ES 250 Practice Final Exam

1. Given that

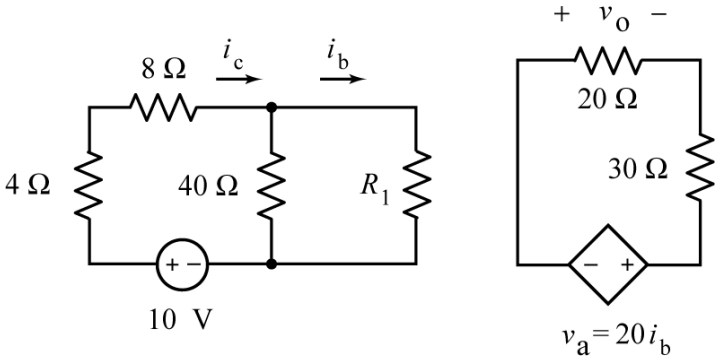
$$v_a = 8 \text{ V},$$

Determine the values of R_1 and v_o:

$$R_1 = \_\_\_\_\_ \ \Omega,$$

and

$$v_o = \_\_\_\_\_ \text{ V}$$

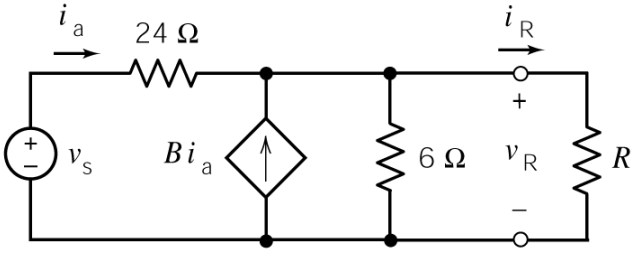


2. Given that $0 \le R \le \infty$ in this circuit, consider these two observations:

When $R = 2\ \Omega$ then $v_R = 4$ V and $i_R = 2$ A.

When $R = 6\ \Omega$ then $v_R = 6$ V and $i_R = 1$ A.

Fill in the blanks in the following statements:



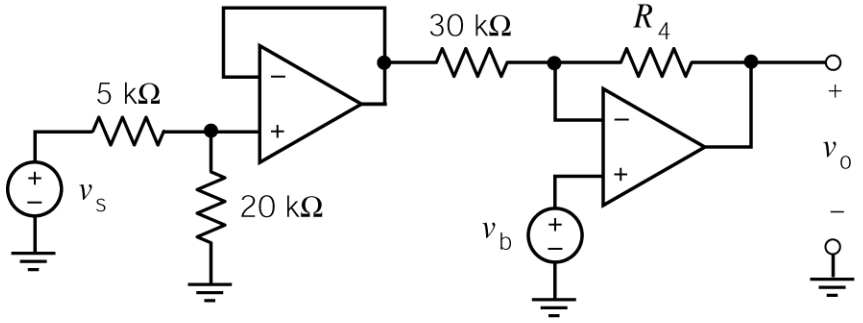
a. The maximum value of i_R is _____A.

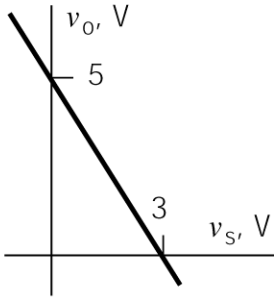
b. The maximum value of v_R is _____V.

c. The maximum value of $p_R = i_R v_R$ occurs when R = _____Ω.

d. The maximum value of $p_R = i_R v_R$ is _____W.

3.



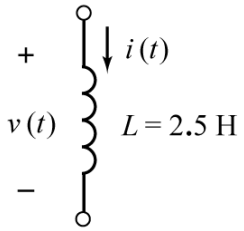


The input to this circuit is the voltage, v_s. The output is the voltage v_o. The voltage v_b is used to adjust the relationship between the input and output. Determine values of R_4 and v_b that cause the circuit input and output have the relationship specified by the graph

$$v_b = \_\_\_\_\_ \text{ V and } R_4 = \_\_\_\_\_ \text{ kΩ}.$$

4. Consider this inductor. The current and voltage are given by

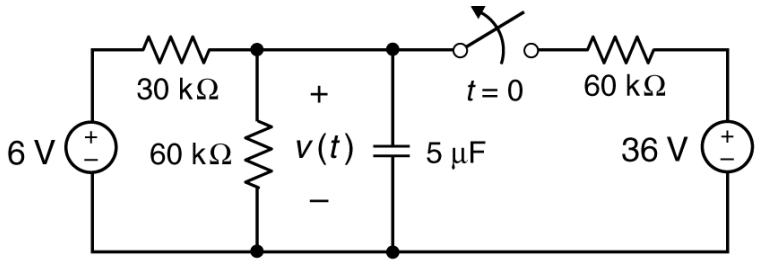
$$i(t)=\begin{cases}5t-4.6 & 0\le t\le 0.2\\ at+b & 0.2\le t\le 0.5\\ c & t\ge 0.5\end{cases} \quad \text{and} \quad v(t)=\begin{cases}12.5 & 0<t<0.2\\ 25 & 0.2<t<0.5\\ 0 & t>0.5\end{cases}$$



