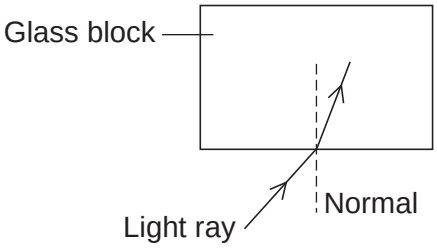
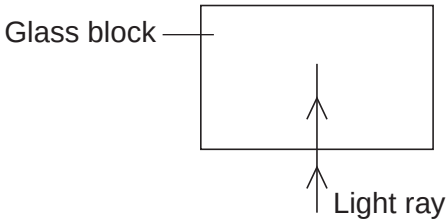


Diagram B



2 (d) (i) Look at **Diagram A**.

What name is given to the process that happens as the light enters the glass block?

.....

(1 mark)

2 (d) (ii) Look at **Diagram B**.

The light enters the glass block without changing direction.

Why?

.....

.....

(1 mark)

7

4.5.6.1.2 Speed

Question 70

June 2012 | PH1FP | Original Q3 | Legacy

3 A school is near a busy road. A car travels past the school at high speed.



The students notice that the sound of the car engine seems to change as the car travels past the school. A teacher says that this is an example of the Doppler effect. The students decide to study the sound they hear from passing cars.

3 (a) (i) Give **one** risk the students should consider when doing their study.

.....

(1 mark)

3 (a) (ii) As a car travels towards the students, the frequency of the sound the students hear is different to the frequency of the sound they would hear if the car was stationary.

Draw a ring around the correct answer in the box to complete the sentence.

Compared to the sound from the stationary car, the frequency has

decreased.
increased.
become quieter.

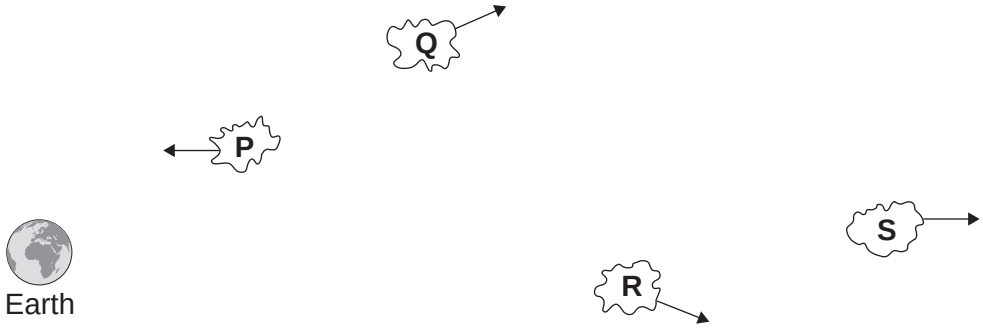
(1 mark)

4.5.6.1.2 Speed

Question 70 · continued

3 (b) In the same way as the sound from the car engine changes, the light from most galaxies also seems to have a change in observed frequency. This is called red-shift.

3 (b) (i) The diagram shows four galaxies, **P**, **Q**, **R** and **S**. The arrows show the direction the galaxies are moving relative to the Earth.



Which **one** of the galaxies is moving the fastest?

Write the correct answer in the box.

Which **one** of the galaxies will produce the biggest red-shift?

Write the correct answer in the box.

(2 marks)

Question 3 continues on the next page

4.5.6.1.2 Speed

Question 70 · continued

3 (b) (ii) Most scientists support a theory that the Universe began from a very small initial point. Red-shift can be used as evidence for this theory.

What name is given to the theory that the Universe began from a very small initial point?

.....

(1 mark)

3 (b) (iii) Cosmic microwave background radiation (CMBR) provides more evidence for this theory. CMBR is detected coming from space.

Where does CMBR come from?

Tick (✓) **one** box.

CMBR only comes from near the Sun. ☐

CMBR comes from all parts of the Universe. ☐

CMBR only comes from the Moon. ☐

(1 mark)

3 (b) (iv) Which statement gives the reason why most scientists support the theory that the Universe began from a very small initial point?

Tick (✓) **one** box.

The evidence proves it happened. ☐

There is no other way of explaining how the Universe began. ☐

At the moment it is the best way of explaining our scientific knowledge. ☐

(1 mark)

7

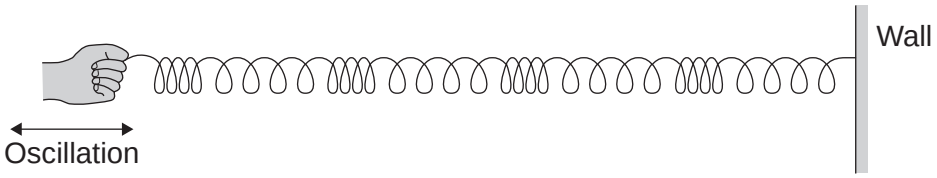
4.5.6.1.2 Speed

Question 71

June 2012 | PH1FP | Original Q6 | Legacy

6 **Diagram 1** shows a longitudinal wave being produced in a stretched spring.

Diagram 1



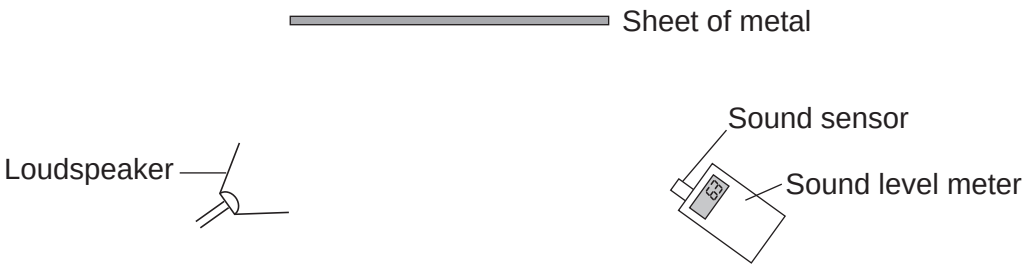
6 (a) A longitudinal wave has areas of compression and areas of rarefaction.

Mark with the letter **C**, **one** area of compression shown in **Diagram 1**.

(1 mark)

6 (b) **Diagram 2** shows the apparatus a teacher uses to demonstrate that sound can be reflected.

Diagram 2



6 (b) (i) Using a ruler, draw on **Diagram 2** to show how sound from the loudspeaker is reflected by the sheet of metal to the sound sensor.

(2 marks)

6 (b) (ii) The teacher replaced the sheet of metal with a sheet of glass.

When he did this, the reading on the sound level meter went down.

Suggest why.

.....

.....

(1 mark)

4.5.6.1.2 Speed

Question 71 · continued

6 (b) (iii) The teacher changed the output from the loudspeaker to increase the amplitude of the sound wave produced.

What effect, if any, does this increase of amplitude have on the loudness of the sound?

Draw a ring around the correct answer.

makes the sound quieter	**does not change the loudness of the sound**	**makes the sound louder**

(1 mark)

6 (b) (iv) The loudspeaker produces a sound wave at a frequency of 850 Hz. The wavelength of the sound wave is 0.4 m.

Calculate the speed of the sound wave.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Speed = ... m/s

(2 marks)

6 (c) Music concerts are sometimes performed in sports halls. The concerts can be spoilt because of the sound reflected from the floor and walls.

What word is used to describe a reflected sound?

.....

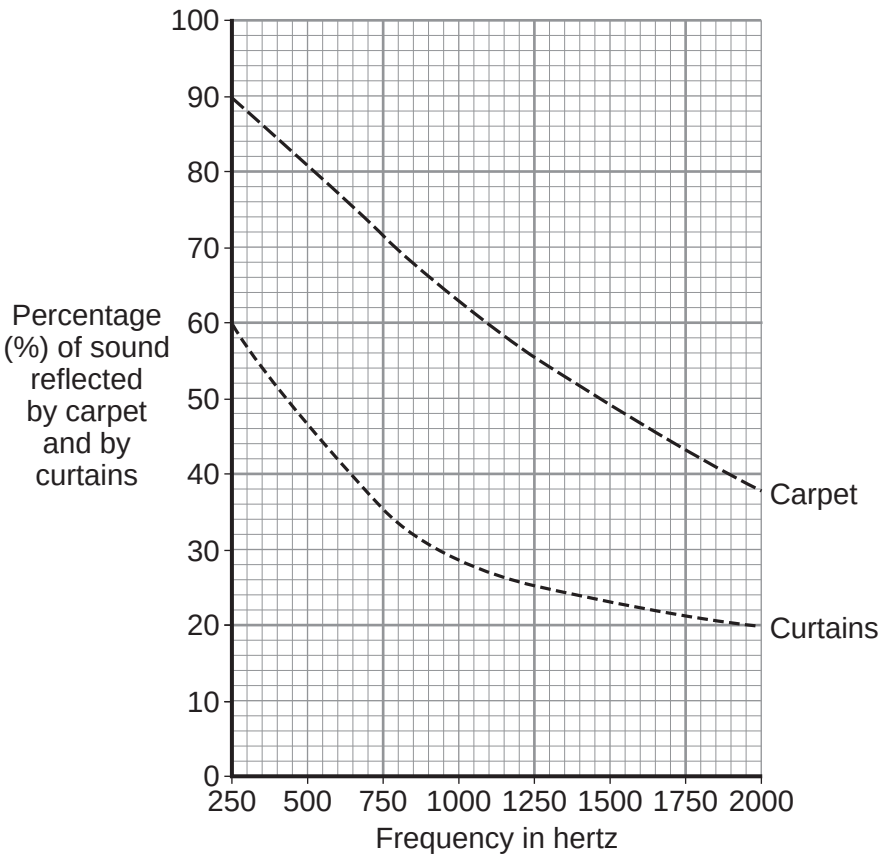
(1 mark)

Question 6 continues on the next page

4.5.6.1.2 Speed

Question 71 · continued

6 (d) The graph shows how the percentage of sound reflected from the floor and from the walls of a large room can be reduced by carpets and by curtains.



6 (d) (i) Over which range of frequencies do curtains reduce the percentage of sound reflected the most?

Tick (✓) **one** box.

from 250 Hz to 750 Hz ☐

from 750 Hz to 1250 Hz ☐

from 1250 Hz to 1750 Hz ☐

(1 mark)

4.5.6.1.2 Speed

Question 71 · continued

6 (d) (ii) The manager of a sports hall plans to use the hall for regular music concerts. He has enough money to buy either carpet or curtains, but not both.

To improve the sound an audience hears, it would be better to hang curtains on the walls rather than laying a carpet over the floor.

Use the data in the graph to explain why.

.....

.....

.....

.....

(2 marks)

11

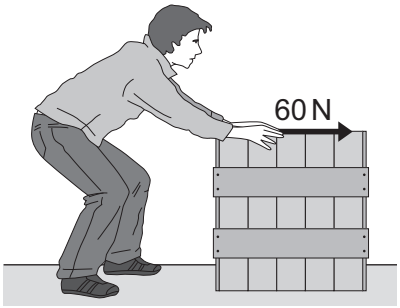
Turn over for the next question

4.5.6.1.2 Speed

Question 72

June 2012 | PH2FP | Original Q3 | Legacy

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



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

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

(1 mark)

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

..... N

Give the reason for your answer.

.....

.....

(2 marks)

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

Use the correct equation from the Physics Equations Sheet.

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

Choose the unit from the list below.

joule **newton** **watt**

.....

.....

Work done = ...

(3 marks)

6

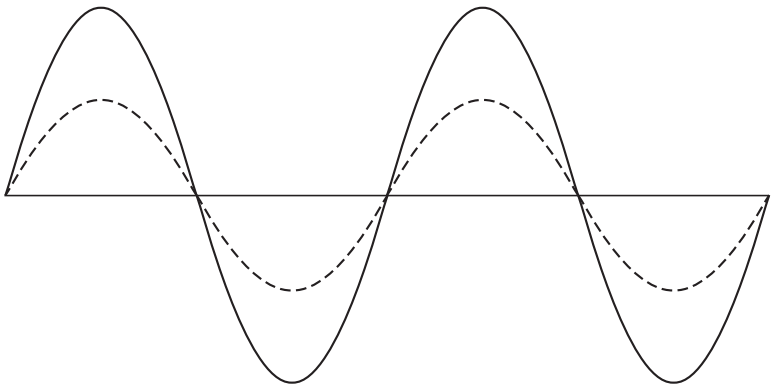
4.5.6.1.2 Speed

Question 73

January 2013 | PH1FP | Original Q4 | Legacy

4 (a) **Diagram 1** shows two waves.

Diagram 1



4 (a) (i) Name **one** wave quantity that is the same for the two waves.

.....

(1 mark)

4 (a) (ii) Name **one** wave quantity that is different for the two waves.

.....

(1 mark)

4 (a) (iii) The waves in **Diagram 1** are transverse.

Which **one** of the following types of wave is **not** a transverse wave?

Draw a ring around the correct answer.

gamma rays **sound** **visible light**

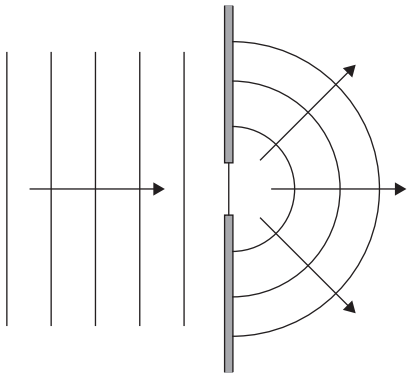
(1 mark)

4.5.6.1.2 Speed

Question 73 · continued

4 (b) **Diagram 2** shows water waves in a ripple tank moving towards and passing through a gap in a barrier.

Diagram 2



4 (b) (i) The water waves spread out after passing through the gap in the barrier.

What name is given to the process causing the waves to spread out?

.....

(1 mark)

4 (b) (ii) Every second, 8 waves pass through the gap in the barrier. The waves have a wavelength of 0.015 metres.

Calculate the speed of the water waves and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Speed = ...

(3 marks)

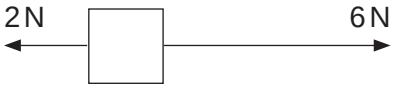
7

4.5.6.1.2 Speed

Question 74

January 2013 | PH2FP | Original Q1 | Legacy

1 (a) The diagram shows two forces acting on an object.



What is the resultant force acting on the object?

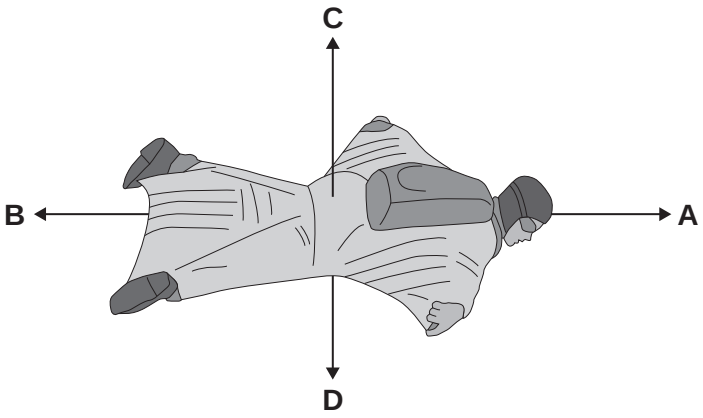
Tick (✓) **one** box.

- 8 N to the right ☐
- 8 N to the left ☐
- 4 N to the right ☐
- 4 N to the left ☐

(1 mark)

1 (b) BASE jumpers jump from very high buildings and mountains for sport.

The diagram shows the forces acting on a BASE jumper in flight.
The BASE jumper is wearing a wingsuit.



4.5.6.1.2 Speed

Question 74 · continued

1 (b) (i) Draw a ring around the correct answer in the box to complete each sentence.

The BASE jumper accelerates forwards when force **A** is

smaller than
equal to
bigger than

force **B**.

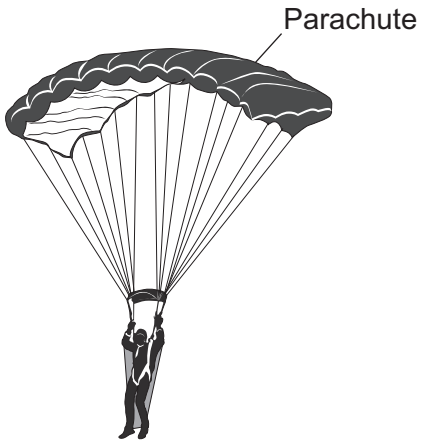
The BASE jumper falls with a constant speed when force **C** is

smaller than
equal to
bigger than

force **D**.

(2 marks)

1 (b) (ii) To land safely the BASE jumper opens a parachute.



What effect does opening the parachute have on the speed of the falling BASE jumper?

.....

Give a reason for your answer.

.....

.....

(2 marks)

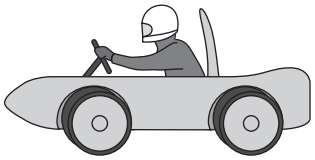
5

4.5.6.1.2 Speed

Question 75

January 2013 | PH2FP | Original Q6 | Legacy

6 Some students designed and built an electric-powered go-kart.
The go-kart is shown below.



6 (a) Suggest **two** changes that could be made to the design of the go-kart to increase its top speed.

1 .....

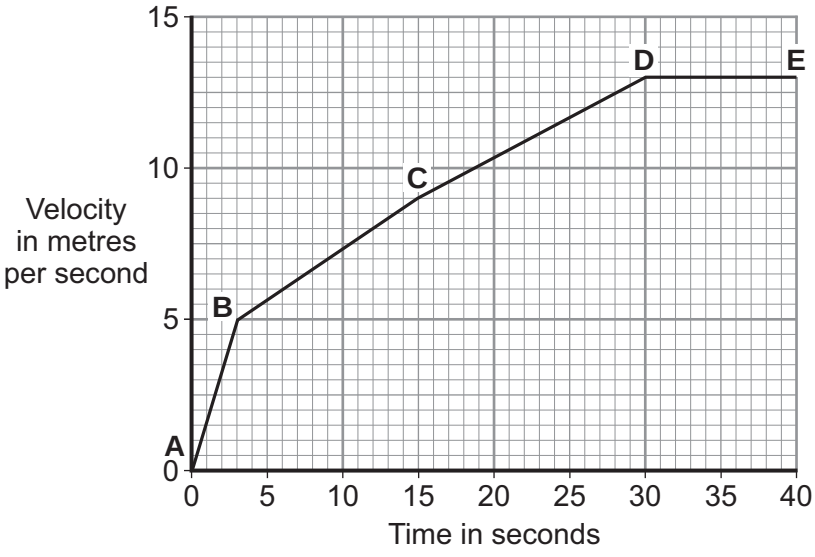
.....

2 .....

.....

(2 marks)

6 (b) A go-kart with a new design is entered into a race.
The velocity-time graph for the go-kart, during the first 40 seconds of the race, is shown below.



4.5.6.1.2 Speed

Question 75 · continued

6 (b) (i) Between which **two** points did the go-kart have the greatest acceleration?

Tick (✓) **one** box.

A–B ☐

B–C ☐

C–D ☐

Give a reason for your answer.

.....

.....

(2 marks)

6 (b) (ii) The go-kart travels at a speed of 13 m/s between points **D** and **E**.
The total mass of the go-kart and driver is 140 kg.

Calculate the momentum of the go-kart and driver between points **D** and **E**.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Momentum = ... kg m/s
(2 marks)

6

4.5.6.1.2 Speed

Question 76

June 2013 | PH1FP | Original Q5 | Legacy

5 (a) A lorry has an air horn. The air horn produces sound waves in the air.

5 (a) (i) Use **one** word to complete the following sentence.

Sound waves cause air particles to ..... .

(1 mark)

5 (a) (ii) The air horn produces sound waves at a constant frequency of 420 Hz.
The wavelength of the sound waves is 0.80 m.

Calculate the speed of the sound waves.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Speed = ... m/s

(2 marks)

5 (b) A person standing at the side of the road, as the lorry goes past, hears the sound from the air horn change pitch.

5 (b) (i) What determines the pitch of a sound?

Draw a ring around the correct answer.

amplitude **frequency** **loudness**

(1 mark)

5 (b) (ii) As the lorry moves away from the person, the air horn continues to produce sound waves with a wavelength of 0.80 m.

What is the wavelength of the sound waves the person heard?

Draw a ring around the correct answer.

shorter than 0.8 m **equal to 0.8 m** **longer than 0.8 m**

(1 mark)

4.5.6.1.2 Speed

Question 76 · continued

5 (b) (iii) The sound waves the person heard from the moving air horn are different to the sound waves the air horn produced.

What name is given to this effect?

Draw a ring around the correct answer.

diffraction **Doppler** **refraction**

(1 mark)

6

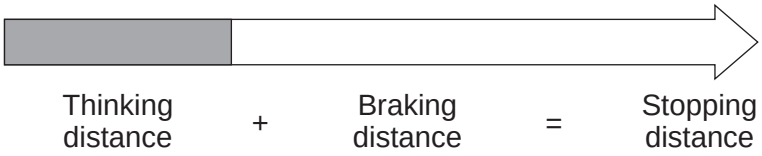
Turn over for the next question

4.5.6.1.2 Speed

Question 77

June 2013 | PH2FP | Original Q6 | Legacy

6 The diagram shows how the thinking distance and braking distance of a car add together to give the stopping distance of the car.



6 (a) Use words from the box to complete the sentence.

distance	**energy**	**force**	**time**

The stopping distance is found by adding the distance the car travels during the driver's reaction ..... and the distance the car travels under the braking ..... . *(2 marks)*

6 (b) Which **one** of the following would **not** increase the thinking distance?

Tick (✓) **one** box.

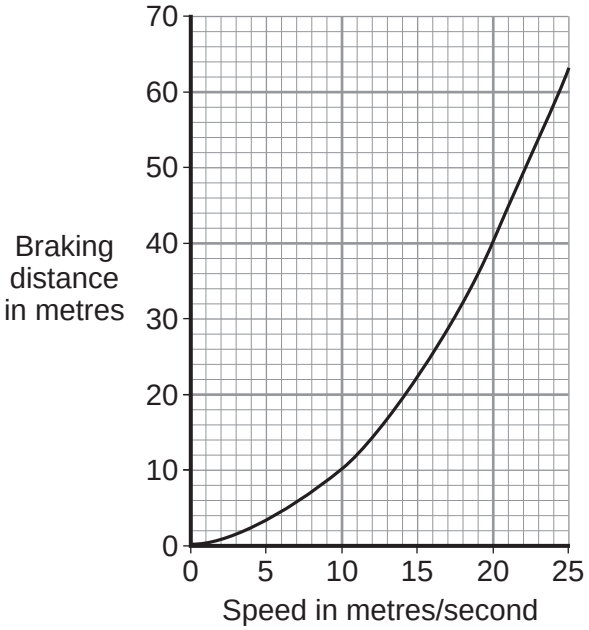
The car driver being tired. ☐

The car tyres being badly worn. ☐

The car being driven faster. ☐

(1 mark)

6 (c) The graph shows how the braking distance of a car changes with the speed of the car. The force applied to the car brakes does not change.



4.5.6.1.2 Speed

Question 77 · continued

6 (c) (i) What conclusion about braking distance can be made from the graph?

.....

.....

.....

.....

(2 marks)

6 (c) (ii) The graph is for a car driven on a dry road.

Draw a line on the graph to show what is likely to happen to the braking distance at different speeds if the same car was driven on an icy road.

(1 mark)

6 (d) A local council has reduced the speed limit from 30 miles per hour to 20 miles per hour on a few roads. The reason for reducing the speed limit was to reduce the number of accidents.

6 (d) (i) A local newspaper reported that a councillor said:

"It will be much safer because drivers can react much faster when driving at 20 miles per hour than when driving at 30 miles per hour."

This statement is wrong. Why?

.....

.....

(1 mark)

6 (d) (ii) The local council must decide whether to introduce the lower speed limit on a lot more roads.

What evidence should the local council collect to help make this decision?

.....

.....

.....

.....

(2 marks)

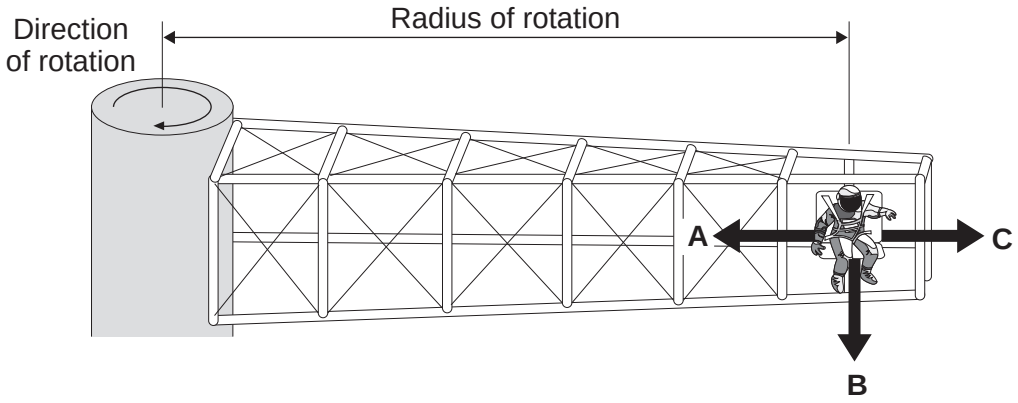
9

4.5.6.1.2 Speed

Question 78

June 2013 | PH3FP | 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) In which direction, **A**, **B** or **C**, does the centripetal force on the astronaut act?

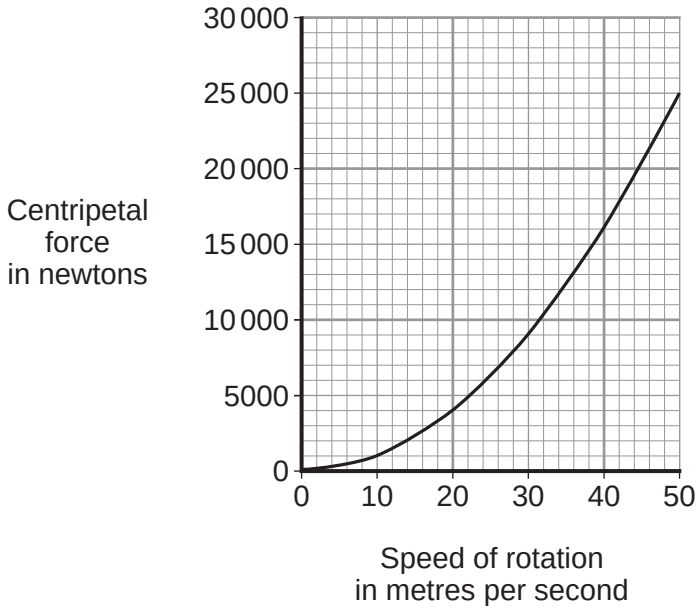
Write your answer in the box. ☐

(1 mark)

5 (b) The centripetal force on the astronaut is measured.

Graph X shows how the centripetal force is affected by the speed of rotation. The radius of rotation is kept the same.

Graph X



5 (b) (i) Use **Graph X** to determine the centripetal force on the astronaut when rotating at a speed of 30 metres per second.

Centripetal force = ... newtons

(1 mark)

4.5.6.1.2 Speed

Question 78 · continued

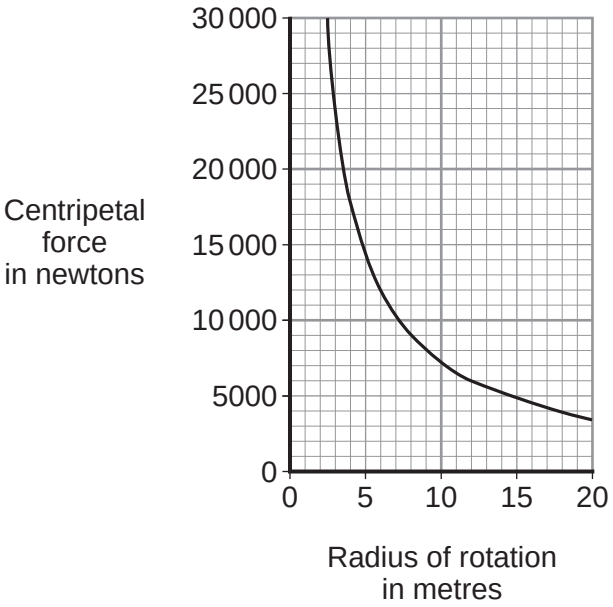
5 (b) (ii) Complete the following sentence to give the conclusion that can be made from **Graph X**.

Increasing the speed of rotation of a G-machine will ..... the centripetal force on the astronaut.

(1 mark)

5 (b) (iii) **Graph Y** shows how the centripetal force is affected by the radius of rotation, when the speed of rotation is kept the same.

Graph Y



Complete the following sentence to give the conclusion that can be made from **Graph Y**.

The greater the radius of rotation, the ..... the centripetal force on the astronaut.

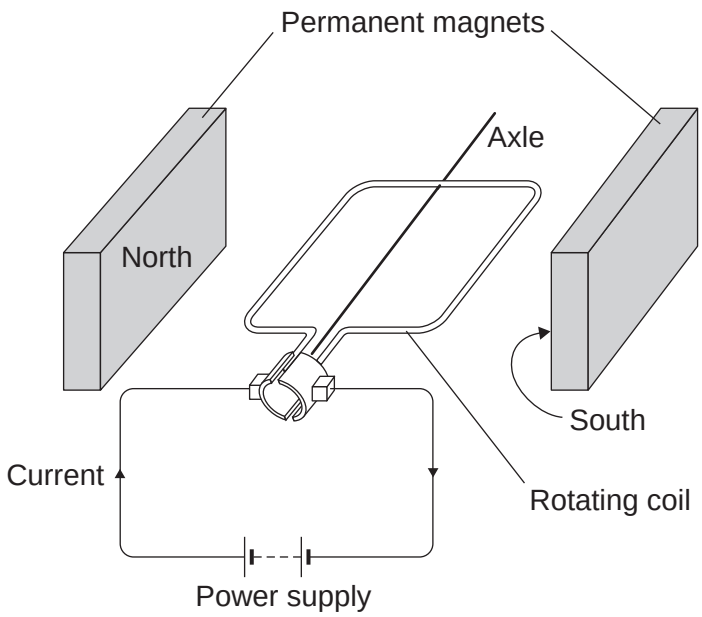
(1 mark)

Question 5 continues on the next page

4.5.6.1.2 Speed

Question 78 · continued

5 (c) The G-machine is rotated by an electric motor. The diagram shows a simple electric motor.



The following statements explain how the motor creates a turning force. The statements are in the wrong order.

M – The magnetic field interacts with the magnetic field of the permanent magnets.

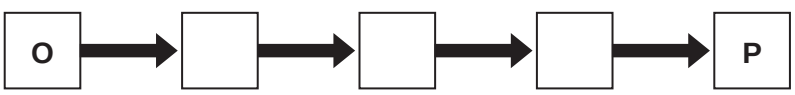
N – A magnetic field is created around the coil.

O – The power supply applies a potential difference across the coil.

P – This creates a force that makes the coil spin.

Q – A current flows through the coil.

Arrange the statements in the correct order. Two of them have been done for you.



(2 marks)

4.5.6.1.2 Speed

Question 78 · continued

5 (d) The electric motor produces a turning force.

Give **two** ways of increasing the turning force.

1 .....

.....

2 .....

.....

(2 marks)

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

It costs a lot of money to send astronauts into space.

This is [an economic / an environmental / a social] issue.

(1 mark)

9

4.5.6.1.2 Speed

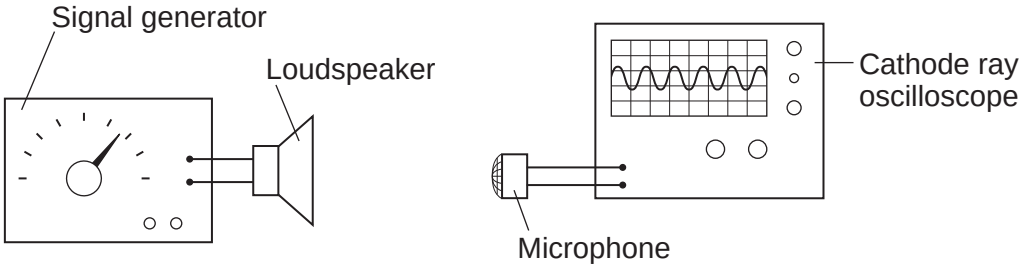
Question 79

June 2014 | PH1FP | Original Q2 | Legacy

2 (a) **Figure 2** shows a signal generator connected to a loudspeaker.

