AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.6.1 WAVES IN AIR, FLUIDS AND SOLIDS (PACK 3)

SCORE	PERCENTAGE
/155	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

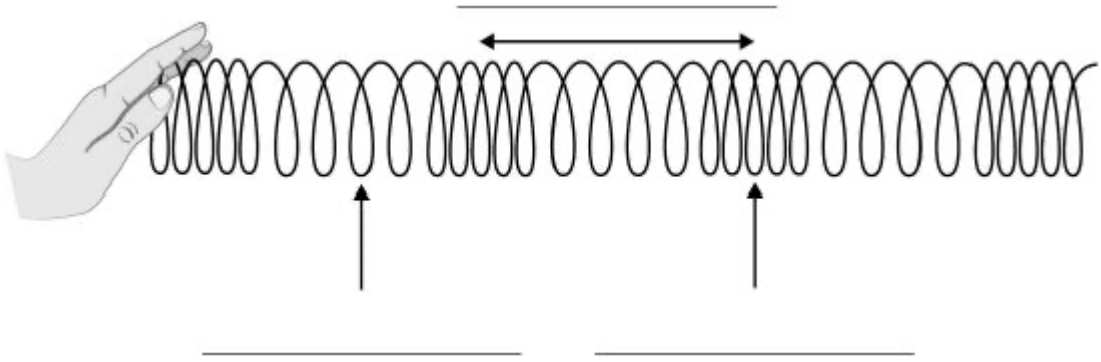
AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Figure 1 shows a slinky spring used to model a sound wave.

Figure 1



(a) Label the arrows on **Figure 1**

Choose the answers from the box.

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

(3)

(b) What type of wave is a sound wave?

Tick **one** box.

electromagnetic ☐

longitudinal ☐

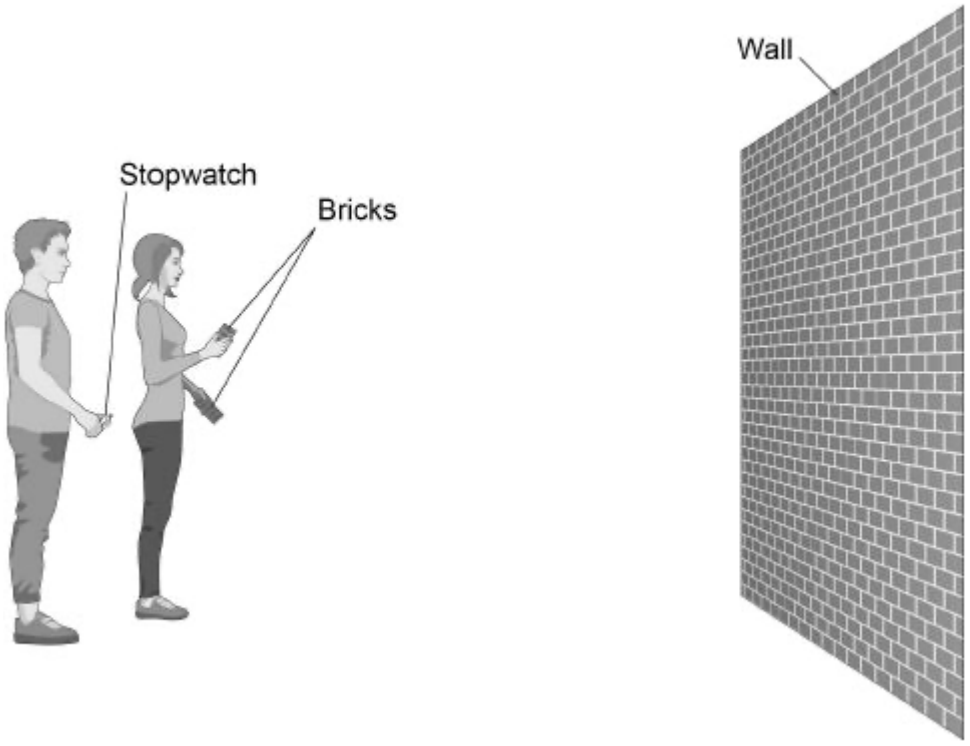
transverse ☐

(1)

(c) **Figure 2** shows two students measuring the speed of sound in air.

Figure 2

STEMUP.CO.UK



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)
(Total 8 marks)

Q2.

A car aerial receives radio waves from a radio transmitter.

Radio waves are transverse waves.

Sound waves are longitudinal waves.

STEMUP.CO.UK

(a) Describe the difference between transverse waves and longitudinal waves.

_____

_____

_____

_____

(2)

(b) The radio waves have a frequency of 4.8×10^9 Hz

Wave speed of electromagnetic waves = 3.0×10^8 m/s

Calculate the wavelength of the radio waves.

Give your answer to 2 significant figures.

_____

_____

_____

_____

Wavelength = _____ m

(3)

(c) Describe how the radio waves reaching the car aerial produce signals in the electrical circuit of the car radio.

_____

_____

_____

_____

_____

_____

_____

_____

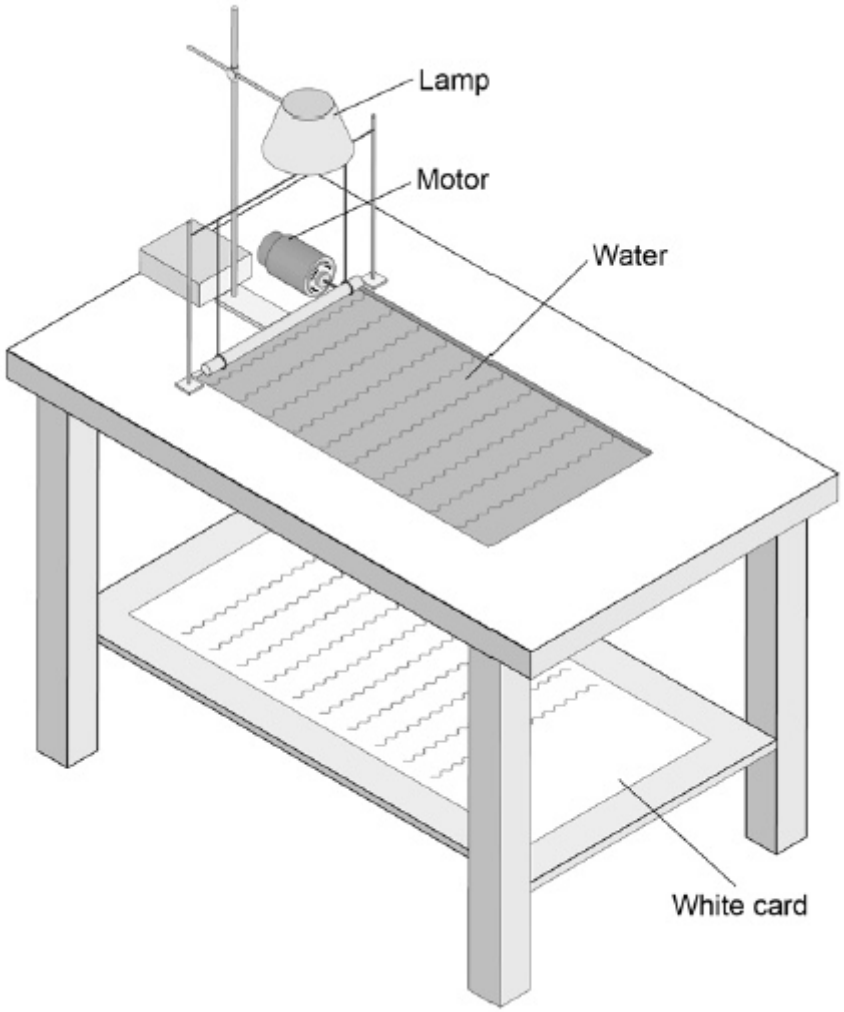
(3)

(Total 8 marks)

Q3.

