Solutions

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

2.1

- any two: they are **transverse**; they travel at the **same speed** c in a vacuum; they can travel through a vacuum

2.2

- $c = \mathbf{3.0 \times 10^{8}}$ m s$^{\mathbf{-1}}$

2.3

- **400** nm to **700** nm

2.4

- radio waves < visible light < X-rays

3.1 D

- γ-rays have the highest frequency (shortest wavelength) on the EM spectrum

3.2

- $\lambda = c/f$

$$\lambda = \frac{3.0 \times 10^{8} \text{ m s}^{-1}}{100 \times 10^{6} \text{ Hz}} = \mathbf{3.0} \text{ m}$$

3.3

- the pulse covers the width **twice** (there and back)

$$d_{\text{total}} = ct = (3.0 \times 10^{8} \text{ m s}^{-1})(8.4 \times 10^{-6} \text{ s}) = 2520 \text{ m}$$

$$\text{width} = \tfrac{1}{2} \times 2520 \text{ m} = \mathbf{1.3 \times 10^{3}} \text{ m}$$

- assumption: light travels in a straight line at c through air (air treated as a vacuum)

3.4

- **ultraviolet** has the higher frequency
- on the spectrum UV is **closer to the high-frequency end** (shorter λ) than infrared