Homework-3

3.3-3) Radiation resistance of top-loaded monopole is

given by $R_{r1} = 40\pi^2 \left(\frac{h}{\lambda}\right)^2 (1+\cos\beta h)^2$

given $h = 0.2\lambda$ and $\beta = \frac{2\pi}{\lambda}$

So $R_{r1} = 40\pi^2 \left(\frac{h}{\lambda}\right)^2 \left(1+\cos \frac{2\pi}{\lambda} h\right)^2$

$= 40\pi^2 \left(\frac{0.2\lambda}{\lambda}\right)^2 \left(1+\cos \frac{2\pi}{\lambda} 0.2\lambda\right)^2$

$= 40\pi^2 (0.2)^2 (1+\cos 0.4\pi)^2$

$= 27.65\Omega$

$\boxed{R_{r1} = 27.65\Omega}$

Radiation resistance of short dipole is

$R_{r2} = 40\pi^2 \left(\frac{h}{\lambda}\right)^2$

$h = 0.2\lambda$

$= 40\pi^2 \left(\frac{0.2\lambda}{\lambda}\right)^2$

$= 40\pi^2 (0.04)$

$\boxed{R_{r2} = 15.79\Omega}$

Radiation resistance for quarter-wave monopole is $Z_A = \frac{1}{2}(72 + j42.5)$

$$Z_A = 36 + j21.3\Omega$$

the quarter-wave monopole has imaginary impedance component. but the top-loaded monopole and short dipole antennas don't have imaginary impedance. The top-loaded monopole offers high impedance compared to short-dipole antenna

5) given frequency $f = 1300\,KHz$, $P_r = 25\,KW$

height $h = 200\,feet$

$= 200 \times 0.3048\,m$

$R_a = 41.13\Omega$

$h = 60.96\,m$

$$I_a = \sqrt{\frac{2P_{rad}}{R_a}}$$

$$= \sqrt{\frac{2(25K)}{41.13}}$$

$$I_a = 34.86\,A$$

$h = \frac{L}{2} = 60.96\,m$

$L = 121.92\,m$

$$I_m = \frac{I_a}{\sin\left(\frac{\pi L}{\lambda}\right)}$$

Since frequency is 1300KHz ; $\lambda = 230.8m$

$$I_m = \frac{34.86}{\sin\left(\frac{180 \times 121.92}{230.8}\right)}$$

$$= 34.99A$$

$$\boxed{I_m = 35A}$$

$$F(\theta)\Big|_{90°} = \frac{\cos\left(\frac{\pi L}{\lambda}\cos\theta\right) - \cos\left(\frac{\pi L}{\lambda}\right)}{\sin\theta}$$

$$= \frac{\cos\left(\frac{180 \times 121.92 \cdot \cos 90°}{230.8}\right) - \cos\left(\frac{180 \times 121.92}{230.8}\right)}{\sin 90}$$

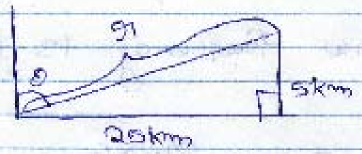
$$= 1 + 0.08$$

$$F(\theta)\Big|_{90°} = 1.08$$

$$E(\theta)\Big|_{90°} = \frac{60 I_m}{\sigma_1} F(\theta)\Big|_{90°}$$

$$= \frac{60(35)(1.08)}{25 \times 10^{3}} \Rightarrow \boxed{E(\theta)\Big|_{90°} = 90.72 \frac{mV}{m}}$$

b) Electric field strength at point B



So $\theta = 90 - \tan^{-1}\left(\frac{5}{25}\right)$

$= 78.69°$

$\boxed{\theta = 1.37 \text{ rad}}$

here

$r = \sqrt{25^2 + 5^2}$

$= 25.49 km$

$\boxed{r = 25.49 \times 10^3 mt}$

$$F(\theta)\Big|_{78.69°} = \frac{\cos\left(\frac{\pi L}{\lambda}\cos\theta\right) - \cos\left(\frac{\pi L}{\lambda}\right)}{\sin\theta}$$

$$= \frac{\cos\left(\frac{180 \times 121.92}{230.8}\cos 78.69\right) - \cos\left(\frac{180 \times 121.92}{230.8}\right)}{\sin(78.69)}$$

$$= \frac{0.947 + 0.08}{0.98}$$

$$F(\theta)\Big|_{78.69°} = 1.047$$

$$E(\theta)\Big|_{78.69} = \frac{60 I_m}{r} F(\theta)\Big|_{78.69} \Rightarrow \frac{60(35)}{25.49 \times 10^3}(1.047)$$

$$\boxed{E(\theta)\Big|_{78.69} = 86.25 \text{ mv/m}}$$