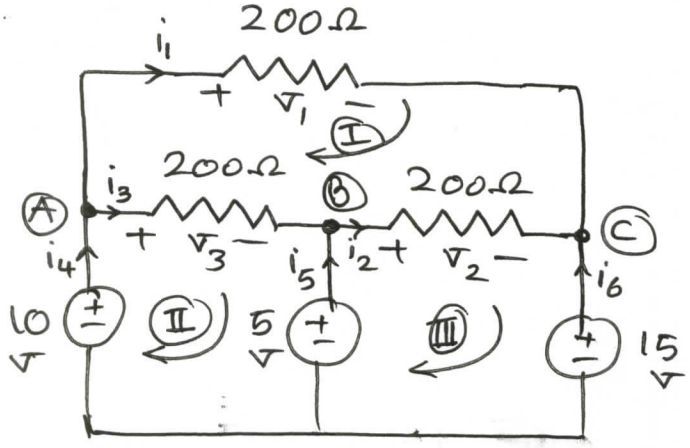
HW#2
MAE140
Fall 2013

2-30

(a)



(b) Loop (I): $v_1 - v_2 - v_3 = 0$

Loop (II): $v_3 + 5 - 10 = 0 \Rightarrow v_3 = 5V$

Loop (III): $v_2 + 15 - 5 = 0 \Rightarrow v_2 = -10V$

$\Rightarrow v_1 = -5V$

(c) $v_1 = 200 i_1 \Rightarrow i_1 = \frac{-5}{200} = -0.025A$

$v_2 = 200 i_2 \Rightarrow i_2 = \frac{-10}{200} = -0.05A$

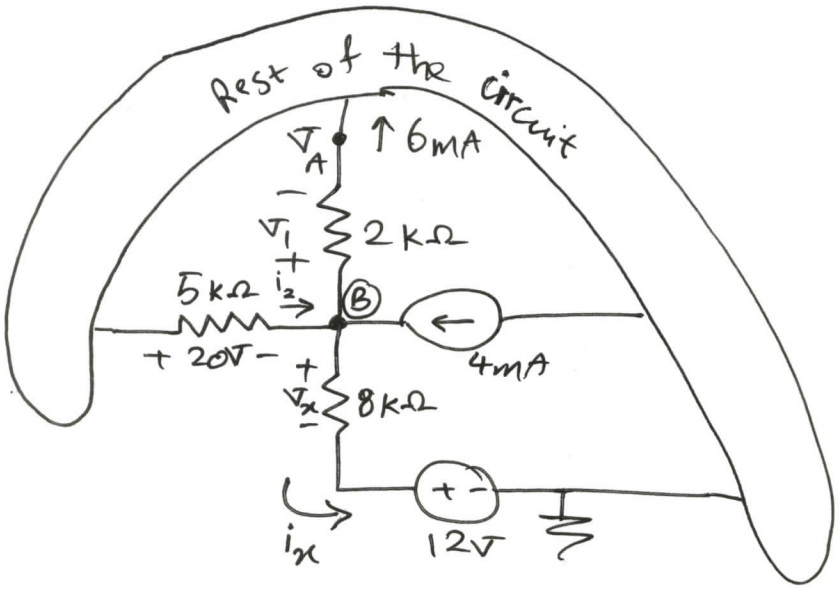
$v_3 = 200 i_3 \Rightarrow i_3 = \frac{5}{200} = 0.025A$

(d) KCL at Node (A): $i_4 = i_1 + i_3 = 0A$

KCL at Node (B): $i_2 = i_3 + i_5 \Rightarrow i_5 = -0.075A$

KCL at Node (C): $i_1 + i_2 + i_6 = 0 \Rightarrow i_6 = 0.075A$

2-32



(a) Elements equations

$$\begin{cases} v_1 = 2\,k\Omega \times 6\,mA = 12\,V \\ 20\,V = 5\,k\Omega\, i_2 \Rightarrow i_2 = 4\,mA \\ v_x = 8\,k\Omega\, i_x \end{cases}$$

KCL at Node (B): $-6\,mA + i_2 + 4\,mA - i_x = 0$

$$\Rightarrow i_x = 2\,mA$$

Thus, $v_x = 8\,k\Omega \times 2\,mA = 16\,V$

(b) Sum of the currents into the rest of the circuit is as;