The diagram shows a ripple tank.

STEMUP.CO.UK



(a) The motor makes a noise when it is turned on.

Describe the differences between the properties of the sound waves produced by the motor and the water waves in the ripple tank.

(4)

STEMUP.CO.UK

(b) The period of the sound waves produced by the motor is 8.3 milliseconds.

Calculate the frequency of the sound waves.

Use the Physics Equations Sheet.

Frequency = _____ Hz

(3)

(c) Explain how a student could make appropriate measurements and use them to determine the wavelength of the waves in the ripple tank.

STEMUP.CO.UK

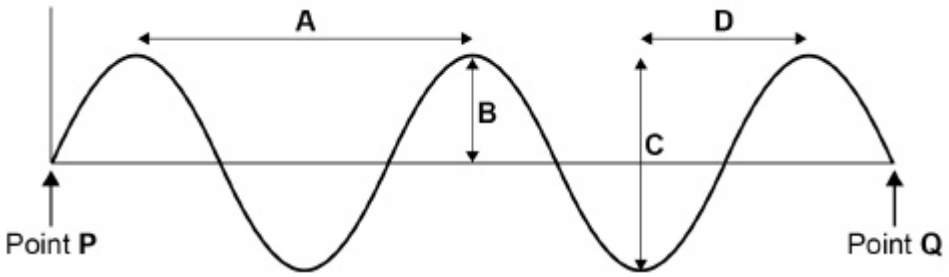
_____

(6)

(Total 13 marks)

Q4.

The diagram shows a wave.



(a) Which arrow shows the amplitude of the wave?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) Which arrow shows the wavelength of the wave?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) It takes 0.5 seconds for a wave in the diagram to travel from point **P** to point **Q**.

Calculate the frequency of the waves shown in the diagram.

_____

_____

_____

Frequency = _____ Hz

(2)

(d) What type of wave is sound?

Tick **one** box.

Electromagnetic ☐

Longitudinal ☐

STEMUP.CO.UK

Transverse ☐

(1)

Two students carried out an experiment to determine the speed of sound.

This is the method used.

1. Student A stands 100 m away from Student B.
2. Student A bangs two blocks of wood together making a loud sound.
3. Student B starts a stopclock when he sees the blocks of wood bang together.
4. Student B stops the stopclock when he hears the sound and records the time.
5. The students repeat steps 2–4 several times.

The students calculated the speed of sound from their results.

(e) Suggest the most likely source of error in the experiment.

_____

_____

(1)

(f) The speed of sound calculated was lower than the true speed of sound in air.

Suggest **one** improvement to the students' method that would give a more accurate value for the speed of sound.

_____

_____

(1)

(g) A student compares the properties of visible light waves and radio waves.

Which **two** properties are the same for both visible light waves **and** radio waves?

Tick **two** boxes.

Both are transverse waves ☐

Both can travel through a vacuum ☐

Both have the same amplitude ☐

Both have the same frequency ☐

Both have the same wavelength ☐

(2)

STEMUP.CO.UK

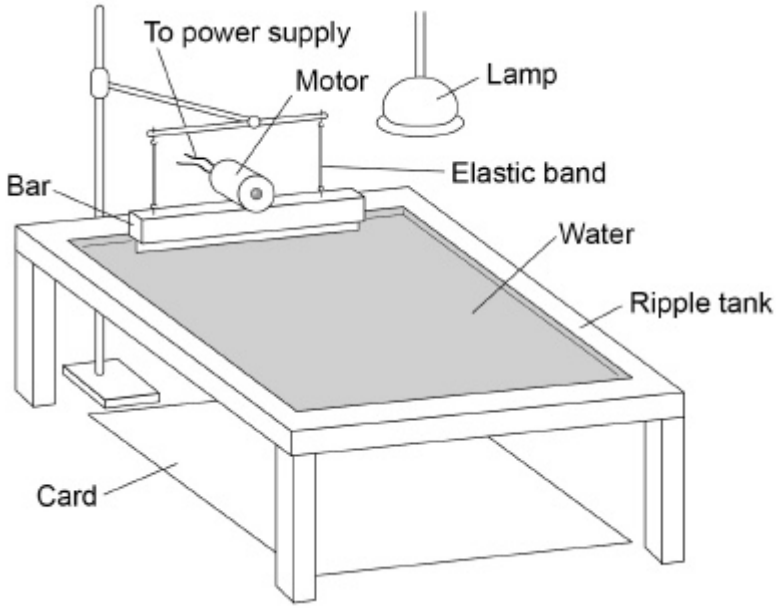
(Total 9 marks)

Q5.

A group of students investigate the features of waves.

Figure 1 shows some of the equipment they use.

Figure 1



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

_____

(1)

(b) The students want to determine the wave speed of water waves in the ripple tank.

Describe a method the students could use.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

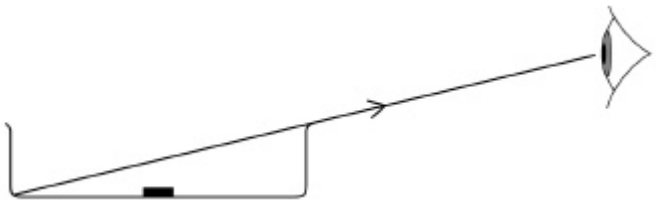
STEMUP.CO.UK

(4)

Figure 2 and **Figure 3** show the ‘magic coin’ trick.

A coin is glued to the bottom of a bowl and an observer stands where they cannot see the coin (**Figure 2**).

Figure 2



Another person fills the bowl with water.

The observer and the coin do not move.

After the water is added the observer can see the coin (**Figure 3**).

Figure 3



(c) Explain why the observer can now see the coin in **Figure 3**.

(3)

(d) Some types of wave are longitudinal and some types of wave are transverse.

Describe the difference between longitudinal waves and transverse waves.

STEMUP.CO.UK

_____

_____

(2)

(Total 10 marks)

Q6.

A baby monitor has a sensor unit that transmits an image of the baby and the noises the baby makes to a monitor unit.

The monitor unit then displays an image of the baby and emits the noises the baby makes.

(a) Compare the properties of the waves that transmit images and noises from the monitor unit.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The sensor unit can detect infrared and visible light.

Suggest **one** advantage of being able to detect infrared.

