1 Different types of waves are used in hospitals.

(a) Some of the waves used are electromagnetic.

(i) Which of these properties is the same for all electromagnetic waves?

(1)

- ☒ **A** amplitude
- ☒ **B** frequency
- ☒ **C** speed in free space
- ☒ **D** wavelength in free space

(ii) Draw a line linking each type of electromagnetic wave with its use.

(2)

type of electromagnetic wave	**use**
gamma rays	heating food for patients
microwaves	imaging broken bones
x-rays	with medical tracers

(iii) Electromagnetic waves are transverse.

Describe how the vibrations of a transverse wave relate to the direction in which the wave travels.
You may draw a diagram to help your answer.

(1)

(b) Another type of wave used in hospitals is ultrasound.

Ultrasound waves are used to make images of internal organs.

A scanner emits an ultrasound wave into the patient and records any reflections.

(i) The frequency of ultrasound waves is outside the range of human hearing.

Which of these could be the frequency of an ultrasound wave?

(1)

- ☒ **A** 45 Hz
- ☒ **B** 450 Hz
- ☒ **C** 4 500 Hz
- ☒ **D** 45 000 Hz

(ii) The scanner records the time from when a wave is emitted to when its reflection is received.

A technician calculates the depth of the reflection using the equation

$$\text{depth} = \frac{1}{2} \times \text{speed of ultrasound in patient} \times \text{time recorded by scanner}$$

Explain why the technician uses the value $\frac{1}{2}$ in the equation.

(2)

.....

.....

.....

.....

.....

(iii) An ultrasound wave travels faster in the patient than it does in air.

Explain how a change in speed affects the wavelength of the ultrasound wave.

(2)

.....

.....

.....

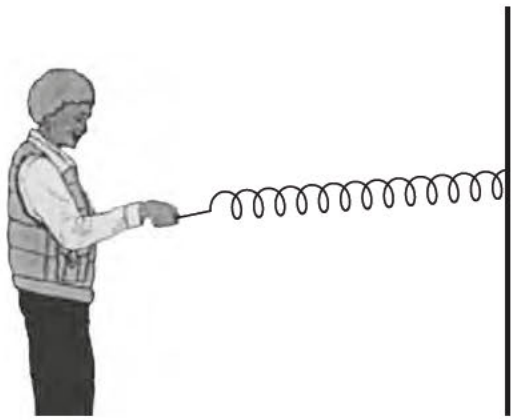
.....

.....

(Total for Question 1 = 9 marks)

2 A teacher demonstrates different types of wave.

(a) He uses a spring to demonstrate longitudinal waves.



(i) Draw arrows on the diagram to show the directions in which the teacher moves his hand.

(1)

(ii) Give an example of a longitudinal wave.

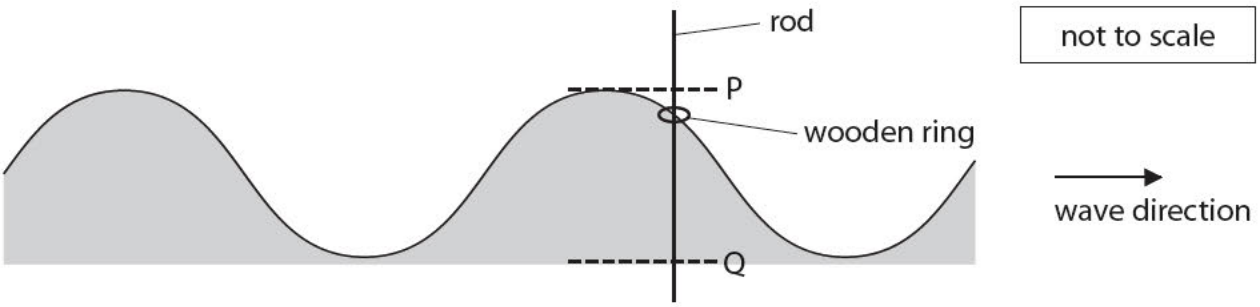
(1)

(b) The teacher then demonstrates transverse waves.

He fixes a vertical rod in a pond.

He places a small wooden ring on the rod.

The ring floats on the water and moves up and down the rod as waves go past.



(i) On the diagram, draw a line to show one wavelength.

Label your line with the letter W.

(1)

(ii) The distance from P to Q is 5.0 cm.

Determine the amplitude of the wave.

(1)

amplitude = ... cm

(iii) The wooden ring reaches point P every 15 s.

Calculate the frequency of the wave.

Give the unit.

(3)

frequency = ... unit .....

(iv) Explain how the movement of the wooden ring demonstrates that this wave is transverse.

(2)

.....

.....

.....

.....

(v) The wave shown is a water wave.

Give a different example of a transverse wave.

