Solutions

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

2.1

- that light behaves as a wave (it interferes)

2.2

- $d \sin\theta = m\lambda$

2.3

- bright-fringe condition $d \sin\theta = m\lambda$ with $m = 1$:

$$\sin\theta = \frac{m\lambda}{d} = \frac{1 \times 600 \times 10^{-9}\ \text{m}}{0.20 \times 10^{-3}\ \text{m}} = 3.0 \times 10^{-3}$$

- $\theta = \mathbf{0.17}^\circ$

3.1 A

- $m\lambda$.

3.2 B

- sharper and more widely spaced.

3.3

(a)

- 300 lines per millimetre is 300×10^3 lines per metre; the spacing is the reciprocal:

$$d = \frac{1}{N} = \frac{1}{300 \times 10^3\ \text{m}^{-1}}$$

- $d = \mathbf{3.33 \times 10^{-6}}$ m

(b)

- grating equation $d \sin\theta = m\lambda$ with $m = 1$:

$$\sin\theta = \frac{m\lambda}{d} = \frac{1 \times 500 \times 10^{-9}\ \text{m}}{3.33 \times 10^{-6}\ \text{m}} = 0.150$$

- $\theta = \mathbf{8.6}^\circ$

3.4

(a)

- $\Delta L = 2\lambda = \mathbf{1.2 \times 10^{-6}}$ m

(b)

- small angles: $y = \dfrac{\lambda L}{d} = \dfrac{(600 \times 10^{-9})(1.5)}{0.30 \times 10^{-3}}$
- $y = \mathbf{3.0 \times 10^{-3}}$ m (3.0 mm)

(c)

- $\Delta L = \frac{1}{2}\lambda = \mathbf{300}$ nm

(d)

- the central maximum is white, because every wavelength has zero path difference there
- each first-order maximum is a spectrum; red is deviated most, since $d \sin\theta = \lambda$ and red has the longest wavelength