

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box .
If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

1 There are many different types of waves.

(a) Waves on the surface of water are transverse waves.

Sound waves are longitudinal waves.

Describe the difference between transverse waves and longitudinal waves.

(2)

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(b) Figure 1 shows a ripple tank.

This is used to study the behaviour of water waves.

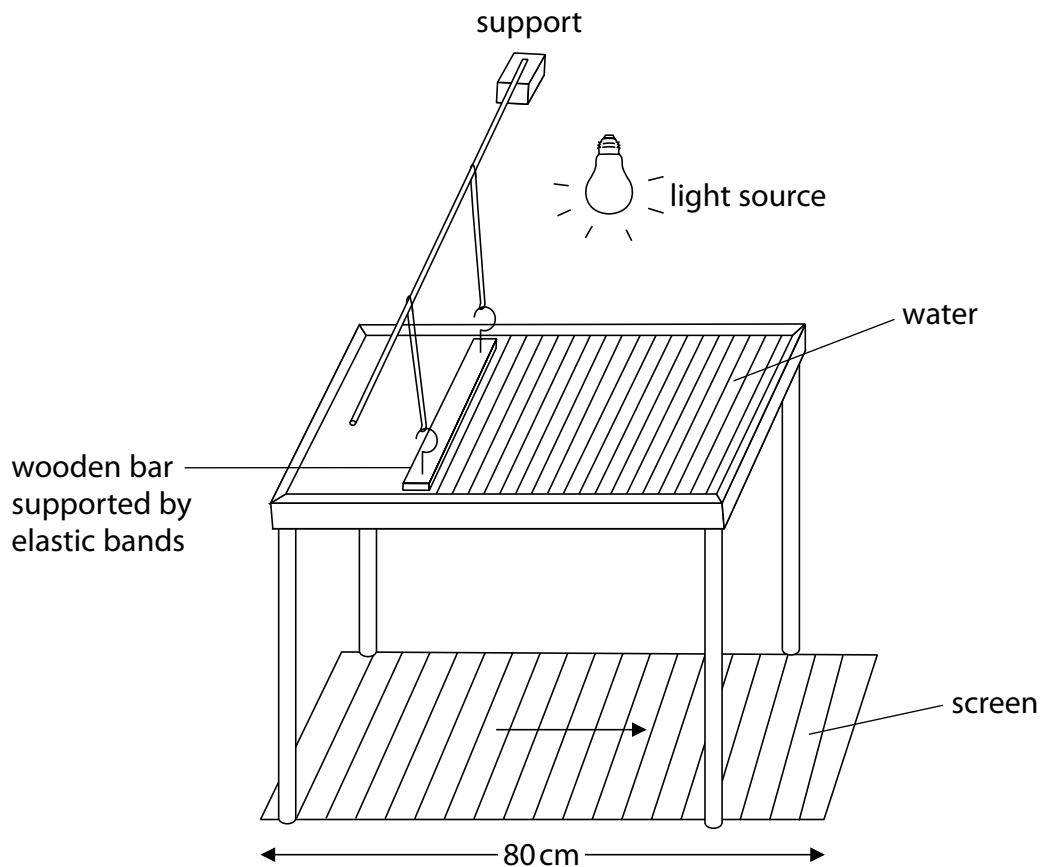


Figure 1

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Water waves are produced in the tank.

The shadow of the waves is projected onto the screen below the tank.

The waves appear to move in the direction of the arrow.

(i) Describe how to determine the frequency of the waves.

(2)

(ii) The screen is 80 cm long.

What is the approximate wavelength of the waves as seen on the screen?

(1)

- A 4 cm
- B 8 cm
- C 40 cm
- D 80 cm

(iii) A student uses the image to estimate the speed of the water wave as 75 cm/s.

Which of these is a reason why the estimate is not correct?

(1)

- A the student used a ruler without mm markings
- B the light was not bright enough
- C the student's measurement was inaccurate
- D the wave seen on the screen is magnified

(Total for Question 1 = 6 marks)

9 (a) Explain what happens to the wavelength of light when it passes from air into glass. (2)

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*(b) Figure 13 shows a beam of red light approaching one side of a rectangular glass block. The beam of light will pass through the block and leave through the opposite side. **AB** is a wavefront.

