ENGR 2910
HOMEWORK 10 SOLUTIONS

① $v = 0$ at $t = -\frac{2}{3}\pi$
and increasing at $80{,}000 \frac{V}{s}$

a) $v(t) = 80\cos(\omega t + \phi)$

$\frac{dv(t)}{dt} = -80\omega \sin(\omega t + \phi)$

when $\cos(\ ) = 0 \Rightarrow \sin(\ ) = 1$

$\Rightarrow 80\omega = 80{,}000$ or $\boxed{\omega = 1000 \frac{rad}{s}}$

b) $f = \frac{\omega}{2\pi} = 159.155\ Hz$

$T = \frac{1}{f} = 6.28\ ms$

$\frac{-\frac{2}{3}\pi}{6.28} = -0.3335 \Rightarrow \phi = -90 - (-0.3335)(360) = 30°$

$\boxed{v = 80\cos(1000t + 30°)}$

② a) $f = 50{,}000$

$\omega = 2\pi f = 314{,}159 \frac{rad}{s}$

b) $I = \frac{V}{Z_c} = \frac{10\times10^{-3}\angle 0°}{\left(\frac{1}{j\omega C}\right)} = j\omega C(10\times10^{-3})\angle 0°$

$= (10\times10^{-3})\omega C \angle 90°$

$\boxed{\phi = 90°}$

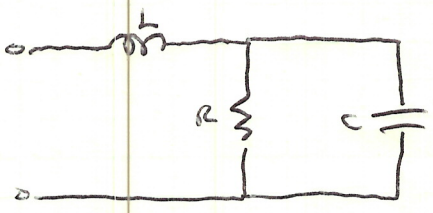
c) $I_m = 628.32\mu A = 10\times10^{-3}\omega C$

$\frac{1}{\omega C} = \frac{10\times10^{-3}}{628.32\times10^{-6}} = 15.92\ \Omega$ REACTANCE $\boxed{X_c = -15.92\ \Omega}$

d) $C = \frac{1}{(15.92)\omega} = \frac{1}{(15.92)(314{,}159)} = 0.2\ \mu F$

e) $Z_c = \frac{1}{j\omega C} = \frac{-j}{\omega C} = -j\,15.92\ \Omega$

(3)



