P1]

(a) $E_x = E_0\, e^{i(kz-\omega t)}$

$E_y = E_0\, e^{i(kz-\omega t+\pi/2)}$

$$\Rightarrow \vec{E} = E_0(\hat{x} + e^{i\pi/2}\hat{y})\, e^{i(kz-\omega t)}$$ 1,5 ptos

$$\Rightarrow \langle S\rangle_t = \frac{1}{2}\varepsilon_0 |\vec{E}|^2 c$$

$$= \frac{1}{2}\varepsilon_0 \vec{E}\cdot\vec{E}^* c$$

$$= \frac{1}{2}\varepsilon_0 (\hat{x} + e^{i\pi/2}\hat{y})(\hat{x} + e^{-i\pi/2}\hat{y})\, c$$

$$= \frac{1}{\cancel{2}}\varepsilon_0 \cancel{(1+1)} E_0^2 c$$

$$\therefore \boxed{\langle S\rangle_t = \varepsilon_0 E_0^2 c}$$ 1,5 ptos

(b) Sin pérdida de la generalidad, del 1° polarizador sólo emerge E_x

$$\Rightarrow I_1 = \frac{1}{2}\varepsilon_0 E_0^2 c$$ 1,5 ptos

Por ley de Malus, del 2° polarizador emerge:

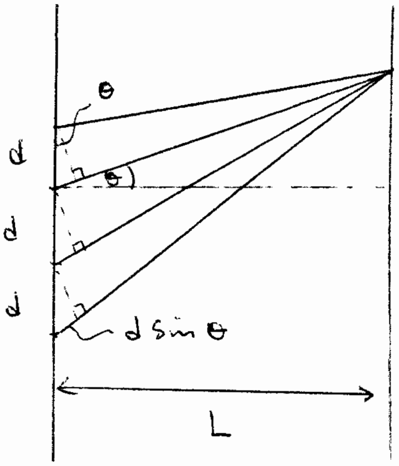
$$I_2 = I_1 \cos^2 30°$$

$$= \frac{1}{2}\varepsilon_0 E_0^2 c \left(\frac{\sqrt{3}}{2}\right)^2$$

$$= \frac{3}{8}\varepsilon_0 E_0^2 c$$

$$\therefore \boxed{\langle S\rangle_t = I_2 = \frac{3}{8}\varepsilon_0 E_0^2 c}$$ 1,5 ptos

P3



(i) $E_p = E_0\, e^{i(kr-\omega t)}\left(1+e^{ik\Delta}+e^{i2k\Delta}+e^{i3k\Delta}\right)$

$$E_p = E_0\cdot e^{i(kr-\omega t)}\cdot\frac{1-(e^{ik\Delta})^4}{1-e^{ik\Delta}}$$

$$E_p = E_0\cdot e^{i(kr-\omega t)}\cdot\frac{e^{-i2k\Delta}-e^{i2k\Delta}}{e^{-i\frac{k\Delta}{2}}-e^{i\frac{k\Delta}{2}}}\cdot\frac{e^{i2k\Delta}}{e^{i\frac{k\Delta}{2}}}$$

$$\boxed{E_p = E_0\cdot e^{i(kr-\omega t+\frac{3}{2}k\Delta)}\cdot\frac{\sin(2k\Delta)}{\sin\left(\frac{k\Delta}{2}\right)}}$$

1,5 ptos

(ii) $I_p = \langle S\rangle_t$

$$I_p = \frac{1}{2}\varepsilon_0|E_p|^2 c$$

$$\boxed{I_p = \frac{1}{2}\varepsilon_0 E_0^2 c\,\frac{\sin^2(2k\Delta)}{\sin^2\left(\frac{k\Delta}{2}\right)}}$$

1,5 ptos

(iii) Max de I_p en $\frac{k\Delta}{2} = m\pi$ $\quad m = 0, 1, 2, \ldots$

$$\Rightarrow d\sin\theta = m\lambda$$

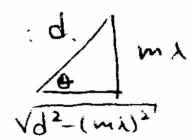
para λ: $d\sin\theta = m\lambda$

para $\lambda + d\lambda$: $d\sin(\theta+\Delta\theta) = m(\lambda + d\lambda)$

$$\Rightarrow d\sin\theta\underbrace{\cos\Delta\theta}_{\approx 1} + d\cos\theta\underbrace{\sin\Delta\theta}_{\approx\Delta\theta} = m\lambda + m\,d\lambda$$

$$\Rightarrow \cancel{d\sin\theta} + d\cdot\cos\theta\cdot\Delta\theta = \cancel{m\lambda} + m\,d\lambda$$

$$\Rightarrow \boxed{\Delta\theta = \frac{m\,d\lambda}{d\cos\theta} = \frac{m\,d\lambda}{\sqrt{d^2-(m\lambda)^2}}}$$



1,5 ptos

(iv) Criterio de Rayleigh: Máximo de un diagrama en el mínimo del otro

$$d\sin(\Delta\theta) = \frac{\lambda}{4}$$

$$\Delta\theta \approx \frac{\lambda}{4d}$$

$$\Rightarrow \boxed{\frac{m\,d\lambda}{\sqrt{d^2-(m\lambda)^2}} = \frac{\lambda}{4d}}$$

1,5 ptos