where a, b and c are real constants. (The current is given in Amps, the voltage in Volts and the time in seconds.) Determine the values of the constants:

a = _____A/s, b = _____A and c = _____A

5. This circuit is at steady state when the switch opens at time $t = 0$.

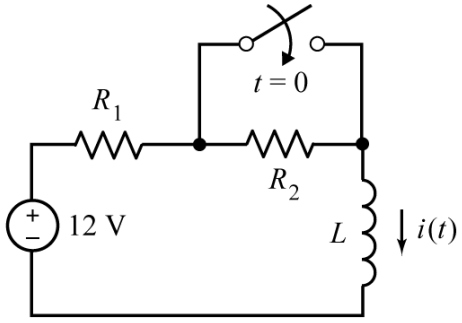


The capacitor voltage is $v(t)=A+Be^{-at}$ for $t\ge 0$. Determine the values of the constants A, B, and a:

A = _____ V, B = _____ V and a = _____ s.

6. This circuit is at steady state before the switch closes at time t = 0. After the switch closes, the inductor current is given by

$$i(t)=0.6-0.2e^{-5t}\ \text{A} \quad \text{for } t\ge 0$$



Determine the values of R_1, R_2 and L:

R_1 = _____ Ω, R_2 = _____ Ω

and

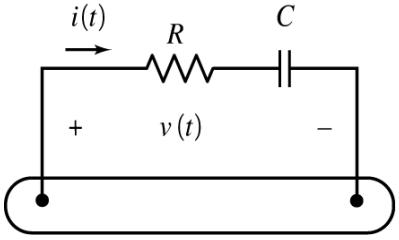
L = _____ H

7. The voltage and current for this circuit are given by

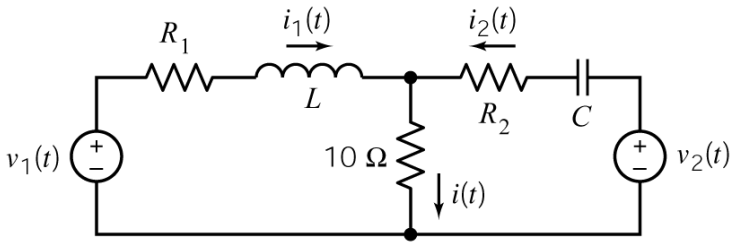
$v(t) = 20\cos(20t + 15°)$ V and $i(t) = 1.49\cos(20t + 63°)$ A

Determine the values of the resistance, R, and capacitance, C:

R = _____ Ω and C = _____ mF.



8.



This circuit is at steady state. The voltage source voltages are given by

$$v_1(t) = 12 \cos(2t - 90°) \text{ V} \quad \text{and} \quad v_2(t) = 5 \cos(2t + 90°) \text{ V}$$

The currents are given by

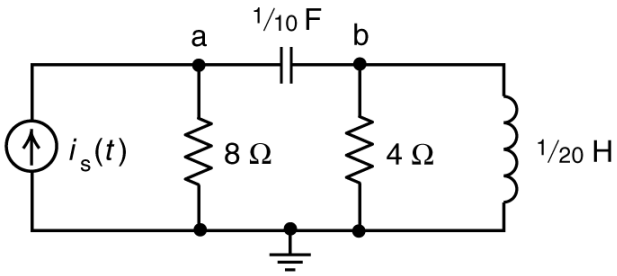
$$i_1(t) = 744 \cos(2t - 118°) \text{ mA}, \; i_2(t) = 540.5 \cos(2t + 100°) \text{ mA} \; \text{and} \; i(t) = A \cos(2t - 164°) \text{ mA}$$

Determine the values of A, R_1, R_2, L and C:

$A =$ _____ mA, $R_1 =$ _____ Ω, $R_2 =$ _____ Ω, $L =$ _____ H and $C =$ _____ mF.

9. The input this circuit is the current

$$i_s(t) = 2\cos(5t + 15°) \text{ A}.$$



In the frequency domain, this circuit is represented by the node equation

$$\begin{bmatrix} d + j0.5 & -j0.5 \\ -j0.5 & 0.25 + je \end{bmatrix} \begin{bmatrix} \mathbf{V}_a \\ \mathbf{V}_b \end{bmatrix} = \begin{bmatrix} 2\angle 15° \\ 0 \end{bmatrix}$$

where $\mathbf{V}_a$ and $\mathbf{V}_b$ are the phasor node voltages and d and e are real numbers. Determine the values of d and e.

$d =$ _____Ω and $e =$ _____Ω