Final Exam Review - ELE 202 W 2023

Q 1: [20 marks]

Q 1: Part a) The switch in Figure 1 a has been opened for a long time. At $t = 0$, the switch is closed.

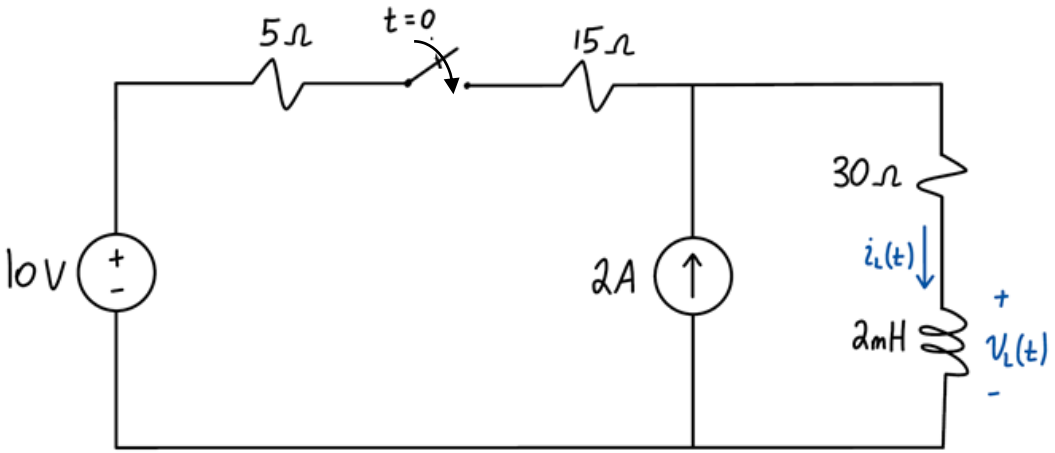
i) Calculate $i_L(0^+)$ and $i_L(\infty)$ (**Use Source Transformation only when solving for** $i_L(\infty)$) **[4 marks]**

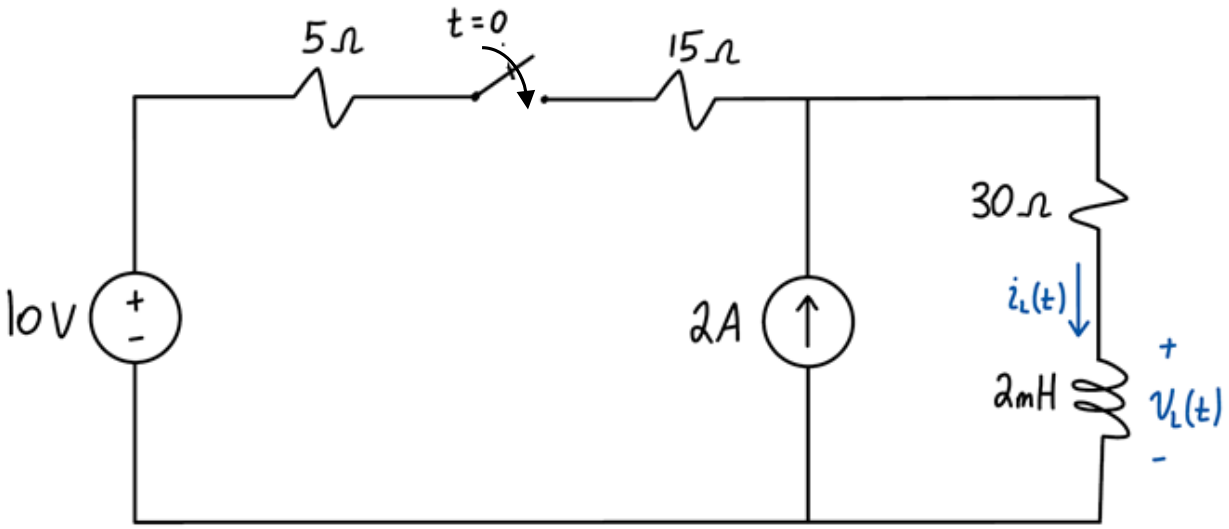
ii) Determine an expression for $i_L(t)$ for t>0 **[3 marks]**

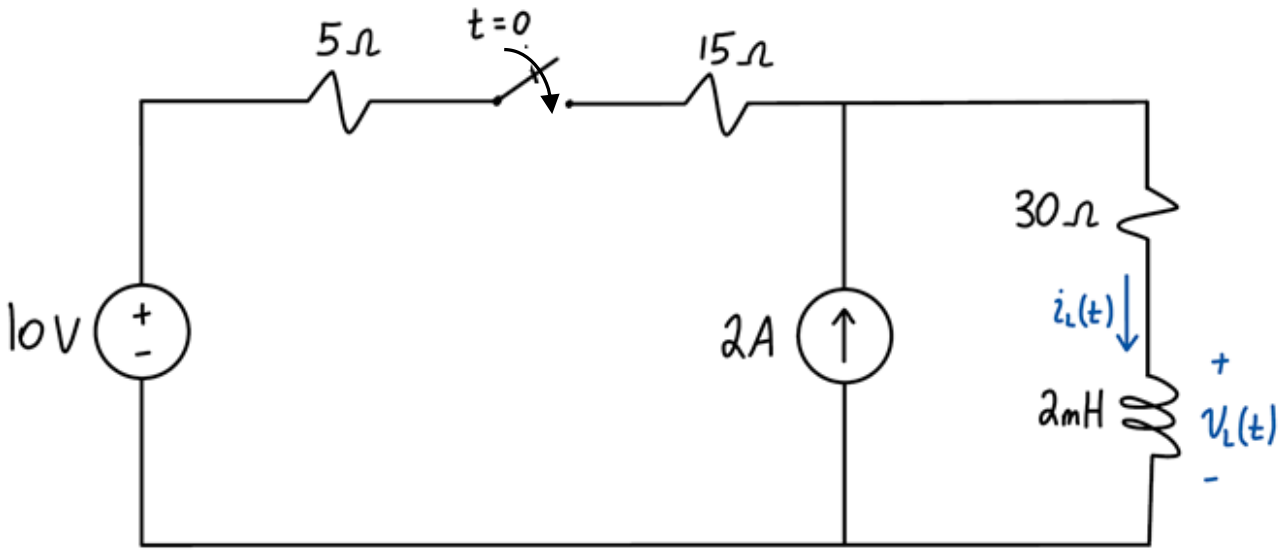
iii) Determine an expression for $v_L(t)$ for t>0 **[2 marks]**

