Solutions

Each answer shows the steps, then the **result**.

2.1

- the superposition of two **coherent** waves to give a **steady pattern** of constructive and destructive amplitude

2.2

- they have a **constant phase difference** (and the same frequency)

2.3

- constructive: $\Delta x = n\lambda$
- destructive: $\Delta x = (n + \frac{1}{2})\lambda$

2.4

- their phases change **randomly** (not coherent), so any pattern flickers and averages out

2.5

- 11 fringes = 10 gaps, so $x = 20\ \text{mm}/10 = \mathbf{2.0}\ \text{mm}$

3.1 B

- destructive interference when the path difference is $(n + \frac{1}{2})\lambda$

3.2

(a) 9 fringes = 8 gaps

- $x = 18\ \text{mm}/8 = \mathbf{2.25}\ \text{mm}$

(b) $\lambda = ax/D$

$$\lambda = \frac{(0.40 \times 10^{-3}\ \text{m})(2.25 \times 10^{-3}\ \text{m})}{1.5\ \text{m}} = \mathbf{6.0 \times 10^{-7}}\ \text{m}$$

(c) $f = c/\lambda$

$$f = \frac{3.0 \times 10^{8}\ \text{m s}^{-1}}{6.0 \times 10^{-7}\ \text{m}} = \mathbf{5.0 \times 10^{14}}\ \text{Hz}$$

3.3

- light from the two slits is **coherent** and overlaps on the screen
- path difference $= n\lambda \rightarrow$ **in phase** $\rightarrow$ **bright** fringe
- path difference $= (n + \frac{1}{2})\lambda \rightarrow$ **out of phase** $\rightarrow$ **dark** fringe

3.4

(a) fringe spacing **decreases** ($x = \lambda D/a$, so $x \propto 1/a$)

(b) fringe spacing **increases** ($x \propto D$)