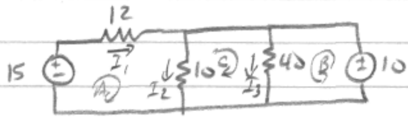
HW #1 SOLN

1.



$I_1 = I_A$

$I_2 = I_A - I_C$

$I_3 = I_B + I_C$

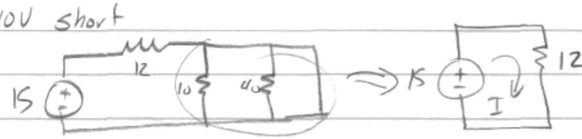
$$15 = 22 I_A - 10 I_C$$
$$10 = 40 I_B + 40 I_C$$
$$0 = 50 I_C - 10 I_A + 40 I_B$$

$$\Rightarrow \begin{pmatrix} 15 \\ 10 \\ 0 \end{pmatrix} = \begin{pmatrix} 22 & 0 & -10 \\ 0 & 40 & 40 \\ -10 & 40 & 50 \end{pmatrix} \begin{pmatrix} I_A \\ I_B \\ I_C \end{pmatrix}$$

$$\left.\begin{aligned} I_A &= .416 \\ I_B &= .833 \\ I_C &= -.583 \end{aligned}\right\} \quad \begin{aligned} I_1 &= 0.416\text{ A} \\ I_2 &= 1\text{ A} \\ I_3 &= 0.25\text{ A} \end{aligned}$$

2. SAME CIRCUIT BY SUPERPOSITION

A) 10V short



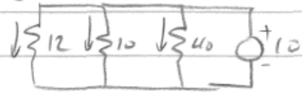
= 0 Ω

$I_{12} = \frac{15}{12}\text{ A} = 1.25\text{A} \rightarrow$

$I_{10} = 0$

$I_{40} = 0$

B) 15V short



$I_{40} = \frac{10\text{V}}{40} = .25\text{A} \downarrow$

$I_{10} = \frac{10}{10} = 1\text{ A} \downarrow$

$I_{12} = \frac{10\text{V}}{12\Omega} = .833 \leftarrow$

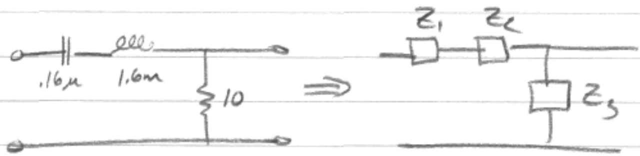
TOTAL: $I_1 = 1.25\text{A} - .833 = .417\text{ A}$

$I_2 = 1\text{ A}$

$I_3 = .25\text{A}$

AGREES

3.



$$\frac{V_o}{V_1} = \frac{Z_3}{Z_1 + Z_2 + Z_3} = \left(\frac{R}{R + j\omega L - \frac{j}{\omega C}}\right)\frac{\omega C}{\omega C}$$

$$= \frac{\omega RC}{R\omega C + j(\omega^2 LC - 1)}$$

$$\left|\frac{v_o}{v_1}\right| = \frac{\omega RC}{\left[(\omega RC)^2 + (\omega^2 LC - 1)^2\right]^{1/2}}$$

RESONANCE @ $\omega_o^2 LC = 0$

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

Turn to software to "look" at freq response.

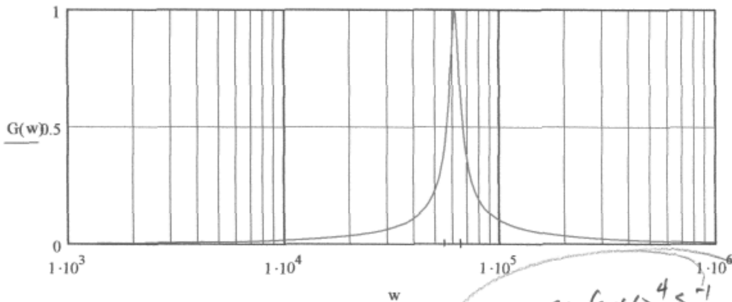
If $R_L = 10\Omega$ (Same valu of R)

$$\frac{V_o}{V_1} = \frac{Z_3}{Z_1 + Z_2 + Z_3 + Z_4} = \frac{R}{2R + j\omega L - \frac{j}{\omega C}}$$

