

1. A beam of white light is incident at 50.00° to the normal to a single pane window. The pane is made of glass with an index of refraction that ranges from 1.524 at the blue end of the visible spectrum to 1.509 at the red end. What is the angular spread in the colors in the beam when

(a) it enters the pane?

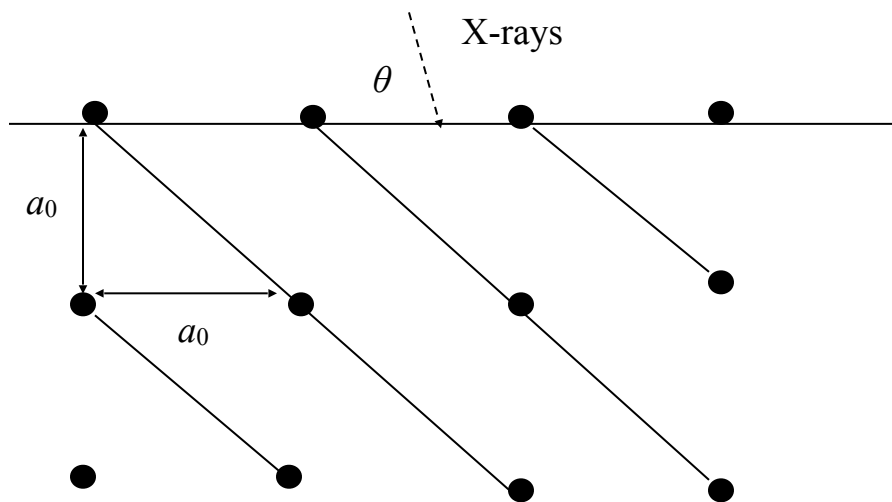
(b) when it emerges from the opposite side?

2. Millimeter-wave radar generates a narrower beam than conventional radar, making it less vulnerable to anti-radar missiles.

(a) Calculate the full angular width of the central maximum, from first minimum to first minimum, produced by a 220 GHz (chosen to take advantage of a low-absorption atmospheric window) radar beam emitted by a 55.0 cm diameter circular antenna.

(b) What is this angle for a more conventional circular aperture that has a diameter of 2.3 m and emits at a wavelength of 1.6 cm?

3. In the figure, the first-order reflection from the planes shown angled at 45° occurs when an X-ray beam of wavelength 0.260 nm makes an angle of $\theta = 63.8^\circ$ with the top face of a crystal. What is the unit cell size a_0 ?



4. Assume that the limits of the visible spectrum are arbitrarily chosen as 400 nm and 700 nm. Calculate the number of rulings per millimeter of a diffraction grating that will spread the first-order spectrum through an angle of 20.0° . [*Hint: The difference in angles cannot be considered small. Use a compound angle formula from trigonometry*]

5. The reflection of a perpendicularly incident light ray by a soap film in air has an interference maximum at wavelength 600 nm and a minimum at 450 nm, with no minimum in between. If the refractive index is 1.33 for the soap film, what is the film thickness?

6. The Sun and you are approximately ideal black-body radiators with surface temperatures 5800 K and 98.6°F respectively. Assuming this, in each case,

- (a) find the wavelength at which thermal radiation is maximum
- (b) identify the type of electromagnetic wave corresponding to that wavelength
- (c) estimate the total power emitted by thermal radiation.

7. The electric component of a beam of polarized light, assuming SI units, is

$$E_y = 5.00 \sin [10^6 z + \omega t]$$

- (a) Find value for ω and write an expression for the magnetic field component of the wave.
- (b) What are the period and intensity of this light?
- (c) In which region of the electromagnetic spectrum is this wave?