The signal generator is adjusted to change the sound wave produced by the loudspeaker.

Figure 2

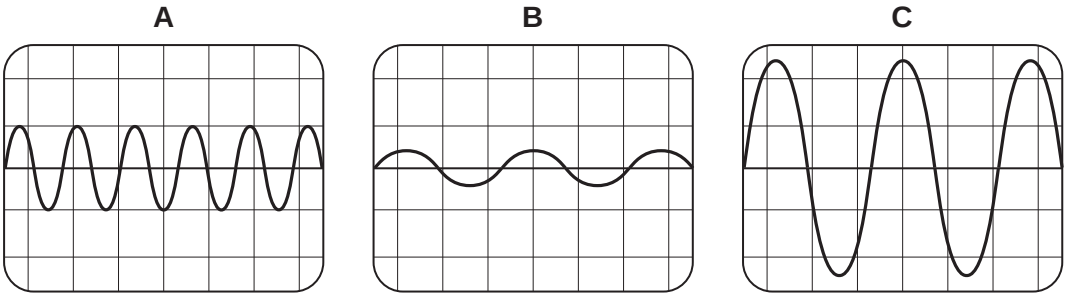


A microphone connected to a cathode ray oscilloscope (CRO) is used to detect the sound waves from the loudspeaker.

Figure 3 shows the CRO traces, **A**, **B** and **C**, produced by three different sound waves.

The settings on the CRO were the same for each trace.

Figure 3



Use the correct letter, **A**, **B** or **C**, to complete each sentence.

2 (a) (i) The sound wave with the highest frequency is shown by trace ☐.

[1 mark]

2 (a) (ii) The sound wave with the smallest amplitude is shown by trace ☐.

[1 mark]

4.5.6.1.2 Speed

Question 79 · continued

2 (b) The loudspeaker produces a sound wave with a frequency of 850 hertz and a wavelength of 0.4 metres.

Calculate the speed of this sound wave. Give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

joules **metres / second** **watts**

[3 marks]

.....

.....

.....

Speed = ...

2 (c) A motorbike is driven towards a microphone and CRO which are placed by the side of the road.

The motorbike emits a sound wave of constant frequency.

Draw a ring around the correct answer to complete each sentence.

[2 marks]

As the motorbike moves towards the microphone, the frequency of the sound wave detected by the microphone will be

higher than
the same as
lower than

the frequency of the sound wave produced by the motorbike.

The wavelength of the sound wave detected by the microphone will be

longer than
the same as
shorter than

the wavelength of the sound wave from the motorbike.

7

4.5.6.1.2 Speed

Question 80

June 2014 | PH1FP | Original Q8 | Legacy

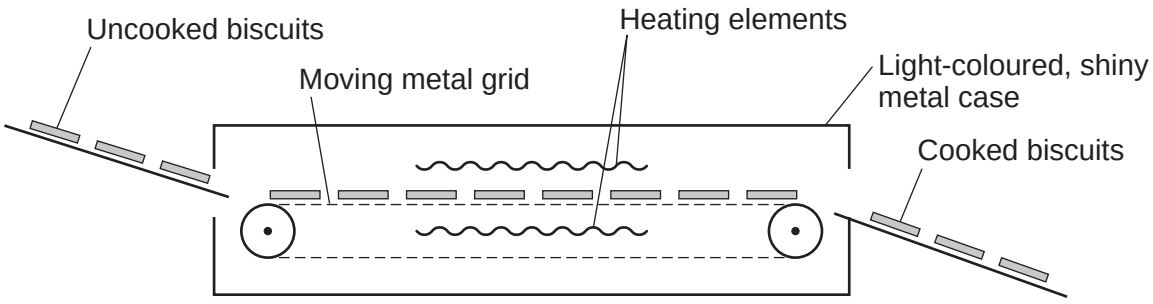
8 **Figure 11** shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

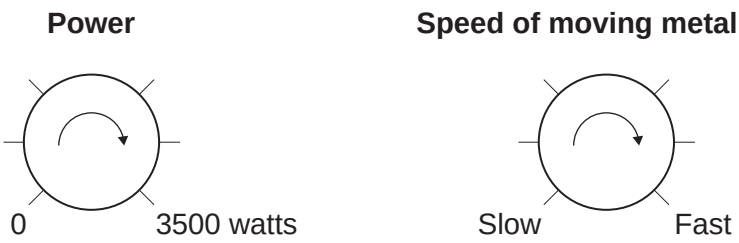
The biscuits turn brown as they cook.

Figure 11



The oven has two control knobs, as shown in **Figure 12**.

Figure 12



8 (a) Which type of electromagnetic radiation makes the biscuits turn brown?

[1 mark]

.....

8 (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 80 · continued

8 (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

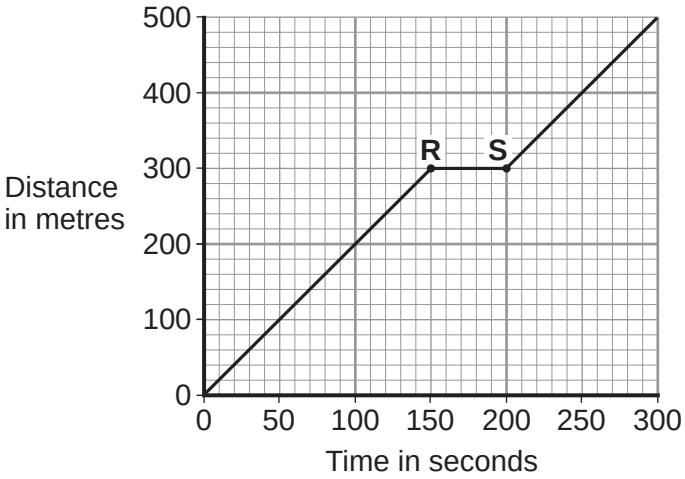
4.5.6.1.2 Speed

Question 81

June 2014 | PH2FP | Original Q2 | Legacy

2 (a) **Figure 3** shows the distance–time graph for a person walking to a bus stop.

Figure 3



2 (a) (i) Which **one** of the following statements describes the motion of the person between points **R** and **S** on the graph?

Tick (✓) **one** box.

[1 mark]

Not moving ☐

Moving at constant speed ☐

Moving with increasing speed ☐

4.5.6.1.2 Speed

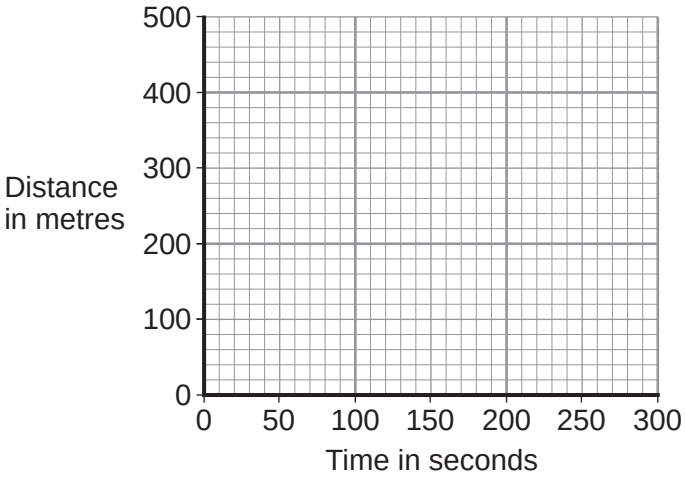
Question 81 · continued

2 (a) (ii) Another person, walking at constant speed, travels the same distance to the bus stop in 200 seconds.

Complete **Figure 4** to show a distance–time graph for this person.

[1 mark]

Figure 4



2 (b) A bus accelerates away from the bus stop at 2.5 m/s^2.

The total mass of the bus and passengers is 14 000 kg.

Calculate the resultant force needed to accelerate the bus and passengers.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Resultant force = ... N

4

4.5.6.1.2 Speed

Question 82

June 2014 | PH3FP | Original Q7 | Legacy

7 (a) What is ultrasound?

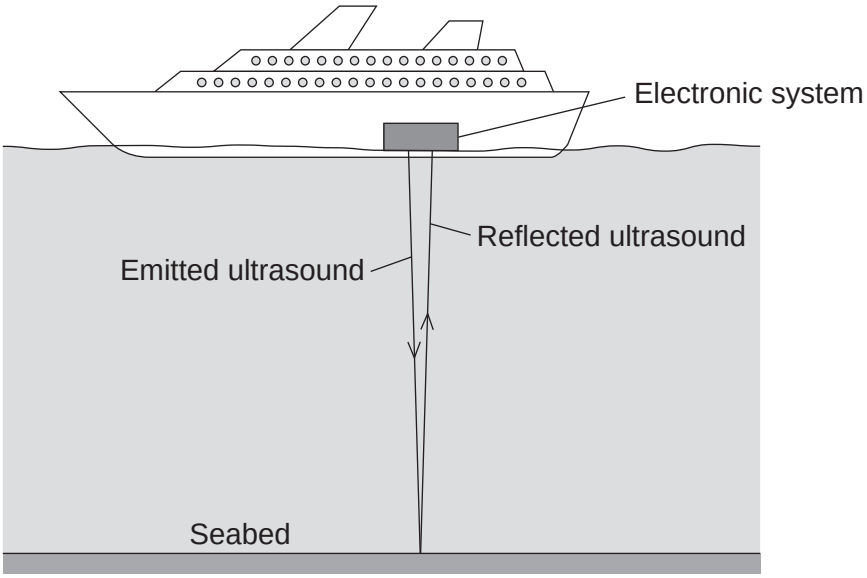
[1 mark]

.....

.....

7 (b) **Figure 12** shows how ultrasound is used to measure the depth of water below a ship.

Figure 12



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 82 · continued

7 (c) Ultrasound can be used in medicine for scanning.

State **one** medical use of ultrasound scanning.

[1 mark]

.....

7 (d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 13** uses X-rays to produce these images.

Figure 13



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

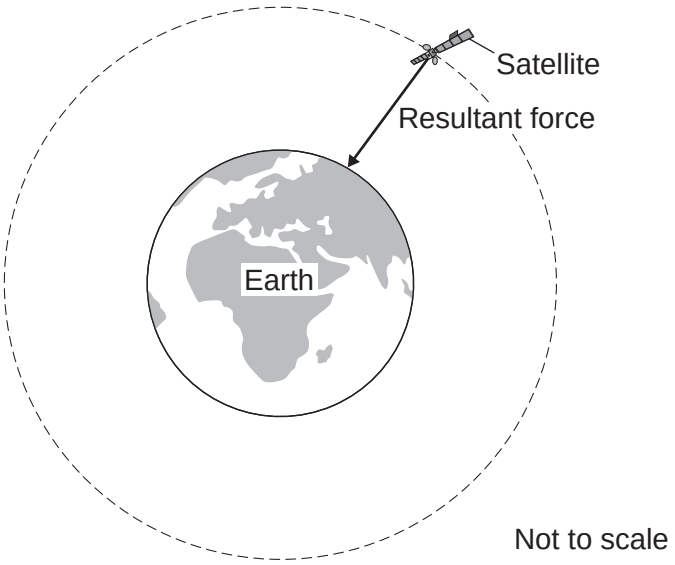
4.5.6.1.2 Speed

Question 83

June 2014 | PH3FP | Original Q8 | Legacy

8 Man-made satellites can orbit the Earth, as shown in **Figure 14**.

Figure 14



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force.

8 (a) What provides the centripetal force on the satellite?

[1 mark]

.....

8 (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 83 · continued

8 (c) **Table 4** gives data for five different satellites orbiting the Earth.

Table 4

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

8 (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]

.....

.....

8 (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 8 continues on the next page

4.5.6.1.2 Speed

Question 83 · continued

8 (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 84

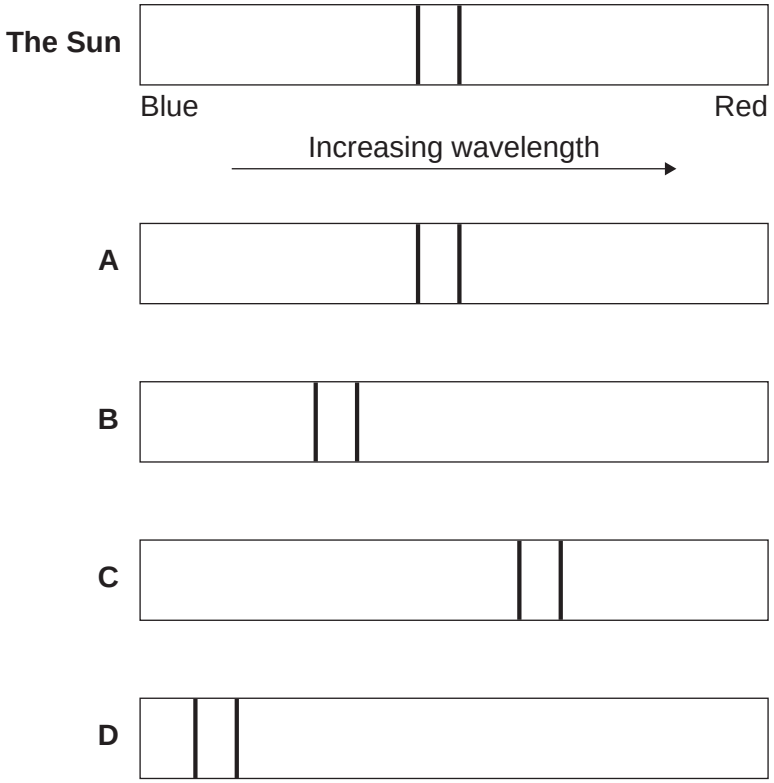
June 2015 | PH1FP | Original Q6 | Legacy

6 Scientists can use the visible light spectrum from distant stars to determine whether the stars are moving.

The visible light spectrum from stars includes dark lines at specific wavelengths.

6 (a) **Figure 9** shows the visible light spectrum from the Sun and from four other stars, **A**, **B**, **C** and **D**.

Figure 9



6 (a) (i) Which star, **A**, **B**, **C** or **D**, is moving away from the Earth?

[1 mark]

4.5.6.1.2 Speed

Question 84 · continued

6 (a) (ii) How does the speed of star **B** compare with the speed of star **D**?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
The speed of star **B** is greater than the speed of star **D**.	
The speed of star **B** is less than the speed of star **D**.	
The speed of star **B** is the same as the speed of star **D**.	

6 (b) A radio wave is emitted by a star.
The radio wave has a wavelength of 1500 m and a frequency of 200 000 Hz.

Calculate the speed of this radio wave.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Choose the correct unit from the list below.

m **m/s** **m/s^2**

.....

.....

.....

Speed = ... unit .....

5

4.5.6.1.2 Speed

Question 85

June 2015 | PH2FP | Original Q3 | Legacy

3 (a) When a force is applied to a spring, the spring extends by 0.12 m. The spring has a spring constant of 25 N/m.

Calculate the force applied to the spring.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

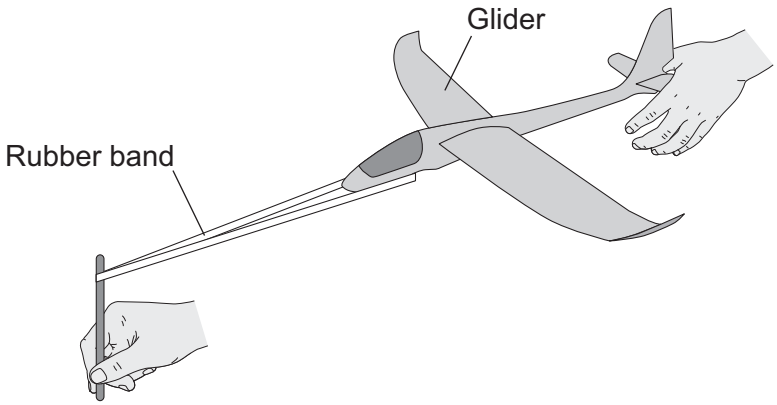
.....

.....

Force = ... N

3 (b) **Figure 2** shows a toy glider. To launch the glider into the air, the rubber band and glider are pulled back and then the glider is released.

Figure 2



3 (b) (i) Use the correct answers from the box to complete the sentence.

[2 marks]

chemical	**elastic potential**	**kinetic**	**thermal**

When the glider is released, the ..... energy stored in the rubber band decreases and the glider gains ..... energy.

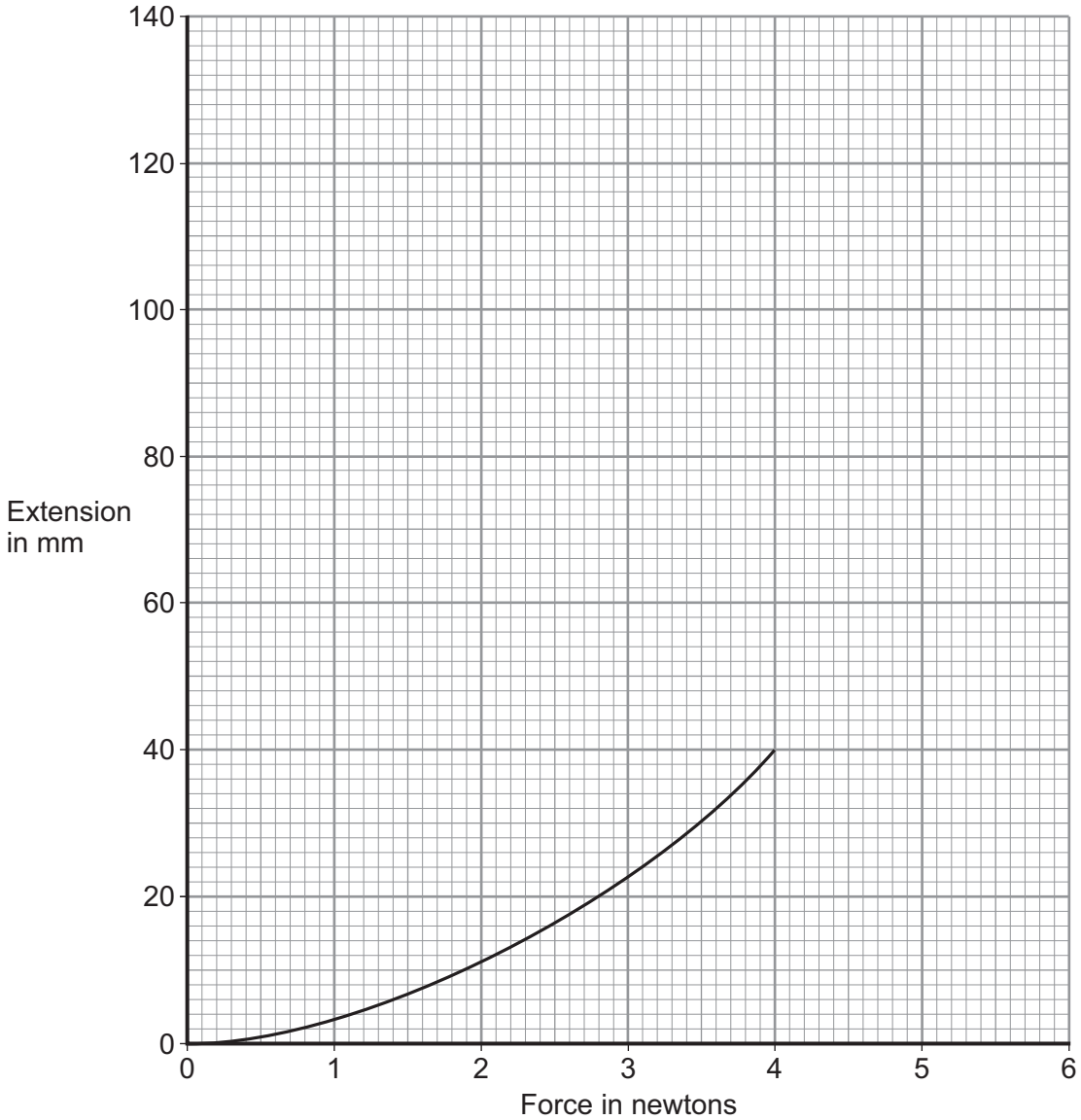
Question 3 continues on the next page

4.5.6.1.2 Speed

Question 85 · continued

3 (b) (ii) **Figure 3** shows how the extension of the rubber band varies with the force applied to the rubber band.

Figure 3



What can you conclude, from **Figure 3**, would happen to the extension of the rubber band if the force applied to the rubber band was increased to 6 N?

The rubber band does **not** break.

[2 marks]

.....

.....

.....

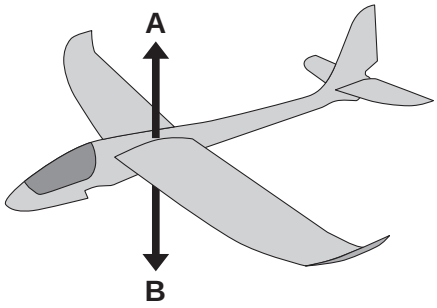
.....

4.5.6.1.2 Speed

Question 85 · continued

3 (c) **Figure 4** shows the vertical forces, **A** and **B**, acting on the glider when it is flying.

Figure 4



3 (c) (i) What name is given to the force labelled **B**?

[1 mark]

Draw a ring around the correct answer.

drag **friction** **weight**

3 (c) (ii) Which **one** of the following describes the downward speed of the glider when force **B** is greater than force **A**?

[1 mark]

Tick (✓) **one** box.

Downward speed increases ☐

Downward speed is constant ☐

Downward speed decreases ☐

8

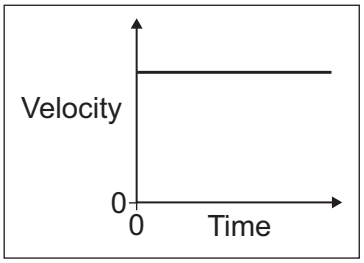
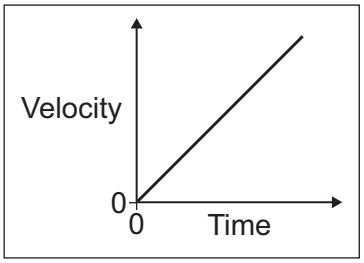
4.5.6.1.2 Speed

Question 86

June 2015 | PH2FP | Original Q5 | Legacy

5 (a) Draw **one** line from each velocity–time graph to the statement describing the motion shown by the graph.

[2 marks]

Velocity–time graph	Motion shown by graph
	Constant acceleration
	Not moving
	Constant deceleration
	Constant velocity

5 (b) Use the correct answer from the box to complete the sentence.

[1 mark]

energy	**momentum**	**speed**

The velocity of an object includes both the ..... of the object and the direction the object is moving.

Question 5 continues on the next page

4.5.6.1.2 Speed

Question 86 · continued

5 (c) At the start of a race, a horse accelerates from a velocity of 0 m/s to a velocity of 9 m/s in 4 seconds.

5 (c) (i) Calculate the acceleration of the horse.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

Acceleration = ... m/s^2

5 (c) (ii) When the horse accelerates, what, if anything, happens to the air resistance acting against the horse?

[1 mark]

Tick (✓) **one** box.

The air resistance decreases. ☐

The air resistance is constant. ☐

The air resistance increases. ☐

5 (d) A horse and a pony walk across a field at the same constant speed.

The horse has 4000 joules of kinetic energy.

The pony is **half** the mass of the horse.

What is the kinetic energy of the pony?

[2 marks]

Draw a ring around the correct answer.

2000 J **4000 J** **8000 J**

Give a reason for your answer.

.....

.....

8

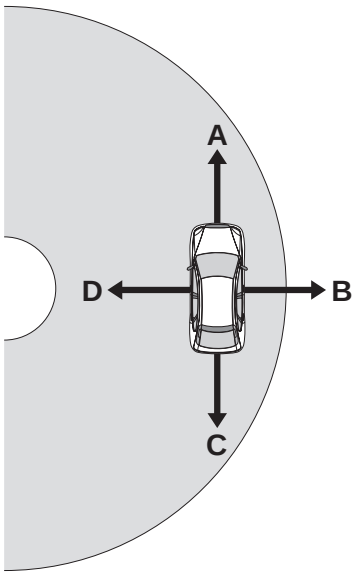
4.5.6.1.2 Speed

Question 87

June 2015 | PH3FP | Original Q8 | Legacy

8 (a) **Figure 15** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 15



There is a resultant force acting on the car. This resultant force is called the centripetal force.

8 (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** ☐

8 (a) (ii) State the name of the force that provides the centripetal force.

[1 mark]

.....

4.5.6.1.2 Speed

Question 87 · continued

8 (a) (iii) State **two** factors that affect the size of the centripetal force acting on the car.

[2 marks]

1 .....

2 .....

8 (b) **Figure 16** shows a racing car.

Figure 16



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

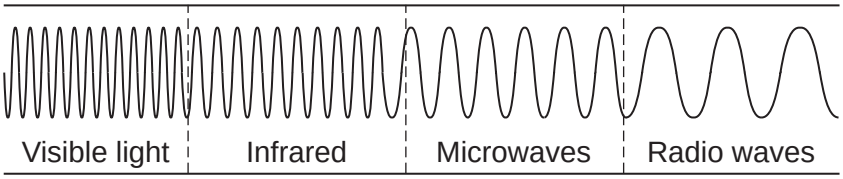
Question 88

June 2016 | PH1FP | Original Q3 | Legacy

3 Infrared and microwaves are two types of electromagnetic radiation.

Figure 4 shows the positions of the two types of radiation within part of the electromagnetic spectrum.

Figure 4



3 (a) (i) Name **one** type of electromagnetic radiation which has more energy than infrared.

[1 mark]

_____

3 (a) (ii) Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

[3 marks]

greater than	**less than**	**the same as**

The wavelength of infrared is _____ the wavelength of microwaves.

The frequency of microwaves is _____ the frequency of infrared.

The speed of microwaves in a vacuum is _____ the speed of infrared in a vacuum.

4.5.6.1.2 Speed

Question 88 · continued

3 (b) Cosmic Microwave Background Radiation (CMBR) is electromagnetic radiation that fills the universe.

Only one theory about the origin of the universe can explain the presence of CMBR.

3 (b) (i) Give the name of this theory.

[1 mark]

_____

3 (b) (ii) Which other piece of evidence supports this theory?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
the diffraction of sound waves	
the electromagnetic spectrum	
the red-shift of light from distant galaxies	

6

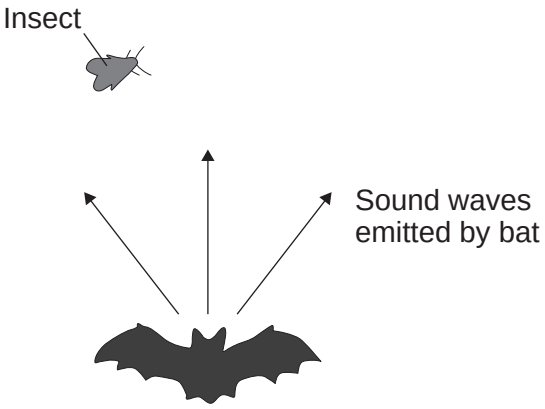
4.5.6.1.2 Speed

Question 89

June 2016 | PH1FP | Original Q6 | Legacy

6 Bats use the reflection of high pitched sound waves to determine the position of objects. **Figure 10** shows a bat and an insect flying in front of the bat.

Figure 10



6 (a) What determines the pitch of a sound wave?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
amplitude	
frequency	
speed	

6 (b) State the name given to reflected sound waves.

[1 mark]

_____

4.5.6.1.2 Speed

Question 89 · continued

6 (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.

6 (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

6 (e) Sound waves are longitudinal. Describe a longitudinal sound wave.

[2 marks]

_____

_____

_____

_____

8

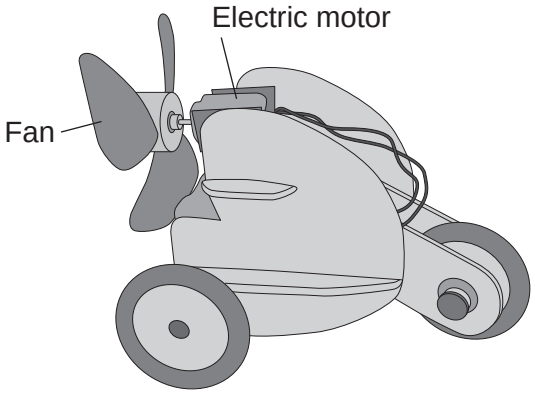
4.5.6.1.2 Speed

Question 90

June 2016 | PH2FP | Original Q3 | Legacy

3 **Figure 5** shows an air-driven toy.
When the electric motor is switched on the fan rotates.
The fan pushes air backwards making the toy move forwards.

Figure 5



3 (a) (i) The toy has a mass of 0.15 kg and moves forward with a velocity of 0.08 m/s.

How is the momentum of the toy calculated?

[1 mark]

Tick (✓) **one** box.

0.15 + 0.08 = 0.230 ☐

0.15 ÷ 0.08 = 1.875 ☐

0.15 × 0.08 = 0.012 ☐

3 (a) (ii) What is the unit of momentum?

[1 mark]

Tick (✓) **one** box.

kg m/s ☐ m/s^2 ☐ kg/m/s ☐

4.5.6.1.2 Speed

Question 90 · continued

3 (a) (iii) Use the correct answer from the box to complete the sentence.

[1 mark]

less than	equal to	more than

The momentum of the air backwards is _____ the momentum of the toy forwards.

3 (b) The electric motor can rotate the fan at two different speeds.

Explain why the toy moves faster when the fan rotates at the higher of the two speeds.

[2 marks]

_____

_____

_____

_____

5

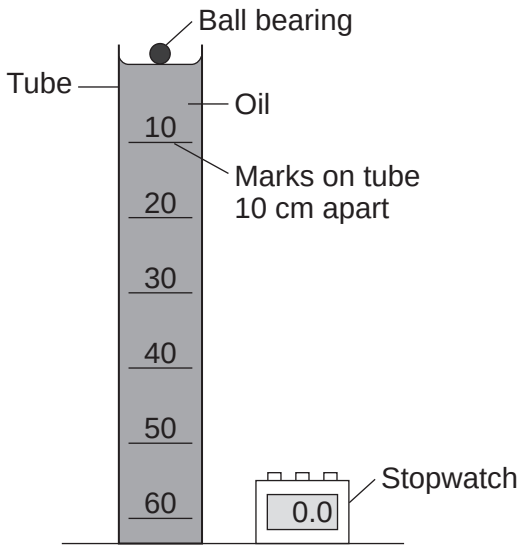
4.5.6.1.2 Speed

Question 91

June 2016 | PH2FP | Original Q8 | Legacy

8 A student investigated how the speed of a ball bearing changes as the ball bearing falls through a tube of oil.
Figure 12 shows the equipment the student used.

Figure 12



The student measured the time taken for the ball bearing to fall different distances.
Each distance was measured from the top of the oil.

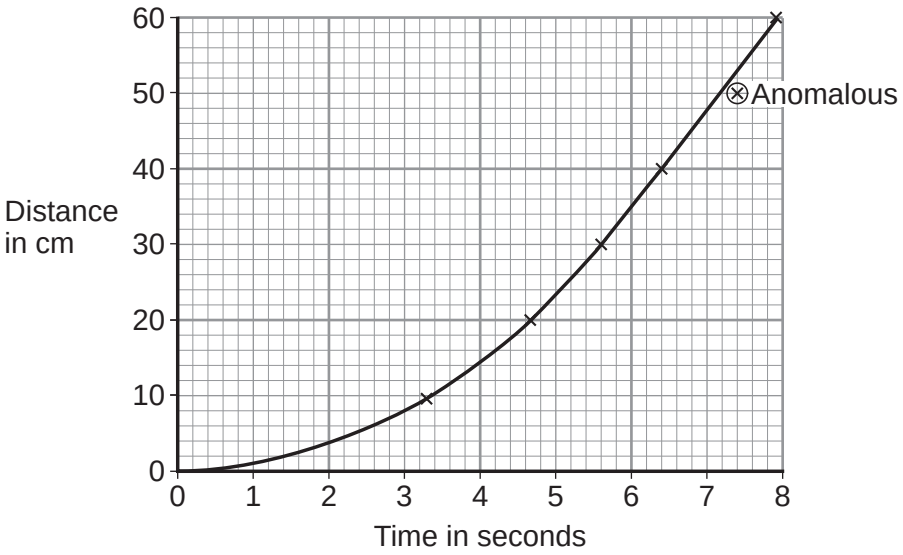
8 (a) What is likely to have been the main source of error in this investigation?

