**Q1.**
The photograph shows a pulse oximeter. This is used to show the heart rate and the amount of oxygen in the blood.


(i) Where is the oximeter usually placed to take measurements? **(1)**

- ☒ **A** on the finger
- ☒ **B** over the heart
- ☒ **C** on the neck
- ☒ **D** on the wrist

(ii) There are two LEDs used in an oximeter.
One emits visible light.
State what type of radiation the other LED emits. **(1)**

(iii) The oximeter shows a heart rate of 89 beats per minute.
Calculate the frequency in beats per second. **(2)**

(iv) Calculate the time between each heartbeat.
Use the equation

$$\text{time between heartbeats} = \frac{1}{\text{frequency}}$$

**(2)**

**Q2.**
There is a piece of music called "The Flight of the Bumble Bee."
This takes 4 minutes to play.
During this time, a bee flies 1608 m.
Calculate the average speed of the bee. **(3)**

**Q3.**
An earthquake causes a sea wave.
This sea wave travels 26 400 m in two minutes.
Calculate the speed of the wave.
Use the equation

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

**(3)**

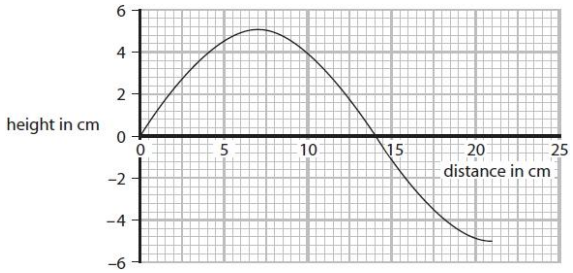
**Q4.**
Sound waves travel at 330 m/s in air.
A student sees a flash of lightning.
The student hears the sound of thunder 4.0 s later.
Calculate the distance from the student to the flash of lightning.
Use the equation $x = v \times t$ **(2)**

**Q5.**
A wave has a frequency of 15 Hz. Its wavelength is 125 m.
Calculate the speed of the wave.
State the unit. **(3)**

A different water wave has a wavelength of 0.25 m and a frequency of 1.5 Hz.
Calculate the wave speed. **(2)**

**Q7.**
Figure 8 shows part of a wave.

Use data from Figure 8 to calculate the wavelength of the wave. **(2)**



**Q8.**
The electromagnetic spectrum is continuous.
Different regions of the spectrum have different properties.
An electromagnetic wave has a frequency of $7 \times 10^9$ Hz.
The speed of the wave is $3 \times 10^8$ m/s.
Calculate the wavelength of the wave.

(3)

**Q9.**
(i) Which row of the table is correct for sound waves?

| | sound waves are | can sound waves transfer energy? |
|---|---|---|
| ☐ A | longitudinal | yes |
| ☐ B | longitudinal | no |
| ☐ C | transverse | yes |
| ☐ D | transverse | no |

(1)

(ii) A sound wave has a frequency of 440 Hz and a wavelength of 0.75 m.
Calculate the wave speed of the sound wave.

(2)

**Q10.**
Light and sound waves are produced at the same time by an explosion on Earth.
(i) The sound of the explosion is heard 1920 metres away 6.0 seconds after the explosion has happened.
Calculate the speed of sound in air.

(2)

(ii) A scientist is standing a long way from the explosion.
Explain why he hears the explosion a few seconds after he sees it.

(2)

**Q11.**
A student is standing 600 m from a firework display.
A firework explodes with a loud bang, and a flash of light is seen.
Describe how a student can measure the time it takes for the sound wave from the loud bang to travel 600 m.

(2)

**Q12.**
A man throws a stone into a pond.
Devise a method of measuring the frequency of the waves.

(2)

**Q13.**
Sound waves are longitudinal waves.
Water waves are transverse waves.
Describe the difference between longitudinal waves and transverse waves.

(3)

**Q14.**
(a) Seismic (earthquake) waves can be either P-waves or S-waves.
Which row of the table is correct for P-waves?

| | type of wave | can they be refracted? |
|---|---|---|
| ☐ A | longitudinal | yes |
| ☐ B | transverse | no |
| ☐ C | longitudinal | no |
| ☐ D | transverse | yes |

(1)

(b) Explain why it is difficult to predict when an earthquake will happen.

(2)

**Q15.**
The electromagnetic spectrum is continuous.
Different regions of the spectrum have different properties.
(a) (i) Name an electromagnetic wave that is also an ionising radiation.