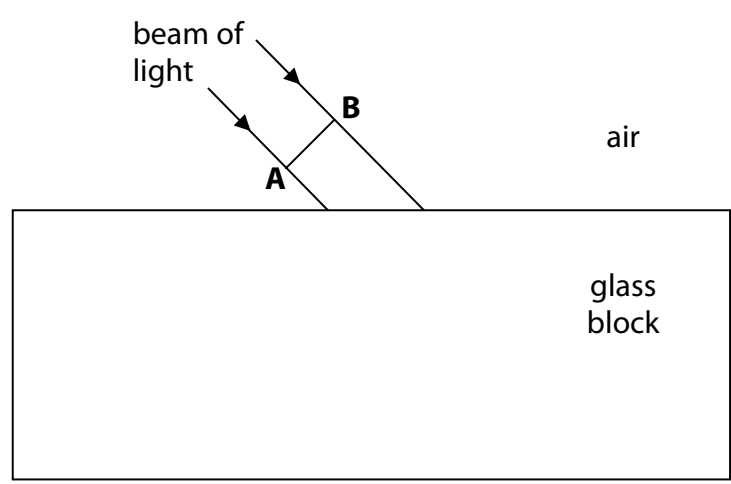


Figure 13

Discuss the path of the wavefront **AB** as it enters and leaves the glass block. (6)

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(c) The distance between the Earth and the Sun is 1.50×10^{11} m.

Light takes 500 s to travel from the Sun to the Earth.

The wavelength of red light is 670 nm.

Calculate the frequency of red light, using only the data provided.

(4)

frequency = Hz

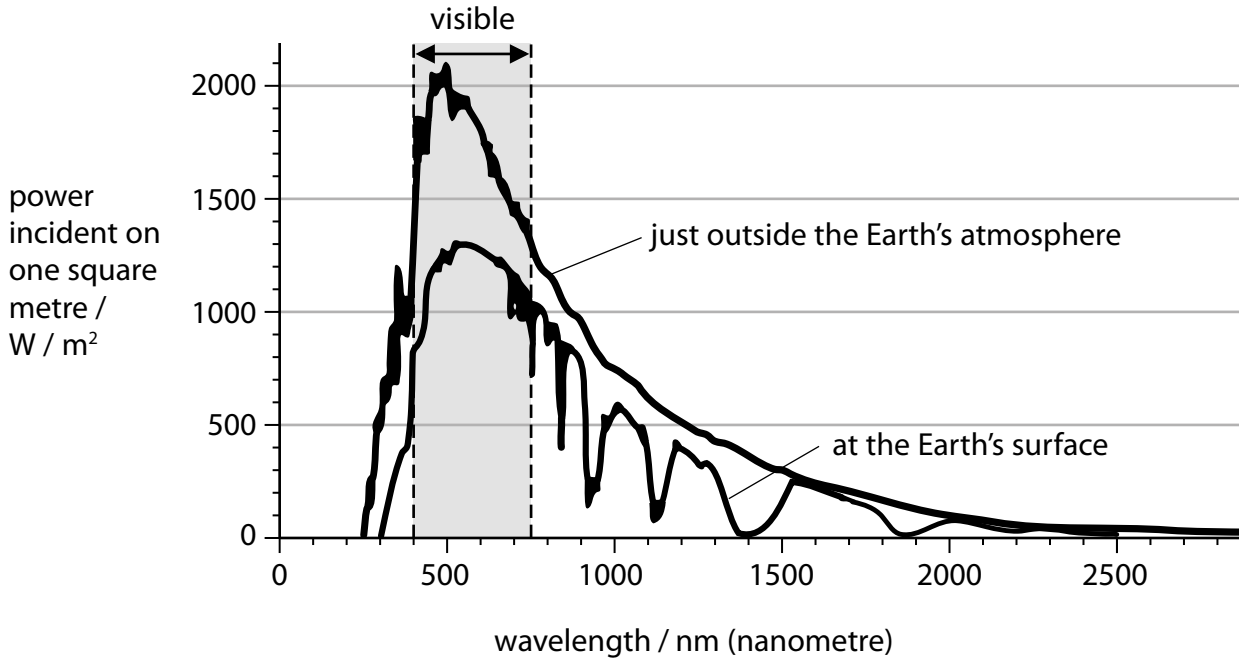
(Total for Question 9 = 12 marks)

Radiation from our Sun and from other stars

4 (a) Our Sun emits different amounts of radiation at different wavelengths.

