Problem 1

Parallel rays of green mercury light with a wavelength of 546 nm pass through a slit covering a lens with a focal length of 60.0 cm. In the focal plane of the lens the distance from the central maximum to the first minimum is 10.2 mm. What is the width of the slit?

Problem 2

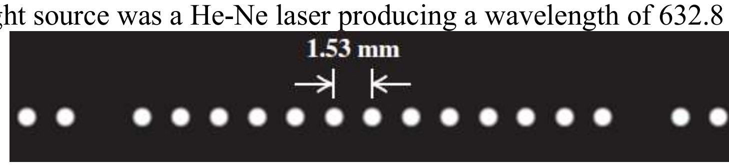
Red light of wavelength 633 nm from a helium–neon laser passes through a slit 0.350 mm wide. The diffraction pattern is observed on a screen 3.00 m away. Define the width of a bright fringe as the distance between the minima on either side.
(a) What is the width of the central bright fringe?
(b) What is the width of the first bright fringe on either side of the central one?

Problem 3

Monochromatic light of wavelength λ = 620 nm from a distant source passes through a slit 0.450 mm wide. The diffraction pattern is observed on a screen 3.00 m from the slit. In terms of the intensity at the peak of the central maximum, what is the intensity I_0 of the light at the screen for the following distances from the center of the central maximum
(a) 1.00 mm
(b) 3.00 mm

Problem 4

A diffraction experiment involving two thin parallel slits yields the pattern of closely spaced bright and dark fringes shown in the figure. Only the central portion of the pattern is shown in the figure. The bright spots are equally spaced at 1.53 mm center to center (except for the missing spots) on a screen 2.50 m from the slits. The light source was a He-Ne laser producing a wavelength of 632.8 nm.



(a) How far apart are the two slits?
(b) What is the width of the slits?

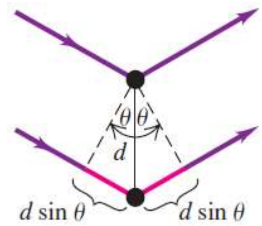
Problem 5

If a diffraction grating produces a third-order bright spot for red light (of wavelength 700 nm) at 65° from the central maximum, at what angle will the second-order bright spot be for violet light (of wavelength 400 nm)?

Problem 6

When laser light of wavelength 632.8 nm passes through a diffraction grating, the first bright spots occur at ±17.8° from the central maximum.
(a) What is the line density (in lines cm) of this grating?
(b) How many additional bright spots are there beyond the first bright spots?

Problem 7



X rays of wavelength 0.0850 nm are scattered from the atoms of a crystal. The second-order maximum in the Bragg reflection occurs when the angle θ in the figure is 21.5°. What is the spacing between adjacent atomic planes in the crystal?

Problem 8

If you can read the bottom row of your doctor's eye chart, your eye has a resolving power of 1 arcminute (1 arcmin = 1/60 degree). If this resolving power is diffraction limited, to what effective diameter of your eye's optical system does this correspond? (Use Rayleigh's criterion and assume λ = 550 nm.)

Problem 9

Although we have discussed single-slit diffraction only for a slit, a similar result holds when light bends around a straight, thin object, such as a strand of hair. In that case, *a* is the width of the strand. From actual laboratory measurements on a human hair, it was found that when a beam of light of wavelength 632.8 nm was shone on a single strand of hair, and the diffracted light was viewed on a screen 1.25 m away, the first dark fringes on either side of the central bright spot were 5.22 cm apart. How thick was this strand of hair?

Problem 10

What is the longest wavelength that can be observed in the third order for a transmission grating having 9200 slits/cm? Assume normal incidence.

Problem 11

Impressionist painter Georges Seurat created paintings with an enormous number of dots of pure pigment, each of which was approximately 2.00 mm in diameter. The idea was to have colors such as red and green next to each other to form a scintillating canvas, such as in his masterpiece, *A Sunday Afternoon on the Island of La Grande Jatte*. Assume λ = 500 nm and a pupil diameter of 5.00 mm. Beyond what distance would a viewer be unable to discern individual dots on the canvas?