[1 mark]

Question 91 · continued

8 (b) **Figure 13** shows the student's results plotted as a graph.

Figure 13



8 (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.

8 (b) (ii) What can you conclude from the graph about the speed of the ball bearing during the first four seconds?

[1 mark]

_____

_____

8 (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]

_____

_____

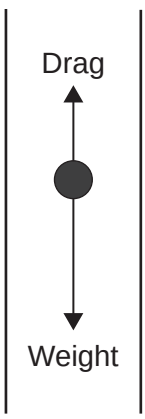
Question 8 continues on the next page

4.5.6.1.2 Speed

Question 91 · continued

8 (b) (iv) The directions of the two forces acting on the ball bearing as it falls through the oil are shown in **Figure 14**.

Figure 14



Explain, in terms of the forces shown in **Figure 14**, why the ball bearing reaches its terminal velocity.

[2 marks]

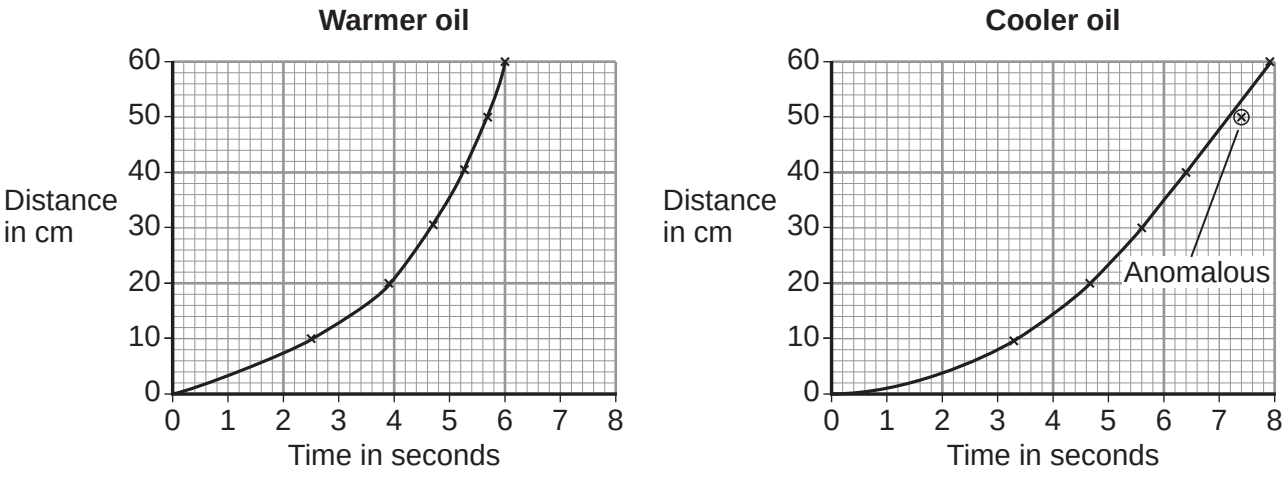
4.5.6.1.2 Speed

Question 91 · continued

8 (c) The student repeated the investigation using warmer oil.

Figure 15 shows the set of results using the warmer oil **and** the set of results using the cooler oil.

Figure 15



Compare the two graphs in **Figure 15**.

Use the correct answer 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 92

June 2016 | PH3FP | Original Q5 | Legacy

5 (a) Ultrasound is sound above the maximum frequency that humans can hear.

What is the maximum frequency that most humans can hear?

[1 mark]

Tick (✓) **one** box.

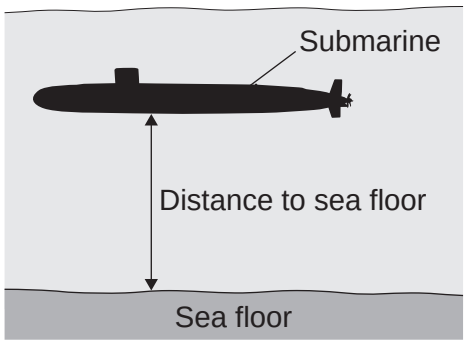
20 Hz ☐

2000 Hz ☐

20 000 Hz ☐

5 (b) **Figure 7** shows a submerged submarine.

Figure 7



Not to scale

The submarine sends a pulse of ultrasound to the sea floor.
The pulse takes 0.25 seconds to travel from the submarine to the sea floor.

The speed of sound in water is 1600 m/s.

Calculate the distance from the submarine to the sea floor.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Distance = _____ m

4.5.6.1.2 Speed

Question 92 · continued

5 (c) The ultrasound is reflected from the sea floor back to the submarine.
Use the correct answer from the box to complete the sentence.

[1 mark]

half	the same as	twice

The total distance the ultrasound pulse travelled is _____ the distance to the sea floor.

5 (d) The submarine moves through the sea and every few seconds sends a pulse of ultrasound to check the distance to the sea floor.

Table 1 shows the time taken for five ultrasound pulses to travel from the submarine to the sea floor and back to the submarine.

Table 1

Pulse number	Time for pulse to return in seconds
1	0.50
2	0.45
3	0.38
4	0.40
5	0.48

Describe how the distance from the submarine to the sea floor changed over these five pulses.

[2 marks]

_____

_____

_____

_____

6

4.5.6.1.2 Speed

Question 93

June 2017 | PH1FP | Original Q6 | Legacy

6 Starter pistols are used in athletics events to start races. A starter pistol makes a loud bang and produces a puff of smoke.

Figure 10 shows two people who investigated the speed of sound using a starter pistol and a stopclock.

Figure 10

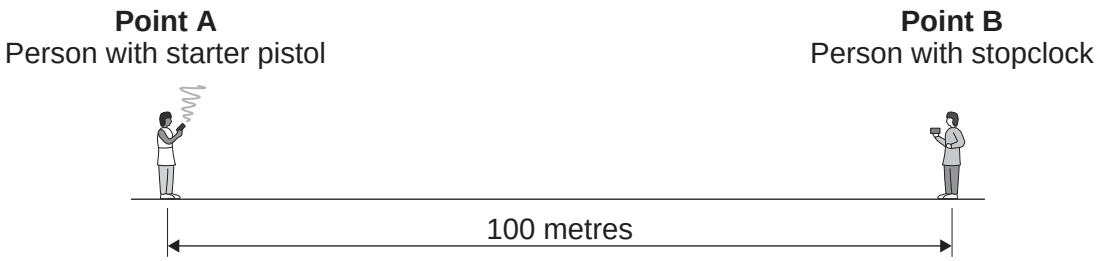


Figure 10 is not drawn to scale.

6 (a) The person at **Point B** sees the puff of smoke before hearing the bang from the starter pistol.

What does this tell you about the speed of sound compared with the speed of light?

[1 mark]

_____

_____

6 (b) The frequency of the sound wave produced by the pistol was 800 Hz

The wavelength of the sound wave was 0.42 m

Calculate the speed of the sound wave.

Use the correct equation from the Physics Equations Sheet.

Choose the correct unit.

m/s^2 **m/s** **m^2/s**

[3 marks]

_____

_____

_____

Speed = _____ unit _____

4.5.6.1.2 Speed

Question 93 · continued

6 (c) Complete **Table 1** to show the properties of the sound wave at **Point B** compared with the sound wave at **Point A**.

[3 marks]

Tick (✓) **one** box for each property comparison.

Table 1

Properties of the sound wave at Point B compared to Point A	greater than	less than	the same as
amplitude			
frequency			
speed			

6 (d) A sound wave can be reflected. What name is given to a reflected sound wave?

[1 mark]

_____

6 (e) Which **two** of these statements are true for sound waves?

[2 marks]

Tick (✓) **two** properties.

	Tick (✓)
Sound waves can travel through a vacuum.	
Sound waves are transverse waves.	
Sound waves are longitudinal waves.	
Sound waves transfer energy.	
Sound waves are electromagnetic waves.	

10

4.5.6.1.2 Speed

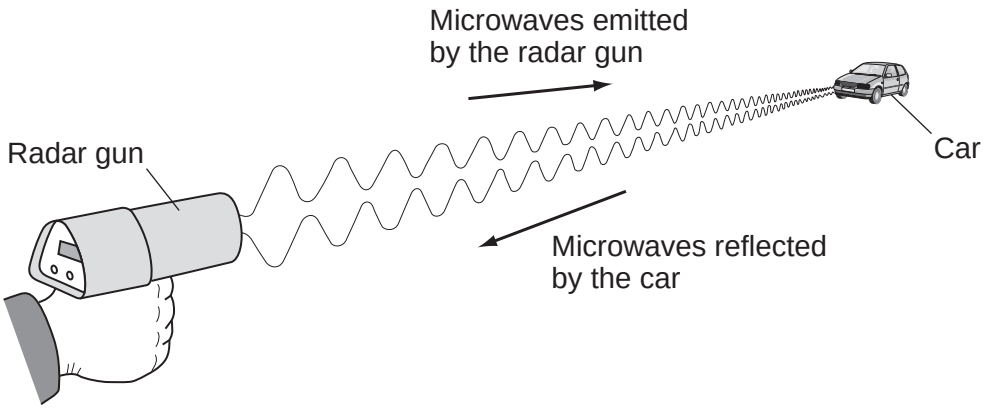
Question 94

June 2017 | PH1FP | Original Q8 | Legacy

8 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 13**.

Figure 13



8 (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]

_____

8 (b) The data in **Table 3** are measurements taken from three different cars on the same piece of road.

Table 3

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 94 · continued

8 (b) (i) State which car in **Table 3** is moving towards the radar gun. Give a reason for your answer.

[2 marks]

Car _____

Reason _____

_____

8 (b) (ii) State which car in **Table 3** 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 95

June 2017 | PH2FP | Original Q2 | Legacy

2 A car driver sees the traffic lights ahead change to red. The driver applies the brakes to stop the car.

The stopping distance of the car is the thinking distance plus the braking distance.

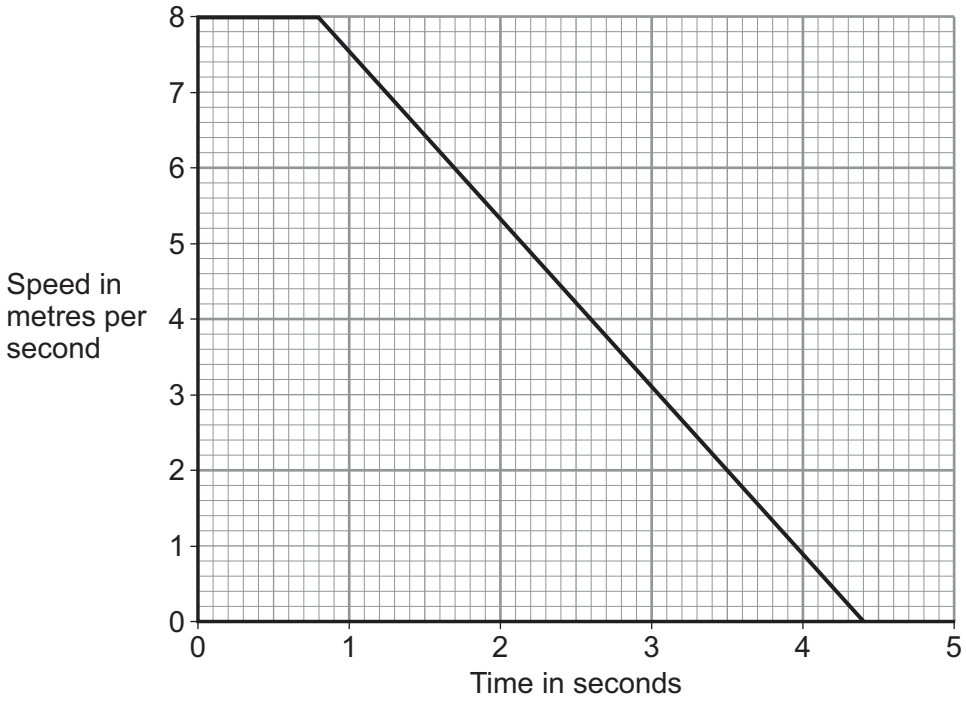
2 (a) Draw **one** line from each distance to the description of that distance.

[2 marks]

Distance	Description
Stopping	The distance the car moves between the brakes being applied and the car stopping.
Braking	The distance the car moves between the driver seeing the red light and the car stopping.
	The distance the car moves between the driver seeing the red light and applying the brakes.

2 (b) **Figure 3** shows how the speed of the car changes from the instant that the driver sees the traffic lights change to red.

Figure 3



4.5.6.1.2 Speed

Question 95 · continued

2 (b) (i) What is the reaction time of the driver?

[1 mark]

Tick (✓) **one** box.

0.8 s ☐ 3.6 s ☐ 4.4 s ☐

2 (b) (ii) Using a mobile phone while driving may increase the reaction time of the driver.

Explain the effect of an increased reaction time on the stopping distance of the car.

[2 marks]

_____

_____

_____

_____

2 (b) (iii) The car has a mass of 750 kg

How is the kinetic energy of the car calculated when the car is travelling at 8 m/s?

[1 mark]

Tick (✓) **one** box.

$\frac{1}{2} \times 750 \times 8$ ☐

$\frac{1}{2} \times 750 \times 8^2$ ☐

$\frac{1}{2} \times 750^2 \times 8^2$ ☐

2 (b) (iv) Use the correct answers from the box to complete the sentence.

Each answer may be used once, more than once or not at all.

[2 marks]

decreases	**does not change**	**increases**

When the brakes of the car are applied,

the kinetic energy of the car _____ and

the temperature of the brakes _____ .

8

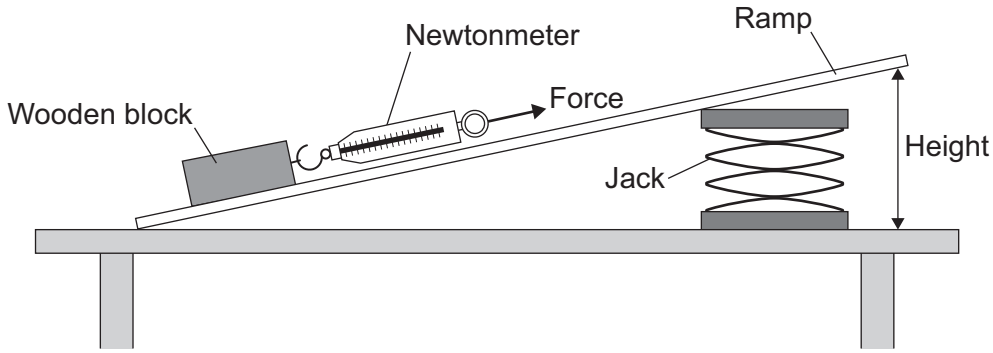
4.5.6.1.2 Speed

Question 96

June 2017 | PH2FP | Original Q4 | Legacy

4 A student investigated how the height of a ramp affects the force needed to pull a wooden block up the ramp at a steady speed. **Figure 6** shows the apparatus used by the student.

Figure 6



4 (a) Complete the following sentence.

[1 mark]

To pull the wooden block up the ramp the student must do work against the force of friction and the force of _____ .

4 (b) (i) What was the independent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

The force used to pull the wooden block. ☐

The height of the ramp. ☐

The mass of the wooden block. ☐

4 (b) (ii) What was a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

The force used to pull the wooden block. ☐

The height of the ramp. ☐

The mass of the wooden block. ☐

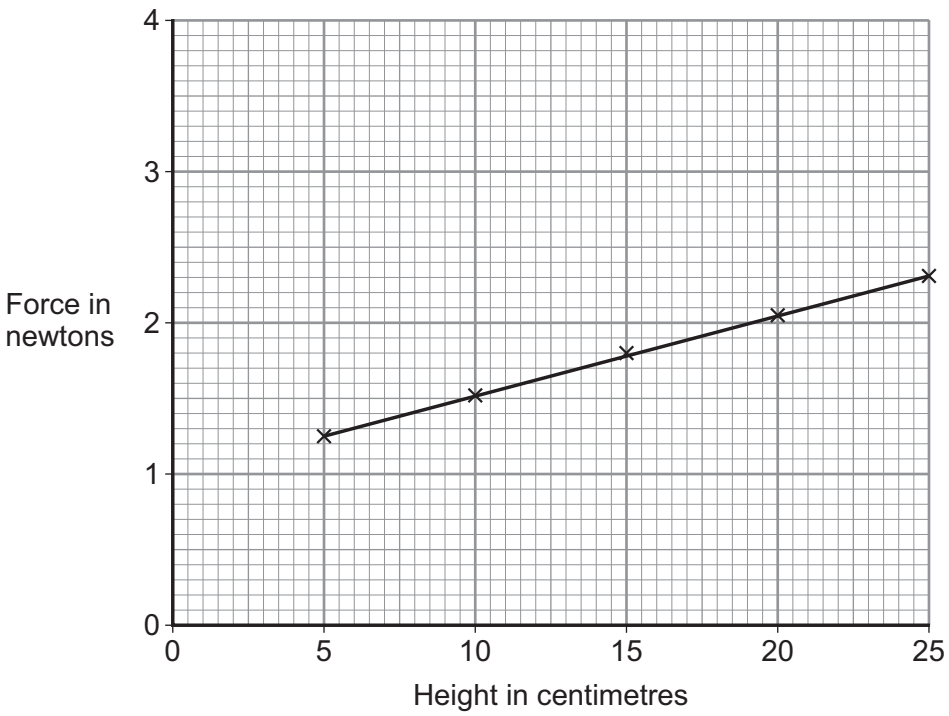
Question 4 continues on the next page

4.5.6.1.2 Speed

Question 96 · continued

4 (c) The results from the investigation are plotted in **Figure 7**.

Figure 7



4 (c) (i) How do you know from **Figure 7**, that none of the results were anomalous?

[1 mark]

_____

_____

4 (c) (ii) Use **Figure 7** to estimate the force needed to pull the wooden block along the ramp when the ramp is lying flat on the bench.

[1 mark]

Force = _____ N

4 (c) (iii) What conclusion should be made from the results shown in **Figure 7**?

[2 marks]

_____

_____

_____

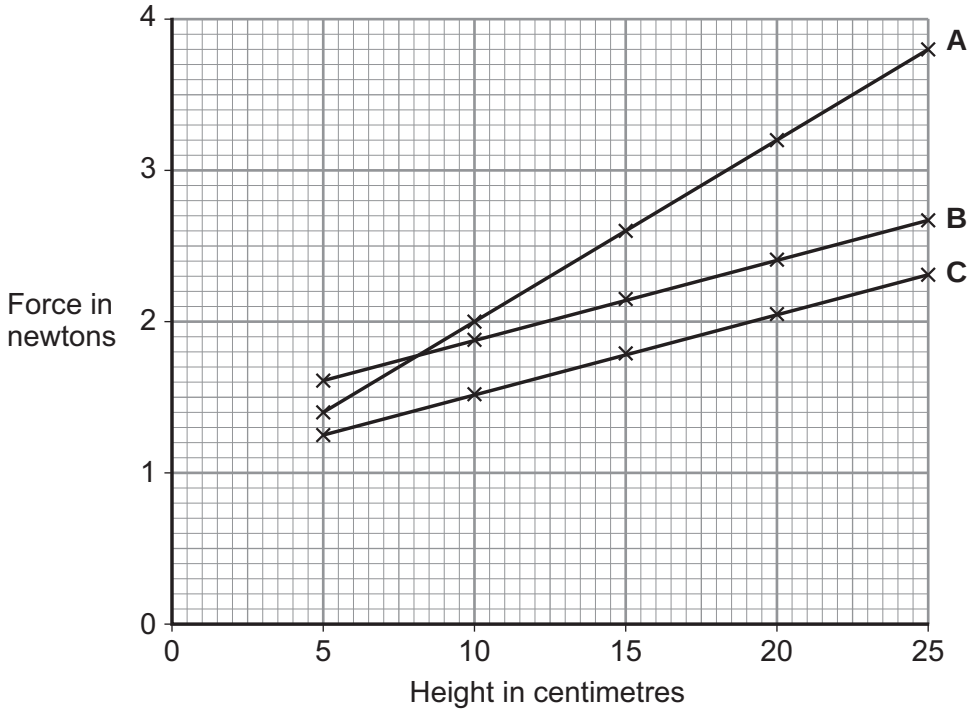
_____

4.5.6.1.2 Speed

Question 96 · continued

4 (c) (iv) Another student used the same apparatus to repeat the investigation.
The student increased the force of friction by fixing a rough material to the bottom of the wooden block.

Figure 8



Which of the following, **A**, **B** or **C**, in **Figure 8**, shows the results obtained by this student?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

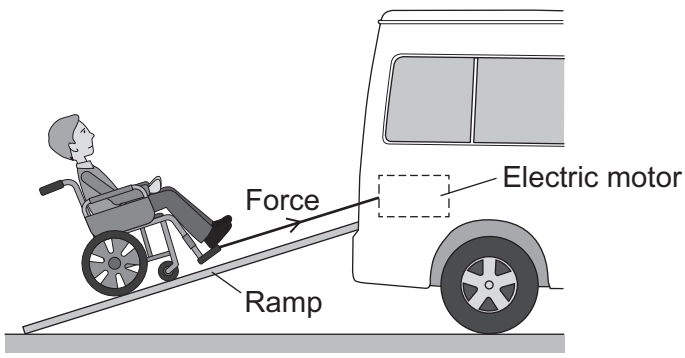
Question 4 continues on the next page

4.5.6.1.2 Speed

Question 96 · continued

4 (d) **Figure 9** shows how a ramp is used to help move a child in a wheelchair into a car. The wheelchair is pulled up the ramp by a cable attached to an electric motor.

Figure 9



A force of 260 N is used to pull the child and wheelchair up the ramp.
The ramp is 1.2 m long.

Calculate the work done to pull the child and wheelchair up the ramp.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

Work done = _____ J

10

4.5.6.1.2 Speed

Question 97

June 2017 | PH3FP | Original Q4 | Legacy

4 (a) Ultrasound can be used to produce an image of an unborn baby.

4 (a) (i) What is ultrasound?

[1 mark]

_____

_____

4 (a) (ii) What happens to the ultrasound when it reaches the skin of an unborn baby?

[1 mark]

Tick (✓) **one** box.

It is all reflected and none is transmitted. ☐

Some is reflected and some is transmitted. ☐

None is reflected and it is all transmitted. ☐

4 (a) (iii) Give another medical use of ultrasound.

[1 mark]

Tick (✓) **one** box.

breaking up kidney stones ☐

treating cancer ☐

destroying bacteria ☐

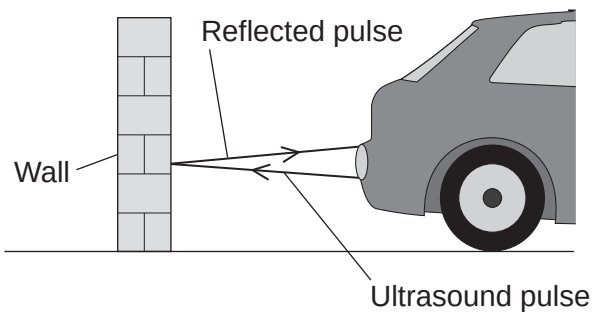
Question 4 continues on the next page

4.5.6.1.2 Speed

Question 97 · continued

4 (b) A parking sensor on the back of a car emits an ultrasound pulse and receives the reflected pulse as shown in **Figure 7**.

Figure 7



Complete the sentence to describe how the time taken for the reflected pulse to return to the car changes as the car moves.

[1 mark]

As the car moves closer to the wall the reflected pulse takes _____ time to return to the car.

4 (c) The parking sensor emits an ultrasound pulse. The reflected pulse is received 0.006 seconds later.

The speed of ultrasound in air is 330 m/s.

Calculate the distance from the car to the wall.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

_____

Distance from the car to the wall = _____ m

4.5.6.1.2 Speed

Question 97 · continued

4 (d) There are four parking sensors spaced equally along the back of the car.

Suggest **one** advantage of using four sensors instead of just using one sensor.

[1 mark]

_____

_____

8

Turn over for the next question

4.5.6.1.2 Speed

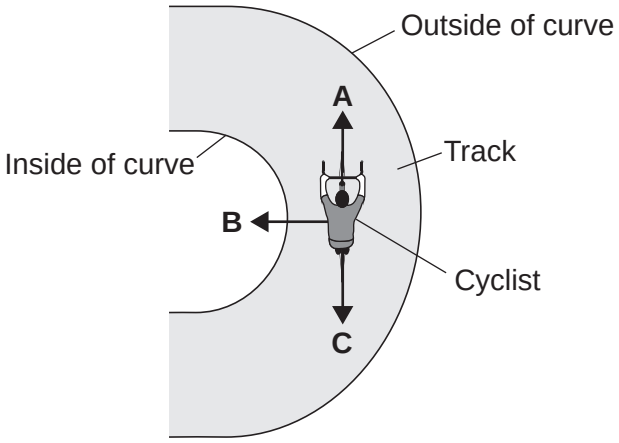
Question 98

June 2017 | PH3FP | Original Q6 | Legacy

6 **Figure 11** shows a cyclist moving at a constant speed around a circular part of a cycle track.

There is a centripetal force acting on the cyclist when he is in the position shown in **Figure 11**.

Figure 11



6 (a) (i) When the cyclist is in the position shown in **Figure 11**, in which direction, **A**, **B** or **C**, does the centripetal force act?

[1 mark]

Direction _____

6 (a) (ii) What effect does the centripetal force have on the cyclist?

[1 mark]

_____

_____

Question 6 continues on the next page

4.5.6.1.2 Speed

Question 98 · continued

6 (b) (i) The cyclist moves around the circular part of the track a second time, at the same speed. This time he is closer to the outside of the bend.

What effect does this have on the centripetal force needed?

[1 mark]

Tick (✓) **one** box.

The centripetal force is bigger. ☐

The centripetal force stays the same. ☐

The centripetal force is smaller. ☐

6 (b) (ii) A second cyclist moves around the circular part of the track. The second cyclist has a greater mass than the first cyclist.

What effect does the greater mass have on the centripetal force needed?

[1 mark]

Tick (✓) **one** box.

The centripetal force is bigger. ☐

The centripetal force stays the same. ☐

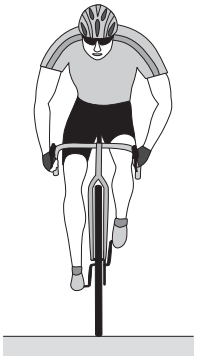
The centripetal force is smaller. ☐

4.5.6.1.2 Speed

Question 98 · continued

6 (c) **Figure 12** shows a stationary cyclist with both feet on the pedals.

Figure 12



Use the correct answers from the box to complete the sentence.

Each answer may be used once, more than once or not at all.

[2 marks]

heavy	high	low	narrow	wide

The cyclist on the stationary bicycle is unstable and is likely to topple over.

This is because the cyclist and bicycle have a _____ centre of mass and a _____ base.

6

4.5.6.1.2 Speed

Question 99

June 2018 | 8463/1F | Original Q1

0 1 **Figure 1** shows a cyclist riding along a flat road.

Figure 1



0 1 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**	**kinetic**

As the cyclist accelerates, the _____ energy store in the cyclist's body decreases and the _____ energy of the cyclist increases.

0 1 . 2 The mass of the cyclist is 80 kg. The speed of the cyclist is 12 m/s.

Calculate the kinetic energy of the cyclist.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

_____

_____

_____

_____

Kinetic energy = _____ J

4.5.6.1.2 Speed

Question 99 · continued

0 1 . 3 When the cyclist uses the brakes, the bicycle slows down.

This causes the temperature of the brake pads to increase by 50 °C.
The mass of the brake pads is 0.040 kg.
The specific heat capacity of the material of the brake pads is 480 J/kg °C.

Calculate the change in thermal energy of the brake pads.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 1 . 4 How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

[1 mark]

- Decreased ☐
- Increased ☐
- Not affected ☐

7

4.5.6.1.2 Speed

Question 100

June 2018 | 8463/2F | Original Q1

0 1 . 1 The Sun is a star.

Which galaxy is the Sun in?

Tick **one** box.

[1 mark]

Cartwheel ☐

Milky Way ☐

Starburst ☐

Tadpole ☐

0 1 . 2 Light takes 500 seconds to travel from the Sun to the Earth.

Light travels at 300 000 kilometres per second.

Calculate the distance between the Sun and the Earth.

Use the equation:

distance = speed × time

[2 marks]

Distance = _____ kilometres

4.5.6.1.2 Speed

Question 100 · continued

Table 1 gives information about some of the planets in our solar system.

The planets are in order of increasing distance from the Sun.

Table 1

Planet	Time to orbit the Sun in years
Mercury	0.2
Venus	0.6
Earth	1.0
Mars	
Jupiter	12.0

0 1 . 3 There are some planets in our solar system missing from **Table 1**.

How many planets are missing?

[1 mark]

0 1 . 4 Estimate how many years it takes Mars to orbit the Sun.

[1 mark]

_____ years

0 1 . 5 Calculate how many times Venus will orbit the Sun in 9 years.

[2 marks]

In 9 years Venus will orbit the Sun _____ times.

7

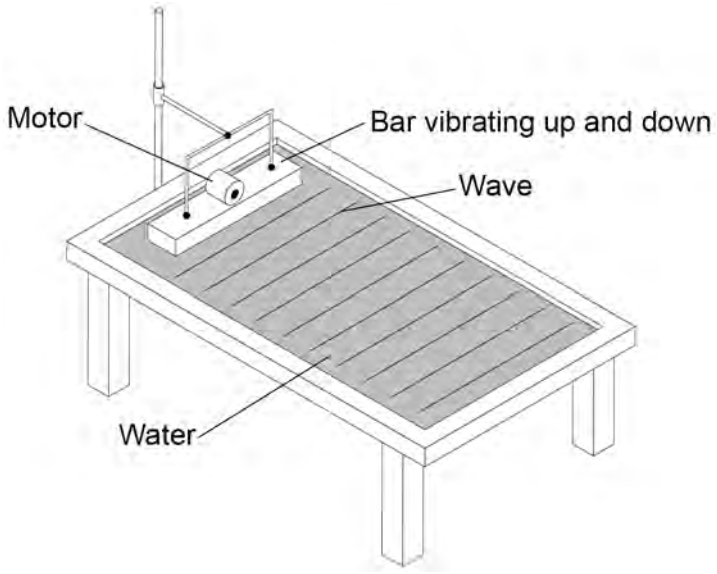
4.5.6.1.2 Speed

Question 101

June 2018 | 8463/2F | Original Q3

0 3 **Figure 2** shows a ripple tank that a student used to investigate water waves.

Figure 2



0 3 . 1 The student adjusted the speed of the motor so that the bar hit the water more times each second.

What happened to the frequency of the waves produced?

Tick **one** box.

[1 mark]

Decreased ☐

Did not change ☐

Increased ☐

0 3 . 2 Describe how the frequency of the water waves in the ripple tank can be measured.

[2 marks]

4.5.6.1.2 Speed

Question 101 · continued

0 3 . 3 The student measured the frequency of the water waves as 5 hertz.

Calculate the period of the water waves.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

Choose the unit.

metres	**metres / second**	**seconds**

[3 marks]

Period = _____ Unit _____

6

4.5.6.1.2 Speed

Question 102

June 2018 | 8463/2F | Original Q12

1 2 P-waves and S-waves are two types of seismic wave caused by earthquakes.

1 2 . 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. ☐

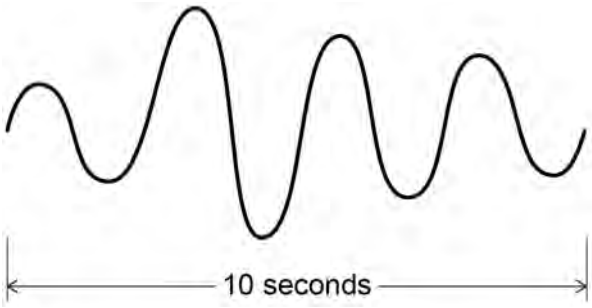
P-waves are transverse and S-waves are longitudinal. ☐

P-waves are longitudinal and S-waves are transverse. ☐

Seismometers on the Earth's surface record the vibrations caused by seismic waves.

