

- M1.(a)** (i) Coherent – used to transfer / transmit image (out of body) 1
- Coherent – same fibre arrangements **at both ends of bundle**
- Allow same relative position*
- Do not allow symmetrical* 1
- (ii) Non-coherent – used to transfer light into body (to illuminate) 1
- Non-coherent – random fibre arrangement along bundle
- Do not allow not symmetrical* 1
- (b) $\sin \theta_c = 1.49 / 1.52$
- $\theta_c = 79$ (degree) 1

[5]

- M2.(a)** Idea that fibres in a coherent bundle maintain the same relative position to each other B1
- In incoherent bundles the fibres may be in different / random positions (at each end) B1
- Coherent bundle needs to be used for the observation image. Incoherent bundle may be used for the light transmission B1
- 3
- (b) Mentions charge coupled device / CCD B1
- Capacitor / photosite / photodiode charges / stores charge as light falls on it B1

(Photons arriving cause) electrons to be excited / emitted

B1

Charge depends on light intensity

B1

Lots of photosites / concept of pixels

B1

ANY 3

Max 3

(c) (i) Core

M0

So that total internal reflection can occur

A1

1

(ii) $79(.4)^\circ$

B1

1

(iii) Ray leaving one fibre and entering adjacent fibre

B1

Reduces resolution / image will be blurred / less clear /
limits angle through which fibre may be bent

B1

2

[10]

M3. (a) horizontal line from A to B at 1.5

Vertical line at B from 1.5 to value between 1.5 and 1.4 and then horizontal line
from B to C

Vertical line at C from value to 1.0 (if possible) and then horizontal line from C to D

3

- (b) Use of non-coherent to transmit light into body/ provide illumination
 Use of coherent to transmit image/ light to form an image (from inside to viewer /camera)

2

[5]

- M4.** (a) coherent same relative position of fibres at both ends ✓
 coherent transfers picture from inside of body to viewer ✓
 non-coherent no relative order to the fibres ✓
 non-coherent carries light into body/for illumination ✓

4

- (b) $\sin \theta_c = 1.55/1.60$ $\theta_c = 76$ (75.6) (degree) ✓

1

[5]

- M5.** (a) **property explanation**
 monochromatic waves of single frequency/wavelength
 collimated produces an approximately parallel beam
 coherent waves produced are in constant phase with each other

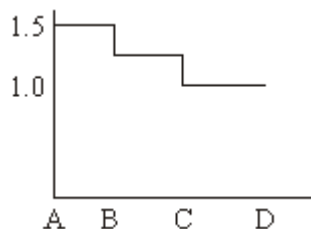
two correct properties (1)
each correct explanation (1)(1)

3

- (b) (i) illuminate the inside of a body **(1)**
 (ii) stopping bleeding/cutting tissue/treatment of tumours **(1)**

2

(c) (i)



n (constant) = 1.5 from A to B, slight decrease and constant from B to C **(1)**
at C, n decreases to 1, remains at 1 from C to D **(1)**

$$1.5 = \frac{\sin i}{\sin 10^\circ} \quad \mathbf{(1)}$$

$$i = 15(.1)^\circ \quad \mathbf{(1)}$$

4

[9]

M6.(a) $\frac{\sin i}{\sin r} = \frac{\sin C}{l} \quad \mathbf{(1)} = \frac{1.40}{1.55} = 0.903 \quad \mathbf{(1)}$

angle $C = 64.6^\circ \quad \mathbf{(1)}$

3

(b) on outer edge only of core **(1)**
two to four reflections **(1)**
[no marks for zig-zag]

2

(c) (i) smaller difference between the core index and cladding index makes critical angle larger **(1)**
therefore increases the chance of light escaping **(1)**

(ii) makes internal angle of incidence at core-cladding interface more likely to be less than the critical angle **(1)**
therefore increases the chance of light escaping **(1)**

max 3

[8]

