AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.4.1.2

Speed

Past-paper questions

Tier	**Foundation**
Question groups	**33**
Available paper years	**2018–2025**

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.

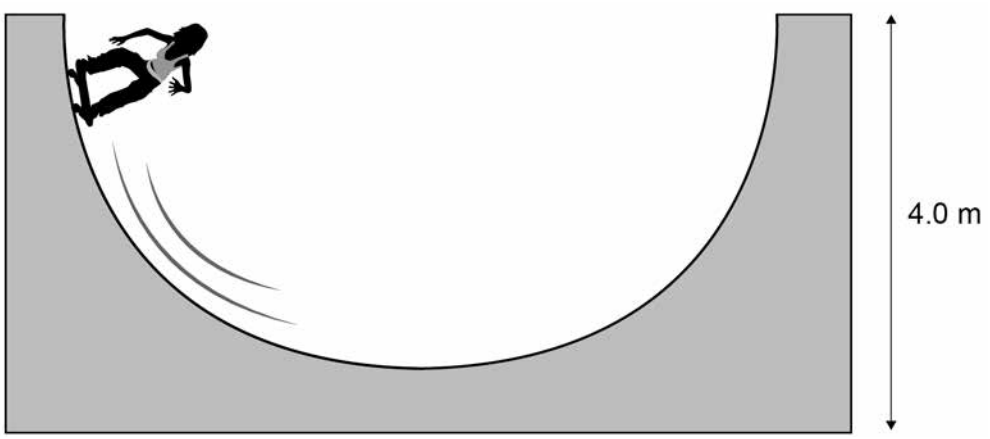
6.5.4.1.2 Speed

Question 01

June 2018 | 8464/P/1F | Original Q3

0 3 **Figure 5** shows a girl skateboarding on a semi-circular ramp.

Figure 5



The girl has a mass of 50 kg

0 3 . 1 Calculate the gravitational potential energy (g.p.e.) of the girl at the top of the ramp.

Use the equation:

g.p.e. = mass × gravitational field strength × height

gravitational field strength = 9.8 N/kg

[2 marks]

g.p.e. = _____ J

0 3 . 2 The girl has a speed of 7 m/s at the bottom of the ramp.

Calculate the kinetic energy of the girl at the bottom of the ramp.

Use the equation:

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

[2 marks]

Kinetic energy = _____ J

6.5.4.1.2 Speed

Question 01 · continued

0 3 . 3 Not all of the g.p.e. has been transferred to kinetic energy.

Which **two** statements explain why?

[2 marks]

Tick **two** boxes.

Some energy is wasted. ☐

The mass of the girl is too low. ☐

The ramp is not high enough. ☐

The g.p.e. of the girl is not zero. ☐

The speed of the girl is too great. ☐

0 3 . 4 Explain how lubricating the wheels of the skateboard can increase the speed of the girl.

Use ideas about energy in your explanation.

[3 marks]

9

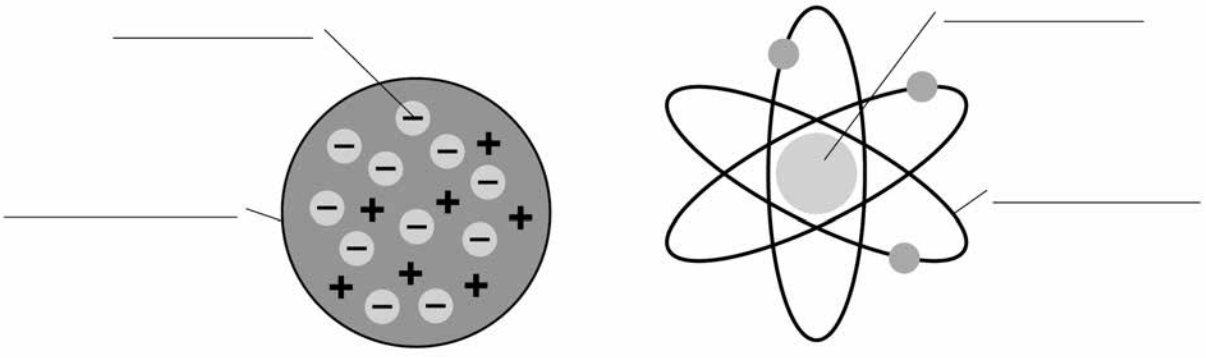
6.5.4.1.2 Speed

Question 02

June 2018 | 8464/P/1F | Original Q6

0 6 **Figure 9** shows two models of the atom.

Figure 9



0 6 . 1 Write the labels on **Figure 9**

Choose the answers from the box.

[4 marks]

atom	**electron**	**nucleus**
neutron	**orbit**	**proton**

0 6 . 2 Explain why the total positive charge in every atom of an element is always the same.

[2 marks]

Question 6 continues on the next page

6.5.4.1.2 Speed

Question 02 · continued

0 6 . 3 The results from the alpha particle scattering experiment led to the nuclear model.

Alpha particles were fired at a thin film of gold at a speed of 7% of the speed of light.

Determine the speed of the alpha particles.

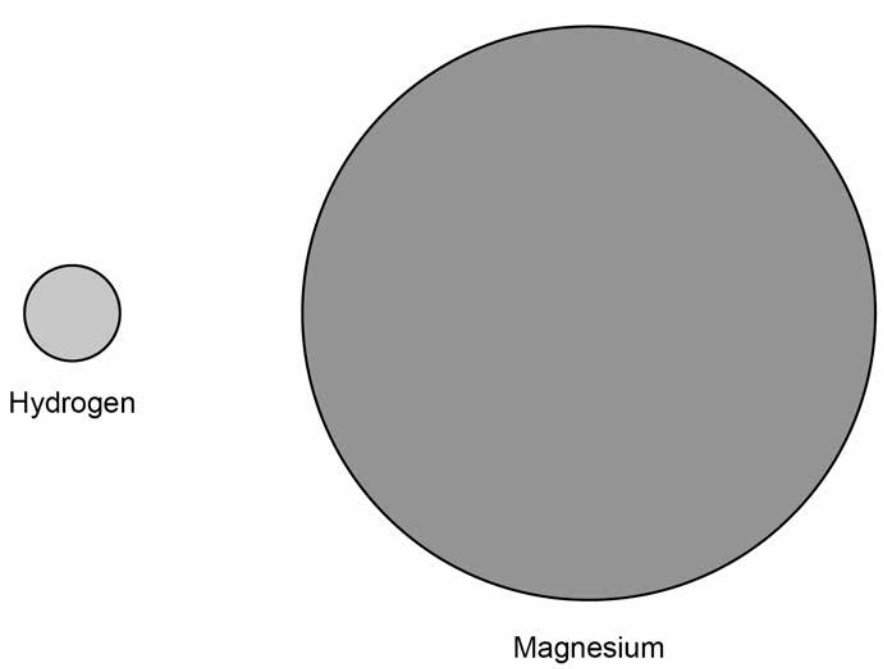
Speed of light = 300 000 000 m/s

[2 marks]

Speed = _____ m/s

0 6 . 4 **Figure 10** shows two atoms represented as solid spheres.

Figure 10



A hydrogen atom has a radius of 2.5×10^{-11} m

Determine the radius of a magnesium atom.

Use measurements from **Figure 10**

[2 marks]

Radius = _____ m

10

6.5.4.1.2 Speed

Question 03

June 2018 | 8464/P/2F | Original Q1

0 1 . 1 Which of these is a scalar quantity?

[1 mark]

Tick **one** box.

displacement ☐

distance ☐

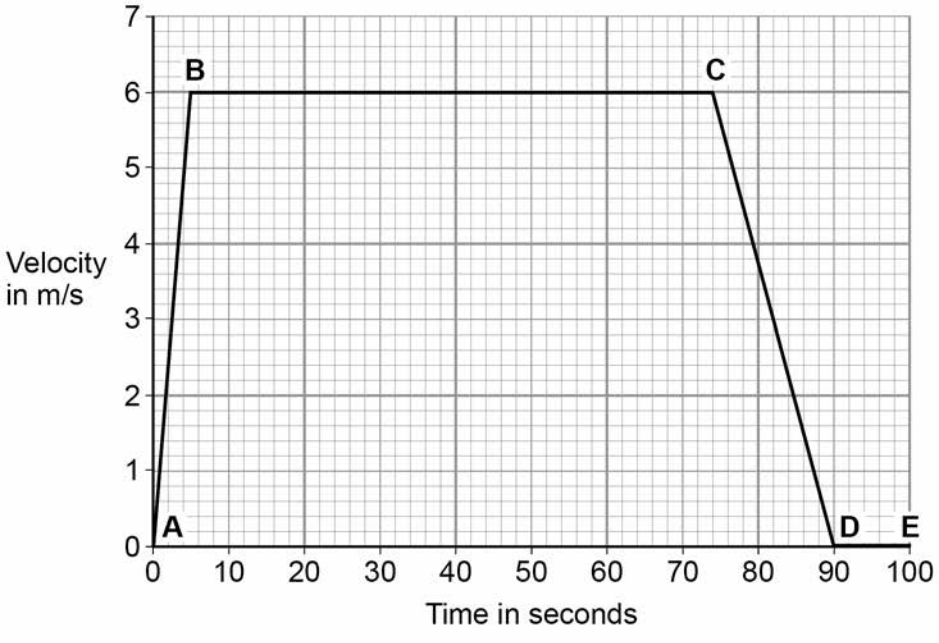
force ☐

velocity ☐

0 1 . 2 A woman cycled along a straight flat road.

Figure 1 shows how the woman's velocity changed with time.

Figure 1



Which part of the graph shows the woman moving at constant velocity?

[1 mark]

Tick **one** box.

BC ☐ **CD** ☐ **DE** ☐

Question 03 · continued

0 1 . 3 Which part of the graph shows the woman stationary?

[1 mark]

Tick **one** box.

BC ☐ **CD** ☐ **DE** ☐

Between points **A** and **B** the woman was accelerating.

0 1 . 4 Use **Figure 1** to determine the total time for which she was accelerating.

[1 mark]

Time = _____ s

0 1 . 5 Use **Figure 1** to determine her increase in velocity between points **A** and **B**.

[1 mark]

Increase in velocity = _____ m/s

0 1 . 6 Calculate her acceleration between points **A** and **B**.

Use the equation:

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

[2 marks]

Acceleration = _____ m/s^2

Question 1 continues on the next page

6.5.4.1.2 Speed

Question 03 · continued

0 1 . 7 Estimate how a typical cycling speed of 6 m/s compares with a typical walking speed.

[1 mark]

Tick **one** box.

about twice as fast ☐

about four times faster ☐

about eight times faster ☐

8

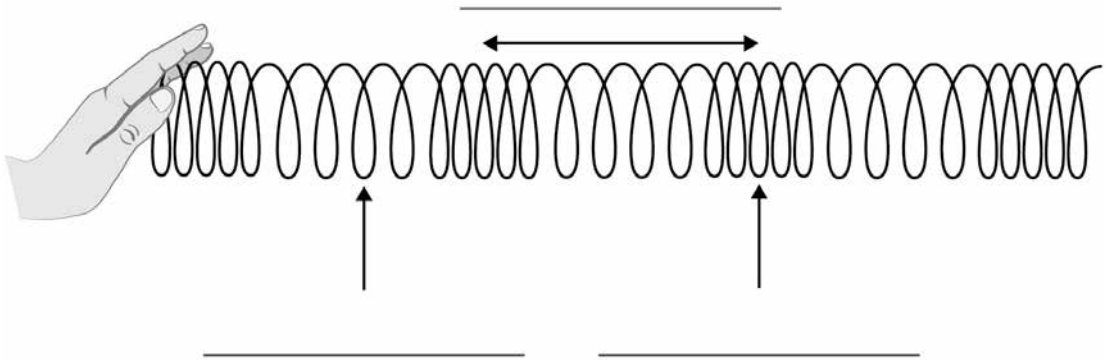
6.5.4.1.2 Speed

Question 04

June 2018 | 8464/P/2F | Original Q2

0 2 **Figure 2** shows a slinky spring used to model a sound wave.

Figure 2



0 2 . 1 Label the arrows on **Figure 2**

Choose the answers from the box.

[3 marks]

amplitude	**compression**	**frequency**
rarefaction		**wavelength**

0 2 . 2 What type of wave is a sound wave?

[1 mark]

Tick **one** box.

- electromagnetic ☐
- longitudinal ☐
- transverse ☐

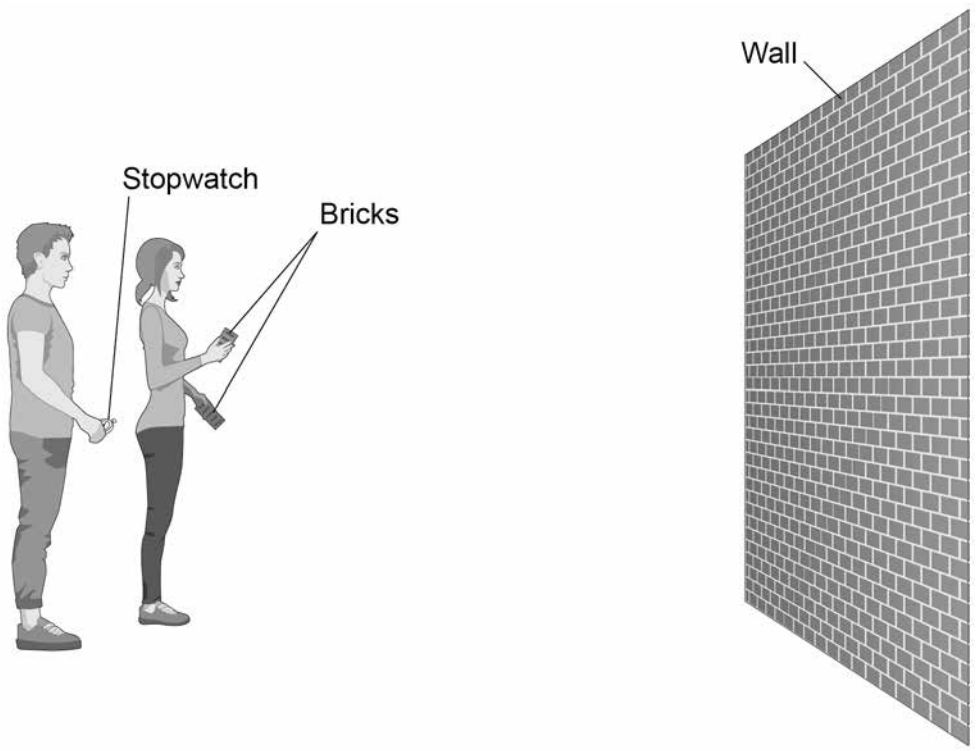
Question 2 continues on the next page

6.5.4.1.2 Speed

Question 04 · continued

0 2 . 3 **Figure 3** shows two students measuring the speed of sound in air.