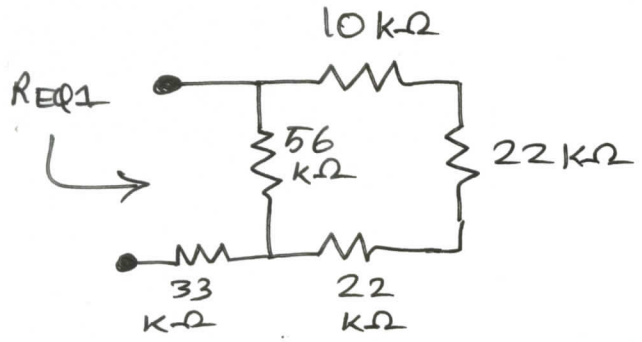
$$6\,mA - i_2 - 4\,mA + i_x = 6\,mA - 4\,mA - 4\,mA + 2\,mA$$
$$= 0\,mA$$

(c) $v_1 = 2 \times 6 = 12\,V$ Voltage accross the 2kΩ resistor

v_A with respect to the ground ($\perp$) is as;

$$v_A = -v_1 + v_x + 12 = -12 + 16 + 12 = 16\,V$$

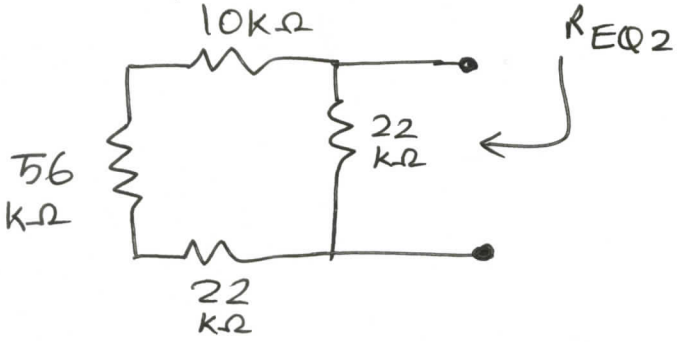
2-38



$10+22+22=54\ k\Omega$

$56 \| 54 = \frac{56 \times 54}{56+54} = 27.49\ k\Omega$

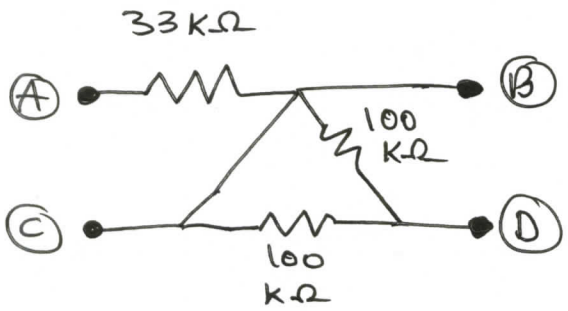
$\Rightarrow R_{EQ1} = 27.49+33 = 60.49\ k\Omega$



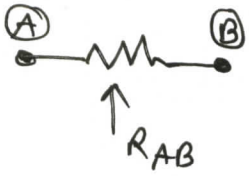
$56+10+22=88\ k\Omega$

$\Rightarrow R_{EQ2} = 88 \| 22 = 17.6\ k\Omega$

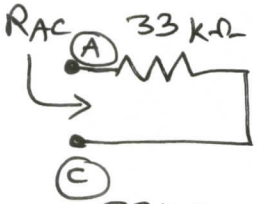
2-43



A-B: $R_{AB} = 33\ k\Omega$



A-C:



$\Rightarrow R_{AC} = 33\ k\Omega$

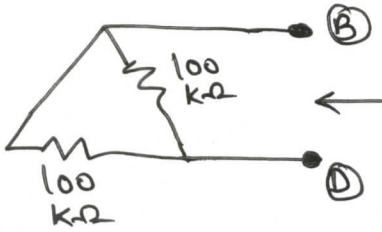
A-D:

$\Rightarrow R_{AD} = (100 \| 100) + 33 = 83\ k\Omega$

B-C:

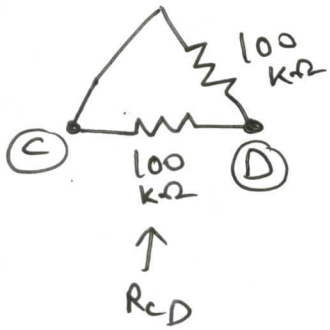
$\Rightarrow R_{BC} = 0\ k\Omega$

B-D:



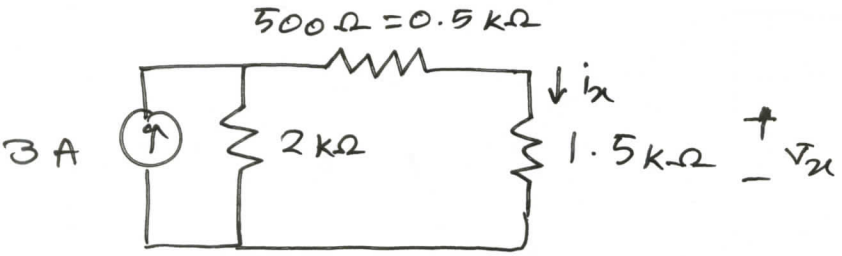
$\leftarrow R_{BD} \Rightarrow R_{BD} = 100 \| 100 = 50\ k\Omega$

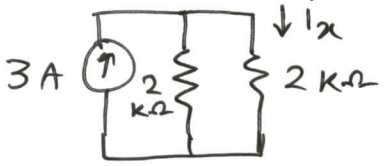
C-D:



$\Rightarrow R_{CD} = 100 \| 100 = 50\ k\Omega$

2-56



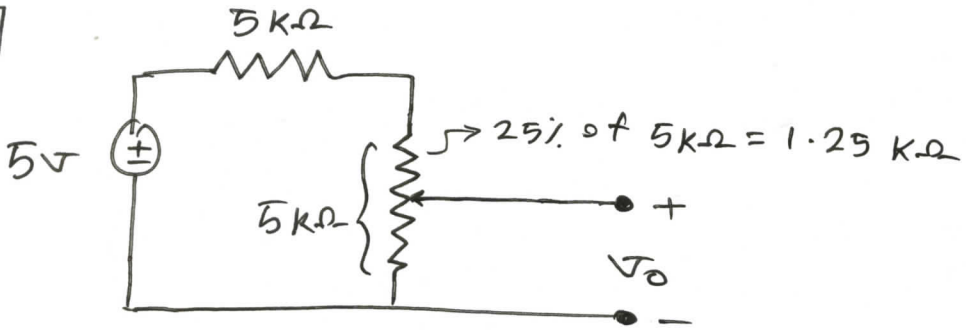


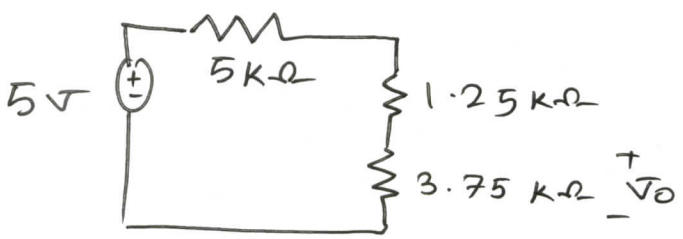
Current division:

$$i_x^\circ = \frac{2 \times 3}{2+2} = 1.5\ A$$

$$V_x = 1.5 \times 10^3\ \Omega \times i_x^\circ = 2.25 \times 10^3\ V$$

2-59



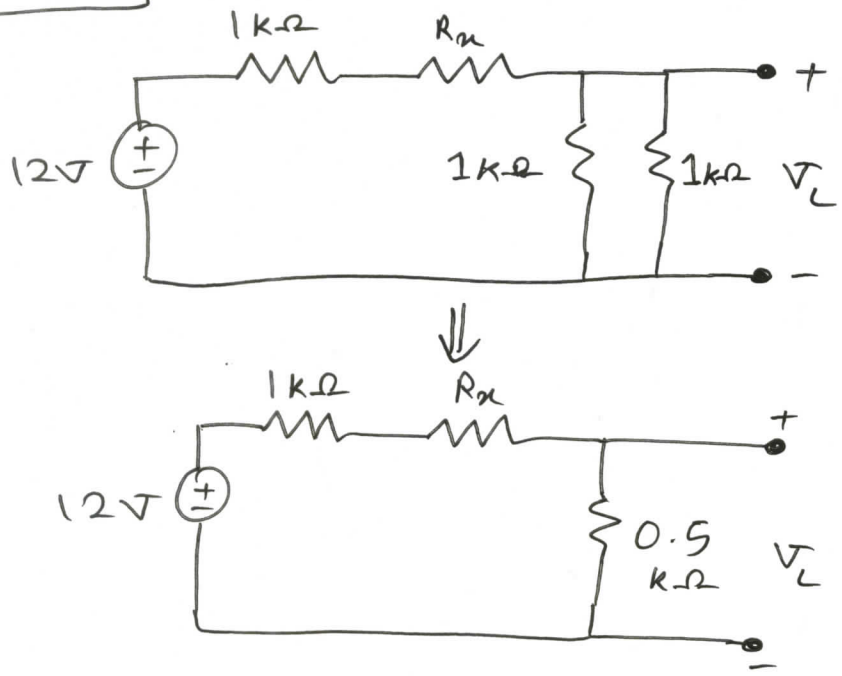


Voltage division:

$$V_o = \frac{3.75}{5+1.25+3.75} \times 5$$

$$= 1.875\ V$$

2-66



Voltage division:

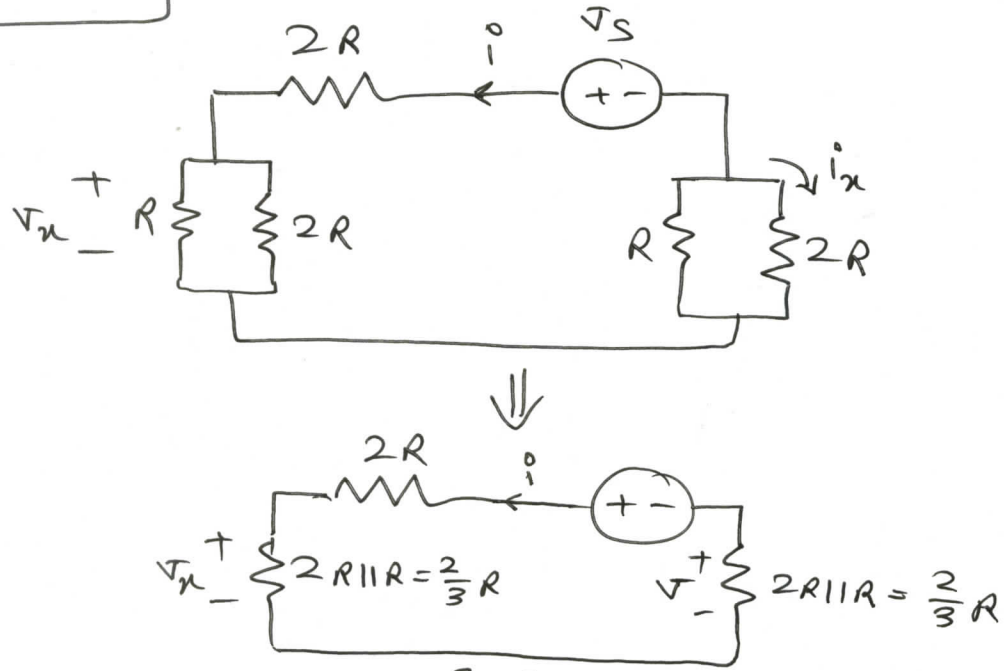
$$V_L = \frac{0.5}{1+R_x+0.5} \times 12$$

$$V_L = 2$$

$$\Rightarrow 2 = \frac{0.5}{1+R_x+0.5} \times 12$$

$$\Rightarrow R_x = 1.5\ k\Omega$$

2-70

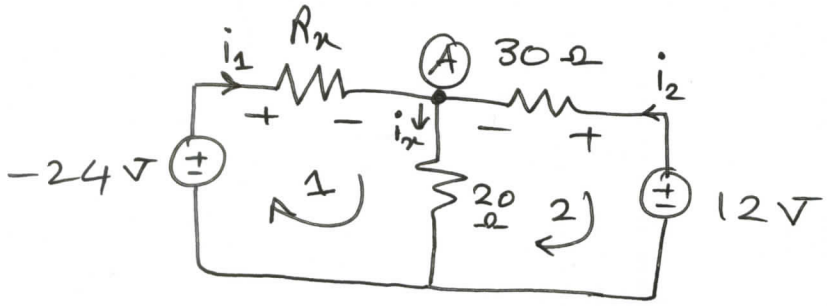


Voltage division: $V_x = \frac{\frac{2}{3}R}{2R+\frac{2}{3}R+\frac{2}{3}R} \times V_S = 0.2V_S$

Note that $v = -v_x = -0.2\, v_s$

$$\Rightarrow i_x = -\frac{0.2 v_s}{2R} = \frac{-v_s}{10R}$$

2-74



Loop1: $R_x i_1 + 0 - (-24) = 0$ (*)

