

Electromagnetic Spectrum

Mark Scheme 1

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Properties of Waves including Light and Sound
Sub-Topic	Electromagnetic Spectrum
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 1

Time Allowed: 78 minutes

Score: /65

Percentage: /100

Question	Answer	Mark
1(a)(i)	Sketch of <u>curved</u> optic fibre with light ray undergoing at least one total internal reflection	B1
(a)(ii)	Light travels down (optic) fibres into or out of body To examine internal organ/part Light travels both ways into and out of body OR To destroy (cancerous) cells by heating OR Endoscope/fibre bundle inserted into body To view internal organ body part OR for keyhole surgery	B1 B1 B1 (B1) (B1) (B1) (B1)
(b)	Light in air: $3 \times 10^8 \text{ m/s}$ Microwaves in vacuum: $3 \times 10^8 \text{ m/s}$ Sound in steel: 6000 m/s	B1 B1 B1
(c)	$n = \text{speed in air} / \text{speed in glass (or rearranged)}$ OR $1.5 = 3 \times 10^8 / \text{speed in glass (or rearranged)}$ $2.0 \times 10^8 \text{ m/s}$	C1 A1
		Total: 9

- 2 (a) clear attempt at semi circles, at least 3 [1]
same wavelength as incoming wavefronts, by eye [1]
- (b) speed \div wavelength or $20 \div 2.5$ or $v = f\lambda$ [1]
8 Hz or 8 s^{-1} or 8 waves/second [1]
- (c) candidate's (b) OR "the same" OR nothing [1]
- (d) low frequency signals have longer wavelength (than high frequency signals) OR [1]
high frequency signals have shorter wavelength
- low frequency signals / long wavelength signals diffract more OR [1]
low frequency / short wavelength signals diffract less

- 3 (a) (i) X-rays B1
- (ii) Infra-red B1
- (b) (i) $v = f\lambda$ in any form OR $v \neq f$ OR $3.0 \times 10^8 \div (2.45 \times 10^9)$ C1
0.12m A1

[Total: {4}]

- 4 (a) (i) $2.0 - 4.0 \times 10^8$ m/s *Unit penalty applies B1
- (ii) $(f =) v/\lambda$ or $3.0 \times 10^8/4.0 \times 10^{-7}$ ecf from 6(a)(i) C1
 7.5×10^{14} Hz *Unit penalty applies ecf from 6(a)(i) A1
- (b) (i) 55° *Unit penalty applies B1
- (ii) $\sin i/\sin r = n$ or $\sin 55^\circ/1.5$ or 0.54610 ecf from 6(b)(i) C1
 33° *Unit penalty applies ecf from 6(b)(i) A1 [6]

*Apply unit penalty once onl

- 5 (a) (i) light of a single wavelength / frequency ignore 'one colour' B1
- (ii) $n = \sin i / \sin r$ OR $1.52 = \sin 50 / \sin r$ OR $\sin r = \sin 50 / 1.52$ C1
 30.26° at least 2 s.f. A1
- (iii) ray closer to normal in block B1
ray parallel to incident ray emerging from block B1
- (b) (i) $n = v_A / v_G$ OR $n = 1.54 / v_G$ OR $v_G = 3 \times 10^8 / 1.54$ C1
 $1.948 \times 10^8 \text{ m/s}$
- (ii) ray with smaller angle of refraction than red in block i.e. violet ray under red ray B1
emerging ray parallel to incident ray B1 [9]
- 6 (a) (i) sound B1
- (ii) particle OR mechanical OR compression OR longitudinal B1
OR matter wave
- (iii) ultra violet/uv B1
- (b) $v = f\lambda$ OR $\lambda = v/f$ B1
 $3.0 \times 10^8 / 2.5 \times 10^8$ OR $3.0 \times 10^8 = 2.5 \times 10^8 \lambda$ C1
1.2 m A1

[Total: 6]

- 7 (a) red ray refracted away from normal B1
 violet ray refracted more than red ray in prism B1
 violet ray further refracted from red ray to screen B1 3
- (b) $1.52 = \sin 40^\circ / \sin r$ M1
 $\sin r = \sin 40^\circ / 1.52 (= 0.423)$ C1
 $r = 25^\circ$ A1 3
- (c) (i) 3×10^8 m/s A1
 (ii) same as (i) A1 2
[8]

8	(a) (i)	x-rays or gamma ra	B1	2
	(ii)	infra red or radio	B1	
	(b)	$f = v/\lambda$ or $3 \times 10^8 / 1 \times 10^{-12}$ $= 3 \times 10^{20}$ Hz	C1 A1	2
(c)	3×10^8 m/s	1	1 [5]	

- 9 (a) expect two internal reflections at sensible angles 1 1
- (b) angle of incidence at Y greater than critical angle 1
 total internal reflection occurs 1 2
- (c) (i) frequency = velocity/wavelength or $1.9 \times 10^8 / 3.2 \times 10^{-7}$ 1
 $= 5.9 \times 10^{14}$ Hz 1
- (ii) refractive index = $3/1.9$ or $1.9/3$ 1
 $= 1.58$ (no e.c.f.) 1 4
(7)