v) Draw $i_L(t)$ versus time **[2 marks]**

Hints: $\tau = \frac{L}{R}$, $y(t) = y(\infty) + [y(0^+) - y(\infty)]e^{-\frac{t}{\tau}}$




5Ω
t=0
15Ω
30Ω
10V
+
-
2A
$i_L(t)$
+
2mH
$v_L(t)$
-


5Ω
t=0
15Ω
30Ω
10V
+
-
2A
$i_L(t)$
+
2mH
$v_L(t)$
-

Q 1: Part b)

The switch in Figure 1 b has been closed for a long time. At $t = 0$, the switch is opened.

i) Calculate $v_C(0^+)$ and $v_C(\infty)$ (**Use Superposition Principle only when solving for $v_C(0^+)$**) **[4 marks]**

ii) Determine an expression for $v_C(t)$ for t>0 **[3 marks]**

iii) Determine an expression for $i_C(t)$ for t>0 **[2 marks]**

Hints: $\tau = RC$, $y(t) = y(\infty) + [y(0^+) - y(\infty)]e^{-\frac{t}{\tau}}$

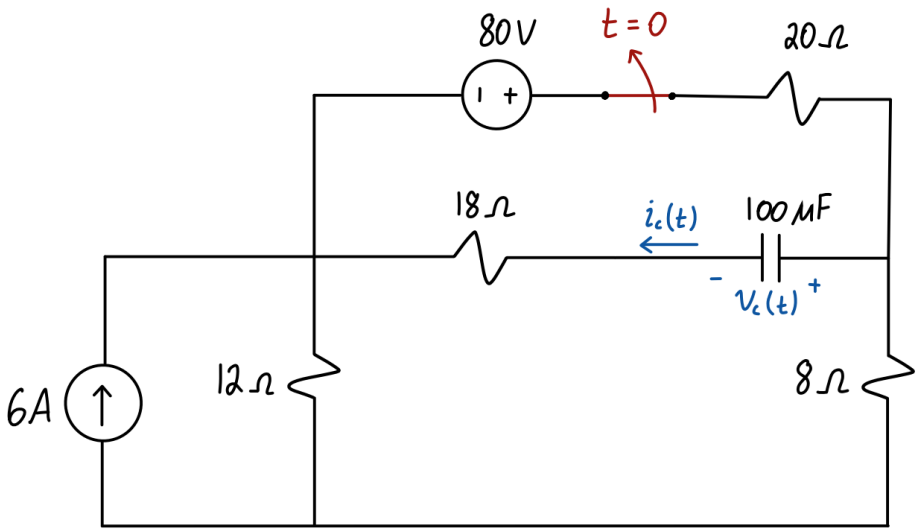
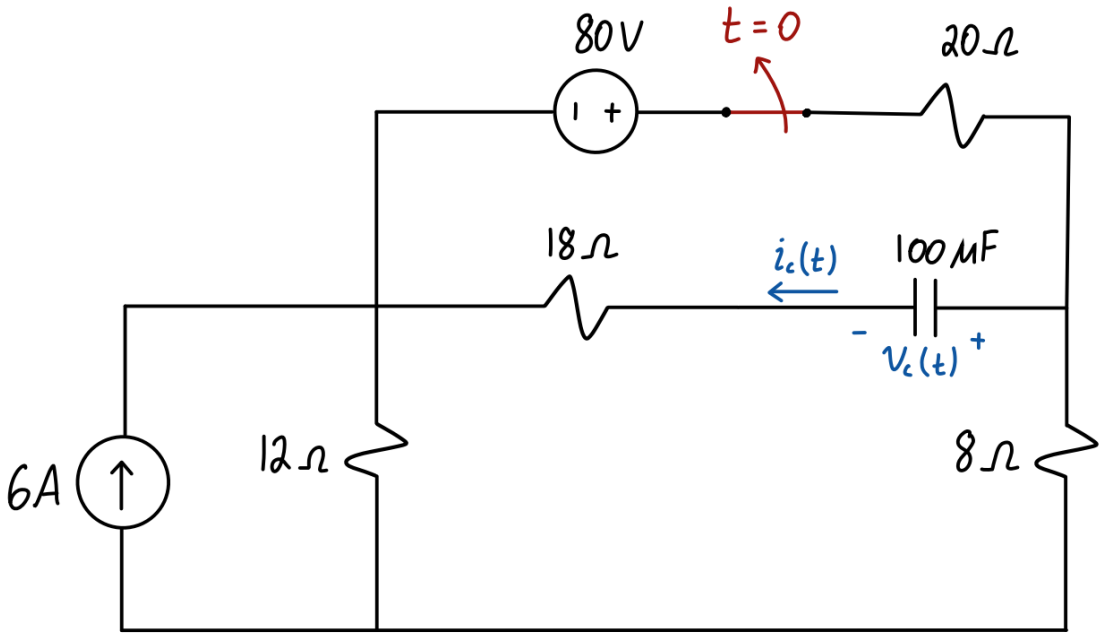
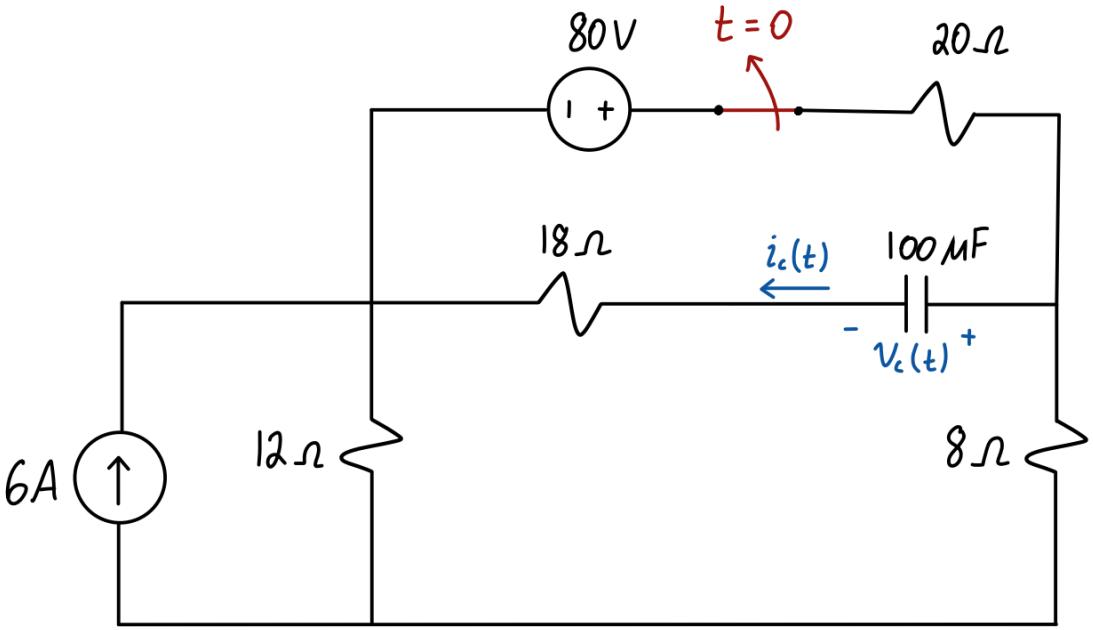