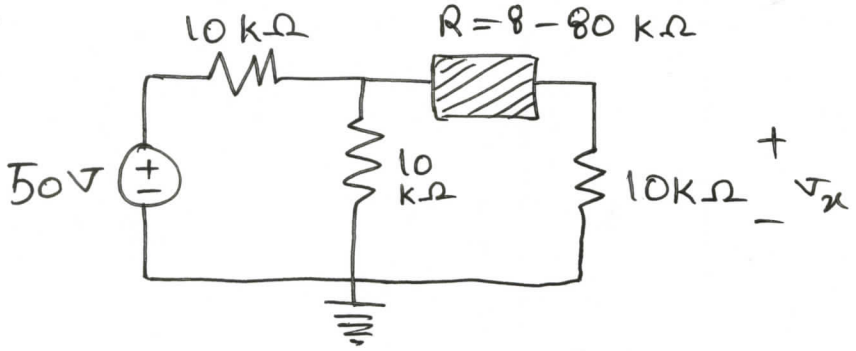
Loop2: $-30 i_2 + 12 - 0 = 0 \Rightarrow 30 i_2 - 12 = 0 \Rightarrow i_2 = \frac{12}{30}$ (I)

Node (A): $i_1 + i_2 = i_x = 0 \Rightarrow i_1 = -i_2$ (**)

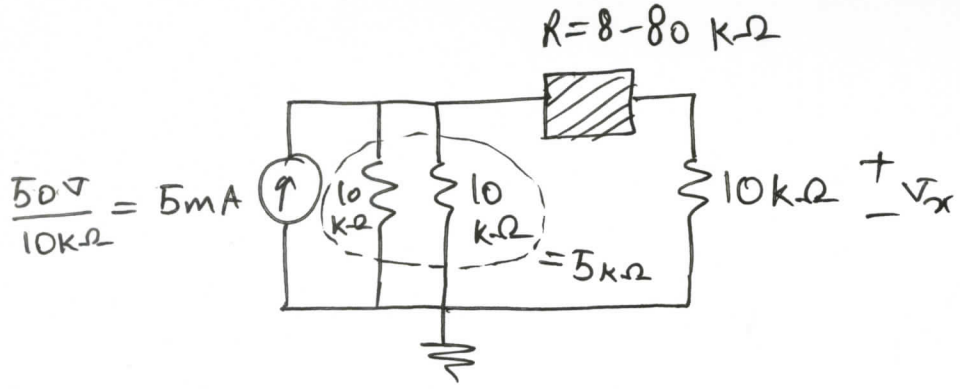
(*) & (**) $\Rightarrow R_x(-i_2) = -24 \Rightarrow R_x i_2 = 24$ (II)

(I) & (II) $\Rightarrow R_x = 60\ \Omega$

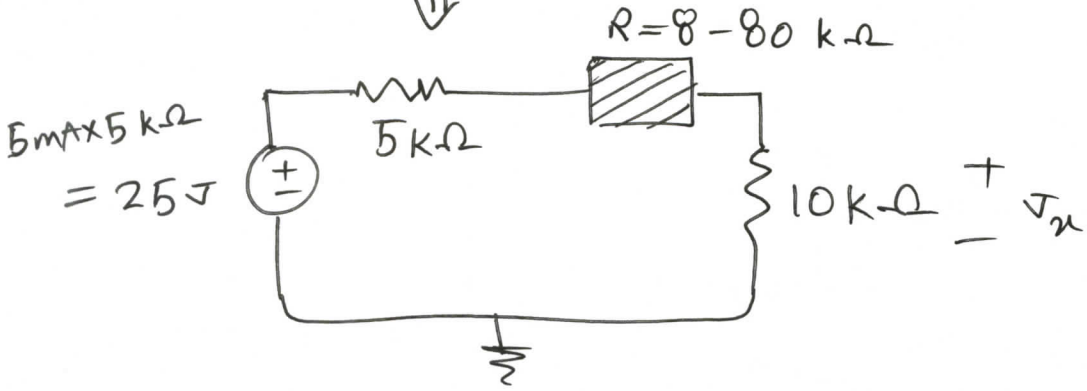
2-78



Using Source transformation;



(Using another Source transformation)



Voltage division: $V_x = \frac{10}{5+R+10} \times 25 \ V$

$R = 8\,k\Omega \Rightarrow V_x = 10.86\,V$

$R = 80\,k\Omega \Rightarrow V_x = 2.63\,V$

$\Rightarrow V_x = 2.63 - 10.86\,V$