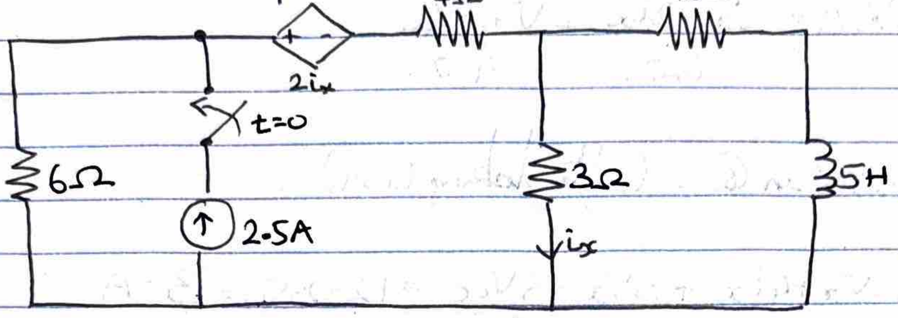
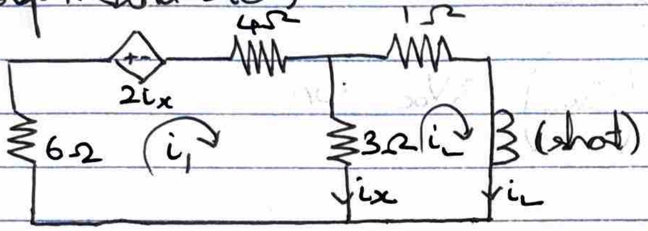
8.6-13

This circuit is equivalent to:



Step 1: Find $i(0^+)$



Use MCA

$i_x = i_1 - i_L$

$10i_1 + 2i_x + 3(i_1 - i_L) = 0 \Rightarrow 10i_1 + 5(i_1 - i_L) = 0$

$\Rightarrow 15i_1 - 5i_L = 0 \Rightarrow 3i_1 - i_L = 0$ —— (1)

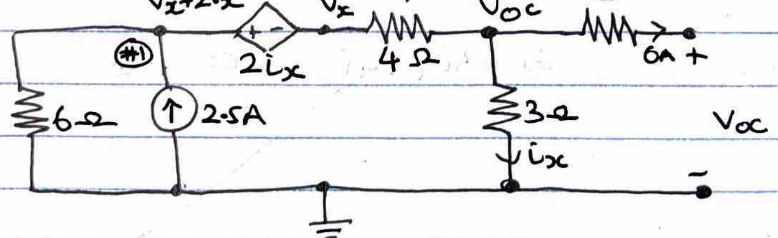
In mesh 2: $3(i_L - i_1) + 1i_L = 0$

$\Rightarrow 4i_L - 3i_1 = 0 \Rightarrow 3i_1 - 4i_L = 0$ —— (2)

Add (1)&(2): $4i_L - i_L = 0 \Rightarrow i_L = 0$

$\therefore i(0^+) = i(0^-) = 0A$ —— (3)

Step 2: Find Norton equivalent



$i_x = \dfrac{V_{oc}}{3}$ —— (4)

$\dfrac{V_x - V_{oc}}{4} = \dfrac{V_{oc}}{3} \Rightarrow 3V_x - 3V_{oc} = 4V_{oc} \Rightarrow V_x = \dfrac{7V_{oc}}{3}$ —— (5)

Apply KCL at #1:

$$2.5A = \frac{V_x + 2i_x}{6\Omega} + \frac{V_x - V_{oc}}{4\Omega} \quad — (6)$$

Subs (4), (5) in (6): (after taking LCM)

$$2\lfloor 4, 6 \\ \quad 2, 3$$

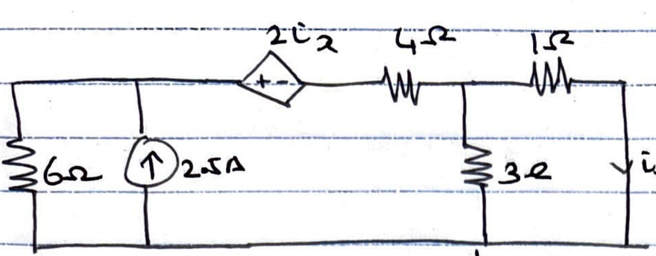
$$2V_x + 4i_x + 3V_x - 3V_{oc} = 12 \times 2.5A = 30A$$

$$\Rightarrow 5V_x + 4i_x - 3V_{oc} = 30A$$

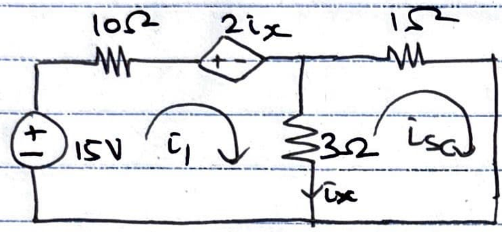
$$\Rightarrow 5\left(\frac{7V_{oc}}{3}\right) + 4\left(\frac{V_{oc}}{3}\right) - 3V_{oc} = 30A$$

$$\Rightarrow 35V_{oc} + 4V_{oc} - 9V_{oc} = 90A$$

$$\Rightarrow 30V_{oc} = 90A \quad \Rightarrow V_{oc} = 3V \quad — (7)$$



III (source trans)



$i_x = i_1 - i_{sc}$ —— (8)

$3i_x + 10i_1 + 2i_x = 15V \overset{(8)}{\Rightarrow} 10i_1 + 5(i_1 - i_{sc}) = 15V$

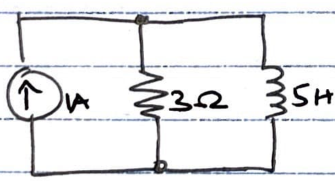
$\Rightarrow 15i_1 - 5i_{sc} = 15V$ —— (9) $\Rightarrow 5i_1 - i_{sc} = 5V$

$3(i_{sc} - i_1) + 1i_{sc} = 0 \Rightarrow -3i_1 + 4i_{sc} = 0$ —— (10)

(9) + 5×(10) $= -5i_{sc} + 20i_{sc} = 15V$

$\therefore i_{sc} = \frac{15}{15} = 1A$

$\therefore R_t = \frac{V_{oc}}{I_{sc}} = 3\Omega$ —— (11)



$\therefore i(t) = I_{sc} + (i(0^+) - I_{sc})e^{-t(R_t/L)}$

(3) (11)

$i(t) = 1 + (0-1)e^{-t(3/5)}$

$\boxed{\therefore i(t) = 1 - e^{-t(3/5)}}$ $t \geq 0$