_____

_____

(1)

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

Equation _____

(1)

(d) The signals for the monitor unit are transmitted as electromagnetic waves with a wavelength of 0.125 m.

Wave speed of electromagnetic waves = 3×10^8 m / s

STEMUP.CO.UK

Calculate the frequency of the signal.

Frequency = _____ Hz

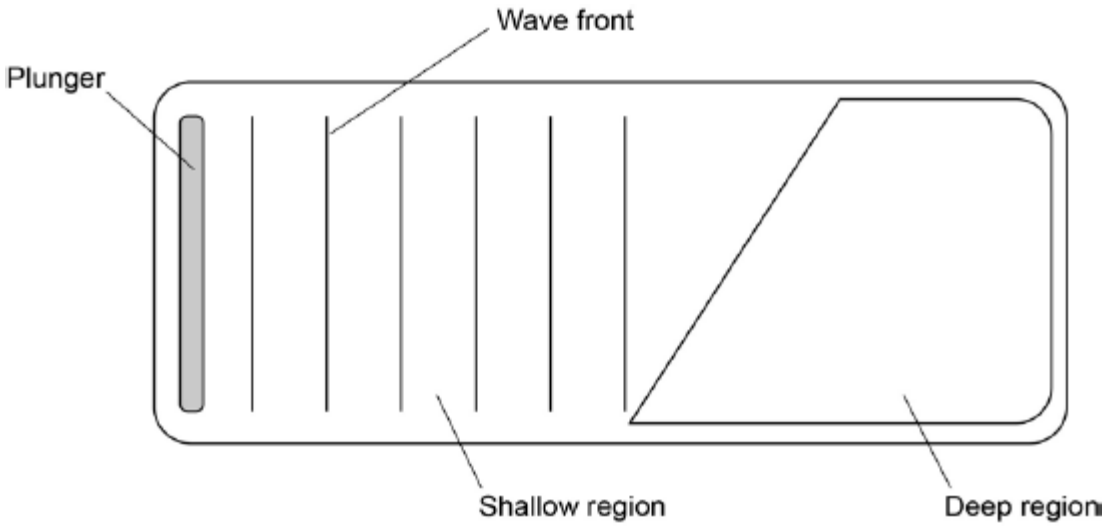
(3)

(Total 9 marks)

Q7.

Some students did an investigation to study the behaviour of waves.

The figure below shows a ripple tank that they used to model the behaviour of waves.



(a) Complete the wave fronts on the figure above.

Show how the wave is refracted as it passes from the shallow region into the deep region.

(1)

(b) Explain what happens to the waves as they pass into the deep region.

(2)

(c) The waves generated on the surface of the water are transverse waves.

Describe the differences between longitudinal waves and transverse waves.

STEMUP.CO.UK

You may include labelled diagrams to help your answer.

(3)

(d) Some students investigate the properties of the waves generated in the figure above.

Student **A** says 'the waves move water from one end of the tank to the other'.

Student **B** says 'that's wrong. Only the waves move, not the water'.

Suggest what the students could do to decide which of them is correct.

(2)

(e) Another student uses a ripple tank where all the water is the same depth.

She measures the wavelength of each wave as 0.34 m.

The period of each wave is 0.42 s.

Calculate the speed of the wave.

Use the correct equation from the Physics Equation Sheet.

Give the unit.

Give your answer to three significant figures.

STEMUP.CO.UK

Speed = _____

Unit = _____

(5)

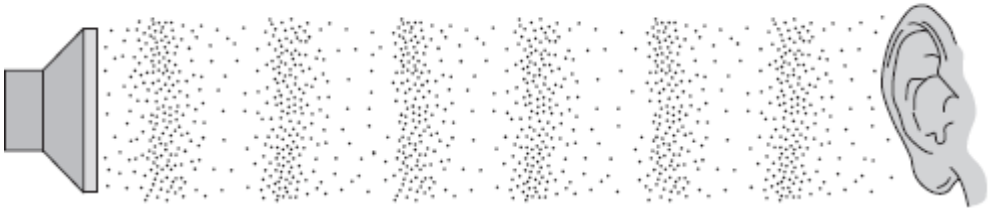
(Total 13 marks)

Q28.

A sound wave is an example of a longitudinal wave.

(a) **Figure 1** shows the air particles in a sound wave as the wave travels from a loudspeaker to an ear.

Figure 1



Write a letter **R** on **Figure 1** to show an area of rarefaction.

(1)

(b) Complete the sentence about longitudinal waves.

The vibrations of the air particles are _____ to the direction of energy transfer.

(1)

(c) A stationary car horn emits a sound wave of frequency 400 Hz.

The wavelength of the wave is 0.85 m.

Calculate the speed of sound.

Use the correct equation from the Physics Equations Sheet.

_____

_____

_____

Speed of sound = _____ m / s

(2)

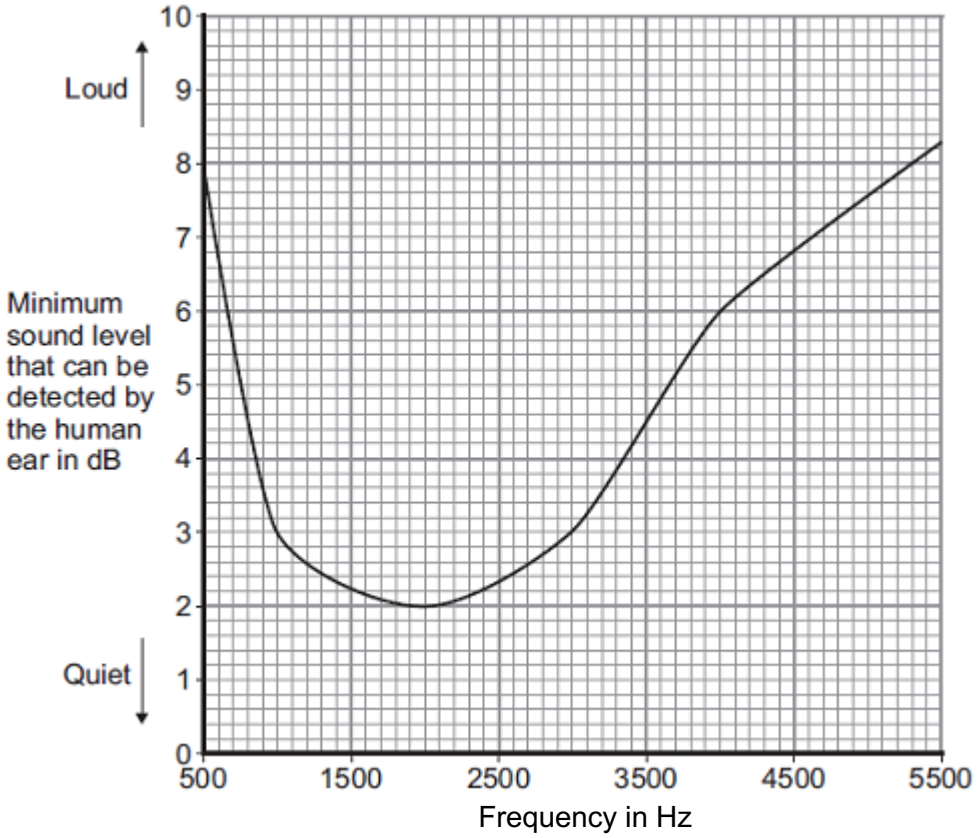
(Total 4 marks)

Q29.