The graphs show how much radiation is measured for a given wavelength

- just outside the Earth's atmosphere
- at the Earth's surface.



(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The minimum wavelength of radiation received from our Sun at the Earth's surface is about

(1)

- A 0 nm
- B 250 nm
- C 310 nm
- D 520 nm

(ii) Name the type of radiation that has a wavelength of 800 nm.

(1)

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(iii) Suggest why there is a difference in the two graphs at a wavelength of 1850 nm. (2)

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(b) The velocity of light in a vacuum is 300 000 000 m/s (3×10^8 m/s).

1 nm = 10^{-9} m (1 / 1 000 000 000 m)

Calculate the frequency of radiation that has a wavelength of 800 nm. Give the unit. (4)

frequency = unit

(c) Some light is emitted with a wavelength of 600.0 nm from our Sun. When measured in the spectrum of another star, the light has a wavelength of 598.8 nm.

Explain what information this gives about the star. (2)

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(Total for Question 4 = 10 marks)

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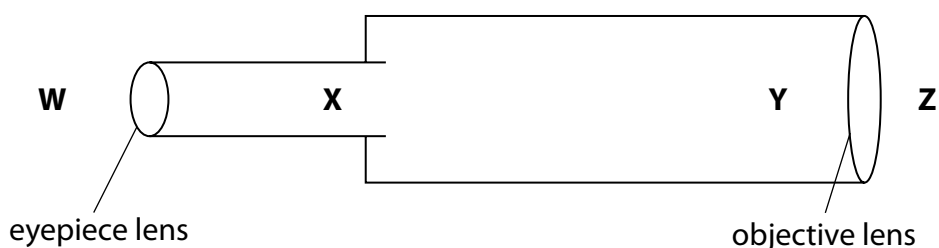
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Refraction

- 5 (a) The diagram shows a telescope consisting of two converging lenses.



The telescope is used to look at the Moon.

The objective lens produces a real image of the Moon.

- (i) Which position on the diagram shows where the real image of the Moon is formed?

Put a cross (☒) in the box next to your answer.

(1)

- A position W
- B position X
- C position Y
- D position Z

- (ii) Describe the function of the eyepiece lens.

(2)

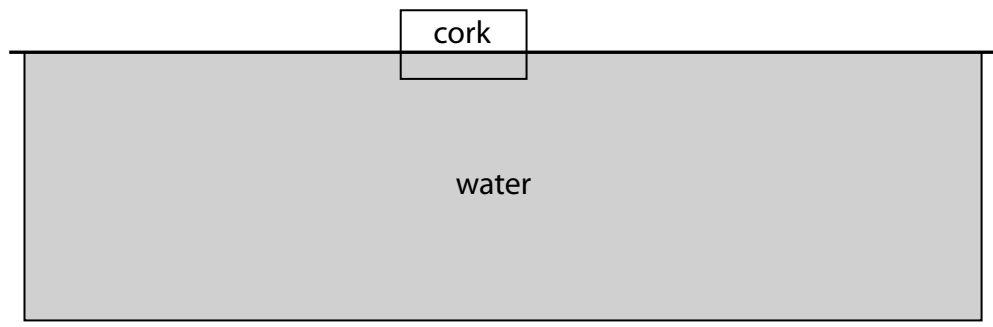
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(b) (i) A cork floats on some water.



Describe how this arrangement can be used to show whether waves on the water surface are transverse or longitudinal.

You may add to the diagram to help your answer.

