6-6 Waves – Trilogy

1.0 **Figure 1** shows an incomplete electromagnetic spectrum.

Figure 1

A	**microwaves**	**B**	**C**	**ultraviolet**	**D**	**gamma**

1.1 Which position are X-rays found in?

Tick **one** box.

[1 mark]

A ☐

B ☐

C ☐

D ☐

1.2 Which **three** waves can cause ionisation?

Tick **three** boxes.

[1 mark]

Gamma rays ☐

Infrared ☐

Microwaves ☐

Radio waves ☐

Visible light ☐

Ultraviolet ☐

X-rays ☐

1.3 Electromagnetic waves have many practical uses.

Draw **one** line from each type of electromagnetic wave to its use.

[2 marks]

Electromagnetic wave

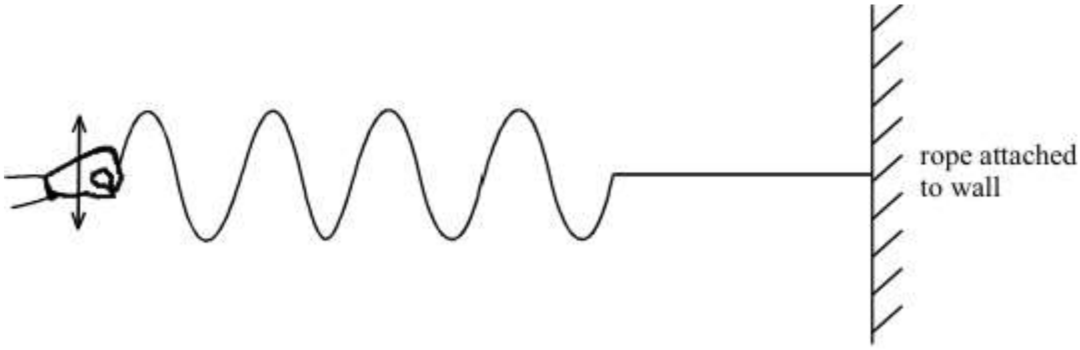
- Radio waves
- Visible light
- Gamma rays

Use

- Medical treatments
- Television transmissions
- Fibre optic communications
- Sun tanning

2.0 **Figure 2** shows some waves travelling along a rope.

Figure 2



2.1 Show on the diagram:

The wavelength of one of the waves (labelled with a **W**)

The amplitude of one of the waves (labelled with an **A**)

[2 marks]

2.2 State the type of waves travelling on the rope.

Explain how you can tell.

[2 marks]

Type of wave____

Explanation ____

____

2.3 The waves shown in the diagram were produced in two seconds.

Calculate the frequency of the waves.

[2 marks]

Frequency = ________ Hz

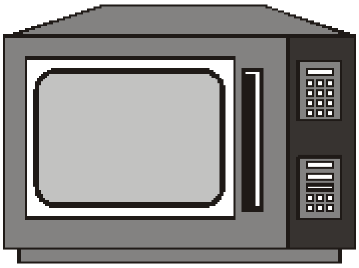
2.4 Calculate the time period of the waves.

State the unit.

[2 marks]

Time period = ________ Unit ____

3.0 Microwave ovens use microwave radiation to cook food.



The instruction manual of a microwave oven stated:

Frequency of microwaves: 10 000 million Hz.

Wavelength 0.02 m.

3.1 Calculate the speed of waves in the microwave according to the information in the instruction manual.

Give your answer in standard form.

[3 marks]

Speed = ______________ m/s

3.2 The speed of visible light is 3×10^8 m/s.

Was the information in the instruction manual correct?

Explain your answer.

[1 mark]

____

____

3.3 Simon said “When the microwave is working, it lights up. That’s the microwaves.”

Explain whether Simon was correct.

[2 marks]

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3.4 Putting a beaker of water in a microwave and turning it on for a minute or two will increase the temperature of the water.

