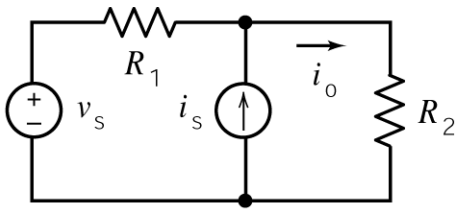
# Another Sample ES 250 Second Midterm Exam

**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.

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

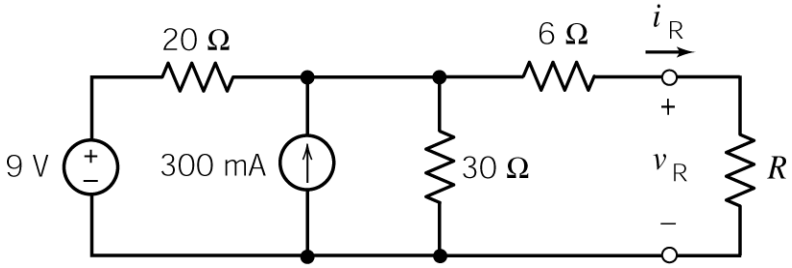
The values of the resistances are $R_1$ = _____ Ω and $R_2$ = _____ Ω.

**2.** Fill in the blanks in the following statements:

When $R$ = 9 Ω then $v_R$ = _____V.

When $R$ = _____Ω then $v_R$ = 5.4 V.

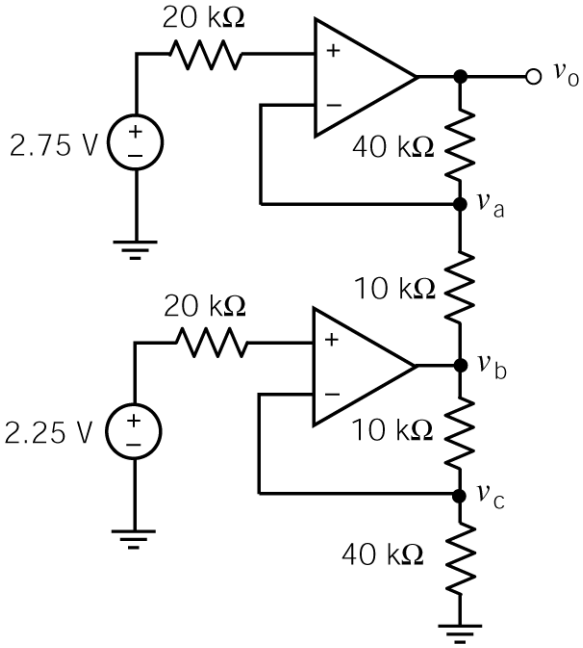
When $R$ = _____Ω then $i_R$ = 300 mA.



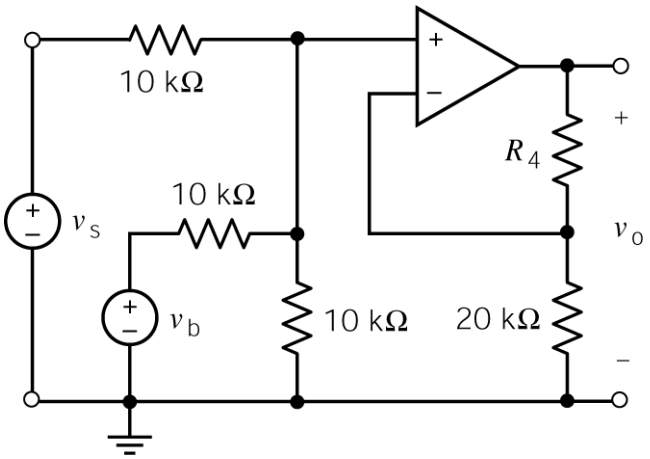

**3.** Determine the values of the node voltages $v_a$, $v_b$, $v_c$ and $v_o$:

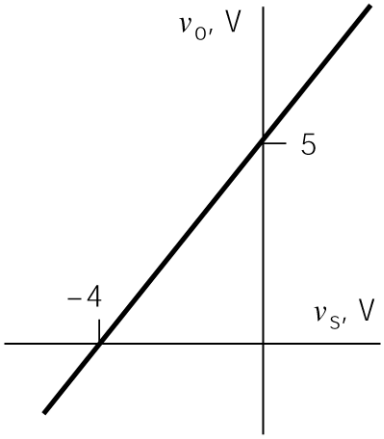
$v_a$ = _____ V, $v_b$ = _____ V,

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



**4.**

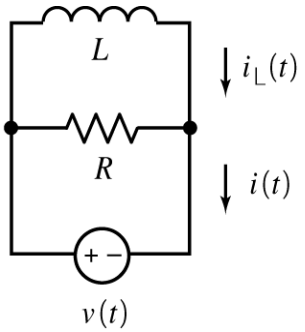



The input to this circuit is the voltage, $v_s$. The output is the voltage $v_o$. The voltage $v_b$ is used to adjust the relationship between the input and output. Determine values of $R_4$ and $v_b$ that cause the circuit input and output have the relationship specified by the graph

$v_b$ = _____ V and $R_4$ = _____ kΩ.

