AQA Examination-style questions

1 In a secure communications system, an optical fibre is used to transmit digital signals in the form of infrared pulses. The fibre has a thin core, which is surrounded by cladding that has a lower refractive index than the core.

(a) **Figure 1** shows a cross-section of a straight length of the fibre.

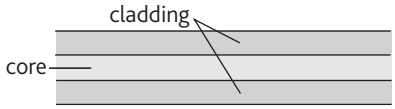

Figure 1

(i) The core has a refractive index of 1.52 and the cladding has a refractive index of 1.35. Show that the critical angle at the core–cladding boundary is 62.6°.

(ii) Sketch the path of a light ray in the core that is totally internally reflected when it reaches the core–cladding boundary. *(6 marks)*

(b) (i) Explain why the cladding is necessary.

(ii) An optical fibre is used to transmit digital images from a security camera to a computer where the images are stored. A prominent notice near the camera informs people that the camera is in use. Discuss the benefits and drawbacks associated with making and storing images of people in this situation. *(7 marks)*

2 The diagram shows a cube of glass. A ray of light, incident at the centre of a face of the cube, at an angle of incidence θ, goes on to meet another face at an angle of incidence of 50°, as shown in **Figure 2**.

critical angle at the glass–air boundary = 45°

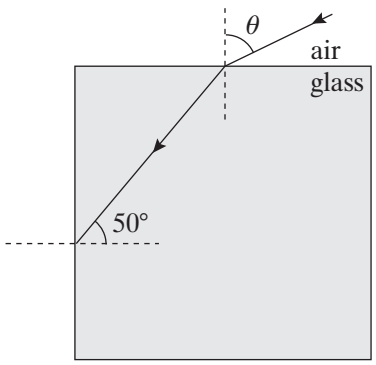

Figure 2

(a) Draw on the diagram the continuation of the path of the ray, showing it passing through the glass and out into the air. *(3 marks)*

(b) Show that the refractive index of the glass is 1.41. *(2 marks)*

(c) Calculate the angle of incidence, θ. *(3 marks)*

AQA, 2005

3 **Figure 3** shows a ray of monochromatic light, in the plane of the paper, incident on the end face of an optical fibre.

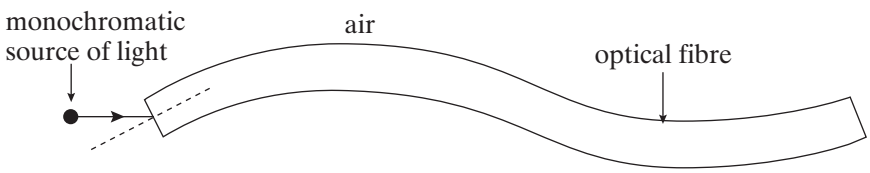

Figure 3

(a) (i) Draw on a copy of the diagram the complete path followed by the incident ray, showing it entering into the fibre and emerging from the fibre at the far end.

(ii) State any changes that occur in the speed of the ray as it follows this path from the source.

Calculations are not required. *(4 marks)*

(b) (i) Calculate the critical angle for the optical fibre at the air boundary.

refractive index of the optical fibre glass = 1.57.

(ii) The optical fibre is now surrounded by cladding of refractive index 1.47.

Calculate the critical angle at the core–cladding boundary.

(iii) State **one** advantage of cladding an optical fibre. *(6 marks)*

AQA, 2004

4 (a) State what is meant by *coherent sources* of light. *(2 marks)*

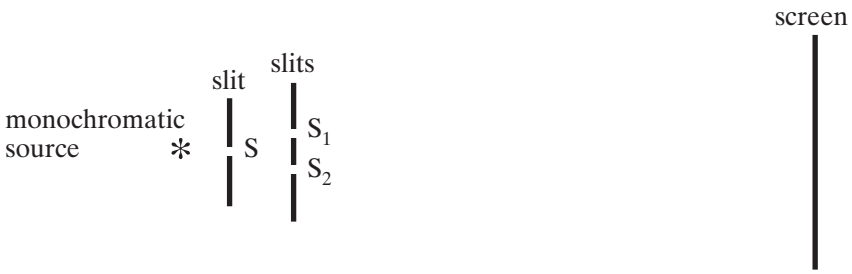

Figure 4

(b) Young's fringes are produced on the screen from the monochromatic source by the arrangement shown in **Figure 4**.

(i) Explain why slit S should be narrow.

(ii) Why do slits S_1 and S_2 act as coherent sources? *(4 marks)*

(c) The pattern on the screen may be represented as a graph of intensity against position on the screen. The central fringe is shown on the graph in **Figure 5**. Copy and complete this graph to represent the rest of the pattern by drawing on **Figure 5**. *(2 marks)*

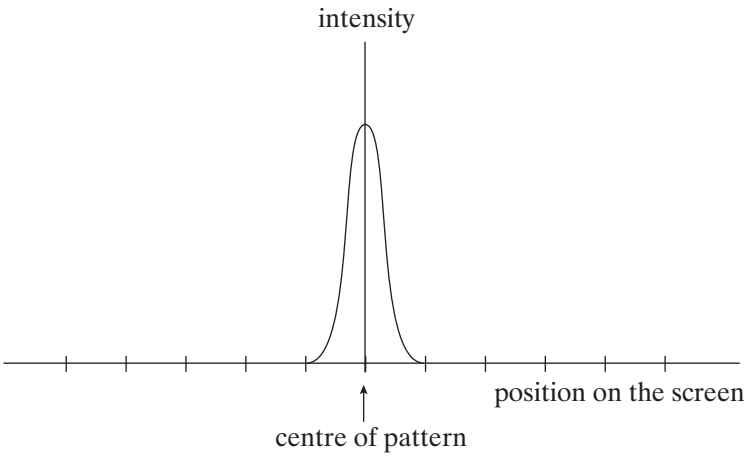

Figure 5

AQA, 2005

5 A diffraction grating has 940 lines per mm.

(a) Calculate the distance between adjacent lines on the grating. *(1 mark)*

(b) Monochromatic light is incident on the grating and a second-order spectral line is formed at an angle of 55° from the normal to the grating. Calculate the wavelength of the light. *(3 marks)*

AQA, 2006