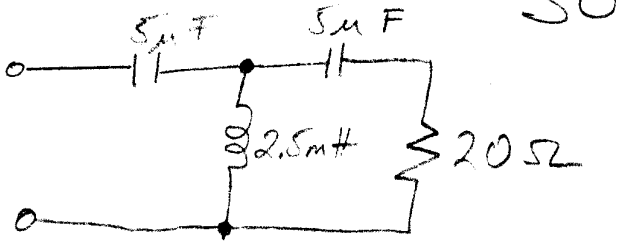
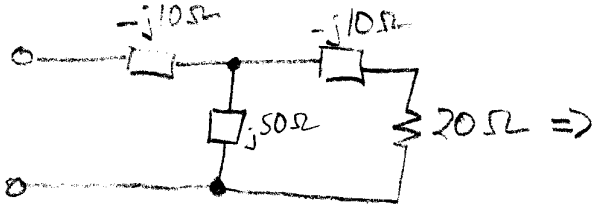
ENGR 210
FOR HW #12 – Last one!

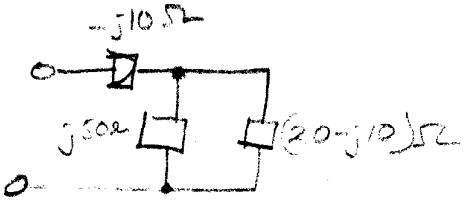
SOLUTIONS

8-18 (1)



$Z_R = R$
$Z_L = j\omega L$
$Z_C = -\frac{j}{\omega C}$
$\omega = 20k \frac{rad}{s}$



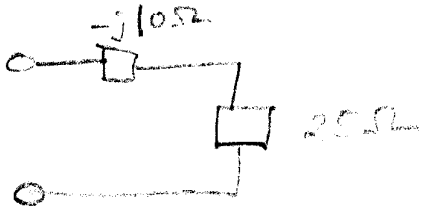


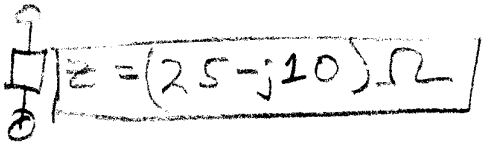
$$\frac{(20-j10)\,j50}{20-j10+j50} = \frac{j1000 - j^2 500}{20+j40}$$

$$= \frac{500+j1000}{20+j40}$$

$$= \frac{25(1+j2)}{1+j2}$$

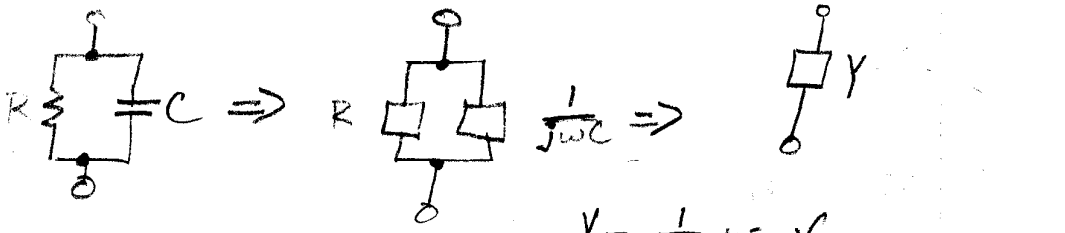
$$= 25$$





$$\boxed{Z = (25 - j10)\,\Omega}$$

8-19 (2)



$R = 1200\,\Omega$

$\omega C = \frac{1}{1200}\,\mathcal{U}$

$C = 833\,pF$

$$\boxed{\begin{array}{l} R = 1200\,\Omega \\ C = 833\,pF \end{array}}$$

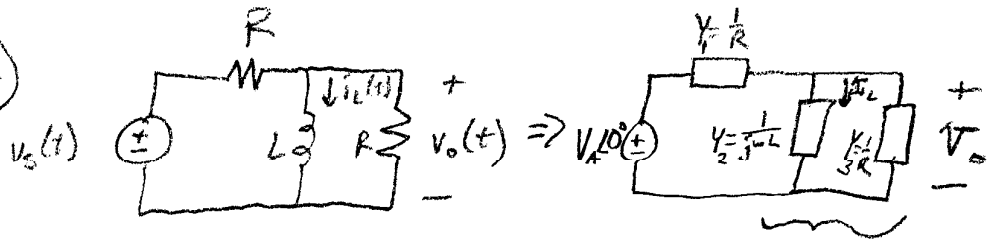
$$Y = \frac{1}{R} + j\omega C$$

$$= \frac{1}{600 - j600}\left(\frac{600 + j600}{600 + j600}\right)$$

$$= \frac{600}{2 \cdot 600^2} + j\frac{600}{2 \cdot 600^2}$$

$$= \frac{1}{1200} + j\frac{1}{1200}$$

3/8-24)



$$Y_{eq} = \frac{1}{R} + \frac{1}{j\omega L}$$

by voltage division:

