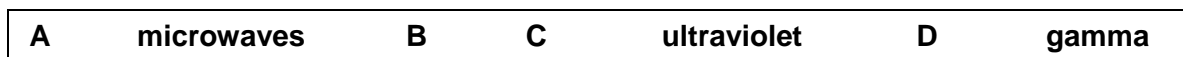


6-6 Waves – Trilogy

1.0 Figure 1 shows an incomplete electromagnetic spectrum.

Figure 1



1.1 Which position are X-rays found in?

Tick **one** box.

[1 mark]

A		<input type="checkbox"/>
B		<input type="checkbox"/>
C		<input type="checkbox"/>
D		<input type="checkbox"/>

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

Tick **three** boxes.

[1 mark]

Gamma rays	<input type="checkbox"/>
Infrared	<input type="checkbox"/>
Microwaves	<input type="checkbox"/>
Radio waves	<input type="checkbox"/>
Visible light	<input type="checkbox"/>
Ultraviolet	<input type="checkbox"/>
X-rays	<input type="checkbox"/>

1.3 Electromagnetic waves have many practical uses.

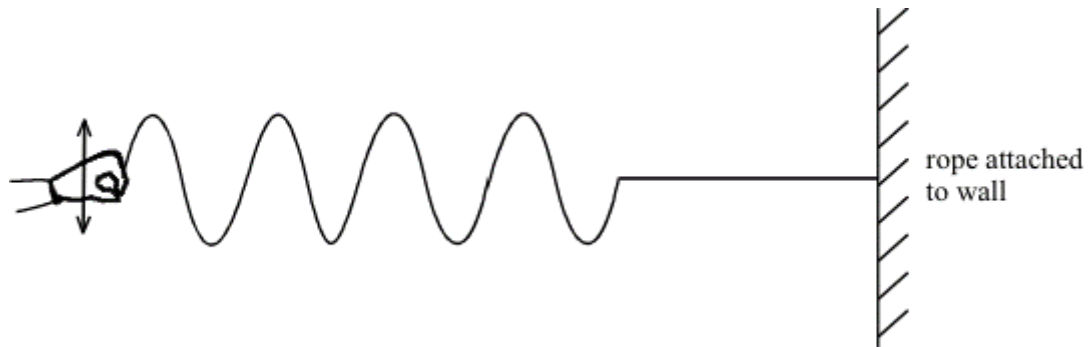
Draw **one** line from each type of electromagnetic wave to its use.

[2 marks]

Electromagnetic wave	Use
Radio waves	Medical treatments
Visible light	Television transmissions
Gamma rays	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

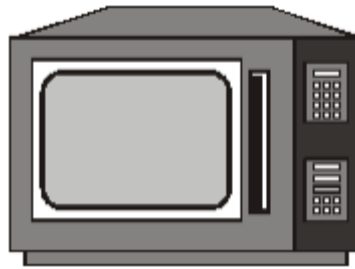
2.4 Calculate the time period of the waves.

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.”

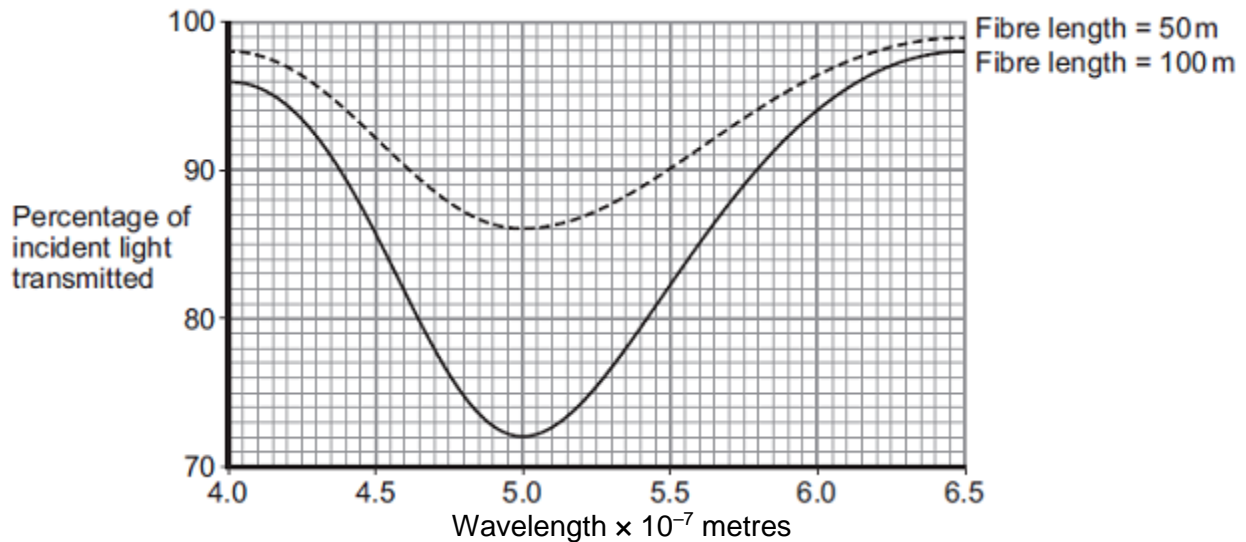
Explain whether Simon was correct.

