

HOMEWORK FOR THURSDAY, JULY 28, 2005

1. A diffraction grating has lines spaced $2.00 \mu\text{m}$ apart. Let's consider white visible light (wavelengths ranging from $0.400 \mu\text{m}$ for violet light to $0.700 \mu\text{m}$ for red light) shining on it.

(a) Determine all the angles for which interference maxima occur for violet light.

(b) Determine all the angles for which interference maxima occur for red light.

(c) Over what range of angles are the first, second, etc. orders of the spectrum found?

(d) Which orders are complete (i.e., have angles less than 90° for all wavelengths)?

(e) Which orders are completely separate, and do not overlap with any other orders?

2. A diffraction pattern for monochromatic light of wavelength $\lambda = 500 \text{ nm}$ is observed from a single slit of width $a = 0.08 \text{ mm}$. How would the pattern be affected by the following action; for example, does it widen out or narrow down or remain the same?

Doubling the slit width:

Halving the slit width: .

Changing the light to blue light: .

Changing the light to red light: .

3. It is generally considered undesirable to “close down” a camera lens to a very small aperture, because the quality of the picture is adversely affected. Explain which phenomenon we have discussed causes this.

4. What is the angle corresponding to the first diffraction minimum for sounds of human speech (say 1000 Hz) passing through a doorway 1.0 m wide?

Express in words the meaning of your result.