

# The Electromagnetic Spectrum

## Mark Scheme 1

<b>Level</b>	IGCSE(9-1)
<b>Subject</b>	Physics
<b>Exam Board</b>	Edexcel IGCSE
<b>Module</b>	Double Award (Paper 1P)
<b>Topic</b>	Waves
<b>Sub-Topic</b>	The Electromagnetic Spectrum
<b>Booklet</b>	Mark Scheme 1

**Time Allowed:** 68 minutes

**Score:** /56

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	60%	55%	50%	<50%

Question number	Answer	Notes	Marks
1 (a)	two correct comparative statements about temperature:- MP1 Bear('s fur) and snow about the same temperature; MP2 Bear's head/nose/eyes warmer (than fur); MP3 Bear's eyes are warmer than eyes/nose OR bear's eyes are the warmest; MP4 Sky/air is cooler than bear/snow OR sky/air is the coldest;	allow reverse arguments  bear's nose is cooler than its eyes  bear/snow warmer than air	2

<p>(b) (i)</p>	<p>Any two of -            MP1. (hollow) hair / fibres contains an <u>insulator</u>;            MP2. air is an insulator/poor conductor (of thermal energy);            MP3. air is kept / trapped near the body (by fur);            MP4. convection currents cannot form between hairs;            MP5. white fur is a poor emitter of thermal energy / I R;</p>	<p>hair is an insulator</p> <p>only small convection currents can form</p>	<p>2</p>
<p>(ii)</p>	<p>Any three of -            MP1. Black (skin) is a good emitter/radiator of thermal energy;            MP2. White (fur) is a good reflector of thermal energy;            MP3. Black (skin) is a good absorber of thermal energy;            MP4. the reflected thermal energy is absorbed by the black (skin);</p>	<p>Allow white fur is a poor emitter.</p>	<p>3</p>
<p>(c) (i)</p>	<p>Any two of-            MP1. Snow reflects UV OR does not absorb UV;            MP2. Sky absorbs UV OR does not reflect UV;            MP3. Bear('s fur) absorbs UV OR does not reflect UV;            MP4. Bear's eyes reflect UV OR do not absorb UV;</p>	<p>ignore other verbs such as emits radiates</p>	<p>2</p>

(ii)	<p>Any one of-</p> <p>Sky absorbs UV;</p> <p>Sky not emitting UV; Sun not included in image;</p>	<p>allow air or atmosphere for sky ignore 'blocks out' Accept sky doesn't reflect or only reflects UV diffusely</p>	1
(iii)	<p>Any two of -</p> <p>MP1. UV/light travels in air, not in glass or hair (material);</p> <p>MP2. UV is absorbed by hair;</p> <p>MP3. TIR does not happen;</p> <p>MP4. explanation of why TIR can't happen ;</p>	<p>light/UV always travels in the less dense medium ORA for optical fibre</p> <p>Allow reflection in hair is external, not internal there is no critical angle</p>	2

Total 12 marks

Question number	Answer	Notes	Marks
2 (a) (i)	C (ultra violet);		1
(ii)	A (longitudinal);		1
(iii)	C (internal structure of objects);		1
(b) (i)	<p>any sensible use further detail e.g.</p> <p>sterilising medical equipment; gamma kills bacteria;</p> <p>OR</p> <p>treating cancer/mutates cancer cells; radiotherapy/focused gamma rays;</p> <p>OR</p> <p>detecting cancer; PET scanner/(radioactive) tracers/gamma camera;</p>	<p>ignore CT scan, CAT scan, MRI scan</p> <p>allow kills cancer/cells</p> <p>allow scintillation counter</p>	2

(ii)	<p>any 2 of:</p> <p>MP1. any one sensible comment about risk for either; e.g. increased risk of cancer/mutation of cells damage to neighbouring/good/healthy cells</p> <p>MP2. a further detail of the risk; e.g. radiation is ionising gamma has high/highest energy</p> <p>MP3. statement about the relative risk/exposure of doctor or patient; e. patient is only exposed for a short period of time doctor has continual (low level) exposure</p>		2
(iii)	<p>any one sensible method; e.g.</p> <p>(use for a) limited time idea of working at a distance/in another room</p>	<p>ignore protective clothing, lead shielding, lead apron etc.</p>	1

Total 8 marks

Question number	Answer	Notes	Marks	
3	a i	Any two from – Radio; Microwaves; Infrared; Visible;		2
	ii	Microwaves; Infrared;		2
	b	D                    Increasing wavelength		1
	c i	(wave) speed = frequency x wavelength		1
	ii	Substitution into correct equation; Evaluation; Unit; Eg. (wave) speed = 200 000 x 1500 300 000 000 m/s	Accept equivalent Accept recognised symbols  mark unit and calc independently  Power Of Ten error = -1 e.g. not converting kHz to Hz  Accept <ul style="list-style-type: none"> <li>• bald answer</li> <li>• answer in SF</li> <li>• alternative speed units with corresponding evaluation e.g. 300 000 km/s 1.08 x 10<sup>12</sup> km/hour</li> </ul>	3

