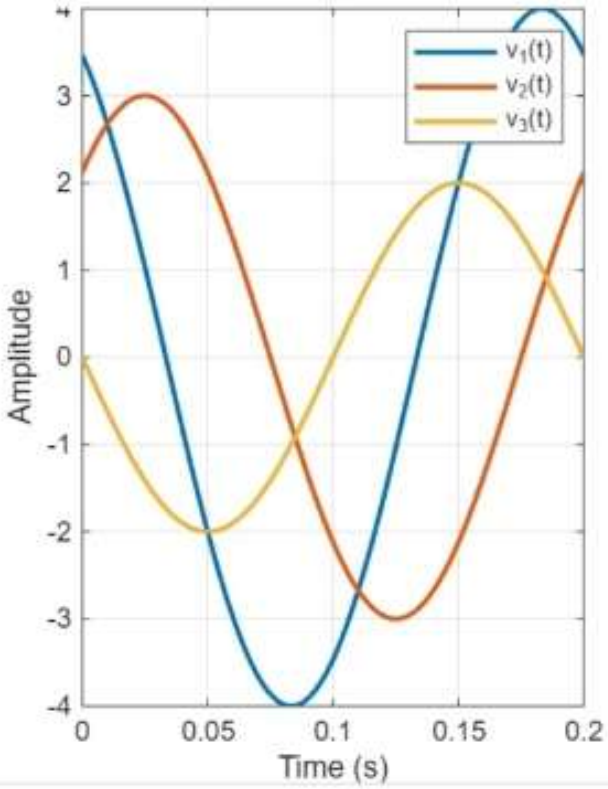
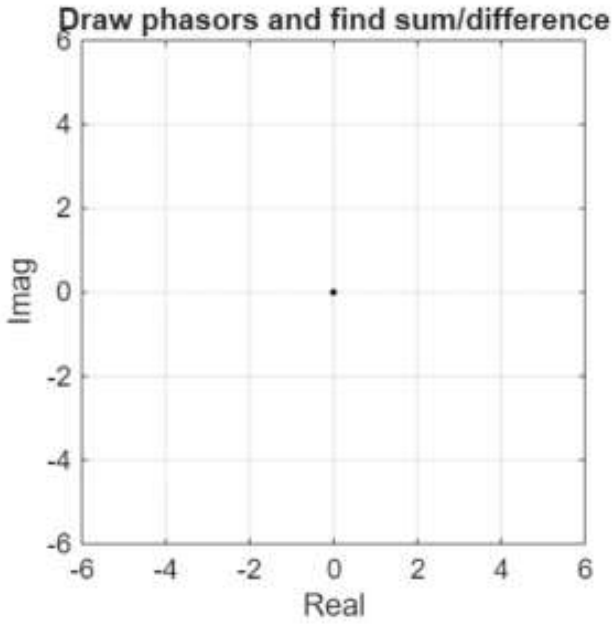

Mech Family
كن أنت التغيير
اللجنة الأكاديمية في قسم
الهندسة الميكانيكية

Question 1:


v1(t)
v2(t)
v3(t)
Amplitude
Time (s)
0
0.05
0.1
0.15
0.2
-4
-3
-2
-1
0
1
2
3


Draw phasors and find sum/difference
Imag
Real
-6
-4
-2
0
2
4
6

Wednesday Assignment 5/6/2020

Q) $f = 5Hz$ $T = \frac{1}{5} = 0.2s$, $\omega = 10\pi$ rad/s

$v = A\cos(\omega t + \theta)$

$v_1(t) = 10\pi(0.085) + \theta_1 = \pi \rightarrow \theta_1 = 30°$ $V_1(j\omega) = 4\angle 30°$

