Mark scheme for Extension Worksheet – Topic 4, Worksheet 5

1 **a** We need the angular separation to be equal to the diffraction angle, i.e.

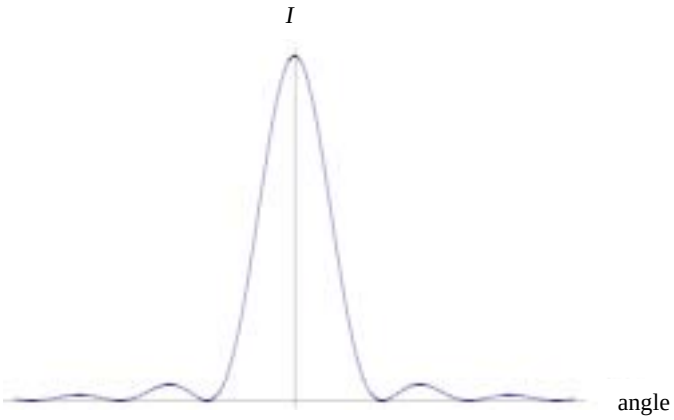
$\frac{s}{D} = 1.22\frac{\lambda}{b} \Rightarrow \frac{2.0\times10^{-3}}{D} = 1.22\frac{700\times10^{-9}}{3.0\times10^{-3}}$; hence

$D = \frac{2.0\times10^{-3}\times3.0\times10^{-3}}{1.22\times700\times10^{-9}} = 7.0$ m [2]

b The diffraction angle would get smaller; and so the angular separation being larger than the diffraction angle, we would have resolution. [2]

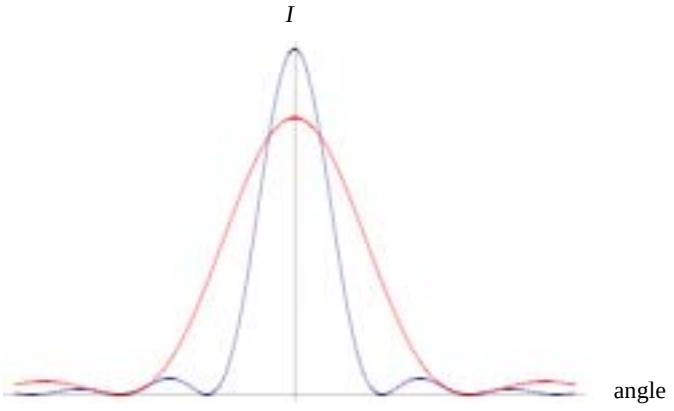
2 See page 261 of *Physics for the IB Diploma* or page 63 of *Physics for the IB Diploma Exam Preparation Guide*. [3]

3 **a** See blue graph. (It is worth knowing that the intensity of the first side maximum is less than 5% of the central maximum.) General shape with secondary maxima sufficiently low; minima at zero intensity.



[2]

b If the slit width is decreased then the intensity of the central maximum decreases since less light goes through the slit; and the angle of the first diffraction minimum gets larger i.e. pattern gets wider; (See graph below in red with slit width half that of the blue slit width.)



[2]

4 The light transmitted through the first polariser has intensity $\frac{I_0}{2}$ and is vertically polarised. If the transmitted intensity though the second sheet is also $\frac{I_0}{2}$ this means that it is either ordinary plastic or a polariser with a vertical axis, i.e. **B**. [1]

5 The light transmitted through the first polariser has intensity $\frac{I_0}{2}$; so

$$\frac{I_0}{8} = \frac{I_0}{2}\cos^2\theta \Rightarrow \cos^2\theta = \frac{1}{4} \Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = 60^\circ$$ [2]

6 **a** At a particular angle of incidence the reflected light is completely horizontally polarised; and so cannot be transmitted through a polariser with a vertical axis. [2]

b The angle of 52° is the polarising or Brewster angle; and so $n = \tan 52^\circ = 1.28$ [2]

7 Choose a piece of plastic and view each of the sources through the plastic as you rotate the plastic. If there is no change in intensity, then the piece of plastic chosen is not a polariser; if the chosen piece of plastic does show a variation in intensity as it is rotated then you are holding a polariser and the source for which there is a variation is the source of polarised light. [2]