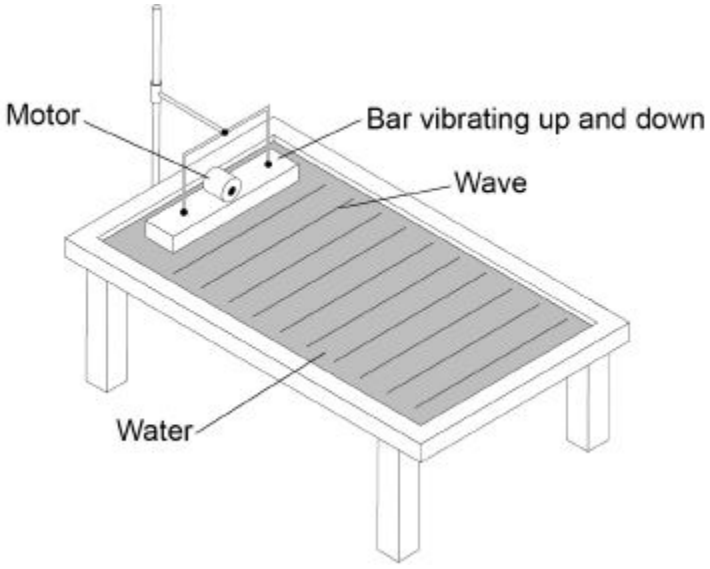
GCSE Physics

Waves

Question Paper

Time available: 60 minutes
Marks available: 52 marks

1. The diagram below shows a ripple tank that a student used to investigate water waves.



(a) 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.

Decreased ☐

Did not change ☐

Increased ☐

(1)

(b) Describe how the frequency of the water waves in the ripple tank can be measured.

_____

_____

_____

_____

(2)

(c) 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**

Period = _____ Unit = _____

(3)

(Total 6 marks)

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

(a) Which **one** of the statements about P-waves and S-waves is correct?

Tick **one** box.

P-waves and S-waves are transverse. ☐

P-waves and S-waves are longitudinal. ☐

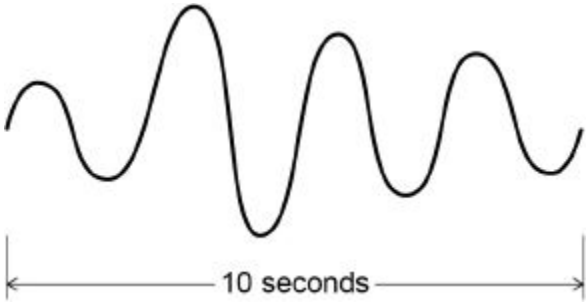
P-waves are transverse and S-waves are longitudinal. ☐

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

(1)

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

The diagram below shows the vibration recorded by a seismometer for one P-wave.



(b) Calculate the frequency of the P-wave shown in the diagram above.

Frequency = _____ Hz

(1)

(c) Write down the equation which links frequency, wavelength and wave speed.

(1)

(d) The P-wave shown in the diagram above is travelling at 7200 m/s.

Calculate the wavelength of the P-wave.

Wavelength = _____ m

(3)

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

_____

_____

_____

_____

_____

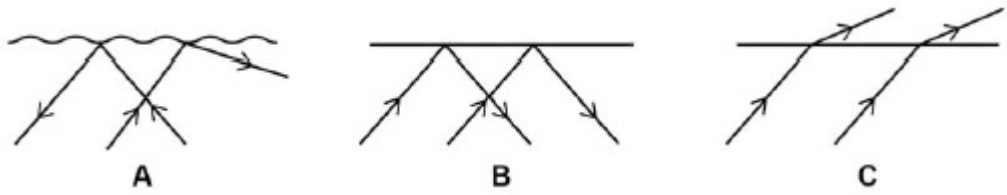
_____

(2)

(Total 8 marks)

3. (a) **Figure 1** shows what happens to rays of light incident on three different surfaces.

Figure 1



Which **one** of the diagrams shows diffuse reflection?

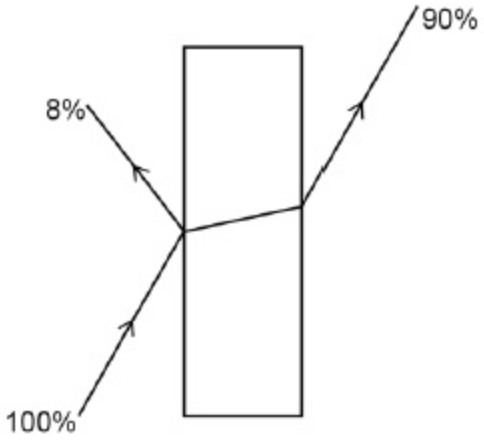
Tick **one** box.