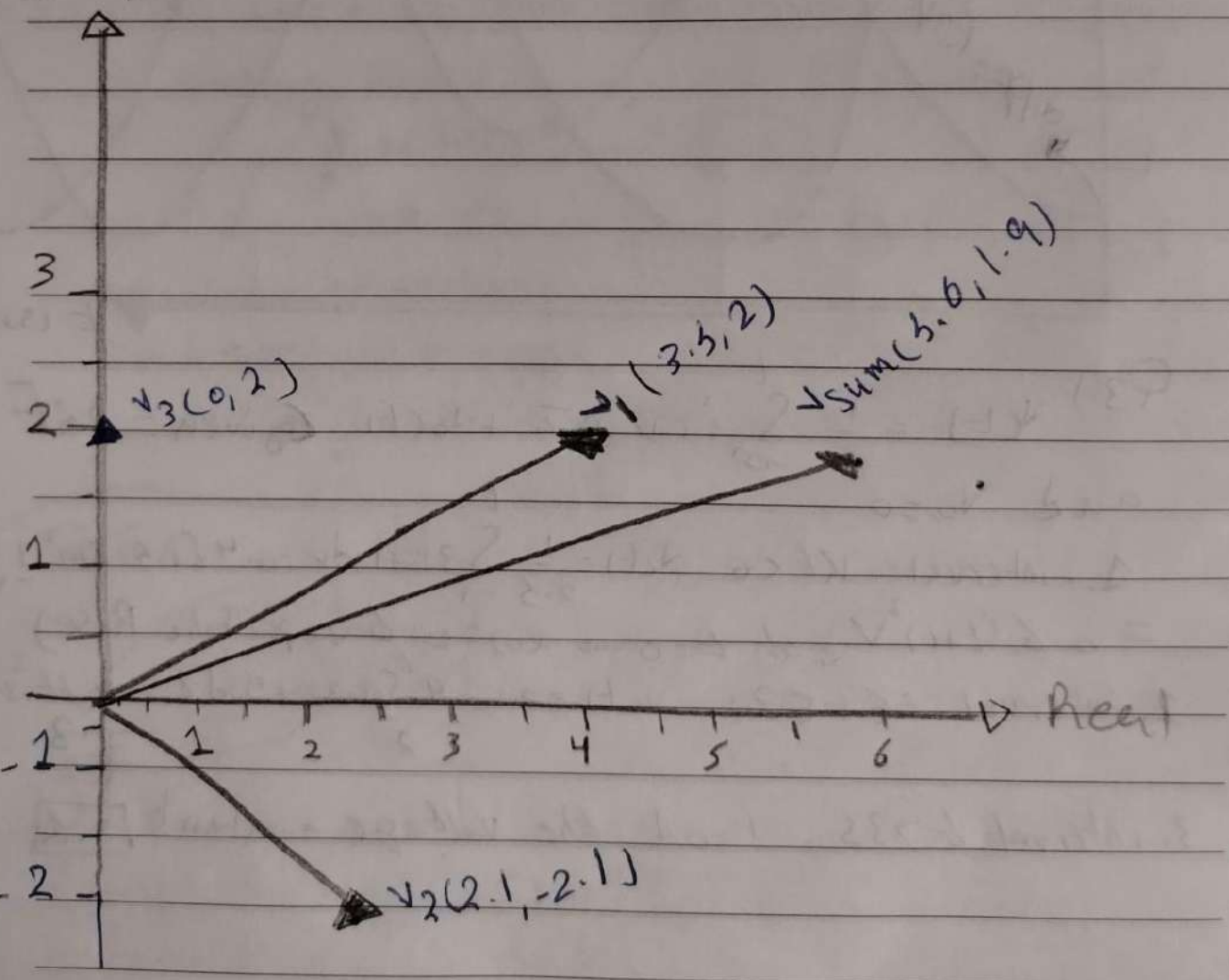
$v_2(t) = 10\pi(0.025) + \theta_2 = \text{zero} \rightarrow \theta_2 = -45°$ $V_2(j\omega) = 3\angle -45°$

$v_3(t) = \text{yellow} \rightarrow -\sin(\omega t)$ wave $\rightarrow V_3(j\omega) = 2\angle 90°$

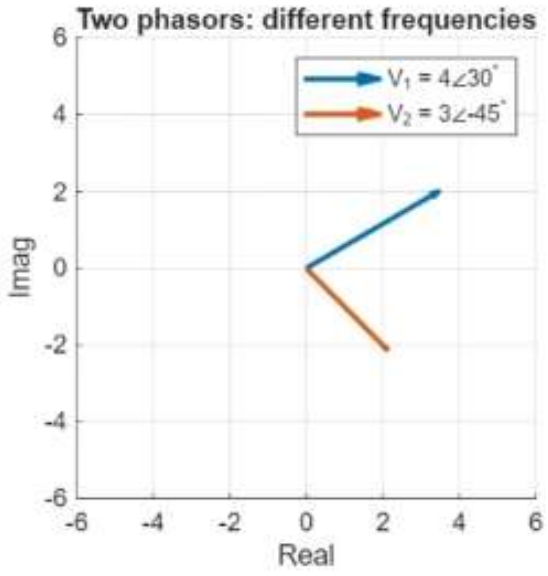
$V_{sum} = V_1(j\omega) + V_2(j\omega) + V_3(j\omega) = (4\angle 30) + (2\angle 90° + (3\angle -45$

