Chapter 28 Solutions - 3, 5, 7, 9, 11, 12, 14, 17, 20, 21, 26, 28

3. This problem refers to Sec 28.1, interference between waves. The waves of the two identical speakers, on at $x_1 = 0$ and the other at $x_2 > 0$, can add constructively (waves are in phase with each other) or destructively (waves are out of phase with each other). The person at x_p = 20m $>> x_2$ hears loudest sounds when $x_2 - x_1 = \lambda, 2\lambda, 3\lambda$ …… Thus, with λ = 70 cm = 0.7 m and x_2 < 5m, the second speaker positions can be 0.0m, 0.7m; 1.4m; 2.1m; 2.8m, 3.5m, 4.2m; 4.9m .

5. Again, this problem refers to Sec 28.1, recognizing now that the distance between the two speakers $x_2 - x_1$ = 1.4 m should be such that an odd number of half-wave lengths should fit between the two speakers:

$$x_2 - x_1 = \frac{\lambda_1}{2}, \frac{3\lambda_2}{2}, \frac{5\lambda_3}{2}, \frac{7\lambda_4}{2}, etc..$$

   Thus, λ_1 = 2.8m; λ_2 = 0.93m; λ_3 = 0.56 m, λ_4 = 0.4m

7. This problem refers to Sec. 28.3, (see Fig 28.3 and 28.4). The slits are a distance d = 0.070mm = 7 x 10^{-5}m apart. The screen is at h = 2m.
   a. The zeroth order fringe is the center of the pattern of fringes: by definition it is at x =0, and it is directly below the middle of the two slits. Therefore, the distances from the zeroth order fringe to the slits are the same: the difference is 0.
   b. Difference for the first bright fringe x is such that

$$\frac{x}{h} = \frac{\Delta S}{d} = \frac{\lambda}{d} \rightarrow x_1 = \frac{\lambda h}{d} = 1.56\,cm$$

   c. $x_2 = 2x_1$ = 3.12 cm
   d. $x_3 = 3x_1$ = 4.68 cm

9. Again, as above, reference to Sec. 28.3. Slit separation d = 0.100 mm = 10^{-4}m. Slit-to-screen distance h=1.5m . Yellow light wavelength λ = 589 mm = 5.89 x 10^{-7}m.
   a. Distance x from zeroth order bright fringe to third **bright** fringe is such that path length difference ΔS = 3 λ, thus, with

$$\frac{\Delta S}{d} = \frac{x}{h} \rightarrow x = \frac{(3\lambda)(h)}{d} = 2.65\,cm$$

   b. To third **dark** fringe, ΔS = λ/2, thus

$$x = \frac{\Delta S}{d} h = 2.21\,cm$$