## SAMPLE PROBLEM B

### Diffraction Gratings

**PROBLEM**

**Monochromatic light from a helium-neon laser ($\lambda = 632.8$ nm) shines at a right angle to the surface of a diffraction grating that contains 150 500 lines/m. Find the angles at which one would observe the first-order and second-order maxima.**

**SOLUTION**

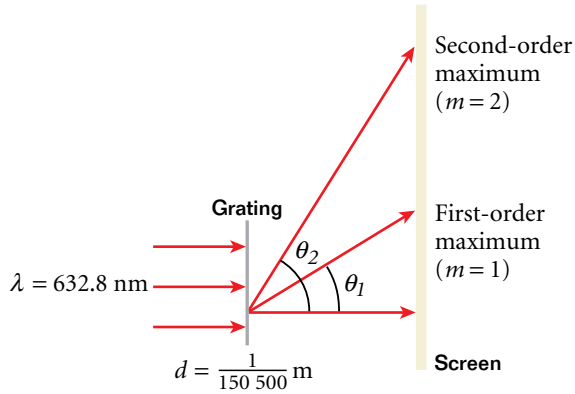
**1.** DEFINE

**Given:** $\lambda = 632.8 \text{ nm} = 6.328 \times 10^{-7} \text{ m}$ $\quad m = 1 \text{ and } 2$

$$d = \frac{1}{150\,500 \dfrac{\text{lines}}{\text{m}}} = \frac{1}{150\,500} \text{ m}$$

**Unknown:** $\theta_1 = ?$ $\quad \theta_2 = ?$

**Diagram:**




**2.** PLAN

**Choose an equation or situation:** Use the equation for a diffraction grating.

$$d \sin \theta = \pm m\lambda$$

**Rearrange the equation to isolate the unknown:**

$$\theta = \sin^{-1}\left(\frac{m\lambda}{d}\right)$$

**3.** CALCULATE

**Substitute the values into the equation and solve:**

For the first-order maximum, $m = 1$:

$$\theta_1 = \sin^{-1}\left(\frac{\lambda}{d}\right) = \sin^{-1}\left(\frac{6.328 \times 10^{-7} \text{ m}}{\dfrac{1}{150\,500} \text{ m}}\right)$$

$$\boxed{\theta_1 = 5.465°}$$

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