Figure 16 shows the vibration recorded by a seismometer for one P-wave.

Figure 16



1 2 . 2 Calculate the frequency of the P-wave shown in **Figure 16**.

[1 mark]

Frequency = _____ Hz

4.5.6.1.2 Speed

Question 102 · continued

June 2018 | 8463/2F | Original Q12

12.3 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

12.4 The P-wave shown in **Figure 16** is travelling at 7200 m/s.

Calculate the wavelength of the P-wave.

[3 marks]

Wavelength = _____ m

12.5 Explain why the study of seismic waves provides evidence for the structure of the Earth's core.

[2 marks]

8

4.5.6.1.2 Speed

Question 103

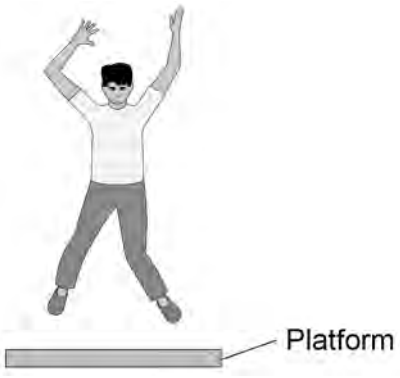
June 2019 | 8463/1F | Original Q11

1 1 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 18 shows a volunteer taking part in the experiment.

Figure 18



An electronic timer measured the time that the volunteer was in the air.

1 1 . 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

Question 103 · continued

1 1 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

1 1 . 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.

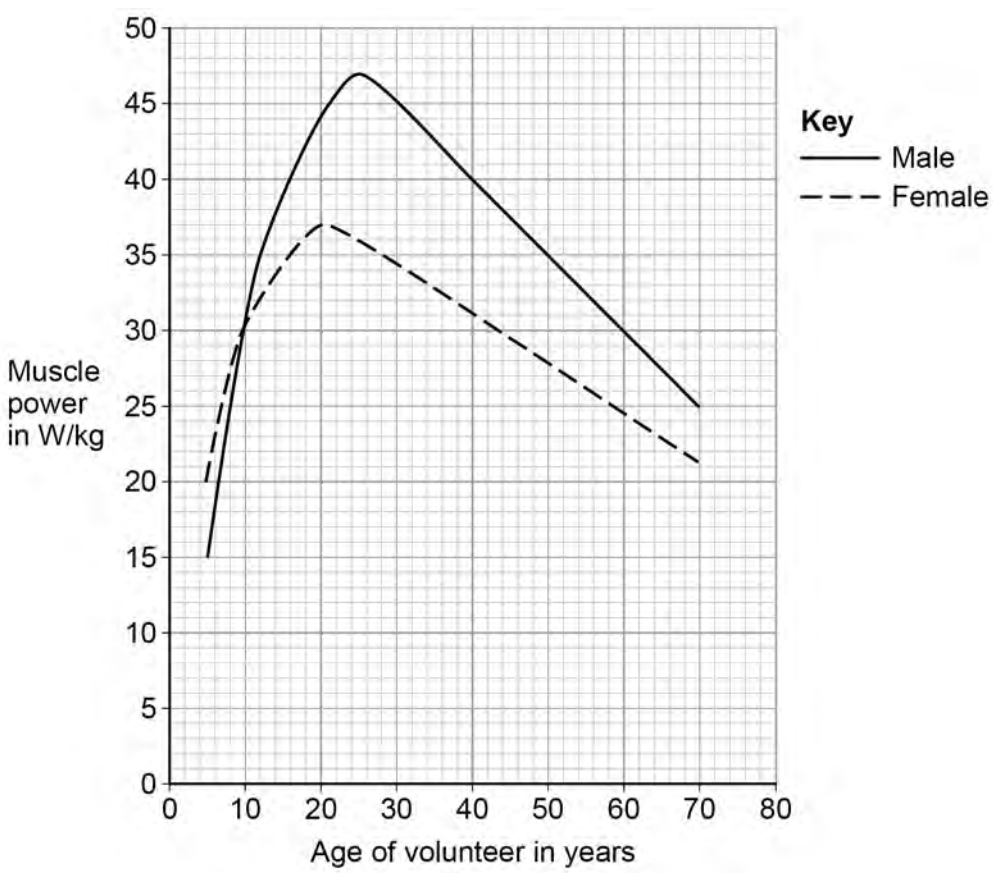
Calculate his mass.

[3 marks]

Mass = _____ kg

Figure 19 shows the scientist's results.

Figure 19



4.5.6.1.2 Speed

Question 103 · continued

1 1 . 4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 19** in your answer.

[4 marks]

1 1 . 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]

1

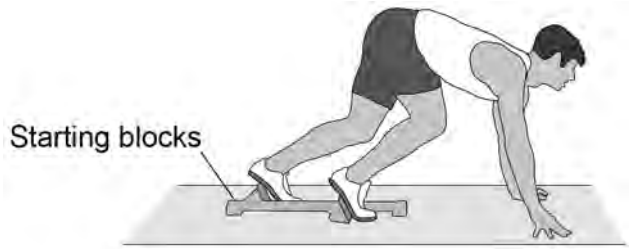
4.5.6.1.2 Speed

Question 104

June 2019 | 8463/2F | Original Q1

0 1 **Figure 1** shows an athlete on starting blocks waiting to start a 100 metre race.

Figure 1



0 1 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

equal to	**greater than**	**less than**

The force from the athlete pushing backwards on the starting blocks

is _____ the force from the starting

blocks pushing forwards on the athlete.

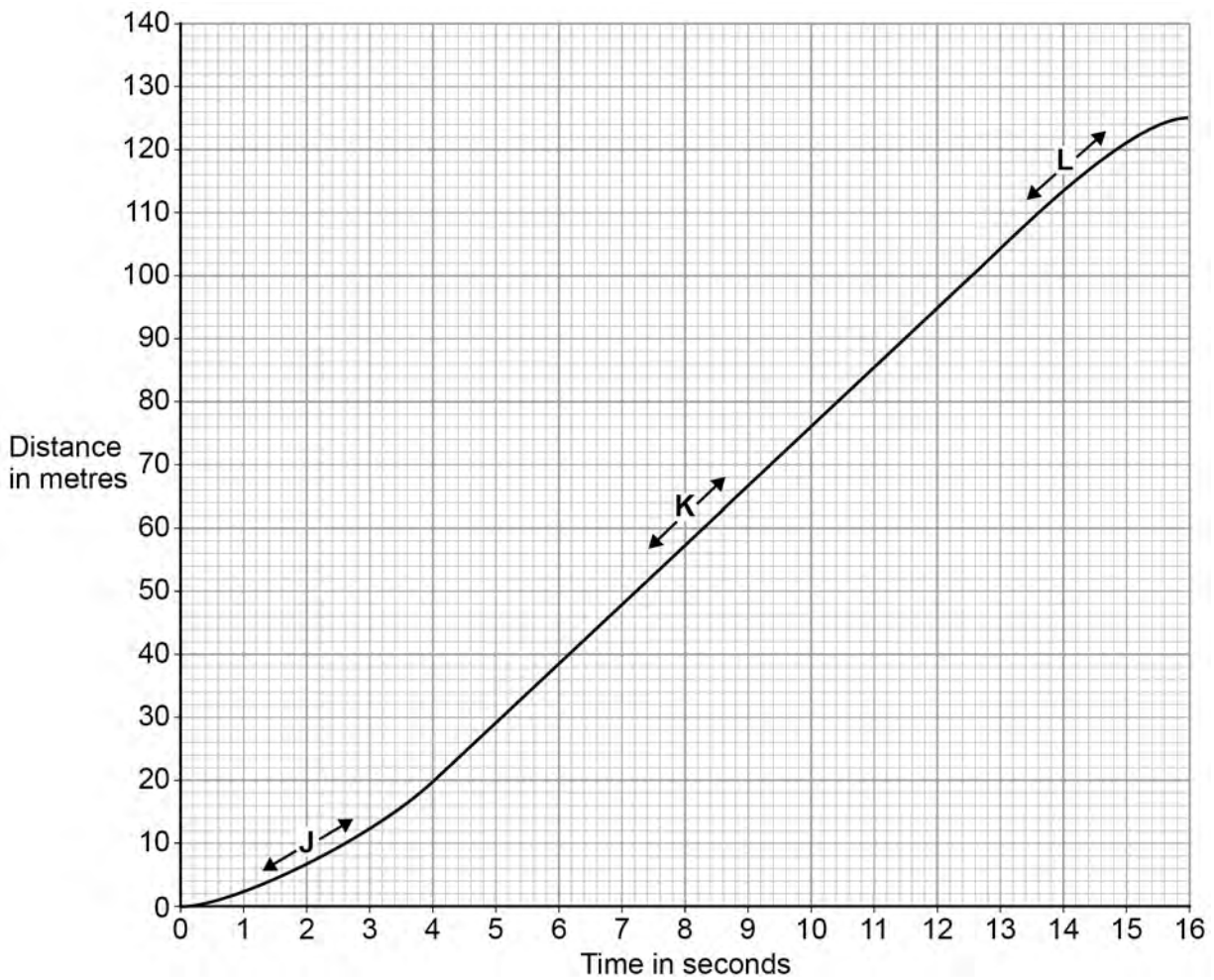
Question 1 continues on the next page

4.5.6.1.2 Speed

Question 104 · continued

Figure 2 shows a distance-time graph for the athlete from the moment the race starts.

Figure 2



4.5.6.1.2 Speed

Question 104 · continued

0 1 . 2 Three parts of the distance-time graph are labelled **J**, **K** and **L**.

Draw **one** line from **each** of the labels to the correct description of the athlete's motion for that part of the graph.

[2 marks]

Labels	Description of motion
J	not moving
K	constant speed
L	decreasing speed
	increasing speed

0 1 . 3 What distance does the athlete travel after the end of the race before stopping?

[1 mark]

Distance = _____ m

0 1 . 4 Calculate the average speed of the athlete between the start and finish of the 100 metre race.

Use the equation:

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

[2 marks]

_____

_____

_____

Average speed = _____ m/s

4.5.6.1.2 Speed

Question 104 · continued

0 1 . 5 The athlete runs faster than a typical person.

What is the average running speed of a typical person in metres per second?

[1 mark]

Tick (✓) **one** box.

1.5 ☐

3.0 ☐

4.5 ☐

6.0 ☐

7

4.5.6.1.2 Speed

Question 105

June 2019 | 8463/2F | Original Q2

0 2 Most galaxies are moving away from the Earth. Scientists can determine the speed of a galaxy by observing the light from the galaxy.

0 2 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

frequency	**speed**	**wavelength**

When scientists observe the light from distant galaxies, they observe an increase in the _____ of light from those galaxies.

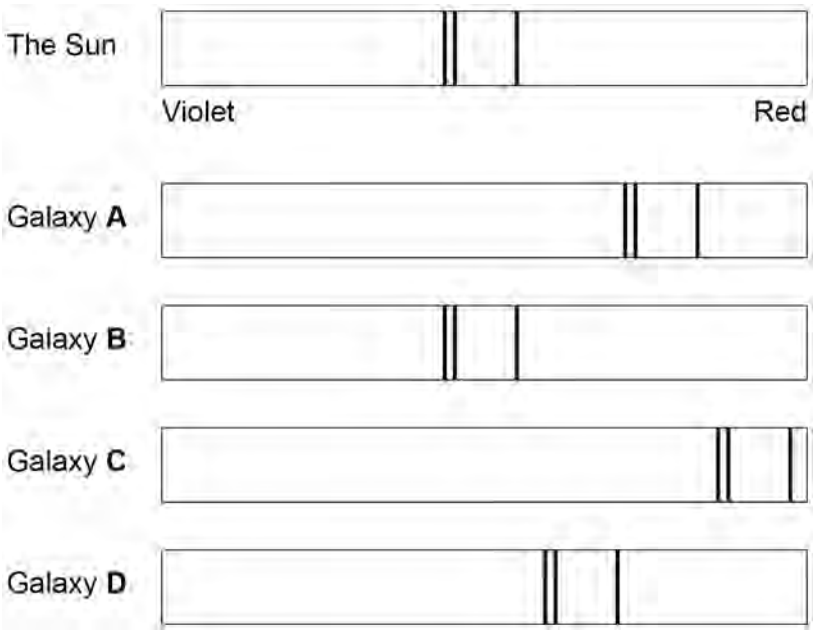
Question 105 · continued

The light spectra from stars and galaxies include dark lines.

The lines have the same pattern.

Figure 3 shows the light spectrum from the Sun and from four galaxies.

Figure 3



0 2 . 2 Which galaxy is moving the fastest away from the Earth?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 3 Which galaxy is the furthest away from the Earth?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

4.5.6.1.2 Speed

Question 105 · continued

0 2 . 4 The Big Bang theory is one way to explain the origin of the universe.

How does the Big Bang theory describe the universe when it began?

[1 mark]

Tick (✓) **one** box.

- Very big and very dense ☐
- Very big and extremely hot ☐
- Very dense and extremely hot ☐
- Very small and extremely cold ☐

0 2 . 5 Which statement about the Big Bang theory is correct?

[1 mark]

Tick (✓) **one** box.

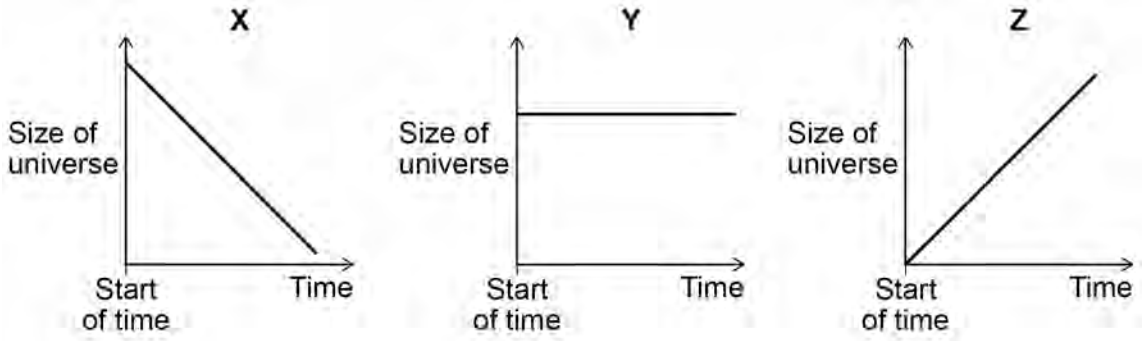
- Scientists have proved that the theory is correct. ☐
- Scientific evidence supports the theory. ☐
- There is no other way to explain the origin of the universe. ☐

4.5.6.1.2 Speed

Question 105 · continued

0 2 . 6 **Figure 4** shows three ways that the size of the universe may have changed with time.

Figure 4



Which graph would the Big Bang theory suggest is correct?

[2 marks]

Tick (✓) **one** box.

X ☐ Y ☐ Z ☐

Give a reason for your answer.

_____

_____

7

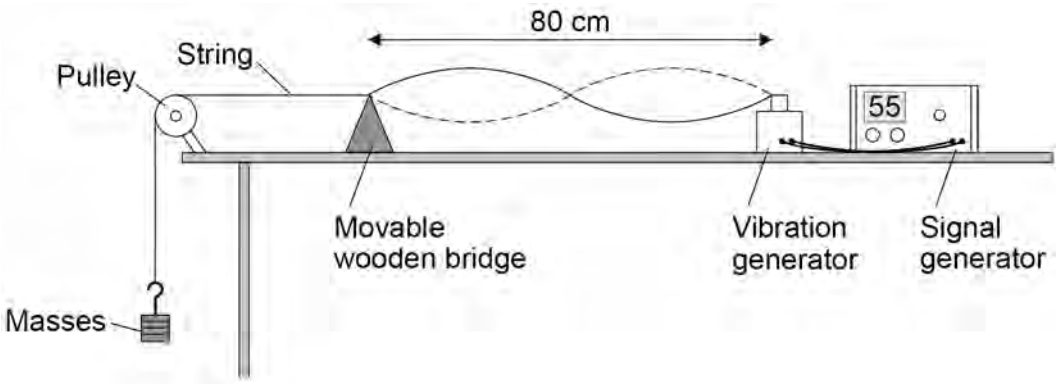
4.5.6.1.2 Speed

Question 106

June 2019 | 8463/2F | Original Q9

0 9 **Figure 23** shows the apparatus used to investigate the waves in a stretched string.

Figure 23



The frequency of the signal generator is adjusted so that the wave shown in **Figure 23** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 23**.

0 9 . 1 The wavelength of the wave shown in **Figure 23** was measured as 80 cm

What piece of apparatus would have been suitable for measuring this wavelength?

[1 mark]

0 9 . 2 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

0 9 . 3 The string in **Figure 23** vibrates at 55 Hz

Calculate the wave speed of the wave shown in **Figure 23**.

Use data given in **Figure 23**.

[3 marks]

Wave speed = _____ m/s

4.5.6.1.2 Speed

Question 106 · continued

0 9 . 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 9 . 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 23**.

Describe a method the student could use for this investigation.

[4 marks]

11

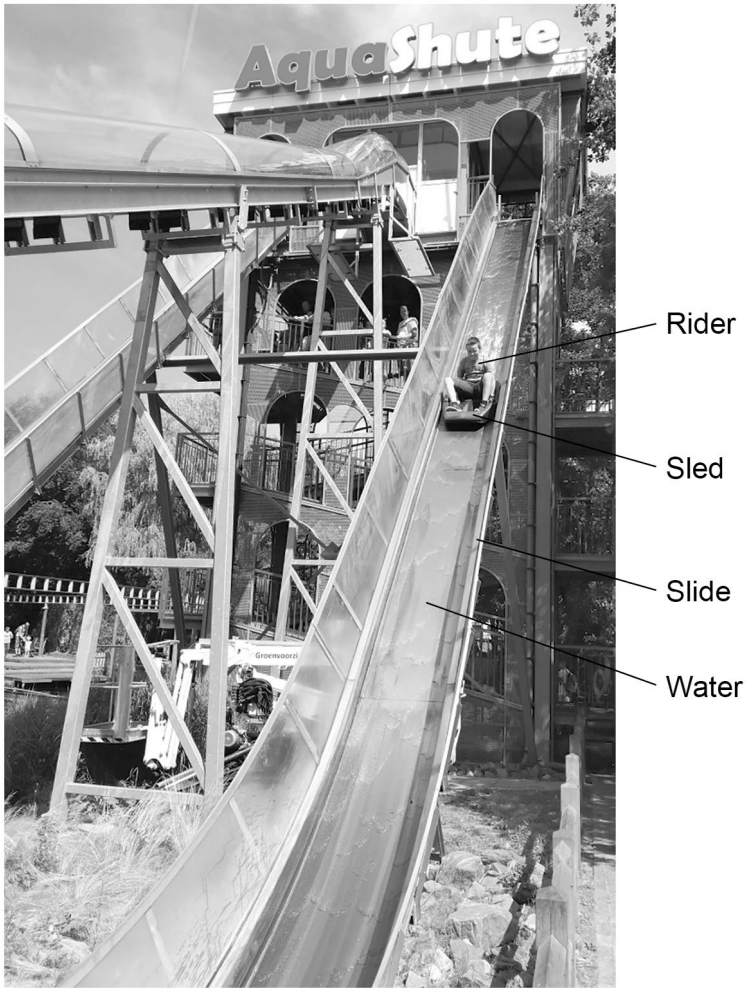
4.5.6.1.2 Speed

Question 107

November 2020 | 8463/1F | Original Q2

0 2 **Figure 4** shows a theme park ride called AquaShute.

Figure 4



0 2 . 1 Riders of the AquaShute sit on a sled and move down a slide.

There is a layer of water between the sled and the slide.

How does the layer of water affect the friction between the sled and the slide?

[1 mark]

Tick (✓) **one** box.

The friction is decreased. ☐

The friction is increased. ☐

The friction is not affected. ☐

4.5.6.1.2 Speed

Question 107 · continued

0 2 . 2 The mass of one rider is 62.5 kg.

The height of the slide is 16.0 m.

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the rider at the top of the slide.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

0 2 . 3 At the bottom of the slide the speed of the rider is 12 m/s.

The mass of the rider is 62.5 kg.

Calculate the kinetic energy of the rider at the bottom of the slide.

Use the equation:

kinetic energy = 0.5 × mass × $(\text{speed})^2$

[2 marks]

Kinetic energy = _____ J

Question 2 continues on the next page

4.5.6.1.2 Speed

Question 107 · continued

0 2 . 4 When a rider reaches the bottom of the slide, the sled decelerates and stops.

Give **two** factors that will affect how far the sled will move before it stops.

[2 marks]

1 _____

_____

2 _____

_____

7

4.5.6.1.2 Speed

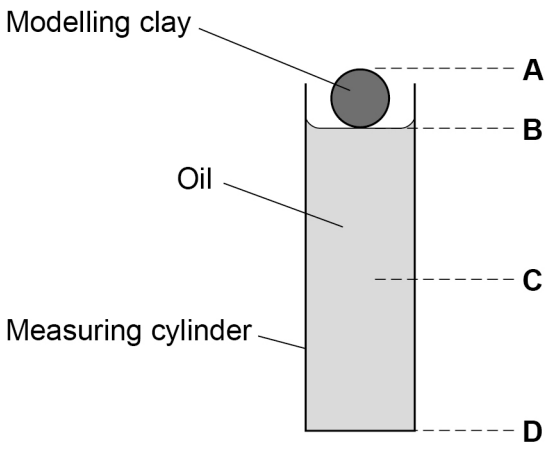
Question 108

November 2020 | 8463/2F | Original Q1

0 1 A student dropped a piece of modelling clay into oil.

Figure 1 shows the modelling clay just before it was dropped into the oil.

Figure 1



0 1 . 1 What was the distance fallen by the modelling clay?

[1 mark]

Tick (✓) **one** box.

from A to C ☐

from A to D ☐

from B to C ☐

from B to D ☐

0 1 . 2 What measuring instrument should be used to measure the distance fallen?

[1 mark]

_____

Question 1 continues on the next page

Question 108 · continued

The student dropped four pieces of modelling clay, each with a different shape.

For each piece the student measured the time taken to fall the same distance through the oil.

0 1 . 3 The student removed each piece of modelling clay from the oil before dropping the next piece.

Suggest **one** reason why.

[1 mark]

The student repeated the measurements and calculated mean values.

Table 1 shows the results.

Table 1

Shape	Time taken in seconds			
	Drop 1	Drop 2	Drop 3	Mean
 Sphere	47	38	41	42
 Cube	68	49	57	58
 Cylinder	34	37	34	**X**
 Cone	29	23	26	26

0 1 . 4 Calculate value **X** in **Table 1**.

[2 marks]

X = _____ s

4.5.6.1.2 Speed

Question 108 · continued

0 1 . 5 Each piece of modelling clay had the same mass.

Which shape in **Table 1** had the smallest resistive force acting against it as it fell?

Tick (✓) **one** box.

Give **one** reason for your answer.

[2 marks]

Cone ☐

Cube ☐

Cylinder ☐

Sphere ☐

Reason _____

_____

0 1 . 6 How would the time taken to fall change if the modelling clay was dropped through air instead of through oil?

[1 mark]

Tick (✓) **one** box.

Time through air would be less. ☐

Time through air would be more. ☐

Time through air would be the same. ☐

Question 1 continues on the next page

Question 108 · continued

0 1 . 7 The mass of a piece of modelling clay was 0.050 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the piece of modelling clay.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 1 . 8 Weight causes the modelling clay to fall through the oil.

Weight is a non-contact force.

Which of the following are also non-contact forces?

Tick (✓) **two** boxes.

[2 marks]

- Air resistance ☐
- Electrostatic force ☐
- Friction ☐
- Magnetic force ☐
- Tension ☐

12

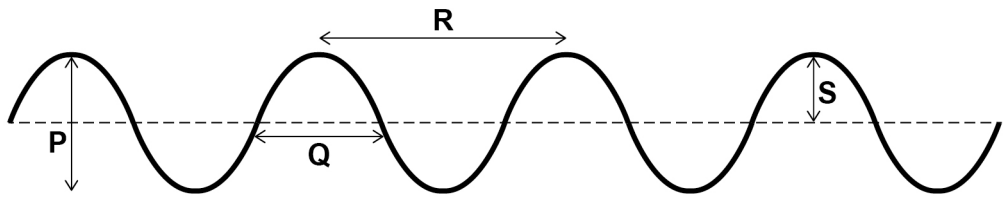
4.5.6.1.2 Speed

Question 109

November 2020 | 8463/2F | Original Q3

0 3 **Figure 2** shows some waves.

Figure 2



0 3 . 1 Which arrow represents the wavelength of the waves?

[1 mark]

Tick (✓) **one** box.

P ☐

Q ☐

R ☐

S ☐

0 3 . 2 Which arrow represents the amplitude of the waves?

[1 mark]

Tick (✓) **one** box.

P ☐

Q ☐

R ☐

S ☐

4.5.6.1.2 Speed

Question 109 · continued

0 3 . 3 The waves have a frequency of 0.20 hertz.

Calculate the period of the waves.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

Period = _____ s

0 3 . 4 The frequency of the waves is increased. The speed of the waves stays the same.

What happens to the wavelength of the waves?

[1 mark]

Tick (✓) **one** box.

- The wavelength decreases. ☐
- The wavelength increases. ☐
- The wavelength stays the same. ☐

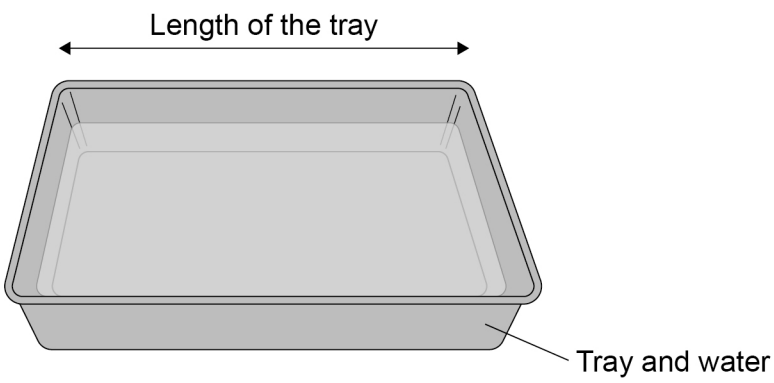
Question 3 continues on the next page

Question 109 · continued

A student investigated how the speed of water waves is affected by the depth of water in a tray.

Figure 3 shows some water in a rectangular tray.

Figure 3



The student lifted one end of the tray and then dropped it.

This made a wave which travelled the length of the tray.

0 3 . 5 The student measured the length of the tray.

What else should the student measure in order to calculate the speed of the wave?

[1 mark]

Tick (✓) **one** box.

- Area of the bottom of the tray ☐
- Depth of water in the tray ☐
- Temperature of the water in the tray ☐
- Time taken by the wave to travel the length of the tray ☐

4.5.6.1.2 Speed

Question 109 · continued

0 3 . 6 What was the independent variable in this investigation?

[1 mark]

Depth of water ☐

Length of tray ☐

Speed of waves ☐

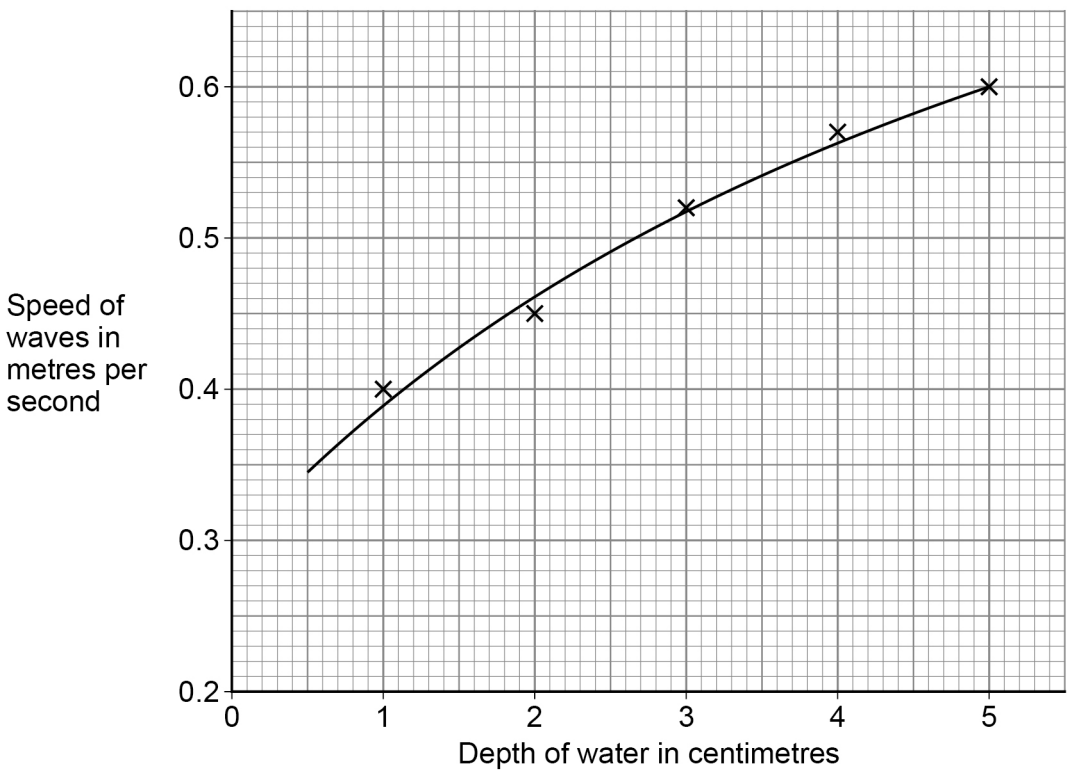
Question 3 continues on the next page

4.5.6.1.2 Speed

Question 109 · continued

Figure 4 shows the results.

Figure 4



0 3 . 7 Give **one** conclusion that can be made from **Figure 4**.

[1 mark]

0 3 . 8 What was the speed of a wave when the depth of water was 2.5 cm?

[1 mark]

Speed of wave = _____ m/s

9

4.5.6.1.2 Speed

Question 110

November 2020 | 8463/2F | Original Q7

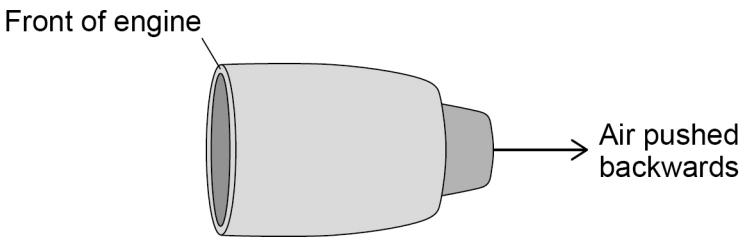
0 7 . 1 An aircraft travels at a constant velocity.

How is the velocity of the aircraft different to the speed of the aircraft?

[1 mark]

0 7 . 2 **Figure 11** shows one of the engines on the aircraft.

Figure 11



Air is taken into the front of the engine and pushed out of the back of the engine.

Explain the effect this has on the engine.