Figure 3



One student bangs two bricks together.

The sound wave produced is reflected from the wall and travels back to the students.

Describe how they can determine the speed of sound.

[4 marks]

8

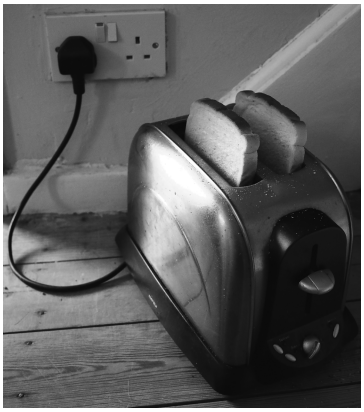
6.5.4.1.2 Speed

Question 05

June 2019 | 8464/P/1F | Original Q5

0 5 **Figure 7** shows a toaster.

Figure 7



The toaster is connected to the mains supply using a three-core cable.

0 5 . 1 What is the function of the earth wire inside the cable?

[1 mark]

Tick (✓) **one** box.

To carry the current from the supply to the toaster ☐

To complete the circuit in the toaster ☐

To melt if a fault occurs inside the toaster ☐

To stop the metal case of the toaster becoming live if a fault occurs ☐

0 5 . 2 Complete the sentences.

Choose answers from the box.

[3 marks]

blue	**brown**	**orange**	**white**	**yellow**

The insulation around the earth wire is green and _____ .

The insulation around the live wire is _____ .

The insulation around the neutral wire is _____ .

6.5.4.1.2 Speed

Question 05 · continued

0 5 . 3 The toaster is switched on for 120 seconds.

The power of the toaster is 850 watts.

Calculate the energy transferred by the toaster.

Use the equation:

energy transferred = power × time

[2 marks]

Energy transferred = _____ J

0 5 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

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

When bread is lowered into the toaster, a spring is stretched. The stretched spring stores _____ energy.

After the bread is toasted, the spring makes the toast move upwards. As the speed of the toast increases, the _____ energy of the toast increases.

6.5.4.1.2 Speed

Question 05 · continued

0 5 . 5 Write the equation which links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

0 5 . 6 The toast was moved upwards by the spring.

The change in gravitational potential energy of the toast was 0.049 J

The mass of the toast was 0.050 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the toast.

[3 marks]

Change in height = _____ m

12

6.5.4.1.2 Speed

Question 06

June 2019 | 8464/P/2F | Original Q3

0 3 **Figure 4** shows two children playing table tennis.

The boy hits the ball from one end of the table.

Figure 4



0 3 . 1 Why does the velocity of the ball change when the boy hits it?

[1 mark]

Tick (✓) **one** box.

The direction of the ball does not change. ☐

There is a resultant force on the ball. ☐

The mass of the ball increases. ☐

The speed of the ball is constant. ☐

6.5.4.1.2 Speed

Question 06 · continued

0 3 . 2 The ball has an average speed of 11 m/s

The ball takes 0.25 s to travel the same distance as the length of the table.

Calculate the length of the table.

Use the equation:

distance travelled = speed × time

[2 marks]

Length of table = _____ m

Question 3 continues on the next page

6.5.4.1.2 Speed

Question 06 · continued

0 3 . 3 A table tennis ball should only be used if it bounces to at least 75% of the height it was dropped from.

A manufacturer tested a table tennis ball.

Table 1 shows the results.

Table 1

Height ball was dropped from in cm	Height of bounce in cm
30.0	25.1

Determine whether the ball can be used.

Use the data from **Table 1**.

[3 marks]

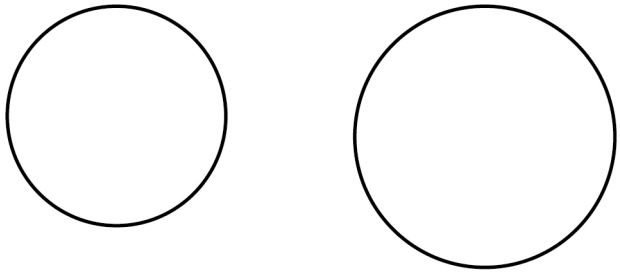
6.5.4.1.2 Speed

Question 06 · continued

0 3 . 4 **Figure 5** shows two table tennis balls.

The balls are different sizes but have the same mass.

Figure 5



Both balls were dropped onto the table from the same height.

After they were dropped, the resultant force on the smaller ball was greater than the resultant force on the larger ball.

Explain why.

[2 marks]

8

6.5.4.1.2 Speed

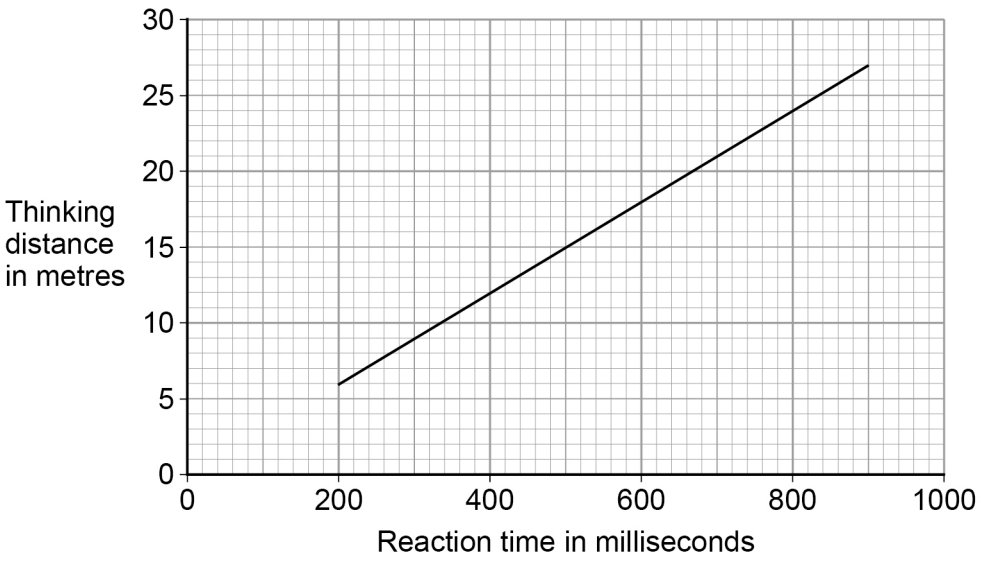
Question 07

June 2019 | 8464/P/2F | Original Q4

0 4 The thinking distance of a car depends on the reaction time of the driver.

Figure 6 shows how thinking distance varies with reaction time for a car travelling at 30 m/s

Figure 6



0 4 . 1 The reaction time of a driver can double if the driver is distracted.

Explain the effect doubling the reaction time has on the thinking distance.

Use data from **Figure 6**.

[2 marks]

0 4 . 2 Give the reason why there are no values of thinking distance for reaction times less than 200 milliseconds.

[1 mark]

Question 07 · continued

A driver measured her reaction time using an online test. She did the test five times.

Table 2 shows the results.

Table 2

Reaction time in milliseconds				
258	265	302	248	327

0 4 . 3 How does the data in **Table 2** show that it was important that the driver did the test five times?

[1 mark]

0 4 . 4 Calculate the mean reaction time of the driver.

[2 marks]

Mean reaction time = _____ ms

0 4 . 5 The driver is driving her car at 30 m/s

Determine the thinking distance.

Use **Figure 6** and your answer from Question **04.4**

[1 mark]

Thinking distance = _____ m

6.5.4.1.2 Speed

Question 07 · continued

0 4 . 6 The driver applies the brakes and the car comes to a stop.

The force exerted by the brakes affects the braking distance.

Give **two** other factors that affect the braking distance.

[2 marks]

1 _____

2 _____

0 4 . 7 Write down the equation that links distance, force and work done.

[1 mark]

_____

0 4 . 8 When the driver applies the brakes, there is a constant resultant force of 6.0 kN on the car.

The car travels a distance of 75 m before stopping.

Calculate the work done in stopping the car.

[3 marks]

_____

_____

_____

_____

_____

_____

Work done = _____ J

13

6.5.4.1.2 Speed

Question 08

June 2019 | 8464/P/2F | Original Q6

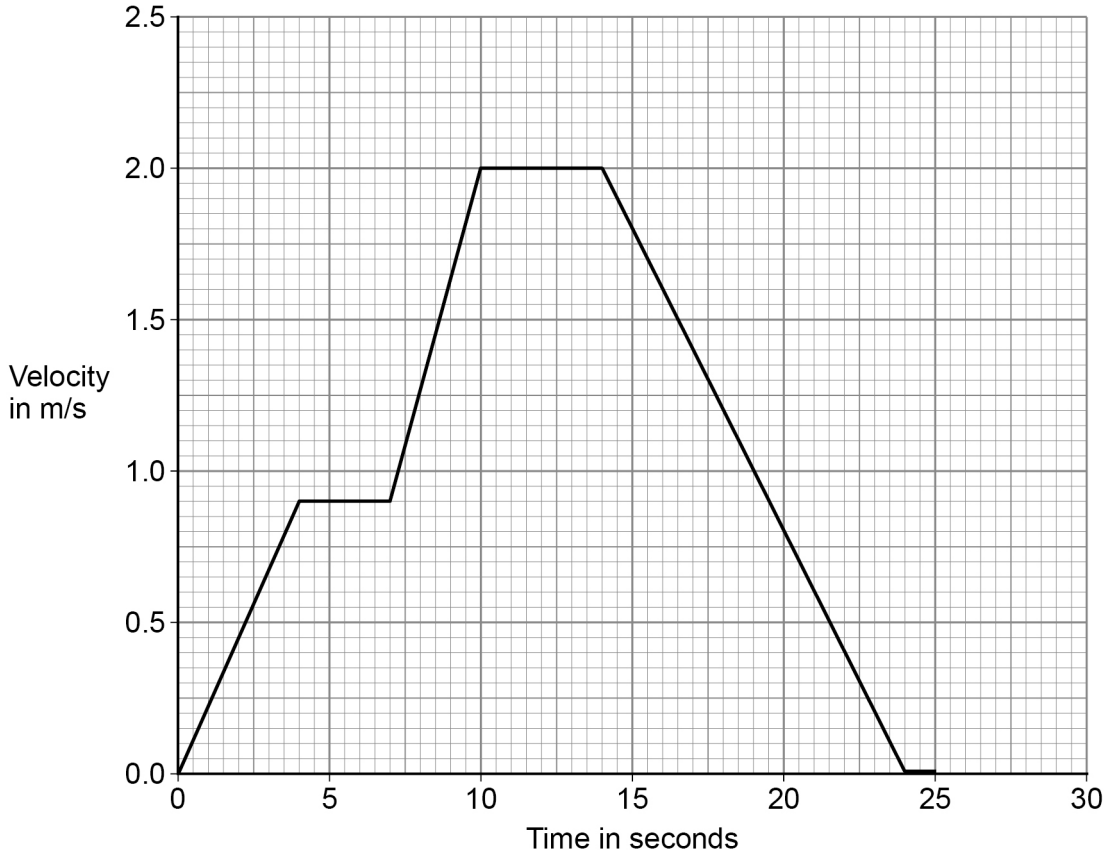
0 6 **Figure 9** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 9



Figure 10 is a velocity–time graph for part of the runner's warm-up.

Figure 10



6.5.4.1.2 Speed

Question 08 · continued

0 6 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = _____ s

0 6 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = _____ m/s^2

Question 6 continues on the next page

6.5.4.1.2 Speed

Question 08 · continued

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

0 6 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

0 6 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

0 6 . 5 The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

[3 marks]

Wavelength = _____ m

6.5.4.1.2 Speed

Question 08 · continued

0 6 . 6 **Table 3** shows some information about four types of Bluetooth.

Table 3

Type	Power in milliwatts	Range in metres
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

11

6.5.4.1.2 Speed

Question 09

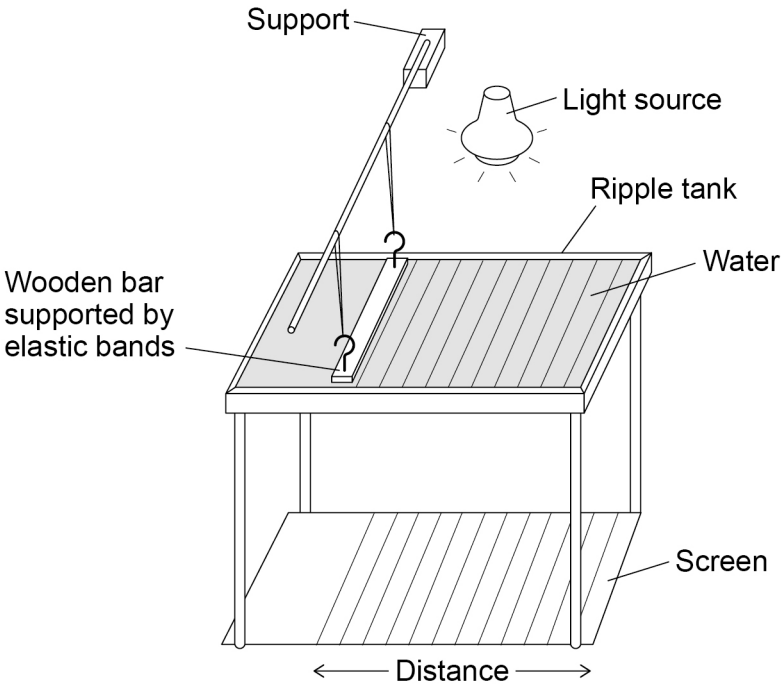
June 2019 | 8464/P/2F | Original Q7

0 7 **Figure 11** shows the equipment a teacher used to determine the speed of a water wave.

The equipment includes:

- a ripple tank filled with water
- a wooden bar that creates ripples on the surface of the water
- a light source which causes a shadow of the ripples on the screen.

Figure 11



0 7 . 1 Describe how equipment in **Figure 11** can be used to measure the wavelength, frequency and speed of a water wave.

