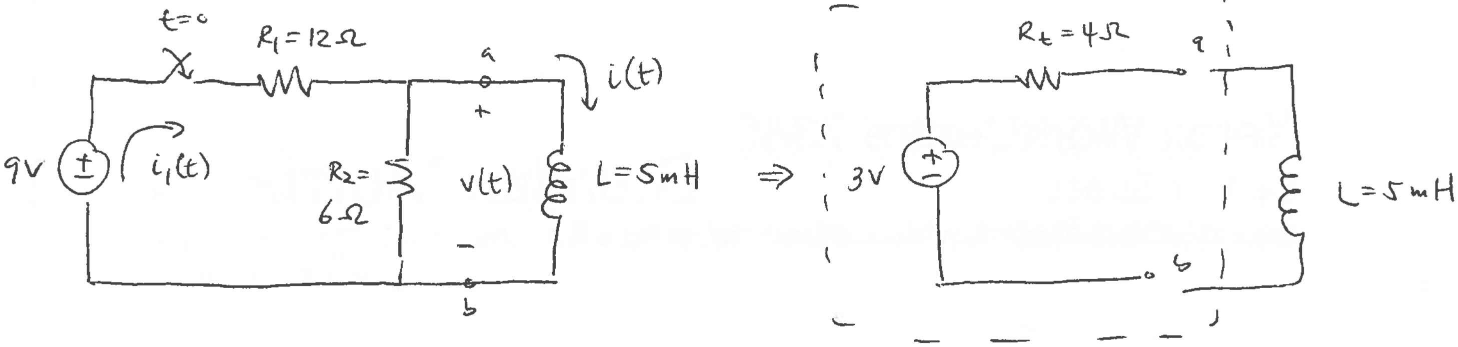
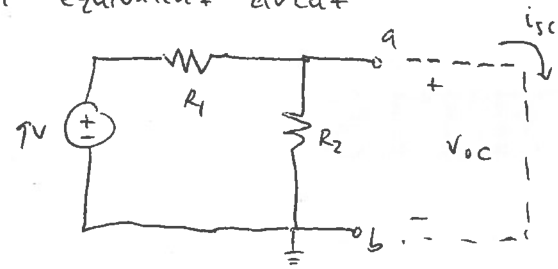
Find i, v, and i_1



equivalent circuit



by voltage divider

$$V_{oc} = 9\left(\frac{R_2}{R_1+R_2}\right) = 9\left(\frac{6}{6+12}\right) = 3V$$

KCL @ a

$$\frac{V_a - 9}{R_1} + \frac{V_a}{R_2} + i_{sc} = 0$$

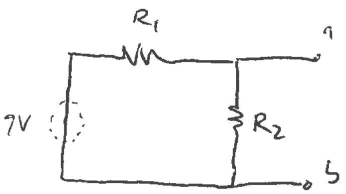
$$i_{sc} = \frac{9 - V_a}{R_1} - \frac{V_a}{R_2}$$

because of short circuit $V_a = V_b = 0$

$$i_{sc} = \frac{9}{R_1} = \frac{9}{12} = \frac{3}{4} A$$

$$R_t = \frac{V_{oc}}{i_{sc}} = \frac{3}{3/4} = 4\Omega$$

using shortcut of zeroing dependent sources



$$R_t = R_1 \| R_2 = \frac{6 \cdot 12}{6+12} = \frac{72}{18} = 4\Omega$$

Using the Thevenin equivalent circuit

$$\tau = \frac{L}{R} = \frac{5m}{4} = \frac{5}{4} m = 1.25 \text{ mSec}$$

solving for $i(t)$

$t \ll 0$

no current

$v(t) = 0$

$i_1(t) = 0$

$i_1(t) = 0$

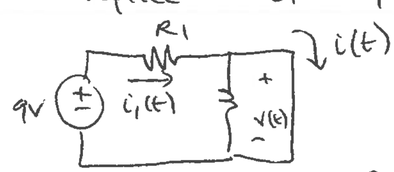
$t = 0^+$ right after switch

current cannot change in inductor imediately

$i(0^-) = i(0^+) = 0$

$t \gg 0$

replace inductor by short circuit



$$i_1(t) = i(t) = \frac{9}{R_1} = \frac{9}{12} = \frac{3}{4} A = i_F$$

$$v(t) = 0 = V_f$$

solving for $i(t)$

$$\boxed{\begin{aligned} i(t) &= i_F + [i(0^+) - i_F]\, e^{-t/\tau} \\ &= \frac{3}{4} + \left[0 - \frac{3}{4}\right] e^{-t/1.25m} = \frac{3}{4} - \frac{3}{4} e^{-800t} \qquad t > 0 \end{aligned}}$$

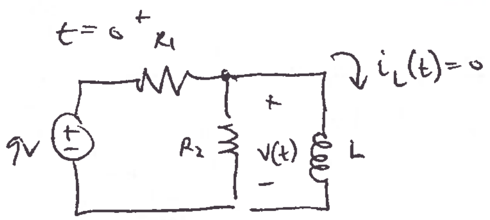
solving for voltage $v(t)$

we can use current/voltage relationship of inductor

$$v(t) = L\frac{di(t)}{dt} = L\left(-\frac{3}{4}(-800)\, e^{-800t}\right) = 5m\left(3 \cdot 200\, e^{-800t}\right) = 3e^{-800t} \qquad t > 0$$

or we can use the general first-order formula

$t = 0^+$



since all current goes through R_2

use a voltage divider

$$v(0^+) = 9\left(\frac{R_2}{R_1 + R_2}\right) = 3V$$

and we saw earlier

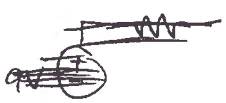
$V_f = 0\ V$.

~~$i_L(t)$~~

$$\boxed{v(t) = 0 + [3 - 0]\, e^{-800t} = 3e^{-800t}}$$

solving for $i_1(t)$

for $t \gg 0$



we saw

$$i_1(t) = i(t) = \frac{3}{4}A = i_{1F}$$

for $t = 0^+$

$$i_1(0^+) = \frac{v(0^+)}{R_2} = \frac{3}{6} = \frac{1}{2}A$$

$$i_1(t) = i_{1F} + [i_1(0^+) - i_{1F}]\, e^{-t/\tau}$$

$$= \frac{3}{4} + \left[\frac{1}{2} - \frac{3}{4}\right] e^{-t/\tau}$$

$$\boxed{i_1(t) = \frac{3}{4} - \frac{1}{4} e^{-800t}}$$

using circuit analysis

$$i_1(t) = \frac{9 - v(t)}{R_1} = \frac{9 - v(t)}{12}$$

$$= \frac{9 - 3e^{-800t}}{12}$$

$$\boxed{= \frac{3}{4} - \frac{1}{4} e^{-800t}}$$