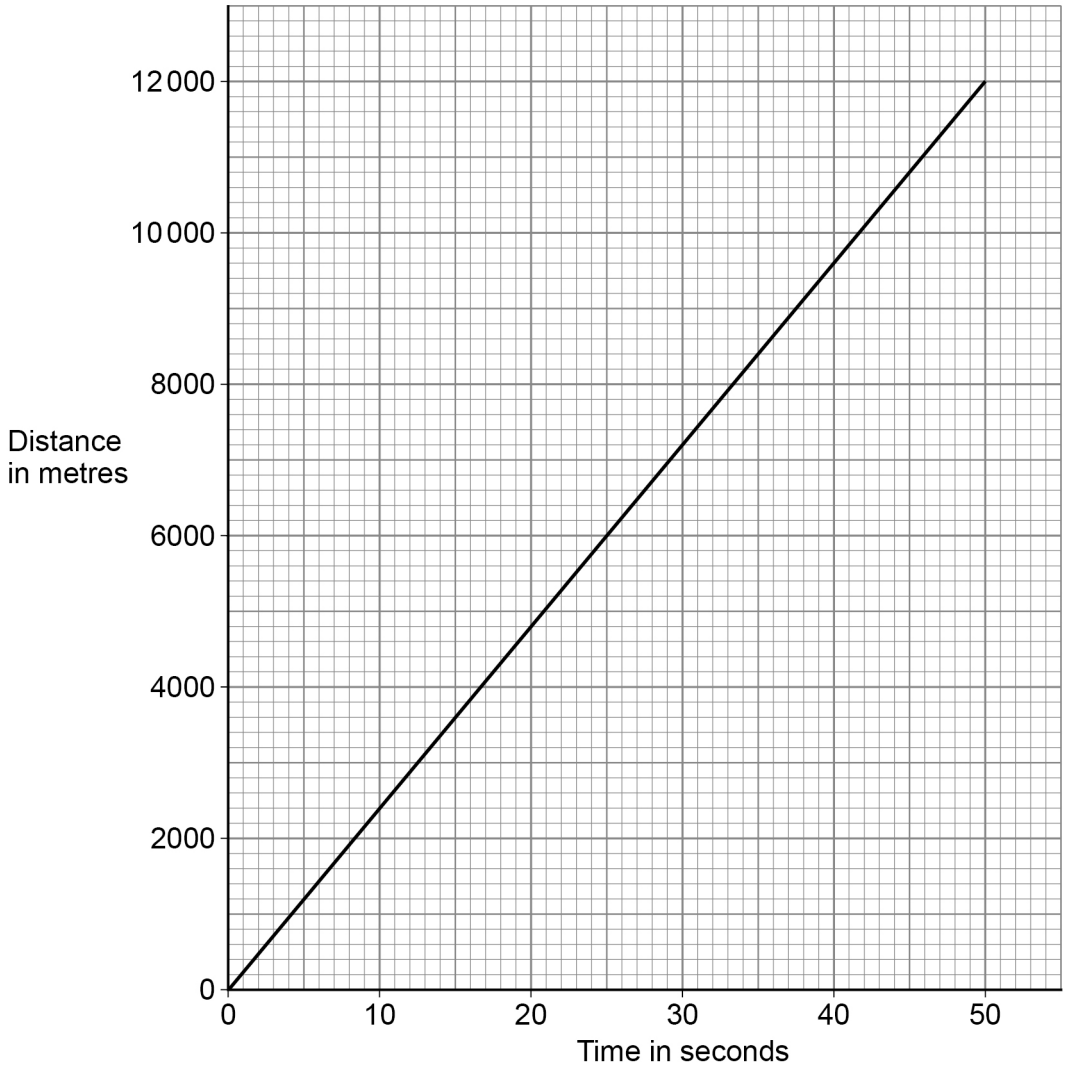
[2 marks]

4.5.6.1.2 Speed

Question 110 · continued

0 7 . 3 **Figure 12** shows a distance-time graph for the aircraft.

Figure 12



Determine the speed of the aircraft.

[3 marks]

Speed = _____ m/s

Question 7 continues on the next page

4.5.6.1.2 Speed

Question 110 · continued

0 7 . 4 Write down the equation that links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 7 . 5 At a different stage of the flight, the aircraft was travelling at a velocity of 250 m/s.

The aircraft then decelerated at 0.14 m/s^2.

Calculate the time taken for the aircraft to decelerate from 250 m/s to 68 m/s.

[4 marks]

Time = _____ s

4.5.6.1.2 Speed

Question 110 · continued

0 7 . 6 Write down the equation that links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 7 . 7 When the aircraft landed, it travelled 2000 m before stopping.

The work done to stop the aircraft was 140 000 000 J.

Calculate the mean force used to stop the aircraft.

[3 marks]

Mean force = _____ N

15

4.5.6.1.2 Speed

Question 111

November 2020 | 8463/2F | Original Q9

0 9 . 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 9 . 2 Write down the equation that links distance travelled (s), speed (v) and time (t).

[1 mark]

_____

0 9 . 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

Question 9 continues on the next page

4.5.6.1.2 Speed

Question 111 · continued

0 9 . 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]

4.5.6.1.2 Speed

Question 111 · continued

0 9 . 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

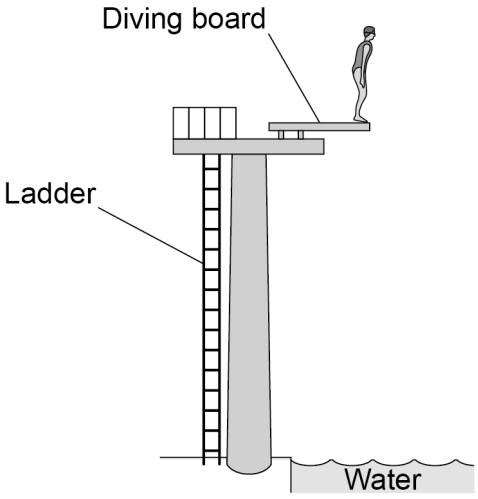
4.5.6.1.2 Speed

Question 112

November 2021 | 8463/1F | Original Q7

0 7 **Figure 11** shows a diver about to dive off a diving board.

Figure 11



0 7 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

elastic potential	**gravitational potential**	**kinetic**	**nuclear**

As the diver falls towards the water there is a decrease in

her _____ energy.

As the diver falls towards the water there is an increase in

her _____ energy.

4.5.6.1.2 Speed

Question 112 · continued

0 7 . 2 Write down the equation which links kinetic energy (E_k), mass (m) and speed (v).

[1 mark]

0 7 . 3 At the instant the diver hits the water, the kinetic energy of the diver is 5040 J.

The speed of the diver is 12 m/s.

Calculate the mass of the diver.

[3 marks]

Mass = _____ kg

0 7 . 4 Most of the kinetic energy of the diver is transferred to the water.

How does this affect the thermal energy of the water?

[1 mark]

Tick (✓) **one** box.

The thermal energy decreases. ☐

The thermal energy stays the same. ☐

The thermal energy increases. ☐

7

4.5.6.1.2 Speed

Question 113

November 2021 | 8463/2F | Original Q1

0 1 **Figure 1** shows a water wave.

Figure 1



0 1 . 1 What type of wave is a water wave?

[1 mark]

Tick (✓) **one** box.

Electromagnetic ☐

Longitudinal ☐

Transverse ☐

0 1 . 2 Which statement describes the movement of the water at point **X**?

[1 mark]

Tick (✓) **one** box.

The water at point **X** does **not** move. ☐

The water at point **X** moves to the left and right. ☐

The water at point **X** moves up and down. ☐

4.5.6.1.2 Speed

Question 113 · continued

0 1 . 3 The wave has a frequency of 2.0 hertz.

The wavelength is 0.032 metres.

Calculate the wave speed.

Use the equation:

wave speed = frequency × wavelength

Choose the unit from the box.

[3 marks]

m^2/s	**m/s**	**s^2**

Wave speed = _____ Unit _____

0 1 . 4 What is transferred by all waves?

[1 mark]

Tick (✓) **one** box.

- Energy ☐
- Information ☐
- Water ☐

Question 1 continues on the next page

4.5.6.1.2 Speed

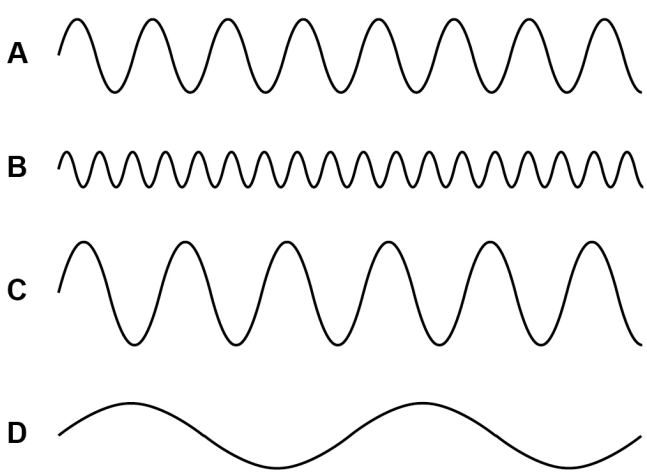
Question 113 · continued

Figure 2 shows four water waves.

The waves are all drawn to the same scale.

The waves all travel at the same speed.

Figure 2



0 1 . 5 Which wave has the longest wavelength?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 6 Which wave has the highest frequency?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

8

4.5.6.1.2 Speed

Question 114

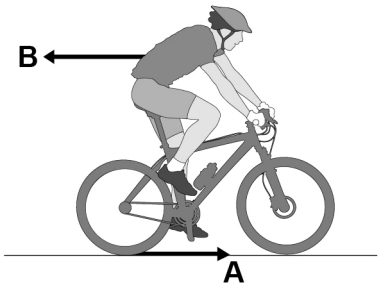
November 2021 | 8463/2F | Original Q2

0 2 **Figure 3** shows a cyclist on a bicycle.

The cyclist is moving at a constant velocity.

Arrows **A** and **B** represent the horizontal forces acting on the bicycle and cyclist.

Figure 3



0 2 . 1 What is force **A**?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Friction ☐
- Tension ☐
- Upthrust ☐

4.5.6.1.2 Speed

Question 114 · continued

0 2 . 2 What is force **B**?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Magnetic ☐
- Tension ☐
- Upthrust ☐

0 2 . 3 What is the relationship between force **A** and force **B** when the cyclist travels at a constant velocity?

[1 mark]

Tick (✓) **one** box.

- **A = B** ☐
- **A > B** ☐
- **A < B** ☐

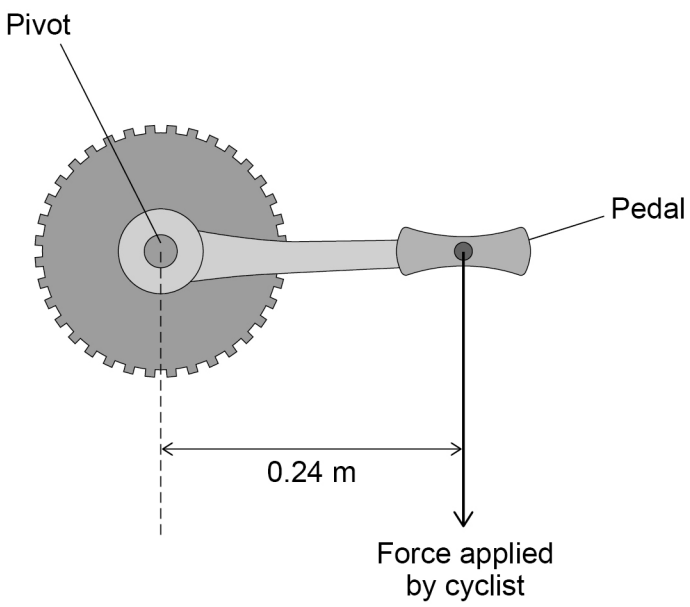
Question 2 continues on the next page

4.5.6.1.2 Speed

0 2 . 4 The cyclist applies a force of 150 N to one of the bicycle pedals.

Figure 4 shows the distance between the force applied and the pivot.

Figure 4



Calculate the moment about the pivot caused by the force applied to the pedal in **Figure 4**.

Use the equation:

moment of a force = force × distance

[2 marks]

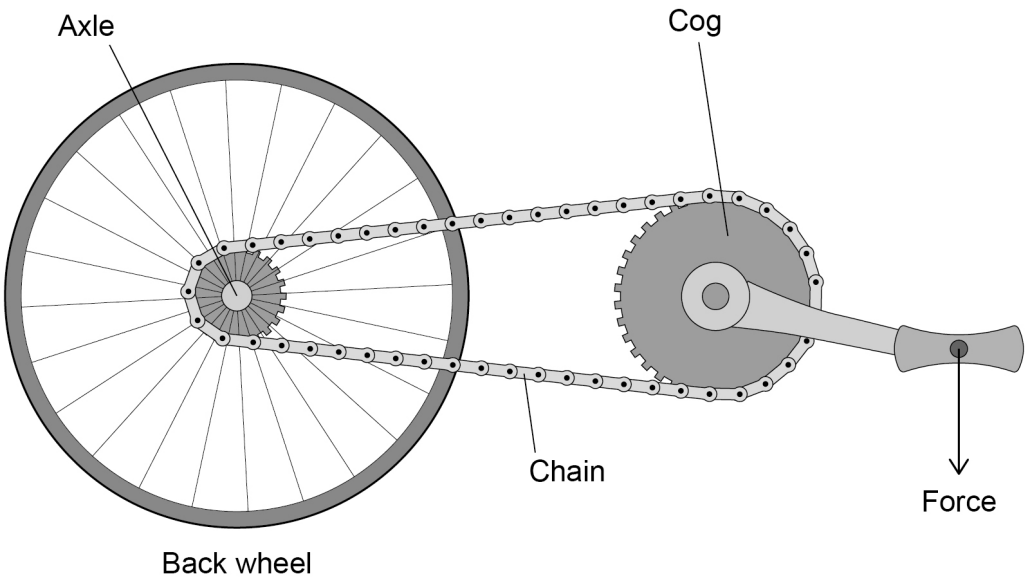
Moment = _____ N m

4.5.6.1.2 Speed

Question 114 · continued

0 2 . 5 **Figure 5** shows how the pedal is connected to the back wheel of the bicycle.

Figure 5



Complete the sentence.

Choose the answer from the box.

[1 mark]

axle	**chain**	**cog**

The force from the cyclist pushing down on the pedal is transmitted to the back wheel by the _____ .

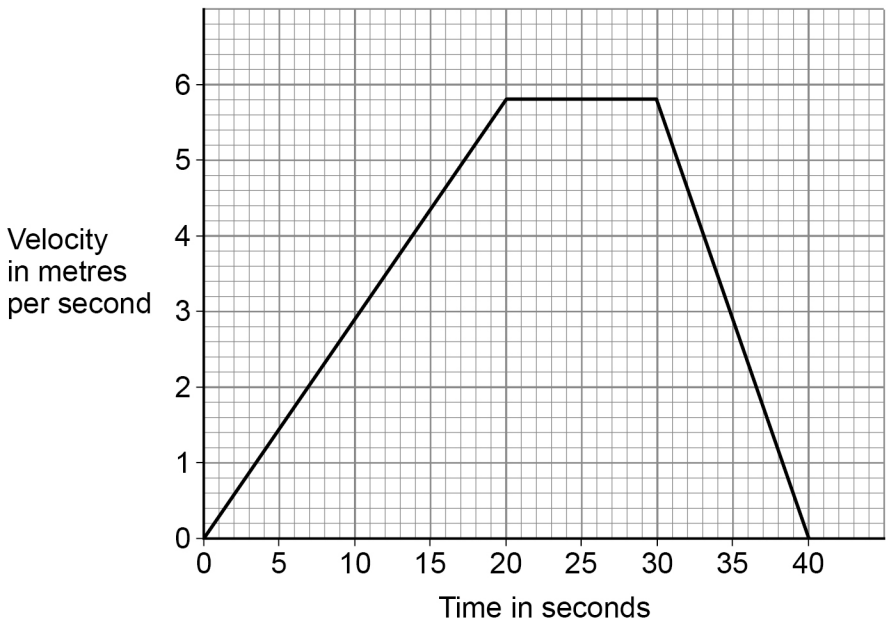
Question 2 continues on the next page

4.5.6.1.2 Speed

Question 114 · continued

Figure 6 shows how the velocity of the cyclist changes during a journey.

Figure 6



0 2 . 6 What is the change in velocity of the cyclist in the first 20 seconds of the journey?

[1 mark]

Tick (✓) **one** box.

5.2 m/s ☐

5.4 m/s ☐

5.6 m/s ☐

5.8 m/s ☐

4.5.6.1.2 Speed

Question 114 · continued

0 2 . 7 Determine the acceleration of the cyclist during the first 20 seconds of the journey.

Use your answer from Question **02.6**

Use the equation:

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

[2 marks]

Acceleration of the cyclist = _____ m/s^2

0 2 . 8 Complete the sentence.

Choose the answer from the box.

[1 mark]

deceleration	**speed**	**velocity**

Between 30 and 40 seconds the cyclist moves with

a constant _____ .

Question 2 continues on the next page

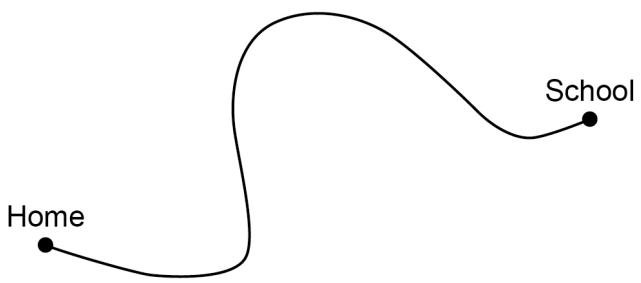
4.5.6.1.2 Speed

Question 114 · continued

0 2 . 9 The cyclist travels from home to school.

Figure 7 shows the route the cyclist followed.

Figure 7



Draw an arrow on **Figure 7** to show the displacement of the cyclist.

[1 mark]

11

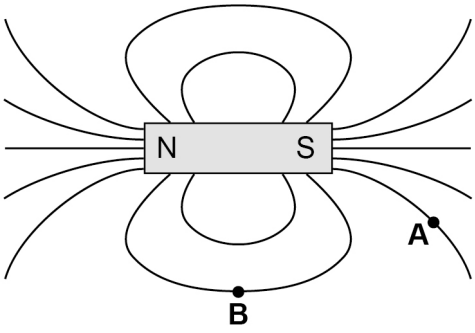
4.5.6.1.2 Speed

Question 115

November 2021 | 8463/2F | Original Q7

0 7 **Figure 16** shows the magnetic field pattern around a bar magnet.

Figure 16



0 7 . 1 Draw an arrow at point **A** and point **B** to show the direction of the magnetic field at each point.

[1 mark]

0 7 . 2 A bar magnet produces its own magnetic field.

Complete the sentence.

Choose the answer from the box.

[1 mark]

an electromagnet	**an induced magnet**	**a permanent magnet**

A bar magnet is an example of _____ .

4.5.6.1.2 Speed

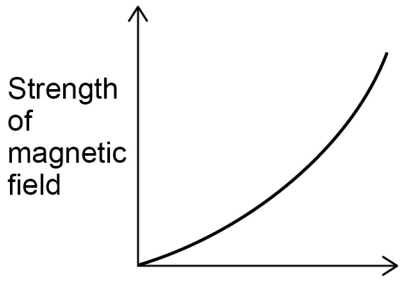
Question 115 · continued

0 7 . 3 Which graph shows how the strength of the magnetic field varies with distance from the bar magnet?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.



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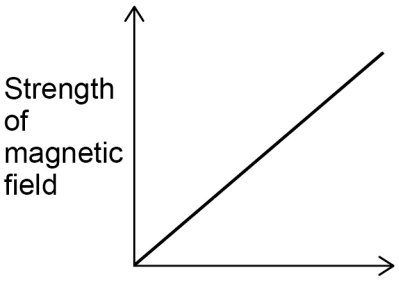

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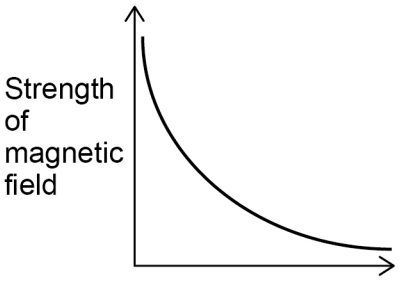


☐

Reason _____

_____

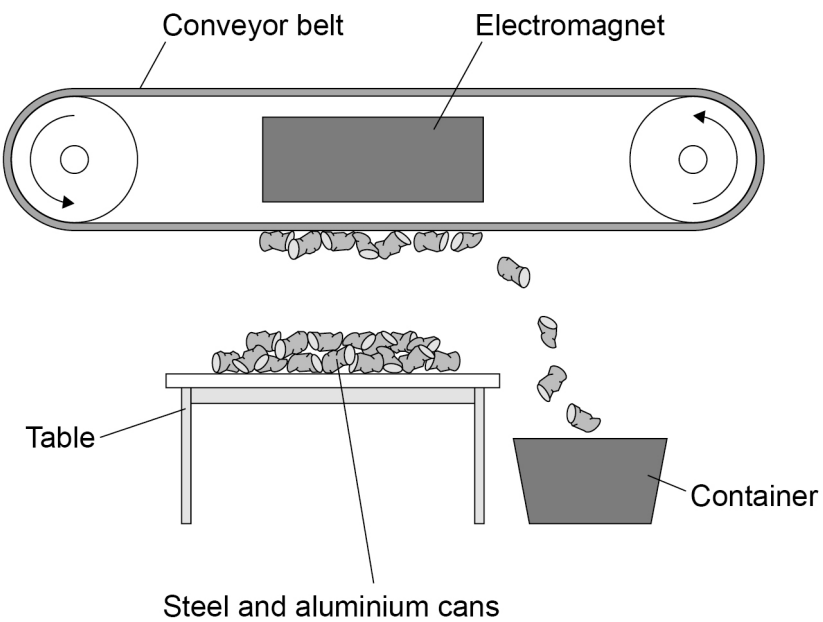
Question 7 continues on the next page

4.5.6.1.2 Speed

Question 115 · continued

Figure 17 shows an electromagnet being used to separate aluminium cans from steel cans.

Figure 17



0 7 . 4 Explain how the electromagnet and conveyor belt are used to separate the steel cans from the aluminium cans.

[2 marks]

4.5.6.1.2 Speed

Question 115 · continued

0 7 . 5 At the top of the table the strength of the magnetic field is only just enough to pick the cans up.

Describe **two** ways to increase the strength of magnetic field at the top of the table.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 6 Write down the equation which links distance travelled (*s*), speed (*v*) and time (*t*).

[1 mark]

_____

0 7 . 7 The conveyor belt moves a can at a speed of 1.7 m/s.

Calculate the time taken to move the can 3.3 m at this speed.

Give your answer to 2 significant figures.

[4 marks]

_____

_____

_____

_____

_____

Time taken (2 significant figures) = _____ s

13

4.5.6.1.2 Speed

Question 116

November 2021 | 8463/2F | Original Q8

0 8 The thinking distance and braking distance for a car vary with the speed of the car.

0 8 . 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 8 continues on the next page

4.5.6.1.2 Speed

Question 116 · continued

0 8 . 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 8 . 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]

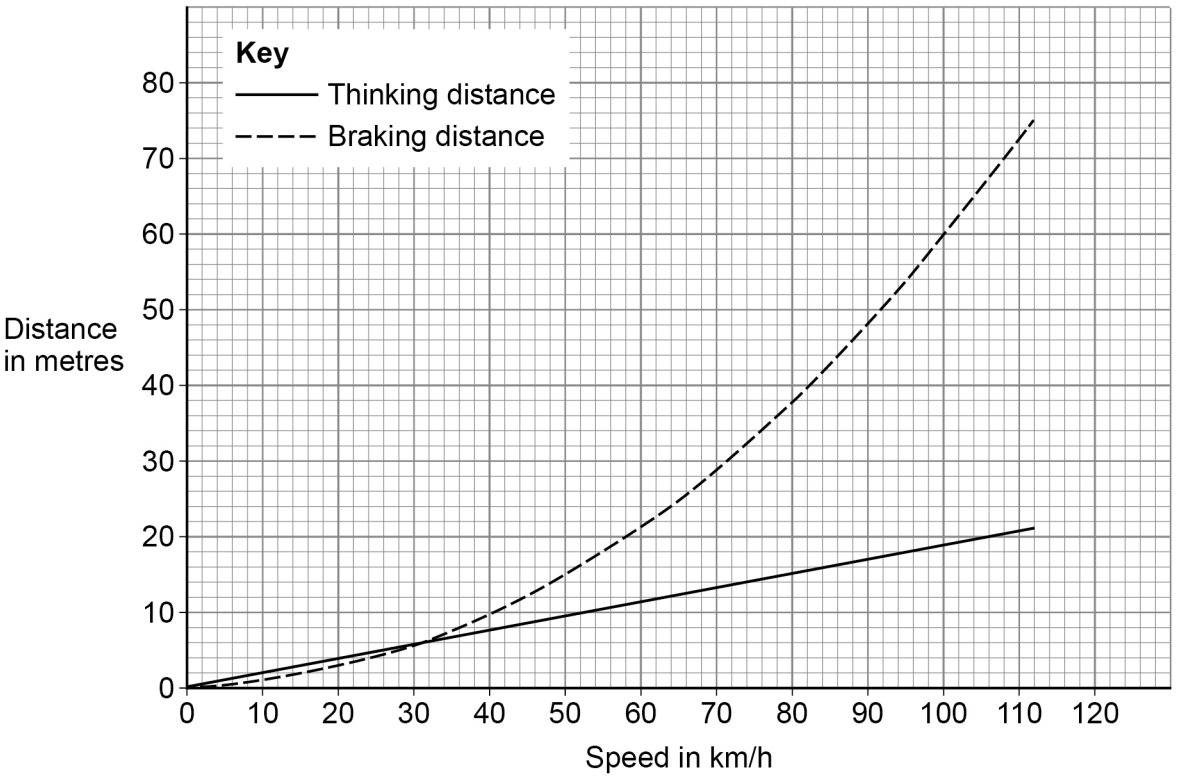
Deceleration = _____ m/s^2

4.5.6.1.2 Speed

Question 116 · continued

0 8 . 4 **Figure 18** shows how the thinking distance and braking distance for a car vary with the speed of the car.

Figure 18



Determine the stopping distance when the car is travelling at 80 km/h.

[2 marks]

Stopping distance = _____ m

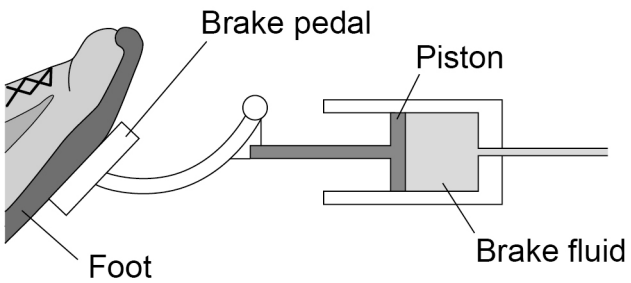
Question 8 continues on the next page

4.5.6.1.2 Speed

Question 116 · continued

Figure 19 shows part of the braking system for a car.

Figure 19



0 8 . 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 116 · continued

0 8 . 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

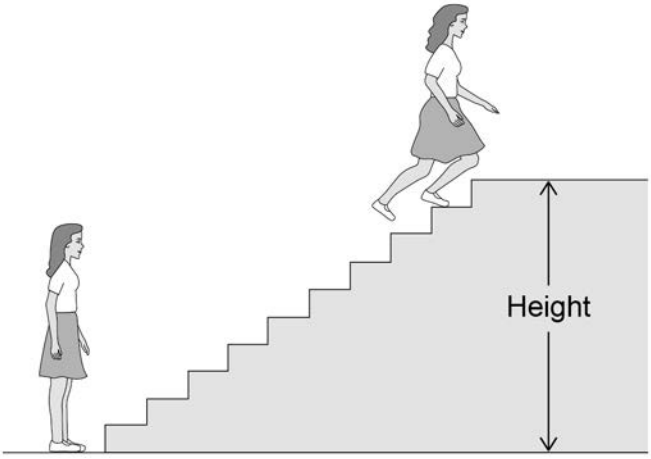
Question 117

June 2022 | 8463/1F | Original Q2

0 2 A girl ran to the top of some stairs.

Figure 2 shows the stairs.

Figure 2



0 2 . 1 The girl measured the height of the stairs.

What measuring instrument should she have used?

[1 mark]

0 2 . 2 The height of the stairs was 1.7 m.

The mass of the girl was 50 kg.

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the girl.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

4.5.6.1.2 Speed

Question 117 · continued

0 2 . 3 A boy ran up the same stairs and did 1800 J of work.

The time it took the boy to run up the stairs was 1.44 s.

Calculate the power of the boy.

Use the equation:

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

[2 marks]

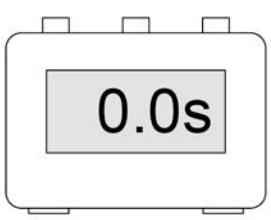
Power = _____ W

0 2 . 4 Which stop-clock was used to measure the time the boy took to run up the stairs?

[1 mark]

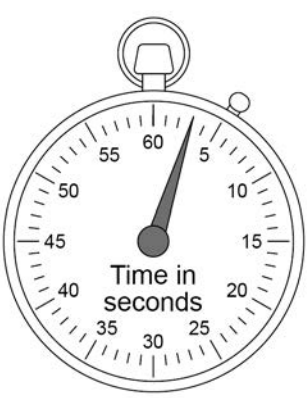
Tick (✓) **one** box.

Stop-clock A



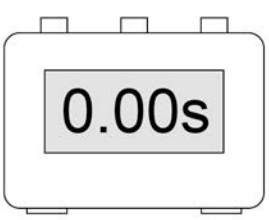
☐

Stop-clock B



☐

Stop-clock C



☐

4.5.6.1.2 Speed

Question 117 · continued

0 2 . 5 The boy had a speed of 2.0 m/s at the top of the stairs.

The mass of the boy was 70 kg.

Calculate the kinetic energy of the boy at the top of the stairs.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

Kinetic energy = _____ J

8

4.5.6.1.2 Speed

Question 118

June 2022 | 8463/2F | Original Q5

0 5 Ultraviolet and visible light are both parts of the electromagnetic spectrum.

0 5 . 1 How does the speed of ultraviolet in a vacuum compare to the speed of visible light in a vacuum?

[1 mark]

Tick (✓) **one** box.

Ultraviolet travels at a faster speed than visible light. ☐

Ultraviolet travels at a slower speed than visible light. ☐

Ultraviolet travels at the same speed as visible light. ☐

0 5 . 2 **Figure 9** shows parts of the electromagnetic spectrum.

Figure 9

Radio waves	A	B	C	D	X-rays	Gamma rays

Which letters represent the positions of ultraviolet and visible light in the electromagnetic spectrum?

[2 marks]

Ultraviolet _____

Visible light _____

4.5.6.1.2 Speed

Question 118 · continued

0 5 . 3 **Table 3** shows the range of wavelengths for different types of ultraviolet.

Table 3

Type	Range of wavelength in nanometres
Ultraviolet **A** (UVA)	315–400
Ultraviolet **B** (UVB)	280–315
Ultraviolet **C** (UVC)	100–280

Determine which type of ultraviolet shown in **Table 3** has the largest range of wavelengths.

To gain full marks you must calculate the range of wavelengths for each type of ultraviolet.

[3 marks]

Type of ultraviolet with the largest range of wavelengths _____

Question 5 continues on the next page

4.5.6.1.2 Speed

Question 118 · continued

Figure 10 shows how different types of ultraviolet are absorbed by the ozone layer in the Earth's atmosphere.

Table 4 shows the relative ionising power from each type of ultraviolet.

Figure 10

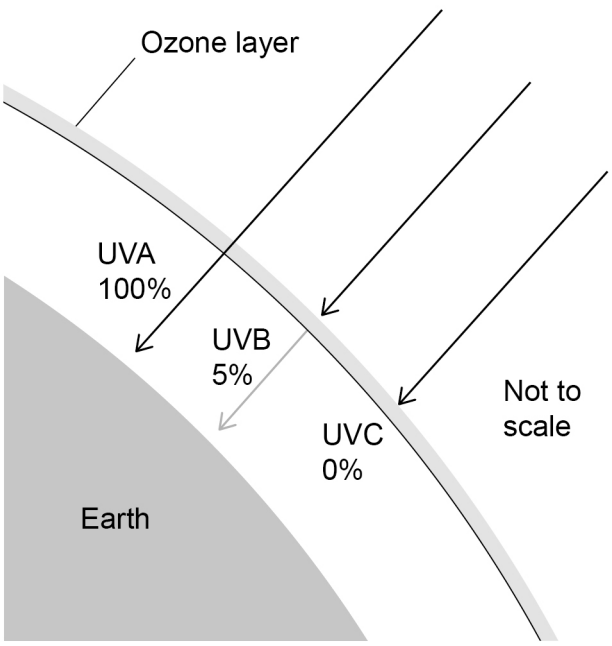


Table 4

Type	Relative ionising power
UVA	Low
UVB	Medium
UVC	High

0 5 . 4 Explain the importance of the ozone layer in reducing the risk to people from all types of ultraviolet.

Use **Figure 10** and **Table 4**.

[4 marks]

0 5 . 5 The Sun emits visible light.