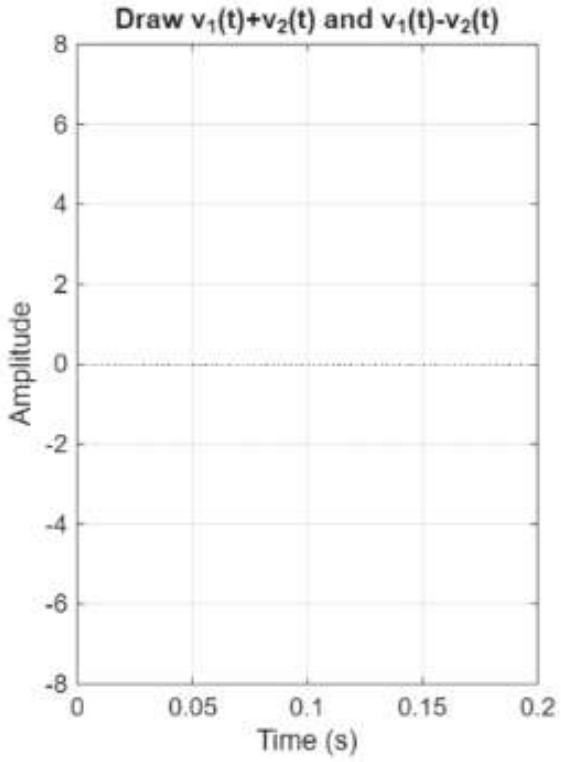
$= 5.585\angle 18.6°$

$V_1 - V_2 = 1.343 + j4.121 - 4.33\angle 71.9°$



Question 2:

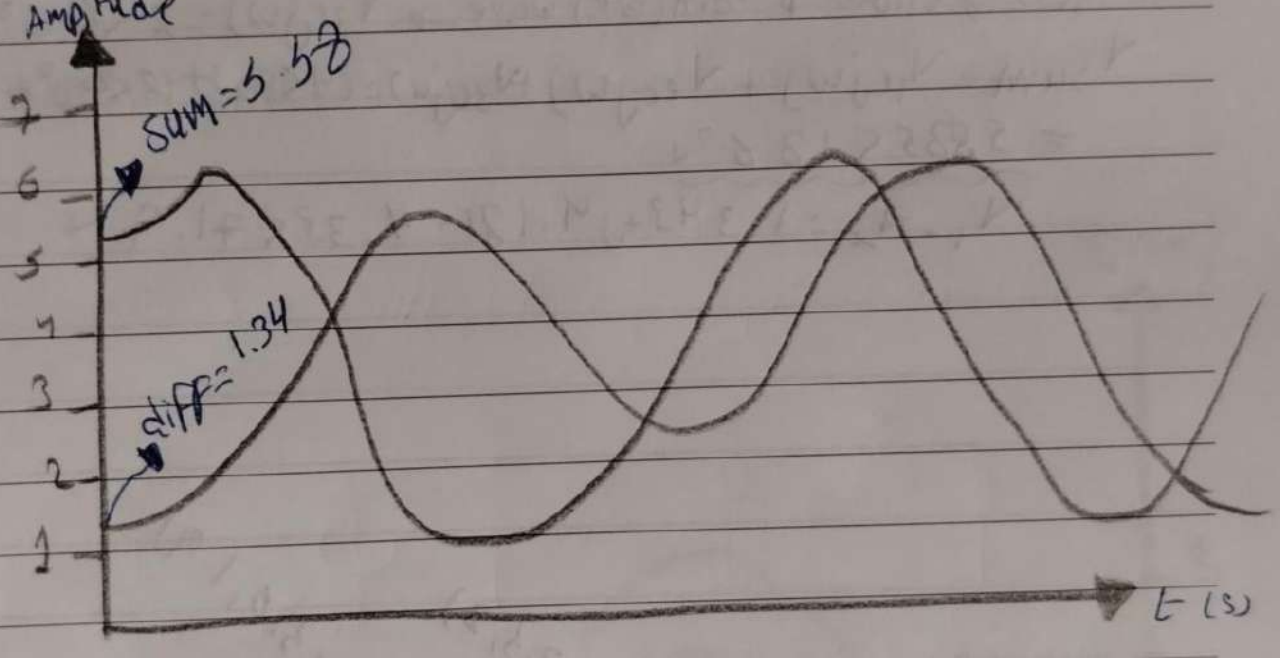

Two phasors: different frequencies
V1 = 4∠30°
V2 = 3∠-45°
Imag
Real
6
4
2
0
-2
-4
-6
-6
-4
-2
0
2
4
6


Draw v1(t)+v2(t) and v1(t)-v2(t)
Amplitude
Time (s)
8
6
4
2
0
-2
-4
-6
-8
0
0.05
0.1
0.15
0.2

Q2) Two phasors with different Frequencies

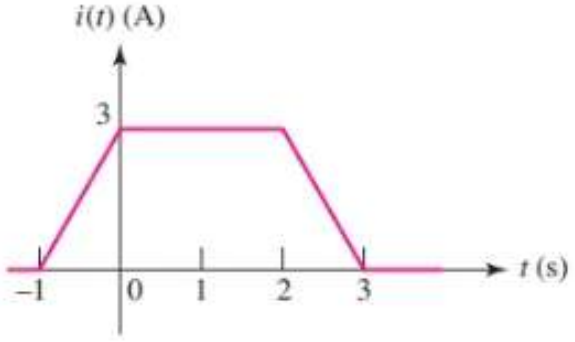
$V(t)_{diff} = 4\cos(\omega_1 t + 30^\circ) - 3\cos(\omega_2 t - 45^\circ)$

$V(t)_{sum} = 4\cos(\omega_1 t + 30^\circ) + 3\cos(\omega_2 t - 45^\circ)$



Question 3:

Assuming the passive sign convention, sketch the voltage which develops across the terminals of a 2.5 F capacitor in response to the current waveforms shown



