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CH 21-22 Exam

1) a) $X_C = \frac{1}{C\omega} = \frac{1}{2\pi f C} = \frac{1}{2\pi(60)(30\times10^{-6}\,F)} = 88.4\,\Omega$

b) $Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{(60)^2 + (0-88.4)^2} = 107\,\Omega$

c) $I_{max} = \frac{\Delta V_{max}}{Z} = \frac{1.2\times10^2}{107} = 1.12\,A$

d) $\tan\phi = \frac{(X_L - X_C)}{R} \Rightarrow \phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$

$= \tan^{-1}\left(\frac{0-88.4}{60}\right) = -55.8^\circ$

Voltage lags behind current.

2) $I = P/A \Rightarrow \frac{1}{P} = \frac{1}{IA} \Rightarrow P = IA$

$= 1360\left(4\pi(1.5\times10^{11})^2\right) = 3.85\times10^{26}\,W$

3) $n_1 \sin\theta_1 = n_2 \sin\theta_2 \Rightarrow$ ($n_1 = 1$, $\theta_2 = \theta_1/2$) $\sin\theta_1 = n_2 \sin(\theta_1/2)$

$\theta_1 = 2\theta_2$

$\Rightarrow \sin 2\theta_2 = n_2 \sin(\theta_1/2) \Rightarrow 2\sin(\theta_1/2)\cos(\theta_1/2) = 1.56\sin(\theta_1/2)$

$\Rightarrow \cos(\theta_1/2) = \frac{1.56}{2} \Rightarrow \theta_1 = 2\cos^{-1}\left(\frac{1.56}{2}\right)$

$= 77.5^\circ$

4) $P = I_{rms} V_{rms} = (50)(3600) = 180000 W$

$P = I_{rms} V_{rms} \Rightarrow I_{rms} = \frac{P}{V_{rms}} = \frac{180000 W}{100,000 V}$

$= 1.8 A$

$P = I_{rms}^2 R = (1.8)^2 (100) = 324 W$

$\frac{324 W}{180000 W} (100) = .18\%$

5) a) $n_1 \sin\theta_1 = n_2 \sin\theta_2 \Rightarrow \theta_1 = \sin^{-1}\left(\frac{n_2 \sin\theta_2}{n_1}\right)$

$= \sin^{-1}\left(\frac{1 \sin 30°}{1.5}\right) = 19°$ ← angle of refraction first surface

$\theta_1 = 90° - 19° = 71°$ $\alpha_1 = 180° - 60° - 71° = 49°$

$\theta_2 = 90° - 49° = 41°$ ← angle of incidence second surface

$\theta_2 = \sin^{-1}\left(\frac{n_1 \sin\theta_2}{n_2}\right) = \sin^{-1}\left(\frac{1.5 \sin 41°}{1}\right)$

$= 79°$ ← angle of refraction second surface

b) The angles of reflection are going to be the same

$\theta_1 = 30°$ $\theta_2 = 41°$

6) $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\Rightarrow 1 \sin(30°) = 1.52 \sin(\theta_2)$

$\Rightarrow \frac{.5}{1.52} = \sin\theta_2 \Rightarrow \theta_2 = \sin^{-1}(.33) = 19.2°$

b) $n_2 \sin\theta_2 = n_3 \sin\theta_3$

$\Rightarrow 1.52 \sin 19.2 = 1 \sin\theta_3$

$\Rightarrow \theta_3 = \sin^{-1}(.5) = 30°$