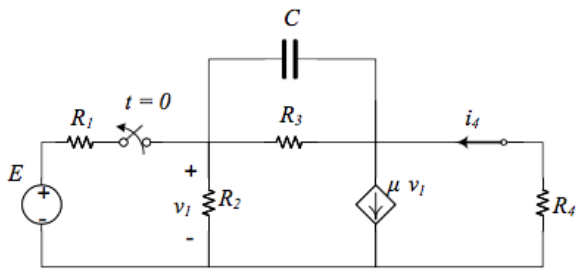
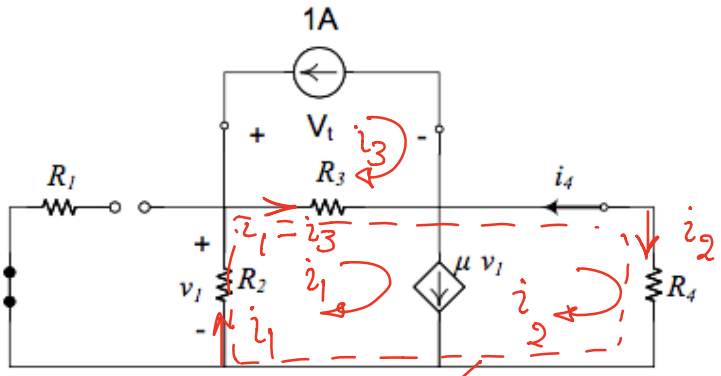




Supermesh

Rth

Connect a current source with 1A and find the voltage V_t

$v_1 = -i_1 R_2$

$i_3 = -1$

super mesh

$R_2 i_1 + R_3 (i_1 - i_3) + i_2 R_4 = 0$

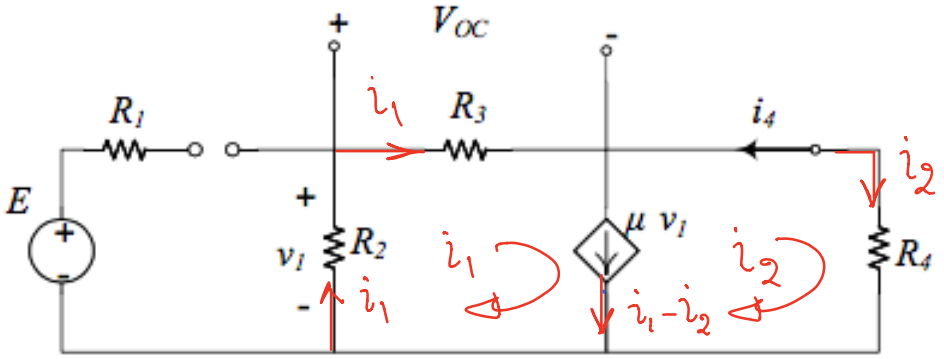
$i_1 - i_2 = \mu v_1 = -\mu i_1 R_2$

Solve for i_1 & i_2 & i_3

$v_t = R_3 \times (i_1 - i_3)$

$R_{th} = V_t = R_3 (i_1 - i_3) = R_3 (i_1 + 1) = 7.4386$

Voc



Supermesh $i_1 R_2 + R_3 i_1 + i_2 R_4 = 0$ —(1)

$i_1 - i_2 = \mu v_1$

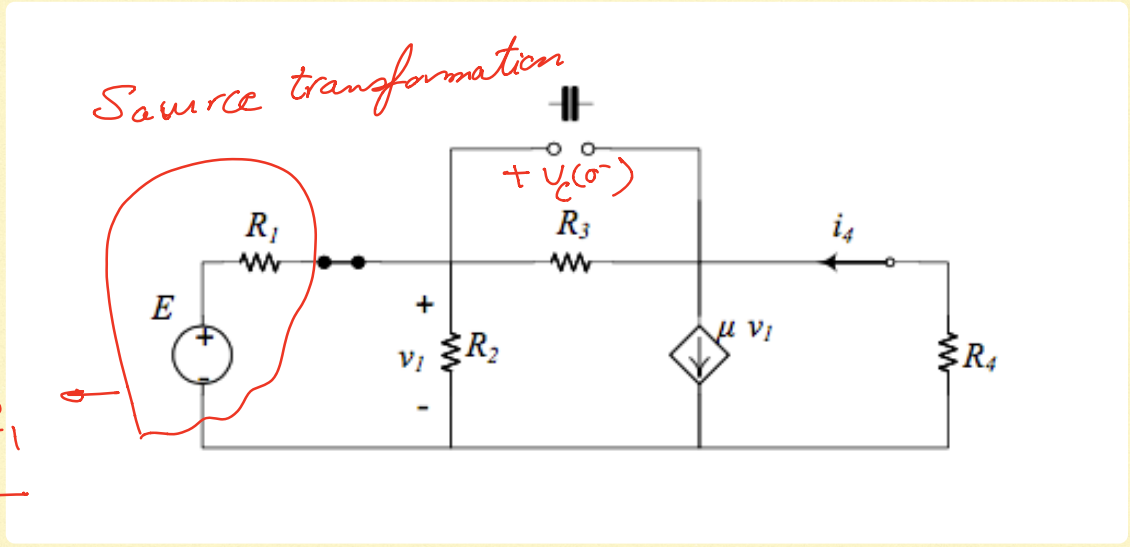
$= -\mu i_1 R_2$ —(2)