Figure 1 b: RC circuit with DC input


80V
t = 0
20Ω
18Ω
$i_c(t)$
100μF
$v_c(t)$
6A
12Ω
8Ω


80V
t = 0
20Ω
18Ω
$i_c(t)$
100μF
$v_c(t)$
6A
12Ω
8Ω

Q 2: [20 marks] Solve the circuit given below using Nodal Analysis.

1. Write the nodal equations at all the non-reference nodes **[6 marks]**
2. Simplify the equations **[4 marks]**
3. Rearrange the equations in Matrix form **[2 marks]**
4. Show all the steps of Cramer's rule to find the Node voltage **[2 marks]**
5. Using a calculator, calculate the numerical values of the Node voltages at all the non reference nodes **[2 marks]**
6. Express $\bar{I}$ in terms of the node voltages and calculate its numerical value. **[2 marks]**
7. Draw a phasor diagram showing $\bar{V}_{s1}$ and $\bar{I}$ phasors. **[2 marks]**

Note: All sources are AC.

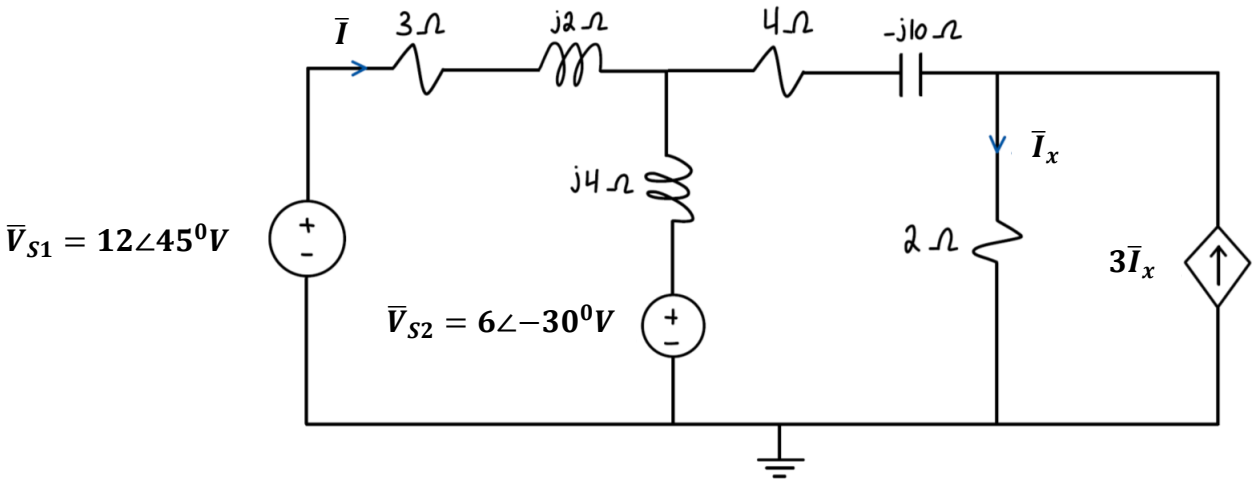
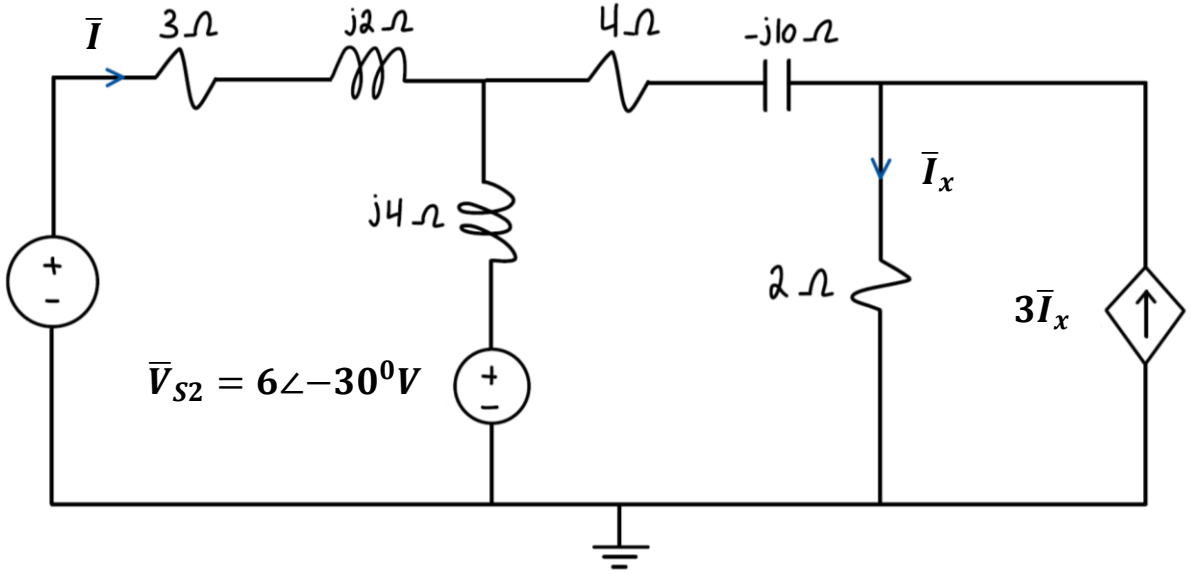
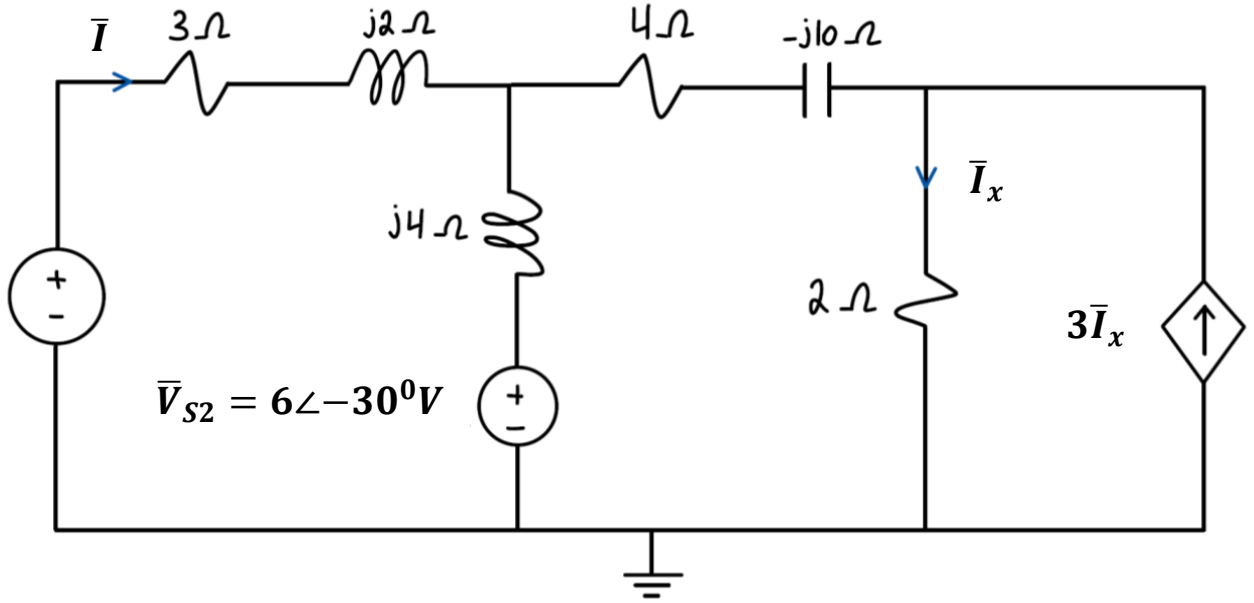


Figure 2: Circuit for Q 2

$\bar{V}_{S1} = 12\angle 45^0 V$



$\bar{V}_{S1} = 12\angle 45^0 V$



Q 3: **[20 marks]** Solve the circuit given below using Mesh Analysis.

1. Write all the mesh equations **[10 marks]**
2. Simplify the equations **[4 marks]**
3. Rearrange the equations in Matrix form **[2 marks]**
4. Show all the steps of Cramer's rule to find the mesh currents **[2 marks]**
5. Using a calculator, calculate the numerical value for the mesh currents **[2 marks]**

Note: All sources are AC.

