7. Waves

7.5 Polarisation

Paper 2

Question Paper

1 **(c)** Two polarising filters are arranged so that their planes are vertical and parallel. The first filter has its transmission axis at an angle of 35° to the vertical and the second filter has its transmission axis at angle α to the vertical, as shown in Fig. 5.2.

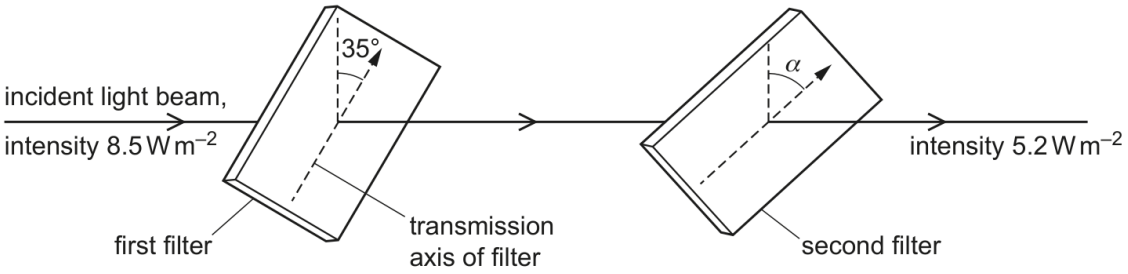


Fig. 5.2

Angle α is greater than 35° and less than 90°. A beam of vertically polarised light of intensity 8.5 W m^{-2} is incident normally on the first filter.

(i) Show that the intensity of the light transmitted by the first filter is 5.7 W m^{-2}.

[1]

(ii) The intensity of the light transmitted by the second filter is 5.2 W m^{-2}.

Calculate angle α.

α = ...° [2]

2 **(a)** A beam of vertically polarised light is incident normally on a polarising filter, as shown in Fig. 5.1.

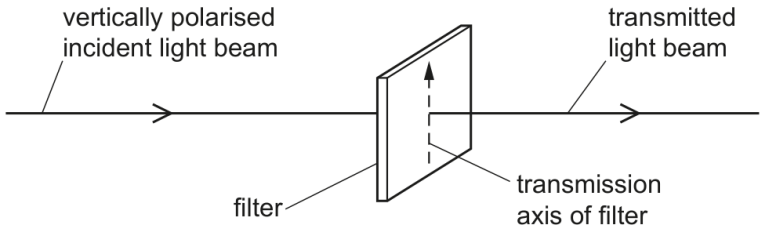


Fig. 5.1

(i) The transmission axis of the filter is initially vertical. The filter is then rotated through an angle of 360° while the plane of the filter remains perpendicular to the beam.

On Fig. 5.2, sketch a graph to show the variation of the intensity of the light in the transmitted beam with the angle through which the transmission axis is rotated.

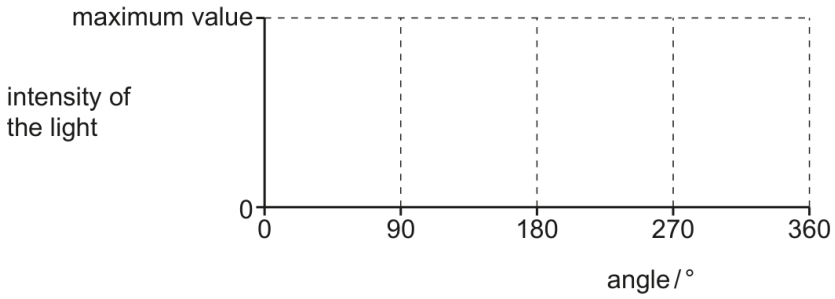


Fig. 5.2

[2]

(ii) The intensity of the light in the incident beam is $7.6\,W\,m^{-2}$. When the transmission axis of the filter is at angle θ to the vertical, the light intensity of the transmitted beam is $4.2\,W\,m^{-2}$.

Calculate angle θ.

θ = ...° [2]

3 **(a)** Polarisation is a phenomenon associated with light waves but not with sound waves.

(i) State the meaning of polarisation.