[6 marks]

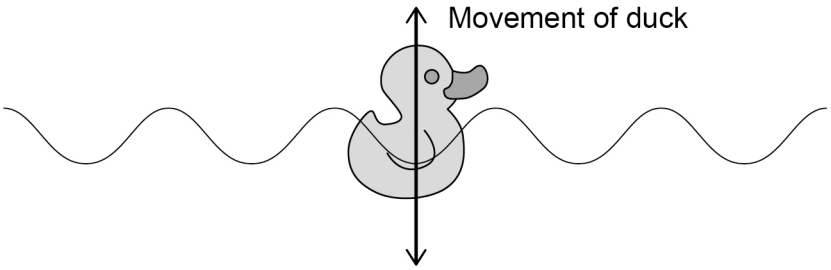
6.5.4.1.2 Speed

Question 09 · continued

The teacher put a plastic duck in the ripple tank as shown in **Figure 12**.

The plastic duck moved up and down as the waves in the water passed.

Figure 12



0 7 . 2 How does the movement of the plastic duck in **Figure 12** demonstrate that water waves are transverse?

[1 mark]

Question 7 continues on the next page

6.5.4.1.2 Speed

Question 09 · continued

0 7 . 3 The teacher measured the maximum height and the minimum height of the plastic duck above the screen as the wave passed.

The teacher repeated his measurements.

Table 4 shows the teacher's measurements.

Table 4

Maximum height in mm	509	513	511
Minimum height in mm	503	498	499

Calculate the mean amplitude of the water wave.

[3 marks]

Mean amplitude = _____ mm

10

6.5.4.1.2 Speed

Question 10

November 2020 | 8464/P/1F | Original Q4

0 4 A scientist had a balloon which was filled with air.

0 4 . 1 Which statement describes how air particles move?

[1 mark]

Tick (✓) **one** box.

- At random speeds in random directions ☐
- At random speeds in the same direction ☐
- At the same speed in random directions ☐
- At the same speed in the same direction ☐

The temperature of the air was 19 °C

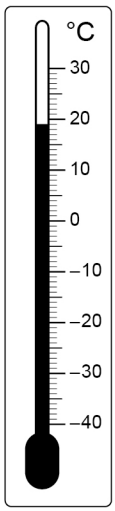
The scientist dipped the balloon into liquid nitrogen.

The temperature of the liquid nitrogen was −196 °C

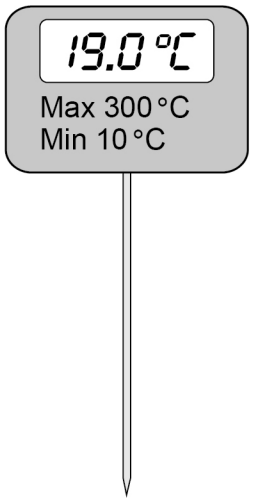
0 4 . 2 Which thermometer could be used to measure the temperature of the liquid nitrogen?

[1 mark]

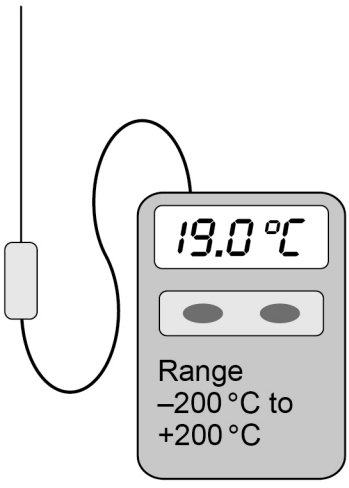
Tick (✓) **one** box.



☐



☐



☐

6.5.4.1.2 Speed

Question 10 · continued

0 4 . 3 The scientist wore special insulating gloves when putting the balloon into the liquid nitrogen.

Suggest why.

[1 mark]

0 4 . 4 When the balloon was put into liquid nitrogen the temperature of the air in the balloon decreased.

Complete the sentences.

Choose answers from the box.

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

[2 marks]

decreased	**stayed the same**	**increased**

As the air in the balloon cooled down, the speed of the particles

_____ . This is because the kinetic energy of the

particles _____ .

Question 4 continues on the next page

0 4 . 5 The air in the balloon had a mass of 0.00320 kg

The temperature of the air in the balloon decreased by 215 °C

The change in thermal energy of the air in the balloon was 860 J

Calculate the specific heat capacity of the air in the balloon.

Use the Physics Equations Sheet.

[3 marks]

Specific heat capacity = _____ J/kg°C

0 4 . 6 The liquid nitrogen boiled.

What happens to the temperature of nitrogen as it boils?

[1 mark]

Tick (✓) **one** box.

- Temperature decreases ☐
- Temperature increases ☐
- Temperature stays the same ☐

6.5.4.1.2 Speed

Question 10 · continued

The scientist recorded measurements to calculate the specific latent heat of vaporisation of nitrogen.

0 4 . 7 What is meant by vaporisation?

[1 mark]

Tick (✓) **one** box.

- A change of state from liquid to gas ☐
- A change of state from solid to gas ☐
- A change of state from solid to liquid ☐

0 4 . 8 The mass of nitrogen that vaporised was 0.0072 kg

1440 J of energy was transferred to the nitrogen as it vaporised.

Calculate the specific latent heat of vaporisation of nitrogen.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of vaporisation = _____ J/kg

13

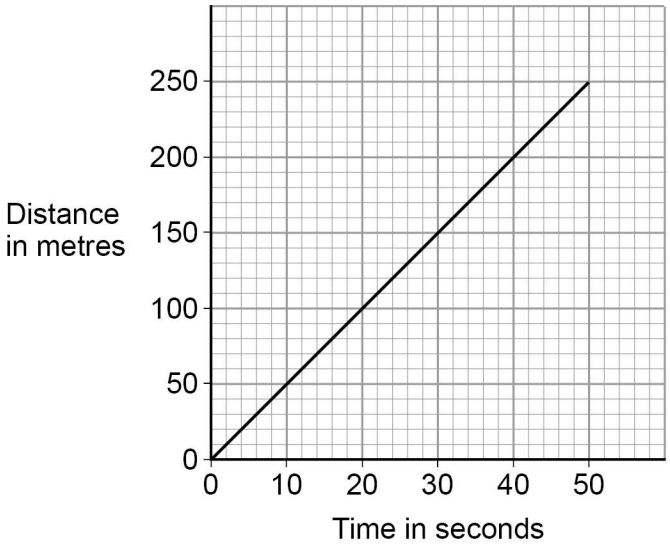
6.5.4.1.2 Speed

Question 11

November 2020 | 8464/P/2F | Original Q4

0 4 **Figure 5** shows a distance-time graph for 50 seconds of a bicycle ride.

Figure 5



0 4 . 1 The gradient of the distance-time graph gives the speed of the bicycle.

Determine the speed of the bicycle.

[2 marks]

Speed = _____ m/s

Question 11 · continued

0 4 . 2 Which force acting on the moving bicycle is a non-contact force?

[1 mark]

Tick (✓) **one** box.

Air resistance ☐

Friction ☐

Gravitational force ☐

Normal contact force ☐

0 4 . 3 The bicycle travels a distance of 250 m

The bicycle exerts a constant horizontal force of 30 N on the ground.

Calculate the work done.

Use the equation:

work done = force × distance

Choose the unit from the box.

[3 marks]

J	**kg**	**m**

Work done = _____ Unit _____

6.5.4.1.2 Speed

Question 11 · continued

0 4 . 4 The bicycle travels at a constant speed.

Complete the sentences.

Choose answers from the box.

[3 marks]

chemical	**frictional**	**kinetic**
magnetic		**tension**

As the bicycle moves, work is done against _____ forces.

There is no change in the cyclist's _____ store of energy.

There is a decrease in the cyclist's _____ store of energy.

9

6.5.4.1.2 Speed

Question 12

0 2 In a sport called far-leaping, an athlete uses a long pole to cross a river.

Figure 4 shows an athlete far-leaping.

Figure 4

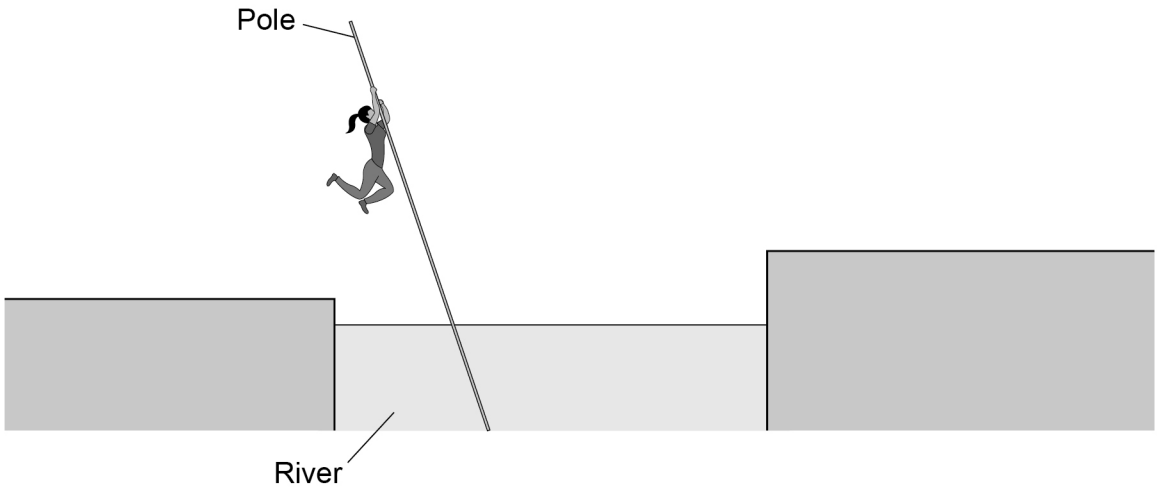
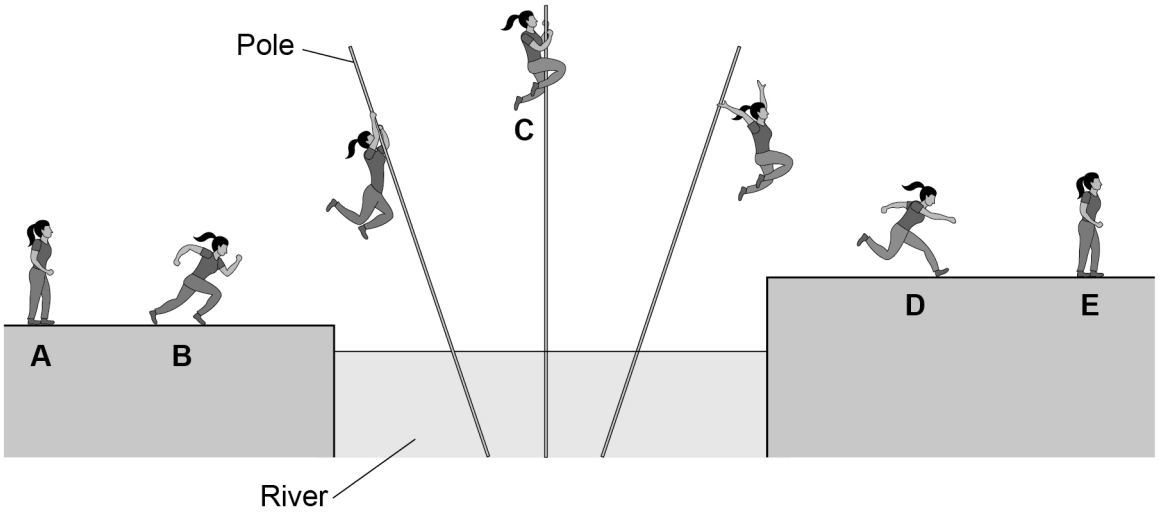


Figure 5 shows the athlete in different stages of far-leaping.

Figure 5



6.5.4.1.2 Speed

Question 12 · continued

0 2 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

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

Between positions **A** and **B** the athlete speeds up. There is

an increase in the athlete's _____ energy and

a decrease in the athlete's _____ store of energy.

0 2 . 2 Between positions **B** and **C** the athlete jumps to the pole and climbs up it.

Which statement describes a change in the athlete's energy between positions **B** and **C**?

[1 mark]

Tick (✓) **one** box.

Elastic potential energy decreases. ☐

Elastic potential energy increases. ☐

Gravitational potential energy decreases. ☐

Gravitational potential energy increases. ☐

Question 2 continues on the next page

Question 12 · continued

0 2 . 3 The pole falls over from position **C**. The athlete lets go of the pole and lands at position **D**.

The change in height of the athlete between positions **C** and **D** is 3.0 m.

mass of athlete = 50 kg

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the athlete between positions **C** and **D**.

Use the equation:

change in gravitational potential energy = mass × gravitational field strength × change in height

[2 marks]

Change in gravitational potential energy = _____ J

6.5.4.1.2 Speed

Question 12 · continued

0 2 . 4 The kinetic energy of the athlete at position **D** is 1600 J.

mass of athlete = 50 kg

Calculate the speed of the athlete at position **D**.

Use the equation:

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

Choose the unit from the box.

[3 marks]

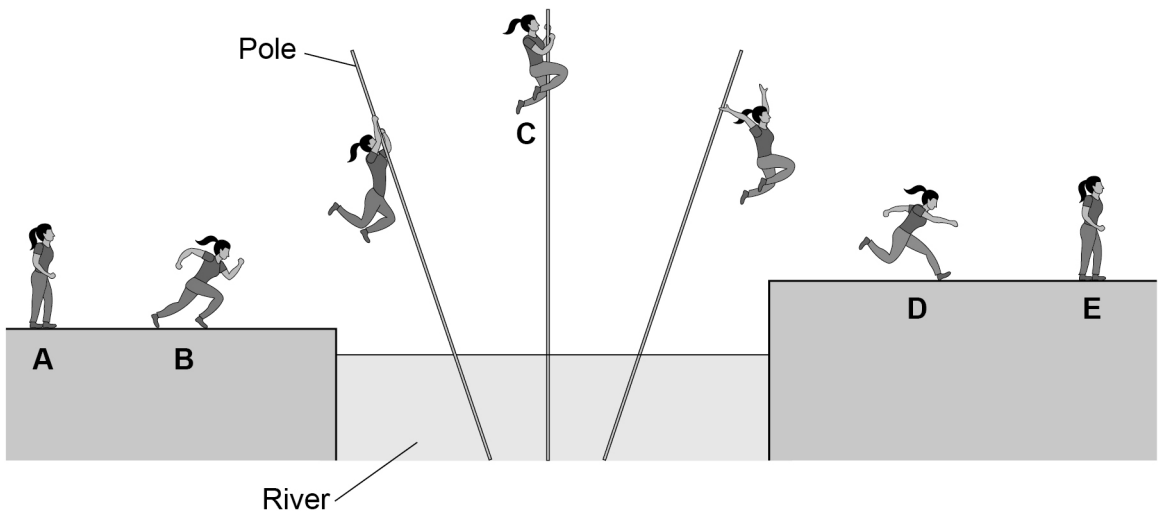
m/s	J/kg	J/s

Speed = _____ Unit _____

Question 2 continues on the next page

Figure 5 is repeated below.