Q3) $v(t) = \frac{1}{C}\int_{-\infty}^{t} i(\tau)\,d\tau + v_0(t)$ Given = 2.5F

and $v_0 = 0$

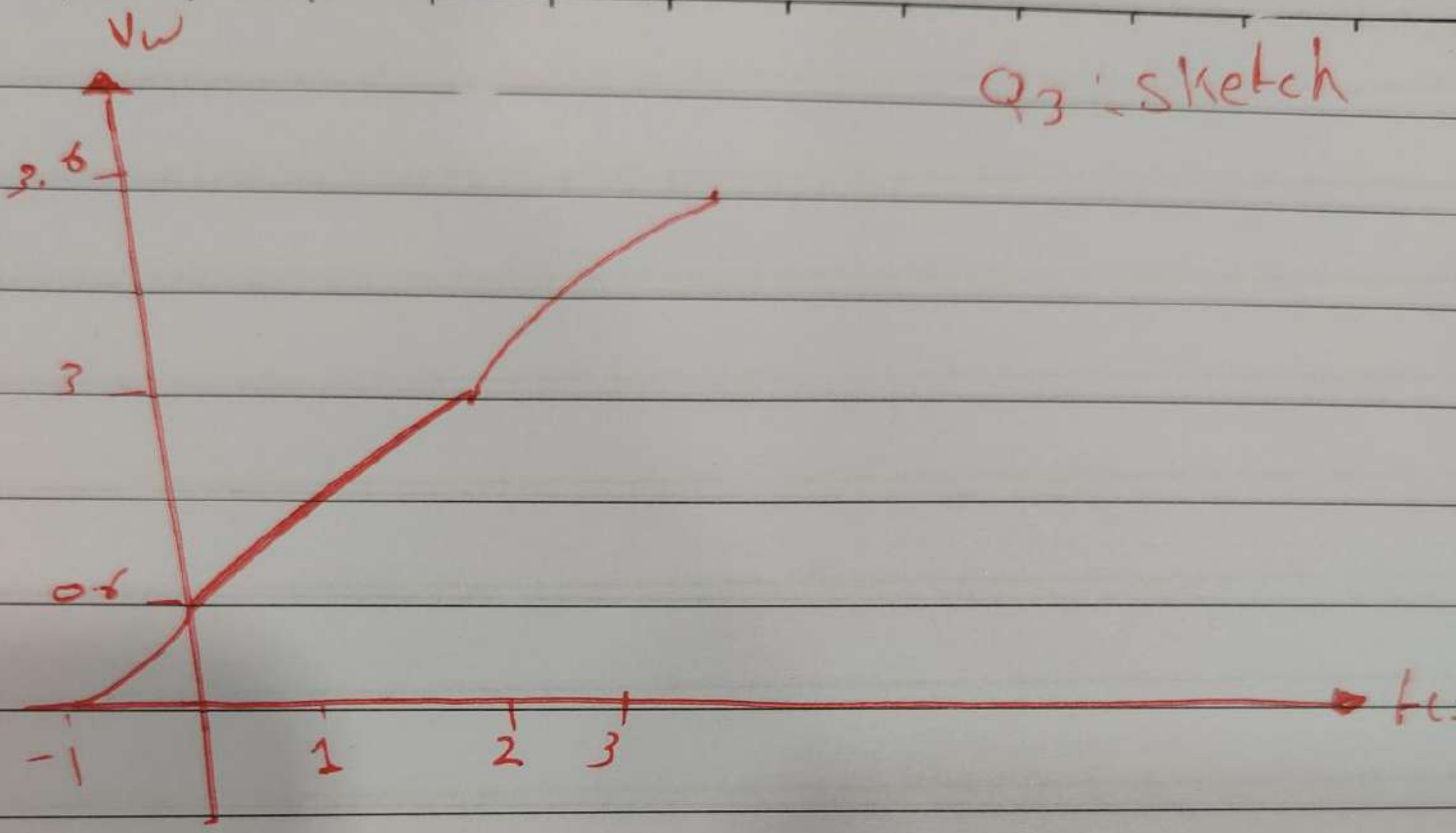
1. interval $-1 < t < 0$ $v(t) = \frac{1}{2.5}\int_{-1}^{t} 3\tau+1\,d\tau = 0.4\left[1.5(\tau+1)^2\right]_{-1}^{t}$

$= 0.6(t+1)^2$ V ∴ at $t=0 \rightarrow v(0) = 0.6$ V (parbolic Rise)

2. interval $2 \leq t \leq 3$:- $v(t) = 3 + 0.4\int_{2}^{t}(-3\tau+9)\,d\tau = -0.6t^2 + 3.6t - 1.8$

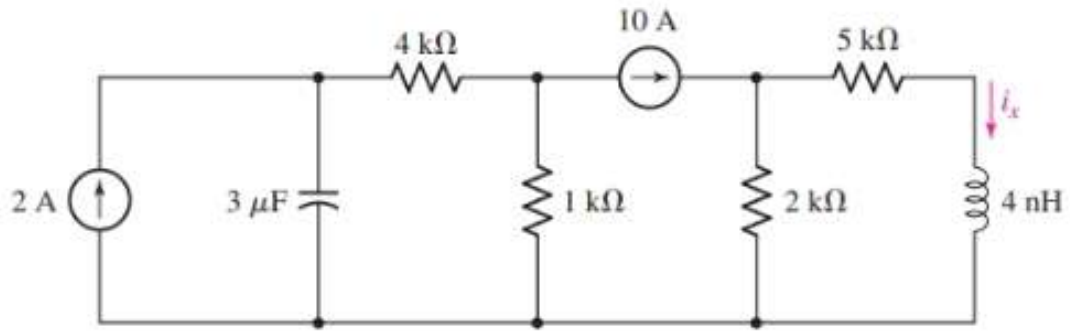
3. interval $t > 3s$: $i = 0A$ the voltage constant 3.6