A ☐ **B** ☐ **C** ☐

(1)

(b) **Figure 2** shows what happens to the energy transferred by a ray of light when the ray of light hits a glass block.

Figure 2



Calculate the percentage of the energy absorbed by the glass block.

_____

_____

Percentage of energy absorbed = _____ %

(1)

(c) Viewing an object through a colour filter may make the object look a different colour.

Complete the sentences.

Choose the answers from the box.

absorbs	**black**	**blue**
red	**reflects**	**transmits**

A red object viewed through a blue filter will look _____.

This is because the red object only _____ red light and the

blue filter only _____ blue light.

(3)

(d) A white surface is viewed through a green filter.

What colour will the surface look?

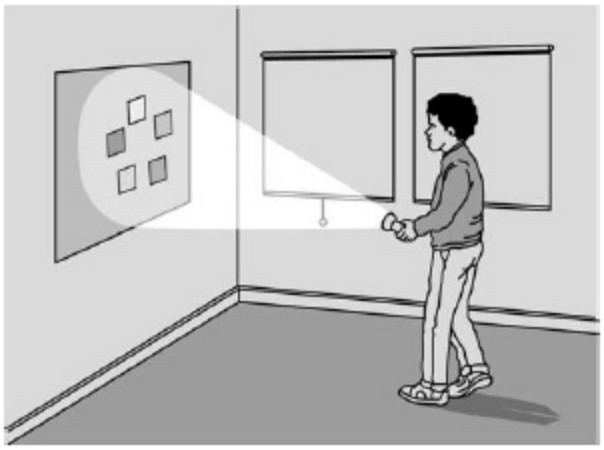
_____

(1)

Cyclists often wear clothing that reflects a lot of light.

Figure 3 shows a student investigating which colours are best at reflecting light.

Figure 3



This is the method used.

1. Small squares of different coloured material were stuck onto a piece of black paper at one end of a darkened laboratory.
2. The student switched on a torch and walked slowly towards the coloured squares.
3. The student stopped walking as soon as he could clearly see a coloured square.
4. The student measured the distance between the torch and the coloured square.

(e) Give a reason why it was important the student did the investigation in a darkened laboratory.

_____

_____

(1)

(f) Give a reason why it was important the area of each coloured square was the same.

_____

_____

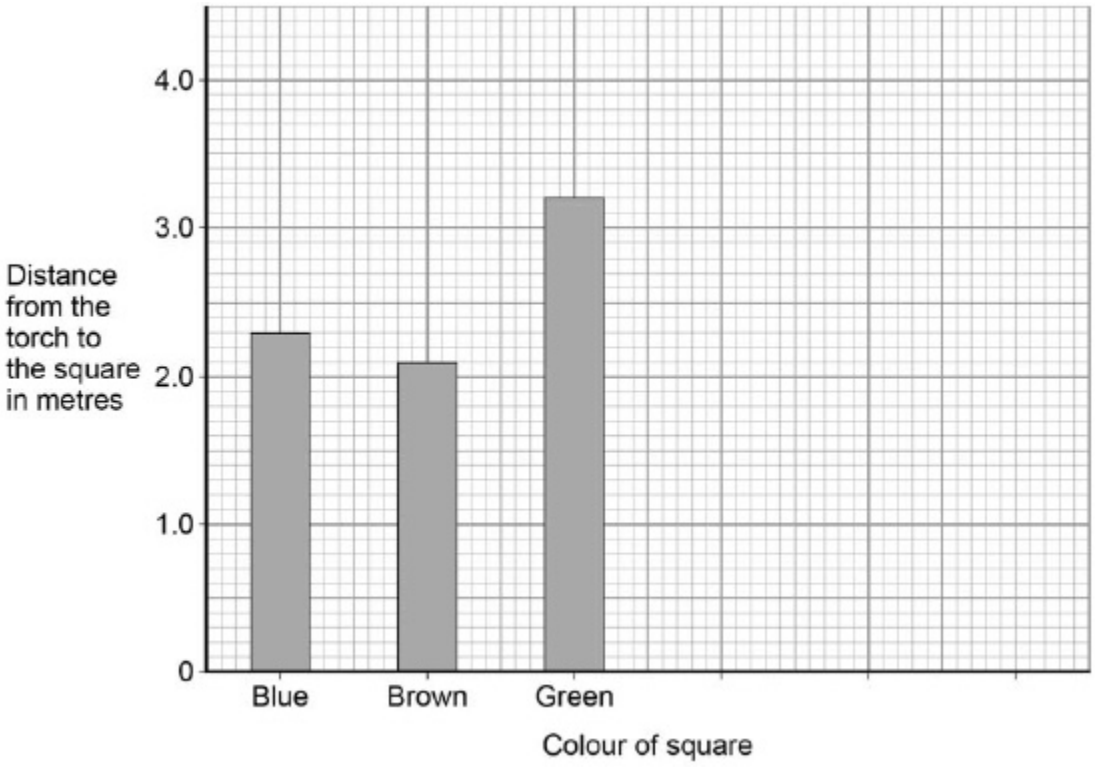
(1)