(1)

(ii) Genuine banknotes contain a special ink.
This ink is invisible under normal light.
Suggest why the ink glows when ultraviolet radiation is shone on it.

(2)

(b) An electromagnetic wave has a frequency of $7 \times 10^9$ Hz.
The speed of the wave is $3 \times 10^8$ m/s.
Calculate the wavelength of the wave.

(3)

*(c) Radiation from different regions of the electromagnetic spectrum can affect the human body in many ways. Discuss the different ways in which excessive exposure to electromagnetic radiations of various frequencies may cause damage to the human body.

**(6)**

**Q16.**

Figure 6 shows a large tank of water.

The tank of water is used to study water waves.

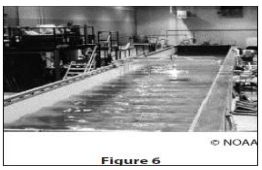


Figure 6

Figure 8 shows part of the inside of the Earth below the surface.

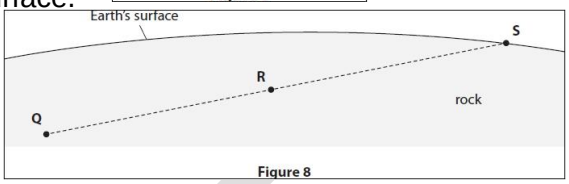


Figure 8

An earthquake starts at **Q**.

A seismic wave travels from **Q** to **S**.

A technician measured the frequency of the water wave in Figure 7 by counting how many waves passed him in 15 s.

Explain why this would **not** be a suitable method for measuring the frequency of the seismic wave in Figure 8.

**(2)**

**Q17.**

The speed of light is $3.0 \times 10^8$ m/s.

The wavelength of yellow light is $5.8 \times 10^{-7}$ m.

Calculate the frequency of yellow light.

State the unit.

Use the equation

$$\text{frequency} = \frac{\text{speed}}{\text{wavelength}}$$

**(3)**

**Q18.**

Figure 6 shows a large tank of water.

The tank of water is used to study water waves.

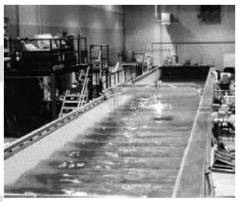


Figure 6

(i) Water waves are transverse waves.
Give another example of a transverse wave.

**(1)**

(ii) Figure 7 shows a side view of part of the tank.

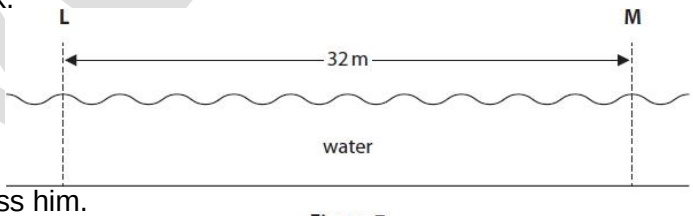


Figure 7

A water wave is moving from **L** to **M**.
Calculate the wavelength of the wave.

**(2)**

(iii) A technician stands at the side of the tank.
He counts the peaks of the waves as they pass him.
12 peaks pass the technician in a time of 15 s.
Calculate the frequency of the wave.

**(2)**

**Q19.**

Water waves are transverse waves.

(i) Give **one** other example of a transverse wave.

**(1)**

(ii) Give **one** example of a longitudinal wave.

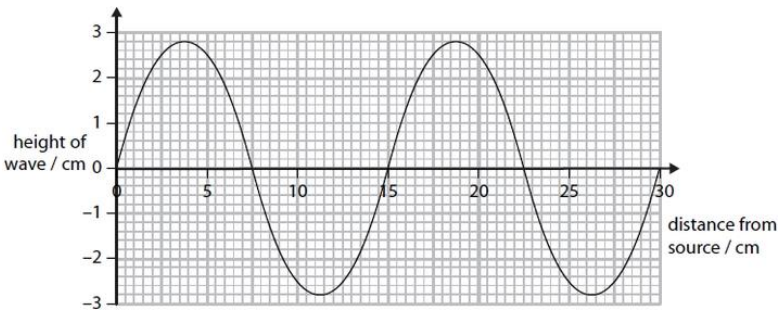
**(1)**

**Q20.**

Figure 2 shows a water wave.

(i) What is the amplitude of this wave?