Describe an experiment to investigate the relationship between the time the microwave is on and the increase in temperature of water in a beaker.

In your answer, include:

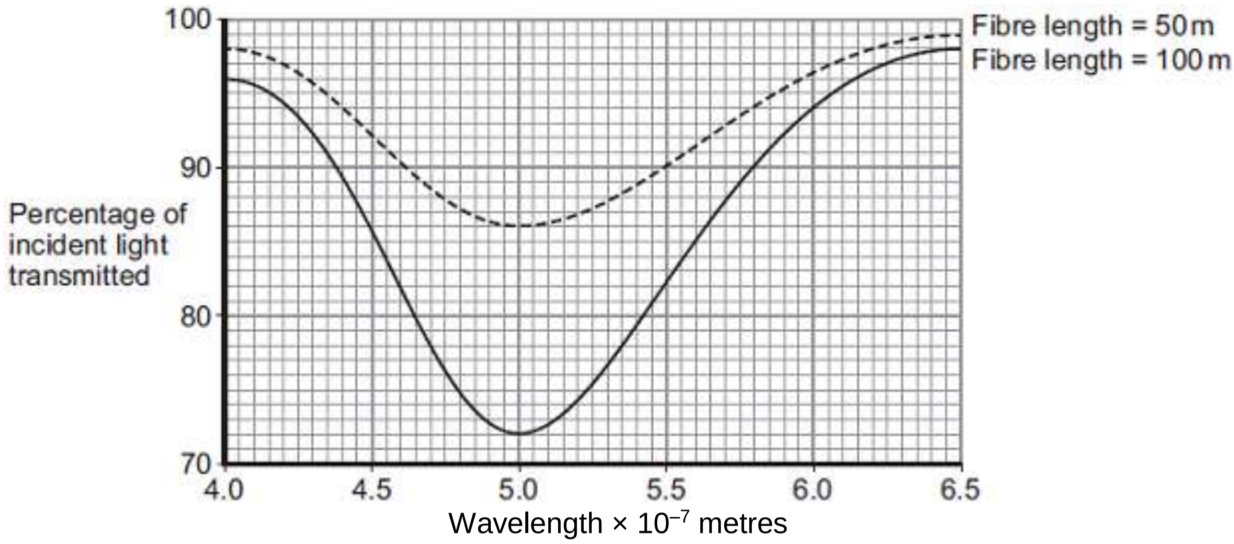
- The equipment you will use
- The measurements you will take
- The safety precautions you will take

[6 marks]

4.0 Different wavelengths of light can be used to transmit information along optical fibres.

Figure 3 below shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.

Figure 3



4.1 Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

[3 marks]

____

____

____

4.2 The speed of light is 3×10^8 m/s.

Calculate the frequency of light that is absorbed the most by the 100m length of fibre.

Give your answer in standard form.

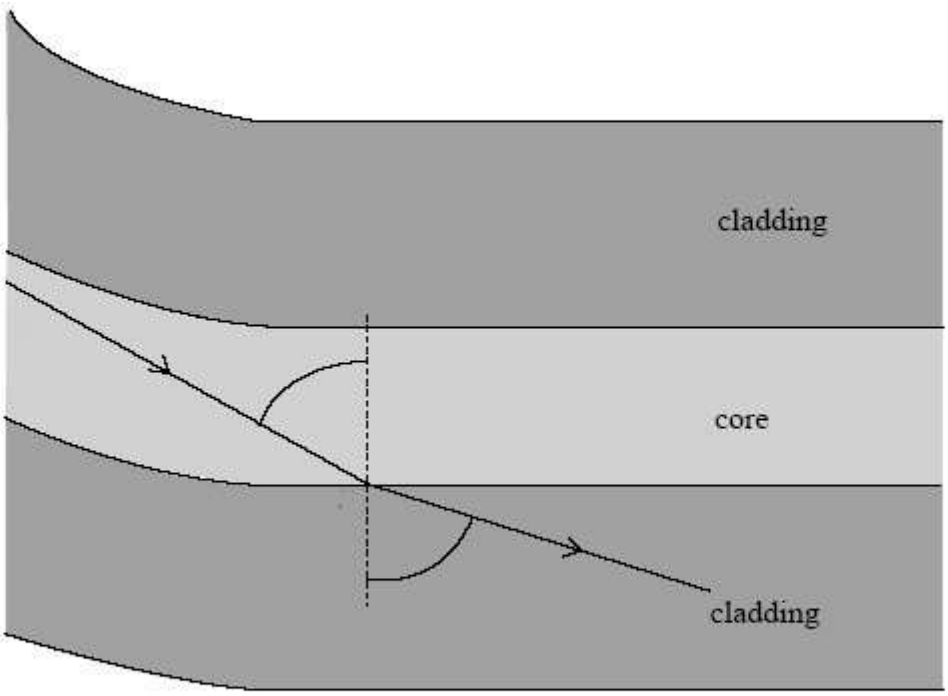
[2 marks]

