Extended Response

17.1 Understanding Diffraction and Interference 29.

Suppose you use a double slit to perform Young's double-slit experiment in air, and then repeat the experiment with the same double slit in water. Does the color of the light change? Do the angles to the same parts of the interference pattern get larger or smaller? Explain.

a. No, the color is determined by frequency. The magnitude of the angle decreases.
b. No, the color is determined by wavelength. The magnitude of the angle decreases.
c. Yes, the color is determined by frequency. The magnitude of the angle increases.
d. Yes, the color is determined by wavelength. The magnitude of the angle increases.

30.

A double slit is located at a distance x from a screen, with the distance along the screen from the center given by y . When the distance d between the slits is relatively large, there will be numerous bright bands.

For small angles (where sin $=$, with in radians), what is the distance between fringes?

a. $\Delta y = \frac{d}{x\lambda}$
b. $\Delta y = \frac{xd}{\lambda}$
c. $\Delta y = \frac{\lambda}{xd}$
d. $\Delta y = \frac{x\lambda}{d}$

17.2 Applications of Diffraction, Interference, and Coherence 31.

Compare the interference patterns of single-slit diffraction, double-slit diffraction, and a diffraction grating.

a. All three interference pattern produce identical bands.
b. A double slit produces the sharpest and most distinct bands.
c. A single slit produces the sharpest and most distinct bands.
d. The diffraction grating produces the sharpest and most distinct bands.

32.

An electric current through hydrogen gas produces several distinct wavelengths of visible light. The light is projected onto a diffraction grating having lines per centimeter. What are the wavelengths of the hydrogen spectrum if the light forms first-order maxima at angles of 24.2\^{}{\circ}, 25.7\^{}{\circ}, 29.1\^{}{\circ}, and 41.0\^{}{\circ}?

a. \lambda_1=\left(10^3\,\text{nm}\right)\sin 24.2^{\circ}=410\,\text{nm}
\lambda_2=\left(10^3\,\text{nm}\right)\sin 25.7^{\circ}=434\,\text{nm}
\lambda_3=\left(10^3\,\text{nm}\right)\sin 29.1^{\circ}=486\,\text{nm}
\lambda_4=\left(10^3\,\text{nm}\right)\sin 41.0^{\circ}=656\,\text{nm}

b. \lambda_1=\left(10^3\,\text{nm}\right)\sin 41.0^{\circ}=410\,\text{nm}
\lambda_2=\left(10^3\,\text{nm}\right)\sin 25.7^{\circ}=434\,\text{nm}
\lambda_3=\left(10^3\,\text{nm}\right)\sin 29.1^{\circ}=486\,\text{nm}
\lambda_4=\left(10^3\,\text{nm}\right)\sin 24.2^{\circ}=656\,\text{nm}

c. \lambda_1=\left(10^3\,\text{nm}\right)\sin 24.2^{\circ}=410\,\text{nm}
\lambda_2=\left(10^3\,\text{nm}\right)\sin 29.1^{\circ}=434\,\text{nm}
\lambda_3=\left(10^3\,\text{nm}\right)\sin 25.7^{\circ}=486\,\text{nm}
\lambda_4=\left(10^3\,\text{nm}\right)\sin 41.0^{\circ}=656\,\text{nm}

d. \lambda_1=\left(10^3\,\text{nm}\right)\sin 41.0^{\circ}=410\,\text{nm}
\lambda_2=\left(10^3\,\text{nm}\right)\sin 29.1^{\circ}=434\,\text{nm}
\lambda_3=\left(10^3\,\text{nm}\right)\sin 25.7^{\circ}=486\,\text{nm}
\lambda_4=\left(10^3\,\text{nm}\right)\sin 24.2^{\circ}=656\,\text{nm}