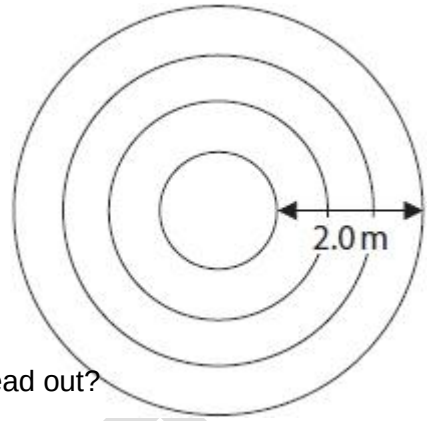
**(1)**




- ☐ **A** 2.8 cm
- ☐ **B** 5.6 cm
- ☐ **C** 7.5 cm
- ☐ **D** 15 cm

(ii) What is the wavelength of this wave?

**(1)**




- ☐ **A** 2.8 cm
- ☐ **B** 7.5 cm
- ☐ **C** 15 cm
- ☐ **D** 30 cm

**Q21.**
A man throws a stone into a pond.
The stone makes waves that spread out in circles.
Figure 4 shows some of the waves.

(i) Which of the following changes is correct as the waves spread out?

**(1)**

- ☐ **A** the amplitude is higher
- ☐ **B** the frequency is higher
- ☐ **C** the wavefront is longer
- ☐ **D** the period is longer

(ii) The stone hits the water 4.0 m from the bank.
The wave speed is 0.70 m/s.
Calculate the time for the wave to reach the bank.

**(2)**

(iii) The wavelength of the waves is the distance between one wavefront and the next.
Use the diagram to find the wavelength of the waves.

**(1)**

(iv) There is a cork which bobs up and down in the water as the wave goes past.
Explain how this shows that the wave is transverse.

**(2)**

**Q22.**

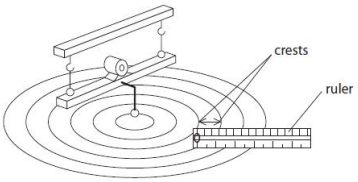
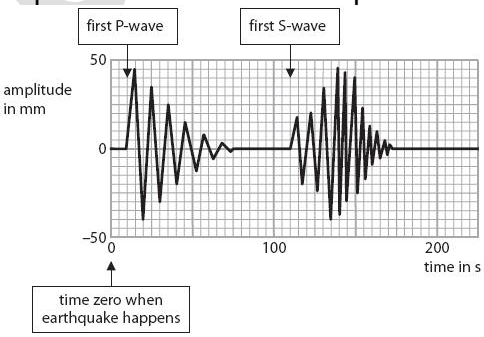



Figure 2 shows water waves spreading out from a source.
A student measures the wavelength of the waves.
He uses a ruler to measure the distance from one crest to the next crest.
Explain how to improve the student's method for measuring the wavelength.

**(2)**

**Q23.**
The chart shows the arrival of earthquake waves at an earthquake monitoring station.




The S − P time (S minus P time) for earthquake waves is the time difference between the arrival of the first P wave and the first S wave.
Use the chart to estimate the S − P time for the earthquake waves shown.

**Q24.**
The photograph shows a pulse oximeter. This is used to show the heart rate and the amount of oxygen in the blood.


(a) (i) Where is the oximeter usually placed to take measurements?
Put a cross ( ☒ ) in the box next to your answer.

(1)

- ☒ **A** on the finger
- ☒ **B** over the heart
- ☒ **C** on the neck
- ☒ **D** on the wrist

(ii) There are two LEDs used in an oximeter.
One emits visible light.
State what type of radiation the other LED emits.

(1)

(iii) The oximeter shows a heart rate of 89 beats per minute.
Calculate the frequency in beats per second.

(2)

(iv) Calculate the time between each heartbeat.
Use the equation

$$\text{time between heartbeats} = \frac{1}{\text{frequency}}$$

(2)

*(b) Doctors use an electrocardiogram (ECG) machine to monitor the action of a person's heart.
Describe how a doctor can use an ECG machine to collect and display information from a person's beating heart in order to check heart action.
You may draw a labelled diagram to help with your answer.

**Q25.**
The students produce a different wave.
This wave has a frequency of 1.7 Hz and a wavelength of 8.0 cm.
Calculate the speed of this wave.

(2)

**Q26.**
Figure 8 shows part of the inside of the Earth below the surface.

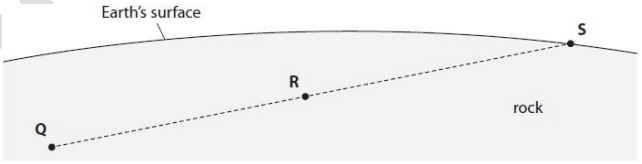



Figure 8

An earthquake starts at **Q**.
A seismic wave travels from **Q** to **S**.
The seismic wave is a longitudinal wave.
(i) Draw arrows on Figure 8 to show how the rock at **R** moves when the seismic wave passes through **R**.