ONLY change is $R \to 2R$ IN denominator

$C := 0.16 \cdot 10^{-6} \quad L := 1.6 \cdot 10^{-3} \quad R := 10$

$$G(w) := \frac{w \cdot R \cdot C}{\sqrt{(wR \cdot C)^2 + \left(w^2 \cdot L \cdot C - 1\right)^2}} \qquad w := 100, 1000 .. 10000000$$

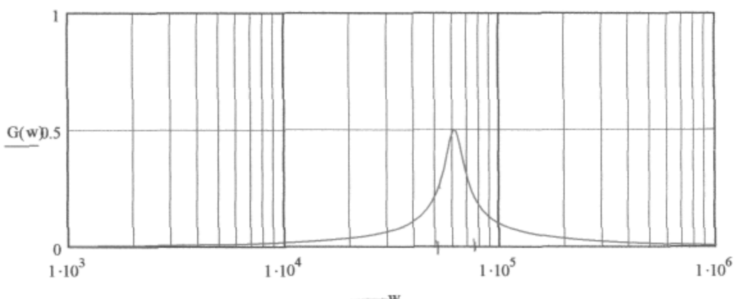


$\omega_0 \sim 6 \times 10^4 \, s^{-1}$

$B\omega \sim 1 \times 10^4 \, s^{-1}$

With Added Internal Resistance of Inductor = 10Ω

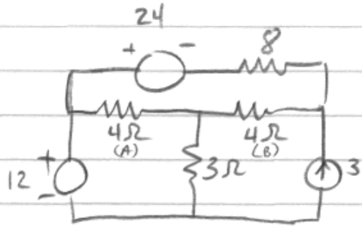
$$G(w) := \frac{w \cdot R \cdot C}{\sqrt{(w \cdot 2R \cdot C)^2 + \left(w^2 \cdot L \cdot C - 1\right)^2}}$$



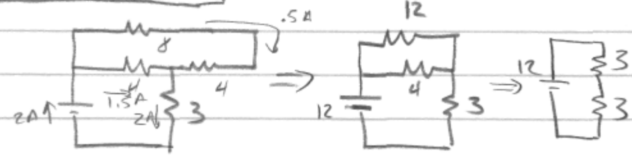
$\omega_0 \approx 6 \times 10^4 \, s^{-1}$

$B\omega \sim 2.5 \times 10^4 \, s^{-1}$

4.



A: 12 V



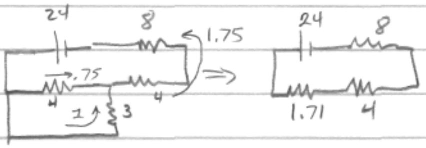
$$I_{12V} = \frac{12V}{6\Omega} = 2A$$

This means 2A out of 12V & 2A thru 3Ω.

There is therefore 6V difference across $4\Omega_{(A)}$ & $4\Omega_{(B)} + 8\Omega$ Path. For $4\Omega_{(A)}$, $I_{4\Omega_A} = \frac{6V}{4\Omega} = 1.5A$

$4_{(B)} + 8\Omega \quad I = \frac{6V}{12} = 0.5A$

B. 24 V



$$I_{24} = \frac{24V}{13.71} = 1.75A$$

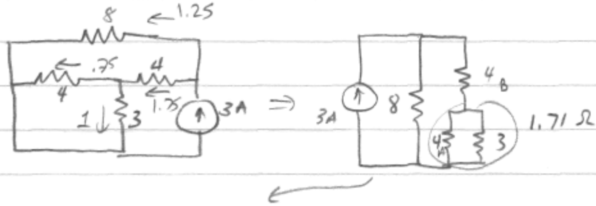
→ 1.75A Thru 24V, 8Ω & $4\Omega_{(B)}$

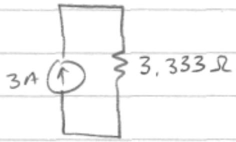
→ 3V across 4Ω∥3Ω.

" results in 1A thru 3Ω &

.75A thru 4Ω

c. 3A





$\Rightarrow V = 10V$

$\therefore I_8 = \frac{10V}{8} = 1.25A$

$I_{4_B} = 1.75A$

$V_{4\|3} = (1.71\Omega)(1.75A) = 2.99V$

$\therefore I_{4A} = .75A$

$I_{3A} = 1A$

The question is what is I thru 3Ω Resistor.
Three contributions are:

$$\left.\begin{array}{ll} 12V: & 2A \downarrow \\ 24V: & 1A \uparrow \\ 3A: & 1A \downarrow \end{array}\right\} \quad 2A \uparrow$$