Figure 5



0 2 . 5 At positions **A** and **E**, the athlete is standing still.

Why does the athlete have less energy in position **E** than in position **A**?

[1 mark]

Tick (✓) **one** box.

Energy has been transferred from the athlete to the air. ☐

The air temperature has decreased. ☐

The height of the athlete above the water has increased. ☐

6.5.4.1.2 Speed

Question 12 · continued

0 2 . 6 Athletes have a large power output when they are far-leaping.

What is meant by the power of an athlete?

[1 mark]

Tick (✓) **one** box.

The rate at which the athlete transfers energy. ☐

The size of the maximum force exerted by the athlete. ☐

The total energy transferred by the athlete. ☐

0 2 . 7 A second athlete crossed the same river by far-leaping.

The second athlete had less power than the first athlete when running between position **A** and position **B**.

Complete the sentences.

Choose answers from the box.

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

[2 marks]

less than	**the same as**	**more than**

Two factors that could explain why the second athlete had less power than the first athlete are:

1. The time taken by the second athlete to run between position **A** and position **B** was _____ the first athlete.

2. The work done by the second athlete was _____ the first athlete.

12

6.5.4.1.2 Speed

Question 13

November 2021 | 8464/P/2F | Original Q3

0 3 The stopping distance of a car is the sum of the thinking distance and the braking distance.

0 3 . 1 The thinking distance is affected by the reaction time of the driver.

Which **two** of the following can affect the reaction time of the driver?

[2 marks]

Tick (✓) **two** boxes.

- Damaged brakes ☐
- Taking drugs ☐
- Tiredness ☐
- Wet roads ☐
- Worn tyres ☐

6.5.4.1.2 Speed

Question 13 · continued

Scientists measured the reaction time for drivers of different ages.

Figure 6 shows the results.

Figure 6



0 3 . 2 At what age did the drivers have the lowest mean reaction time?

[1 mark]

Age = _____ years

0 3 . 3 What was the lowest mean reaction time?

[1 mark]

Time = _____ seconds

Question 3 continues on the next page

6.5.4.1.2 Speed

Question 13 · continued

The braking distance of a car is the distance travelled between the driver applying the brakes and the car stopping.

0 3 . 4 Complete the sentences.

Choose answers from the box.

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

[2 marks]

decreases	**stays the same**	**increases**

When the brakes are applied, the kinetic energy of the

car _____ .

The temperature of the brakes _____ .

6.5.4.1.2 Speed

Question 13 · continued

0 3 . 5 A car is travelling at a speed of 12 m/s.

The driver applies the brakes and the car decelerates at a constant 3.0 m/s^2.

Calculate the braking distance of the car.

Use the equation:

$$\text{braking distance} = \frac{(\text{speed})^2}{2 \times \text{deceleration}}$$

Choose the unit from the box.

[3 marks]

m	kg	s

Braking distance = _____ Unit _____

0 3 . 6 To pass the UK driving test, people must know the typical stopping distance of a car at certain speeds.

Suggest **one** reason why.

[1 mark]

10

6.5.4.1.2 Speed

Question 14

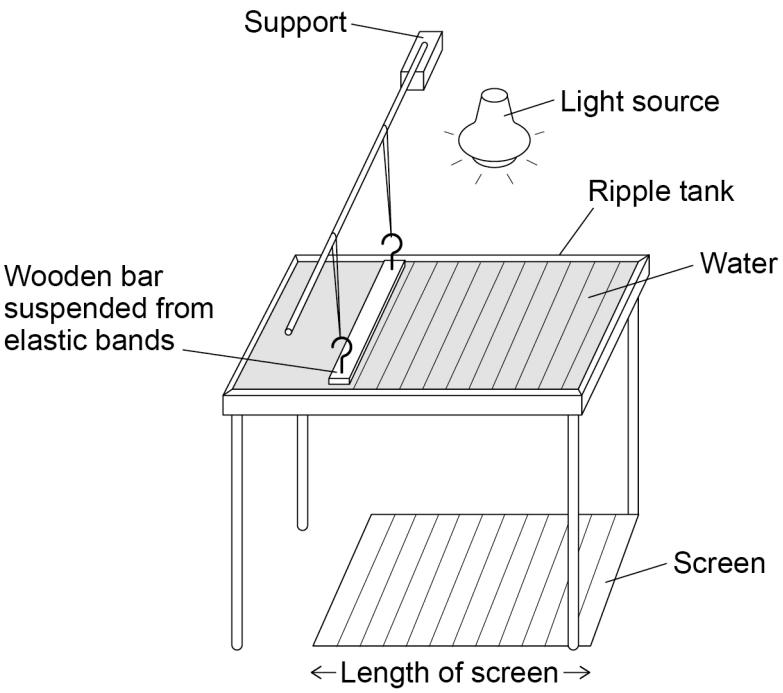
November 2021 | 8464/P/2F | Original Q4

0 4 **Figure 7** shows a ripple tank.

The wooden bar vibrates up and down producing waves on the water.

The light source produces shadows of the water waves on the screen.

Figure 7



0 4 . 1 Describe how the student can measure the frequency and wavelength of the waves.

You should refer to any equipment the student needs in your answer.

[4 marks]

6.5.4.1.2 Speed

Question 14 · continued

A student measured the frequency and wavelength of the waves produced.

Table 1 shows some of the results.

Table 1

Reading	1	2	3	Mean
Frequency in hertz	12.8	12.4	12.3	X

0 4 . 2 Calculate value **X** in **Table 1**.

[1 mark]

X = _____ Hz

0 4 . 3 Why is it a good idea to take repeat readings and then calculate a mean?

[1 mark]

Tick (✓) **one** box.

To reduce the effect of random errors. ☐

To reduce the effect of systematic errors. ☐

To reduce the effect of zero errors. ☐

Question 4 continues on the next page

6.5.4.1.2 Speed

Question 14 · continued

0 4 . 4 The student changed the frequency of the waves in the ripple tank to 20 Hz.

Calculate the period of the waves.

Use the equation:

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

[2 marks]

Period = _____ s

0 4 . 5 At a frequency of 20 Hz the wavelength of the waves was 0.012 m.

Calculate the wave speed.

Use the equation:

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

[2 marks]

Wave speed = _____ m/s

10

6.5.4.1.2 Speed

Question 15

November 2021 | 8464/P/2F | Original Q5

0 5 Scientists are developing a rocket aeroplane designed to travel much faster than jet aeroplanes.

0 5 . 1 The rocket aeroplane must accelerate along a runway to take off.

What would happen to the air resistance acting on the rocket aeroplane as it accelerates?

[1 mark]

0 5 . 2 An upward force called lift will act on the wings of the rocket aeroplane when it moves.

Complete the sentence.

Choose the answer from the box.

[1 mark]

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

As the rocket aeroplane starts to accelerate along the runway, the lift force on the wings will be _____ the weight of the rocket aeroplane.

Question 5 continues on the next page

6.5.4.1.2 Speed

Question 15 · continued

0 5 . 3 During the first 14 seconds the average speed of the rocket aeroplane on the runway will be 35 m/s.

Calculate the distance that the rocket aeroplane will travel during the first 14 seconds.

Use the equation:

distance travelled = average speed × time

[2 marks]

Distance travelled = _____ m

0 5 . 4 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 5 . 5 When the rocket aeroplane travels a distance of 270 m on the runway the engines will do 54 000 000 J of work.

Calculate the average force exerted by the engines.

[3 marks]

Average force = _____ N

6.5.4.1.2 Speed

Question 15 · continued

0 5 . 6 The rocket aeroplane will fly at a greater height than a jet aeroplane.

The height that an aeroplane flies at affects the radiation dose a passenger will receive each hour.

Table 2 shows the speed of each aeroplane and the radiation dose a passenger will receive each hour.

Table 2

Aeroplane	Speed in metres per second	Radiation dose each hour in millisieverts
Rocket aeroplane	8000	0.006
Jet aeroplane	250	0.003

Exposure to ionising radiation has risks and possible consequences.

Evaluate the risks and possible consequences of flying in a rocket aeroplane and in a jet aeroplane.

Assume the same journey is made in each aeroplane.

Use values from **Table 2**.

[6 marks]

14

6.5.4.1.2 Speed

Question 16

June 2022 | 8464/P/1F | Original Q2

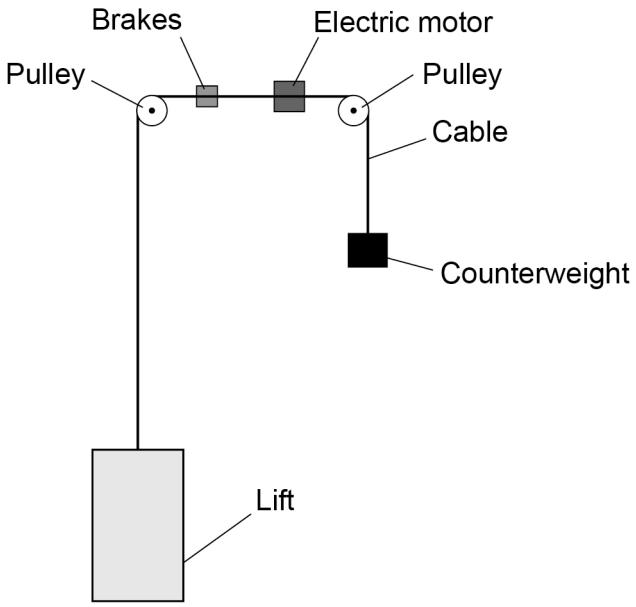
0 2 **Figure 3** shows a lift near the bottom of a building.

The lift is attached by a cable to a counterweight.

An electric motor moves the lift.

The lift is moving up.

Figure 3



0 2 . 1 As the lift moves up, how far does the counterweight move down?

[1 mark]

Tick (✓) **one** box.

A shorter distance than the lift. ☐

The same distance as the lift. ☐

A longer distance than the lift. ☐

6.5.4.1.2 Speed

Question 16 · continued

0 2 . 2 What happens to the gravitational potential energy of the counterweight as it moves down?

[1 mark]

Tick (✓) **one** box.

It decreases ☐

It stays the same ☐

It increases ☐

0 2 . 3 Calculate the change in gravitational potential energy of the lift when it moves up 4.0 m

The mass of the lift is 1300 kg

gravitational field strength = 9.8 N/kg

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Change in gravitational potential energy = _____ J

Question 2 continues on the next page

6.5.4.1.2 Speed

Question 16 · continued

0 2 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

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

Friction between the brakes and the cable causes the speed of the lift to decrease.

As the speed decreases, there is a decrease in the _____ energy of the lift.

As the speed decreases, there is an increase in the _____ energy of the brakes.

0 2 . 5 The motor transfers different amounts of energy each time people use the lift.

Which factors affect the amount of energy transferred by the motor as the lift moves?

[2 marks]

Tick (✓) **two** boxes.

- The distance moved by the lift ☐
- The height of the building ☐
- The length of the steel cable ☐
- The maximum power of the motor ☐
- The weight of the people in the lift ☐

6.5.4.1.2 Speed

Question 16 · continued

0 2 . 6 The weight of the lift and the counterweight stretch the cable by 0.015 m

The cable acts like a spring with a spring constant of 880 000 N/m

Calculate the elastic potential energy of the stretched cable.

Use the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

[2 marks]

Elastic potential energy = _____ J

0 2 . 7 A lift system using a counterweight is more efficient than a lift system that does not use a counterweight.

How does having a more efficient system affect the energy transferred by the motor?

[1 mark]

Tick (✓) **one** box.

- Less energy is transferred. ☐
- The same amount of energy is transferred. ☐
- More energy is transferred. ☐

11

6.5.4.1.2 Speed

Question 17

June 2022 | 8464/P/2F | Original Q5

0 5 The stopping distance of a car is the sum of the thinking distance and the braking distance.

0 5 . 1 Which factors affect the thinking distance?

[2 marks]

Tick (✓) **two** boxes.

- Condition of the tyres ☐
- Driving on wet roads ☐
- Mass of the car ☐
- Tiredness of the driver ☐
- Using a mobile phone ☐

0 5 . 2 Explain why a person should **not** drink alcohol and then drive.

[3 marks]

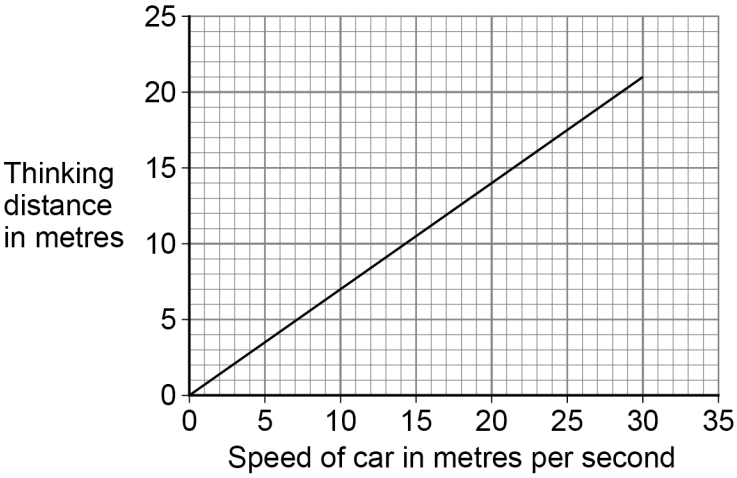
6.5.4.1.2 Speed

Question 17 · continued

The Highway Code gives information on how thinking distance depends on the speed of a car.

Figure 7 shows the information as a graph.

Figure 7



0 5 . 3 What is the speed of a car if the thinking distance is 16 m?

[1 mark]

Speed of car = _____ m/s

0 5 . 4 Describe the relationship between speed and thinking distance.

[2 marks]

_____

_____

_____

_____

0 5 . 5 The Highway Code assumes the driver's reaction time is 0.70 seconds.

Draw a line on **Figure 7** to show the relationship for a driver with a reaction time of 1.4 seconds.

[2 marks]

6.5.4.1.2 Speed

Question 17 · continued

0 5 . 6 A car accelerates at 5.0 m/s^2 over a distance of 45 m

initial velocity of the car = 0 m/s

Calculate the final velocity of the car.

Use the Physics Equations Sheet.

Give your answer to 2 significant figures.

