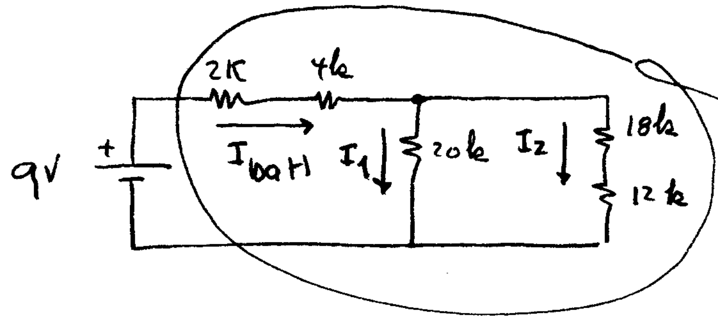
Electronics, H.W. Set 1

1.)



$R_{eq} = [2k \text{ series } 4k]$ series $[20k // (18k \text{ series } 12k)]$ $= \underline{18k}$

$I_{batt} = \dfrac{9V}{18k} = \frac{1}{2}\,ma = I_{2k} = I_{4k}$

$V_{2k} = (\frac{1}{2}\,ma)(2k) = \underline{1V}$

$V_{4k} = (\frac{1}{2}\,ma)(4k) = \underline{2V}$

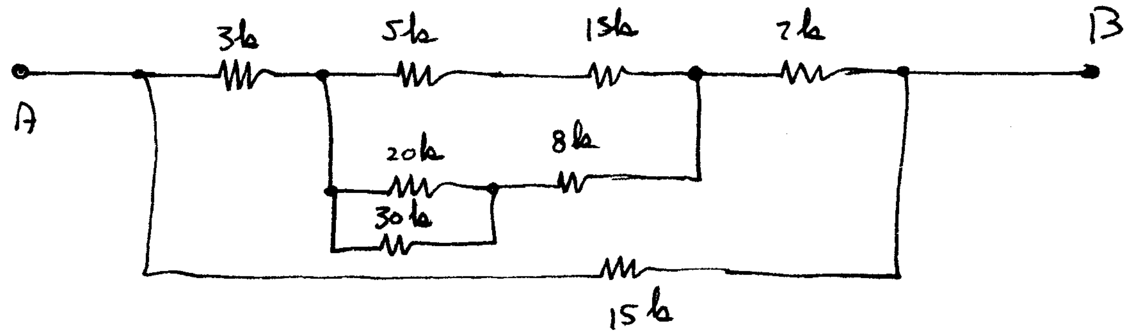
$I_2 = \dfrac{V_{20k}}{30k} = \dfrac{6V}{30k} = \frac{1}{5}\,ma$

$V_{20k} = 9V - (V_{2k} + V_{4k}) = \underline{6V}$; $I_{20k} = \dfrac{V_{20k}}{20k} = \frac{6}{20}\,ma = .3\,ma = I_1$

$V_{18k} = 18k\,(I_2) = 18k\,(\frac{1}{5}\,ma) = \underline{3.6V}$

$V_{12k} = 12k\,(I_2) = 12k\,(\frac{1}{5}\,ma) = \underline{2.4V}$

2)



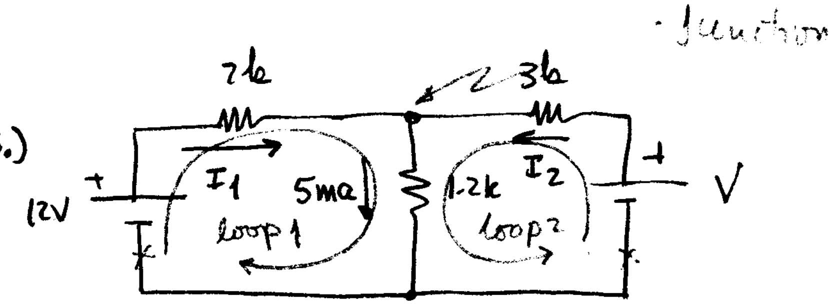
$(20k // 30k)$ Series $8k$ $= R_1 = 20k$

$5k$ Series $15k$ $= R_2 = 20k$

$R_1 // R_2 = 20k // 20k = 10k$

$R_{AB} = [3k \text{ series } (R_1 // R_2) \text{ series } 2k] // 15k = 15k // 15k = \underline{7.5k}$

3.)