Q3 : sketch

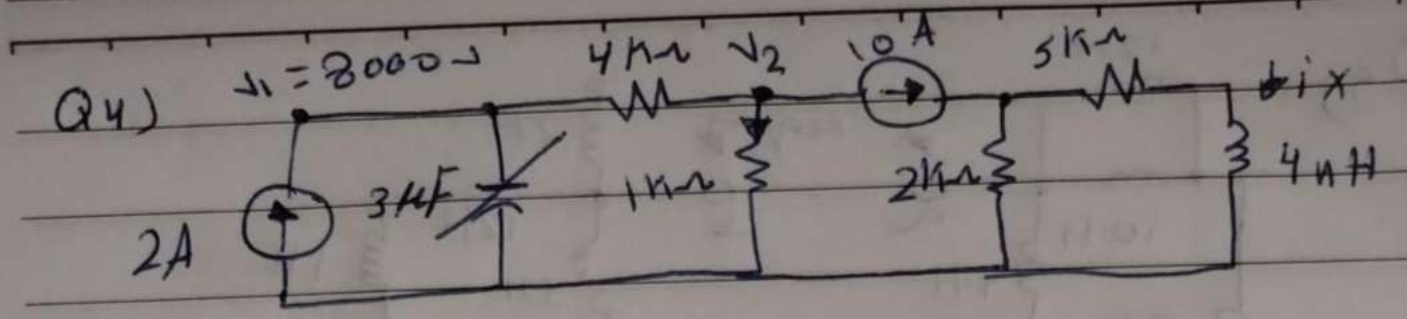


Question 4:

Determine the energy stored in the capacitor and in the inductor.



Q4)



* the capacitor will be open circuit
* the inductor will be short circuit

apply nodal equation at node V_2:

$$2 = \frac{V_2}{1000} + 10 \Rightarrow V_2 = -8000 \text{ volt}$$

$$V_1 - V_2 = (2)(4000) = 8000 - 8000 = 0 \Rightarrow \boxed{V_1 = 0}$$

Energy stored in capacitor: $W_c = \frac{1}{2} C V_1^2$

$$= \frac{1}{2} * (3*10^{-6})(0)^2 = \boxed{0 J}$$

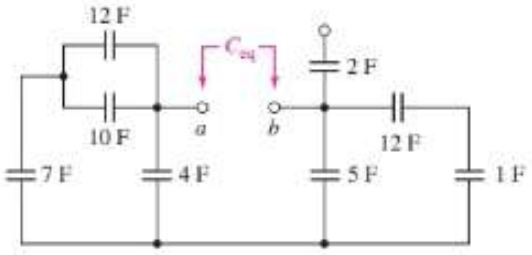
$$i_x = 10 * \frac{2000}{2000+5000} = \frac{20}{7} A = 2.857 A$$

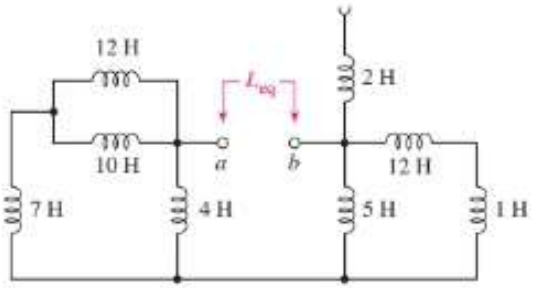
Energy stored in inductor: $W = \frac{1}{2} L i_x^2$

$$= \frac{1}{2} * (4*10^{-9}) * (\frac{20}{7})^2 = \boxed{16.33 nJ}$$

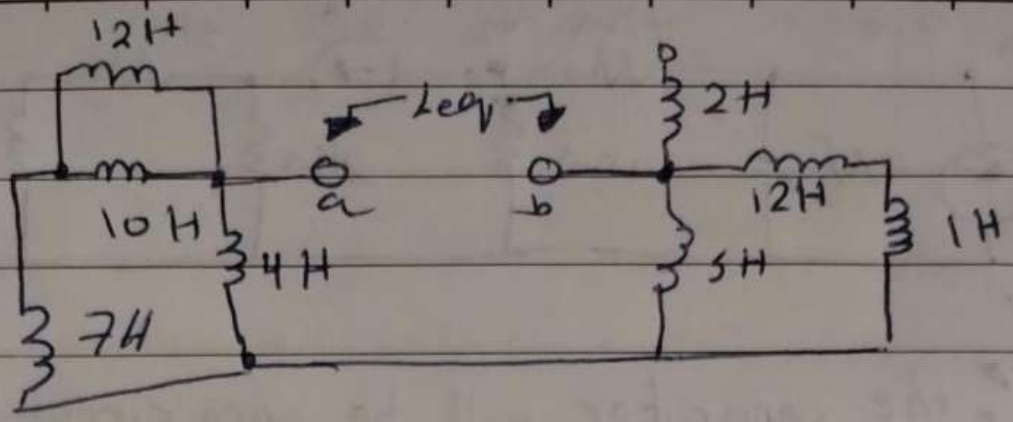
Question 5:

Determine, Ceq, and Leq in the figures shown below





Q5)

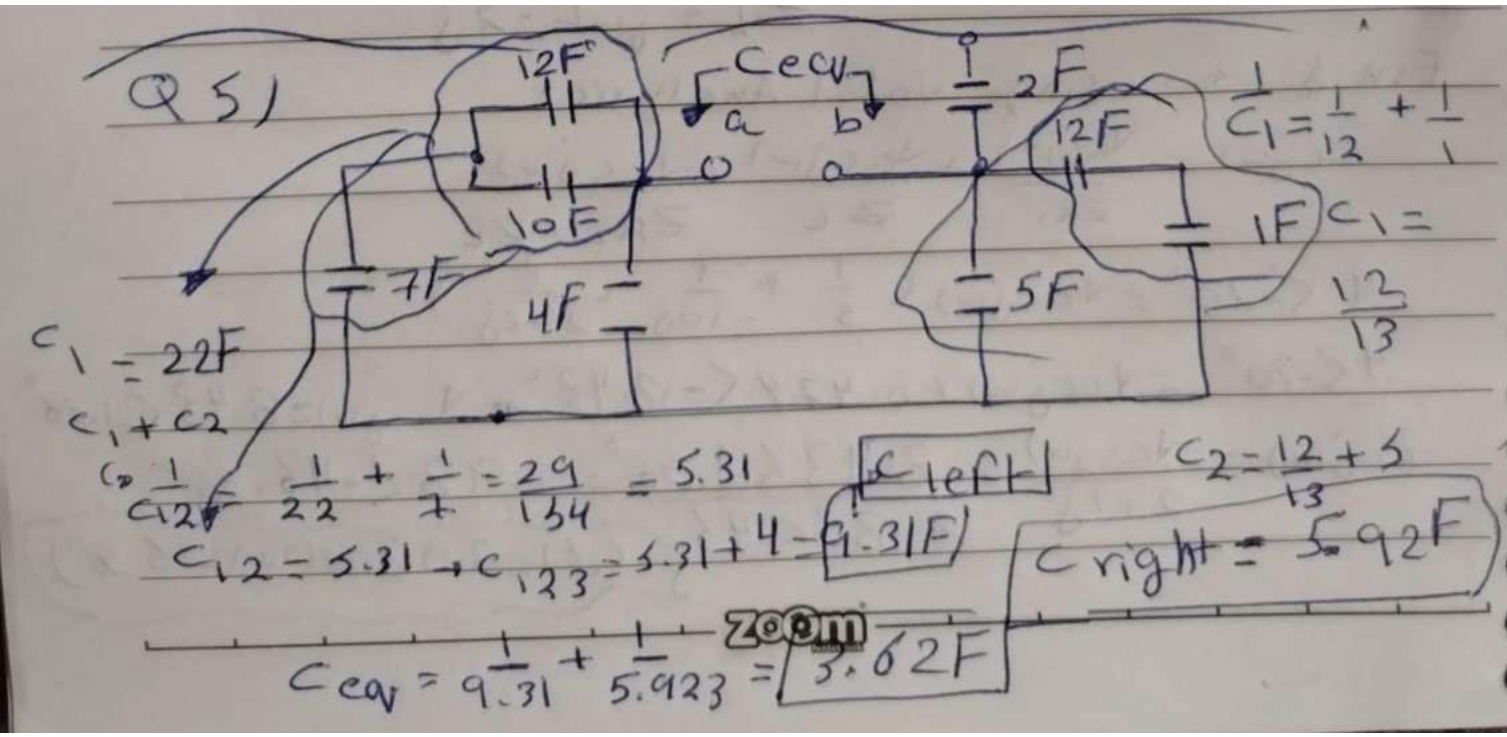


$$L_{right} = \frac{13 * 5}{18} = 3.61\ H$$

$$L_{Left} = \frac{(137//11) * 4}{(137//11) + 4} = 3.03H$$

$L_{equ} = 3.03 + 3.61 = 6.64\ H$

Q 51



$\frac{1}{C_1} = \frac{1}{12} + \frac{1}{1}$

$C_1 = \frac{12}{13}$

$C_1 = 22F$

$C_1 + C_2$

$C_2 = \frac{1}{C_{12}F} \quad \frac{1}{22} + \frac{1}{7} = \frac{29}{154} = 5.31$