[4 marks]

Final velocity (2 significant figures) = _____ m/s

14

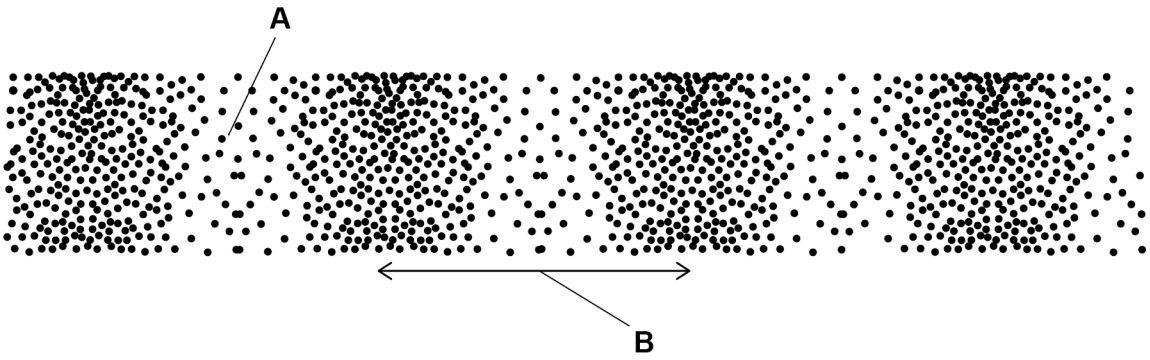
6.5.4.1.2 Speed

Question 18

June 2022 | 8464/P/2F | Original Q6

0 6 **Figure 8** shows a longitudinal wave.

Figure 8



0 6 . 1 What do the labels **A** and **B** on **Figure 8** represent?

Choose answers from the box.

[2 marks]

amplitude	**frequency**	**rarefaction**	**reflection**	**wavelength**

A _____

B _____

6.5.4.1.2 Speed

Question 18 · continued

0 6 . 2 The wave shown in **Figure 8** has a frequency of 4.0 kHz

Calculate the period of the wave.

Use the Physics Equations Sheet.

Give the unit.

[4 marks]

Period = _____ Unit _____

Question 6 continues on the next page

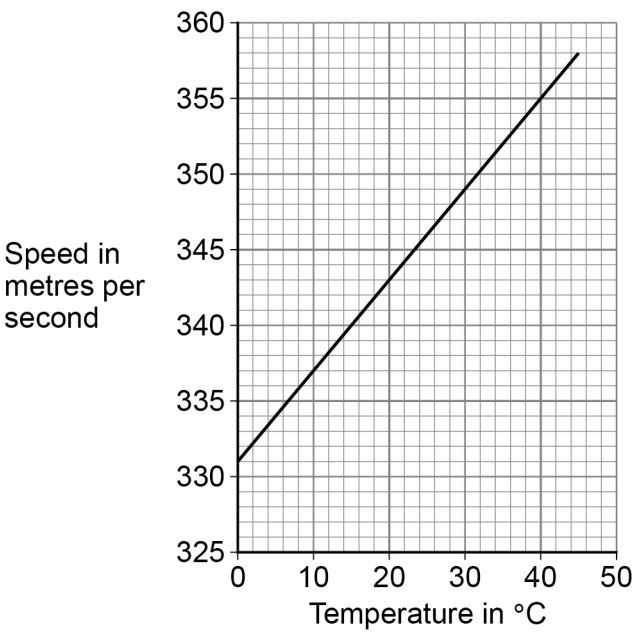
6.5.4.1.2 Speed

Question 18 · continued

Sound waves are longitudinal.

Figure 9 shows how the speed of sound varies with the temperature of the air.

Figure 9



6.5.4.1.2 Speed

Question 18 · continued

Use the Physics Equations Sheet to answer questions **06.3** and **06.4**.

0 6 . 3 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

0 6 . 4 A sound wave with a frequency of 300 Hz travels through the air.

The air has a temperature of 28.0 °C

Determine the wavelength of the sound wave.

Use **Figure 9**.

[4 marks]

Wavelength = _____ m

11

6.5.4.1.2 Speed

Question 19

0 7 **Figure 10** shows competitors in the wheelchair race at the London Marathon.

The distance of the London Marathon is 42 000 m

Figure 10



6.5.4.1.2 Speed

Question 19 · continued

Use the Physics Equations Sheet to answer questions **07.1** and **07.2**.

0 7 . 1 Write down the equation that links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 7 . 2 During the race competitors work against air resistance.

The work done against air resistance by the winner of the race was 3 360 000 J

Calculate the average air resistance acting on the winner of the race.

[3 marks]

Average air resistance = _____ N

Question 7 continues on the next page

6.5.4.1.2 Speed

Question 19 · continued

Use the Physics Equations Sheet to answer questions **07.3** and **07.4**.

0 7 . 3 Which equation links distance travelled, speed and time?

[1 mark]

Tick (✓) **one** box.

distance travelled = speed × time ☐

time = distance travelled × speed ☐

speed = distance travelled × time ☐

0 7 . 4 The distance of the London Marathon is 42 000 m

The winning time for the race was 5600 seconds.

Calculate the average speed of the winner of the race.

[3 marks]

Average speed = _____ m/s

6.5.4.1.2 Speed

Question 19 · continued

0 7 . 5 Explain why the speed of a competitor changes during the race.

[4 marks]

12

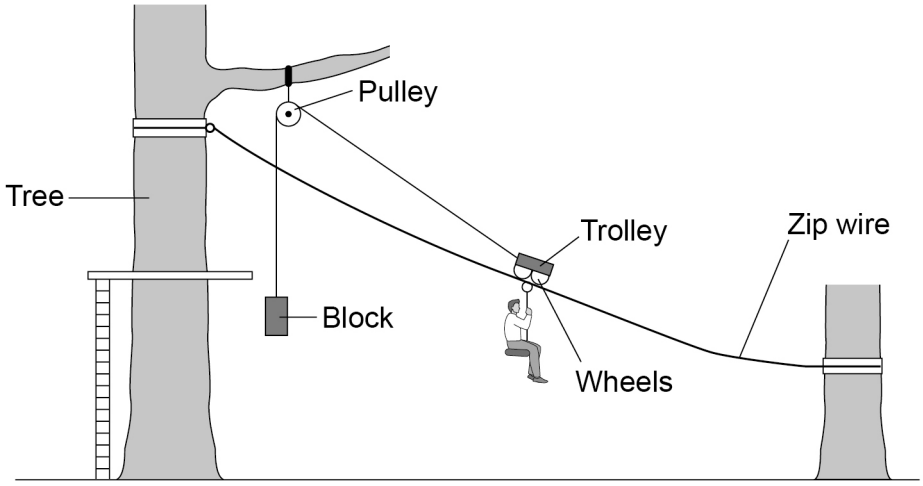
6.5.4.1.2 Speed

Question 20

June 2023 | 8464/P/1F | Original Q2

0 2 **Figure 3** shows a person using a zip wire to move from a tree to the ground.

Figure 3



As the person moves down the zip wire, the block moves upwards.

0 2 . 1 What happens to the gravitational potential energy of the person as the person accelerates down the zip wire?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

6.5.4.1.2 Speed

Question 20 · continued

0 2 . 2 What happens to the kinetic energy of the person as the person accelerates down the zip wire?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

0 2 . 3 The block is 3.4 m above the ground when the person is at the bottom of the zip wire.

mass of block = 2.5 kg

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the block.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

Question 2 continues on the next page

6.5.4.1.2 Speed

Question 20 · continued

The trolley is a seat suspended from wheels which can roll along the zip wire.

0 2 . 4 When the person reaches the end of the zip wire, the person gets off the trolley.

The block falls downwards pulling the trolley back to the top of the zip wire.

maximum speed of block = 4.8 m/s

mass of block = 2.5 kg

Calculate the maximum kinetic energy of the block.

Use the equation:

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

[2 marks]

Maximum kinetic energy = _____ J

0 2 . 5 As the trolley moves, work is done against friction.

What is the effect of this?

[1 mark]

Tick (✓) **one** box.

- Some energy is destroyed. ☐
- Some energy is transferred to the surroundings. ☐
- The total energy of the block and trolley increases. ☐

6.5.4.1.2 Speed

Question 20 · continued

0 2 . 6 The person oils the wheels on the trolley.

Explain how this will affect the speed of the person down the zip wire.

[2 marks]

9

Turn over for the next question

6.5.4.1.2 Speed

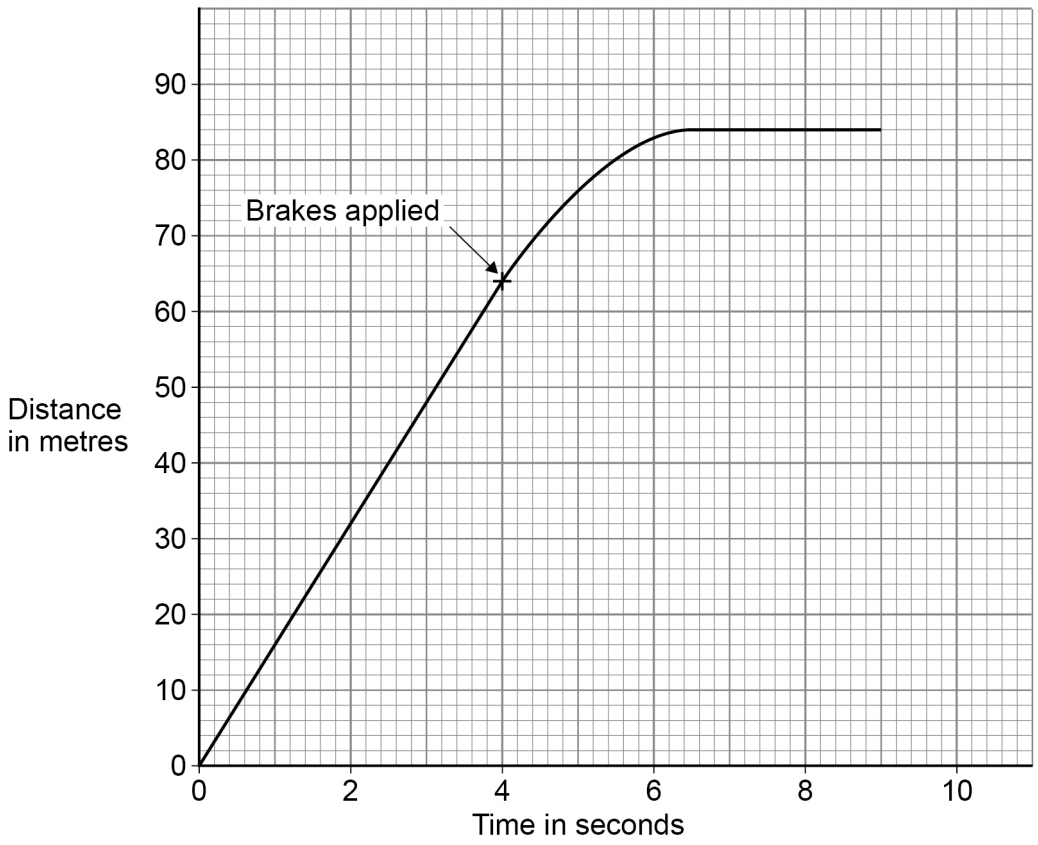
Question 21

June 2023 | 8464/P/2F | Original Q2

0 2 A car contains a device called a black box. The black box records the distance travelled and the time taken for each journey.

Figure 3 shows the distance–time graph for part of a journey.

Figure 3



0 2 . 1 Which feature of **Figure 3** shows that the car travels at a constant speed for the first 4 seconds?

[1 mark]

Tick (✓) **one** box.

The line becomes horizontal. ☐

The line goes through the origin. ☐

The line is straight. ☐

6.5.4.1.2 Speed

Question 21 · continued

0 2 . 2 After 4 seconds the driver applied the brakes and the car slowed down and stopped.

The distance the car travelled after the brakes were applied is called the braking distance.

Determine the braking distance of the car.

Use **Figure 3**.

[2 marks]

Braking distance = _____ m

The black box also records the deceleration of the car.

0 2 . 3 As the car decelerates, the velocity of the car changes by 16 m/s.

The car decelerates for 2.5 seconds.

Calculate the deceleration of the car.

Use the equation:

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

[2 marks]

Deceleration = _____ m/s^2

6.5.4.1.2 Speed

Question 21 · continued

0 2 . 4 If the black box records large decelerations, it identifies that the driving may be dangerous.

Why can large decelerations be dangerous?

[2 marks]

Tick (✓) **two** boxes.

- The brakes on the car can overheat. ☐
- The driver may lose control of the car. ☐
- The force applied by the brakes is very small. ☐
- The reaction time of the driver increases. ☐
- The thinking distance is very short. ☐

0 2 . 5 The black box monitors the speed of the car.

Describe how speed affects braking distance.

[1 mark]

8

6.5.4.1.2 Speed

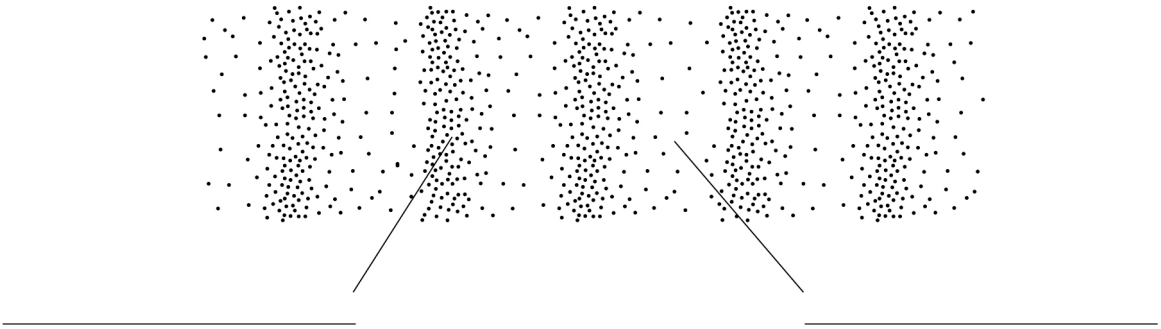
Question 22

June 2023 | 8464/P/2F | Original Q4

0 4 Sound waves are longitudinal waves.

0 4 . 1 **Figure 9** shows a sound wave.

Figure 9



Complete the labels on **Figure 9**.

Choose answers from the box.

[2 marks]

compression	**extension**	**rarefaction**
reflection		**resistance**

6.5.4.1.2 Speed

Question 22 · continued

0 4 . 2 Which of the following is true for longitudinal waves?

[1 mark]

Tick (✓) **one** box.

Longitudinal waves transfer charge. ☐

Longitudinal waves transfer energy. ☐

Longitudinal waves transfer matter. ☐

Question 4 continues on the next page

6.5.4.1.2 Speed

Question 22 · continued

Figure 10 shows a device a farmer uses to scare away birds.