**5.** 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.

**6.** The initial inductor current is $i(0)$ = 25 mA.

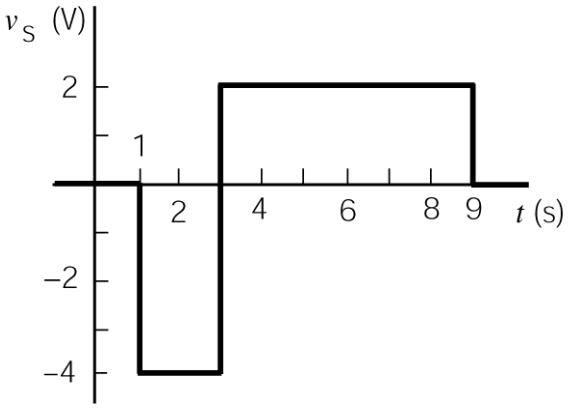
Determine the values of the inductor current at 2, 3, 6 and 9 seconds:

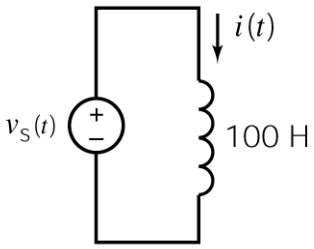
$i(2)$ = _____ mA,

$i(3)$ = _____ mA,

$i(6)$ = _____ mA,

$i(9)$ = _____ mA.

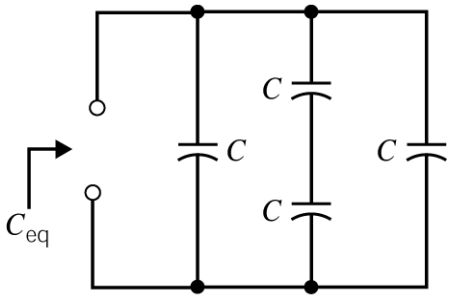


**7.**

a. When $C$ = 10 F then $C_{eq}$ = _____F.

b. When $C$ = _____F then $C_{eq}$ = 8 F.




**8.** This circuit has reached steady state before the switch opens at time $t$ = 0. Determine the values of $i_L(t)$, $v_C(t)$ and $v_R(t)$ immediately before the switch opens:

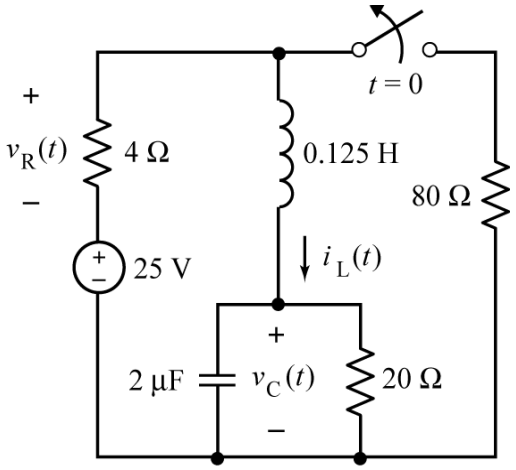
$i_L(0-)$=_____A, $v_C(0-)$ =_____V

and

$v_R(0-)$=_____V

Determine the value of $v_R(t)$ immediately after the switch opens:

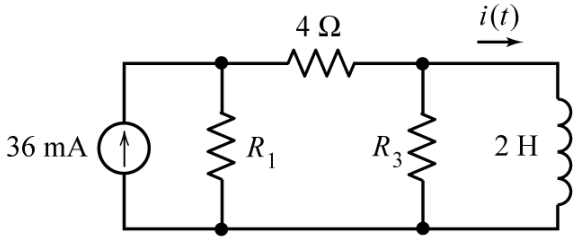
$v_R(0+)$=_____V




**9.** 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 Ω, $R_3$ = 20 Ω, 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.

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

τ = _____ s and $v(\infty)$ = _____ V

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

τ = _____ s and $v(\infty)$ = _____ V