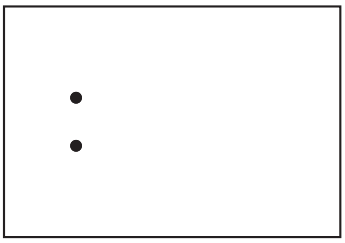
5/14–Wave Optics and Interference

1. In the middle of the white board, make two dots 40cm apart, nearer one end of your board space than the other.



Label one A and the other B. We are going to think of these two dots as point sources of waves with wavelength $\lambda = 20.0cm$. At each point on the paper these two sources are at distances ℓ_A and ℓ_B, and the path difference is $\Delta\ell = \ell_A - \ell_B$.

Use a string and a black pen (color is important) as a compass and draw circles of radius 20cm, 40cm, 60cm, 80cm, 100cm 120cm concentric on both circles. What is true about every point where the circles intersect?

(a) Find and mark in blue ink all points on the board for which the path difference is $\Delta\ell = 0\frac{\lambda}{2}$.

(b) Find and mark in red all points for which $\Delta\ell = +1\frac{\lambda}{2} = (10.0cm)$.

(c) Mark in red points for which $\Delta\ell = -1\frac{\lambda}{2}$.

(d) Mark in blue points for which $\Delta\ell = \pm 2\frac{\lambda}{2}$.

(e) Mark in red points for which $\Delta\ell = \pm 3\frac{\lambda}{2}$.

(f) . . .

This exercise is meant to illustrate the double slit experimental results. Explain how it does this.

2. He-Ne laser light ($\lambda = 700$nm) is incident on a double slit with spacing 1.5 mm between the slits. The diffraction pattern appears on a screen 3m away from the slits.

   (a) Find the spacing between the bright spots (or dark spots)

   (b) Find the location of the first bright spot relative to the central maximum.

   (c) Find the location of the next bright spot.

   (d) Find the location of the first dark spot, relative to the central maximum.

   (e) Find the location of the next dark spot.

3. Repeat the last problem for green laser light of $\lambda = 550$nm. How is it different?

4. He-Ne laser light ($\lambda = 700$nm) is incident on a single slit of width 100μm. The diffraction pattern appears on a screen 3m away from the slits.

   (a) Find the location of the first dark spot, relative to the central maximum.

   (b) Find the location of the next dark spot.