The table shows the student's results.

Colour of square	Distance from the torch to the square in metres
Blue	2.3
Brown	2.1
Green	3.2
Orange	3.4
Red	2.6

Figure 4 shows a bar chart with only three of the student's results.

Figure 4



(g) Complete the bar chart to show all of the results.

(3)

(h) Which colour clothing would be best for a cyclist to wear?

Use the data from the table.

Tick **one** box.

Blue ☐ Brown ☐ Green ☐ Orange ☐ Red ☐

Give a reason for your answer.

_____

_____

_____

(2)

(i) The student did the investigation again to obtain a second set of results.

The second set of results showed the same pattern as the first set.

Complete the sentence.

Choose the answer from the box.

accurate	**precise**	**repeatable**	**reproducible**

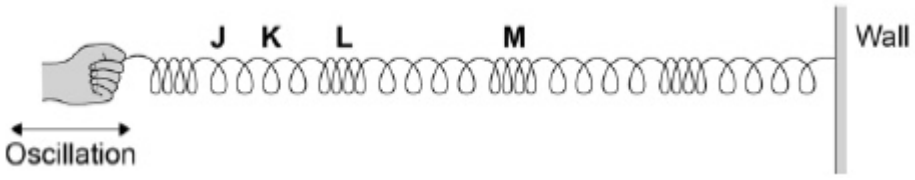
The measurements taken by the student were _____ .

(1)

(Total 14 marks)

4. **Figure 1** shows a longitudinal wave being produced in a stretched spring.

Figure 1



(a) Which of the letters on **Figure 1** shows the centre of a rarefaction?

Tick **one** box.

J ☐ **K** ☐ **L** ☐ **M** ☐

(1)

(b) Which two letters in **Figure 1** have a distance of one wavelength between them?

Tick **one** box.

J and **K** ☐ **K** and **L** ☐ **L** and **M** ☐ **J** and **M** ☐

(1)

(c) Describe how the end of the stretched spring should be moved in order to produce a transverse wave.

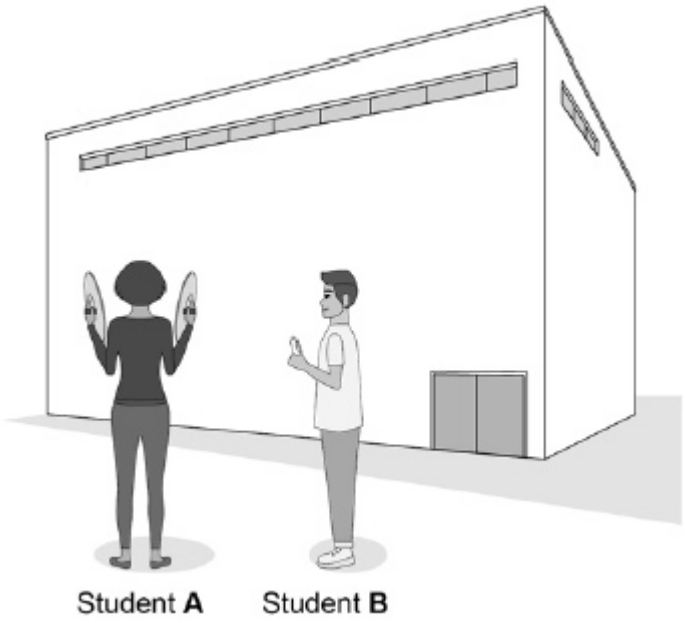
_____

_____

(1)

Figure 2 shows how two students used the sound reflected off a building (an echo) to measure the speed of sound.

Figure 2



This is the method used.

1. Student **A** hit two cymbals together and student **B** started a stopwatch.
2. When student **A** heard an echo she hit the cymbals together again.
3. Student **B** stopped the stopwatch after timing 5 echoes.

The table shows the student's results.