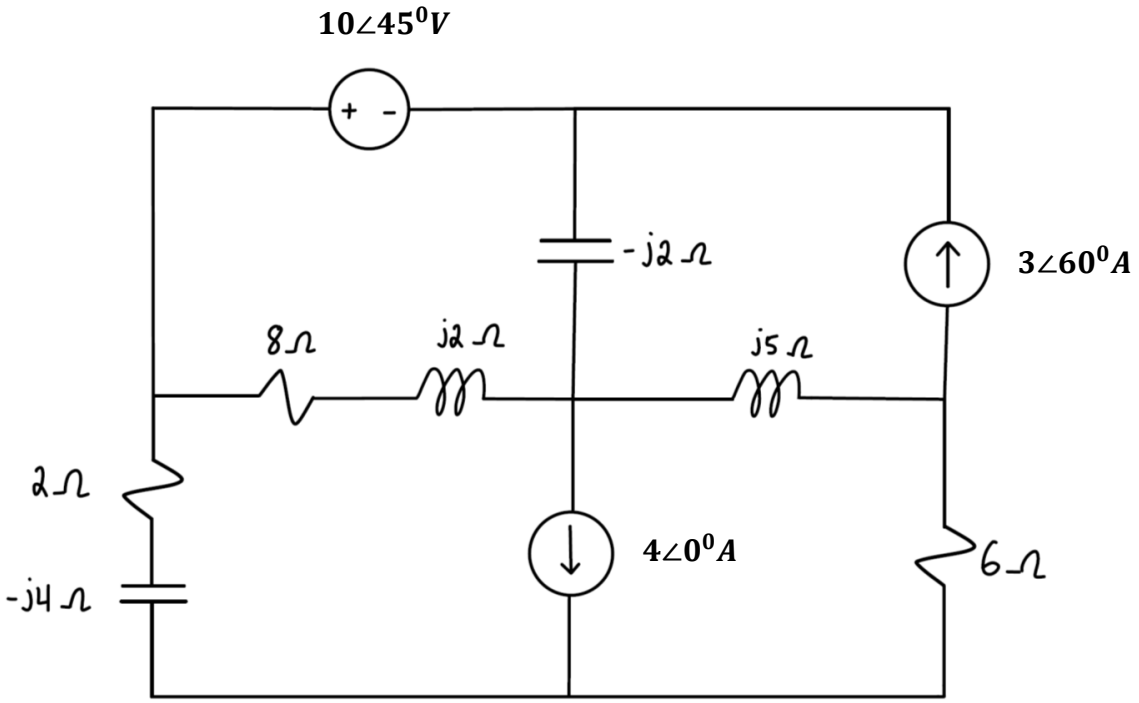
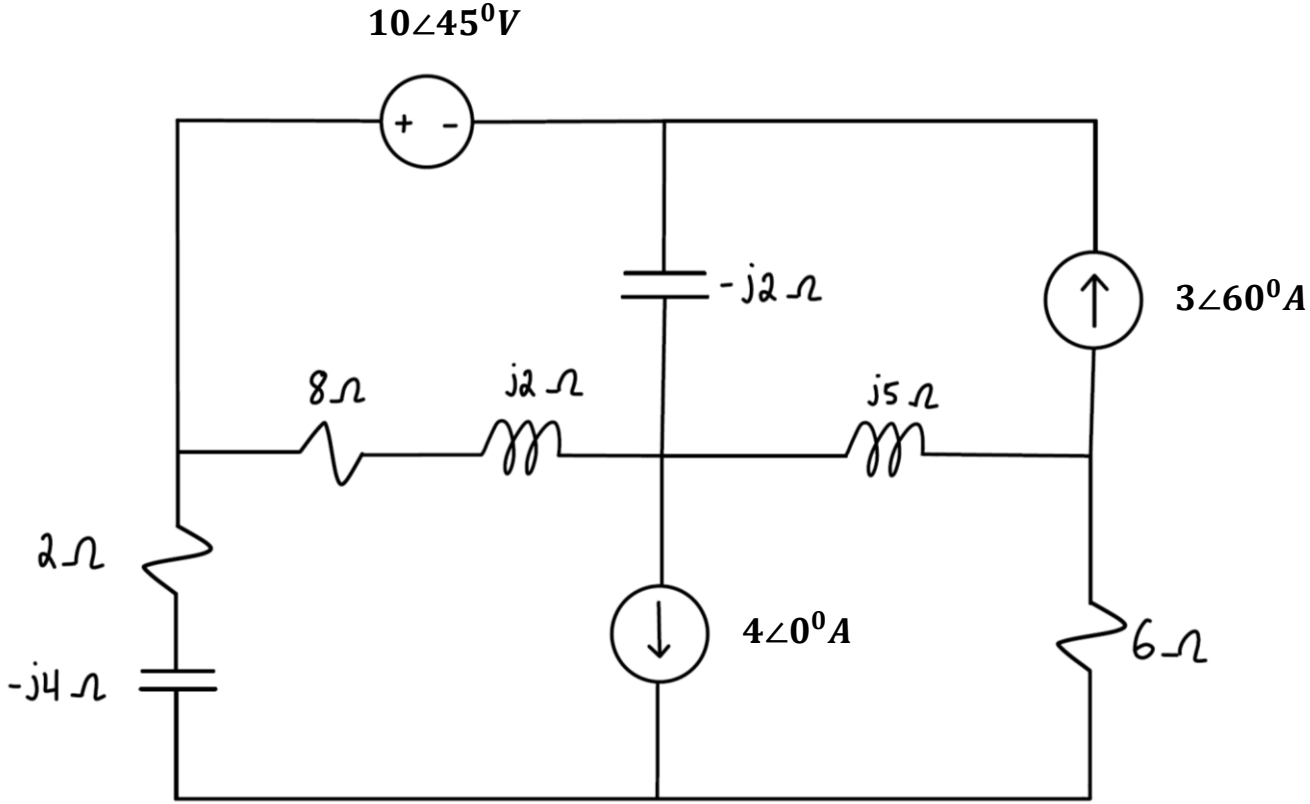
