

Optics MS1

Question Number	Answer	Mark
1(a)(i)	Use of $n = v_1/v_2$ with λ proportional to v (1) (seeing 1.53×414 or $414/1.53 = 271$ nm gets 1st mark) Wavelength in disc = 633 nm (1) (Alternative method finds v in plastic, then f of wave, leading to λ in air. Correct answer by this method scores 2 but incorrect answer can score the method mark) <u>Example of calculation</u> $n = \text{wavelength in air} / \text{wavelength in disc}$ $\lambda \text{ in air} = 1.53 \times 414 = 633 \text{ nm}$	2
1(a)(ii)	Division of a wavelength by 2 or 4 (414 nm or their λ from (a)(i)) (1) Vertical distance = 104 nm or $\frac{1}{4}$ their λ from (a)(i) (1)	2
1(a)(iii)	<u>Destructive interference</u> / superposition (1) Amplitude/intensity of wave is zero/min OR binary value zero OR there is min/no light OR the waves cancel/almost cancel each other OR cancellation (1)	2
1(b)(i)	Use of $\sin \text{critical angle} = 1/n$ (1) $c = 40.8^\circ$ (accept 41°) (1) [bald answer of 41° scores zero] <u>example of calculation</u> $\sin c = 1/1.53$ $c = 40.8^\circ$	2
1(b)(ii)	Marks can only be scored for answers where the light is only in the plastic Reflection shown at point P (1) Angle of incidence = angle of reflection (judge by eye) and greater than their critical angle from (b)(i) (1) (do not penalise if arrows not drawn . Labels could override poor drawing)	2
Total for question		10

Question Number	Answer	Mark
2(a)	Ray drawn along edge of prism (labelled X) (ignore a reflected ray)	1
(b)(i)	$n = 3 \times 10^8 \div 1.96 \times 10^8$ $n = 1.53$ (no unit, ue if one given)	1 1
(b)(ii)	Use of $\sin(\text{critical angle}) = 1/n$ OR use of $\sin i / \sin r = v_1/v_2$ $= n$ $c = 41^\circ$	1 1
(c)	Red light: refraction towards normal at first face but less than refraction for blue light Refracts into air at second face with angle in air > angle in glass	1 1
Total for question		7

Question Number	Answer	Mark
3(a)(i)	angle of incidence (for light travelling from denser medium) which has angle of refraction of 90° (may refer to leaving along surface/boundary) (accept answers based on maximum angle of incidence (1) For light to enter second medium (1))	(1) (1) 2
3(a)(ii)	use of speed of light in vacuum / speed of light in medium = refractive index $\mu = 1.52$ to at least 3 sf <u>Example of calculation</u> $\mu = 3.00 \times 10^8 \text{ m s}^{-1} \div 1.97 \times 10^8 \text{ m s}^{-1}$ $= 1.52$	(1) (1) 2
3(a)(iii)	Use of $\mu = \sin i / \sin r$ (accept stating $\sin c = 1 / \mu$) $c = 41^\circ$ (n.b. ue applies) Allow ecf from (ii) <u>Example of calculation</u> $\sin c = 1 / \mu = 1 / 1.52$ $c = 41^\circ$	(1) (1) 2
3(b)	Light strikes side at greater than critical angle <u>Total internal reflection</u> repeats along the fibre	(1) (1) 2
Total for Question		8

Question Number	Answer		Mark
4(a)	Use of $n = \sin i / \sin r$ $n = 1.5$ <u>Example of calculation</u> $n = \sin 40^\circ \div \sin 25^\circ$ $n = 1.521$	(1) (1)	2
*4(b)	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Max 3 marks for criticism and Max 3 marks for improvement Criticism: Comment on limitations of precision of measurements, e.g. protractor to 1°, thickness of ray, thickness of pencil line Comment on the high uncertainty Comparison of precision of calculated value to that of the values in the table Comment on use of single measurement Improvement: Use larger angle (to reduce percentage uncertainty) Use a laser (with a narrower beam than the ray box) Take measurements over a range of angles Determine mean value of refractive index OR use graph of $\sin i$ vs $\sin r$	(1) (1) (1) (1) (1) (1) (1) (1)	4
	Total for Question		6

Question Number	Answer	Mark
5(a)	$n = \sin 48 / \sin 30$ $n = 1.5$ (common answer will be 1.49) ($n = 0.67$ scores 1 mark for idea of ratio of sin of angles)	(1) (1)
5(b)(i)	QWC - spelling of technical terms must be correct and the answer must be organised in a logical sequence As x increases, y increases OR At a certain angle / critical angle, $y = 90^\circ$ / the light travels along the boundary (do not allow reflects at 90°) For angles greater than the <u>critical</u> angle (in glass) <u>total internal reflection</u> occurs (do not accept TIR)	(1) (1) (1)
5(b)(ii)	Use of $\sin c = 1/n$ $c = 42^\circ$ ecf n from (a) unless $n = 0.67$ which scores 0 here	(1) (1)
	Total for question	7