(3)

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*(ii) The diagram shows water waves approaching a boundary between deep water and shallow water. The arrow shows the direction of travel of the water waves.

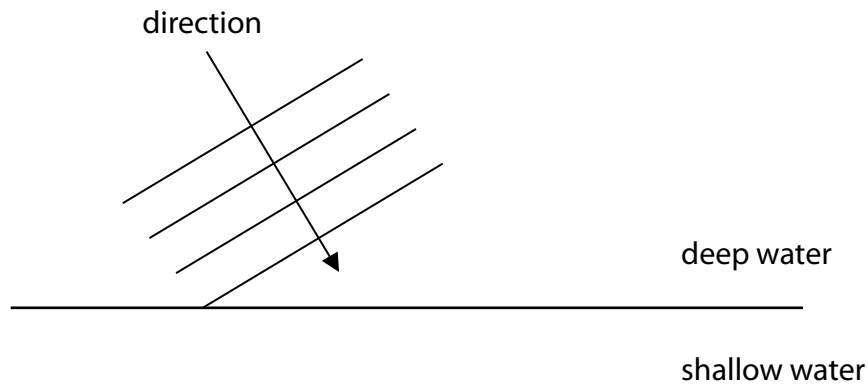
The wave speed in the shallow water is less than the wave speed in the deep water.

The frequency of the waves in the shallow water is the same as their frequency in the deep water.

Explain what happens to the direction and the wavelength of these waves when they pass from the deep water into the shallow water.

You may add to the diagram to help with your answer.

(6)



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(Total for Question 5 = 12 marks)



Elephants and infrasound

- 3 (a) Sound travels through the air as longitudinal waves.

Describe how the air particles move when a sound wave passes.

(2)

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- (b) Elephants call to each other using infrasound.
People cannot hear these infrasound calls.

Which of the following statements is the reason that people cannot hear infrasound?

Put a cross (☒) in the box next to your answer.

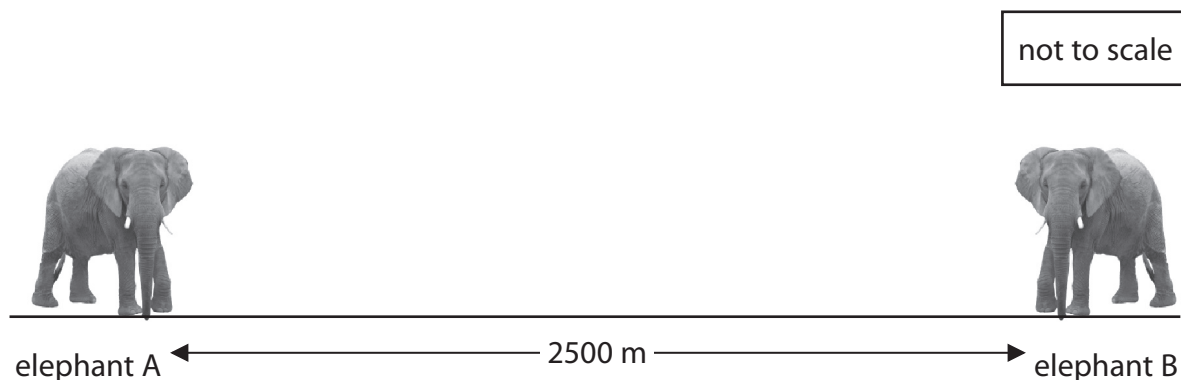
(1)

- A** the amplitude of infrasound is too big
- B** the frequency of infrasound is too low
- C** the speed of infrasound is too fast
- D** the wavelength of infrasound is too short



- (c) Both infrasound waves and ultrasound waves are types of sound waves. They are used by animals to communicate.

Two elephants use infrasound waves for long distance communication. The distance between these two elephants is 2500 m.



Elephant A emits an infrasound call. When elephant B hears the infrasound, it calls back. Elephant A hears the answering call from elephant B. The speed of infrasound is 340 m/s.

- (i) Show that the minimum time for elephant A to call and hear an answer from elephant B is about 15 s.