Figure 10



The device emits a very loud sound.

The farmer measures the sound emitted by the device at different distances from the device.

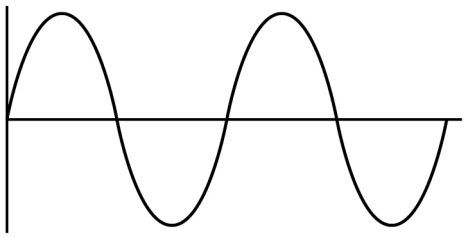
6.5.4.1.2 Speed

Question 22 · continued

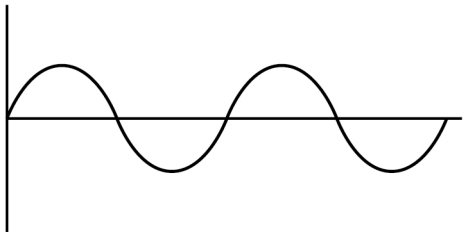
0 4 . 3 **Figure 11** shows a visual display of the sound waves at different distances from the device.

Both waves are drawn to the same scale.

Figure 11



At a distance of 80 m



At a distance of 200 m

Which property of the wave changes between 80 m and 200 m?

[1 mark]

Tick (✓) **one** box.

Amplitude ☐

Frequency ☐

Period ☐

Wavelength ☐

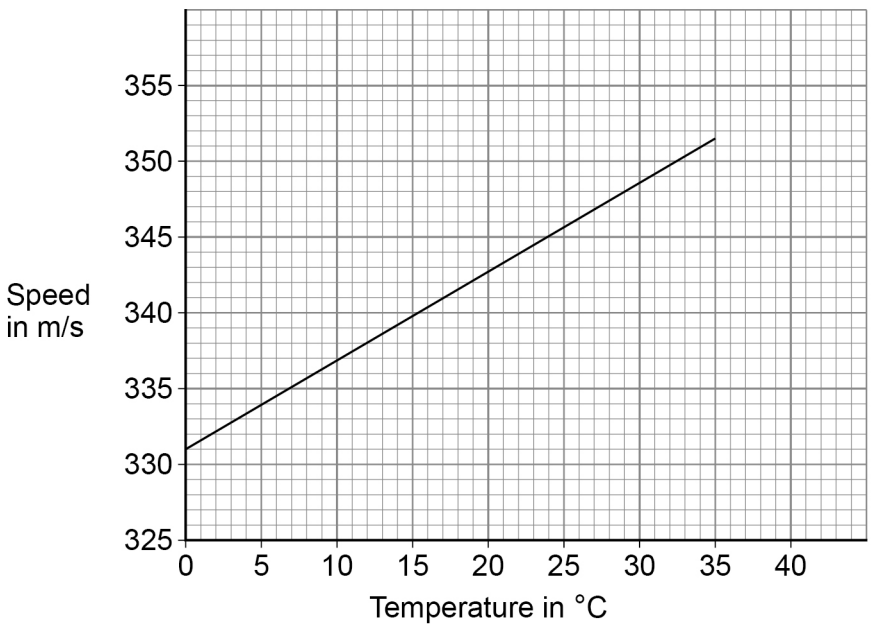
Question 4 continues on the next page

6.5.4.1.2 Speed

Question 22 · continued

Figure 12 shows how the speed of the sound emitted by the device is affected by the temperature of the air.

Figure 12



0 4 . 4 The farmer tests the device on a day when the temperature of the air is 15 °C.

What is the speed of the sound emitted by the device when the temperature of the air is 15 °C?

[1 mark]

Speed = _____ m/s

6.5.4.1.2 Speed

Question 22 · continued

0 4 . 5 The farmer stands a safe distance from the device.

It takes a time of 0.20 s for the sound to travel from the device to the farmer.

Calculate the distance between the device and the farmer.

Use your answer to Question **04.4** and the equation:

distance = speed × time

[2 marks]

Distance = _____ m

0 4 . 6 Explain how the time taken for the sound to reach the farmer is affected by the temperature of the air.

Use **Figure 12**.

[2 marks]

9

6.5.4.1.2 Speed

Question 23

June 2023 | 8464/P/2F | Original Q6

0 6 The Sun emits a continuous spectrum of electromagnetic waves.

Figure 14 names some of the groups of waves in the electromagnetic spectrum.

Figure 14

A	**B**	Infrared	Visible light	Ultraviolet	**C**	Gamma rays

0 6 . 1 Name groups **A**, **B** and **C** in **Figure 14**.

[2 marks]

A _____

B _____

C _____

0 6 . 2 Give **one** similarity and **one** difference between the properties of ultraviolet waves and gamma rays.

[2 marks]

Similarity _____

_____

Difference _____

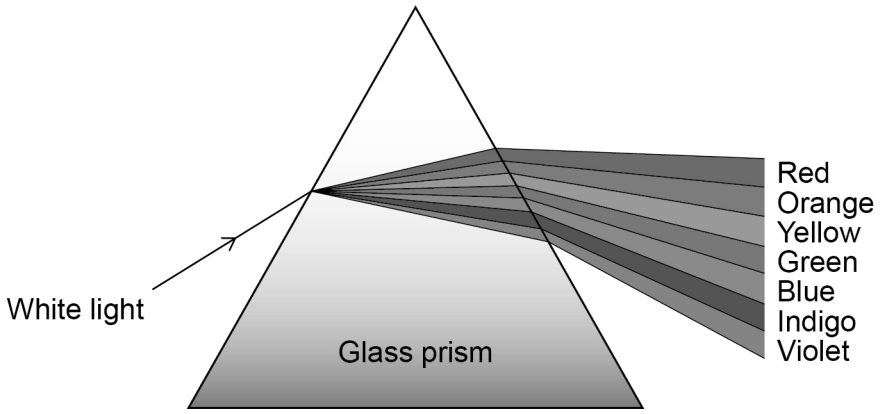
_____

6.5.4.1.2 Speed

Question 23 · continued

Figure 15 shows white light split into a spectrum of different colours by a glass prism.

Figure 15



0 6 . 3 Light changes direction when it enters the glass prism.

What name is given to this process?

[1 mark]

_____

Question 6 continues on the next page

6.5.4.1.2 Speed

Question 23 · continued

Use the Physics Equations Sheet to answer questions **06.4** and **06.5**.

0 6 . 4 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

0 6 . 5 The wave in the middle of the spectrum has a wavelength of 5.0×10^{-7} m.

wave speed of light = 3.0×10^{8} m/s

Calculate the frequency of the wave.

[3 marks]

Frequency = _____ Hz

9

6.5.4.1.2 Speed

Question 24

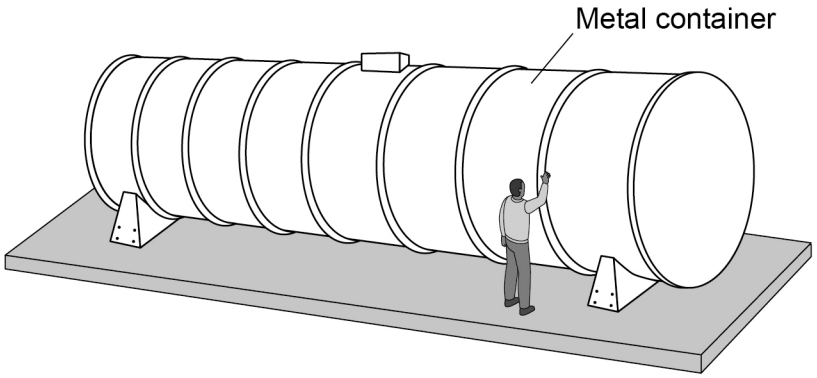
0 5 Data-storage computers get very hot.

Scientists investigated using the sea to cool data-storage computers.

The computers were set up inside a large metal container.

Figure 8 shows the metal container before it was lowered into the sea.

Figure 8



0 5 . 1 Why is the container made of metal?

[1 mark]

Tick (✓) **one** box.

Metal has a high thermal conductivity. ☐

Metal is a good thermal insulator. ☐

Metal is a poor conductor of thermal energy. ☐

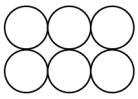
6.5.4.1.2 Speed

Question 24 · continued

0 5 . 2 The walls of the container are solid.

Figure 9 shows an arrangement of six particles in a solid.

Figure 9



The air inside the container is a gas.

Draw an arrangement of six particles in a gas in the box below.

[1 mark]

0 5 . 3 How does the air in the container exert pressure on the container?

[1 mark]

Tick (✓) **one** box.

Air particles absorb energy from the container. ☐

Air particles collide with the walls of the container. ☐

Air particles expand to fill the container. ☐

Question 5 continues on the next page

6.5.4.1.2 Speed

Question 24 · continued

0 5 . 4 As the container is lowered into the sea, the temperature of the air in the container decreases.

Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When the temperature of the air in the container decreases, the average speed of the air particles _____.

0 5 . 5 After the temperature of the air in the container had decreased, the computers were switched on.

The computers caused the temperature of the air to then increase.

Describe how the air pressure in the container changed as the temperature decreased and then increased.

[2 marks]

6.5.4.1.2 Speed

Question 24 · continued

0 5 . 6 The container has a length of 12 m.

The container has a cross-sectional area of 7.5 m^2.

Calculate the volume of the container.

Use the equation:

volume = length × cross-sectional area

[1 mark]

Volume = _____ m^3

Use the Physics Equations Sheet to answer questions **05.7** and **05.8**.

0 5 . 7 Write down the equation that links density (ρ), mass (m) and volume (V).

[1 mark]

0 5 . 8 The average density of the container and its contents is 1100 kg/m^3.

Calculate the mass of the container and its contents.

Use your answer to Question **05.6**

[3 marks]

Mass = _____ kg

11

6.5.4.1.2 Speed

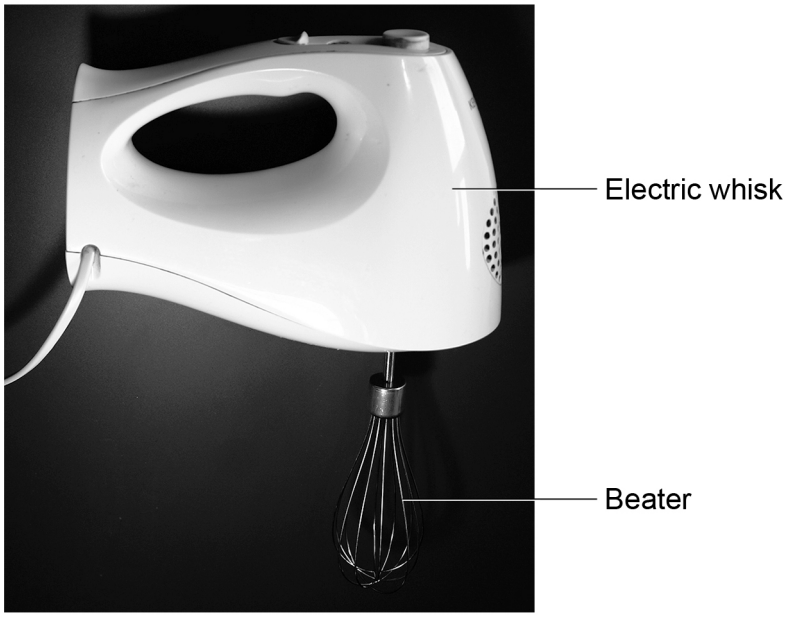
Question 25

June 2024 | 8464/P/1F | Original Q6

0 6 **Figure 10** shows an electric whisk that plugs into the mains electricity supply.

The whisk can mix food by spinning a beater.

Figure 10



0 6 . 1 Give **two** energy stores that increase when the whisk is switched on.

[2 marks]

1 _____

_____

2 _____

_____

6.5.4.1.2 Speed

Question 25 · continued

Use the Physics Equations Sheet to answer questions **06.2** and **06.3**.

0 6 . 2 Work is done by the whisk when it is used to mix food.

Write down the equation that links power (*P*), time (*t*) and work done (*W*).

[1 mark]

0 6 . 3 The power output of the whisk is 92 W.

Calculate the time for the whisk to do 23 000 J of work.

[3 marks]

Time = _____ s

Question 6 continues on the next page

6.5.4.1.2 Speed

Question 25 · continued

Use the Physics Equations Sheet to answer questions **06.4** and **06.5**.

0 6 . 4 Which equation links current (I), power (P) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R^2}$ ☐

$P = I R^2$ ☐

$P = \frac{I^2}{R}$ ☐

$P = I^2 R$ ☐

0 6 . 5 The current in the whisk is 500 mA.

The resistance of the whisk is 640 Ω.

Calculate the power of the whisk.

[3 marks]

Power = _____ W

6.5.4.1.2 Speed

Question 25 · continued

The whisk has several settings that allow the beater to spin at different speeds.

A faster beater speed needs a greater power input from the mains electricity supply.

0 6 . 6 What is the potential difference between the live wire and neutral wire in the mains electricity supply?

[1 mark]

_____ V

0 6 . 7 Changing the beater speed does **not** change the potential difference between the live wire and neutral wire.

The power input to the whisk changes because the current in the whisk changes.

Complete the sentence.

[1 mark]

When the beater speed increases, the current in the whisk increases because the resistance of the whisk _____.

12

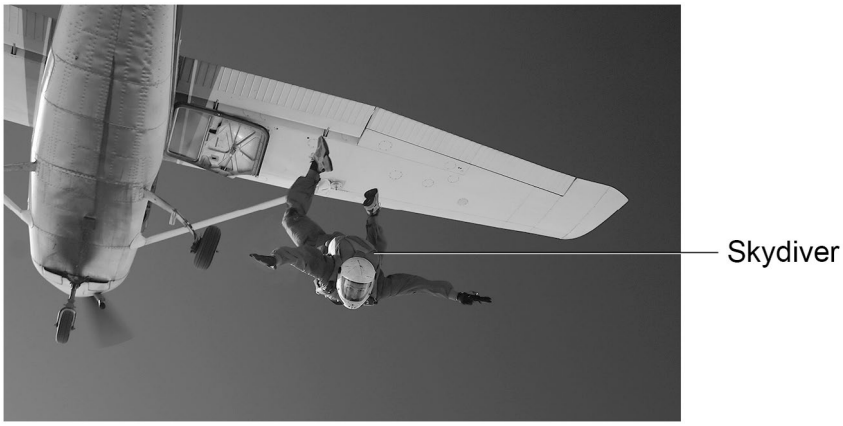
6.5.4.1.2 Speed

Question 26

0 1 **Figure 1** shows a skydiver jumping from an aeroplane.