$C = 25\times10^{-9}$ F
$L = 160\times10^{-6}$ H
$R = 100$ Ω

a) $Z_{EQ} = Z_L + Z_R \| Z_C$

$= j\omega L + \left(R \| \frac{-j}{\omega C}\right)$

$= j\omega L + \left(\frac{1}{\frac{1}{R} + \frac{\omega C}{-j}}\right)$

$= j\omega L + \left(\frac{1}{\frac{-j+\omega CR}{-jR}}\right)$

$= j\omega L + \frac{-jR}{-j+\omega CR}$

$= j\omega L + \frac{-jR(\omega CR + j)}{\omega^2 C^2 R^2 + 1}$

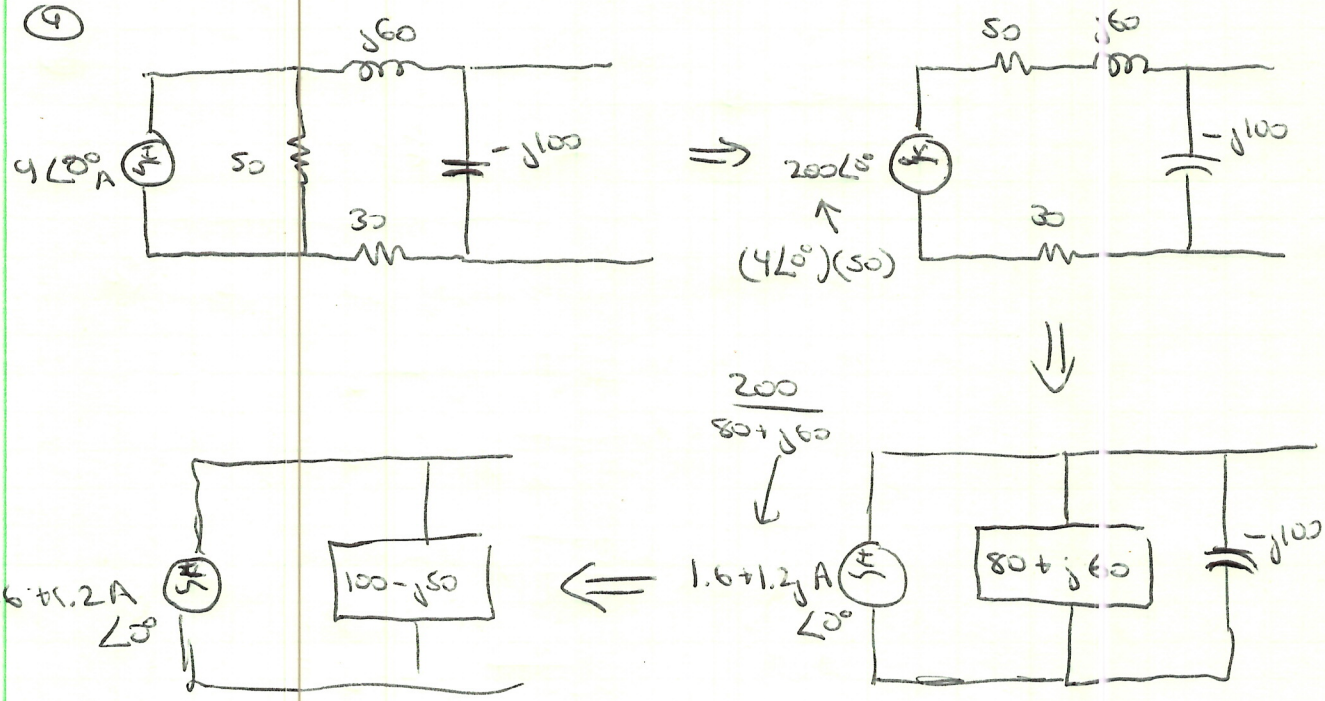
$\Im\{Z_{EQ}\} = \omega L - \frac{\omega CR^2}{\omega^2 C^2 R^2 + 1} = 0$

$\Rightarrow \omega^2 = \frac{(CR^2/L) - 1}{C^2 R^2} = 900\times10^8$

$\boxed{\omega = 300\times10^3 \ \text{rad/s}}$

b) $Z_{EQ}(300k) = j(48) + \frac{(100)(-j133)}{100 - j133} = 64\angle$ Ω

④



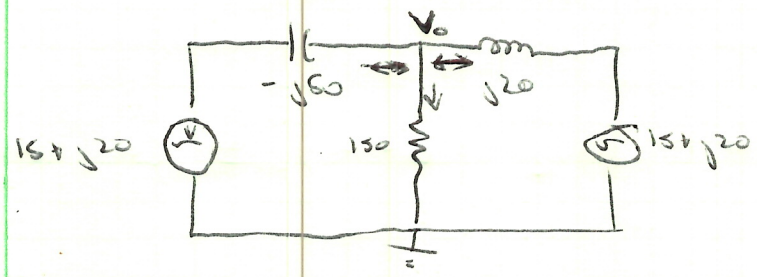
⑤ $Z_L = j\omega L = j20$

$Z_C = \frac{-1}{\omega C} = -j50$

$v_{g_1}(t) = 25\sin(400t + 143.13°) = 25\cos(400t + 53.13°)$

$V_{g_1} = 25\angle 53.13° = 15 + j20$ V

$V_{g_2} = 18.03\angle 33.69 = 15 + j20$ V



KCL: $\frac{(15+j20)-V_o}{-j50} + \frac{(15+j20)-V_o}{j20} = \frac{V_o}{150}$

$V_o = 15\angle 0°$

$v_o(t) = 15\cos(400t)$ V