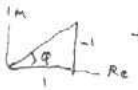
Homework 2 Solutions

2-12 $z = 1000(1-j)\, e^{-j\frac{\pi}{2}}$

$|z| = 1000\sqrt{2}$



$\tan\varphi = -\frac{\pi}{2}$

$V_o = z\, i_o \qquad i_o = \frac{V_o}{z} = \frac{V_o}{|z|} e^{-j\varphi}$

a) $i(t) = Re\left| \frac{10}{\sqrt{2}\,1000} e^{j2\pi 60} e^{j\frac{\pi}{2}} \right| = 7.07\,mA\cos(377t + 0.785)$

b) $P = \frac{V_o i_o}{2}\cos\varphi \qquad V_o = 10\,V \quad i_o = 7.07\,mA \quad \varphi = 0.785$

$P = \frac{10(7.07\times10^{-3})}{2}\frac{1}{\sqrt{2}} = 0.025W$

1) $V_{RMS}^2 = \frac{1}{T}\int_0^T V_0^2\cos^2\left(\frac{2\pi}{T}t\right)dt = \frac{V_0^2}{2}$

$V_{RMS} = \frac{1}{\sqrt{2}}10 = 7.07\,V$

2-15

$z = z_R + z_L + z_C = R + j\left(\omega L - \frac{1}{\omega C}\right) = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}\, e^{j\varphi}$

where $\tan\varphi = \left(\frac{\omega L}{R} - \frac{1}{\omega RC}\right)$

z a minimum when $\omega L - \frac{1}{\omega C} = 0$

$\omega = \frac{1}{\sqrt{LC}}$

2-24 $G(\omega) = \frac{A}{\sqrt{\omega}}$ $dB = 20\log_{10}(G(\omega)) = 20\log_{10}\frac{A}{\omega^{\frac{1}{2}}}$

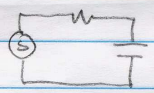
$= 20\log_{10} A - \frac{20}{2}\log_{10}\omega$

drops of 10dB per decade in ω

3-1 $G(\omega) = \frac{1}{\sqrt{1+\omega^2R^2C^2}}$ for $\omega = 10000$ $= \frac{1}{100}$ $Z = \sqrt{R^2 + \frac{1}{\omega^2C^2}}$ for $\omega = 100$ $= 1000$

solve using maple

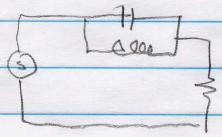
$R = 707\,\Omega$ $C = 14.1\,\mu C$

2) a) 

as $\omega \to 0$ $V_o = V_i$

as $\omega \to \infty$ $V_o = 0$

so 5)

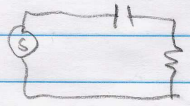
b) 

as $\omega \to 0$ $V_o = V_i$

as $\omega \to \infty$ $V_o = V_i$

in between $V_o < V_i$

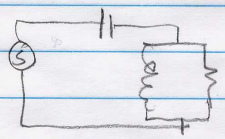
so 6)

c) 

as $\omega \to 0$ $V_o = 0$

as $\omega \to \infty$ $V_o = V_i$

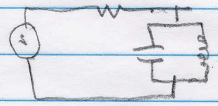
so 4)

d) 

as $\omega \to 0$ $V_o = 0$

as $\omega \to \infty$ $V_o = V_i$

so 2)

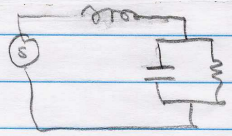
e) 

as $\omega \to 0$ $V_o = 0$

as $\omega \to \infty$ $V_o = 0$

in between $V_o < V_{in}$

so 1)

f) 

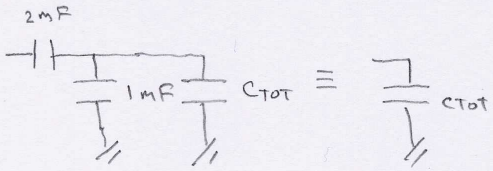
as $\omega \to 0$ $V_o = V_i$

as $\omega \to \infty$ $V_o = 0$

in between $V_o < V_{in}$

so 3)

3)



$$\frac{2(1+C_{TOT})}{2+1+C_{TOT}} = C_{TOT} \Rightarrow C_{TOT}^2 + C_{TOT} - 2 = 0 \qquad C_{TOT} = \frac{-1 \pm \sqrt{1+4\cdot 2}}{2} = 1\,mF$$

not physical

$-2\,mF$