(Total for Question 3 = 9 marks)

Question number	Answer	Notes	Marks
4 a i	96 000 000; matching unit e.g. Hz;	allow $96 \times 10^6$ Allow for 2 marks 96 MHz 96 000 kHz	1 1
ii	Idea that plaque vibrates also;	Allow shakes plaque free breaks plaque up  Ignore ideas of physical contact, e.g.: hits plaque knocks plaque off	1
iii	One of to clean out the <b>debris</b> / eq; to cool the tip / eq ; to reduce damage to the tooth/eq;	allow wash away ignore unqualified 'to clean'	1

b	i	B reflected ;	1
	ii	wave speed = frequency x wavelength;	1
	iii	rearranged equation ; substitution; evaluation; e.g. $f = v/\lambda$ $(f =) \frac{1540}{0.00044}$ 3.5 (MHz)	3  Allow rearrangements and standard abbreviations and symbols e.g. frequency = speed /wavelength $v = f \times \lambda$ etc  rearrange and sub in either order  allow a power of ten (POT) error for 2 marks  allow matching unit e.g. 3500 kHz

(c)	<p>Any TWO from  MP1 US is longitudinal wave  OR  MP1 UV is transverse wave;</p> <p>MP2 US needs a medium;  MP3 UV an electromagnetic wave;</p> <p>MP4 UV has (much) higher frequency than US/  RA;</p> <p>MP5 US has a lower speed than UV;  MP6 UV has same speed as light;</p>	<p>Care- avoid giving two marks for MP1</p> <p>allow equivalent statement about <math>\lambda</math>  speed of <math>\sim 300</math> m/s (in air)  speed of <math>3 \times 10^8</math> m/s</p> <p>Ignore statements about harmful effects</p>	2
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(Total for Question 4 = 11 marks)

Question number	Answer	Notes	Marks						
5 (a)	<table border="1"> <tr> <td>longest wavelength</td> <td style="text-align: center;">→</td> <td>shortest wavelength</td> </tr> <tr> <td>infrared</td> <td>visible (light)</td> <td>ultraviolet</td> </tr> </table>	longest wavelength	→	shortest wavelength	infrared	visible (light)	ultraviolet	<p>All three must be correct for the mark</p> <p>Allow IR for infrared Allow visible (without light) Allow UV for ultraviolet</p>	1
longest wavelength	→	shortest wavelength							
infrared	visible (light)	ultraviolet							
(b)	<p>Any two of:</p> <p>Radio (waves); Microwave(s); x-rays; Gamma (rays);</p>	<p>Allow T-rays</p> <p><math>\gamma</math> - rays or <math>\gamma</math></p>	2						
(c) (i)	<p>Any two of</p> <ol style="list-style-type: none"> <li>1. killing bacteria e.g. in water purification OR in hand driers in toilets OR sterilisation of equipment;</li> <li>2. medical uses e.g. setting dental fillings OR detection of bacteria OR treatment of (named) skin diseases;</li> <li>3. security markings e.g. for checking banknotes;</li> <li>4. fluorescent lamp e.g. tanning machines, black-light, detecting blood /other body fluids;</li> <li>5. data reading e.g. blu-ray devices</li> </ol>	<p>Must be specific, ignore vague answers such as 'used in a hospital', 'for CSI'</p> <p>Allow other sensible suggestions for each MP</p>	2						

Question number	Answer	Notes	Marks
5 (ii)	Any two of 1. cell damage e.g. (skin) cancer, cell mutation; 2. Sunburn/skin aging; 3. eye damage e.g. cataracts, blindness;	Must be specific, do not allow vague answers such as 'causes burns' 'danger to skin' 'burns skin'	2
		<b>Total</b>	<b>7</b>

Question number	Answer	Notes	Marks
6 (a)	A - microwave(s) B - X-rays	REJECT 'micro' REJECT 'X' ACCEPT capital or lower case X, with or without hyphen	2
(b) (i)	C		1
(ii)	D		1

**Total 4 Marks**

Question number	Answer	Notes	Marks
7(a)	any two from  MP1. (same) speed(in a vacuum); MP2. transverse waves; MP3. travel through vacuum/do not require a medium; MP4. em wave/spectrum; MP5. carry information ; MP6. transfer energy;	ignore  refraction reflection diffraction interference heat produced by Sun effects on body do not accept unqualified energy	(2)
(b)	infrared: skin burns;  ultraviolet: damage to surface cells; OR blindness;	ignore for IR skin cancer/ cell mutation /sunburn  accept causes (skin) cancer for UV sunburn for UV damage to eye for UV	(2)
(c)	red;		(1)

**Total for Question 7 = 5 marks**