Unit 16: Interference of light, both constructive, & destructive via single, and double slits.

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Name: _____

Per _____ Date _____

Problems: Solve on separate paper, not in the space below.

What to do: These questions will give you practice in handling data about the two-slit experiment.

1. In a two-slit apparatus the slits are 0.3 mm apart. Fringes in sodium are observed at a distance of 1.2 m from the slits. The separation of the fringes is 2.4 mm.

   a. What is the wavelength of sodium light? (6×10^{-7} m)

   b. The same light gives a fringe separation of 3.6 mm with a different pair of slits. What is the slit separation if the distance between the slits and the fringes is the same? (0.2 mm)

2. Red light of wavelength 7.0×10^{-7} m is shone at right angles through two slits of separation 0.3 mm. Fringes are formed at a distance of 1.3 m from the slits.

   a. What is the fringe spacing? (3×10^{-3} m)

   b. The same light gives a fringe spacing of 2 mm when passed through a different pair of slits. What is the slit separation if the distance between the slits and the fringes is the same? (0.45 mm)

3. In a two-slit apparatus the slits are 0.3 mm apart. White light passes through the slits and fringes are observed at a distance of 2 m from the slits. Red light has a wavelength of 700 nm and blue light has a wavelength of 400 nm.

   a. Calculate the fringe spacing for each colour. (4.7 mm Red : 2.7 mm Blue)

   b. Use your answers to explain the coloured fringes seen on the screen.

4. Light of wavelength 450 nm falls on to two slits separated by 1.0 mm. 10 m away is a screen. What is the fringe spacing on the screen? (4.5×10^{-3} m)

5. Two loudspeakers are placed 4 m apart for an open-air concert. They are playing back a flute sounding a note of 680 Hz. Members of the audience sit in a row, 20 m from the loudspeakers, parallel to the line between the loudspeakers.
Take the speed of sound as 340 m s^{-1}.

Describe, as precisely as possible, what different people in the row will hear.

6. Light from a colour filter is used to produce Young's double-slit fringes. The slit spacing is 0.4 mm. The distance between the slits and the screen on which the fringes are formed is 1.4 m and the distance between successive dark spaces (or bright fringes) is 1.7 mm.
Find the average wavelength of the light used. (486 nm)
Why must the answer be only an average?

7. In a double slit interference experiment, the distance between the slits is 0.0005m and the screen is 2 meters from the slits. Yellow light from a sodium lamp is used and it has a wavelength of 5.89 x 10^{-7} m. Show that the distance between the first and second fringes on the screen is 0.00233 m. (Fringe is another word for bright spot).

8. With two slits spaced 0.2mm apart, and a screen at a distance of *l*=1m, the third bright fringe is found to be displaced h=7.5mm from the central fringe. Show that the wavelength, λ, of the light used is $5\times10^{-7}\,m$.

9. Two radio towers are broadcasting on the same frequency. The signal is strong at A, and B is the first signal minimum. If *d* = 6.8 km, *L* = 11.2 km, and *y* = 1.73 km, what is the wavelength of the radio waves to the nearest meter? (1.04 km)