The human ear can detect a range of frequencies of sound.
Sound level is measured in decibels, dB.

The figure below shows how the minimum sound level that can be detected by the human ear depends on the frequency of sound.

STEMUP.CO.UK



(a) A sound has a frequency of 2000 Hz.

What is the minimum sound level needed to detect the sound?

Minimum sound level: _____ dB

(1)

(b) Which frequency shown in the figure above would require the loudest sound before it could be heard?

Frequency: _____ Hz

(1)

(c) The lowest frequency of sound the human ear can detect is 20 Hz. The wavelength of a sound wave with a frequency of 20 Hz is 17 metres.

Calculate the speed of a sound wave with a frequency of 20 Hz.

Use the correct equation from the Physics Equations Sheet.

_____

_____

_____

Speed = _____ m / s

(2)

(d) Sound waves can be reflected from a wall.

What name is given to reflected sound waves?

STEMUP.CO.UK

_____

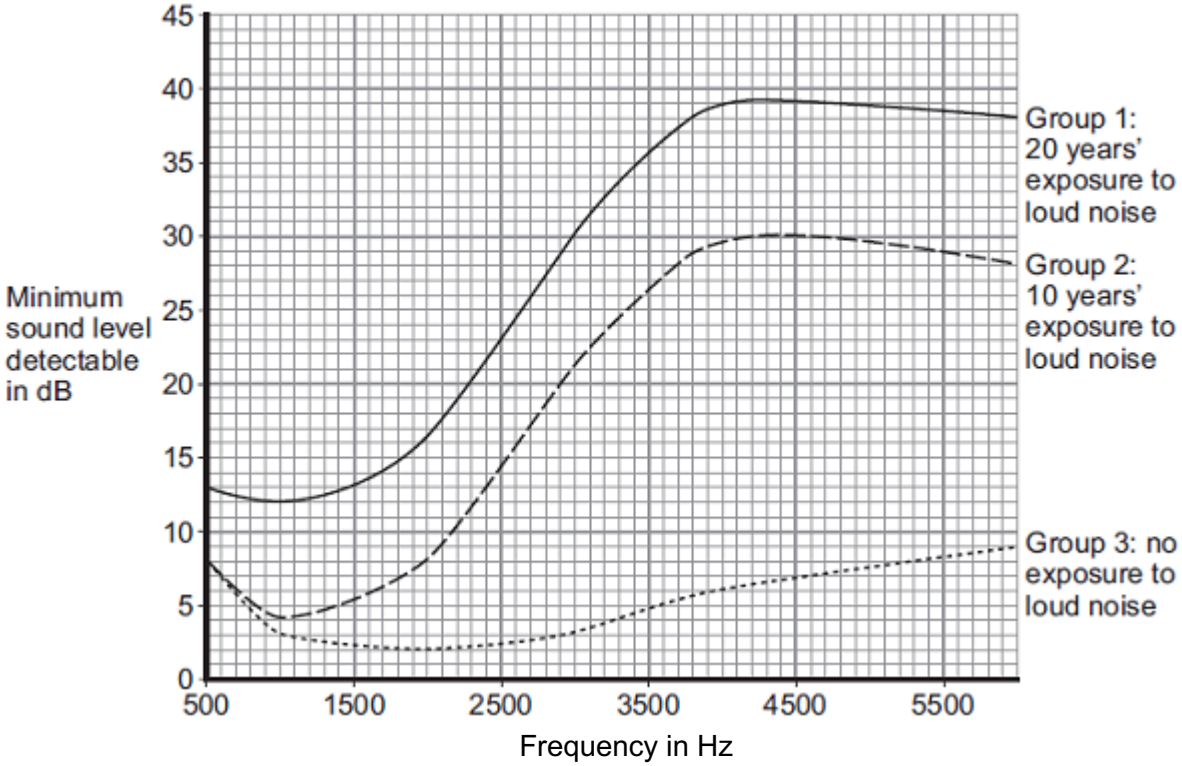
(1)

(Total 5 marks)

Q30.

Exposure to a noisy environment can damage a person's hearing.

The figure below shows the minimum sound level that is needed to detect sounds of different frequencies for three different groups of people.
Sound level is measured in decibels, dB.



(a) Which group of people has the worst hearing?

Group: _____

Use the information from the figure above to give a reason for your answer.

_____

_____

(1)

(b) Give **three** other conclusions that can be made from the figure in part (a).

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

_____

(3)

(Total 4 marks)

Q31.

A Doppler probe emits high frequency sound waves.

A doctor uses a Doppler probe to measure the pulse rate of an unborn baby in its mother's womb.

The sound waves have a frequency of 5.24×10^6 Hz.
The mean speed of sound through human body tissue is 1540 m / s.

Calculate the wavelength of the sound wave emitted by this Doppler probe as it travels through human body tissue.

Give your answer to **three** significant figures.

Use the correct equation from the Physics Equations Sheet.

_____

_____

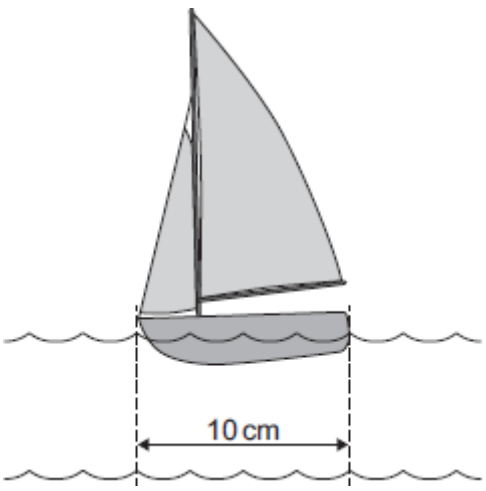
_____

Wavelength = _____ m

(Total 3 marks)

Q32.

A scientist tests a design for a sailing boat using a scale model in a tank of water.



(a) Waves are produced on the surface of the water.

STEMUP.CO.UK

Use the diagram to calculate the wavelength of one wave.

_____

_____

Wavelength = _____ cm

(2)

(b) After testing the scale model, a full-size boat is built. This boat is tested at sea.

(i) The waves at sea have a wavelength of 6 m. The frequency of the waves is 0.5 Hz.

Calculate the speed of the water waves.

Use the correct equation from the Physics Equations Sheet.

_____

_____

Speed = _____ m/s

(2)

(ii) Suggest why a scale-model is tested before a full-size boat is built.