Frequency = ________ Hz

4.3 The inside of optical fibres consist of two layers of glass, core and cladding.

Figure 4 shows how light travels between these two layers.

Figure 4



Suggest why the light travels in this way in the optical fibre.

[2 marks]

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___

___

MARK SCHEME

Qu No.		Extra Information	Marks
1.1	D		1
1.2	Gamma rays Ultra violet X-rays	All three required for the mark	1
1.3	Radio waves – Television transmissions Visible light – Fibre optic communications Gamma rays – Medical treatments	All three correct – **2** marks Two correct – **1** mark If more than one line from any wave, deduct a mark, minimum of zero marks.	2

Qu No.		Extra Information	Marks
2.1	**W** Horizontal distance labelled between two identical points on adjacent waves **A** Vertical distance from peak or trough to mean		1 1
2.2	Transverse waves Wave moving up and down while moving from left to right		1 1
2.3	4 waves / 2 seconds = 2 (Hz)		1 1
2.4	0.5 s / seconds	Allow ecf rom 2.3 if T = 1/f clearly used	1 1

Qu No.		Extra Information	Marks
3.1	$V = f\lambda = 10\,000\,000\,000 \times 0.02$ $= 200\,000\,000$ $= 2 \times 10^8$ m/s	If wrong number of zeros used in calculation, allow ecf.	1 1 1
3.2	(No) as all electromagnetic waves have the same speed.	Ignore reference to speed changing in air.	1
3.3	(No) as the eye cannot see microwaves The light is visible light (from a bulb)		1 1
3.4			
Level 3:	A detailed and coherent description of how to carry out a safe investigation including clear description of equipment to use and explanation of the measurements to take.		5-6
Level 2:	A detailed and coherent description which may be lacking in some details or includes elements which are unlikely to work well (for example lengths of time over 5 mins).		3-4
Level 1:	A description of an experiment which is lacking in detail or is inherently unsafe.		1-2
	No relevant content		
Indicative content			
	Equipment used (does not need to be in a list): - Beaker - Measuring cylinder - Water - Thermometer - Stop watch / use of microwave to time - Microwave Investigation - Pour ~200ml cold water into a beaker - Measure temperature - Put in microwave for 30 seconds - Stir then measure the temperature after - Repeat for a range of times up to 3 mins - Plot a graph of the results		

Qu No.		Extra Information	Marks
4.1	(for both fibres) increasing the <u>wavelength</u> of light decreases and then increases the percentage / amount of light transmitted (for both fibres) the minimum transmission happens at 5 (x 10^{-7} metres) the shorter fibre transmits a greater percentage of light (at the same wavelength)		1 1 1
4.2	$f = c / \lambda$ $= 6 \times 10^{14}$ Hz		1 1
4.3	Light <u>refracts</u> at boundary between cladding and core Light changes speed / slows down in cladding		1 1