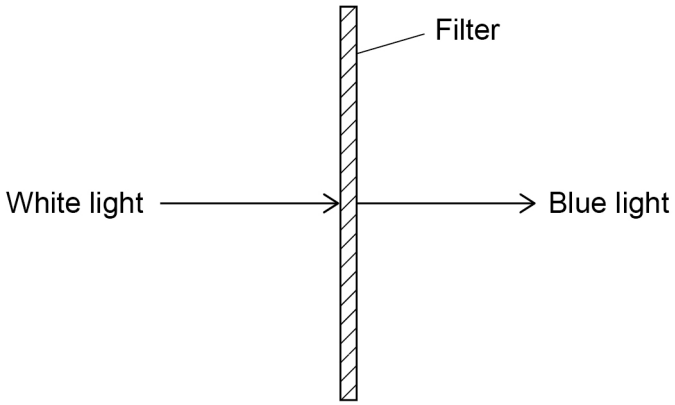
A student concludes that visible light is **not** absorbed by the ozone layer.

Give **one** piece of evidence that shows the student's conclusion is correct.

[1 mark]

0 5 . 6 **Figure 11** shows white light incident on a colour filter.

Figure 11



Complete the sentence.

Choose the answers from the box.

[2 marks]

absorbed	**radiated**	**reflected**	**refracted**	**transmitted**

When white light is incident on the filter, only blue light is _____

and all other colours of light are _____ .

13

4.5.6.1.2 Speed

Question 119

June 2022 | 8463/2F | Original Q7

0 7 Sound travels as longitudinal waves.

0 7 . 1 Complete the sentences.

Choose the answers from the box.

[2 marks]

amplitude	frequency	speed	wavelength

The distance between the centre of one compression of a sound wave and the centre of the next compression is called the _____ .

The number of waves passing a point each second is called the _____ .

0 7 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

opposite	perpendicular	parallel

In a longitudinal wave, the oscillations are _____ to the direction of energy transfer.

Question 7 continues on the next page

4.5.6.1.2 Speed

Question 119 · continued

0 7 . 3 A sound wave has a frequency of 8.0 kHz.

Which of the following is the same as 8.0 kHz?

[1 mark]

Tick (✓) **one** box.

0.0080 Hz ☐

8.0 Hz ☐

8000 Hz ☐

800 000 Hz ☐

0 7 . 4 Calculate the period of a sound wave with a frequency of 8.0 kHz.

Use the Physics Equations Sheet.

[2 marks]

Period = _____ s

4.5.6.1.2 Speed

Question 119 · continued

0 7 . 5 Calculate the wavelength of a sound wave with a frequency of 6600 Hz.

speed of sound = 330 m/s

Use the equation:

$$\text{wavelength} = \frac{\text{speed}}{\text{frequency}}$$

Choose the unit from the box.

[3 marks]

kg	m	N

Wavelength = _____ Unit _____

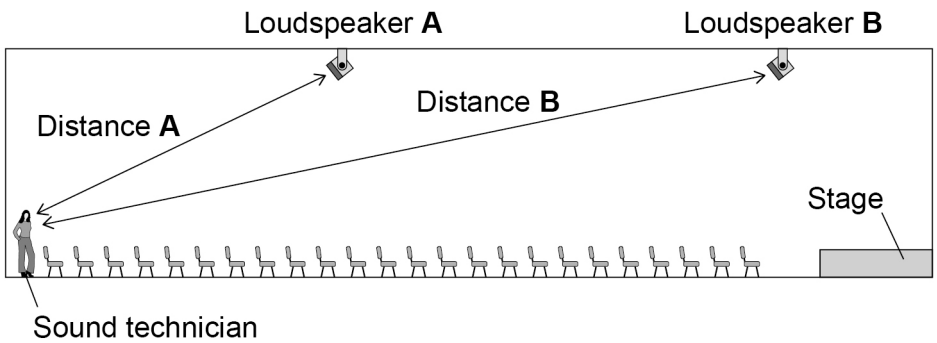
Question 7 continues on the next page

4.5.6.1.2 Speed

Question 119 · continued

Figure 14 shows the arrangement of two loudspeakers at a concert venue.

Figure 14



The loudspeakers in **Figure 14** are tested by playing the same song through both loudspeakers.

A sound technician listens to the song.

Use the Physics Equations Sheet to answer questions **07.6** and **07.7**.

0 7 . 6 Write down the equation which links distance (*s*), speed (*v*) and time (*t*).

[1 mark]

0 7 . 7 Distance **A** on **Figure 14** is 13.2 m.

speed of sound = 330 m/s

Calculate the time taken for the sound to travel from loudspeaker **A** to the technician.

[3 marks]

Time taken = _____ s

4.5.6.1.2 Speed

Question 119 · continued

0 7 . 8 The sound from each loudspeaker travels at the same speed.

For the sound technician to hear the song clearly, the sound from loudspeaker **B** should be emitted slightly before the sound from loudspeaker **A**.

Explain why.

[3 marks]

16

Turn over for the next question

4.5.6.1.2 Speed

Question 120

June 2022 | 8463/2F | Original Q8

0 8 **Figure 15** shows an electric super-car.

Figure 15



0 8 . 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 120 · continued

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 8 . 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 8 continues on the next page

4.5.6.1.2 Speed

Question 120 · continued

0 8 . 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 120 · continued

Use the Physics Equations Sheet to answer questions **08.5** and **08.6**.

0 8 . 5 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 8 . 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

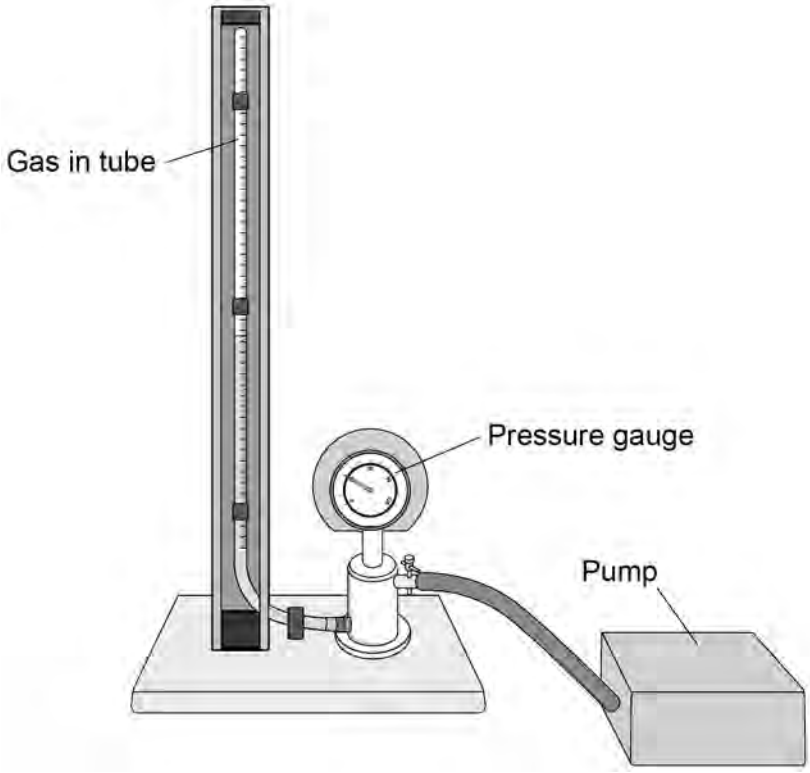
Question 121

June 2023 | 8463/1F | Original Q7

0 7 A teacher demonstrated the relationship between the pressure and the volume of a fixed mass of gas at a constant temperature.

Figure 9 shows the equipment used.

Figure 9



0 7 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

circular paths	**random directions**	**the same direction**

Particles in a gas move in _____.

4.5.6.1.2 Speed

Question 121 · continued

0 7 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

a constant speed	**a constant velocity**	**a range of speeds**

Particles in a gas move with _____.

Question 7 continues on the next page

Question 121 · continued

0 7 . 3 **Table 6** shows some of the results.

Table 6

Pressure in kPa	Volume in cm^3
300	10
200	15
150	20
120	25
100	30

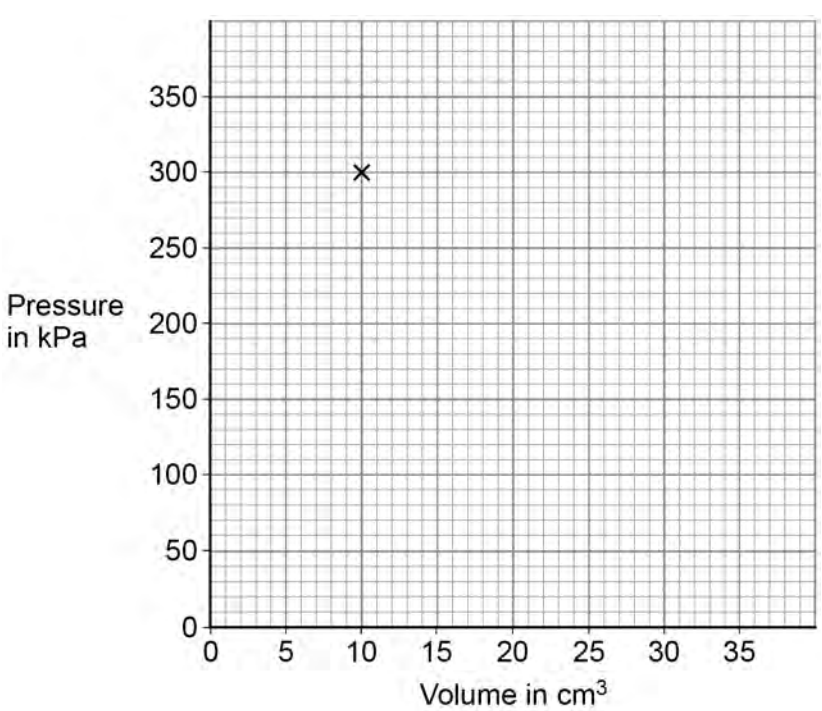
Complete **Figure 10**. The first point has been plotted for you.

You should:

- plot the points from **Table 6**
- draw the line of best fit.

[3 marks]

Figure 10



Question 121 · continued

0 7 . 4 The relationship between the pressure and the volume of a gas is given by the equation:

pressure × volume = constant

Calculate the constant when the pressure of the gas was 300 kPa.

Use **Table 6**.

[2 marks]

Constant = _____ kPa cm^3

0 7 . 5 When the volume of the gas increases, the pressure in the gas decreases.

The temperature of the gas stays the same.

How does increasing the volume affect each of the following quantities?

[3 marks]

Tick (✓) **one** box in **each** row.

Quantity	Decreases	Stays the same	Increases
Mean time between collisions of the particles with the tube			
Mean distance between the particles			
Mean speed of the particles			

10

4.5.6.1.2 Speed

Question 122

June 2023 | 8463/2F | Original Q2

0 2 The stopping distance of a car is the braking distance added to the thinking distance.

0 2 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**electrostatic**	**kinetic**
nuclear		**thermal**

A driver applies the brakes to a moving car.

As the car slows down, there is a decrease in the _____

energy of the car.

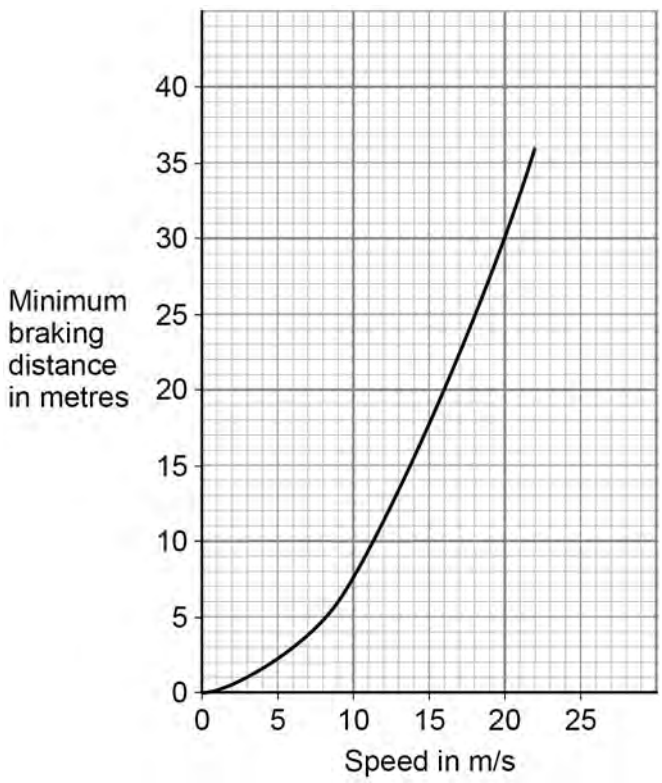
The work done by friction causes an increase in the _____

energy store of the brakes.

Question 2 continues on the next page

0 2 . 2 **Figure 3** shows how the speed of the car affects the minimum braking distance of the car.

Figure 3



Describe the relationship between the speed of the car and the minimum braking distance of the car.

[1 mark]

0 2 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When the road becomes icy, the braking distance _____ .

4.5.6.1.2 Speed

Question 122 · continued

A car driver applies the brakes to decelerate the car as it approaches a road junction.

The car decelerates at 0.25 m/s^2.

mass of the car = 1600 kg

0 2 . 4 Calculate the time taken for the velocity of the car to decrease from 12.5 m/s to 5.0 m/s.

Use the equation:

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

[3 marks]

Time taken = _____ s

0 2 . 5 Calculate the resultant force causing the car to decelerate.

Use the equation:

$$\text{resultant force} = \text{mass} \times \text{deceleration}$$

[2 marks]

Resultant force = _____ N

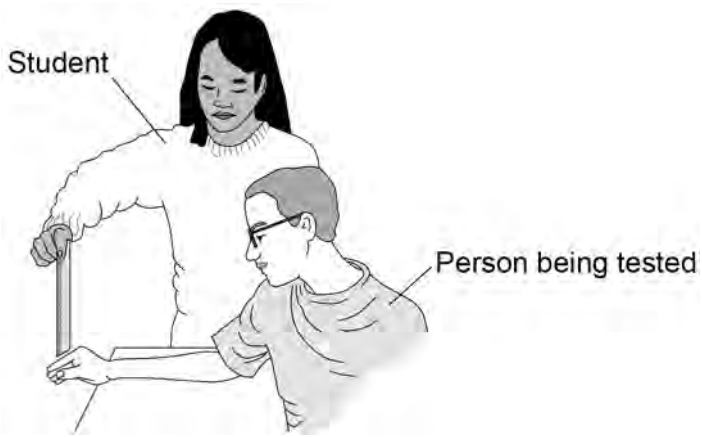
4.5.6.1.2 Speed

Question 122 · continued

Thinking distance is affected by the reaction time of the driver.

Figure 4 shows how a student tested a person's reaction time.

Figure 4



The student held a ruler and then released it.

The person being tested closed his hand to catch the ruler as quickly as possible.

The further the ruler fell the greater the person's reaction time.

0 2 . 6 The student wanted to test the reaction time of the people in her class.

Which of the following could have been a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Distance fallen by the ruler before being caught ☐

Initial height of the ruler above the person's hand ☐

Reaction time of the person being tested ☐

4.5.6.1.2 Speed

Question 122 · continued

0 2 . 7 The student tested three people in her class.

The mean distance that the ruler fell before being caught was 18.2 cm.

If all of the people in her class were tested, the mean distance may not be 18.2 cm.

Suggest why.

[1 mark]

0 2 . 8 Describe how this investigation could be changed to find out how listening to music affects reaction time.

[2 marks]

13

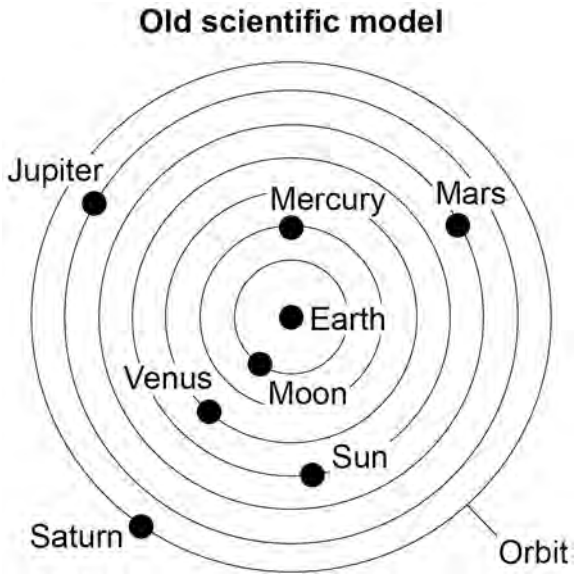
4.5.6.1.2 Speed

Question 123

June 2023 | 8463/2F | Original Q4

0 4 **Figure 10** shows an old scientific model of the solar system that has now been replaced.

Figure 10



0 4 . 1 Which statement is a reason for replacing an old scientific model with a newer scientific model?

[1 mark]

Tick (✓) **one** box.

The old model cannot explain new observations. ☐

The old model has been used by scientists for a long time. ☐

The old model is too simple. ☐

4.5.6.1.2 Speed

Question 123 · continued

0 4 . 2 Compare the model of the solar system used now with the old model of the solar system shown in **Figure 10**.

[4 marks]

Question 4 continues on the next page

Question 123 · continued

Table 1 shows data about four planets.

Table 1

Planet	Mean distance from the Sun in millions of kilometres	Time taken for one orbit in Earth years
Mercury	58	0.25
Venus	108	0.60
Earth	150	1.00
Mars	228	1.90

0 4 . 3 How does the time taken for one orbit change as the mean distance from the Sun increases?

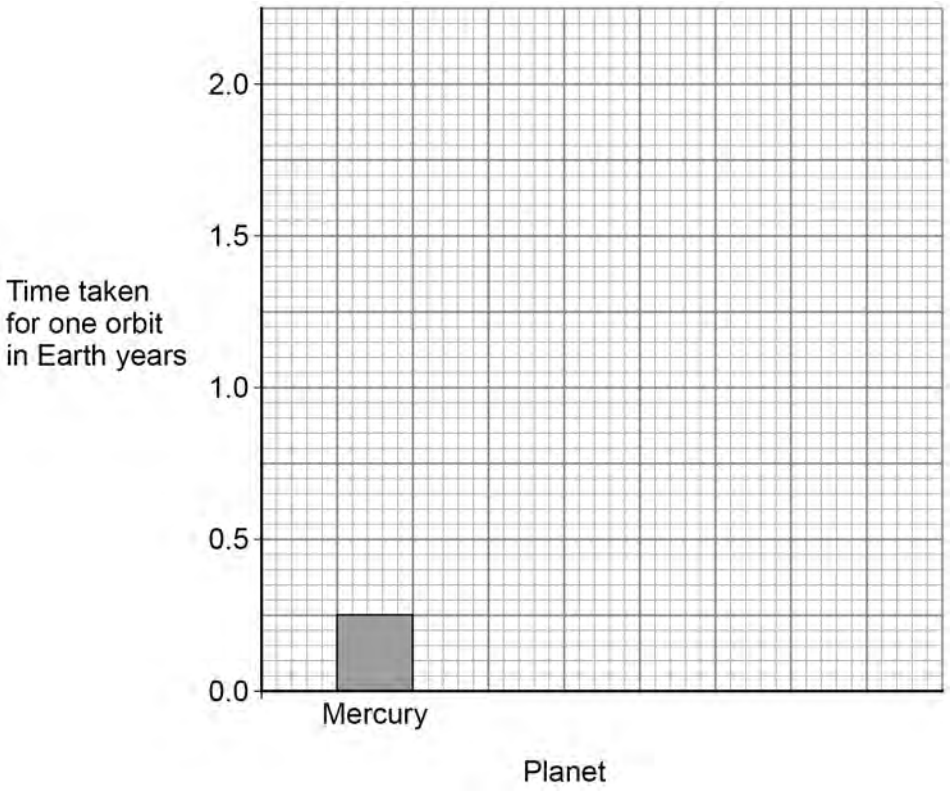
[1 mark]

4.5.6.1.2 Speed

Question 123 · continued

0 4 . 4 The bar chart in **Figure 11** shows some of the data from **Table 1**.

Figure 11



Complete the bar chart.

Use data from **Table 1**.

[2 marks]

Question 4 continues on the next page

0 4 . 5 All stars have a life cycle.

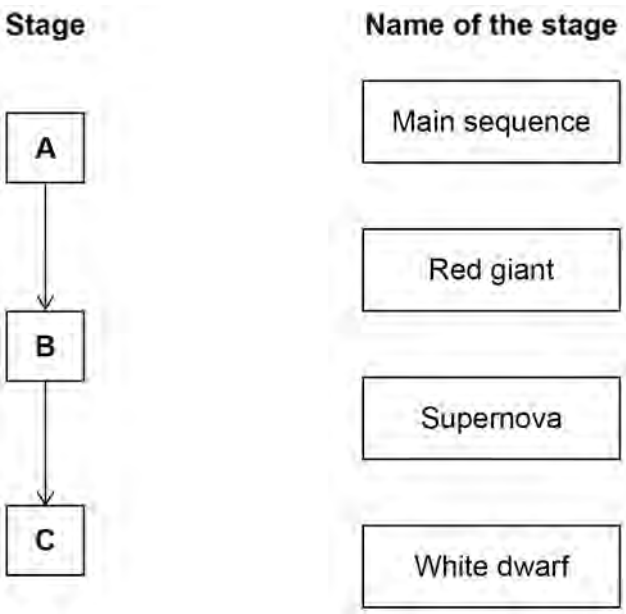
A, **B** and **C** in **Figure 12** represent three stages in the life cycle of the Sun.

The stages are in the correct order.

Draw **one** line from each stage to the name of the stage.

[2 marks]

Figure 12



0 4 . 6 Stars act like black bodies.

Which statement is true for perfect black bodies?

[1 mark]

Tick (✓) **one** box.

They are good reflectors of radiation. ☐

They are the best emitters of radiation. ☐

They easily transmit radiation. ☐

11

4.5.6.1.2 Speed

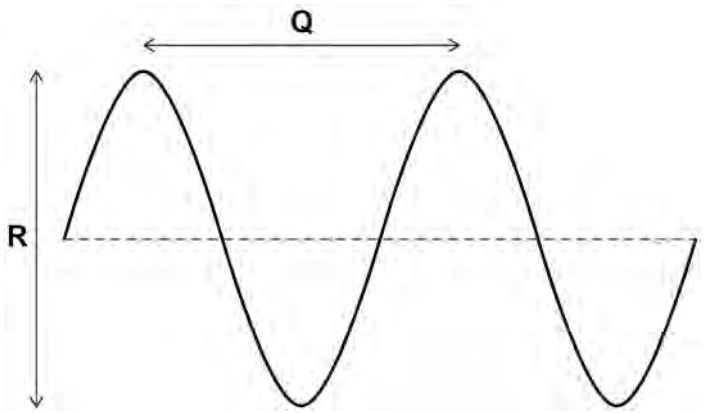
Question 124

June 2023 | 8463/2F | Original Q5

0 5 Electromagnetic waves are transverse.

Figure 13 represents a transverse wave.

Figure 13



0 5 . 1 Which of the following gives the wavelength of the transverse wave?

[1 mark]

Tick (✓) **one** box.

wavelength = $\frac{Q}{2}$ ☐

wavelength = Q ☐

wavelength = 2 Q ☐

0 5 . 2 Which of the following gives the amplitude of the transverse wave?

[1 mark]

Tick (✓) **one** box.

amplitude = $\frac{R}{2}$ ☐

amplitude = R ☐

amplitude = 2 R ☐

4.5.6.1.2 Speed

Question 124 · continued

0 5 . 3 Microwaves are electromagnetic waves used for mobile phone communications.

Which other type of electromagnetic wave is also used for communications?

[1 mark]

Tick (✓) **one** box.

Radio waves ☐

Ultraviolet ☐

X-rays ☐

0 5 . 4 Microwaves from a mobile phone take 0.000 009 s to reach a mobile phone mast.

speed of microwaves = 300 000 000 m/s

Calculate the distance between the mobile phone and the mobile phone mast.

Use the equation:

distance = speed × time

[2 marks]

Distance = _____ m

0 5 . 5 Mobile phone communications is only one of the uses for microwaves.

Give **one** other use of microwaves.

[1 mark]

6

4.5.6.1.2 Speed

Question 125

June 2023 | 8463/2F | Original Q6

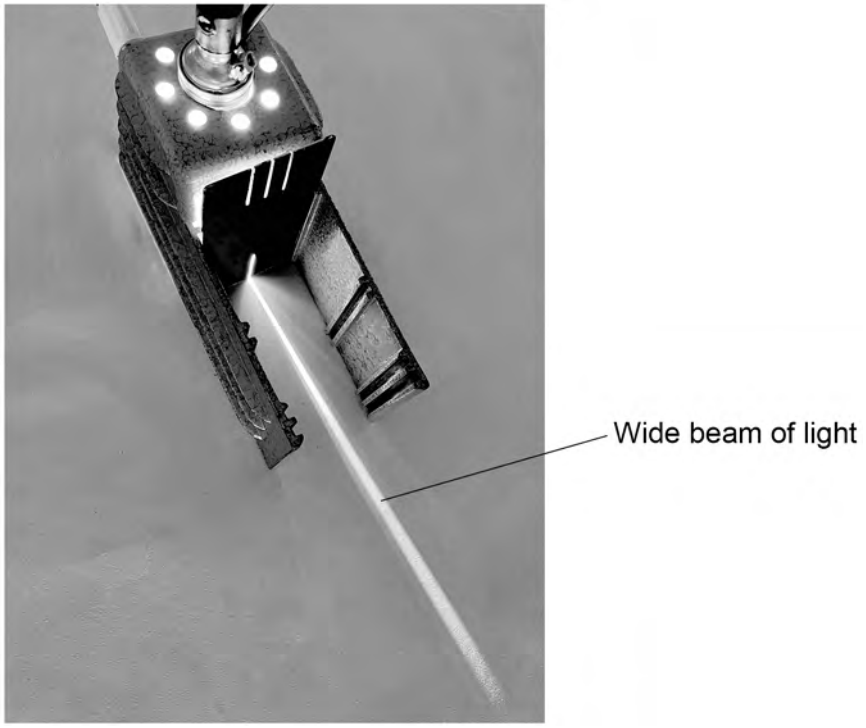
0 6 A student investigated the refraction of light through a glass block.

Figure 14 shows the ray box used.

The student aimed the beam of light from the ray box towards a glass block.

The student measured the angle of incidence at the point where the light entered the glass block.

Figure 14



0 6 . 1 Why is using a wide beam of light less likely to give accurate results than using a narrow beam?

[1 mark]

Tick (✓) **one** box.

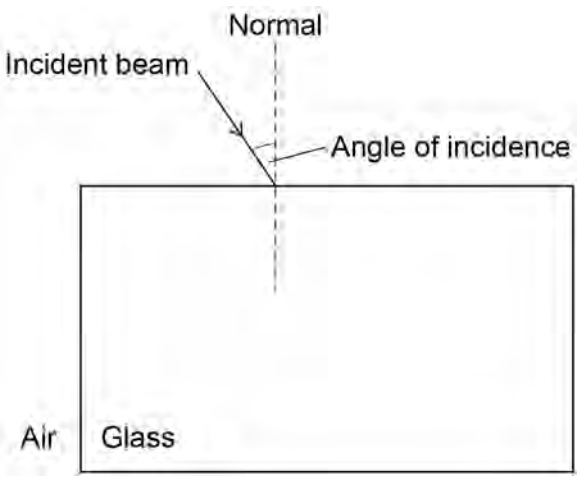
- It will be harder to judge where the centre of the beam is. ☐
- It will cause a smaller uncertainty in the measurements. ☐
- The angle of refraction will be larger than it should be. ☐

4.5.6.1.2 Speed

Question 125 · continued

0 6 . 2 **Figure 15** shows the beam of light incident on the glass block.

Figure 15



Complete **Figure 15** to show the path taken by the beam of light through the glass block and back into the air.

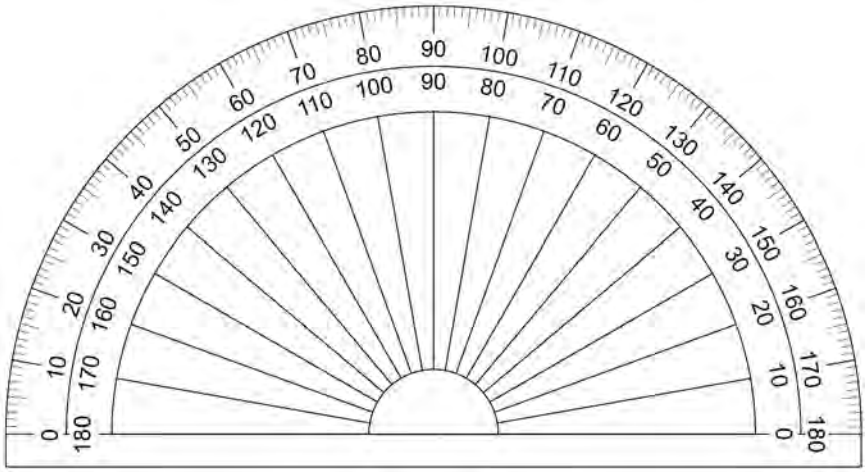
[3 marks]

4.5.6.1.2 Speed

Question 125 · continued

Figure 16 shows the protractor used by the student.

Figure 16



0 6 . 3 What is the resolution of the protractor?

[1 mark]

Tick (✓) **one** box.

1 degree ☐

10 degrees ☐

180 degrees ☐

0 6 . 4 For one angle of incidence the student measured the angle of refraction three times.

The three measurements were:

35° 31° 33°

Calculate the mean angle of refraction.

[1 mark]

Mean angle of refraction = _____ °

4.5.6.1.2 Speed

Question 125 · continued

The student placed a red filter in front of the white beam of light.

Only red light passes through the filter.

0 6 . 5 Complete the sentence.

[1 mark]

When white light is incident on the red filter, all colours except for red are

_____ by the filter.

Use the Physics Equations Sheet to answer questions **06.6** and **06.7**.

0 6 . 6 Write down the equation which links frequency (f), wave speed (v) and wavelength (λ).

[1 mark]

_____

0 6 . 7 Light has a wave speed of 3.0×10^8 m/s in air.

The frequency of the red light is 4.0×10^{14} Hz.

Calculate the wavelength of the red light in air.

[3 marks]

_____

_____

_____

_____

_____

Wavelength = _____ m

11

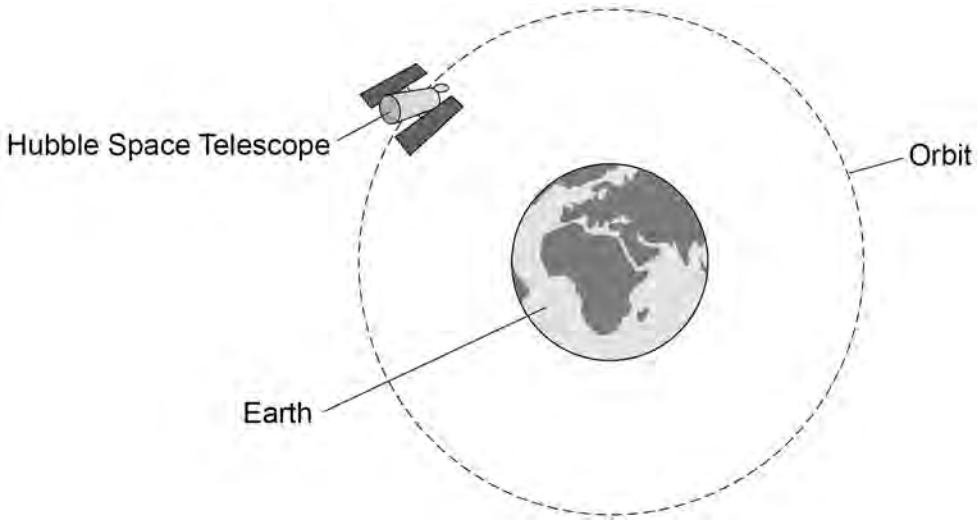
4.5.6.1.2 Speed

Question 126

June 2023 | 8463/2F | Original Q7

0 7 **Figure 17** shows the Hubble Space Telescope orbiting the Earth.

Figure 17



0 7 . 1 What name is given to an object that orbits a planet?

[1 mark]

Tick (✓) **one** box.

A comet ☐

A satellite ☐

A star ☐

0 7 . 2 The Earth exerts a gravitational force on the Hubble Space Telescope.

