

## Chapter 33

### Interference and Diffraction

#### Conceptual Problems

1 • A phase difference due to path-length difference is observed for monochromatic visible light. Which phase difference requires the least (minimum) path length difference? (a)  $90^\circ$  (b)  $180^\circ$  (c)  $270^\circ$  (d) the answer depends on the wavelength of the light.

**Determine the Concept** The phase difference  $\delta$  due to a path difference  $\Delta r$  are related according to  $\delta/2\pi = \Delta r/\lambda$ . Therefore, the least path length difference corresponds to the smallest phase difference. (a) is correct.

2 • Which of the following pairs of light sources are coherent: (a) two candles, (b) one point source and its image in a plane mirror, (c) two pinholes uniformly illuminated by the same point source, (d) two headlights of a car, (e) two images of a point source due to reflection from the front and back surfaces of a soap film.

**Determine the Concept** Coherent sources have a constant phase difference. The pairs of light sources that satisfy this criterion are (b), (c), and (e).

3 • [SSM] The spacing between Newton's rings decreases rapidly as the diameter of the rings increases. Explain qualitatively why this occurs.

**Determine the Concept** The thickness of the air space between the flat glass and the lens is approximately proportional to the square of  $d$ , the diameter of the ring. Consequently, the separation between adjacent rings is proportional to  $1/d$ .

4 • If the angle of a wedge-shaped air film, such as that in Example 32-2 is too large, fringes are not observed. Why?

**Determine the Concept** There are two possible reasons that fringes might not be observed. (1) The distance between adjacent fringes is so small that the fringes are not resolved by the eye. (2) Twice the thickness of the air space is greater than the coherence length of the light. If this is the case, fringes would be observed in the region close to the point where the thickness of the air space approaches zero.

5 • Why must a film that is used to observe interference colors be thin?

**Determine the Concept** Colors are observed when the light reflected off the front and back surfaces of the film interfere destructively for some wavelengths and

# Conceptual Physics 31 Diffraction And Interference Answers

**M Walker**



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