(Optional)

(Pdf)

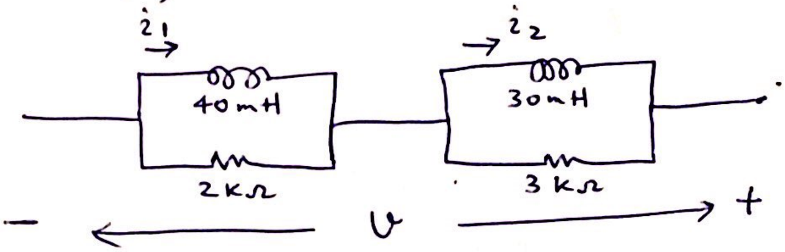
Prob 8.29 Source-Free RL circuits

(PP 305 7th Ed H&D)

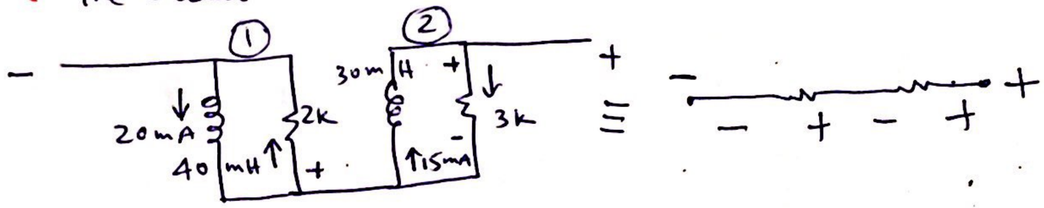
Given $i_1(0) = 20\ mA$

$i_2(0) = 15\ mA$

Find $v(0)$ and $v(15\mu s)$.



Solution: The circuit can be drawn as:



So $v(0) = 20 \times 2 + 15 \times 3 = 85V$

These are two independent circuits :-

So $\tau_1 = \frac{L}{R} = \frac{40}{2} = 20\ \mu s$

and $\tau_2 = \frac{30}{3} = 10\ \mu s$

Hence $i_1(t) = I_0 e^{-t/\tau_1}$

$= 20\, e^{-t/20\times10^{-6}}\ mA$

and $v_1(15\mu s) = 2\times10^3 \times 20\times10^{-3}\, e^{-\frac{15\times10^{-6}}{20\times10^{-6}}}$ $\{$i.e $v = Ri\}$

——— contd

(Optional)

— Contd (305)

Therefore $v_1(15\mu s) = 40 \times e^{-0.75} = 40 \times 0.47$

$v_1(15\mu s) = 18.89\ V$

Likewise $i_2(t) = 15\, e^{-\frac{t}{\tau_2}}$

$= 15\, e^{-\frac{t}{10\times10^{-6}}}\ \underline{m}A$

So $v_2(15\mu s) = 3\times10^{3} \times 15 \times \underline{10^{-3}}\, e^{\frac{-15\times10^{-6}}{10\times10^{-6}}}$

or $v_2 = 45\, e^{-1.5}$

$= 45 \times 0.223$

$v_2(15\mu s) = 10.04\ V$

Hence $v_{Total} = 10.04 + 18.19$

$v(15\mu s) = 28.93$ Volts