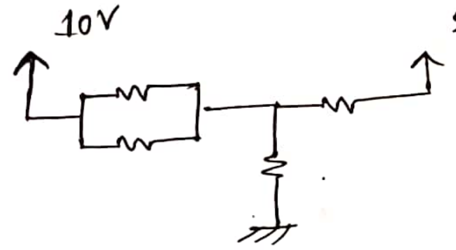
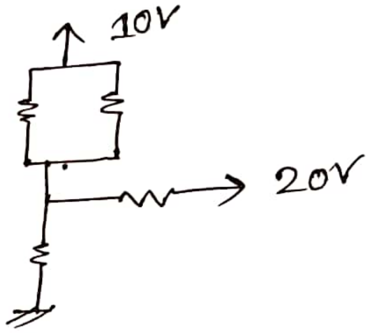
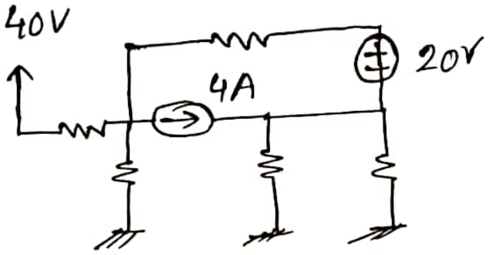
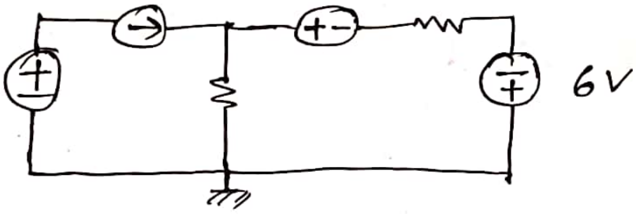
1(a) 

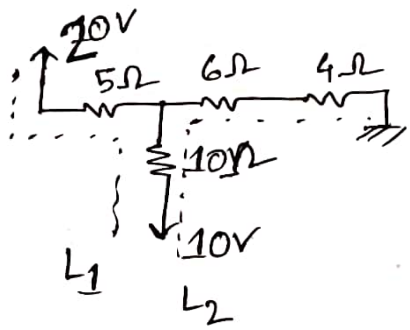
or,



(b) 

2) 

3) $V_x = 20V$.



[KCL]

$I_1 = I_2 + I_3$ ... ... (i)

along L_1, [KVL]

$5I_1 + 10I_3 = 20 - 10 = 10$ ... ... (ii)

along L_2, [KVL]

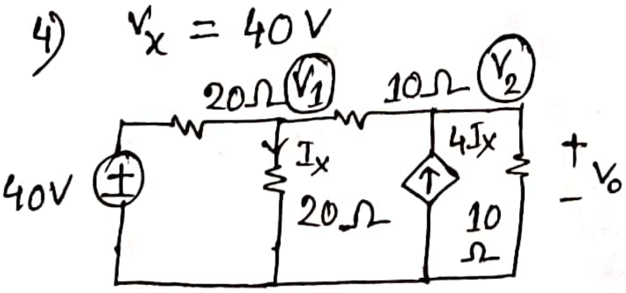
$-10I_3 + 10I_2 = 10 - 0$ ... ... (iii)

∴ solving (i), (ii) and (iii),

$I_1 = 1.5A$, $I_2 = 1.25A$, $I_3 = 0.25A$

(values may change — follow the steps)

4) $V_x = 40V$



Here, $I_x = V_1/20 \Rightarrow 4I_x = \frac{V_1}{5}$

at node V_1, [nodal analysis]

$$\frac{V_1 - 40}{20} + \frac{V_1}{20} + \frac{V_1 - V_2}{10} = 0$$

$$\Rightarrow V_1\left(\frac{1}{20} + \frac{1}{20} + \frac{1}{10}\right) - V_2\left(\frac{1}{10}\right) - \frac{40}{20} = 0$$

... ... (i)

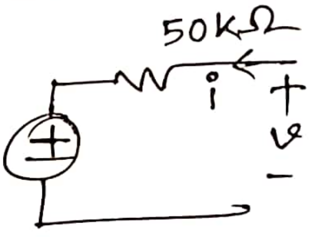
at node V_2, $\frac{V_2-V_1}{10}+\frac{V_2}{10}-4I_x=0$

$$\Rightarrow V_2\left(\frac{1}{10}+\frac{1}{10}\right)-V_1\left(\frac{1}{10}\right)-\frac{V_1}{5}=0$$

$$\Rightarrow V_2\left(\frac{1}{5}\right)-V_1\left(\frac{1}{10}+\frac{1}{5}\right)=0 \quad \cdots \cdots (ii)$$

solving (i) and (ii), $V_1 = 40V$, $V_2 = V_0 = 60V$.

