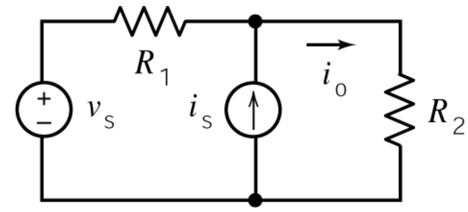
Another Sample ES 250 Final Exam

1. This circuit has two inputs, v_s and i_s, and one output i_o. The output is related to the inputs by the equation



$$i_o = a\,i_s + b\,v_s$$

Given the following two facts:

The output is $i_o = 0.45$ A when the inputs are $i_s = 0.25$ A and $v_s = 15$ V.

and

The output is $i_o = 0.30$ A when the inputs are $i_s = 0.50$ A and $v_s = 0$ V.

Determine the following:

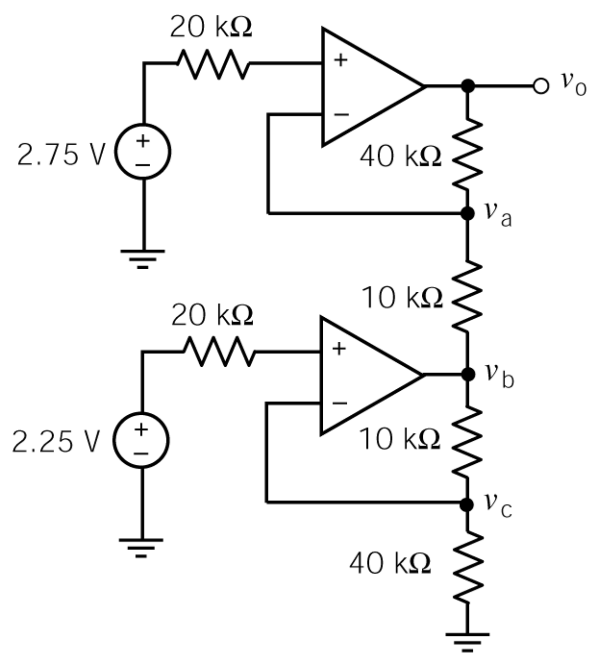
The values of the constants a and b are $a =$ ___________ and $b =$ ___________ A/V.

The values of the resistances are $R_1 =$ ___________ Ω and $R_2 =$ ___________ Ω.

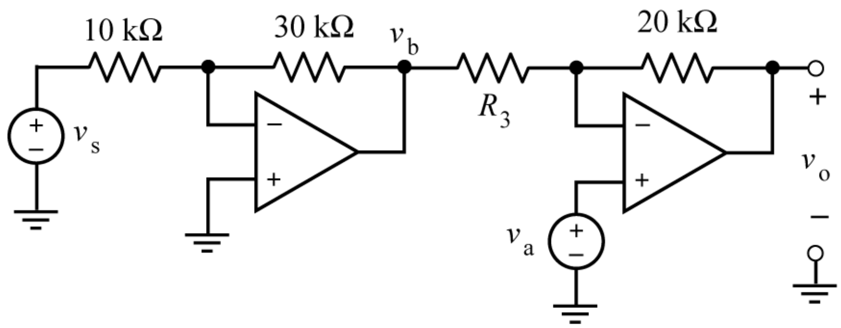
2. Determine the values of the node voltages v_a, v_b, v_c and v_o:

$v_a =$ ___________ V, $v_b =$ ___________ V,

$v_c =$ ___________ V, and $v_o =$ ___________ V.



3.



The node voltage v_b is given by

$$v_b = -3v_s$$

The input to this circuit is the voltage v_s. The output is the node voltage v_o. The output is related to the input by the equation $v_o = m\,v_s + b$ where *m* and *b* are constants.

(a) Suppose $v_o = 18$ V when $v_s = 1$ V and $v_o = 6$ V when $v_s = -1$ V. Determine the values of *m* and *b*:

$m =$ ___________V/V and $b =$ ___________V.

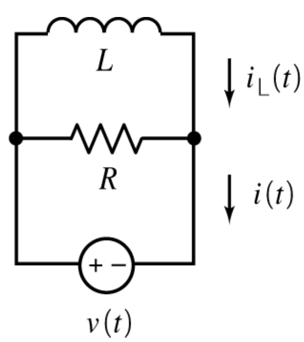
(b) Instead, suppose that $R_3 = 12$ kΩ and $v_a = 3$ V. Determine the values of *m* and *b*:

$m =$ ___________V/V and $b =$ ___________V.

(c) Instead, suppose that we require $v_o = 4\,v_s + 7$. Determine the required values of R_3 and v_a:

$R_3 =$ ___________kΩ and $v_a =$ ___________V.

4. The input to this circuit is the voltage:
$v(t) = 4e^{-20t}$ V for $t > 0$

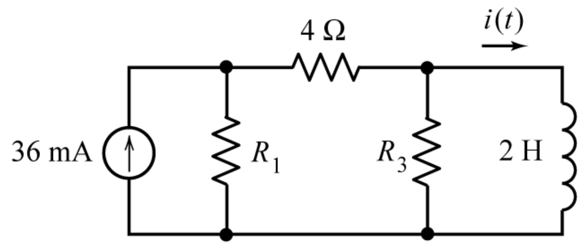


The output is the current: $i(t) = -1.2e^{-20t} - 1.5$ A for $t > 0$

The initial condition is $i_L(0) = -3.5$ A. Determine the values of the resistance and inductance:

$R =$ ___________Ω and $L =$ ___________ H.