(2)

(ii) The frequency of the seismic wave is 12 Hz.
The wave speed of the seismic wave is 7 km / s.
Calculate the wavelength of the seismic wave, in metres.
Use the equation

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

(3)

**Q27.**
A sound wave in air travels a distance of 220 m in a time of 0.70 s.
(i) State the equation linking speed, distance and time.

(1)

(ii) Calculate the speed of the sound wave in air.

(2)

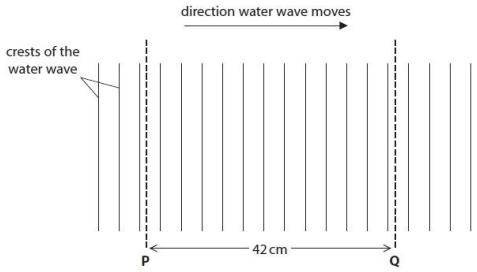


Figure 3

**Q28.**
This question is about waves.
Figure 3 is a diagram of a **water wave** in a ripple tank.

(i) State the number of crests of the wave between **P** and **Q**.

**(1)**

(ii) The distance between **P** and **Q** is 42 cm.
Calculate the wavelength of the water wave in Figure 3.

**(2)**

(iii) Describe how a student could determine the wave speed of the water wave in Figure 3.

**(3)**

**Q29.**
A man throws a stone into a pond.
On the other side of the pond, the water becomes very shallow.
In the shallow water, the wave is slower but the frequency does not change.
State what happens to the wavelength when a wave reaches the shallow water.

**(1)**

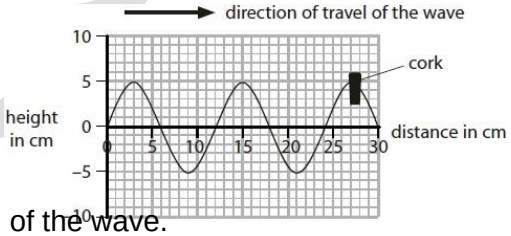
**Q30.**
Geologists use sound waves from a small explosion to search for oil underground.
Complete the sentence by putting a cross ( ☒ ) in the box next to your answer.
(i) These sound waves are called

**(1)**

☒ **A** cosmic waves
☒ **B** seismic waves
☒ **C** volcanic waves
☒ **D** tectonic waves

(ii) A small explosion is triggered at the Earth's surface.
The waves reflect back from the top of the oil field.
Suggest why the waves are reflected from the oil field.

**(1)**




**Q31.**
Figure 4 is a diagram of a water wave.
A cork is floating on the water.

(i) Use the scale on the diagram to measure the wavelength of the wave.

**(2)**

(ii) Describe the motion of the cork.
You should include how the cork moves relative to the direction of travel of the wave.

**(2)**

**Q32. Q33.**
Light travels the 150 million km from the Sun to the Earth in about 500 s.
It takes about 2100 s for light to reach the Earth from Jupiter.
Using this information, calculate the approximate distance of Jupiter from the Earth.

**(2)**

**Q34.**
(i) Figure 9 shows a student sitting on the shore of a lake watching ripples on the surface of the water moving past a toy boat.
The student has a stopwatch.
Describe how the student could determine the frequency f the ripples on the lake.

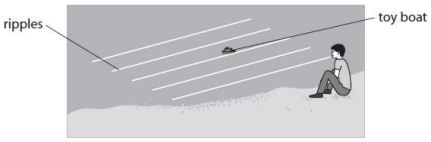


Figure 9

**(3)**

(ii) The speed of a water wave is 1.5 m/s.
The frequency of the wave is 0.70 Hz.
Calculate the wavelength of this wave.
Use the equation
$v = f \times \lambda$