(3)

- (ii) An elephant's infrasound call has a range of 4000 m. Each infrasound call lasts between 2 s and 10 s. Each elephant usually waits about 30 s before it calls again.

Suggest a reason why elephants wait 30 s before calling again.

(1)

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(d) Describe a use of infrasound that does not involve animals.

(2)

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(Total for Question 3 = 9 marks)



Electromagnetic waves

6 (a) The diagram shows the parts of the electromagnetic spectrum.

radio waves	microwaves	infrared	visible light	ultraviolet	X-rays	gamma rays
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(i) Which parts of the electromagnetic spectrum are used for both communication and cooking?

Put a cross (☒) in the box next to your answer.

(1)

- A infrared and microwaves
- B infrared and radio waves
- C microwaves and radio waves
- D radio waves and X-rays

(ii) Fluorescent substances absorb ultraviolet and emit visible light.

Complete the sentence by putting a cross (☒) in the box next to your answer.

Visible light has a

(1)

- A faster speed than ultraviolet
- B higher frequency than ultraviolet
- C lower frequency than ultraviolet
- D smaller wavelength than ultraviolet



(b) Ultraviolet radiation and infrared radiation are emitted by the Sun and reach the surface of the Earth.

(i) Describe a harmful effect of ultraviolet radiation.

(2)

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(ii) Explain why ultraviolet radiation is likely to be more dangerous to humans than infrared radiation.

(2)

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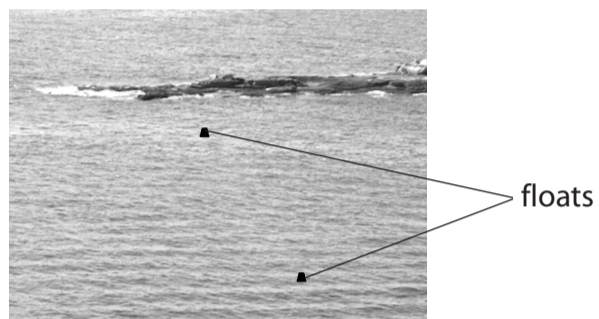


Answer ALL questions.

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Waves carrying information

- 1 The photograph shows a wave in a bay.
The wave was made by a passing boat.



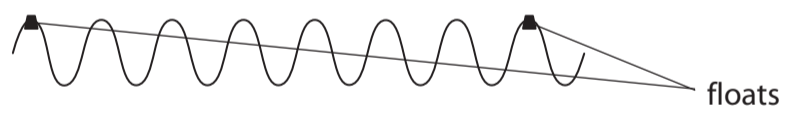
- (a) Which of these best describes what is transferred by the water wave?

Put a cross () in the box next to your answer.

(1)

- A** energy only
- B** water only
- C** both water and energy
- D** neither water nor energy

- (b) The diagram shows the wave as it passes by the two floats.



- (i) The wavelength of the wave is 0.8 m.
Calculate the distance between the floats.

(2)

distance = m



(ii) The frequency of the wave is 0.4 Hz.

How many complete wavelengths pass each float in 20 s?

Put a cross (☒) in the box next to your answer.

(1)

A 0.02

B 0.8

C 8

D 50

(iii) A man on the shore observes the wave.

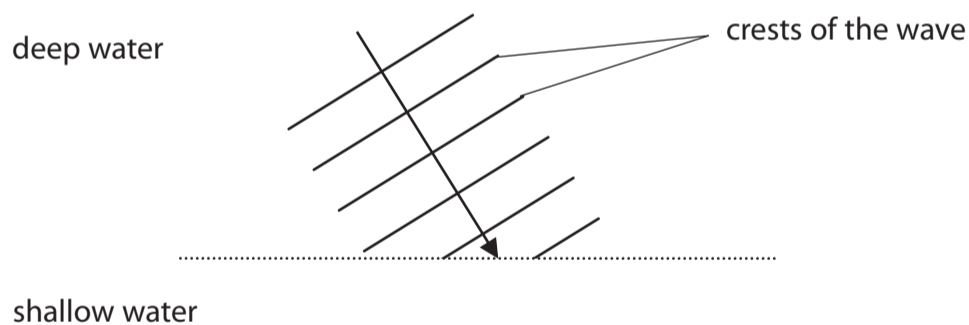
Suggest **one** piece of information the man could gain about the boat by observing the wave that made it.