$C_2 = \frac{12}{13} + 5$

$C_{12} = 5.31 \rightarrow C_{123} = 5.31 + 4 = 9.31F$

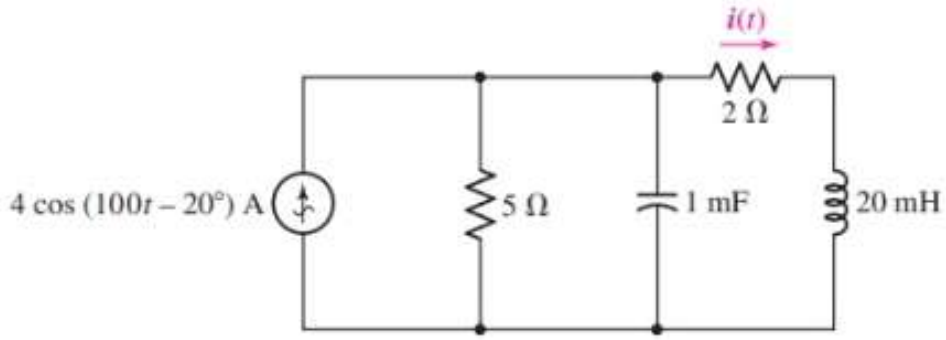
C_{left}

$C_{right} = 5.92F$

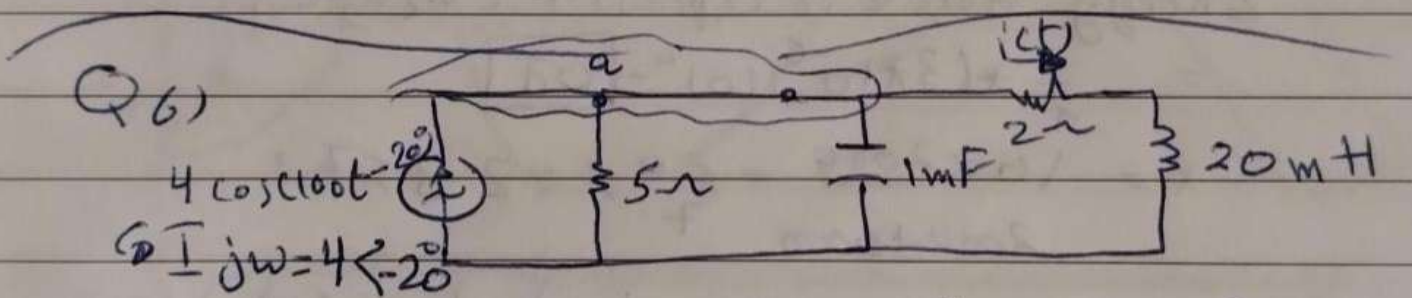
$C_{eq} = \frac{1}{9.31} + \frac{1}{5.923} = 3.62F$

Question 6:

Employ phasor-based analysis to obtain an expression for i(t) in the circuit shown below



Q6)



$\bar{I}\ jw = 4\angle -20°$

$Z_{R_1} = 5\Omega$, $Z_{R_2} = 2\Omega$

$Z_C = \frac{-j}{wC} = -10j$

$Z_L = jwL = 2j$

Find v_a using Nodal Analysis:

$$\bar{I}_c(jw) = \frac{V_{ac}(jw)}{Z_{R_1}} + \frac{V_{ac}(jw)}{Z_C} + \frac{V_{ac}(jw)}{Z_{R_2} + Z_L}$$

$$4\angle -20° = V_{ac}(jw)\left(\frac{1}{5} + \frac{1}{-10j} + \frac{1}{2+2j}\right)$$

$$4\angle -20° = V_{ac}(jw) \times 0.474\angle -18.43° \rightarrow V_{ac}(jw) = 8.43\angle -1.56°$$

$$i(jw) = \frac{V_{ac}(jw)}{2+2j} = \frac{8.43\angle -1.56°}{2.83\angle 45} = 2.98\angle -46.56°$$

$i(t) = 2.98\cos(100t - 46.56°)$