

| Question number | Answer | Notes | Marks |
|-----------------|--|--|-------|
| 11 (a) (i) | any two from: MP1. optical fibres for communication; MP2. endoscopes; MP3. optical fibres in decorative lamps etc.; MP4. safety reflector; MP5. prism in {binoculars / camera / periscope / rangefinder}; | allow 1 mark for unqualified "optical fibres" in the absence of any other marks e.g. bicycle/car reflector, cat's eye | 2 |
| (ii) | idea that light travels from more (optically) dense medium to less (optically) dense medium; incident angle greater than critical angle; | allow if expressed in terms of refractive index allow "has to go from glass to air" / eq. | 2 |
| (b) (i) | normal line drawn correctly by eye where light ray meets flat surface at A; | | 1 |
| (ii) | angle measured in the range 24-30°; | allow ecf from incorrect normal | 1 |
| (iii) | ray emerges from block at position A; refracting correctly away from normal; | | 2 |
| (iv) | $\sin(c) = 1 \div n$; | allow rearrangements and word equations | 1 |
| (v) | substitution AND rearrangement; evaluation; e.g. $n = 1 \div \sin(40^\circ)$ (n =) 1.6 | allow 1.557... | 2 |

Total for question 11 = 11 marks