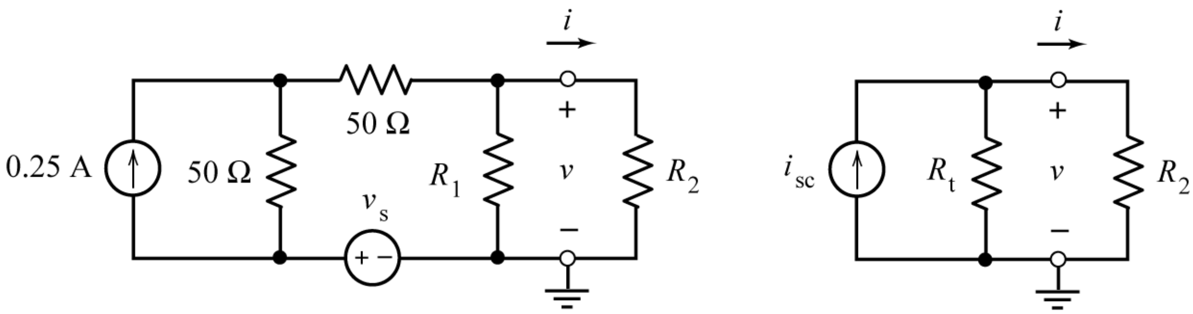
Sample ES 250 Second Midterm Exam

1.



The part of the first circuit to the left of the terminals can be reduced to its Norton equivalent circuit using source transformations and equivalent resistance. The resulting Norton equivalent circuit will be characterized by the parameters:

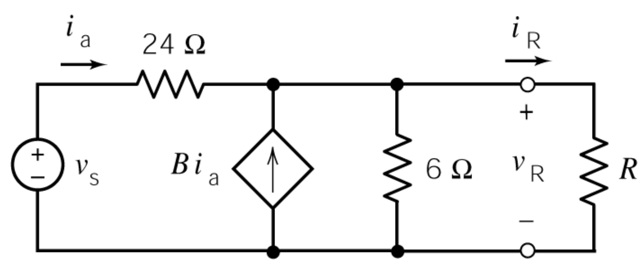
$$i_{sc} = 0.5\text{ A} \quad \text{and} \quad R_t = 20\ \Omega$$

Determine the values of v_s and R_1: v_s =____37.5___V and R_1 =___25_____Ω

Given that $0 \le R_2 \le \infty$, determine the maximum values of the voltage, v, and of the power, $p = vi$:

max v =____10_____V and max p =____1.25____W

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



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

When R = 6 Ω 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 ____4_____A.

b. The maximum value of v_R is ____8_____V.

c. The maximum value of $p_R = i_R v_R$ occurs when R = _____2____Ω.

d. The maximum value of $p_R = i_R v_R$ is ____8____W.

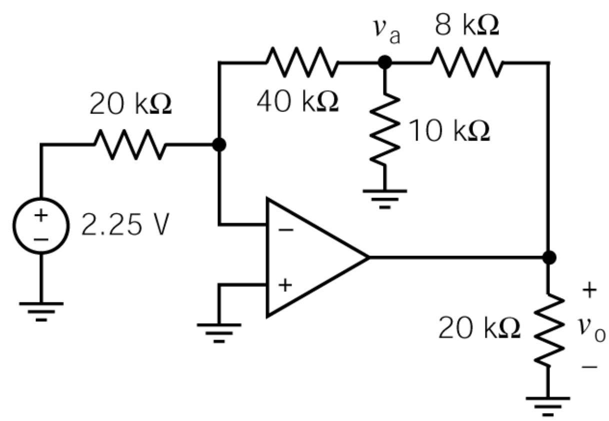
e. When R = 5 Ω then v_R =__5.714__V.

f. When R = _____8____Ω then $v_R = 6.4$ V.

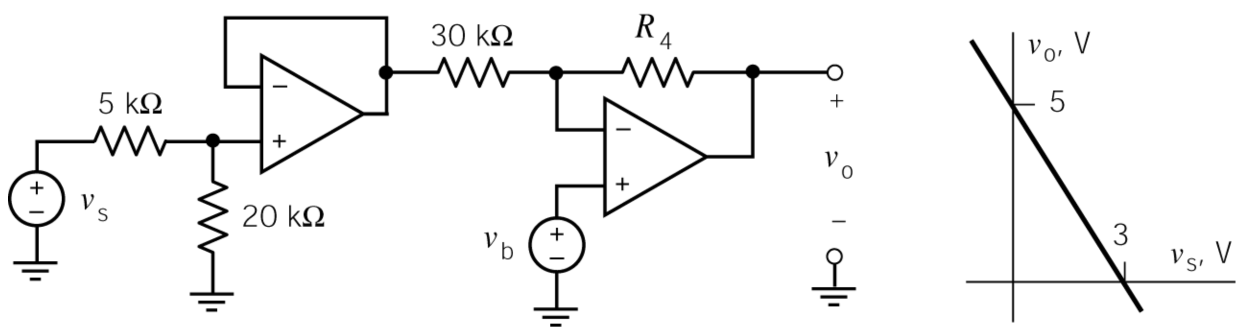
g. When R = _____14____Ω then $i_R = 500$ mA.