$$V_o = V_s \frac{Y_1}{Y_1 + Y_2 + Y_3}$$

$$= V_A \frac{\frac{1}{R}}{\frac{1}{R} + \frac{1}{j\omega L} + \frac{1}{R}}$$

$$= V_A \frac{j\omega L}{j\omega L + R + j\omega L}$$

$$= V_A \frac{j\omega L}{2j\omega L + R}$$

by Ohm's Law

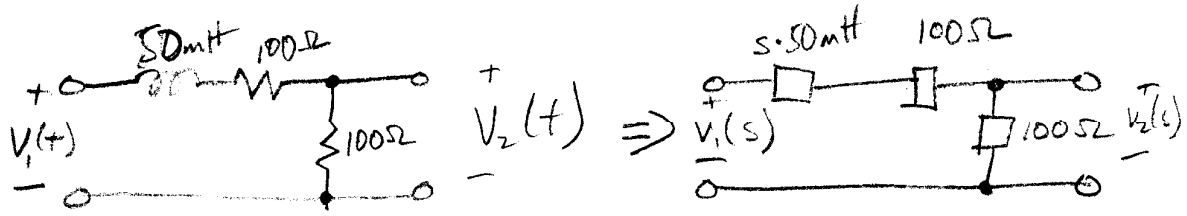
$$I_L = V_o Y_2$$

$$= V_A \frac{j\omega L}{2j\omega L + R} \cdot \frac{1}{j\omega L}$$

$$= \frac{V_A}{R + j2\omega L} \left(\frac{R - j2\omega L}{R - j2\omega L} \right)$$

$$\boxed{I_L = V_A \frac{R - j2\omega L}{R^2 + (2\omega L)^2}}$$

4
12-1)

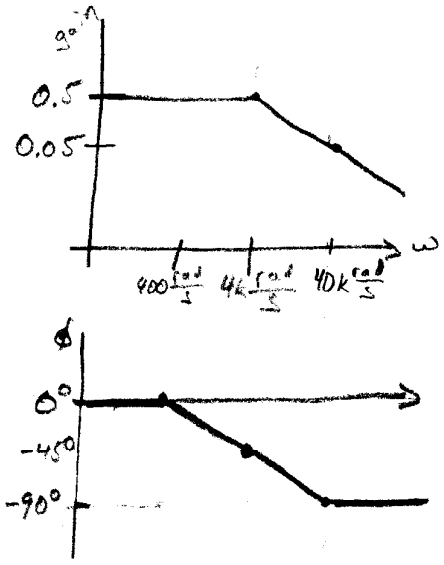


$$V_2(s) = V_1(s)\ \frac{100\,\Omega}{200\,\Omega + s \cdot 50\,mH}$$

$$T_v(s) = \frac{0.5}{1 + \frac{s}{4k\ \frac{rad}{s}}}$$

a) dc gain: 0.5
cut-off freq.: $4k\ \frac{rad}{s}$
low-pass

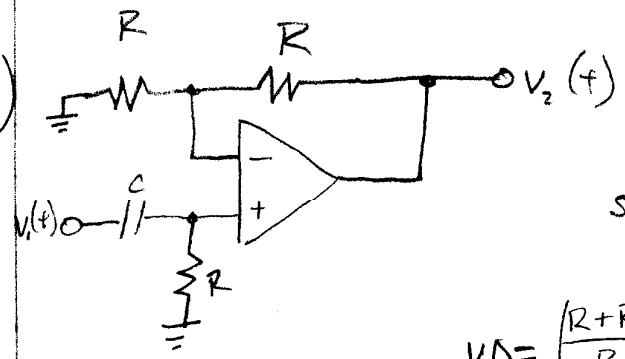
b)



c)

ω	gain
$0.5\omega_c$	0.5
ω_c	0.5
$2\omega_c$	0.25

5) 12-6



subtractor, with $V_1 = 0$

$Z_3 = \frac{1}{Cs}$

$$V_2(s) = \left(\frac{R+R}{R}\right) \cdot \left(\frac{R}{\frac{1}{Cs}+R}\right) V_1(s)$$

$$T_v(s) = 2 \cdot \frac{RCs}{1+RCs}$$

high-pass

passband gain: **2**

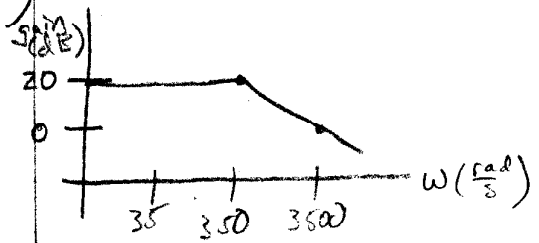
want cutoff at $500\,Hz = 1000\pi \frac{rad}{s}$

$\omega_c = 1000\pi = \frac{1}{RC}$

if $R = 1\,k\Omega$, $C = 318\,nF$ } → any correct, so long as

phase at cutoff is **45°** or **$\frac{\pi}{4}$**

6) 12-7 lowpass, $\omega_c = 350 \frac{rad}{s}$



for $\omega > 350 \frac{rad}{s}$

$$gain_{dB} = -20 \log\left(\frac{\omega}{350}\right) + 20$$

ω	gain
$200 \frac{rad}{s}$	20 dB
$400 \frac{rad}{s}$	18.8 dB
$800 \frac{rad}{s}$	12.8 dB