PHAS1224 Waves, Optics and Acoustics

Problem Class IV

1. Light with wavelength 600nm passes through two very narrow slits and the interference pattern is observed on a screen 3m away. The second order $m = 2$ bright fringe is at 4.8mm from the centre of the central bright fringe. For what wavelength of light would the third order $m = 3$ bright fringe be seen at the same place?

2. A diffraction grating generates an intensity pattern

$$I = I_0 \frac{\sin^2((\pi/\lambda)Nd\sin\theta)}{\sin^2((\pi/\lambda)d\sin\theta)}, \tag{1}$$

where N is the number of slits and d their separation. Explain the position and intensity of the primary maxima. A grating has 50,000 slits over a total width of 75mm. How many primary maxima of yellow light with $\lambda = 700$nm and blue light with $\lambda = 400$nm can be observed respectively?

3. Determine the maximum distance at which a human eye, with a lens diameter of 4mm, is capable of resolving the headlights of a car if the headlights are 1.2m apart when the wavelength of the light is taken to be 500nm.

4. We will soon see in lectures that for a spherical concave mirror the distance from the mirror of an object p, the image formed q, and the focal length of the mirror are related by

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}. \tag{2}$$

An object placed 300cm from such a mirror generates an image at 150cm. To where must we move the object to obtain the object and image at the same distance?