_____

_____

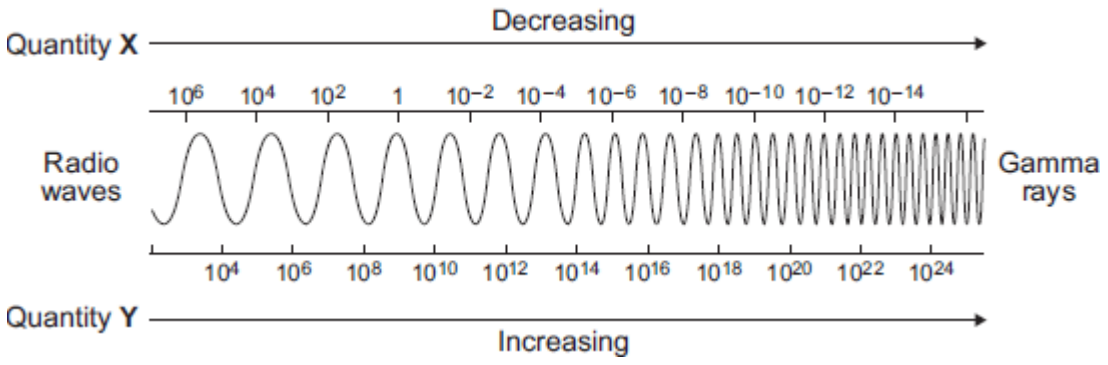
(1)

(Total 5 marks)

Q33.

The electromagnetic spectrum is shown in the diagram below.

Diagram 1



(a) Name quantities **X** and **Y**, and state the units they are measured in.

Quantity **X**: _____ Unit for Quantity **X**: _____

Quantity **Y**: _____ Unit for Quantity **Y**: _____

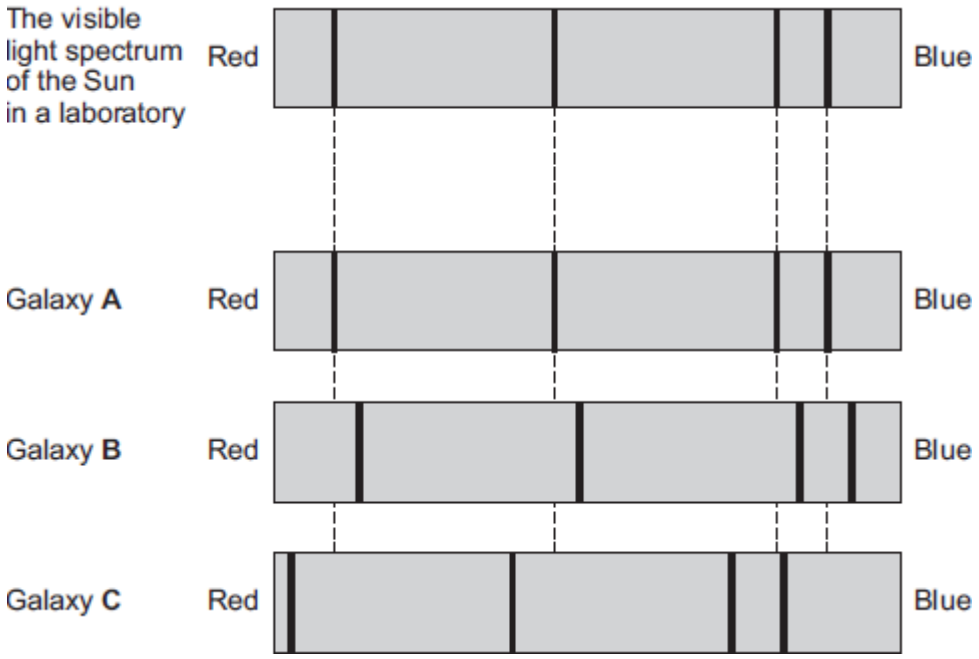
(3)

STEMUP.CO.UK

(b) The visible part of the electromagnetic spectrum from stars includes dark lines. These lines are at specific wavelengths.

Diagram 2 shows the visible light spectra for three galaxies, **A**, **B** and **C**, compared to the visible light spectrum of the Sun as seen in a laboratory.

Diagram 2



(i) Using evidence from the spectra, what conclusions can be made about the movement of galaxies **A**, **B** and **C** relative to the Earth?

(3)

(ii) Compare the speed of galaxy **B** with the speed of galaxy **C** relative to the observer.

(1)

(iii) Explain why it is **not** valid to make conclusions about all galaxies in the

STEMUP.CO.UK

Universe from these spectra.

_____

_____

_____

_____

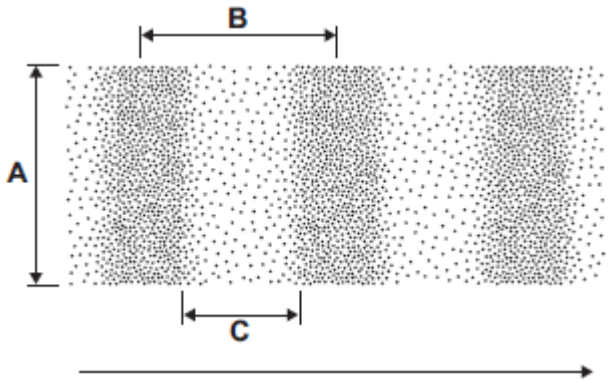
(2)

(Total 9 marks)

Q34.

Sound waves are mechanical waves.

The diagram shows the disturbance of air particles in the path of a sound wave at an instant in time.



(a) (i) Which labelled arrow, **A**, **B** or **C**, correctly identifies the wavelength of the sound wave?

Arrow: _____

(1)

(ii) What type of wave is a sound wave?

Draw a ring around the correct answer.

electromagnetic **longitudinal** **transverse**

(1)

(b) Two students investigate the reflection of sound waves from a building.

One student hits two metal bars together to produce a sound wave.

STEMUP.CO.UK



The second student starts a stop clock when the metal bars are hit together and stops the stop clock when she hears the echo.

The students want to calculate the time it takes the sound wave to travel to the building.

(i) Why must the students divide the time on the stop clock by 2 to calculate the time it takes the sound wave to travel to the building?

_____

_____

(1)

(ii) The students divide each time by 2 and record their results in a table.

	Trial 1	**Trial 2**	**Trial 3**	**Mean**
Time in seconds	0.33	0.27	0.30	

Calculate the mean of the 3 results.

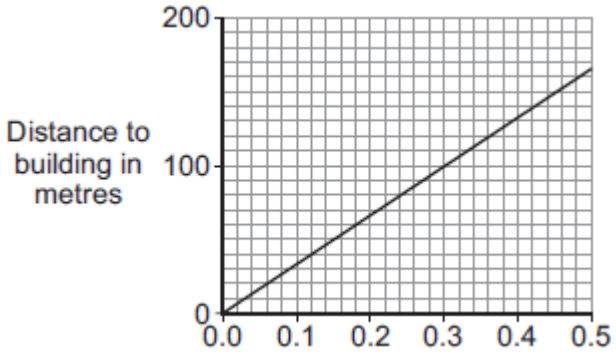
Write the mean in the table.

_____

_____

(2)

(iii) The time taken for the sound wave to reach the building, from different distances, is shown in the graph.



Use the mean time from the table to determine the distance to the building.

STEMUP.CO.UK

_____

Distance = _____ m

(1)

(iv) The students see differences between the results.

Choose **one** improvement the students could make to the investigation.