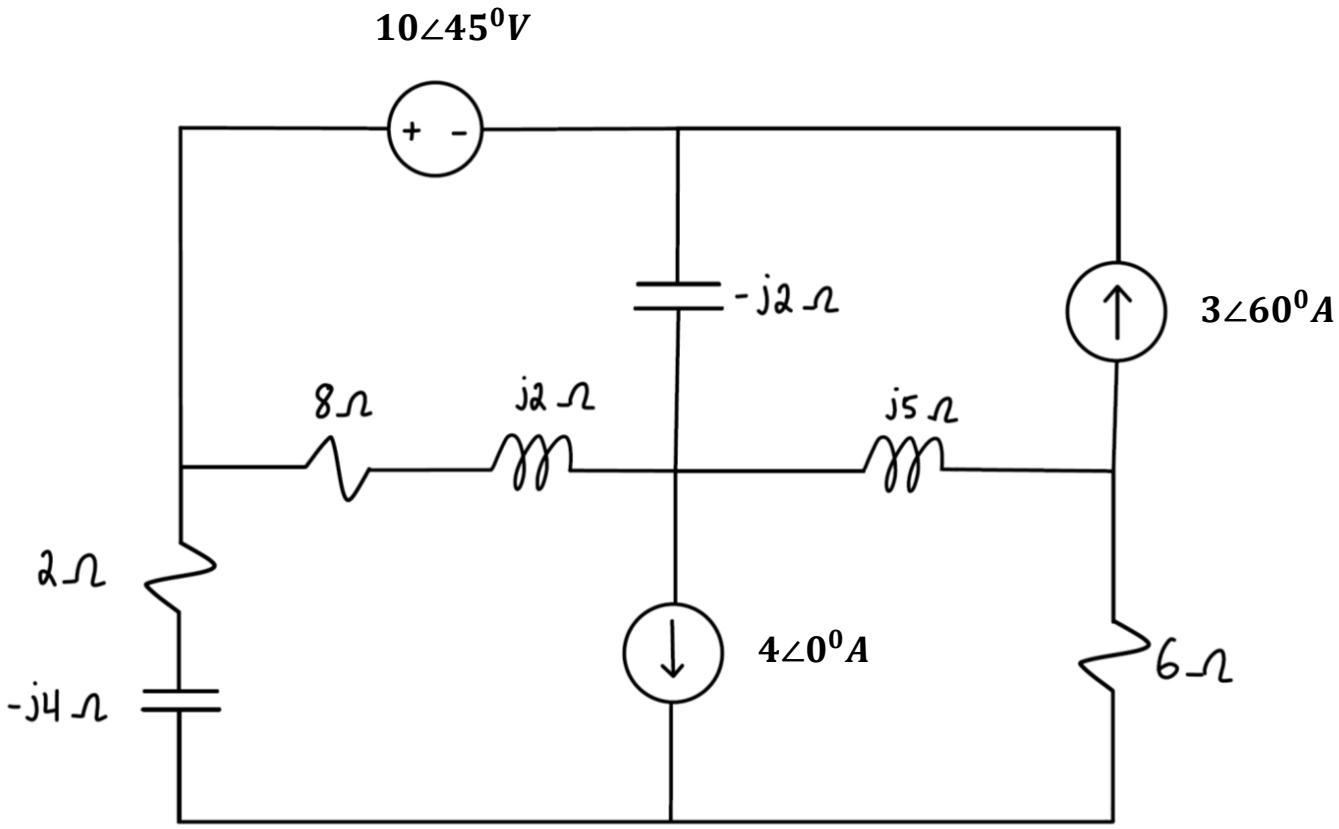


