

Name of the Student: _____

Max. Marks : 19 Marks

Time : 19 Minutes

Mark Schemes

Q1.

(a)

	wavelength	frequency	speed
increases			
stays the same		✓	
decreases	✓		✓

middle column correct ✓

first and third column correct ✓

2

- (b) (i) $(n_1 \sin \theta_2 = n_2 \sin \theta_1)$
 $(1.09) \sin 65.0 = (1.00) \sin \theta_2$ ✓ (giving $\theta_2 = 81^\circ$)

$$\alpha = 9^\circ \text{ ✓ } (8.93^\circ)$$

no internal CE

allow 9.0°

2

- (ii) $1.09 \sin 65 = 1.70 \sin x$
 or $\sin x = 0.58$
 or $x = 35.5^\circ$ ✓ (allow 35° or 36°)
[beware an answer close to the correct value can come from
 $n = 1 / \sin C]$

$$90 - 35.5 = 54.5^\circ \text{ ✓ } (\text{allow } 54^\circ \text{ or } 55^\circ)$$

CE for 90° – their value

2

- (c) (i) total internal reflection
TIR does not gain the mark

1

- (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]

Q2.

- (a) (i) Voltmeter across terminals with nothing else connected to battery / no additional load.

✓

1

- (ii) This will give zero / virtually no current ✓

1

- (b) (i) $\frac{VI}{\epsilon I}$

Answer must clearly show power: ϵI and VI , with I cancelling out to give formula stated in the question ✓

1

- (ii) Voltmeter connected across cell terminals ✓

Switch open, voltmeter records ϵ

Switch closed, voltmeter records V

Both statements required for mark ✓

Candidates who put the voltmeter in the wrong place can still achieve the second mark providing they give a detailed description which makes it clear that:

To measure emf, the voltmeter should be placed across the cell with the external resistor disconnected

And

To measure V , the voltmeter should be connected across the external resistor when a current is being supplied by the cell

2

- (c) Vary external resistor and measure new value of V , for at least 7 different values of external resistor ✓

Precautions - switch off between readings / take repeat readings (to check that emf or internal resistance not changed significantly) ✓

2

- (d) Efficiency increases as external resistance increases ✓

Explanation

Efficiency = Power in R / total power generated

$$I^2 R / I^2 (R + r) = R / (R + r)$$

So as R increases the ratio becomes larger or ratio of power in load to power in internal resistance increases ✓

Explanation in terms of V and ϵ is acceptable

2

[9]