Tick (✓) **one** box.

Improvement	Tick (✓)
Decrease the distance between the students and the building.	
Use a sound sensor and a datalogger to measure the time.	
Play a long note on a musical instrument instead of using metal bars.	

(1)

(v) The students listen to the echo. The echo is quieter than the sound heard when the metal bars are hit together.

How does the amplitude of the echo compare with the amplitude of the sound wave produced by the metal bars?

_____

_____

(1)

(Total 8 marks)

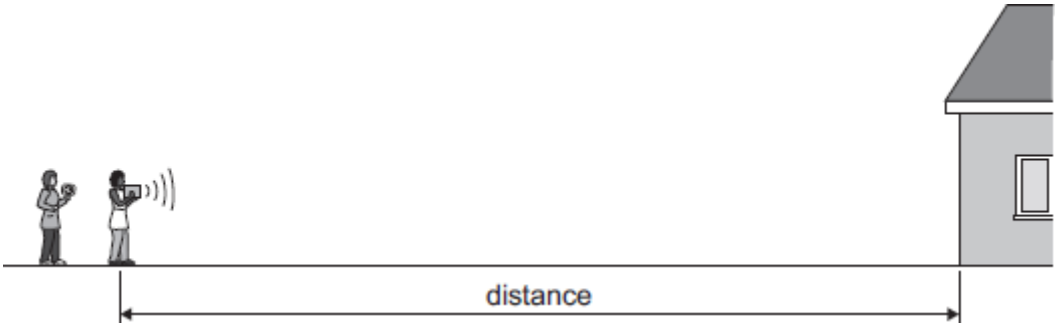
Q35.

Two students investigated the reflection of sound waves from a building.

One student used a signal generator connected to a loudspeaker to produce a short, high-pitched sound wave.

The second student used a stop clock to measure the time taken for the sound wave to return to the students.

The students repeated the experiment at different distances from the building.



STEMUP.CO.UK

(a) Sound is a longitudinal wave.

How is a longitudinal wave different from a transverse wave?

_____

_____

_____

_____

(2)

(b) The students' results are shown in the table.

	Trial 1	**Trial 2**	**Trial 3**
Time in seconds	0.40	0.59	0.92
Distance in metres	50.0	100.0	150.0

(i) What was probably the biggest source of error in the students' investigation?

Give a reason for your answer.

_____

_____

_____

_____

(2)

(ii) The signal generator was set at a frequency of 1.2 kHz.

The speed of sound in air, when the students did the investigation, was 340 m/s.

Calculate the wavelength of the sound wave generated by the speaker.

Use the correct equation from the Physics Equations Sheet.

_____

_____

_____

Wavelength = _____ m

(3)

(Total 7 marks)

Q36.

STEMUP.CO.UK

Waves have many different properties.

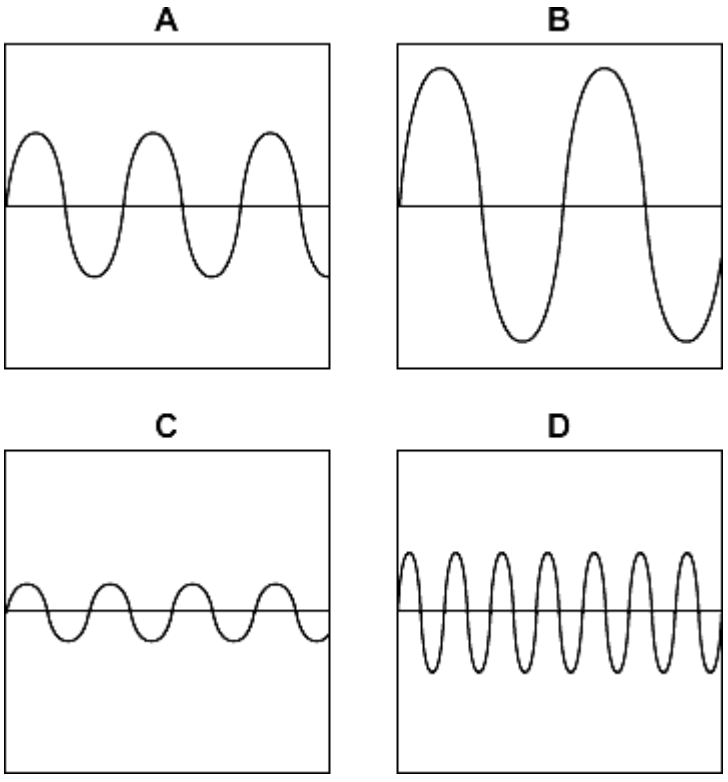
(a) Draw a ring around the correct answer in the boxes to complete each sentence.

Light waves	are longitudinal. are transverse. may be either longitudinal or transverse.
Sound waves	are longitudinal. are transverse. may be either longitudinal or transverse.

(2)

(b) Diagrams **A**, **B**, **C** and **D** show oscilloscope traces of four different sound waves.

The oscilloscope settings are the same each time.



(i) Give the letter of the loudest sound. ☐

(1)

(ii) Give the letter of the highest pitch sound. ☐

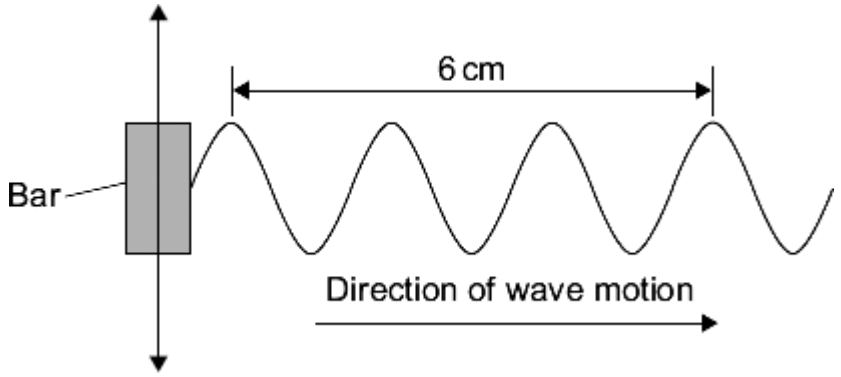
(1)

(Total 4 marks)

STEMUP.CO.UK

Q37.

A ripple tank is used to investigate the behaviour of water waves.
A bar moves up and down to make the waves.



(a) What is the wavelength of each wave in the diagram?

Draw a ring around the correct answer.

2 cm **3 cm** **6 cm**

(1)

(b) The ripple tank produces 10 waves in 2 seconds.

What is the frequency of the waves?

_____

_____

Frequency = _____ hertz

(1)

(c) The bar is made to move faster.

It now produces waves with:

- a frequency of 20 hertz
- a wavelength of 0.5 cm.

