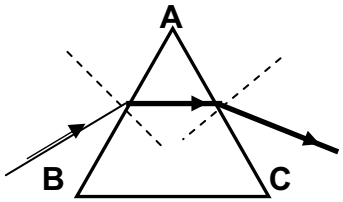
MARKSCHEME: 2823 Wave Properties January 2006 – FINAL VERSION

1. (a) ratio of sini/sinr is constant (WTTE) (accept sini/sinr = n or RI) -------- B1
(do not accept ratio of speeds)
incident ray, refracted ray (and normal) all lie in the same plane------ B1 [2]
(allow 'angles of …..')

(b) (i) *correct path through the prism showing:*
refraction towards normal on entry ---------- B1
refraction away from normal on exit ---------- B1 [2]



(ii) ray of light slows down (allow changes speed) as it enters glass.----- B1 [1]

(iii) Recall of n =sini/sinr ---------- C1
correct substitution ⇒ 1.47 = sin 50/sinr ---------- C1
sinr = sin50/1.47 ⇒ r = 31^{O} (31.4) (allow 31.6 or 32) ---------- A1 [3]

(iv) angle of incidence must be greater than (or = to) critical angle ------ B1 [1]
{ignore any reference to density of media}

(v) correct substitution into n=1/sinC ⇒ e.g. sinC = 1/1.47 ---------- C1
⇒sinC = 0.680 ⇒C = 43^{O} (42.9) ---------- A1 [2]

[Total = 11]

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2. (a) (i) Recall of $n= c_i /c_r$ {or in words) ---------- C1
⇒ $c_r = (3 \times 10^8)/1.52 = 1.97 \times 10^8$ ms^{-1} (allow $2x10^8$) ---------- A1 [2]

(ii) Use of speed = distance/time ---------- C1
$t = 3000/1.97x10^8 = 1.52 \times 10^{-5}$ s ---------- A1 [2]

{allow ecf from (i)}

(b) *meaning of multipath dispersion: e.g.:*
rays (or pulses) take different paths (WTTE) ---------- B1
and arrive at different times (WTTE) ---------- B1
smeared/blurred/spread/elongated/distorted/data corruption -------- B1 [3]
(allow diagrams) (do not allow reduced intensity)

allow any valid method of reducing multipath dispersion, but expect:
use monomode fibre (WTTE) ---------- B1
so that most rays follow the same path ---------- B1 [2]

{also allow core/cladding interface has very large critical angle (WTTE) ---- B1
reducing amount of TIR ---------- B1}

[Total = 9]

3. (a) (i) wave sources that have a constant phase difference (WTTE) ------ B2
{max of 1 mark for sources have same frequency/wavelength/in phase C1}

(ii) sum of <u>displacements</u> (= resultant displacement) (WTTE) ------ B1 [1]
(no marks for reference to amplitude)

(b) (i) constructive interference/waves in phase for maxima
OR destructive interference/waves 'out of phase' ---------- C1
maxima produced when path difference is 0 OR $n\lambda$ (WTTE) ---- A1
minima produced when path difference is $(n+1/2)\lambda$ (WTTE) ------ A1 [3]
(NB answers that do not account for SERIES of both maxima and minima can score maximum of 2 marks only)

(ii) recall of $x = \lambda D/a$ ---------- C1
{expressed in any form; allow unusual symbols if correctly identified}
correct substitution: $x = (3.0 \times 50)/6$ ---------- A1

$x = 25$ cm ---------- A1 [3]

(iii) microwaves <u>vibrate/oscillate/displaced</u> in <u>one plane</u> (WTTE) --------- B1.
{do not allow travel/propagate in one plane)
signal decreases to zero (WTTE) ---------- B1 [2]

[Total = 11]

4. (a) waves (travel out from centre and) are reflected (WTTE) ---------- B1
interference/superpositioning occurs (WTTE) ---------- B1 [2]

(b) correct shape drawn ---------- M1
N labelled at <u>both</u> ends and A in the middle ---------- A1 [2]

(c) wavelength = 0.5 x 2 = 1.0m {allow ecf from (b)} ---------- B1 [1]

[Total = 5]

5 (a) the spreading out (WTTE) of waves ---------- B1
(reject bending/change in direction)
when they pass through a gap OR pass a barrier edge ---------- B1 [2]

(b) (i) semicircular wavefronts leaving the gap ---------- B1
no change in wavelength stated OR
clearly shown (at least 3 waves needed) – judged by eye --------- B1 [2]

(ii)	LESS diffraction would occur – shown or stated ----------	B1	
	wavefronts mainly <u>plane</u> (by eye) (allow curved at edges) ---------	B1	[2]
(iii)	MORE diffraction for SOUND ----------	B1	
	Wavelength of sound > wavelength of light (WTTE) ----------	B1	
	Valid comparison of wavelength of light or sound with doorway e.g. doorway of similar size to wavelength of sound OR wavelength of light is very small compared to door (WTTE) -------	B1	[3]

[Total = 9]