5. After time $t = 0$, a given circuit is represented by this circuit diagram.



a. Suppose that the inductor current is

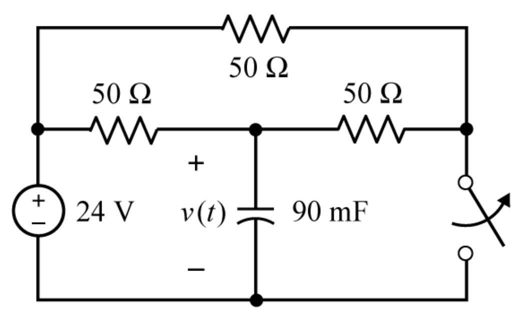
$$i(t) = 21.6 + 28.4e^{-4t} \text{ mA} \quad \text{for } t \geq 0$$

Determine the values of R_1 and R_3: $R_1 =$ ____________ Ω and $R_3 =$ ___________ Ω.

b. Suppose instead that $R_1 = 16\ \Omega$, $R_3 = 20\ \Omega$, the initial condition is $i(0) = 10$ mA, and the inductor current is $i(t) = A + Be^{-at}$ for $t \geq 0$. Determine the values of the constants A, B, and a:

$A =$ ___________ mA, $B =$ ___________ mA and $a =$ ___________ s.

6. a) Determine the time constant, τ, and the steady state capacitor voltage, $v(\infty)$, when the switch is **open**:

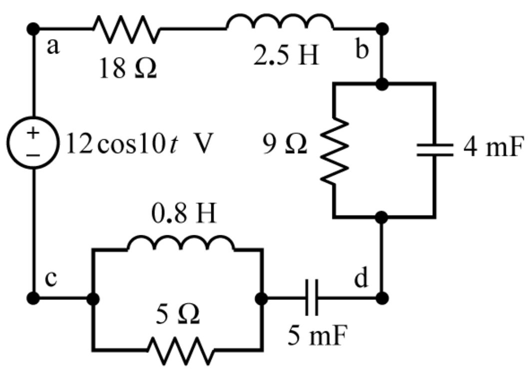


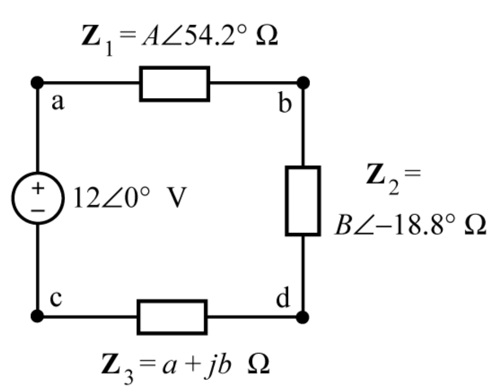
$\tau =$ ___________ s and $v(\infty) =$ ___________ V

b) Determine the time constant, τ, and the steady state capacitor voltage, $v(\infty)$, when the switch is **closed**:

$\tau =$ ___________ s and $v(\infty) =$ ___________V

7. Here is an ac circuit represented in both the time domain and the frequency domain:

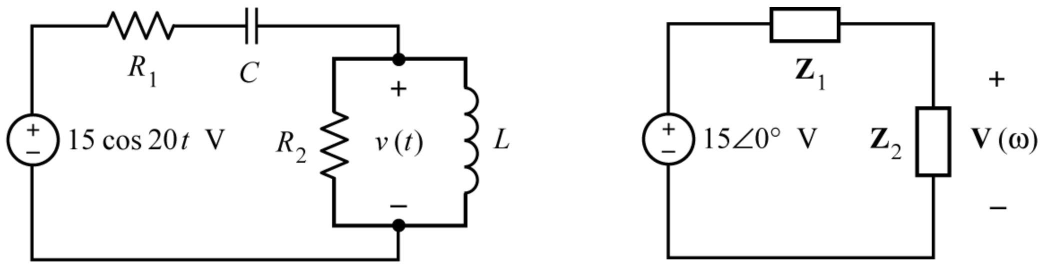




Determine the values of A, B, a and b.

$A =$ ___________ V, $B =$ ___________ Ω, , $a =$ ___________ Ω and $b =$ ___________ Ω.

8. Here is an ac circuit represented in both the time domain and the frequency domain:



Given that $\mathbf{Z}_1 = 15.3\angle -24.1°\ \Omega$, $\mathbf{Z}_2 = 14.4\angle 36.9°\ \Omega$ and $\mathbf{V}(\omega) = A\angle 31.5°\ \text{V}$, determine the values of A, R_1, R_2, L and C.

$A =$ ________ V, $R_1 =$ ________ Ω, $R_2 =$ ________ Ω, $L =$ ________ H and $C =$ _______ mF.