Time for 5 echoes in seconds
3.1
2.7
2.2
3.2

(d) The students decided that the time of 2.2 s was an anomalous result.

What was the most likely cause for this anomalous result?

Tick **one** box.

Not resetting the stopwatch to zero. ☐

Starting the stopwatch too soon. ☐

Timing less than five echoes. ☐

Timing more than five echoes. ☐

(1)

(e) Calculate the mean value of the time for 5 echoes.

Ignore the anomalous result.

_____

_____

mean time = _____ s

(1)

(f) The distance between student A and the building is 75 metres.

Calculate the distance the sound travels in going from student A to the building and back again five times.

_____

_____

distance = _____ m

(1)

(g) Calculate the speed of sound.

Use your answers to Questions (e) and (f) and the equation:

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

_____

_____

_____

_____

speed of sound = _____ m/s

(2)

(h) The value for the speed of sound obtained by the students is not very accurate.

Suggest **two** changes to the method used by the students that would improve the accuracy.

1. _____

_____

2. _____

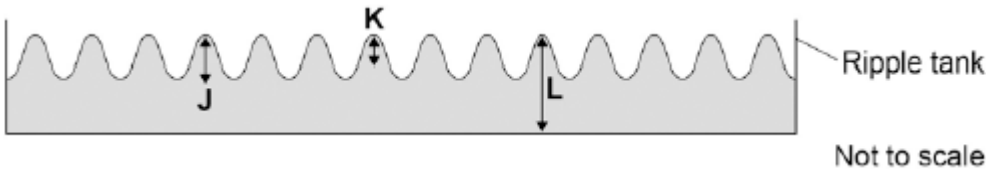
_____

(2)

(Total 10 marks)

5. Small water waves are created in a ripple tank by a wooden bar. The wooden bar vibrates up and down hitting the surface of the water.

The figure below shows a cross-section of the ripple tank and water.



(a) Which letter shows the amplitude of a water wave?

Tick **one** box.

J ☐

K ☐

L ☐

(1)

(b) The speed of the wooden bar is changed so that the bar hits the water fewer times each second.

What happens to the frequency of the waves produced?

Tick **one** box.

Increases ☐

Does not change ☐

Decreases ☐

(1)

(c) Describe how the wavelength of the water waves in a ripple tank can be measured accurately.

_____

_____

_____

_____

_____

(2)

(d) The speed of a wave is calculated using the following equation.

wave speed = frequency × wavelength

The water waves in a ripple tank have a wavelength of 1.2 cm and a frequency of 18.5 Hz.

How does the speed of these water waves compare to the typical speed of a person walking?

_____

_____

_____

_____

_____

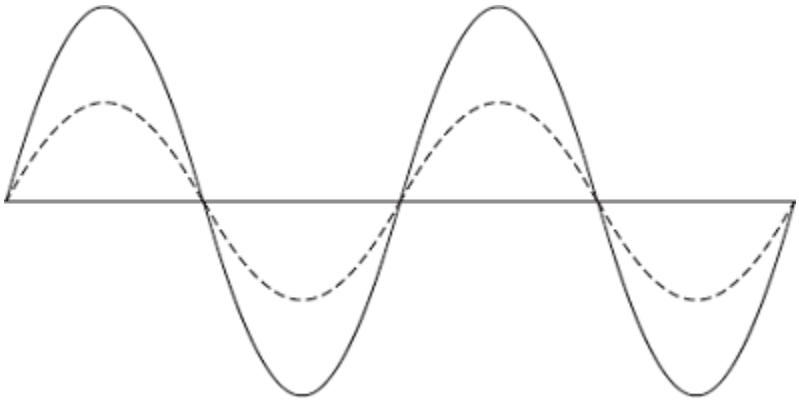
_____

(4)

(Total 8 marks)

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

Diagram 1



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

_____

(1)

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

_____

(1)

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

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

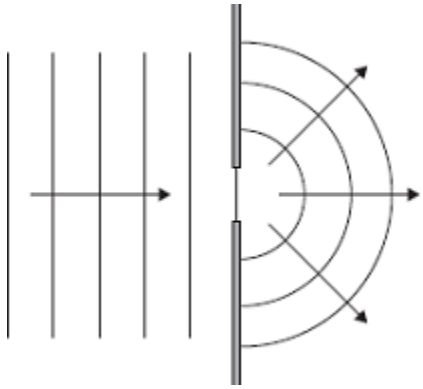
Draw a ring around the correct answer.

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

(1)

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

Diagram 2



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.

_____

_____

_____

Speed = _____

(3)

(Total 6 marks)