Calculate the speed of the water waves in cm/s.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

_____

_____

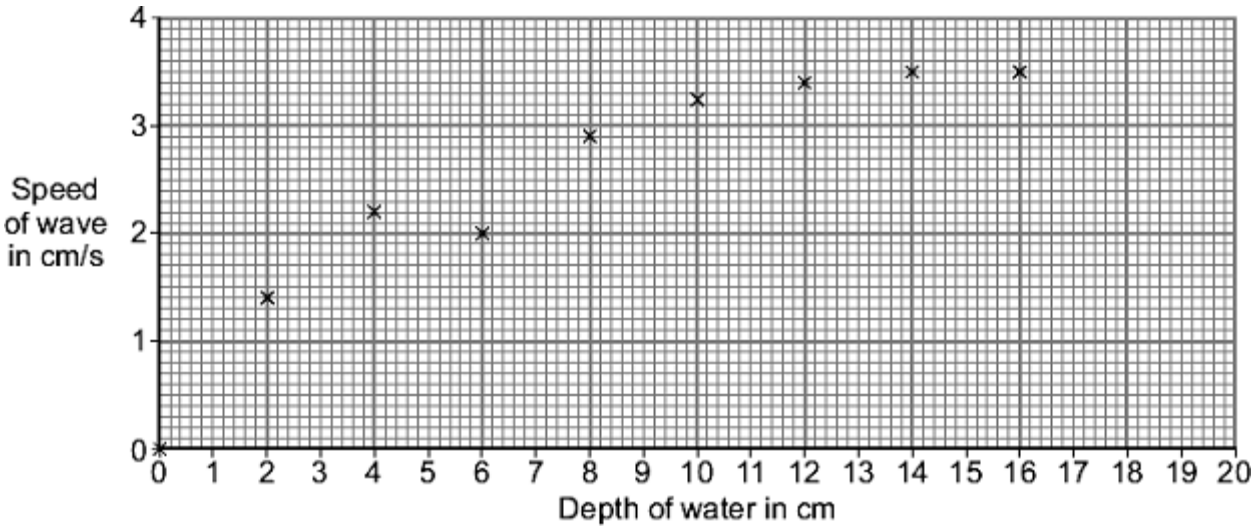
STEMUP.CO.UK

Speed = _____ cm/s

(2)

(d) A student uses the ripple tank to investigate the relationship between depth of water and speed of waves.

The graph shows the student's results.



(i) There is one anomalous result.

On the graph, draw a ring around this anomalous result.

(1)

(ii) On the graph, draw a line of best fit

(1)

(iii) Use your line of best fit to find the speed of the wave at a depth of 20 cm.

Wave speed = _____ cm/s

(1)

(Total 7 marks)

Q38.

Electromagnetic waves behave differently in different situations.

Electromagnetic waves travel at a speed of 3×10^8 m/s in a vacuum.

Microwave radiation has a wavelength of 2 cm.

Calculate the frequency of microwave radiation.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

STEMUP.CO.UK

_____

_____

Frequency = _____ hertz

(Total 2 marks)

Q39.

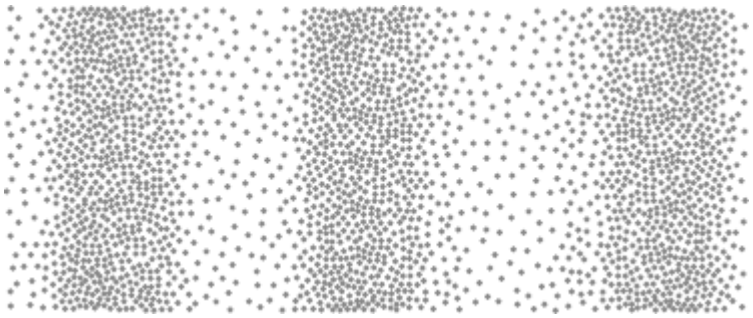
Sound waves cause oscillations in the air. Sound waves are longitudinal.

(a) In which direction are the oscillations of the particles compared to the direction of transfer of energy?

_____

(1)

(b) The diagram shows the disturbance of air molecules in the path of a sound wave at one point in time.



(i) Label the diagram with the letter **R**, in an area of rarefaction.

(1)

(ii) Label the diagram to show one complete wavelength.

(1)

(Total 3 marks)

Q40.

The different parts of the electromagnetic spectrum are shown below.

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

(a) Name a part of the electromagnetic spectrum with:

(i) a longer wavelength than microwaves: _____

(1)

(ii) greater energy than X-rays: _____

(1)

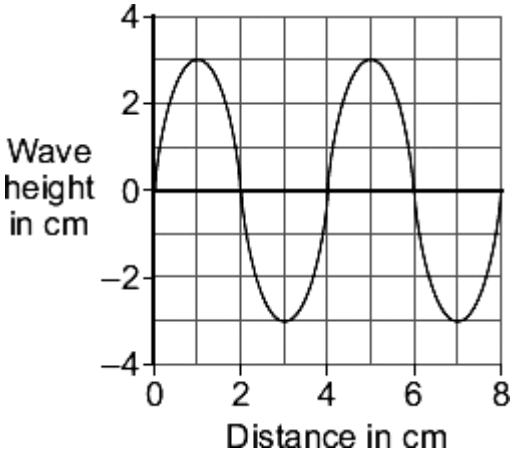
(iii) a higher frequency than ultraviolet: _____

(1)

STEMUP.CO.UK

(b) The properties of water waves can be measured easily in a school lab.

The diagram shows information about waves.



(i) How many complete waves are shown in the diagram?

_____

(1)

(ii) What is the wavelength of each wave in the diagram?

_____ cm

(1)

(iii) What is the amplitude of the waves?

_____ cm

(1)

(iv) Complete the sentence below.

The oscillations of the waves in the diagram are perpendicular to the direction of energy transfer. They are called _____ waves.

(1)

(Total 7 marks)

Q41.

(a) Sound and light are different types of waves.

Give **two** similarities and **two** differences between sound waves and light waves.

_____

_____

_____

_____

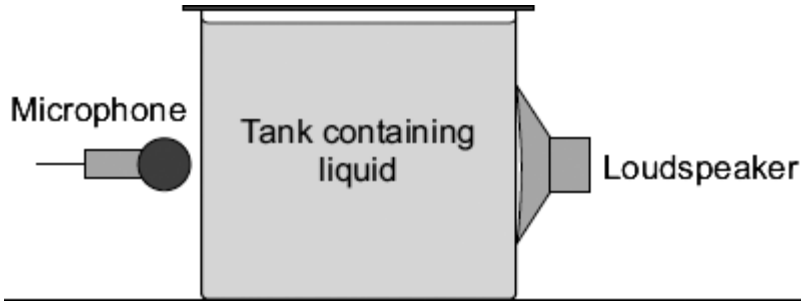
_____

STEMUP.CO.UK

(4)

