

## CH 25-1 – Interference of Light

### Important Ideas

- For sources that are in phase:

$$\text{Constructive Interference:} \quad \text{path-length difference} = |L_1 - L_2| = \Delta L = m\lambda$$

$$\text{Destructive Interference:} \quad \text{path-length difference} = |L_1 - L_2| = \Delta L = \left(m + \frac{1}{2}\right)\lambda$$

- For locations far from the sources, in comparison to the distance  $d$  between the sources,  $\Delta L = d \sin(\theta)$  where  $\theta$  the angle, with respect to a perpendicular bisector, from the source(s) to the location.

$$\text{Constructive Interference:} \quad d \sin(\theta) = m\lambda$$

$$\text{Destructive Interference:} \quad d \sin(\theta) = \left(m + \frac{1}{2}\right)\lambda$$

For a screen at a distance  $L$  from the slits,  $\tan(\theta) = \frac{y}{L}$  where  $y$  is the distance from the central maximum to the  $m$ 'th maximum. For a large distance  $L$  compared to  $d$  (which is often the case), then  $\tan(\theta) \approx \sin(\theta)$  and

$$\text{Constructive Interference:} \quad y_m = \frac{m\lambda L}{d} \quad \text{for } L \gg d \text{ which results in small angles}$$

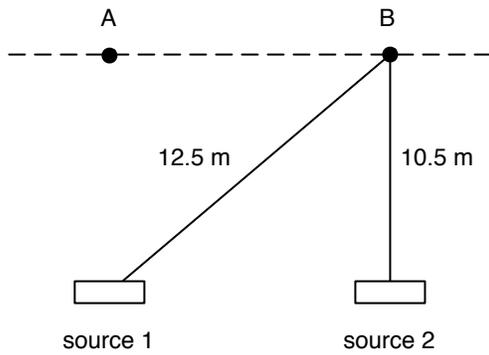
- A diffraction grating is a device with many slits,  $N$ . Greater  $N$  results in brighter maxima and narrower bright lines in the interference pattern. The interference maxima still occur at:

$$\text{Constructive Interference:} \quad d \sin(\theta) = m\lambda$$

1. If the distance  $d$  between two slits is increased, what will happen to the distance between the central maximum and first bright fringe?
  - (a) it will increase (more spread out)
  - (b) it will decrease (less spread out)
  - (c) it will remain the same
2. Which color has a fringe further from the central maximum, red or blue?
  - (a) red
  - (b) blue
  - (c) neither, because their fringes will be at the same location relative to the central maximum



6. Two identical point sources of radio waves are at locations 1 and 2. Each source emits radio waves of wavelength 0.5 m. The location  $B$  is 12.5 m from source 1 and 10.5 m from source 2. What type of interference will occur at location  $B$ ?



7. For the previous question, how many locations *between* points A and B will have total constructive interference?