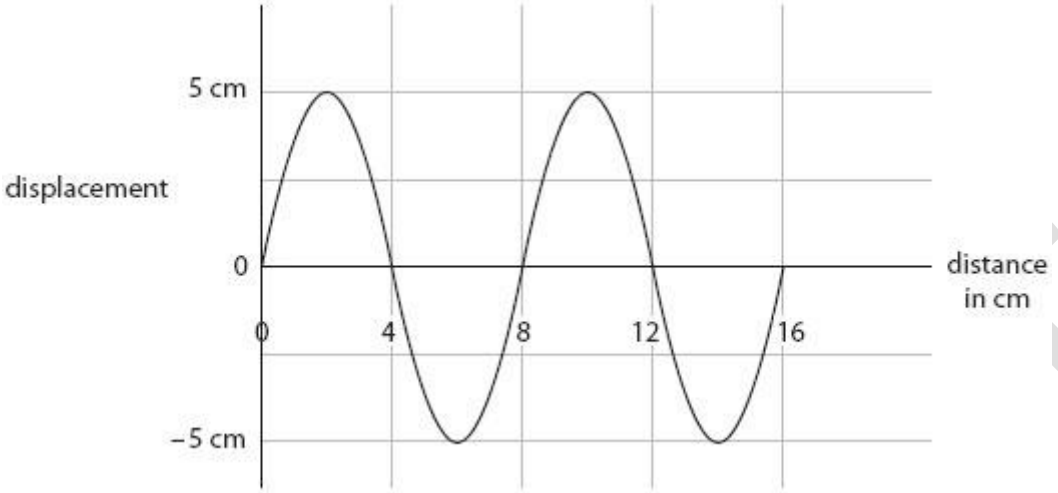
**(2)**

(iii) Water waves are transverse waves.
Describe the difference between transverse waves and longitudinal waves.

**(2)**

**Q35.**

(i) The diagram represents a wave.




State the amplitude and wavelength of the wave.

**(2)**

(ii) 20 waves are sent out in 4 seconds.
Complete the sentence by putting a cross ( ☒ ) in the box next to your answer.
The frequency of the wave is

**(1)**

- ☒ **A** 0.2 Hz
- ☒ **B** 5 Hz
- ☒ **C** 20 Hz
- ☒ **D** 80 Hz

**Q36.**

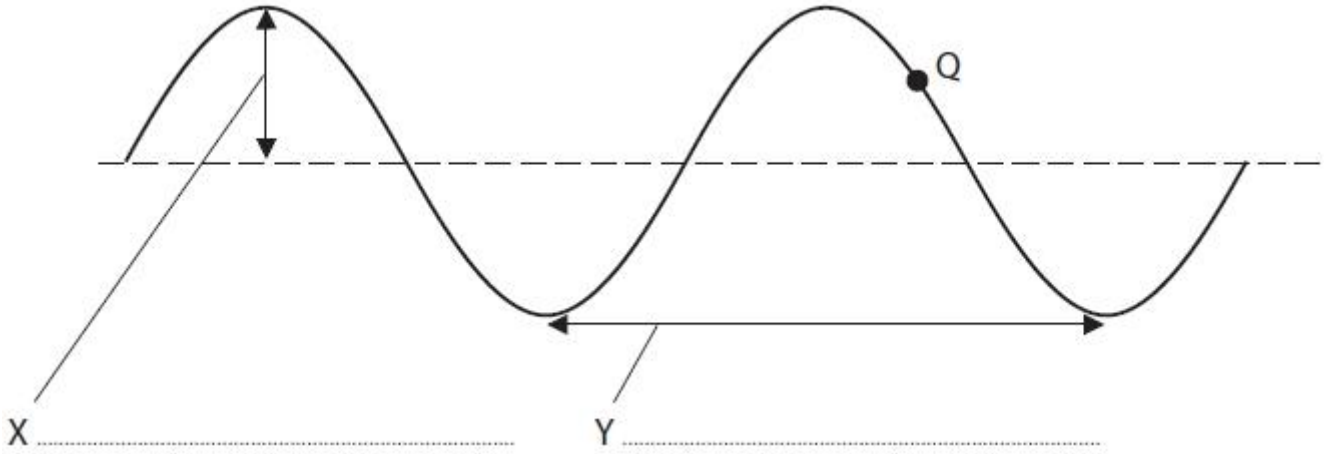
Waves from an earthquake are

**(1)**

- ☒ **A** transverse waves only
- ☒ **B** electromagnetic waves only
- ☒ **C** both transverse and electromagnetic waves
- ☒ **D** both transverse and longitudinal waves

**Q37.**

The diagram shows a transverse wave.




(i) Use words from the box to label the distances X and Y.

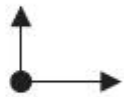
| amplitude | frequency | magnification | speed | wavelength |
|---|---|---|---|---|

**(2)**

(ii) Q is a particle in the wave.
Which of these shows the way in which particle Q moves?
Put a cross (☒) in the box next to your answer.

**(1)**

☐ **A** 

☐ **B** 

☐ **C** 

☐ **D**