

HW #7

①

$$\textcircled{1} \quad v = \frac{c}{n} = \frac{3 \times 10^8}{1.4} \text{ (m/s)} = 2.14 \times 10^8 \text{ (4/3)}$$

$$t = \frac{L}{v} = \frac{10^4}{2.14 \times 10^8} = \underline{0.47 \times 10^{-4} \text{ s}}$$

$$\textcircled{2} \quad E(x, t) = 4.5 \cdot \sin(3.5x - 1.5t)$$

$$\text{(a)} \quad 1.5 = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{1.5} = \underline{4.19}$$

$$\text{(b)} \quad 3.5 = \frac{2\pi}{\lambda} \Rightarrow \lambda = \frac{2\pi}{3.5} = \underline{1.79}$$

$$\text{(c)} \quad v = \frac{\lambda}{T} = \frac{1.79}{4.19} = \underline{0.43}$$

$$\textcircled{3} \quad \left. \begin{array}{l} \lambda_1 = 500 \text{ nm} = 500 \times 10^{-9} \text{ m} \\ \Delta y_1 = 1.5 \text{ mm} = 1.5 \times 10^{-3} \text{ m} \end{array} \right\} \rightarrow \begin{array}{l} \lambda_2 = 700 \text{ nm} = 700 \times 10^{-9} \text{ m} \\ \Delta y_2 = ? \end{array}$$

$$\Delta y = \frac{\lambda L}{d} \Rightarrow \Delta y_1 = \frac{\lambda_1 L}{d}$$

$$\Delta y_2 = \frac{\lambda_2 L}{d}, \text{ then:}$$

$$\Delta y_2 = \frac{\lambda_2 \Delta y_1}{\lambda_1} = \frac{700}{500} \cdot 1.5 = \underline{2.1 \text{ mm}}$$

$$\textcircled{4} \quad d = 0.1 \text{ mm} = 0.1 \times 10^{-3} \text{ m}$$

$$y_m = \frac{\lambda L}{d} \left(m + \frac{1}{2}\right)$$

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$$y_3 = \frac{\lambda L}{d} \left(3 + \frac{1}{2}\right)$$

$$y_6 = \frac{\lambda L}{d} \left(6 + \frac{1}{2}\right)$$

$$\Delta y = y_6 - y_3 = \frac{\lambda L}{d} \cdot 3 = 1.2 \times 10^{-3} \text{ m}$$

$$L = 80 \times 10^{-3} \text{ m}$$

then:

$$\frac{\lambda \cdot 80 \times 10^{-3}}{0.1 \times 10^{-3}} = 1.2 \times 10^{-3} \Rightarrow \lambda = \frac{1.2 \times 10^{-3} \times 0.1 \times 10^{-3}}{80 \times 10^{-3}} =$$

$$= \underline{1.5 \times 10^{-6} \text{ m}} = \underline{1.5 \mu\text{m}}$$

