3 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)

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(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

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

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

(2)

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(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)

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(Total for Question 3 = 9 marks)