Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Waves

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Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

(a) (i) (using $n_1 \sin \theta_1 = n_2 \sin \theta_2$ or $\sin \theta_c = n_2/n_1$ gives)

correct substitution in either equation (eg $1.55 \sin c = 1.45 (\sin 90)$ or $\sin c = 1.45/1.55$) **(1)**

= 0.9355 (accept less sf) **(1)**
c = 69.3(°) **(1)** (accept 69.4°, 69° **or** 70°)

(ii) the angle (of incidence) is less than the **critical angle** or values quoted **(1)**

(iii) (using $n_1 \sin \theta_1 = n_2 \sin \theta_2$ gives)

$1.55 \sin 60 = 1.45 \sin \theta$ **(1)**

($\sin \theta = 1.55 \sin 60/1.45$ =) 0.9258 or 0.926 or 0.93 **(1)**

θ = 67.8° **(1)** (accept 68° **or** 68.4)

7

(b) any **two** from:

keeps signals secure **(1)**

maintains quality/reduces pulse broadening/smearing (owtte) **(1)**

it keeps (most) light rays in (the core due to total internal reflection at the cladding-core boundary) **(1)**

it prevents scratching **of the core (1)**

(keeps core away from adjacent fibre cores) so helps to prevent crossover of **information/signal/data** to **other** fibres **(1)**

cladding provides (tensile) strength for fibre/prevents breakage **(1)**

given that the core needs to be very thin **(1)**

max 2

[9]

Q2.

(a) (i) = 590×10^{-9}m **(1)**

(using $d \sin \theta = n\lambda$ gives)

$\sin\theta = \frac{n\lambda}{\quad}$ or $= \frac{2 \times 590 \times (10^{-9})}{\quad}$ **(1)** = **0.707** or

7.07×10^{8} if nm used **(1)**

$\theta = 45.0°$ **(1)** (accept 45°)

(ii) (sin $\theta \leq 1$) gives $\frac{n\lambda}{d} \leq 1$ or $n \leq \frac{d}{\lambda}$ or $= \frac{1.67 \times 10^{-6}}{590 \times 10^{-9}}$ **(1)** = 2.83 **(1)**

so 3rd order or higher order is not possible **(1)**

alternative solution:
(substituting) ***n* = 3** (into $d \sin\theta = n\lambda$ gives) **(1)**

$\sin\theta \left(= \frac{n\lambda}{d} = \frac{3 \times 590 \times 10^{-9}}{1.67 \times 10^{-6}} \right) = 1.06$ **(1)**

gives 'error'/which is not possible **(1)**

7

(b) (using $d \sin\theta = n\lambda$ gives)

$2\lambda = 1.67 \times 10^{-6} \times \sin 42.1$ **(1)**

$\lambda (= 0.5 \times 1.67 \times 10^{-6} \times \sin 42.1) = 5.6(0) \times 10^{-7}$ m (or 560 nm) **(1)**

2

[9]