30-3 T/F

(a) FALSE

(b) TRUE

(c) TRUE

(d) TRUE

30-18 GIVEN: PPC $C = 5\,nF$

$V = (3V)\cos(500\pi t)$

SHOW: $I_d = C\frac{dV}{dt}$

FIND: I_d

$$I_d = \epsilon_0 \frac{d\Phi}{dt} = \epsilon_0 \frac{d(EA)}{dt} = \epsilon_0 \frac{d\left(\frac{V}{l}A\right)}{dt}$$

$$= \frac{\epsilon_0 A}{l}\frac{dV}{dt} = C\frac{dV}{dt}$$

$$I_d = (5\,nF)\frac{d}{dt}\left[(3V)\cos(500\pi t)\right]$$

$$= -(5\,nF)\left(500\pi \tfrac{s}{s}\right)(3V)\sin(500\pi t)$$

$$= \boxed{-(2.36\times10^{-5}\,A)\sin(500\pi t)}$$

30-46 GIVEN: $f = 100\,MHz$ E.M WAVE

$$B(z,t) = (1\times10^{-8}T)\hat{i}\cos(kz-\omega t)$$

FIND: (a) λ PROP. DIRECTION

(b) $\vec{E}(z,t)$

(c) $\vec{S}$, I

$$c = f\lambda \Rightarrow \lambda = \frac{c}{f} = \frac{3\times10^{8}\,m/s}{100\times10^{6}\,s^{-1}} = \boxed{3\,m}$$

WAVE IS PROP IN $+z$ DIRECTION

$$E(z,t) = c\,B(z,t) = (3\times10^{8}\,m/s)(1\times10^{-8}\,T)\cos(kz-\omega t)$$

$$\frac{m}{s}\,\frac{N}{A\,m}$$

$$\vec{E}(z,t) = -(3\,N/C)\hat{j}\cos(kz-\omega t)$$

$$\hat{k} \qquad -\hat{j} \qquad +\hat{i}$$

$$\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B} = \frac{1}{4\pi\times10^{-7}\,\frac{N}{A^2}}\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 0 & 3\,N/C & 0\\ 1\times10^{-8}\,T & 0 & 0\end{vmatrix}\cos^2(kz-\omega t)$$

$$= \frac{1}{4\pi\times10^{-7}\,\frac{N}{A^2}}\left(3\,\frac{N}{C}\right)\left(1\times10^{-8}\,T\right)\hat{k}\cos^2(kz-\omega t)$$

$$= \frac{3}{4\pi}\hat{k}\cos^2(kz-\omega t)\,\frac{A^2}{C}\,T \Rightarrow \frac{A^2}{s}\,\frac{N}{A\text{-}m}\,m$$

$$= \boxed{2.39\times10^{-2}\,\frac{W}{m^2}\,\hat{k}\cos^2(kz-\omega t)}$$

$$I = |\vec{S}| = 2.39\times10^{-2}\,\frac{W}{m^2}\left(\frac{1}{2}\right)$$

$$= \boxed{1.19\times10^{-2}\,\frac{W}{m^2}}$$

NOTE $k = \frac{2\pi}{\lambda} = \frac{2\pi}{3m}$

$\omega = 2\pi f = 200\pi\times10^{6}\,rad/s$