Solutions

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

2.1

- the **slit spacing** — the centre-to-centre distance between adjacent slits

2.2

- $d = 1/N$ per millimetre

$$d = \frac{1.0 \times 10^{-3}\ \text{m}}{500} = \mathbf{2.0 \times 10^{-6}}\ \text{m}$$

2.3

- many slits contribute, so the maxima are **sharper / brighter** and other directions are more completely cancelled

2.4

- $n_{\max} = \lfloor d/\lambda \rfloor$ — the largest integer with $\sin\theta \le 1$

3.1

- $d = 2.0 \times 10^{-6}$ m

$$\sin\theta = \frac{(1)(600 \times 10^{-9}\ \text{m})}{2.0 \times 10^{-6}\ \text{m}} = 0.30$$

- $\theta = \mathbf{17}^\circ$

3.2

$$\frac{d}{\lambda} = \frac{2.0 \times 10^{-6}\ \text{m}}{600 \times 10^{-9}\ \text{m}} = 3.33$$

- highest order $n = \mathbf{3}$ ($n = 4$ needs $\sin\theta > 1$)

3.3

$$d = \frac{1.0 \times 10^{-3}\ \text{m}}{600} = 1.67 \times 10^{-6}\ \text{m}$$

- largest angle is 90°, where $\sin\theta = 1$

$$n_{\max} = \frac{d}{\lambda} = \frac{1.67 \times 10^{-6}\ \text{m}}{590 \times 10^{-9}\ \text{m}} = 2.8$$

- an order must be a whole number and $\sin\theta$ cannot exceed 1, so the highest observed is the **2nd order**

3.4

- shine **parallel monochromatic** light normally on the grating
- measure the **angle** θ of a known order n from the straight-through beam

- calculate $\lambda = d\sin\theta/n$

3.5 B

- more lines per mm ⇒ smaller d ⇒ larger $\sin\theta$ for each order ⇒ **larger** angle