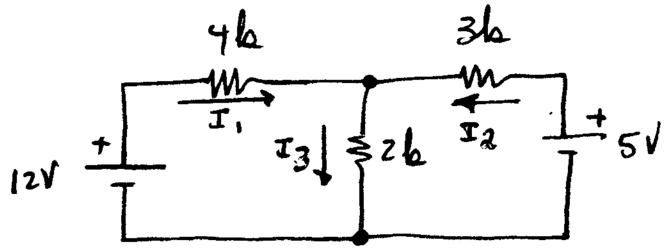
loop 1: $0 = 12V - 2kI_1 - \overbrace{(5ma)(1.2k)}^{6V} \rightarrow 6V = 2kI_1 \rightarrow \boxed{I_1 = +3ma}$

loop 2: $0 = V - 3kI_2 - (5ma)(1.2k)$

junction: $I_1 + I_2 = 5ma \rightarrow \boxed{I_2 = 5ma - 3ma = +2ma}$

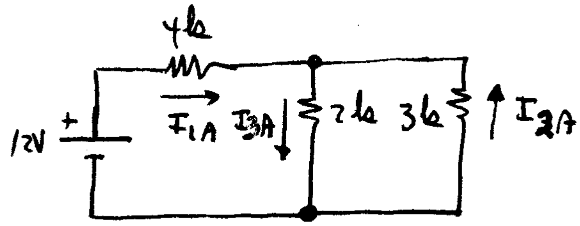
$\boxed{V = 3k\,I_2 + 6V = (3k)(2ma) + 6V = 6V + 6V = 12V}$

4.)



superposition

Partial Circuit "A"



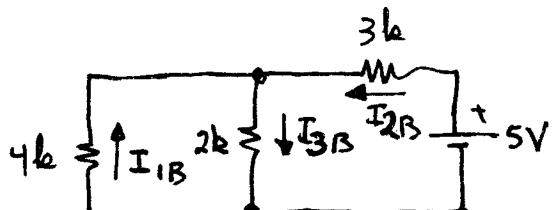
$I_{1A} = \frac{12V}{5.2k} = 2.31\ ma$

$I_{3A} = 1.38\ ma$

$I_{2A} = -0.92ma$

note arrow!

Partial Circuit "B"



$I_{2B} = \frac{5V}{4\frac{1}{3}k} = 1.15ma$

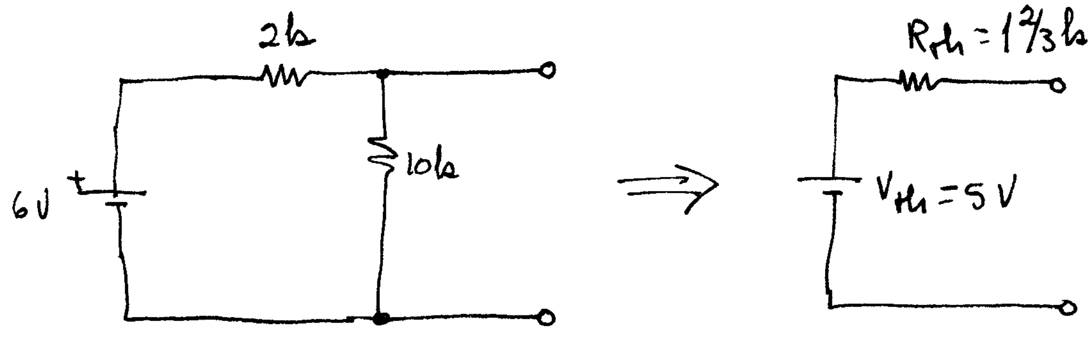
$I_{3B} = 0.77ma$

$I_{1B} = -0.38ma$

note the arrow!

$$\boxed{\begin{aligned} I_3 &= I_{3A} + I_{3B} = (0.77 + 1.38)ma = \underline{2.15ma} \\ I_2 &= I_{2A} + I_{2B} = (-0.92 + 1.15)ma = \underline{0.23ma} \\ I_1 &= I_{1A} + I_{1B} = (2.31 - 0.38)ma = \underline{1.93ma} \end{aligned}}$$

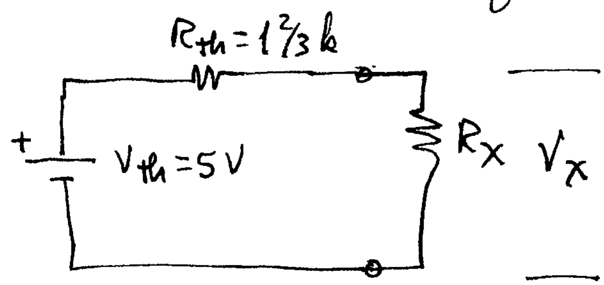
5.+6.) the easiest method is to work #6 first:



$$V_{th} = \frac{6V}{12k}\, 10k = \underline{5V}$$

$$R_{th} = 2k // 10k = \frac{10k}{6} = \underline{1\tfrac{2}{3}k}$$

to find V_x, the equivalent circuit is



$$V_x = \left(\frac{V_{th}}{R_{th} + R_x}\right) R_x$$

a.) $V_x = V_{th} = \underline{5V}$ $(R_x = \infty)$

b.) $V_x = \left(\frac{5V}{1\frac{2}{3}k + 1M}\right) 1M \cong \underline{5V}$

c) $V_x = \left(\frac{5V}{1\frac{2}{3}k + 10k}\right) 10k = \underline{4.29V}$

d.) $V_x = \left(\frac{5V}{1\frac{2}{3}k + 1k}\right) 1k = \underline{1.87V}$

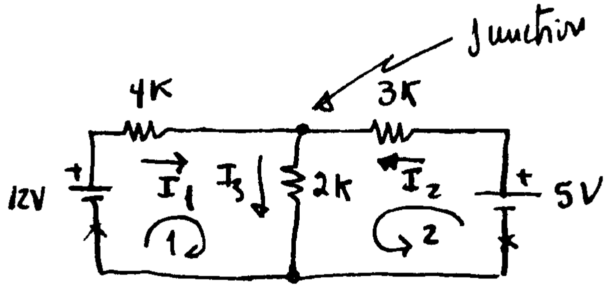
e.) $V_x = \left(\frac{5V}{1\frac{2}{3}k + 0.1k}\right) 0.1k = \underline{0.28V}$

f) $V_x = \left(\frac{5V}{1\frac{2}{3}k + 1\Omega}\right) 1\Omega = \underline{.003V}$

g.) $V_x = \left(\frac{5V}{1\frac{2}{3}k}\right) 0 = \underline{0}$

set 1, P.4

7.)



KVL

① loop 1: $0 = 12V - I_1 4k - I_3 2k$

② loop 2: $0 = 5V - 3kI_2 - 2kI_3$

KCL

③ junction: $I_1 + I_2 = I_3$

①+③

$0 = 12V - I_1 4k - (I_1 + I_2) 2k$ ④

$0 = 5V - 3kI_2 - 2k(I_1 + I_2)$ ⑤

②+③

④: $0 = 12 - 6kI_1 - 2kI_2 \rightarrow I_1 = \frac{12 - 2kI_2}{6k} = \frac{6 - 1kI_2}{3k}$

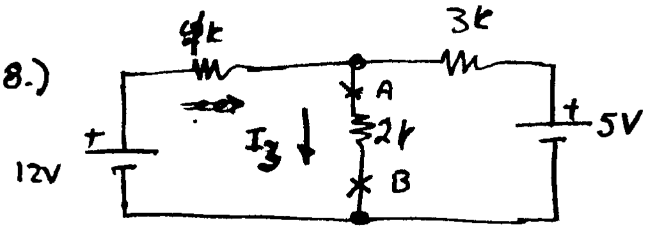
④+⑤ $\underbrace{0 = 5V - 5kI_2 - 2kI_1 = 5V - 5kI_2 - 2k\left[\frac{(12 - 2kI_2)}{6k}\right]}$

$0 = 5V - 4V - I_2\left(5k - \frac{4}{6}k\right)$

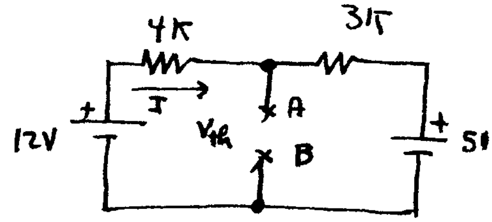
$\therefore \boxed{I_2 = \frac{1V}{4\frac{1}{3}k} = \underline{0.23\,ma}}$

$\boxed{I_1 = 1.92\,ma}$

$\boxed{I_3 = 2.15\,ma}$

8.) 

2k removed $\Rightarrow$

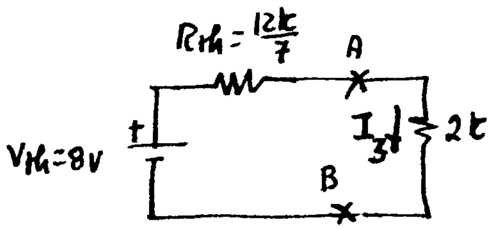


$V_{th} = 12V - I(4k)$; $I: \ 0 = 12V - I4k - I3k - 5$

$= 12V - 4V = 8V$ $\qquad I = \frac{7V}{7k} = 1ma$

$R_{th} = 4k // 3k = 12k/7$

net result



$$\boxed{I_3 = \frac{8V}{2k + \frac{12k}{7}} = \frac{56}{26} = 2.15\ ma}$$