Draw an arrow on **Figure 17** to show the gravitational force.

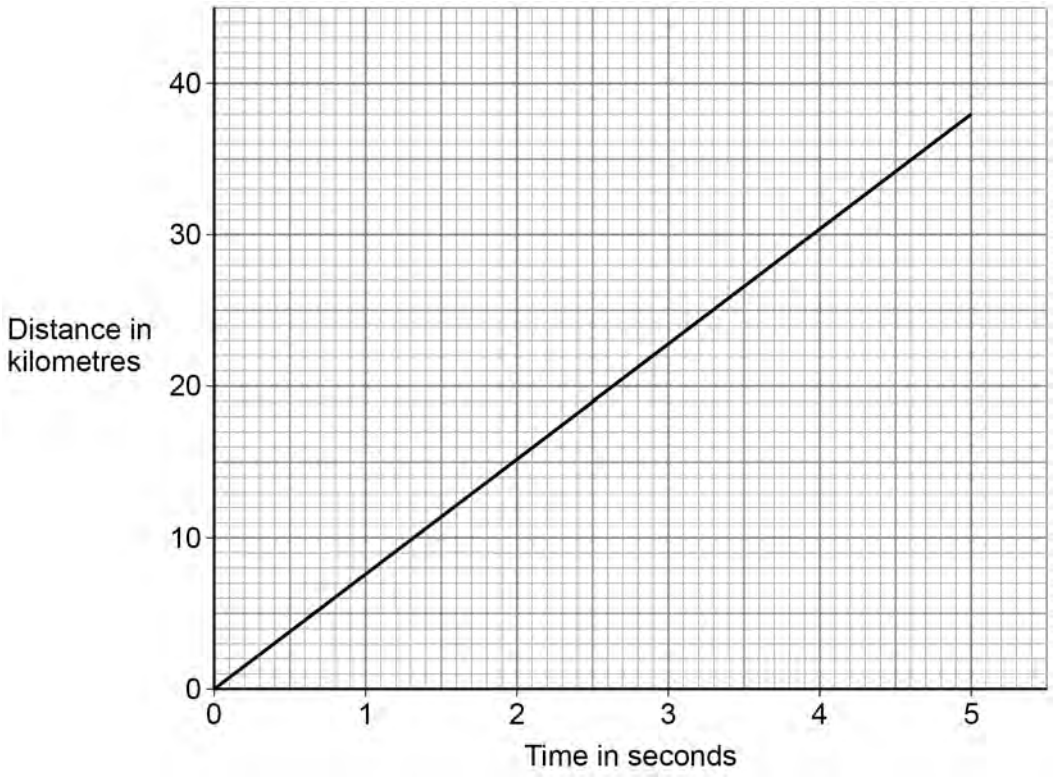
[1 mark]

4.5.6.1.2 Speed

Question 126 · continued

0 7 . 3 **Figure 18** shows how the distance travelled by the Hubble Space Telescope during its orbit changes with time.

Figure 18



The gradient of the line in **Figure 18** gives the speed of the Hubble Space Telescope.

Determine the speed of the Hubble Space Telescope.

Give your answer in km/s.

[3 marks]

Speed = _____ km/s

4.5.6.1.2 Speed

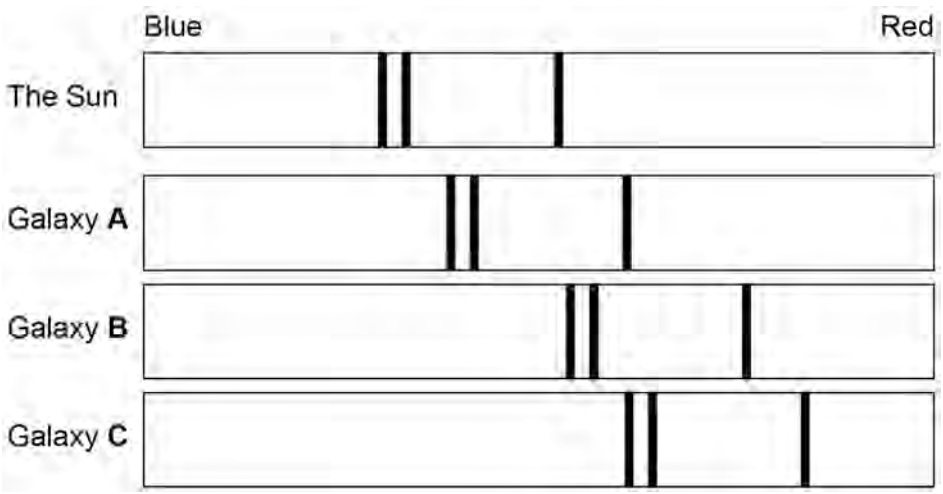
Question 126 · continued

The Hubble Space Telescope can detect the visible light spectra from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

Figure 19 shows the visible light spectra from the Sun and three galaxies.

Figure 19



0 7 . 4 Which galaxy is moving away from the Earth the fastest?

[1 mark]

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

4.5.6.1.2 Speed

Question 126 · continued

0 7 . 5 Which galaxy is the furthest away from the Earth?

[1 mark]

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

0 7 . 6 New scientific observations indicate that many galaxies rotate too quickly for the known mass of the stars they contain.

Why is it important that new scientific observations are peer reviewed?

[1 mark]

Tick (✓) **one** box.

To check the observations are correct ☐

To identify control variables ☐

To provide more proof ☐

8

4.5.6.1.2 Speed

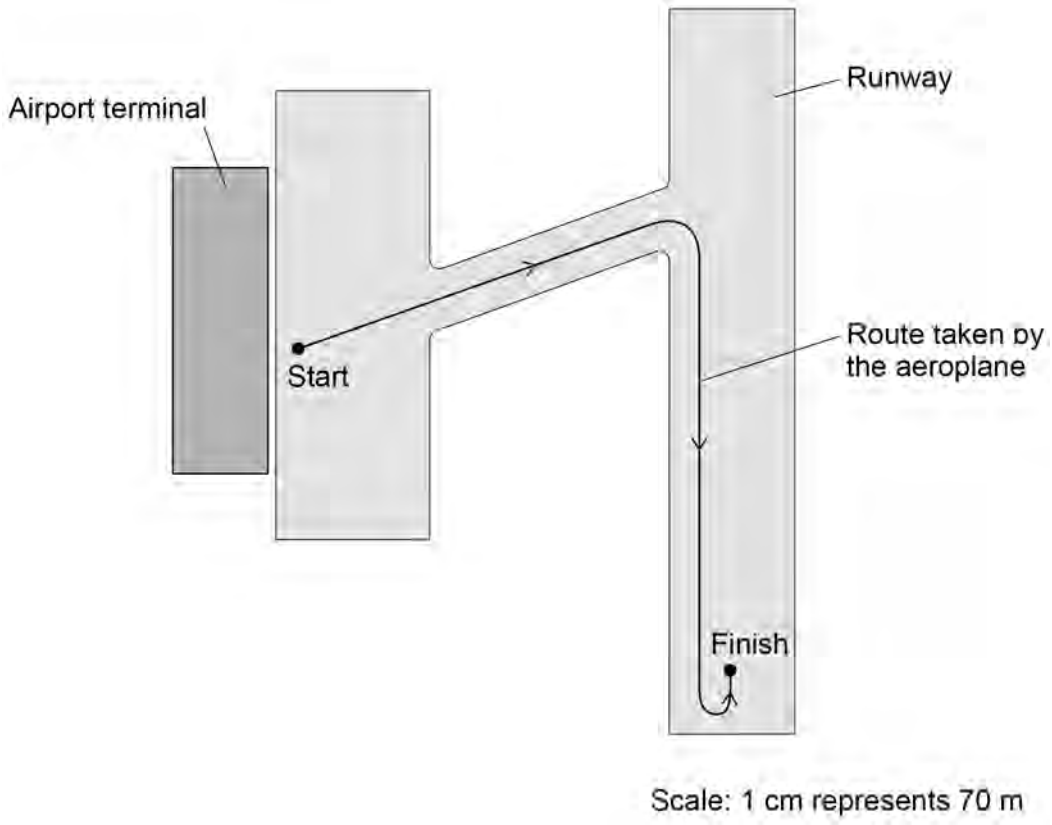
Question 127

June 2023 | 8463/2F | Original Q10

1 0 **Figure 25** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 25 has been drawn to scale.

Figure 25



1 0 . 1 Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 25**.

[2 marks]

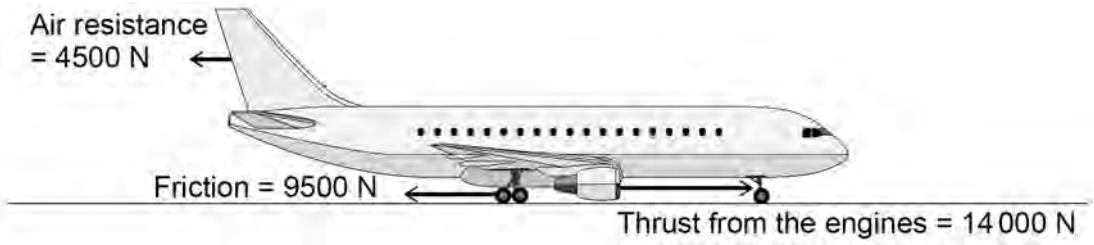
Displacement = _____ m

4.5.6.1.2 Speed

Question 127 · continued

Figure 26 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 26



1 0 . 2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = _____ N

1 0 . 3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

1 0 . 4 Air resistance and friction are contact forces.

Give **one** other example of a contact force.

[1 mark]

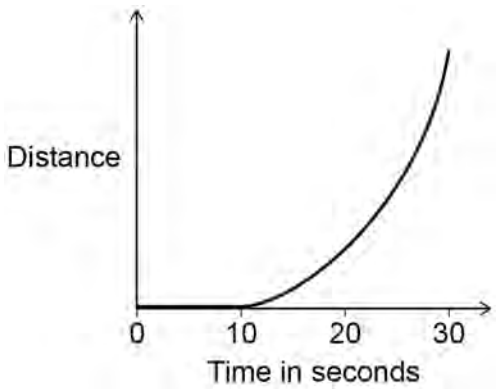
4.5.6.1.2 Speed

Question 127 · continued

1 0 . 5 The aeroplane stops for a short time and then accelerates along the runway.

Figure 27 shows a distance–time sketch-graph for this stage of the journey.

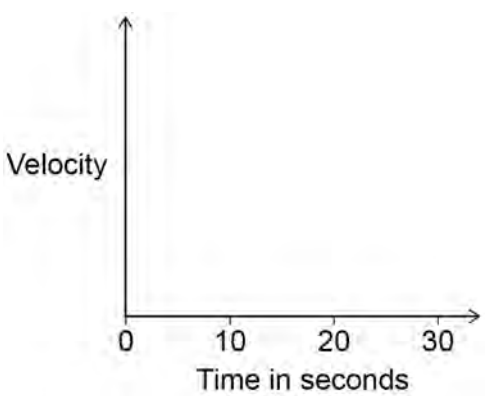
Figure 27



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 28**.

[2 marks]

Figure 28



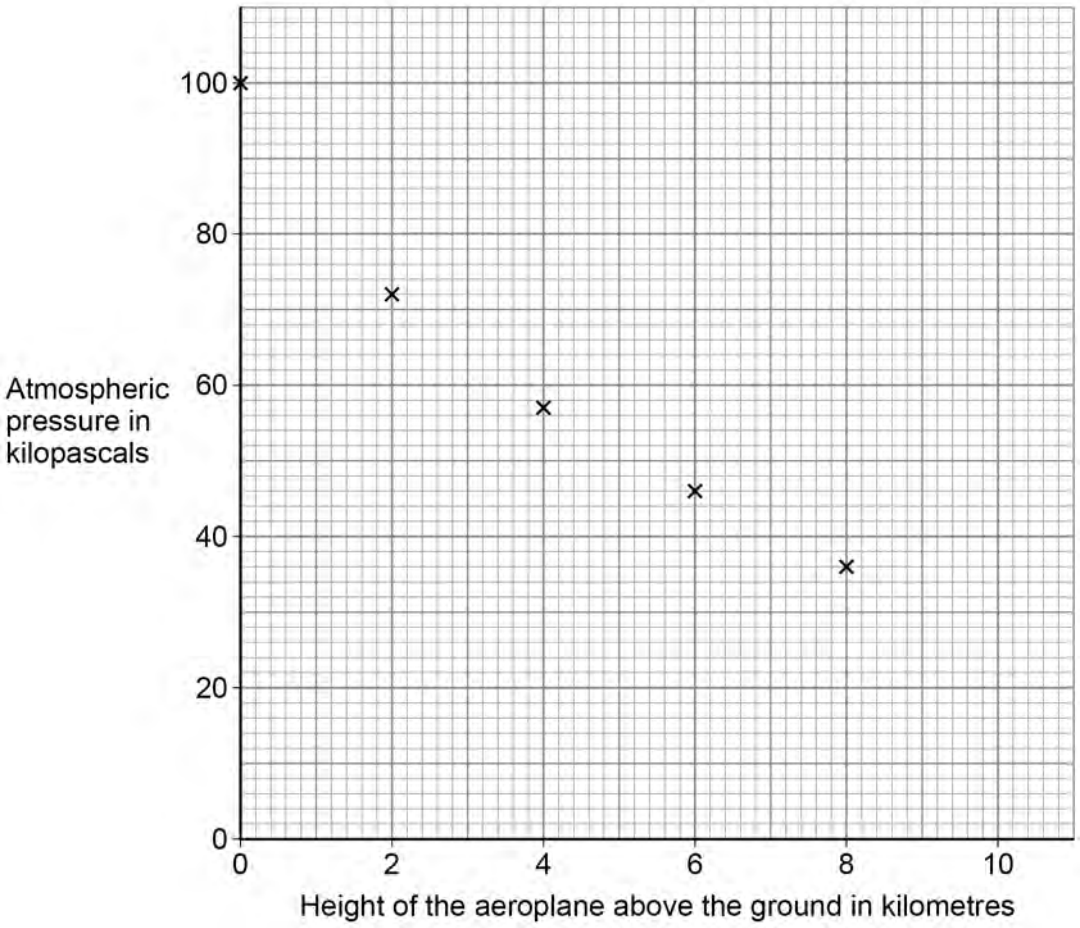
4.5.6.1.2 Speed

Question 127 · continued

1 0 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 29 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 29



Estimate the atmospheric pressure when the height of the aeroplane above the ground is 10 km.

[2 marks]

Atmospheric pressure = _____ kPa

Question 10 continues on the next page

4.5.6.1.2 Speed

Question 127 · continued

1 0 . 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 128

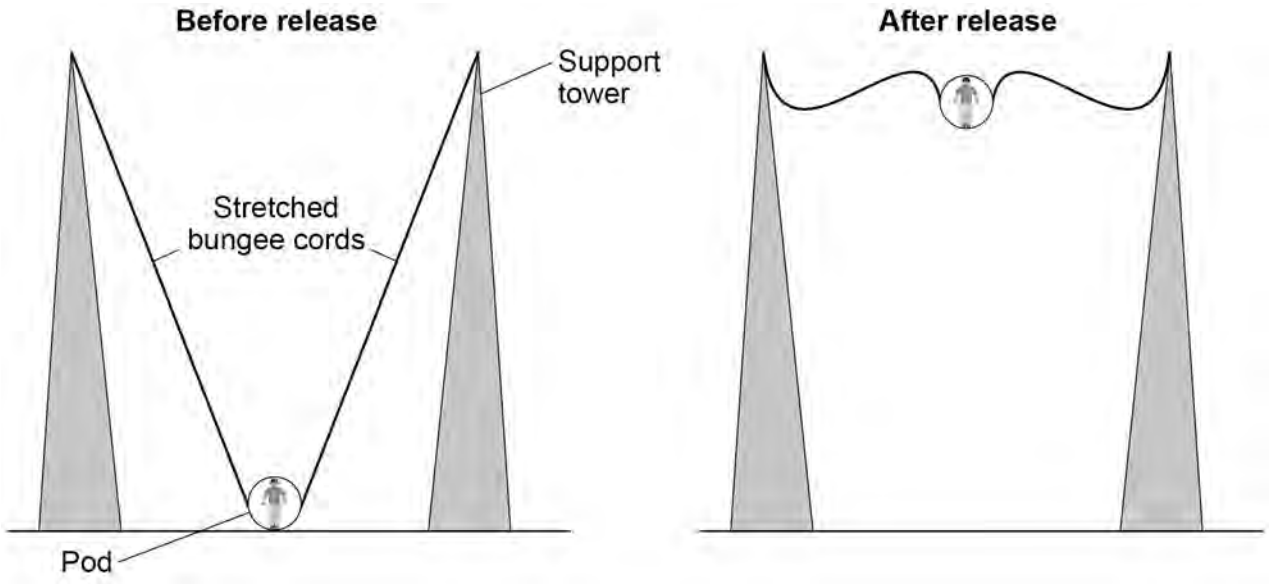
June 2024 | 8463/1F | Original Q3

0 3 In a ride at a theme park, a person is strapped into a pod that is attached to two stretched bungee cords.

The bungee cords behave like springs.

Figure 7 shows a person using the ride.

Figure 7



0 3 . 1 How is the extension of each bungee cord calculated?

[1 mark]

Tick (✓) **one** box.

stretched length + original length ☐

stretched length – original length ☐

stretched length × original length ☐

stretched length ÷ original length ☐

Question 128 · continued

0 3 . 2 Before the pod is released, the extension of each bungee cord is 7.5 m.

spring constant of the bungee cord = 800 N/m

Calculate the elastic potential energy stored in each stretched bungee cord.

Use the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

0 3 . 3 The maximum speed of the pod is 15 m/s.

The mass of the pod is 240 kg.

Calculate the maximum kinetic energy of the pod.

Use the equation:

kinetic energy = 0.5 × mass × (speed)^2

[2 marks]

Maximum kinetic energy = _____ J

Question 128 · continued

Use the Physics Equations Sheet to answer questions **03.4** and **03.5**.

0 3 . 4 Which equation links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m)?

[1 mark]

Tick (✓) **one** box.

$E_p = \frac{m \times g}{h}$ ☐

$E_p = \frac{m}{g \times h}$ ☐

$E_p = m \times g \times h$ ☐

0 3 . 5 The pod has 24 000 J of gravitational potential energy when at its maximum height.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

[3 marks]

Maximum height = _____ m

Question 3 continues on the next page

4.5.6.1.2 Speed

Question 128 · continued

0 3 . 6 Why is the maximum gravitational potential energy of the pod less than the initial elastic potential energy of the bungee cords?

[2 marks]

Tick (✓) **two** boxes.

- Energy is created. ☐
- Energy is destroyed. ☐
- Energy is transferred to the surroundings. ☐
- Work is done against air resistance. ☐
- Work is done by the force of gravity. ☐
- Work is done by the person in the pod. ☐

11

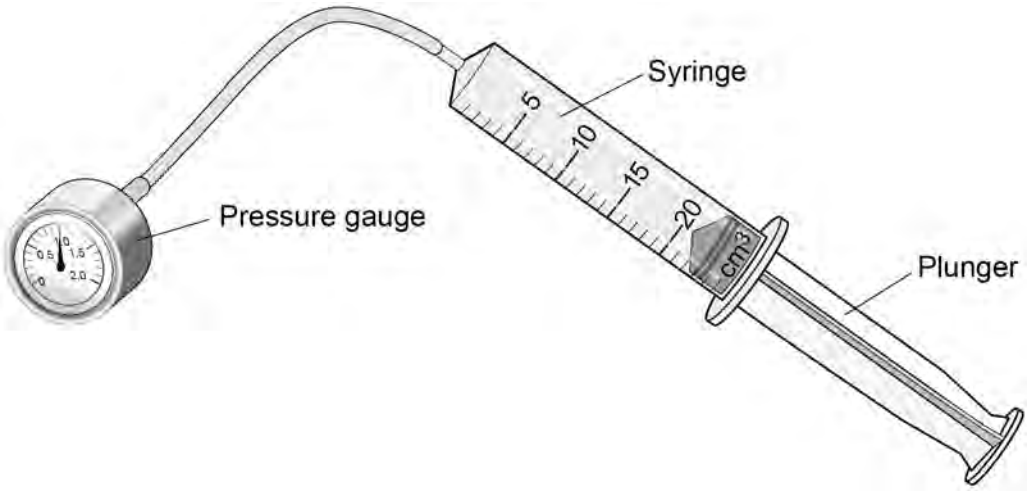
4.5.6.1.2 Speed

Question 129

0 5 A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

Figure 10 shows the equipment used.

Figure 10



When the plunger was pushed slowly into the syringe, the temperature of the air stayed the same.

0 5 . 1 How did pushing the plunger in affect the volume of air in the syringe?

[1 mark]

Tick (✓) **one** box.

The volume decreased. ☐

The volume stayed the same. ☐

The volume increased. ☐

4.5.6.1.2 Speed

Question 129 · continued

0 5 . 2 How did pushing the plunger in affect the distance between the air particles in the syringe?

[1 mark]

Tick (✓) **one** box.

The distance decreased. ☐

The distance stayed the same. ☐

The distance increased. ☐

0 5 . 3 How did pushing the plunger in affect the frequency of collisions between the air particles and the syringe walls?

[1 mark]

Tick (✓) **one** box.

The frequency of collisions decreased. ☐

The frequency of collisions stayed the same. ☐

The frequency of collisions increased. ☐

0 5 . 4 How did pushing the plunger in affect the air pressure in the syringe?

[1 mark]

Tick (✓) **one** box.

The air pressure decreased. ☐

The air pressure stayed the same. ☐

The air pressure increased. ☐

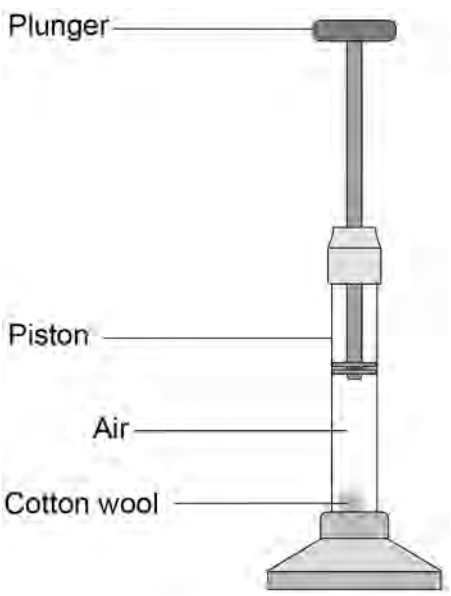
4.5.6.1.2 Speed

Question 129 · continued

A fire piston is a special type of syringe that can be used to start fires.

Figure 11 shows a fire piston.

Figure 11



The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

0 5 . 5 How does an increase in temperature affect the mean speed of the air particles inside the syringe?

[1 mark]

Tick (✓) **one** box.

The mean speed of the particles decreases. ☐

The mean speed of the particles does not change. ☐

The mean speed of the particles increases. ☐

4.5.6.1.2 Speed

Question 129 · continued

0 5 . 6 When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is 2.60×10^{-8} kg.

specific heat capacity of air = 1010 J/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

[3 marks]

Temperature change = _____ °C

8

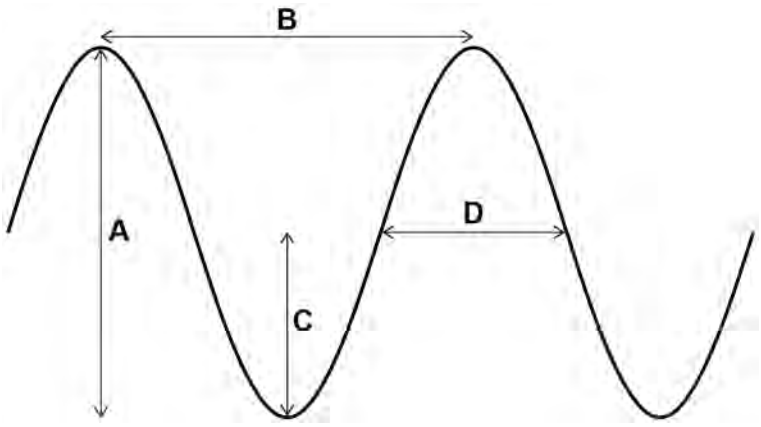
4.5.6.1.2 Speed

Question 130

June 2024 | 8463/2F | Original Q4

0 4 **Figure 7** represents a transverse wave.

Figure 7



0 4 . 1 Which arrow represents the amplitude of the wave?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 4 . 2 Which arrow represents the wavelength of the wave?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 130 · continued

0 4 . 3 A wave has a frequency of 5000 Hz.

Calculate the period of the wave.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

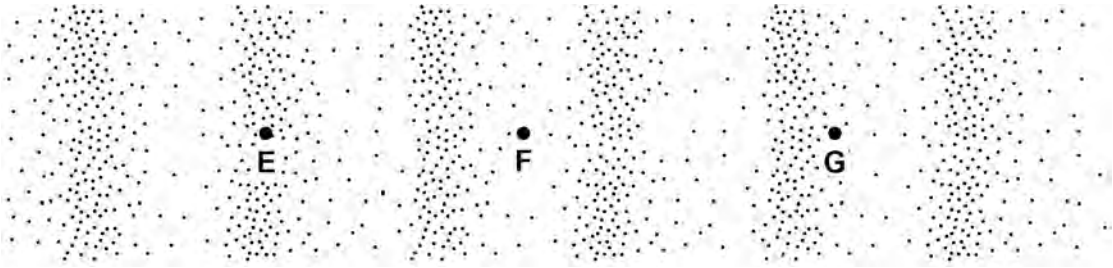
Period = _____ s

0 4 . 4 Give **one** example of a transverse wave that can travel through a vacuum.

[1 mark]

0 4 . 5 **Figure 8** represents a longitudinal wave.

Figure 8



Which point is at the centre of a rarefaction?

[1 mark]

Tick (✓) **one** box.

E ☐ **F** ☐ **G** ☐

4.5.6.1.2 Speed

Question 130 · continued

0 4 . 6 A sound wave has a frequency of 750 Hz.

speed of sound in air = 330 m/s

Calculate the wavelength of the sound wave.

Use the equation:

$$\text{wavelength} = \frac{\text{wave speed}}{\text{frequency}}$$

[2 marks]

Wavelength = _____ m

0 4 . 7 Describe a method that could be used to determine the speed of sound in air.

[4 marks]

4.5.6.1.2 Speed

Question 130 · continued

0 4 . 8 When a sound wave moves from air into water, the speed of the wave increases.

The frequency of the sound wave does **not** change.

Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When a sound wave moves from air into water its

wavelength _____.

13

Turn over for the next question

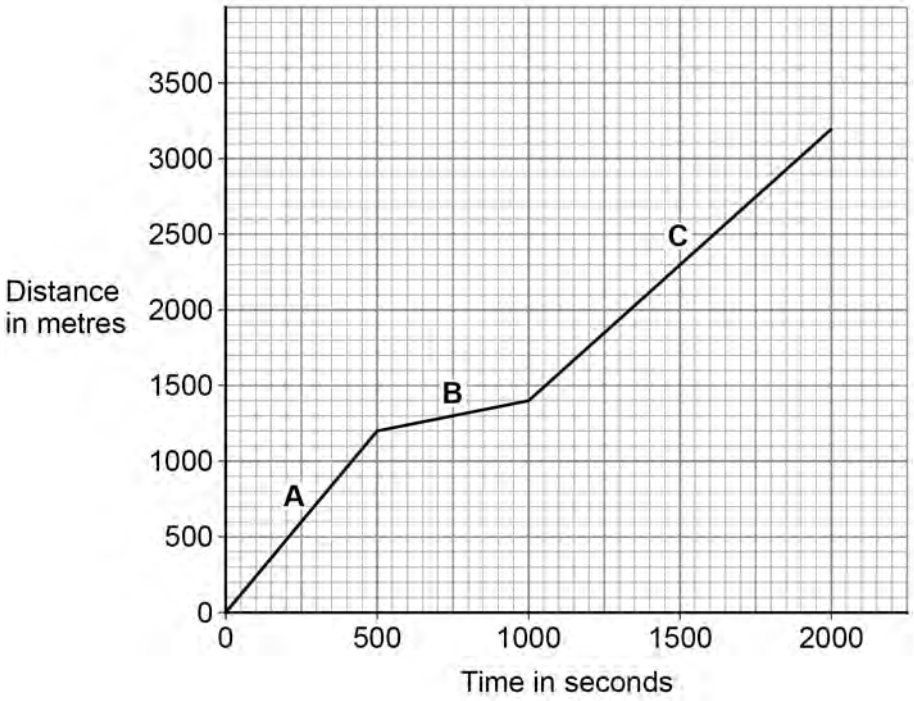
4.5.6.1.2 Speed

Question 131

0 5 A person has been for a walk.

Figure 9 shows the distance–time graph for the walk.

Figure 9



0 5 . 1 Some quantities are scalar quantities and others are vector quantities.

Which of the following are scalar quantities?

[2 marks]

Tick (✓) **two** boxes.

- Displacement ☐
- Distance ☐
- Force ☐
- Speed ☐
- Velocity ☐

Question 131 · continued

0 5 . 2 What was the total distance walked by the person in 2000 seconds?

[1 mark]

Total distance = _____ m

0 5 . 3 Calculate the average speed of the person during the 2000 seconds.

Use your answer to Question **05.2**

Use the equation:

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

[2 marks]

_____

_____

_____

Average speed = _____ m/s

0 5 . 4 Which section of **Figure 9** shows the person walking the slowest?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Reason _____

_____

4.5.6.1.2 Speed

Question 131 · continued

0 5 . 5 The person walked slowest when going up some steps.

Complete the sentence.

Choose the answer from the box.

[1 mark]

air resistance	**friction**	**gravity**

When walking up the steps, the person did more work against the force of _____.

0 5 . 6 On another day, the person ran the same route.

What is a typical speed for a person running?

[1 mark]

Tick (✓) **one** box.

0.3 m/s ☐

3.0 m/s ☐

30 m/s ☐

9

4.5.6.1.2 Speed

Question 132

June 2024 | 8463/2F | Original Q9

0 9 **Figure 17** shows a young child using a baby walker.

Figure 17



0 9 . 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 132 · continued

Use the Physics Equations Sheet to answer questions **09.2** and **09.3**.

0 9 . 2 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 9 . 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 9 . 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]

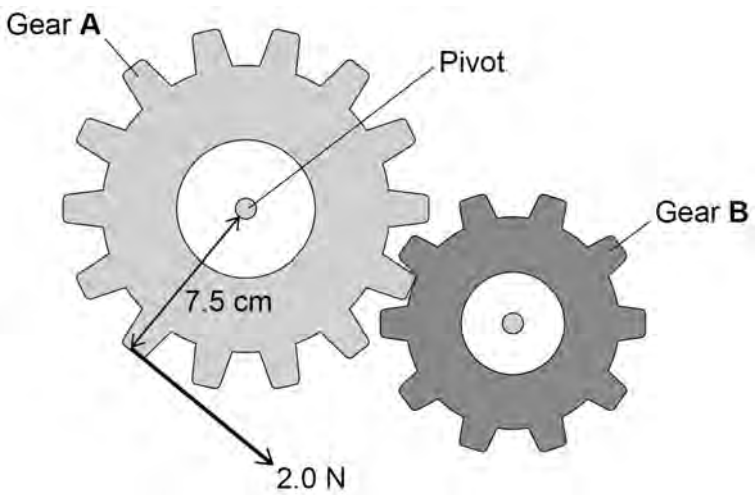
4.5.6.1.2 Speed

Question 132 · continued

There are some toy gears on the front of the baby walker.

Figure 18 shows the gears.

Figure 18



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 132 · continued

Use the Physics Equations Sheet to answer questions **09.5** and **09.6**.

0 9 . 5 Write down the equation which links distance (*d*), force (*F*) and moment of a force (*M*).

[1 mark]

0 9 . 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 9 . 7 Explain what happens to gear **B** when the child applies the force to gear **A**.

