

MARKSCHEME 2823/01- JANUARY 2003

1. (a) $n = c_A/c_G$ OR c_1/c_2 OR c_i/c_r {OR ratio of speeds } B1
 where " c_A "= speed (of light) in air AND " c_G "= speed (of light) in glass B1 [2]
 {Allow "ratio of speeds in air and glass" for 2 marks}
- OR $n = \sin i / \sin r$ B1
 where i = angle of incidence (in air) AND r = angle of refraction (in glass) B1
- (b)(i) correct substitution into $n = c_i / c_r : 1.54 = 3 \times 10^8 / c_g$ C1
 $c_g = 1.95 \times 10^8 \text{ ms}^{-1}$ (expect 1.948) A1 [2]
 {Allow 1.9 OR 2.0 OR 2 provided substitution is correct i.e. using $n = 1.54$ }
- (ii) use of $n = 1/\sin C$ C1
 $\sin C = 1/1.54 \Rightarrow C = 40.5^\circ$ (expect 40.493) A1 [2]
 {Allow 40° or 41° but not the usual 42° }
- (c)(i) recall of $n_G = \sin i / \sin r$ C1
 correct substitution into $\sin i = \sin r \times 1.54 = \sin 30 \times 1.54$ C1
 $\sin i = 0.77 \Rightarrow i = 50.4^\circ$ (expect 50.35) A1 [3]
 {Allow 50° but not 51° }
- (ii) 60° {look for value shown in diagram if no answer is given in (ii)} B1 [1]
- (iii) TIR shown at Q {roughly correct judged by eye unless angles labelled} B1
explanation: angle of incidence > critical angle (WTTE) B1 [2]
 Allow ecf from (ii) if cand's $i < C$:
 ray refracted at Q away from normal, B1
 because it speeds up OR enters a less dense medium OR $i < C$ (WTTE) B1

QUESTION TOTAL = 12

2. (a) *Longitudinal* any valid example
e.g. sound /ultra sound (accept 'P waves' but reject "Earthquake") B1
- Transverse* any valid example
e.g. light / microwaves etc./ emwaves / any emradiation
(accept sea waves or ripple-tank waves but not "water waves") B1 [2]
- (b)(i) frequency = number of waves/vibrations/oscillations/cycles per unit time B1 [1]
{allow "per second"}
- (ii) period = time taken for 1 complete cycle/wave/vibration/oscillation B1 [1]
{allow 1/f, provided f has been correctly defined above}
- (c)(i) 4×10^{-5} m { not 4 or 4×10^5 } B1 [1]
- (ii) air particle vibrates (seen or implied in remainder of answer) B1
in the same direction as the wave (WTTE) B1
{allow left to right, backwards and forwards, longitudinally but NOT up and down}
description of motion during any full cycle (allow ecf for transverse) B1 [3]
{do not penalise reference to random thermal motion of air molecules}
- (iii) **similarity:** e.g.
both have same amplitude / frequency / period
OR move/vibrate/travel longitudinally OR both have (random) thermal motion B1
- difference:** e.g. movements (90°) out of phase (WTTE) B1 [2]
- (iv) wavelength = 0.8 m B1 [1]
- (v) recall of $v = f \lambda$ C1
correct substitution: $f = v/\lambda = 340/0.8$ C1
 $f = 425$ Hz A1 [3]

QUESTION TOTAL = 14

3. (a)(i) (transmitter emits) microwaves that are (vertically plane) POLARISED B1
 {allow vibrate/move/travel in the same plane, but do NOT allow 'transverse'}
- detector ONLY detects waves (polarised) PARALLEL to it (WTTE) B1 [2]
- (ii) maximum reading OR reading would increase (WTTE) B1 [1]
- (iii) the waves are TRANSVERSE {allow polarised if not gained in (i)} B1 [1]
- (b)(i) INTERFERENCE (OR SUPERPOSITION) B1 [1]
- (ii) Any 2 points from:
 equal distance travelled by waves from both slits (OR zero path diff.)
 waves meet in phase B1+B1
 constructive interference occurs
- (iii) idea that path difference/phase difference changes implied in 1. or 2). B1
- OR correct reference to destructive AND constructive interference
 1. low reading at A because path difference is an odd number of $\frac{1}{2}\lambda s$ B1
- OR 180° out of phase (or in antiphase)
 2. high reading at B when path difference is a whole number of λs (not 0) B1 [3]
- OR waves meet in phase (allow zero or 2π phase difference)
- (iv) FEWER (highs and lows) (OR more spread out) M1
 any valid explanation: e.g reference to $x \propto 1/a$ OR $x = \lambda D/a$ (not $\lambda = ax/D$) A1 [2]
- OR since wave sources closer together, further distance needed along the arc to create the longer path difference of λ . (WTTE)

QUESTION TOTAL = 12

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4. (a)(i) Node = (a point of) zero displacement/amplitude/disturbance/movement B1 [1]
 (allow " point of totally destructive interference")
- (ii) Antinode = (a point of) maximum amplitude (WTTE) B1
 (allow "point of totally constructive interference")
- correct diagram of a standing wave shown here or in (b) B1 [2]
- (b) a suitable wave source such as tuning fork/loud-speaker/blowing
 AND suitable air column such as a measuring cylinder/pipe or tube B1
- Description of ACTION TAKEN: e.g adjusting length
 AND how standing wave is DETECTED e.g. loud sound produced B1
- type of wave correctly identified as LONGITUDINAL B1
- one node N AND one anti-node A correctly labelled (for cand's diagram) B1 [4]

{For a transverse example, maximum of 2 marks for 'TRANVERSE' and correct N and A }

QUESTION TOTAL = 7