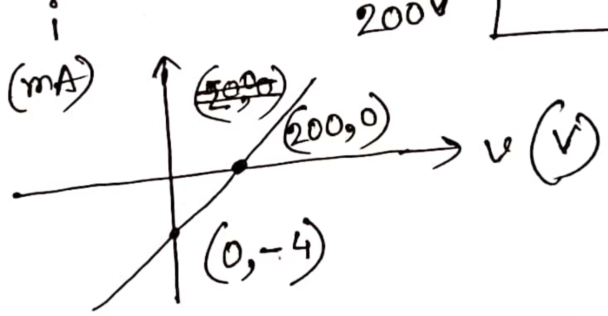
5) The given circuit is equivalent to:



$v = 50i + 200$

$\Rightarrow i = \frac{v}{50} - \frac{200}{50}$

$= \frac{v}{50} - 4 \quad \cdots (i)$



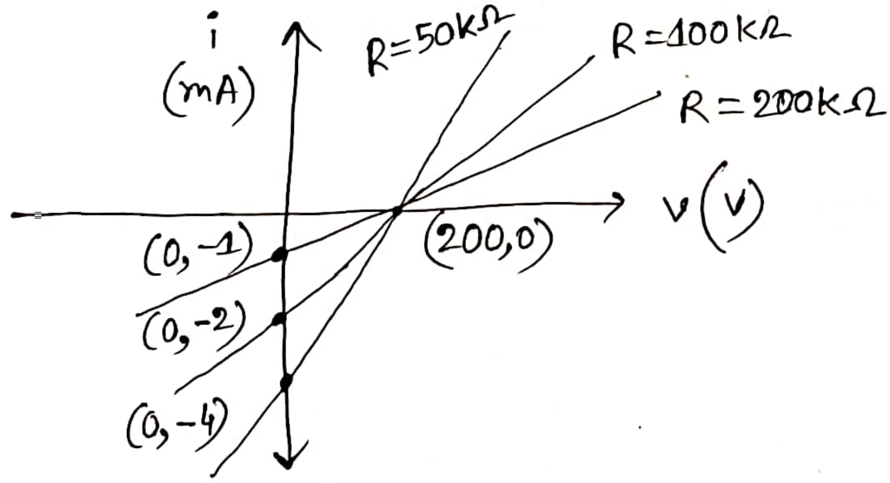
∴ y intersecting point: $(0,-4)$.

for x-intersecting point, $i=0$ at that point. ∴ (i) $\Rightarrow V=200$

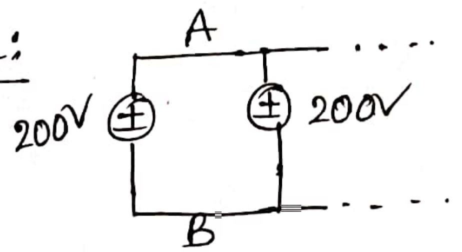
∴ the point: $(200,0)$

if $R = 100\,k\Omega$, $i = v/100 - 2$; when $R = 200\,k\Omega$, $i = \frac{v}{200} - 1$

x-intersecting point will be fixed.



Note:



placing a voltmeter across A-B node will always provide 200V

6) a. AB : current source, $I_2 = -5$ mA

BC : resistor, $R_{BC} = \frac{1}{slope} = \frac{1}{\frac{4-(-5)}{4-(-5)}} = 1\ K\Omega$

CD : (i) current source in parallel to a resistor

(ii) or, voltage source in series with " "

$$R_{CD} = 1/slope = \frac{1}{\frac{6-4}{10-4}} = \frac{1}{2/6} = 3K\Omega$$

(i) $\boxed{i = \frac{V}{R} + I_0}$ or, $i = \frac{V}{3} + I_0$

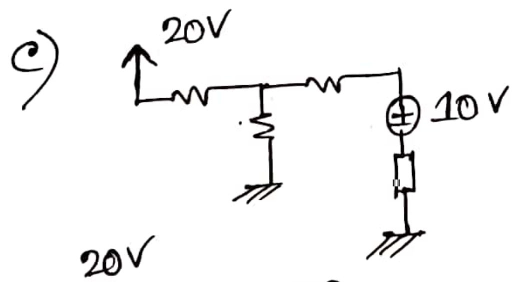
at point C, $i = 4$ mA, $V = 4V$

$\therefore\ 4 = \frac{4}{3} + I_0 \Rightarrow I_0 = (4 - 4/3) = 2.67$ mA

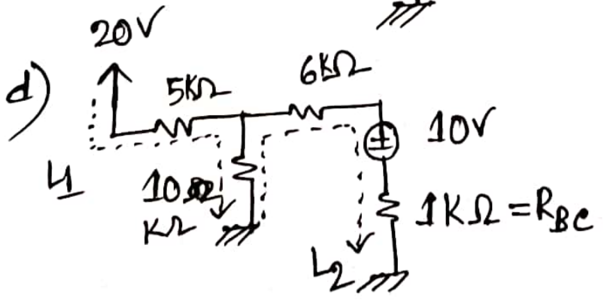
similarly for (ii). You need to solve either in 1st or 2nd method.

b) $V = 2V$ is within BC region. It is represented by a resistor. So, $I_2 = \frac{V}{R} = 2/1 = 2$ mA.

c)



d)



$I_1 = I_2 + I_3$ [KCL]

KVL at L1,

$5I_1 + 10I_3 = 20 - 0$

KVL at L2,

$-10I_3 + 6I_2 + 1I_2 = 0 - 10 - 0$

$\therefore\ I_1 = 1.55$ mA

$I_2 = 0.32$ mA

$I_3 = 1.22$ mA

[in question, some values were in Ω; so answers may change.