Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

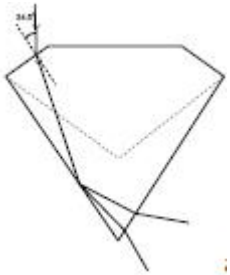
(a) (i) sin*C* = 1/*n* = 1/2.42 ✔ (= 0.413)
C = 24.4° ✔ (allow 2 or more sig figs)
Answer only gains both marks

2

(ii) sin θ_{dia} = sin θ_{air} / *n* = sin 50.2 / 2.42 ✔ (= 0.317)
θ_{dia} = 18.5° ✔ (allow 2 or more sig figs)
Answer only gains both marks
Answer can be 18° or 19° depending on rounding

2

(iii) TIR shown at bottom left surface ✔(If the reflected ray were extended it would pass through the writing below the diagram between the 'i' in 'it' and the full stop at the end of 'diamond'.) ray leaves bottom right surface either with an increased emergent angle or straight though if hitting normally ✔
(The second mark is consequential on gaining the first mark)



acceptable emergent rays

2

(iv) it has smaller critical angle / critical angle is 22°
allowing more / same number / greater chance / increased probability of TIR's occurring greater/same sparkle ✔✔ max 2
'reflect more' is insufficient for a mark

2

(b) (i) $c_{core} = c_{air} / n = 3.00 \times 10^8 / 1.55 = 1.9 \times 10^8$ (ms^{-1})✔(1.94× 10^8 ms^{-1})
1 sig fig is not acceptable if no other answer is given

1

(ii) (n = $c_{air} / c_{core} = f\lambda$air / $f\lambda$core =λair /λcore)
λcore = λair / *n* or 1300 × (10^{-9}) / 1.55✔
= 8.4 × 10^{-7} (m)✔(8.39 × 10^{-7} m or 839 nm)

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The first mark is for the equation or substitution ignoring powers of 10 errors

1st mark can be gained from calculating the frequency ($f = 3.0 \times 10^{8} / 1300 \times 10^{-9} = 2.3 \times 10^{14}$ (Hz) which then can be used to find the the wavelength

Using this method the answer can range between $8.4 \times 10^{-7} \longrightarrow 8.7 \times 10^{-7}$ (m) and consider ecf's from (b)(i)

2

(iii) protects the core (from scratches etc)
prevents crosstalk / stops signal crossing from one fibre to another / increases critical angle / reduces pulse broadening / reduces smearing / prevents multipath dispersion
allows fibre to be supported / touched (without losing light)

✔any one point

Preventing signal loss is not enough for the mark.

1

[12]

Q2.

(a)

	wavelength	**frequency**	**speed**
increases			
stays the same		✓	
decreases	✓		✓

middle column correct ✓
first and third column correct ✓

2

(b) (i) ($n_1 \sin\theta_2 = n_2 \sin\theta_2$)
(1.09)sin 65.0 = (1.00)sinθ_2 ✓ (giving $\theta_2 = 81°$)

α = 9(°) ✓ (8.93°)
no internal CE
allow 9.0°

2

(ii) 1.09sin65 = 1.70sin$x$
or sin$x$ = 0.58
or x = 35.5 (°) ✓ (allow 35° or 36°)
[beware an answer close to the correct value can come from n = 1 / sinC]

90 − 35.5 = 54.5(°) ✓ (allow 54° or 55°)
CE for 90° − their value

2

(c) (i) <u>total</u> internal reflection
TIR does not gain the mark

1

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(ii) diagram showing core / cladding and light ray TIR at interface at least once with another TIR shown on the diagram or suggested in their explanation ✓

labelling is not required and reflections do not have to be accurate provided they are shown on the correct side of the normal

light fibre consists of core and cladding with lower refractive index / optical density ✓

light (incident) at angle greater than the critical angle (results in TIR) ✓

3

[10]

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