.....

.....

..... [1]

(ii) State why light waves can be plane polarised but sound waves cannot.

.....

.....

..... [1]

(b) Two polarising filters A and B are positioned so that their planes are parallel to each other and perpendicular to a central axis line XY, as shown in Fig. 4.1.

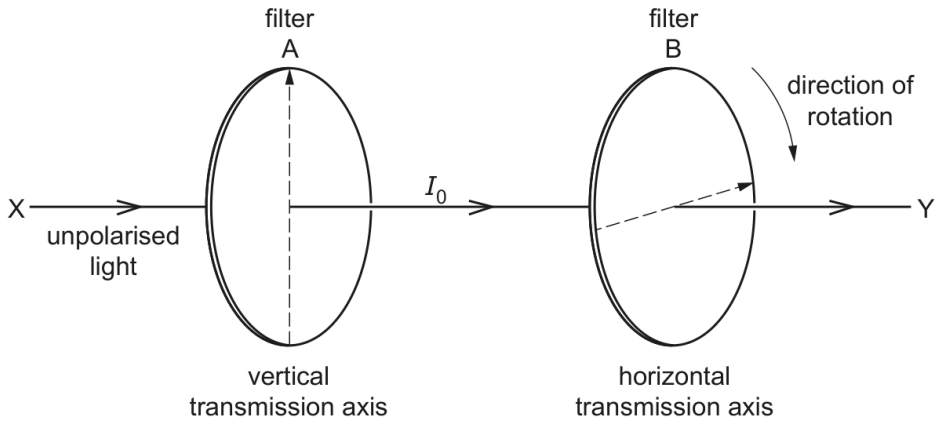


Fig. 4.1

The transmission axis of filter A is vertical and the transmission axis of filter B is horizontal.

Unpolarised light of a single frequency is directed along the line XY from a source positioned at X. The light emerging from filter A is vertically plane polarised and has intensity I_0.

Filter B is rotated from its starting position about the line XY, as shown in Fig. 4.1.

After rotation, the intensity of the light emerging from filter B is $\frac{1}{4} I_0$.

Calculate the angle of rotation of filter B from its starting position.

angle of rotation = ... ° [3]

4 **(c)** A beam of vertically polarised light of intensity I_0 is incident normally on a polarising filter that has its transmission axis at 30° to the vertical, as shown in Fig. 5.2.

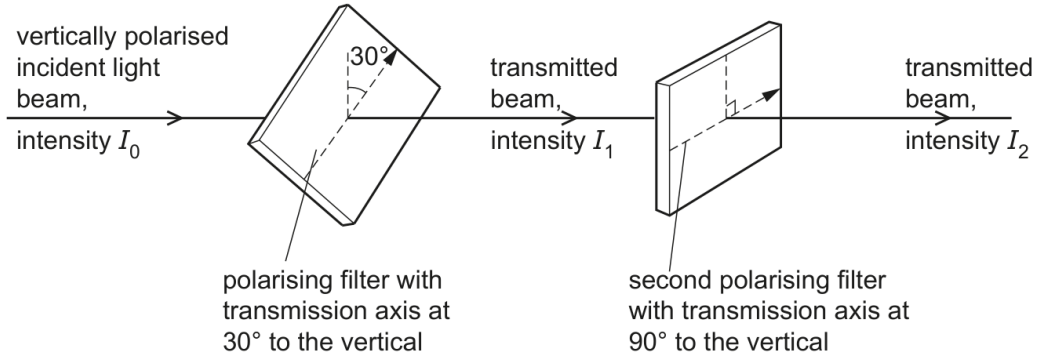


Fig. 5.2

The transmitted light from the first polarising filter has intensity I_1. This light is then incident normally on a second polarising filter that has its transmission axis at 90° to the vertical. The transmitted light from the second filter has intensity I_2.

Calculate:

(i) the ratio $\frac{I_1}{I_0}$

$\frac{I_1}{I_0}$ = ... [2]

(ii) the ratio $\frac{I_2}{I_0}$.

$\frac{I_2}{I_0}$ = ... [2]