Figure 3: Circuit for Q 3


$10\angle 45^0 V$
+ -
$-j2\ \Omega$
$3\angle 60^0 A$
$8\ \Omega$
$j2\ \Omega$
$j5\ \Omega$
$2\ \Omega$
$-j4\ \Omega$
$4\angle 0^0 A$
$6\ \Omega$


$10\angle 45^0 V$
+ -
-j2 Ω
$3\angle 60^0 A$
8Ω
j2 Ω
j5 Ω
2Ω
-j4 Ω
$4\angle 0^0 A$
6Ω

Q 4: [20 marks] Determine the Thevenin equivalent at terminals $a - b$ of the circuit shown in Figure 4. The circuit is given in time domain. Please convert the component values to phasor domain before solving for the required variables.

1. Calculate the Thevenin equivalent voltage, V_{th}. Use the **source transformation only** as an analysis tool. If you use any other methods, marks will not be assigned even the value calculated is correct. **[8 marks]**
2. Calculate Z_{th}. **[8 marks]**
3. Calculate the value of Z_L for maximum power **[2 marks]**
4. Determine the maximum power absorbed by Z_L **[2 marks]**

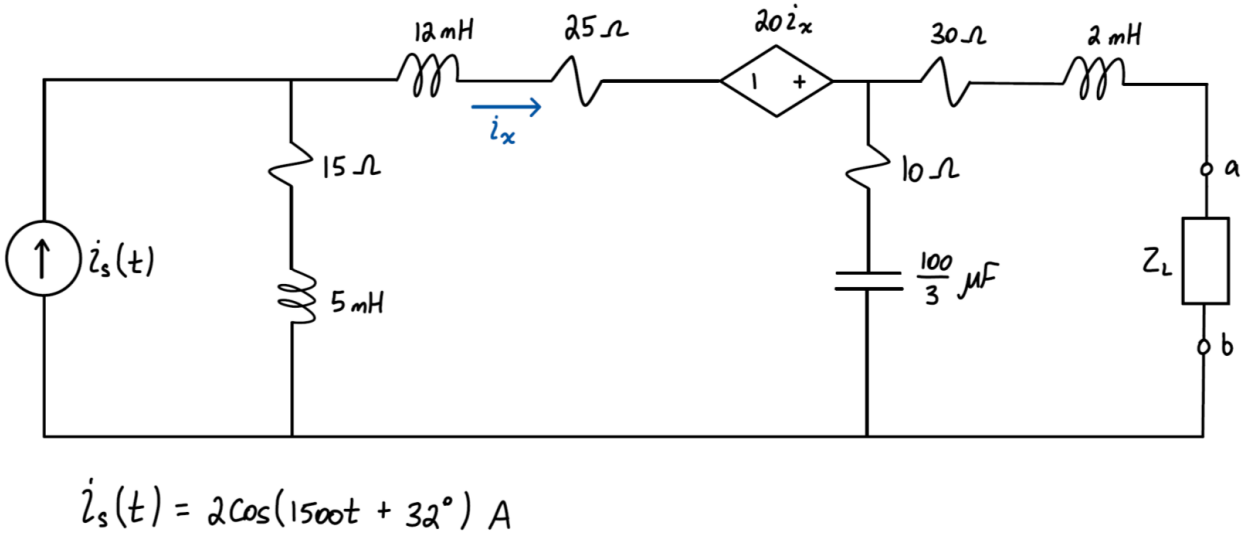
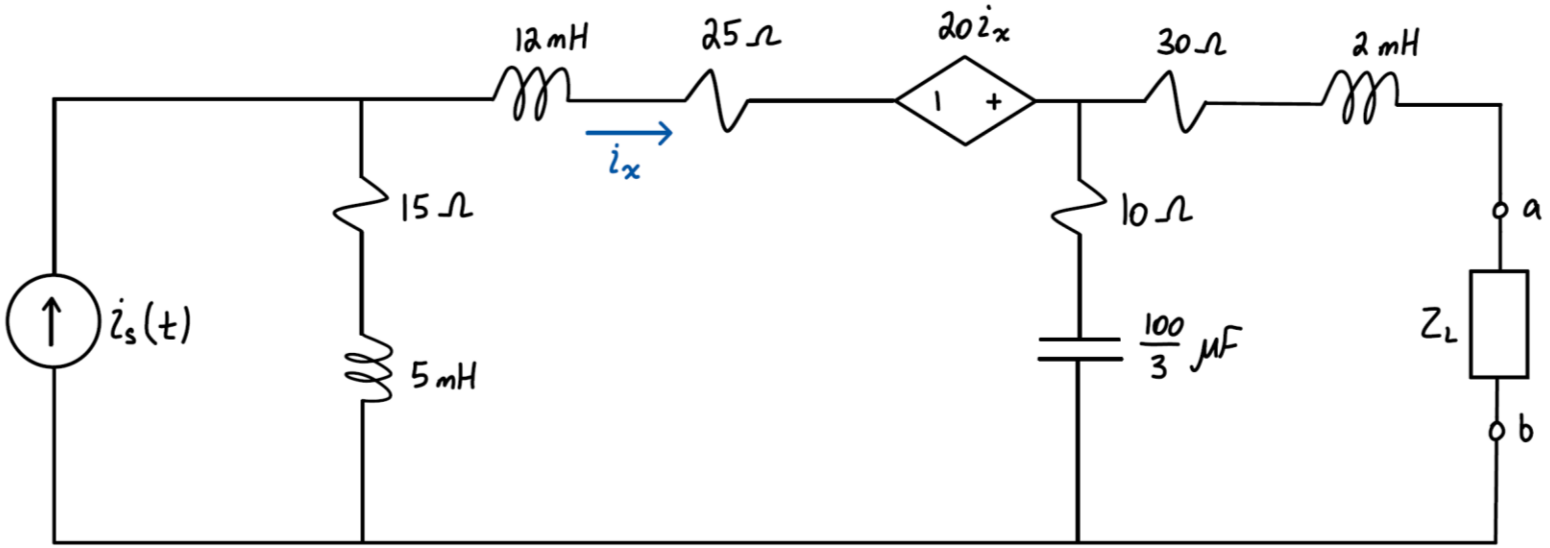
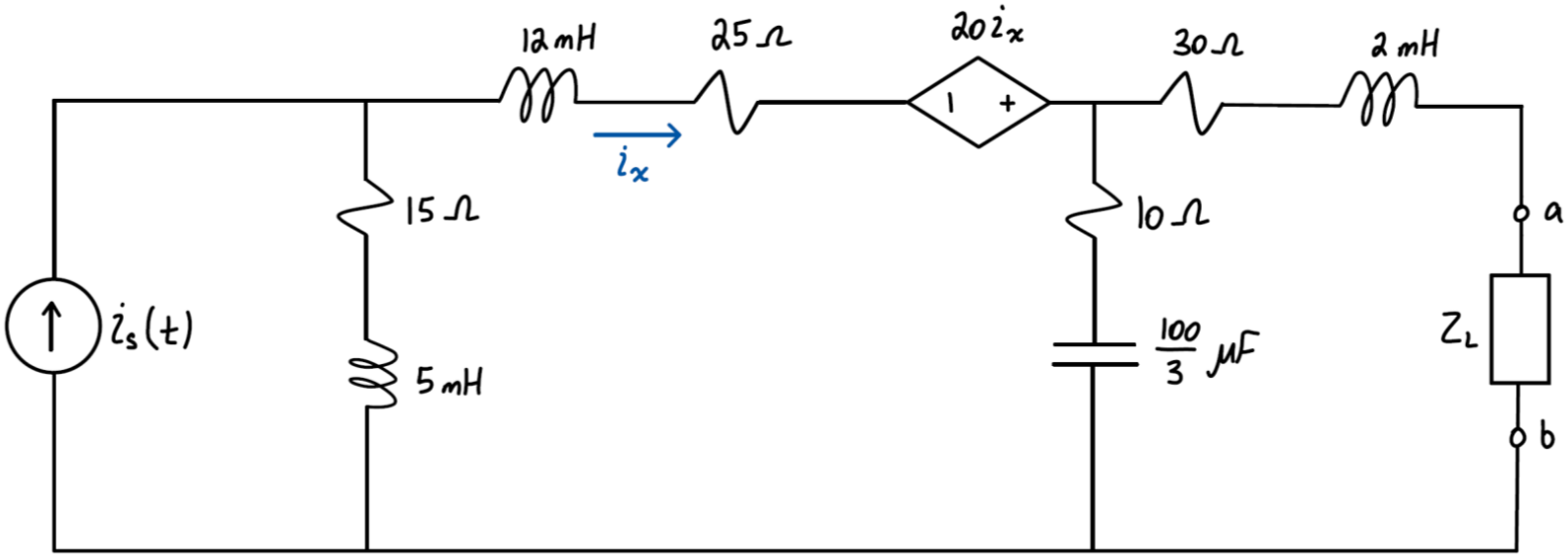