3. Determine the values of the node voltages v_a and v_o:

v_a = ____–4.5____ V and v_o = ____–9___ V.



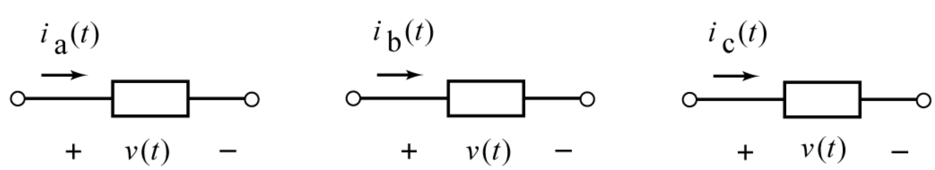
4.



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 = ___1.62__ V and R_4 = ___62.5___ kΩ.

5. One of these three elements is a resistor, one is a capacitor and one is an inductor:



Given $$v(t) = 24\cos(5t)\ \text{V},$$

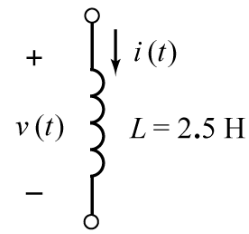
And $i_a(t) = 3\cos(5t)$ A, $i_b(t) = 12\sin(5t)$ A and $i_c(t) = -1.8\sin(5t)$ A

Determine the resistance of the resistor, the capacitance of the capacitor and the inductance of the inductor. (We require positive values of resistor, capacitance and inductance.)

resistance = ___8___Ω, capacitance = ___0.015___F and inductance = ___0.4__H

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

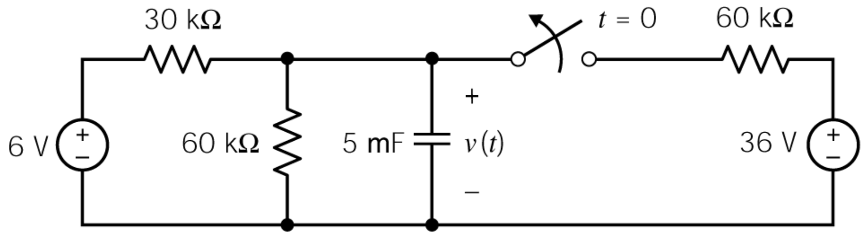
$$i(t)=\begin{cases}5t-4.6 & 0\le t\le 0.2\\ at+b & 0.2\le t\le 0.5\\ c & t\ge 0.5\end{cases}\quad\text{and}\quad v(t)=\begin{cases}12.5 & 0<t<0.2\\ 25 & 0.2<t<0.5\\ 0 & t>0.5\end{cases}$$



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 = ___10___A/s, b = ___–5.6___A and c = ___–0.6__A

7. 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:

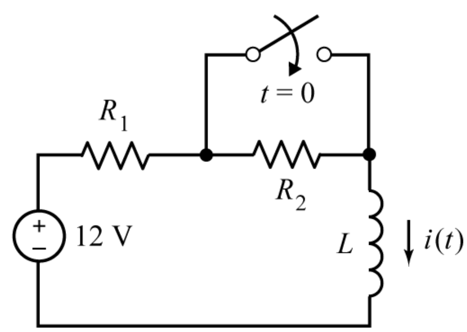
A = ____4__ V, B = __8___ V and a = ___0.01___ s.

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

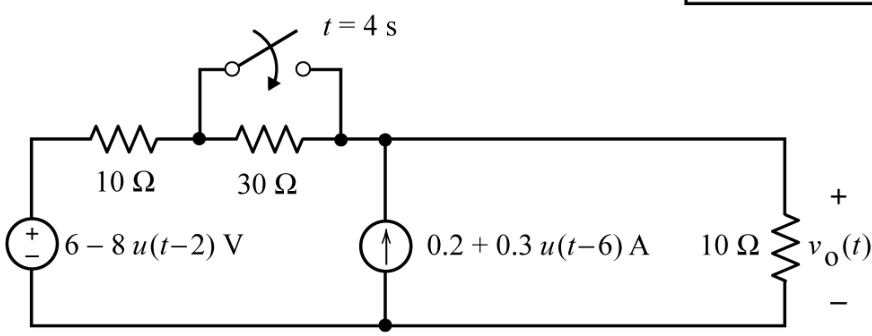
$$i(t)=0.6-0.2e^{-5t}\text{ A}\quad\text{for } t\ge 0$$

Determine the values of R_1, R_2 and L:

R_1 = ___20____ Ω , R_2 = ___10____ Ω and L = ___4____ H



9.



Determine $v_o(1)$, $v_o(3)$, $v_o(5)$, and $v_o(7)$; the values of the voltage $v_o(t)$ at times t = 1, 3, 5 and 7 seconds.

$v_o(1)$ = ____2.8___ V, $v_o(3)$ = ____1.2___ V, $v_o(5)$ = ____0_____ V, and $v_o(7)$ = ___1.5____ V