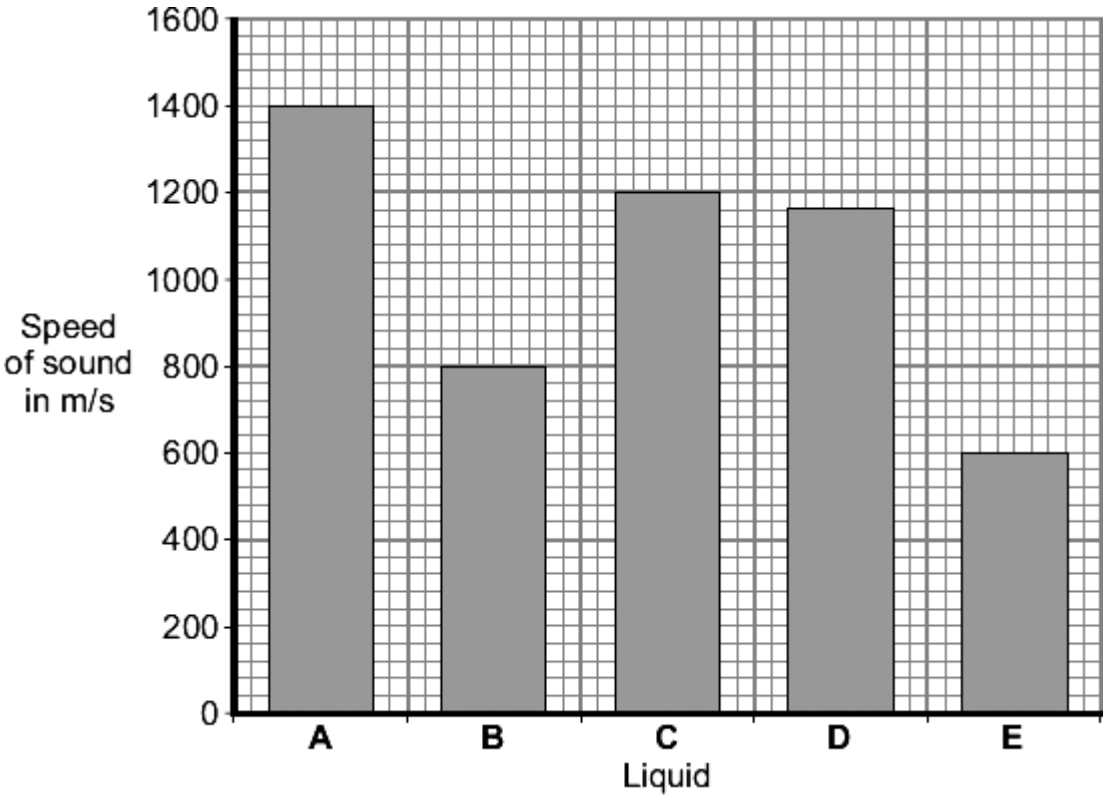
(b) A student does an experiment to investigate the speed of sound in different liquids.

The student uses the apparatus shown.



A loudspeaker makes a sound wave. The sound wave travels through the liquid in the tank. The time it takes to travel this distance is used to calculate the speed of sound.

The bar chart shows the student's results.



(i) When a sound wave with a frequency of 4800 hertz passes through one of the liquids, it has a wavelength of 0.25 m.

Calculate the speed of the wave and identify the liquid used.

STEMUP.CO.UK

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

_____

_____

_____

Speed = _____ m/s

The liquid used was _____

(3)

(ii) The student's hypothesis was:
'There is a link between the density of a liquid and the speed of sound in the same liquid.'

Liquid	Density in g/cm^3	Speed of sound in m/s
Ethoxyethane	0.71	985
Ethanol	0.80	1150
Kerosene	0.82	1300
Water	1.00	1500
Mercury	13.50	1450

Use the information in the table to decide whether the student's hypothesis was completely correct or not.

Was the student's hypothesis completely correct?

Draw a ring around your answer. **Yes** / **No**

Give reasons for your answer.

_____

_____

_____

_____

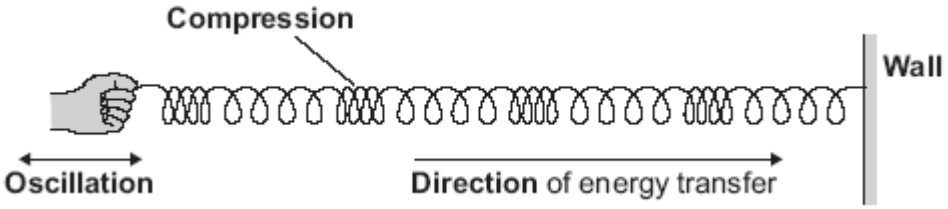
(2)

(Total 9 marks)

Q42.

STEMUP.CO.UK

(a) The diagram shows a longitudinal wave being produced in a stretched spring.



(i) Use the bold words from the diagram to complete the following sentence. Put only **one** word in each space.

A longitudinal wave is one in which the _____ causing

the wave is parallel to the _____ of energy transfer.

(2)

(ii) Name the type of energy that is transferred by longitudinal waves.

_____

(1)

(b) The diagram shows water waves made by a wave machine in a swimming pool.



Every second, two waves go past a person standing in the swimming pool.

The waves have a wavelength of 0.8 metres.

Calculate the speed of the water waves.

Write down the equation you use, and then show clearly how you work out your answer.

Give the correct unit in your answer.

_____

_____

_____

_____

_____

_____

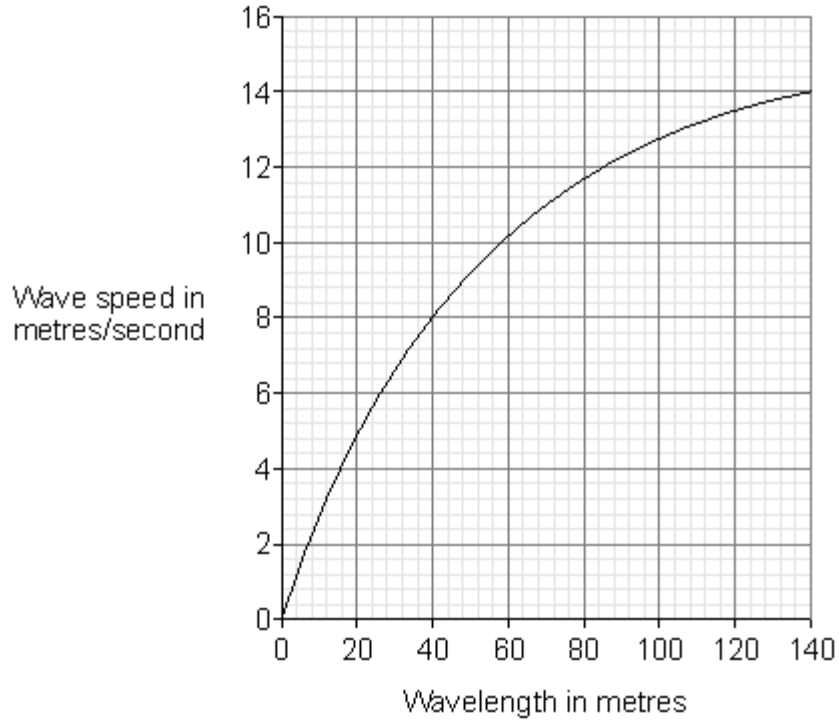
_____

STEMUP.CO.UK

Wave speed = _____

(3)

(c) The graph shows how the speed of deep ocean waves depends on the wavelength of the waves.



What can you conclude from the graph?

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

STEMUP.CO.UK