PH-214 Homework 2

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Problem 1

Radiation occurs.

Problem 2

$$P = \frac{q^2\,a^2}{6\pi\epsilon_0 c^3} \qquad a = \frac{1.6 * 10^6 \text{ m/s}}{2 \text{ s}} = 8 * 10^5 \text{ m/s}^2 \qquad q = 1.6 * 10^{-}19 \text{ C}$$

$$P = \frac{\left(1.6 * 10^{-19}\right)^2 * \left(8 * 10^5\right)^2}{6\pi * (8.85 * 10^{-12}) * (3 * 10^8)^3} = \boxed{3.63 * 10^{-42} \text{ W}}$$

Problem 3

$$\epsilon_0 = \frac{\text{C}^2}{\text{N} \cdot \text{m}^2} \qquad q = \text{C} \qquad a = \frac{\text{m}}{\text{s}^2} \qquad c = \frac{\text{m}}{\text{s}}$$

$$P = \frac{q^2\,a^2}{6\pi\epsilon_0 c^3} = \frac{\text{C}^2 * \frac{\text{m}^2}{\text{s}^4}}{\frac{\text{C}^2}{\text{N}\cdot\text{m}^2} * \frac{\text{m}^3}{\text{s}^3}} = \text{C}^2 * \frac{\text{m}^2}{\text{s}^4} * \frac{\text{N} \cdot \text{m}^2}{\text{C}^2} * \frac{\text{s}^3}{\text{m}^3} = \boxed{\frac{\text{N} \cdot \text{m}}{\text{s}} = \text{W}}$$

Problem 4

$$v = 7.5 * 10^{14} \text{ Hz} \qquad \theta = 30^\circ \qquad E_0 = 10^3 \text{ V/m}$$

$$\omega = v * 2\pi = 4.71 * 10^{15} \text{ rad/s} \qquad \omega = ck \qquad k = 1.57 * 10^7\,\hat{x}$$

$$\overrightarrow{E} = E_0 e^{i(k\cdot r - \omega t)}$$

$$\overrightarrow{E_0} = 10^3 * \langle 0,\, \sin 30^\circ,\, \cos 30^\circ \rangle = \langle 0,\, 866,\, 500 \rangle$$

$$\overrightarrow{E} = \boxed{(866\hat{y} + 500\hat{z})\, e^{i(1.57*10^7\,\hat{x}\cdot r - 4.71*10^{15} t)}}$$

$$\overrightarrow{B} = B_0 e^{i(k\cdot r - \omega t)}$$

$$\overrightarrow{B_0} = \frac{1}{c} * 10^3 * \langle 0,\, \sin 120^\circ,\, \cos 120^\circ \rangle = \left\langle 0, -1.66 * 10^{-6},\, 2.88 * 10^{-6} \right\rangle$$

$$\overrightarrow{B} = \boxed{(-1.66 * 10^{-6}\hat{y} + 2.88 * 10^{-6}\hat{z})\, e^{i(1.57*10^7\,\hat{x}\cdot r - 4.71*10^{15} t)}}$$