The skydiver is accelerating downwards.

Figure 1



0 1 . 1 Which force causes the skydiver to accelerate?

[1 mark]

Tick (✓) **one** box.

- Electromagnetic force ☐
- Gravitational force ☐
- Magnetic force ☐

0 1 . 2 Which force increases as the skydiver accelerates?

[1 mark]

Tick (✓) **one** box.

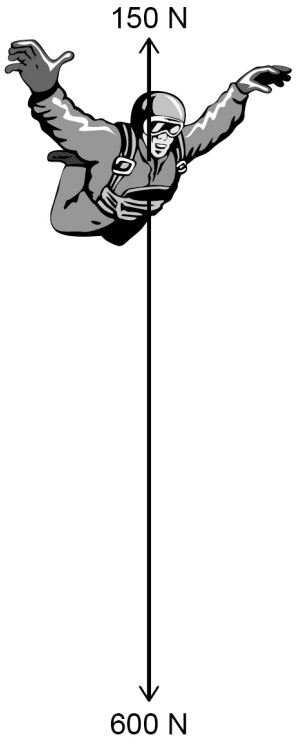
- Air resistance ☐
- Normal contact force ☐
- Tension ☐

6.5.4.1.2 Speed

Question 26 · continued

Figure 2 shows the two forces acting on the skydiver a few seconds after jumping from the aeroplane.

Figure 2



0 1 . 3 Calculate the resultant force acting on the skydiver in **Figure 2**.

[1 mark]

Resultant force = _____ N

Question 1 continues on the next page

6.5.4.1.2 Speed

Question 26 · continued

0 1 . 4 Eventually the skydiver stops accelerating and falls at a constant velocity.

What is the resultant force acting on the skydiver when falling at a constant velocity?

[1 mark]

Tick (✓) **one** box.

- 0 N ☐
- 150 N ☐
- 600 N ☐

0 1 . 5 What name is given to the constant velocity of the skydiver?

[1 mark]

Tick (✓) **one** box.

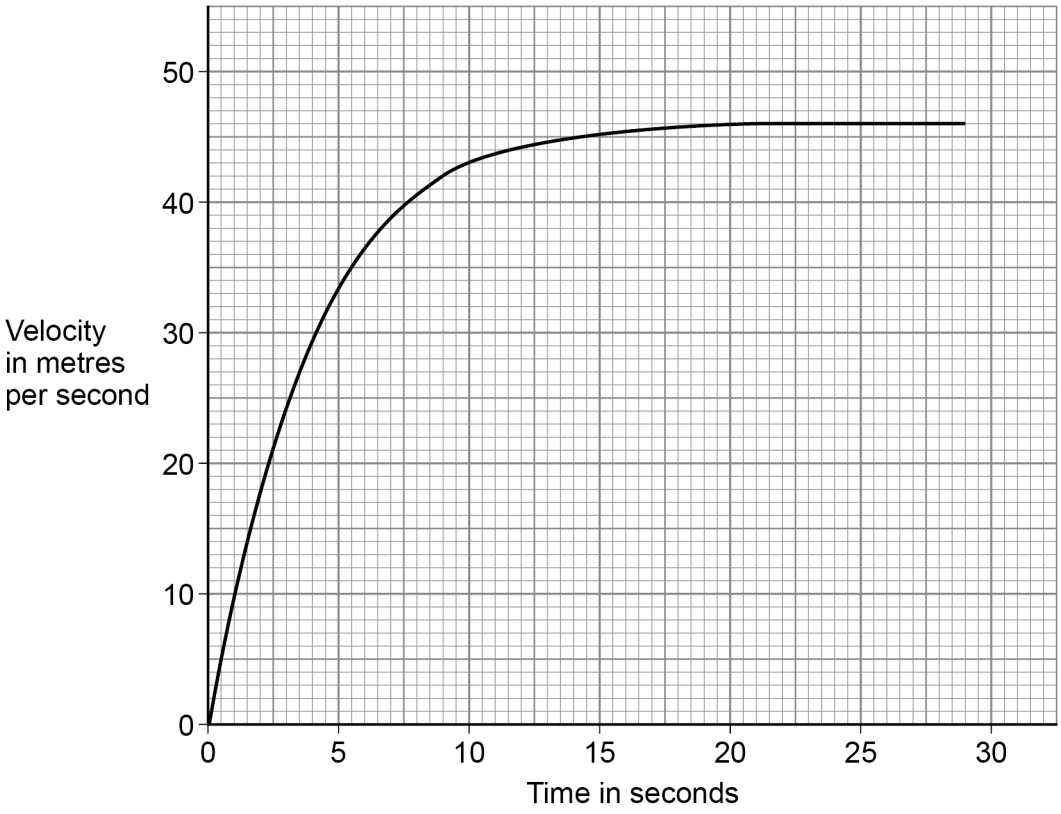
- Average velocity ☐
- Initial velocity ☐
- Terminal velocity ☐

6.5.4.1.2 Speed

Question 26 · continued

Figure 3 shows a velocity–time graph for the skydiver.

Figure 3



0 1 . 6 How many seconds did the skydiver accelerate for?

Use **Figure 3**.

[1 mark]

_____ s

0 1 . 7 What was the constant velocity of the skydiver?

Use **Figure 3**.

[1 mark]

_____ m/s

6.5.4.1.2 Speed

Question 26 · continued

0 1 . 8 After opening a parachute, the skydiver fell at a constant speed of 3.6 m/s for 25 seconds.

Calculate the distance travelled by the skydiver during this time.

Use the equation:

distance travelled = speed × time

[2 marks]

Distance travelled = _____ m

9

6.5.4.1.2 Speed

Question 27

June 2024 | 8464/P/2F | Original Q3

0 3 **Figure 6** shows an electronic whistle used by a referee in a football match.

Figure 6



When the button is pressed the whistle emits sound waves that travel through the air.

0 3 . 1 What is transferred by the sound waves as they travel through the air?

[1 mark]

Tick (✓) **one** box.

Energy ☐

Mass ☐

Temperature ☐

Question 3 continues on the next page

6.5.4.1.2 Speed

Question 27 · continued

0 3 . 2 What is a typical value for the speed of sound in air?

[1 mark]

Tick (✓) **one** box.

- 33 m/s ☐
- 330 m/s ☐
- 3300 m/s ☐
- 33 000 m/s ☐

6.5.4.1.2 Speed

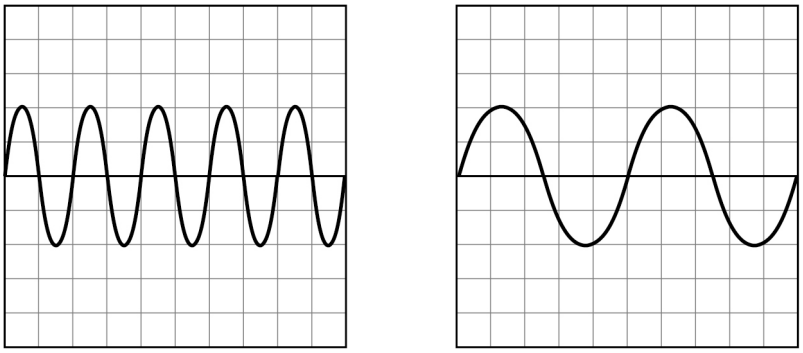
Question 27 · continued

The whistle can emit two different sound waves, **A** and **B**.

Figure 7 shows the two different sound waves as displayed on a screen.

The sound waves are drawn to the same scale.

Figure 7



Wave **A**

Wave **B**

0 3 . 3 Complete the sentences to describe a difference and a similarity between the two waves.

Choose answers from the box.

[2 marks]

amplitude	**frequency**	**wavelength**	**period**

Difference

Wave **A** has a greater _____ than wave **B**.

Similarity

Wave **A** has the same _____ as wave **B**.

Question 3 continues on the next page

6.5.4.1.2 Speed

Question 27 · continued

0 3 . 4 Wave **A** has a frequency of 4.0 kHz.

Which of the following is the same as 4.0 kHz?

[1 mark]

Tick (✓) **one** box.

4.0 Hz ☐

4000 Hz ☐

4 000 000 Hz ☐

4 000 000 000 Hz ☐

0 3 . 5 Calculate the period of wave **A**.

Use your answer from Question **03.4** and the equation:

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

[2 marks]

Period = _____ s

6.5.4.1.2 Speed

Question 27 · continued

0 3 . 6 Sound waves in air are longitudinal waves.

Complete the sentence to describe a sound wave.

Choose answers from the box.

[2 marks]

compression	**deflection**	**diffraction**	**rarefaction**	**reflection**

When sound waves travel through air they create areas

of _____ and _____.

9

Turn over for the next question

6.5.4.1.2 Speed

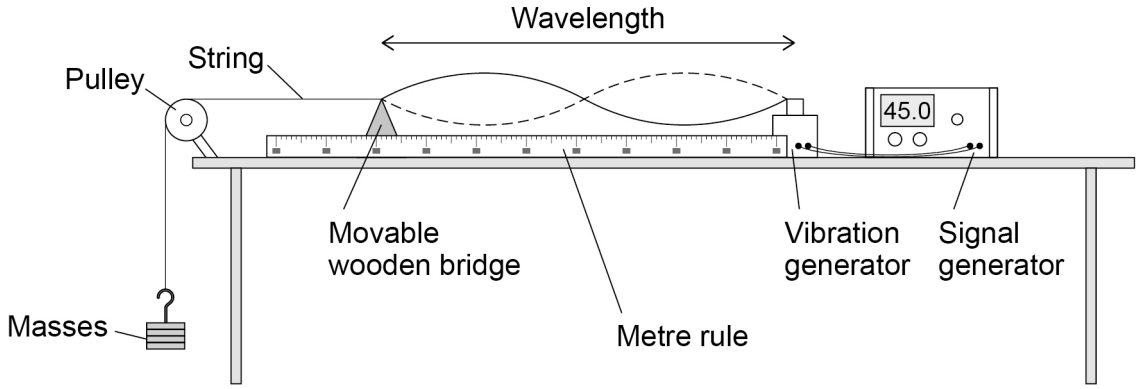
Question 28

June 2024 | 8464/P/2F | Original Q6

0 6 A teacher demonstrated how the frequency of a wave on a string affects the wavelength of the wave.

Figure 11 shows the equipment used.

Figure 11



The frequency of the signal generator is adjusted so that the wave shown in **Figure 11** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 11**.

0 6 . 1 Describe a method the teacher could use to investigate how the frequency of the wave affects the wavelength.

[4 marks]

6.5.4.1.2 Speed

Question 28 · continued

Use the Physics Equations Sheet to answer questions **06.2** and **06.3**.

0 6 . 2 Which equation links frequency (f), wavelength (λ) and wave speed (v)?

[1 mark]

Tick (✓) **one** box.

$f = \lambda \times v$ ☐

$\lambda = f \times v$ ☐

$v = f \times \lambda$ ☐

0 6 . 3 The wave on the string has a frequency of 45.0 Hz.

The wave speed is 35.1 m/s.

Calculate the wavelength of the wave.

[3 marks]

Wavelength = _____ m

8

6.5.4.1.2 Speed

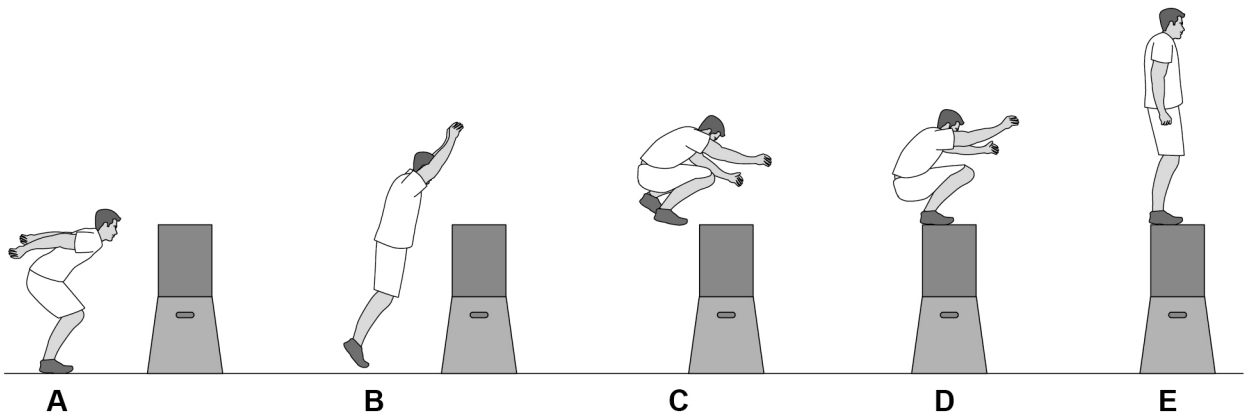
Question 29

June 2025 | 8464/P/1F | Original Q3

0 3 A person performs a 'vertical box jump'.

Figure 4 shows five different stages, **A**, **B**, **C**, **D** and **E**, of the jump.

Figure 4



0 3 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

A	B	C	D	E

The person has the least gravitational potential energy at stage _____.

The person has the greatest kinetic energy at stage _____.

6.5.4.1.2 Speed

Question 29 · continued

0 3 . 2 The person in **Figure 4** has a mass of 60 kg.

The person leaves the ground with a speed of 5.5 m/s.

Calculate the kinetic energy of the person.

Use the equation:

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

[2 marks]

Kinetic energy = _____ J

0 3 . 3 The person has a mass of 60 kg.

The height of the jump is 1.5 m.

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the person at a height of 1.5 m.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

Question 3 continues on the next page

6.5.4.1.2 Speed

Question 29 · continued

0 3 . 4 The person jumps onto a box higher than the one in **Figure 4**, on page 12.

To jump onto a higher box, the person's speed when leaving the ground is different.

Explain how the speed is different when jumping onto a higher box.

You should answer in terms of gravitational potential energy and kinetic energy.

[3 marks]

0 3 . 5 Suggest **one** reason why a person is more likely to be injured when falling off a higher box.

[1 mark]

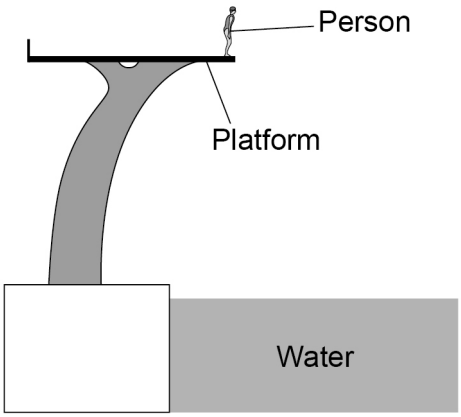
10

6.5.4.1.2 Speed

Question 30

0 1 **Figure 1** shows a person about to dive from a high platform into a pool of water.