[2 marks]

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.

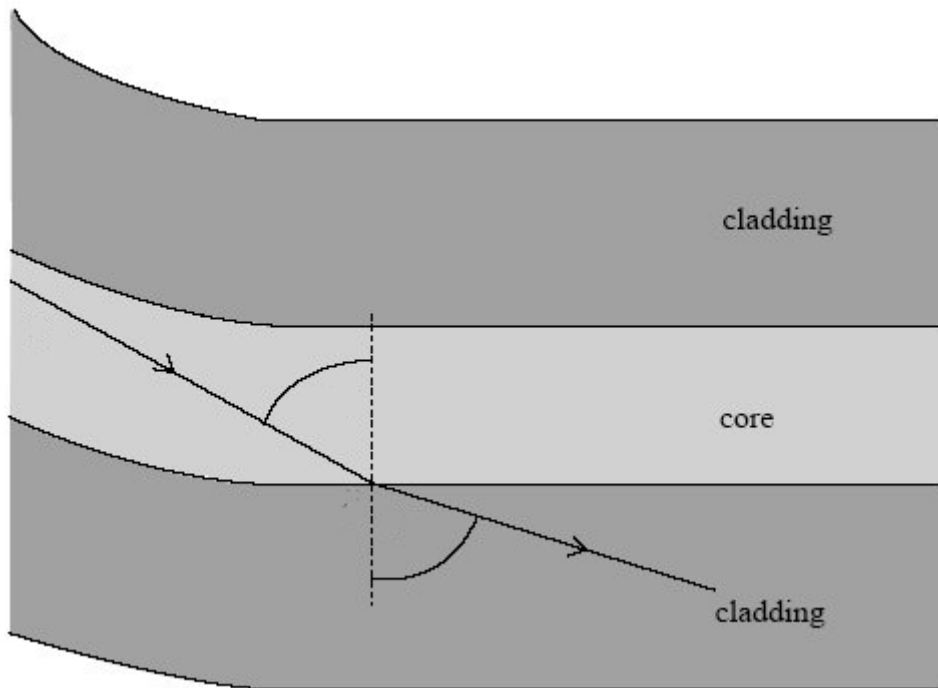
[2 marks]

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]

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		1
	A Vertical distance from peak or trough to mean		1
2.2	Transverse waves		1
	Wave moving up and down while moving from left to right		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	$V = f \lambda = 10\,000\,000\,000 \times 0.02$ $= 200\,000\,000$ $= 2 \times 10^8 \text{ m/s}$	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): <ul style="list-style-type: none"> - Beaker - Measuring cylinder - Water - Thermometer - Stop watch / use of microwave to time - Microwave Investigation <ul style="list-style-type: none"> - 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 5×10^{-7} metres the shorter fibre transmits a greater percentage of light (at the same wavelength)		1 1 1
4.2	$f = c / \lambda$ $= 6 \times 10^{14} \text{ Hz}$		1 1
4.3	Light <u>refracts</u> at boundary between cladding and core Light changes speed / slows down in cladding		1 1