Chapter 15

Terms

Be able to define or discuss the following terms and ideas, with their SI units if appropriate.

1. point source
2. wavelength
3. frequency
4. wavespeed
5. interference
6. total constructive interference
7. central maximum
8. total destructive interference
9. path difference
10. in phase
11. out of phase
12. plane wave
13. Young's double slit experiment
14. diffraction
15. diffraction grating
16. electromagnetic spectrum
17. white light
18. visible light
19. color
20. speed of light

Equations

Understand the meaning and know the SI units of all symbols in these equations; know how to perform each mathematical operation, such as trig functions; know how to solve for any unknown quantity; understand how changing one quantity affects another quantity (if all other quantities remain constant); be able to apply one or more equations to solve a problem.

- path difference for total constructive interference:

$$p.d. = n\lambda \qquad n = 0, 1, 2, ... \tag{1}$$

- path difference for total destructive interference:

$$p.d. = \frac{(2n-1)\lambda}{2} = (n - \frac{1}{2})\lambda \qquad n = 1, 2, 3... \tag{2}$$

- angle for lines of total constructive interference (two sources):

$$\sin(\theta) = \frac{n\lambda}{d} \tag{3}$$

- angle for lines of total destructive interference (two sources):

$$\sin(\theta) = \frac{(n - \frac{1}{2})\lambda}{d} \tag{4}$$

- location of bright fringes on a screen a distance L from two slits separated a distance d in Young's double slit experiment, if $L >> y$ (i.e. L is much greater than y, perhaps 100 times greater for example).

$$\sin(\theta) = \frac{n\lambda}{d} \approx \frac{y}{L} \tag{5}$$

Skills

1. From an interference pattern, identify the value of n for a given line of total constructive or a line of total destructive interference.
2. From an interference pattern, identify the path difference for a given line of total constructive or a line of total destructive interference.
3. From a picture of two 1-D waves, identify whether the will interfere to give total constructive interference, total destructive interference, or something in between.
4. Know how wavelength and slit spacing affect the "spread" in the interference pattern. (Greater spread refers to a greater angle from the central maximum to the first bright fringe, the second bright fringe, etc.)
5. Sketch and explain Young's double slit experiment and why it "showed" that light was a wave (even if scientists did not understand the nature of light or what exactly was oscillating for a light wave.)
6. Calculate the angles for bright fringes and dark fringes of light of a given wavelength incident on two slits, diffracting, and illuminating a screen, as in Young's double slit experiment.
7. List the regions of visible light from lowest wavelength to highest wavelength.
8. List the general regions of the electromagnetic spectrum from lowest wavelength to highest wavelength.
9. Know how slit spacing and wavelength affect diffraction of light incident on a diffraction grating.
10. Calculate the slit spacing d for a diffraction grating if given the number of slits and width of the grating.
11. Calculate the wavelength of light, if given the location of a certain bright fringe on a screen and the distance of the screen in Young's double slit experiment.

Lab Skills

1. Use Young's double slit experiment to measure the wavelength of light incident on the slits.