[2 marks]

14

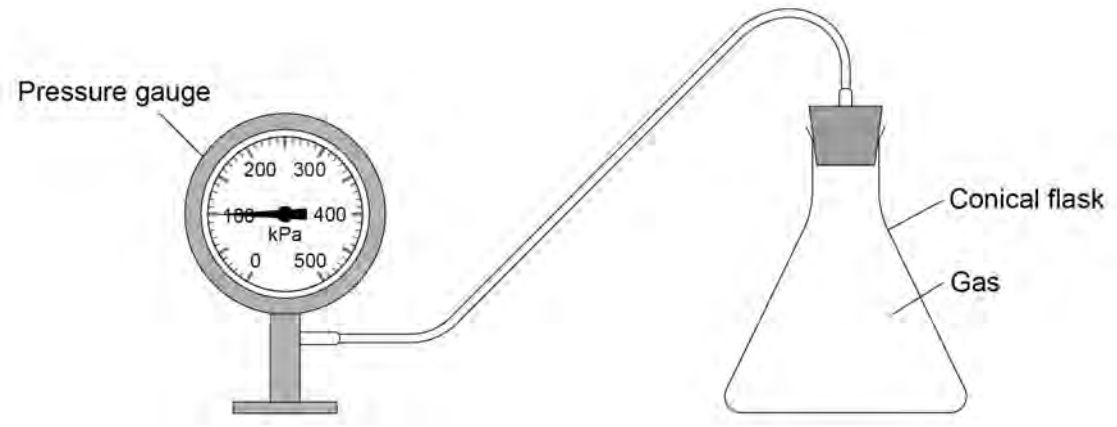
4.5.6.1.2 Speed

Question 133

0 4 A teacher demonstrated how the pressure in a gas varies with temperature.

Figure 7 shows some of the apparatus used.

Figure 7



The teacher heated the conical flask.

The temperature of the gas in the flask increased.

0 4 . 1 How did heating the gas affect the average speed of the gas particles?

[1 mark]

Tick (✓) **one** box.

The speed decreased. ☐

The speed stayed the same. ☐

The speed increased. ☐

Question 133 · continued

0 4 . 2 How did heating the gas affect the average kinetic energy of the gas particles?

[1 mark]

Tick (✓) **one** box.

The kinetic energy decreased. ☐

The kinetic energy stayed the same. ☐

The kinetic energy increased. ☐

As the temperature of the gas increased, the pressure of the gas inside the flask increased.

0 4 . 3 How did increasing the pressure affect the number of collisions each second between gas particles and the walls of the flask?

[1 mark]

Tick (✓) **one** box.

The number of collisions each second decreased. ☐

The number of collisions each second stayed the same. ☐

The number of collisions each second increased. ☐

Question 4 continues on the next page

4.5.6.1.2 Speed

Question 133 · continued

0 4 . 4 What happened to the force exerted on the walls of the flask by the gas particles when the pressure increased?

[1 mark]

Tick (✓) **one** box.

The force exerted decreased. ☐

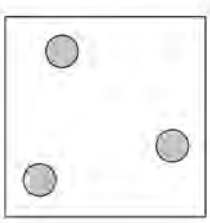
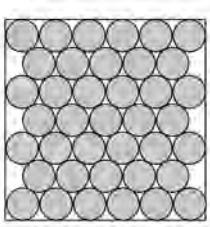
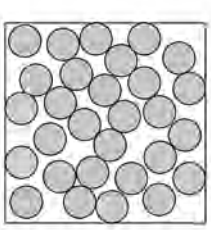
The force exerted stayed the same. ☐

The force exerted increased. ☐

0 4 . 5 At different temperatures, nitrogen can be a gas, a liquid or a solid.

Draw **one** line from the state of matter to the arrangement of particles in each state.

[2 marks]

State of matter	Arrangement of particles
Liquid	
Solid	
Gas	

4.5.6.1.2 Speed

Question 133 · continued

0 4 . 6 The boiling point of nitrogen is –196 °C and the melting point of nitrogen is –210 °C.

What is the state of matter of nitrogen at a temperature of –200 °C?

[1 mark]

Tick (✓) **one** box.

Solid ☐ Liquid ☐ Gas ☐

0 4 . 7 What is the state of matter of nitrogen when the temperature is lower than the melting point of nitrogen?

[1 mark]

Tick (✓) **one** box.

Solid ☐ Liquid ☐ Gas ☐

0 4 . 8 As a substance melts, the temperature of the substance is constant.

What happens to the kinetic energy **and** the potential energy of the particles as the substance melts?

[2 marks]

Tick (✓) **one** box in each row.

	Decreases	Stays the same	Increases
Kinetic energy of particles			
Potential energy of particles			

10

4.5.6.1.2 Speed

Question 134

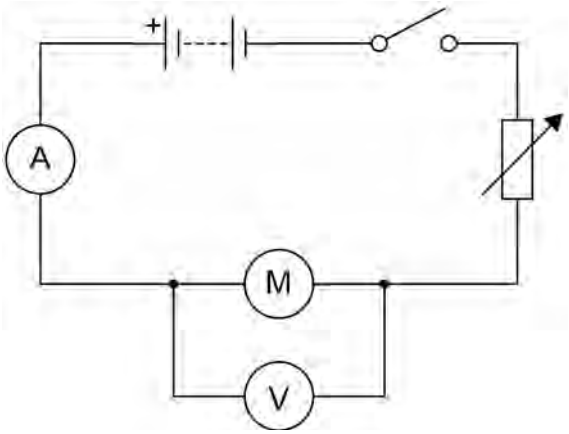
June 2025 | 8463/1F | Original Q7

0 7 A student built a circuit to investigate how the efficiency of a motor varies with the speed of the motor.

The symbol for a motor is 

Figure 12 shows the circuit.

Figure 12



The student used the motor to lift a mass through a height of 1.0 m.

0 7 . 1 The motor took 12 seconds to lift the mass.

The charge flow through the circuit was 6.0 C.

Calculate the current in the circuit.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

[2 marks]

Current = _____ A

4.5.6.1.2 Speed

Question 134 · continued

0 7 . 2 The potential difference across the motor was 8.0 V.

The charge flow through the motor was 6.0 C.

Calculate the energy transferred to the motor.

Use the equation:

energy transferred = charge flow × potential difference

[2 marks]

Energy transferred = _____ J

Question 7 continues on the next page

Question 134 · continued June 2025 | 8463/1F | Original Q7

Use the Physics Equations Sheet to answer questions **07.3** and **07.4**.

0 7 . 3 Which equation links efficiency, total input energy transfer and useful output energy transfer?

[1 mark]

Tick (✓) **one** box.

efficiency = useful output energy transfer × total input energy transfer ☐

efficiency = $\frac{\text{total input energy transfer}}{\text{useful output energy transfer}}$ ☐

efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ ☐

0 7 . 4 The efficiency of the motor was 0.70

The useful output energy transfer of the motor was 1.96 J.

Calculate the total input energy transfer to the motor.

[3 marks]

Total input energy transfer = _____ J

4.5.6.1.2 Speed

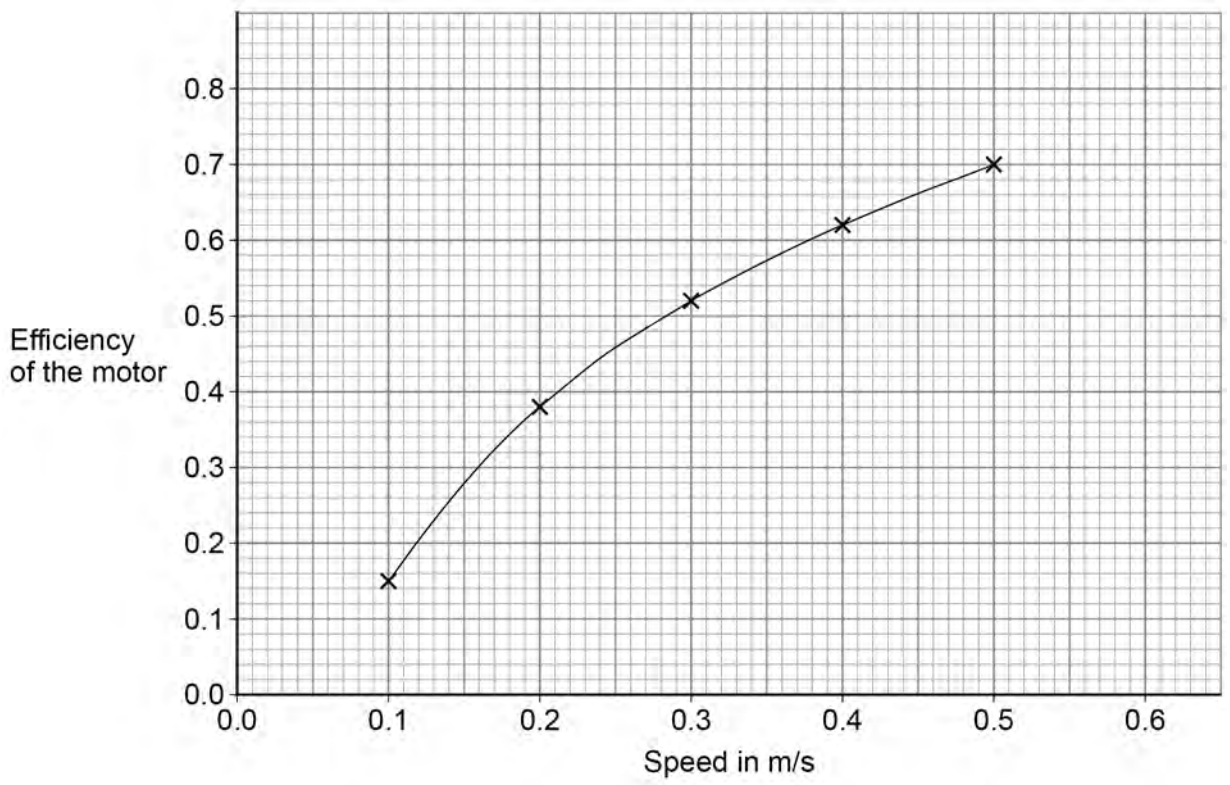
Question 134 · continued

The student adjusted the speed at which the mass was lifted.

For each speed, the student determined the efficiency of the motor.

Figure 13 shows the results.

Figure 13



0 7 . 5 Use **Figure 13** to predict the efficiency of the motor when the speed is 0.6 m/s.

[1 mark]

Efficiency = _____

0 7 . 6 How does **Figure 13** show that the efficiency of the motor is **not** directly proportional to the speed?

[1 mark]

_____

_____

_____

10

4.5.6.1.2 Speed

Question 135

June 2025 | 8463/1F | Original Q8

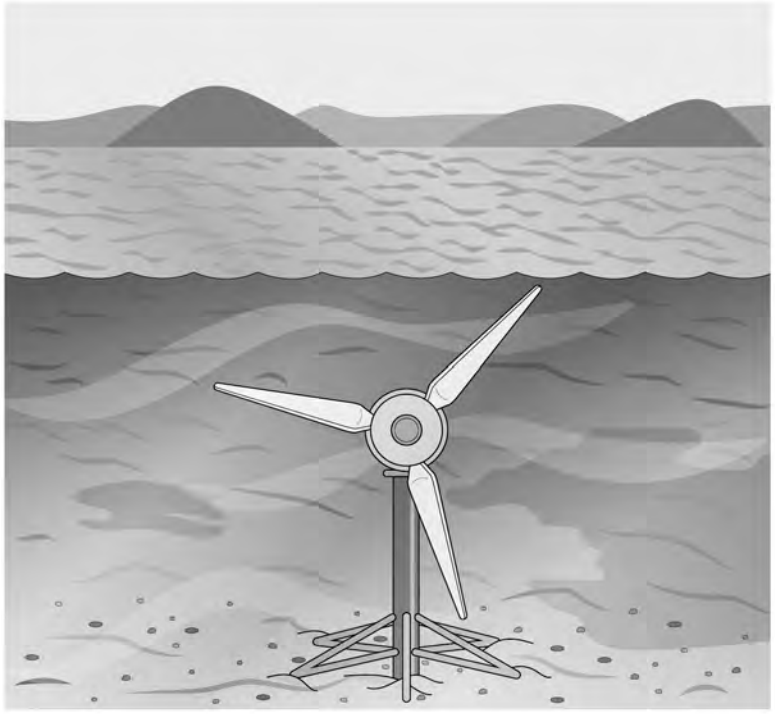
0 8 Tides and wind are two renewable energy resources.

0 8 . 1 Describe the difference between renewable energy resources and non-renewable energy resources.

[2 marks]

Figure 14 shows a new design of tidal turbine to generate electricity using the tides.

Figure 14



4.5.6.1.2 Speed

Question 135 · continued

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 8 . 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 8 continues on the next page

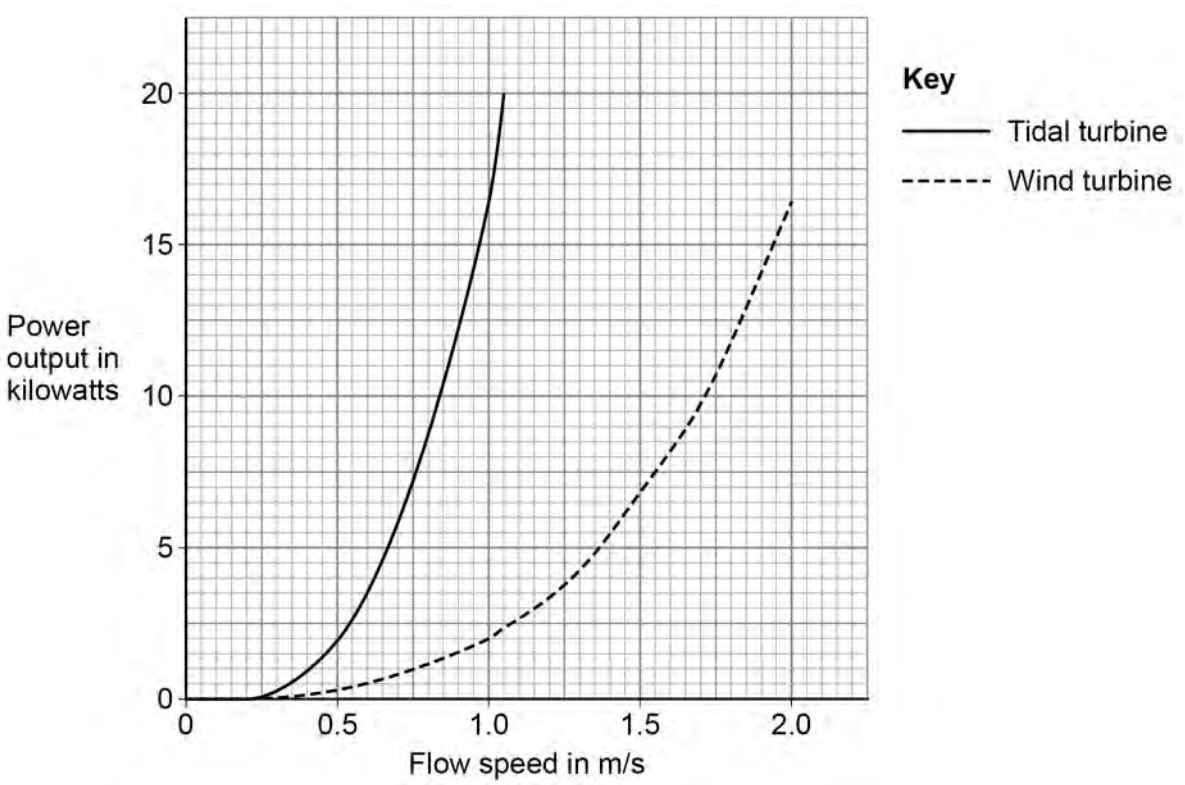
4.5.6.1.2 Speed

Question 135 · continued

The speed of the tide or the speed of the wind past a turbine is called the 'flow speed'.

Figure 15 shows how the power output of a tidal turbine compares with a wind turbine for different flow speeds.

Figure 15



0 8 . 4 As flow speed increases, power output increases.

Give **two** other conclusions that can be made using information from **Figure 15**.

[2 marks]

1 _____

_____

2 _____

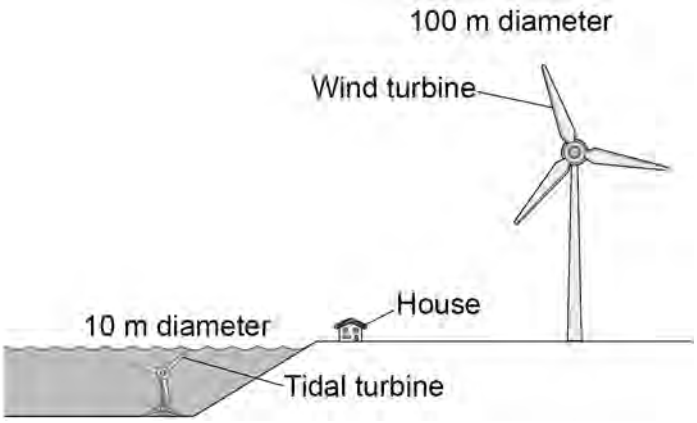
_____

4.5.6.1.2 Speed

Question 135 · continued

0 8 . 5 **Figure 16** shows the turbines used to obtain the data for **Figure 15**.

Figure 16



Compare the environmental impacts of the wind turbine and the tidal turbine in **Figure 16**.

[4 marks]

12

4.5.6.1.2 Speed

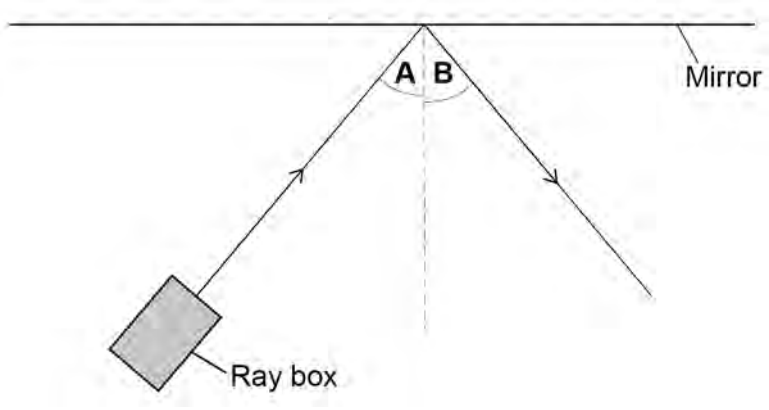
Question 136

0 1 Light waves and water waves can both be reflected.

A student used a ray box and a mirror to investigate the reflection of light.

Figure 1 shows some of the apparatus used.

Figure 1



0 1 . 1 The student measured angle **A** and angle **B**.

What equipment should the student have used to measure each angle?

[1 mark]

Question 1 continues on the next page

4.5.6.1.2 Speed

Question 136 · continued

The student moved the ray box and changed the direction of the ray of light.

The student recorded different pairs of values of angle **A** and angle **B**.

Table 1 shows the results.

Table 1

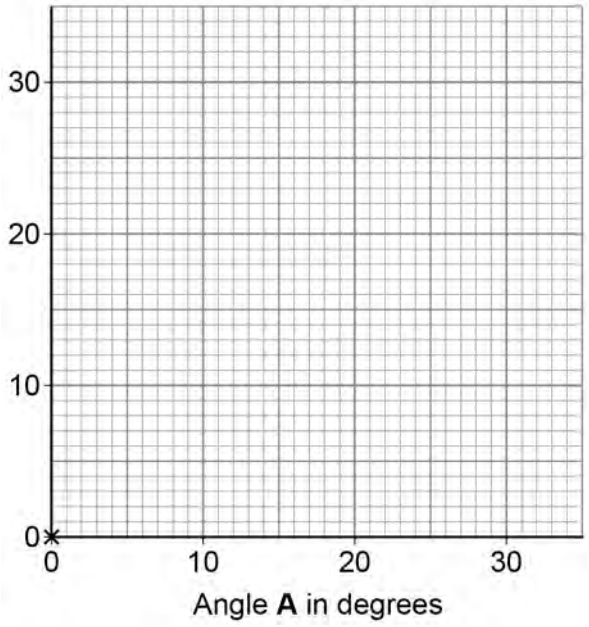
Angle A in degrees	Angle B in degrees
0	0
5	5
11	11
20	20
29	29

4.5.6.1.2 Speed

Question 136 · continued

0 1 . 2 **Figure 2** shows an incomplete graph of the results.

Figure 2



Complete **Figure 2**.

You should:

- label the *y*-axis
- plot the remaining data from **Table 1**
- draw a line of best fit.

[4 marks]

0 1 . 3 What is the relationship between angle **A** and angle **B**?

[1 mark]

Tick (✓) **one** box.

Angle **A** is directly proportional to angle **B**. ☐

There is a negative correlation between angle **A** and angle **B**. ☐

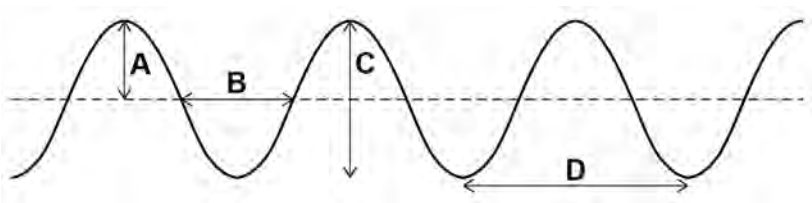
The relationship between angle **A** and angle **B** is non-linear. ☐

4.5.6.1.2 Speed

Question 136 · continued

Figure 3 represents a water wave.

Figure 3



0 1 . 4 Which letter represents the amplitude of the water wave in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 5 Which letter represents the wavelength of the water wave in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

4.5.6.1.2 Speed

Question 136 · continued

0 1 . 6 A water wave in a ripple tank has a wave speed of 0.125 m/s.

The wave has a frequency of 2.5 Hz.

Calculate the wavelength of the wave.

Use the equation:

$$\text{wavelength} = \frac{\text{wave speed}}{\text{frequency}}$$

Choose the unit from the box.

[3 marks]

m	Pa	kg / m

Wavelength = _____ Unit _____

0 1 . 7 The wave has a frequency of 2.5 Hz.

Calculate the period of the wave.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

Period = _____ s

13

4.5.6.1.2 Speed

Question 137

June 2025 | 8463/2F | Original Q2

0 2 Very long trains can be pulled by more than one engine.

A train is made up of four engines pulling trucks filled with coal.

0 2 . 1 The coal in one truck has a mass of 75 000 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the coal in **one** truck.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 2 . 2 **One** engine exerts a forward force of 850 000 N.

Calculate the work done by **one** engine when the train moves a distance of 80 m.

Use the equation:

work done = force × distance moved

[2 marks]

Work done = _____ J

4.5.6.1.2 Speed

Question 137 · continued

0 2 . 3 Each of the four engines exerts a forward force of 850 000 N on the trucks.

Calculate the total forward force on the trucks.

[2 marks]

Total forward force = _____ N

0 2 . 4 The force exerted by the engines on the trucks is a contact force.

Which of the following is also a contact force?

[1 mark]

Tick (✓) **one** box.

- Electrostatic force ☐
- Frictional force ☐
- Gravitational force ☐

Question 2 continues on the next page

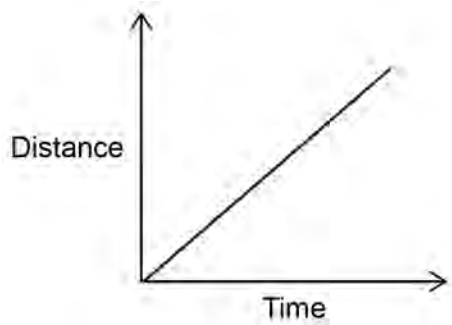
4.5.6.1.2 Speed

Question 137 · continued

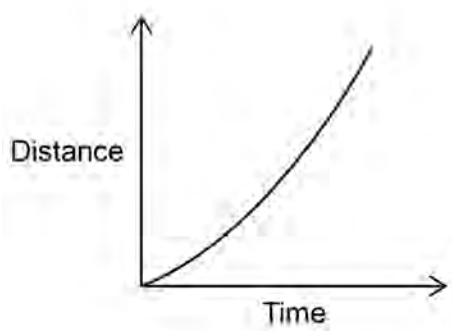
0 2 . 5 Which sketch graph represents the train moving at a constant speed?

[1 mark]

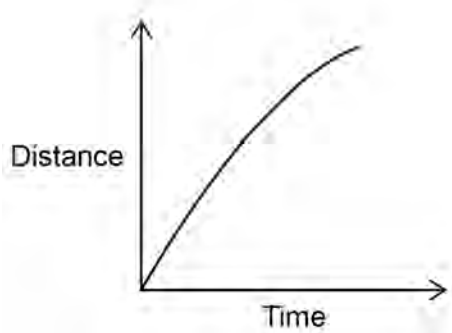
Tick (✓) **one** box.



☐



☐



☐

4.5.6.1.2 Speed

Question 137 · continued

0 2 . 6 The train accelerates for 150 s.

The velocity of the train changes from 16 m/s to 25 m/s.

Calculate the acceleration of the train.

Use the equation:

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

[3 marks]

Acceleration = _____ m/s^2

11

Turn over for the next question

4.5.6.1.2 Speed

Question 138

0 3 Telescopes are used to observe distant objects.

0 3 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

galaxy	**moon**	**nebula**	**star**	**universe**

A natural satellite of a planet is called a _____.

A planet orbits a _____.

0 3 . 2 What is the name of our galaxy?

[1 mark]

Tick (✓) **one** box.

- Andromeda ☐
- Centaurus ☐
- Milky Way ☐
- Whirlpool ☐

Question 138 · continued

0 3 . 3 The Sun is our nearest star.

What will happen to the Sun at the end of its life cycle?

[1 mark]

Tick (✓) **one** box.

It will become a black dwarf. ☐

It will become a black hole. ☐

It will become a neutron star. ☐

The James Webb Space Telescope is the most powerful telescope ever launched into space.

0 3 . 4 Very distant galaxies can be observed using the James Webb Space Telescope.

How does the speed of a very distant galaxy compare to the speed of a much nearer galaxy?

[1 mark]

Tick (✓) **one** box.

A very distant galaxy moves faster. ☐

The speeds are the same. ☐

A very distant galaxy moves slower. ☐

Question 3 continues on the next page

Question 138 · continued

0 3 . 5 There is an observed increase in the wavelength of light from most distant galaxies.

What name is given to this increase in the wavelength of light?

[1 mark]

Tick (✓) **one** box.

Blue-shift ☐

Green-shift ☐

Red-shift ☐

0 3 . 6 Observations from the James Webb Space Telescope support the Big Bang theory.

Complete the sentence.

Choose the answer from the box.

[1 mark]

cold	hot	large

The Big Bang theory suggests that the universe began from a region that

was extremely _____.

0 3 . 7 What does the Big Bang theory suggest is happening to the size of the universe?

[1 mark]

Tick (✓) **one** box.

The universe is getting smaller. ☐

The size of the universe is constant. ☐

The universe is getting bigger. ☐

8

4.5.6.1.2 Speed

Question 139

June 2025 | 8463/2F | Original Q4

0 4 Car **X** and car **Y** have engines that produce the same maximum forward force.

The cars are the same shape, but car **X** has a greater mass than car **Y**.

0 4 . 1 How does the maximum acceleration of car **X** and car **Y** compare?

[1 mark]

Tick (✓) **one** box.

Car **X** has a greater maximum acceleration. ☐

Car **X** and car **Y** have the same maximum acceleration. ☐

Car **X** has a smaller maximum acceleration. ☐

0 4 . 2 Car **Y** has a mass of 900 kg.

Car **Y** accelerates at 2.5 m/s^2.

Calculate the resultant force on car **Y**.

Use the equation:

resultant force = mass × acceleration

[2 marks]

Resultant force = _____ N

Question 4 continues on the next page

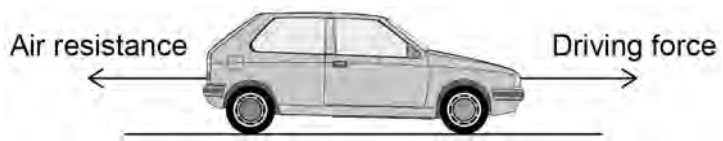
4.5.6.1.2 Speed

Question 139 · continued

0 4 . 3 A car moves at a constant speed on a level road.

Figure 4 shows the horizontal forces on the car.

Figure 4



The driver makes the car accelerate until the car reaches its maximum speed.

Explain how the horizontal forces on the car change as the car accelerates to its maximum speed.

[4 marks]

4.5.6.1.2 Speed

Question 139 · continued

To pass a driving test, drivers need to understand the difference between thinking distance and braking distance.

0 4 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

force	length	time

The thinking distance is affected by the driver's reaction _____.

0 4 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

force	length	time

The braking distance is the distance travelled by the car under the braking

_____.

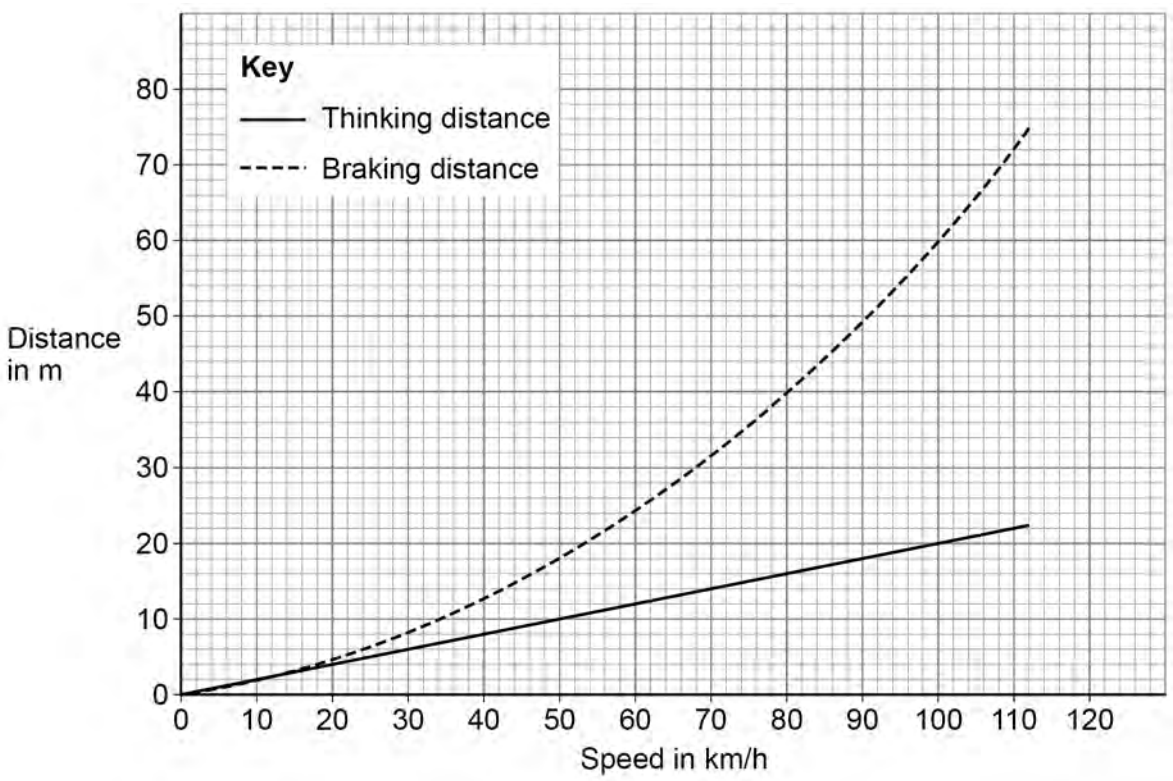
Question 4 continues on the next page

4.5.6.1.2 Speed

Question 139 · continued

0 4 . 6 **Figure 5** shows how speed affects the thinking distance and braking distance of a car.

Figure 5



The car is moving at a speed of 100 km/h.

Calculate the stopping distance of the car.

Use **Figure 5**.

[3 marks]

Stopping distance = _____ m

4.5.6.1.2 Speed

Question 139 · continued

0 4 . 7 Which **two** of the following would **increase** the stopping distance of a car?

[2 marks]

Tick (✓) **two** boxes.

- Fitting new brakes to the car ☐
- Fitting new tyres to the car ☐
- The driver becoming tired ☐
- Driving uphill ☐
- Driving on a wet road ☐

14

Turn over for the next question

4.5.6.1.2 Speed

Question 140

June 2025 | 8463/2F | Original Q8

0 8 In a thunderstorm, lightning produces visible light waves and sound waves.

0 8 . 1 Describe the similarities and differences between visible light waves and sound waves.

[6 marks]

4.5.6.1.2 Speed

Question 140 · continued

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 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 8 . 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