[redacted]

HW 24-1

(1)

$$I_0 \rightarrow I_1 \rightarrow I_2 \rightarrow I_{final}$$

$$I_1 = \frac{1}{2} I_0 \qquad I_2 = I_1 . \cos^2(\theta_1 - \theta_2)$$

$$= \frac{1}{2} I_0 . \cos^2(90^\circ - \theta_2) \doteq \underline{\underline{101.75 \ W/m^2}}$$

(2)

$$I_{final} = I_2 . \cos^2(\theta_3 - \theta_2)$$

$$\doteq \underline{\underline{40.3 \ W/m^2}}$$

(3)

$$\tilde{I}_{final} = \tilde{I}_2 . \cos^2(\theta_2 - \theta_3) = \tilde{I}_1 . \cos^2(\theta_1 - \theta_3) . \cos^2(\theta_2 - \theta_3)$$

$$= \frac{1}{2} I_0 . [\cos(90^\circ - \theta_3) . \cos(\theta_2 - \theta_3)]^2$$

$$\doteq \underline{\underline{5.72 \ W/m^2}}$$

(4) $I_{final, RL} = I_{final, new}$

The total attenuation of an incident unpolarized beam does not depend on the order of the polarizers. It is true that attenuation after the middle polarizer does depend on whether the beam is going from left to right or from right to left, but once the beam has past the last polarizer there is no difference.

HW 24-1

(5)

$$I_0' \longrightarrow I_1' \longrightarrow I_2' \longrightarrow I_{final}'$$

$$I_{final}' = I_2' \cdot \cos^2\theta_3 = I_1' \cdot \cos^2(\theta_2-\theta_3) \cdot \cos^2\theta_3$$

$$= \frac{1}{2} I_0 \cdot \left[\cos(\theta_2-\theta_3) \cdot \cos\theta_3\right]^2$$

$$\doteq \underline{\underline{38.83 \ W/m^2}}$$

HW 24-2

(1)

Since the QWP turns linearly polarized light into circularly polarized with the same intensity. This intensity is cut in half by a polarizer, i.e.:

$$I_{mid} = \frac{1}{2} I_0 = \frac{793}{2} \cdot \frac{W}{m^2} = \underline{\underline{396.5\ W/m^2}}$$

(2)

$$I_{final} = I_{mid} \cdot \cos^2\theta_1 \doteq \underline{\underline{37.86\ W/m^2}}$$

(3)

$$I \propto E^2 \Rightarrow \frac{I_{final}}{I_0} = \frac{E^2_{final}}{E_0^2} \Rightarrow \frac{E_{final}}{E_0} = \sqrt{\frac{I_{final}}{I_0}}$$

$$E_{y,final} = E_{final} \cdot \sin\theta_1$$

$$\frac{E_{y,final}}{E_0} = \sqrt{\frac{I_{final}}{I_0}} \cdot \sin\theta_1 \doteq \underline{\underline{0.2078}}$$

(4)

$$I_{final,new} = I_0 \cdot \cos^2(90° - \theta_1) \cdot \cos^2\theta_1 \doteq \underline{\underline{68.49\ W/m^2}}$$

Once again, QWP doesn't change intensity.

HW 24-2

(5)

Left Circularly polarized:

Since the beam that is incident upon the QWP is polarized
at a 45° angle from the fast axis, the transmitted beam
will be circularly polarized. To determine the handedness of
the polarization, place the a vector along the fast axis
downstream of a vector along the slow axis and then curl
your fingers of your right hand from the slow component
to the fast component. If your thumb points in the direction
of the propagation of the beam, then the beam is right
circularly polarized. If it points opposite to the direction
of propagation, then the beam is left circularly polarized.

(6)

TWO:

The incident beam is linearly polarized in the y-direction.
If $\theta_1 = 0°$, then the incident beam will be totally absorbed.

If $\theta_1 = 90°$, the incident beam will be passed without attenuation. However, this beam will still be polarized along the y-direction and the following polarizer (along the x-direction) will indeed cancel the beam.