(1)

(c) The wave reaches shallow water before it reaches the shore.

Water waves travel more slowly in shallow water.

The diagram shows the wave as it reaches the shallow water.



Complete the diagram to show how the wave travels in the shallow water.

(3)

(Total for Question 1 = 8 marks)



Electromagnetic waves

3 (a) Complete the sentences by putting a cross (☒) in the box next to your answer.

(i) All electromagnetic waves are (1)

- A** longitudinal and have the same amplitude in a vacuum
- B** longitudinal and have the same speed in a vacuum
- C** transverse and have the same amplitude in a vacuum
- D** transverse and have the same speed in a vacuum

(ii) All electromagnetic waves have both uses and dangers.
Their potential danger increases when (1)

- A** frequency decreases and wavelength decreases
- B** frequency increases and wavelength decreases
- C** frequency decreases and wavelength increases
- D** frequency increases and wavelength increases

(b) Some microwaves have a frequency of 1.5×10^{10} Hz.
They travel at a speed of 3.0×10^8 m/s.
Calculate their wavelength. (3)

wavelength = m



(c) Infrared is used in an electric toaster.
Infrared is also used by a television remote control.



electric toaster



television remote control

Explain why using a television remote control does not burn anyone.

(2)

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(d) Gamma rays can cause cancer.
Gamma rays can also be used to treat cancer.

Explain how gamma rays can do both.

(3)

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(Total for Question 3 = 10 marks)



Infrasound and earthquakes

4 (a) Which row of the table is correct for both infrasound radiation and infrared radiation?

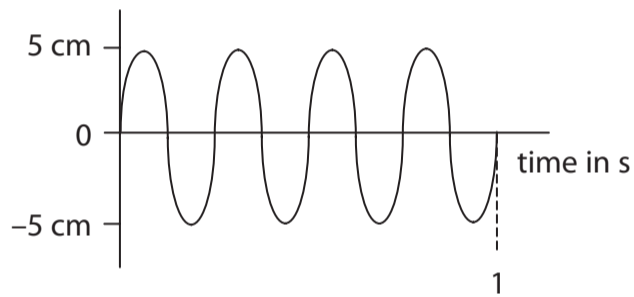
Put a cross (☒) in the box next to your answer.

(1)

	infrasound	infrared
<input type="checkbox"/> A	transverse	transverse
<input type="checkbox"/> B	transverse	longitudinal
<input type="checkbox"/> C	longitudinal	transverse
<input type="checkbox"/> D	longitudinal	longitudinal

(b) State the amplitude of this sound wave.

(1)



amplitude =

(c) Describe how infrasound differs from ultrasound.

(2)

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

Electromagnetic waves

1 (a) Microwaves and X-rays are both electromagnetic waves.

(i) Which row of the table is correct for microwaves and X-rays in a vacuum?

Put a cross (☒) in the box next to your answer.

(1)

	their speeds are	their frequencies are
<input checked="" type="checkbox"/> A	different	different
<input checked="" type="checkbox"/> B	different	the same
<input checked="" type="checkbox"/> C	the same	different
<input checked="" type="checkbox"/> D	the same	the same

(ii) State **one** harmful effect of X-rays on living matter.

(1)

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(b) X-rays are ionising radiation.

(i) State **one** other ionising radiation in the electromagnetic spectrum.

(1)

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(ii) State **one** use of an ionising radiation.

(1)

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(c) (i) State **one** way in which microwave radiation can be harmful to people.

(1)

The microwaves used in ovens have a frequency of about 2450 MHz.
Mobile phones emit microwaves with a frequency of about 2000 MHz.



Microwave ovens have shielding to protect people from the microwave radiation.

(ii) Suggest why the same shielding is **not** necessary for mobile phones.

(3)

(Total for Question 1 = 8 marks)

