Solutions

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

2.1

- restricting the oscillations of a transverse wave to **one plane**

2.2

- sound is **longitudinal** — oscillation is along the direction of travel, so there is no other plane to restrict it to

2.3

- Malus: $I = I_0 \cos^2 \theta$
- $\cos^2 60° = 0.25$, so the intensity is **one quarter**

2.4

- $\cos^2 \theta = 0.5 \Rightarrow \cos \theta = \sqrt{0.5} \Rightarrow \theta = \mathbf{45}°$

2.5

- intensity $\propto A^2$, so $A = A_0\sqrt{0.25} = 0.50\, A_0$ — **half** the amplitude

3.1 B

- all **electromagnetic** waves are transverse, so they can be polarised

3.2

- Malus's law

$$I = I_0 \cos^2 \theta = (12 \text{ W m}^{-2}) \cos^2 30° = 12 \times 0.75 = \mathbf{9.0 \text{ W m}^{-2}}$$

3.3

- first filter
$$I_1 = (8.0 \text{ W m}^{-2}) \cos^2 30° = 8.0 \times 0.75 = 6.0 \text{ W m}^{-2}$$
- second filter, a further 30°

$$I_2 = I_1 \cos^2 30° = 6.0 \times 0.75 = \mathbf{4.5 \text{ W m}^{-2}}$$

3.4

(a) a $\cos^2$ curve: **starts at the maximum** I_0 (axes parallel)

- zero at $\phi = 90°$ and $270°$; back to I_0 at $180°$ and $360°$

(b) $I = I_0 \cos^2 \phi = 0.5\, I_0 \Rightarrow \cos^2 \phi = 0.5$

- $\cos \phi = 0.707 \Rightarrow \phi = \mathbf{45}°$

(c) intensity $\propto A^2$, so $A = A_0\sqrt{0.5} = \mathbf{0.71\, A_0}$

- glare from glass is polarised in one plane, so turning towards 90° to that plane cuts the reflected light, while unpolarised light from inside is only halved

3.5

- polarisation restricts the oscillation to **one plane**
- that is only possible if the oscillation is **perpendicular** to the travel direction — i.e. the wave is **transverse**