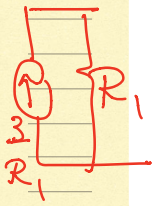
Solving eq (1) & (2), we find that

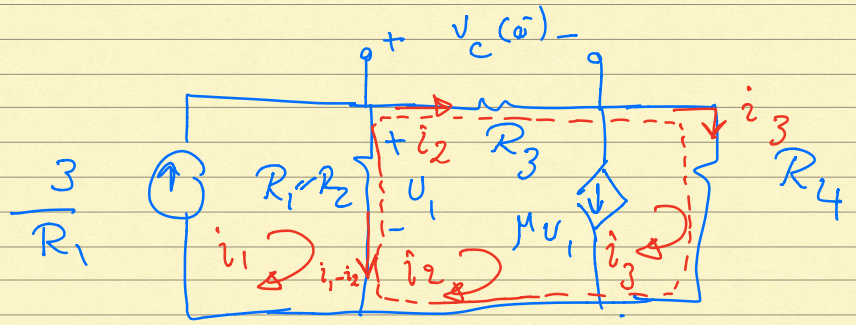
$i_1 = i_2 = 0$

$V_{oc} = 0$

$V_C(0^+)$







$i_1 = \frac{3}{R_1}$, ← loop (1)

$-(i_1 - i_2)(R_1 // R_2) + i_2 R + i_3 R_4 = 0$ ← supermesh

$$i_2 - i_3 = \mu v_1 \quad \leftarrow \text{current source}$$

$$= \mu (i_1 - i_2)(R_1 \parallel R_2)$$

Solving (1), (2) & (3), we get i_1, i_2 & i_3

$$v_c(0^-) = i_2 R_3$$

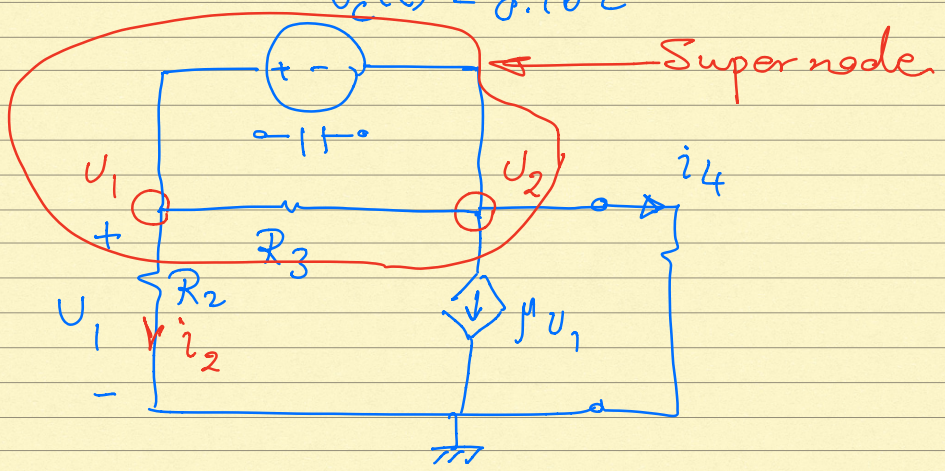
$$= 8.16\ V = v_c(0^+)$$

$$v_c(t) = V_{oc} + [v_c(0^+) - V_{oc}]\, e^{-t/(R_t C)}$$

$$= 8.16\, e^{-1.807t}$$

To find the current in the resistor, we make use of the now known voltage across the capacitor by representing the capacitor as a voltage source with voltage $v_c(t)$

$$v_c(t) = 8.16\, e^{-2t}$$



We can use the node voltage analysis method to find $i_4(t)$.

KCL @ Supernode

$$i_2 + i_4 + \mu v_1 = 0$$

$$\frac{v_1}{R_2} + \frac{v_2}{R_4} + \mu v_1 = 0 \qquad -(1)$$

from the Supernode

$$v_1 - v_2 = v_c(t)$$
$$= 8.16 \; e^{-1.806t}$$

$$v_1 = v_2 + 8.16 \; e^{-1.806t} \qquad -(2)$$

Substituting from (2) into (1)

$$\left(\frac{1}{R_2} + \mu\right)\left(v_2 + 8.16\, e^{-1.806t}\right) = \frac{v_2}{R_4}$$

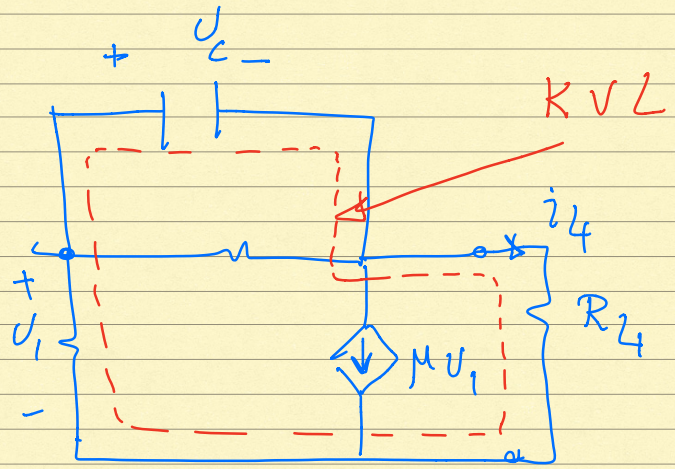
Find v_2 from the above equation, then use it to find i_4

$$i_4 = \frac{v_2}{R_4} = -\frac{102}{53} \; e^{-1.806t}$$

$$v_1 = \frac{612}{1325} \; e^{-1.806t}$$

To verify the solution apply KCL or KVL any where in the circuit and see that it is being satisfied.

For example, we can apply KVL around the loop shown below



KVL @ the loop

$$-v_1 + v_c + i_4 R_4 \text{ (must be)} = 0$$

Substituting for v_1, v_c and i_4, we see that they satisfy the above KVL

Thus it satisfies KVL around the outer loop.