

Light

Mark Scheme 2

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| 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 2 |

Time Allowed: 60 minutes

Score: /50

Percentage: /100

- 1 (a) (i) correct O label B1
- (ii) correct I label B1
- (iii) correct F label, allow correctly labelled dot to left of lens B1
- (iv) correct arrows on both rays, anywhere on each ray B1
- (b) $1/n = \sin i / \sin r$ OR $n = \sin i / \sin r$ in any form OR $\sin i / n$ OR $n \sin i$ C1
 $(r = \sin^{-1}((\sin 35) / 1.5) =) 22^\circ$
 accept if in diagram A1
 emergent ray drawn with $27^\circ \geq r \geq 18^\circ$ B1

[Total: 7]

- 2 (a) $(\alpha =) \sin^{-1}(1/n)$ OR $\sin \alpha = 1/n$ OR $\sin 90^\circ / \sin \alpha = n$ C1
 $(C =) \sin^{-1}(1/1.6)$ C1
 39° OR $38.7(38.682)^\circ$ A1
- (b) any **four** from:
 (initially / $\theta < C$) refracted ray / ray in air / ray emerges
 (initially / $\theta \leq C$) refracted ray / ray in air / ray emerges AND reflected ray
 (initially / $\theta < C$) angle of refraction increasing
 (initially / $\theta < C$) refracted ray gets weaker OR reflected rays gets stronger
 $(\theta = C)$ refracted ray along surface
 (eventually / $\theta > C / r > 90^\circ$) refracted ray disappears OR no more refraction OR does not emerge OR total internal reflection
 (description of) angle of reflection increasing OR always equals angle of incidence B4

[Total: 7]

- 3 (a) (i) Normal at Q drawn AND refracted ray drawn with r less than i B1
(ii) Emerging ray drawn parallel to PQ AND normal drawn B1
(iii) Two equal angles, marked X, between rays and normal B1
- (b) (i) $n = \sin i \div \sin r$ in any form OR $1.62 = \sin 65 \div \sin r$ in any form C1
OR $\sin r = \sin 65 \div 1.62$
 $r = 34^\circ$ A1
- (ii) $n = \text{speed (of light) in air} \div \text{speed (of light) in glass}$ in any form C1
OR $1.62 = 3.0 \times 10^8 \div \text{speed in glass}$ in any form
(speed in glass = $3.0 \times 10^8 \div 1.62$) = 1.8 OR 1.9×10^8 m/s A1
- (c) Dispersion B1

[Total: 8]

- 4 (a) reflected ray in correct quadrant B1
 $34^\circ \leq \text{angle from surface} \leq 42^\circ$ B1
ignore refracted ray for both marks
- (b) angle of incidence: any mark in v box only B1
angle of refraction: any mark in y box only B1
- (c) $\sin i / \sin r = n$ or $\sin i / \sin r = 1/n$ in any form C1
 $\sin r = 1.33 \sin 30$ or $(\sin 30) / 1.33$ or 0.665 or 0.376 C1
 $(r =)42^\circ$ A1
- (d) refracted down compared to incident ray ignore emerging ray M1
between dashed line and 25° above it ignore emerging ray A1

[Total: 9]

- 5 (a) (i) two rays from lamp to mirror **AND** one good ($i \approx r$) reflected ray B1
two good reflected rays **AND** rays traced back above mirror B1
labelled / clear image located at intersection **AND** in correct position B1
- (ii) any two from:
virtual
(longitudinally) inverted
same size (as lamp) **OR** same distance (from mirror) B2
- (b) light reflected back / down **OR** not wasted **OR** room brighter **OR** more light etc.

[Total: 6]

- 6 (a) (i) 1. one normal to mirror drawn B1
2. angle of incidence, labelled B1
- (ii) both reflected rays drawn B1
2. construction lines to locate image, marked I B1
- (b) (i) dot marked C in correct position B1
- (ii) two circular arcs each joining correct points on barrier B1
spacing of arcs same as spacing of incident waves B1

[Total: 7]

- 7 (a) internal reflection **AND** $i = r$ for 1st reflection M1
NOT any ray emerges from sides
ray reaches end of tube after 1 or 2 reflections only A1
- (b) $\sin^{-1}1/n$ **OR** Snell's Law in any form C1
($c = \sin^{-1}1/1.52 =$) 41° B1
- (c) (i) total internal reflection B1
(ii) angle of incidence $> c$
OR light must reach end of fibre with small losses o.w.t.t.e. B1

[Total: 6]