Figure 1



0 1 . 1 The person dived from the platform into the water.

The time taken between the person leaving the platform and entering the water was measured by four people.

The measurements were:

2.1 s 1.9 s 1.3 s 2.0 s

Which measurement is anomalous?

[1 mark]

Tick (✓) **one** box.

2.1 s ☐

1.9 s ☐

1.3 s ☐

2.0 s ☐

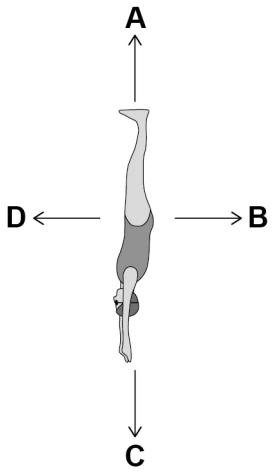
6.5.4.1.2 Speed

Question 30 · continued

0 1 . 2 Air resistance acted on the person during the dive.

Figure 2 shows the person moving vertically downwards.

Figure 2



Which arrow on **Figure 2** shows the direction of the air resistance acting on the person?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

Question 1 continues on the next page

Question 30 · continued

0 1 . 3 Air resistance is a contact force.

Which force is also a contact force?

[1 mark]

Tick (✓) **one** box.

Friction ☐

Gravitational force ☐

Magnetic force ☐

0 1 . 4 What happened to the size of the air resistance force as the speed of the person increased?

[1 mark]

0 1 . 5 After entering the water, the person decelerated for a time of 0.35 s.

The deceleration of the person was 60 m/s^2.

Calculate the change in velocity of the person.

Use the equation:

change in velocity = deceleration × time

[2 marks]

Change in velocity = _____ m/s

6.5.4.1.2 Speed

Question 30 · continued

0 1 . 6 The mass of the person was 75 kg.

Calculate the resultant force on the person when the deceleration was 60 m/s^2.

Use the equation:

resultant force = mass × deceleration

[2 marks]

Resultant force = _____ N

8

Turn over for the next question

6.5.4.1.2 Speed

Question 31

0 3 A student went on a cycling journey that lasted for three days.

The student recorded information about the journey using a cycling app on a mobile phone.

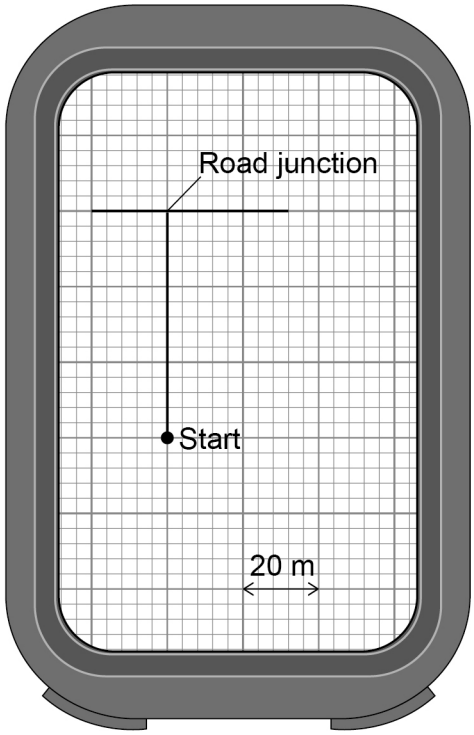
0 3 . 1 At the start of the journey, the student travelled along a straight road to a road junction.

A map on the cycling app showed the road.

Figure 5 shows the map.

The scale of the map is 1 cm **:** 20 m

Figure 5



Question 31 · continued

Calculate the distance travelled by the student between the start and the road junction.

Use **Figure 5**.

[2 marks]

Distance travelled = _____ m

0 3 . 2 The bicycle had a mass of 15 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the bicycle.

Use the equation:

weight = mass × gravitational field strength

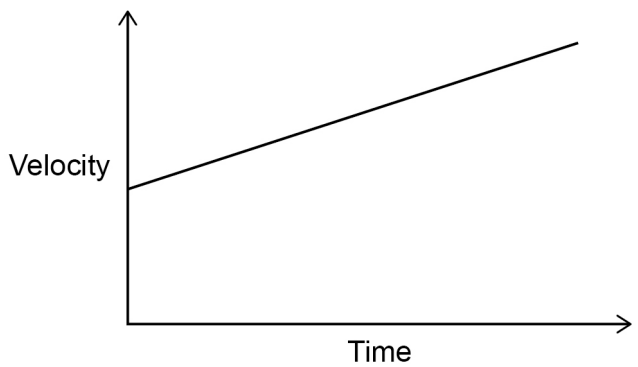
[2 marks]

Weight = _____ N

Question 3 continues on the next page

0 3 . 3 **Figure 6** shows a velocity–time graph for a downhill part of the journey.

Figure 6



The gradient of the graph represents acceleration.

How does **Figure 6** show that the acceleration was constant?

[1 mark]

0 3 . 4 As the student accelerated downhill, the forward force on the student was 250 N.

The work done by the forward force was 4500 J.

Calculate the distance travelled as the student accelerated downhill.

Use the equation:

$$\text{distance travelled} = \frac{\text{work done}}{\text{force}}$$

[2 marks]

Distance travelled = _____ m

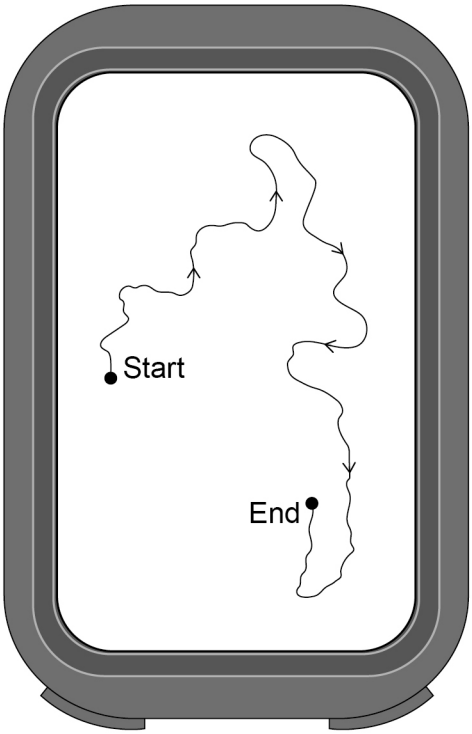
6.5.4.1.2 Speed

Question 31 · continued

0 3 . 5 Most of the roads on the journey were not straight.

Figure 7 shows a map of the route taken for the whole journey.

Figure 7



The line in **Figure 7** represents the total distance travelled when the student reached the end of the journey.

How does the total distance travelled compare with the magnitude of the displacement of the student from the start?

[1 mark]

Tick (✓) **one** box.

Total distance travelled is less than the displacement. ☐

Total distance travelled is equal to the displacement. ☐

Total distance travelled is greater than the displacement. ☐

6.5.4.1.2 Speed

Question 31 · continued

0 3 . 6 Why is distance a scalar quantity?

[1 mark]

Tick (✓) **one** box.

Distance has direction only. ☐

Distance has magnitude only. ☐

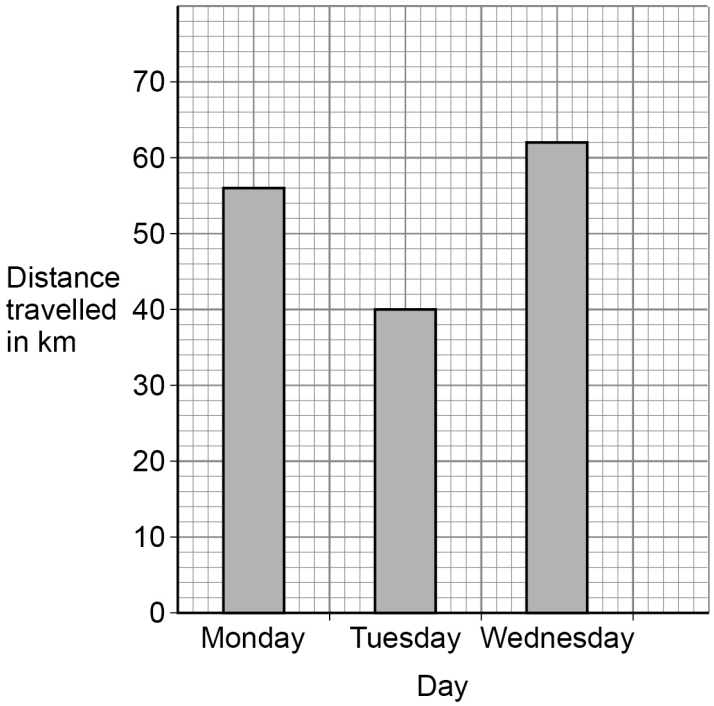
Distance has direction and magnitude. ☐

6.5.4.1.2 Speed

Question 31 · continued

0 3 . 7 **Figure 8** shows the distance travelled by the student each day.

Figure 8



Calculate the total distance travelled by the student.

Use **Figure 8**.

[2 marks]

Total distance travelled = _____ km

11

6.5.4.1.2 Speed

Question 32

June 2025 | 8464/P/2F | Original Q6

0 6 In a dog-sled race, a team of dogs pull on a rope attached to a sled.

Figure 12 shows a dog-sled team.

Figure 12



Use the Physics Equations Sheet to answer questions **06.1** and **06.2**.

0 6 . 1 What equation links distance travelled, speed and time?

[1 mark]

Tick (✓) **one** box.

distance travelled = speed × time ☐

speed = time × distance travelled ☐

time = distance travelled × speed ☐

6.5.4.1.2 Speed

Question 32 · continued

0 6 . 2 The longest dog-sled race in the world covers a distance of 1 500 000 m.

One team finished the race in a time of 670 000 s.

Calculate the average speed of this team during the race.

[3 marks]

Average speed = _____ m/s

0 6 . 3 At the start of the race, 6 dogs pulled on the rope.

The average forward force on the sled from **each** dog was 370 N.

The backwards force on the sled from friction was 520 N.

Calculate the resultant force on the sled.

[2 marks]

Resultant force = _____ N

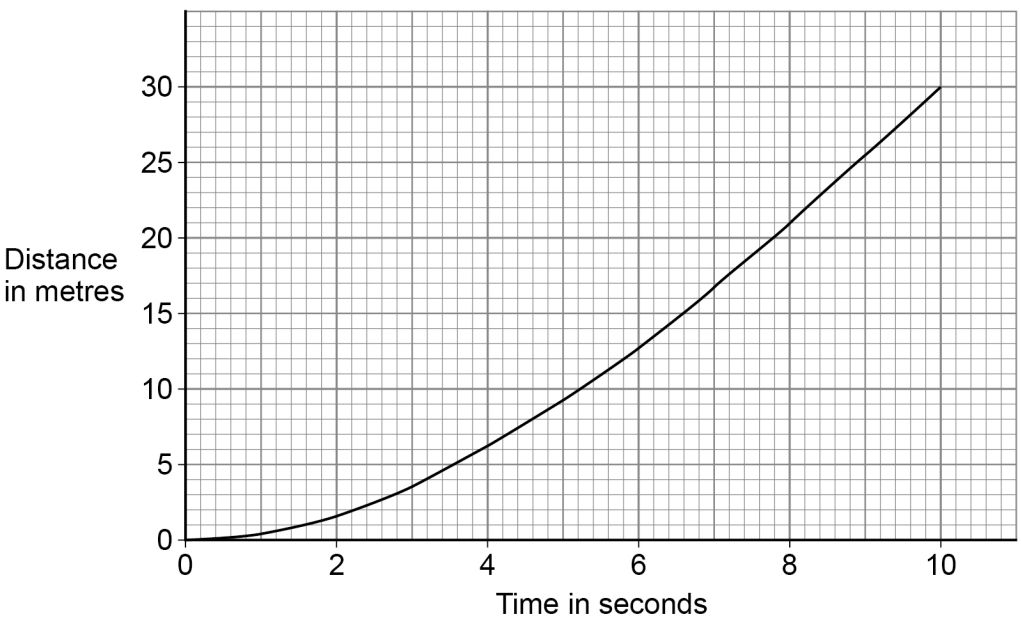
Question 6 continues on the next page

6.5.4.1.2 Speed

Question 32 · continued

Figure 13 shows a distance–time graph for the sled at the start of the race.

Figure 13



0 6 . 4 What does the gradient of the graph in **Figure 13** represent?

[1 mark]

6.5.4.1.2 Speed

Question 32 · continued

0 6 . 5 Later in the race, the sled moved at a constant speed along a flat, horizontal path.

What was the relationship between the size of the horizontal forces acting when the sled moved at a constant speed?

[1 mark]

Tick (✓) **one** box.

friction + air resistance < pull of the rope on the sled ☐

friction + air resistance = pull of the rope on the sled ☐

friction + air resistance > pull of the rope on the sled ☐

0 6 . 6 The rope exerted a force on the sled when the sled was moving.

What is the Newton's Third Law pair to the force of the rope on the sled?

[1 mark]

Tick (✓) **one** box.

The force of friction on the sled ☐

The force of the dogs on the rope ☐

The force of the sled on the rope ☐

9

6.5.4.1.2 Speed

Question 33

June 2025 | 8464/P/2F | Original Q7

0 7 The stopping distance of a car is affected by the condition of the brakes and tyres.

A car is being driven around a corner when the driver sees some roadworks.

0 7 . 1 The driver applies the brakes when the car is 24 m away from the roadworks.

The velocity of the car changes from 18 m/s to 0 m/s.

Calculate the constant deceleration needed to stop the car in a distance of 24 m.

Use the Physics Equations Sheet.

[3 marks]

Deceleration = _____ m/s^2

6.5.4.1.2 Speed

Question 33 · continued

0 7 . 2 As a safety measure, the speed limit on the road was reduced.

Explain how the safety of road users is affected by:

- the condition of the brakes and tyres
- reduced speed.

You should refer to thinking distance and braking distance.

[6 marks]

Extra space

Question 7 continues on the next page

6.5.4.1.2 Speed

Question 33 · continued

0 7 . 3 Two identical cars were driven along a straight, level road.

One car had a greater speed than the other car.

The driver of each car applied the brakes until the cars stopped.

Both cars travelled the same distance while braking.

Explain how braking from a greater speed affected the risk of the brakes overheating.

[3 marks]

12