(1)

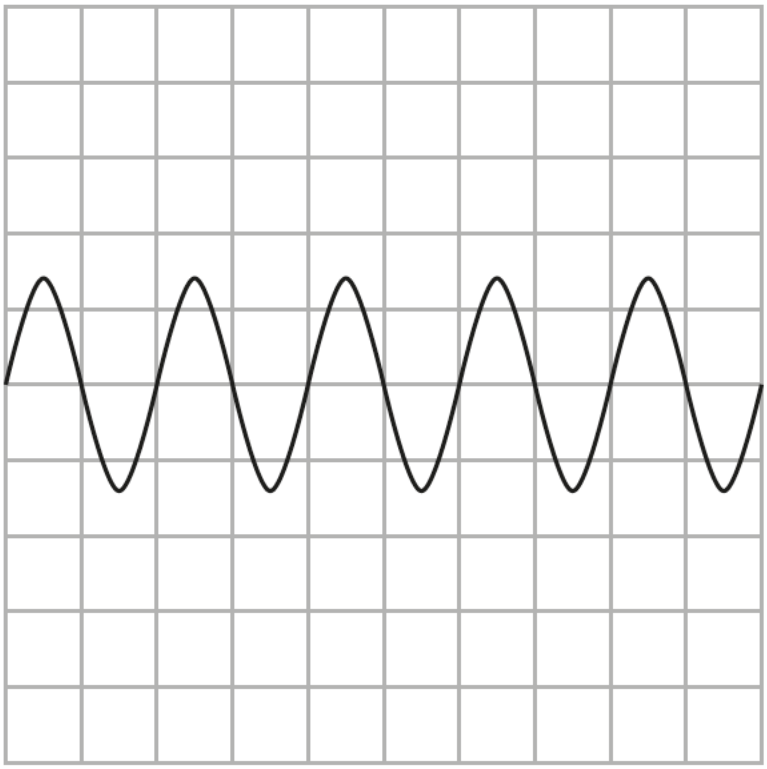
.....

(Total for Question 2 = 10 marks)

3 Waves can travel on water, through air or in a vacuum.

(a) The diagram shows the side-view of a wave on the surface of water.

Each square on the grid represents 1 cm x 1 cm.



(i) State the wavelength of the wave shown.

(1)

wavelength = ... cm

(ii) On the grid sketch the trace of a wave travelling at the same speed, but with a larger amplitude and a lower frequency.

(2)

(b) Two students investigate the speed of sound waves in air.

They use a stopwatch that shows times to the nearest 0.1 s.

They use an outdoor running track as their measure of distance.

The track is straight and 100 m long.

Describe what else they must do to obtain a value for the speed of sound.

(5)

(c) (i) State the equation linking wave speed, frequency and wavelength.

(1)

(ii) The speed of radio waves is 300 000 000 m/s.

A radio wave has a frequency of 31 MHz.

Calculate the wavelength of this radio wave.

(3)

wavelength = ... m

(d) A sound wave and a radio wave have the same wavelength.

State why they have different frequencies.

(1)

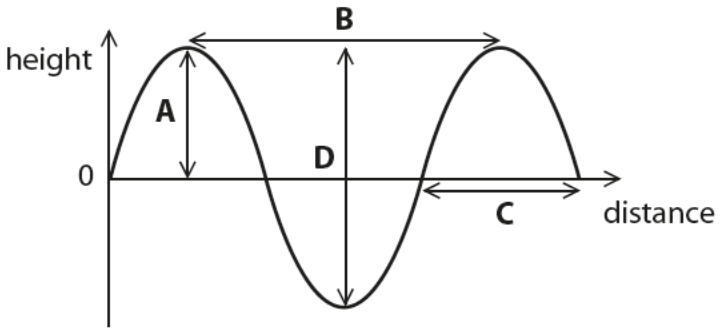
.....

.....

.....

(Total for Question 3 = 13 marks)

4 The diagram shows part of a water wave.



(a) (i) Which letter represents the wavelength?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) Which letter represents the amplitude?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(iii) This water wave is transverse. Other waves can be longitudinal.

State a similarity and a difference between a transverse wave and a longitudinal wave.

(2)

similarity .....

.....

difference .....

.....

(b) A student writes some sentences about electromagnetic waves.

His teacher circles a mistake in each sentence.

In the table, write a suitable correction for each mistake.

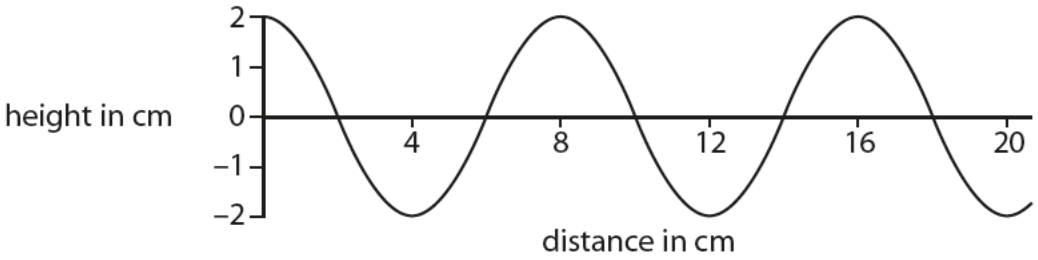
The first one has been done for you.