Figure 4: Circuit for Q 4 – Thevenin Theorem



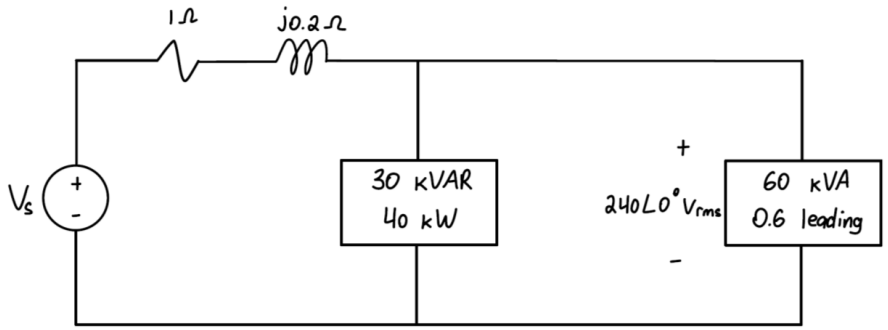
$$i_s(t) = 2\cos(1500t + 32^\circ)\ A$$

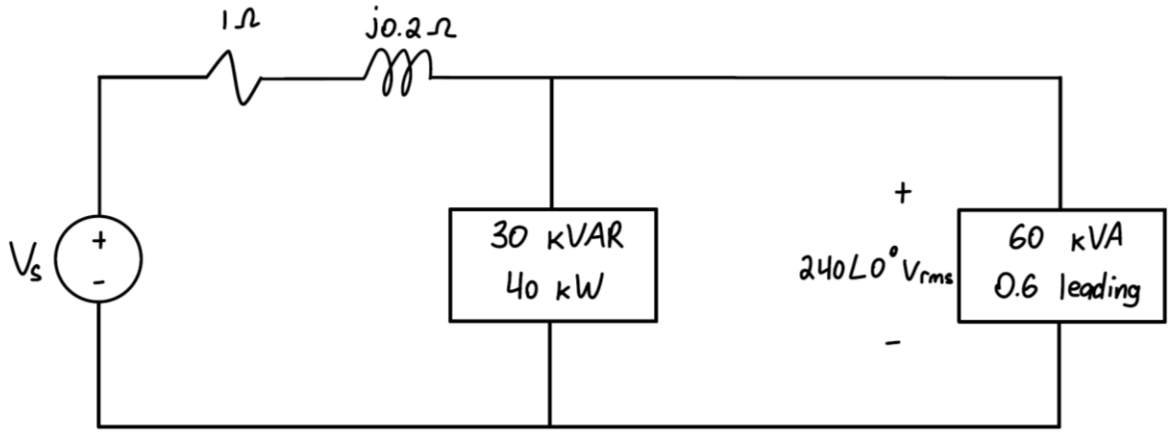


$$i_s(t) = 2\cos(1500t + 32^\circ)\ A$$

Q 5: [20 marks] For the circuit shown in Figure 5, complete the following:

1. Calculate the total apparent power **[3 marks]**
2. Calculate the total average power **[3 marks]**
3. Calculate the total reactive power **[3 marks]**
4. Calculate the total power factor **[3 marks]**
5. Calculate the total impedance **[3 marks]**
6. Calculate the rms value of **Vs** (both magnitude and phase) **[5 marks]**




1Ω
j0.2Ω
+
V_s
-
30 kVAR
40 kW
+
240∠0° V_{rms}
-
60 kVA
0.6 leading