

Light

Mark Scheme 3

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Properties of Waves including Light and Sound
Sub-Topic	Light
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 3

Time Allowed: 54 minutes

Score: /45

Percentage: /100

- 1 (a) $(n =) \sin i / \sin r$ **OR** $\sin 62 / \sin 36$ C1
 1.5(02) C1
 $(v_g =) c/n$ **OR** $3.0 \times 10^8 / 1.5$ C1
 2.0/2.00/1.997 $\times 10^8$ m/s A
- (b) (infra-red/ light) encoded **OR** (sent as) pulses **OR** multiplexing **OR** many messages B1
OR signal **OR** information **OR** data **OR** internet B1
 (optical fibre transmits) light/infra-red (pulse) B1
 total internal reflection/TIR (prevents escape) B1

[Total: 7]

- 2 (a) two of:
 ray through centre of lens undeviated
 ray parallel to axis refracted to right hand focus B2
 rays through left hand focus refracted parallel to axis
- rays extrapolated to a point B1
- accuracy marks: image 6 cm from lens B1
 image 6 cm high B1
- (b) image is virtual/not real AND
 cannot be seen on screen OR no rays come from (position of) image B1

[Total 6]

- 3 (a) correct reflection of left ray
AND $22^\circ \leq$ angle between right ray and surface $\leq 32^\circ$, by protractor
rays projected back to form image in correct position B1
B1 [2]
- (b) both rays refract down M1
rays projected back to form image somewhere in water to the left of where left ray
strikes surface A1 [2]
- (c) $\sin c = 1 / 1.33$ OR $\sin c / \sin r = 1 / 1.33$ C1
OR $\sin^{-1}(1 / 1.33)$ OR $\sin^{-1}0.75$
($c = 48.8^\circ =$) 49° A1 [2]
- (d) appropriate use, accept diagram M1
accept 'endoscope', 'in medicine' is not sufficient A1
clear diagram of the above use or t.i.r. diagram for optical fibre
one from:
light goes down fibre/into body
illuminates internal organ
light/image returns from body/organ o.w.t.t.e. A1 [3]
- [Total: 9]**
- 4 (a) (i) (only) one frequency (accept wavelength) B1
(ii) 4.7×10^{14} Hz OR the same as before OR unchanged B1
- (b) ($n =$) c/v OR $3.0 \times 10^8 / 2.0 \times 10^8$ M1
1.5 A1
- (ii) ($\lambda =$) c/f OR $2.0 \times 10^8 / 4.7 \times 10^{14}$ C1
 $4.3/4.26/4.255319 \times 10^{-7}$ m A [6]

- 5 (a) (i) BOX 2 ticked virtual B1
 BOX 3 ticked magnified B1
- (ii) AB circled B1 [3]
- (b) normal at M towards C B1 [1]
- (ii) $40^\circ \leq \text{angle of reflection} \leq 50^\circ$ B1 [1]
- (iii) any clear indication that OP is also the reflected ray B1 [1]
- (iv) lines extended back from M and P to meet to the right of mirror
 AND indication of intersection as image position M1
- image within 25 mm of right hand margin line
 AND higher than P but within 16 mm [2]
- [Total: 8]

- 6 (a) $n = \sin i / \sin r$ or $n = \sin r / \sin i$ or $(\sin i =) 1.5 \sin 40^\circ$ i or $(\sin r =) 1.5 \sin 40^\circ$
 or 25° C1
 0.9641 C1
 $75/74.6^\circ$ to 2 or more sig. figs. A1 [3]
- (b) (i) $(v =) f\lambda$ or $3.8 \times 10^{14} \times 5.3 \times 10^{-7}$ C1
 2.01×10^8 m/s to 2 or more sig. figs. A1 [2]
- (ii) $(c =) nv$ or $1.5 \times 2.0/2.01/2.014 \times 10^8$ (e.c.f. from 7(b)(i)) C1
 3.02×10^8 m/s (accept 3 or 3.0×10^8 m/s only with working)
 (e.c.f. from 7(b)(i)) A1 [2]
- (c) wave(front) hits/enters the plastic at the same time or incident ray perpendicular
 along normal/at 90° or $i = 0^\circ$ (condone it doesn't hit at an angle) B1
 wave(front) all slows down at the same time or refracted ray perpendicular normal/at
 90° or $r = 0^\circ$ by calculation B1 [2]
- [Total: 9]