(5)

Sentence	Correction
Electromagnetic waves travel at $3 \times (10^2)$ m/s in a vacuum.	10^8
(Sound) waves are electromagnetic.	
(Infra-red) waves are the most harmful to people.	
(Gamma) waves are used for heating up food.	
(Radio) waves have the highest frequency.	
(Gamma) waves have a very long wavelength.	

(Total for Question 4 = 9 marks)

5 The diagram shows a water wave.



(a) (i) The amplitude of the wave is

(1)

- ☒ **A** 1 cm
- ☒ **B** 2 cm
- ☒ **C** 4 cm
- ☒ **D** 8 cm

(ii) The wavelength of the wave is

(1)

- ☒ **A** 2 cm
- ☒ **B** 4 cm
- ☒ **C** 8 cm
- ☒ **D** 20 cm

(b) Describe one difference between transverse and longitudinal waves.

Draw a labelled diagram to help your answer.

(3)

(c) State two properties that are the same for all electromagnetic waves.

(2)

1 .....

2 .....

(d) Some types of wave are used in hospitals.

(i) A scanner uses one type of wave to check for broken bones.



The type of wave emitted by the scanner is

(1)

☒ **A** infrared

☒ **B** microwaves

☒ **C** sound

☒ **D** X rays

(ii) An image of the bone is seen because the waves from the scanner are

(1)

☒ **A** absorbed by the bone

☒ **B** reflected by the bone

☒ **C** refracted by the bone

☒ **D** transmitted by the bone

(iii) Name one type of wave that is used in cancer treatment and explain what it does during the treatment.

(2)

Type of wave .....

Explanation of what it does .....

.....

.....

(Total for Question 5 = 11 marks)

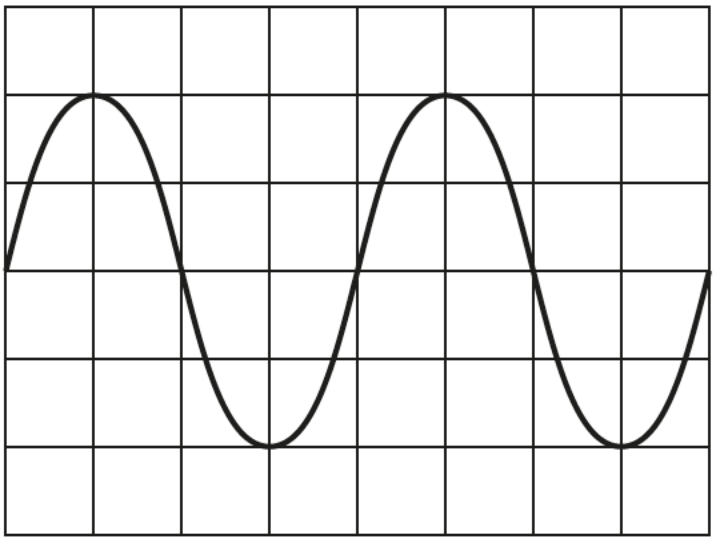
6 (a) Which statement about sound waves is correct?

(1)

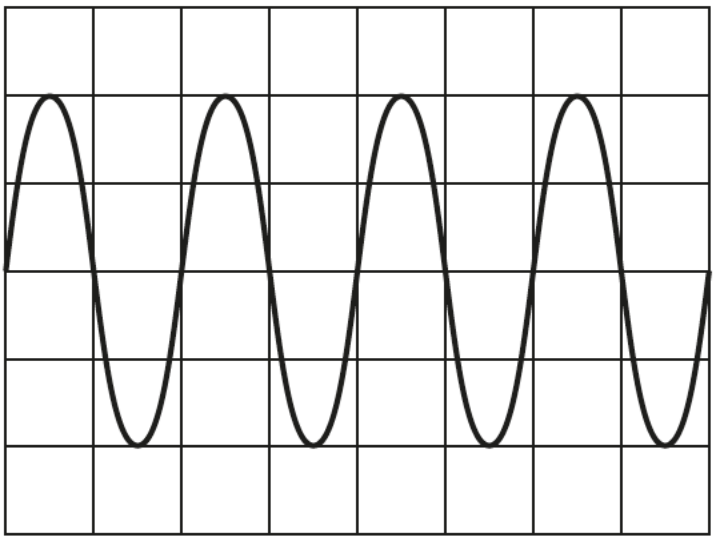
- ☒ **A** sound waves cannot be reflected
- ☒ **B** sound waves are electromagnetic
- ☒ **C** sound waves are longitudinal
- ☒ **D** sound waves are transverse

(b) A microphone is connected to a data logger, which displays each sound wave as a graph.

The diagrams show the graphs for two different sound waves.



Sound wave P



Sound wave Q

The graphs have the same scales.

In the horizontal direction: 1 square = 0.001 s

(i) The amplitude of sound wave Q is

(1)

☒ **A** larger than the amplitude of sound wave P

☒ **B** smaller than the amplitude of sound wave P

☒ **C** the same as the amplitude of sound wave P

☒ **D** zero

(ii) The frequency of sound wave P is 250 Hz.

Find the time period of sound wave P.

(1)

time period = ... s

(iii) Find the frequency of sound wave Q.

(1)

frequency = ... Hz

(Total for Question 6 = 4 marks)