Assignment 1
CSE251
fall 22

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sec : 13

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Ans to Q no 1

(a)

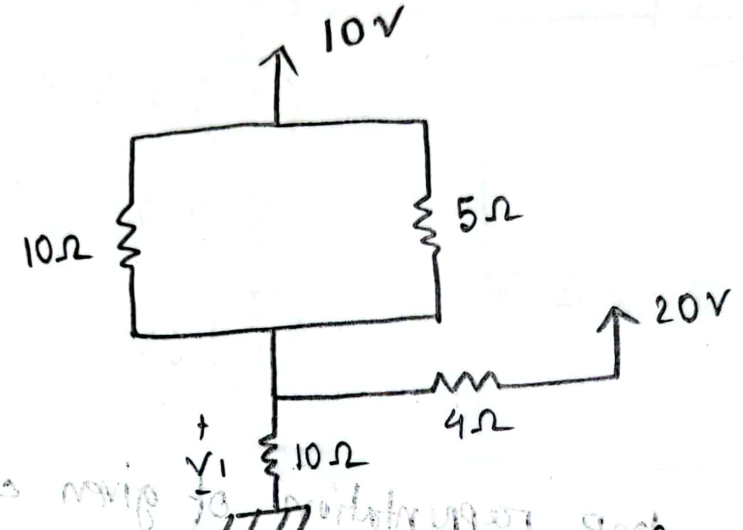


Fig: Alternate representation of given circuit

(b)

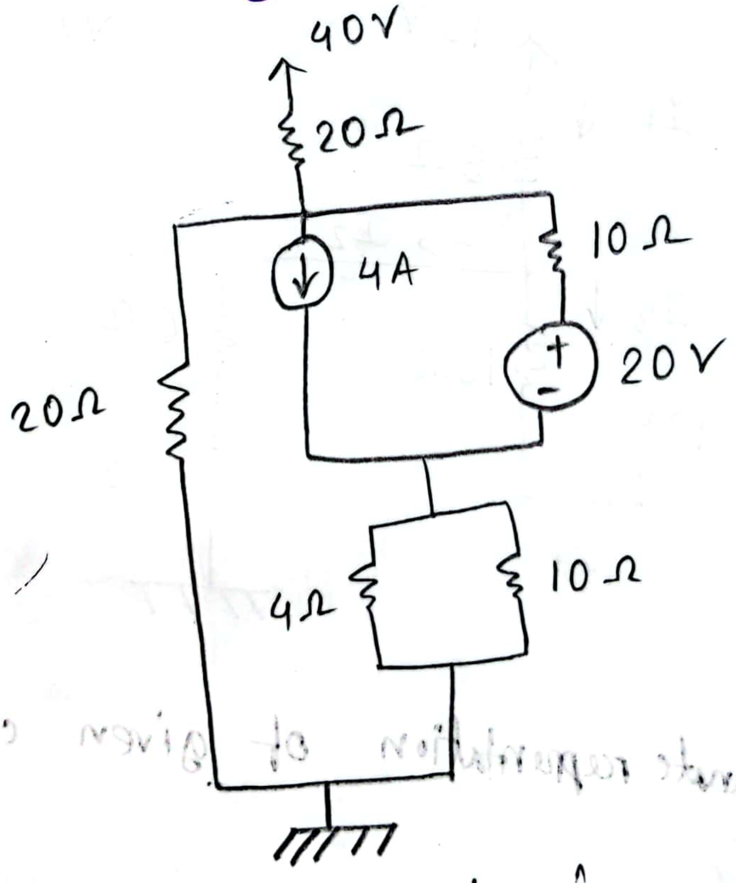


Fig: Alternate representation of given circuit.

Ans to Q no 2

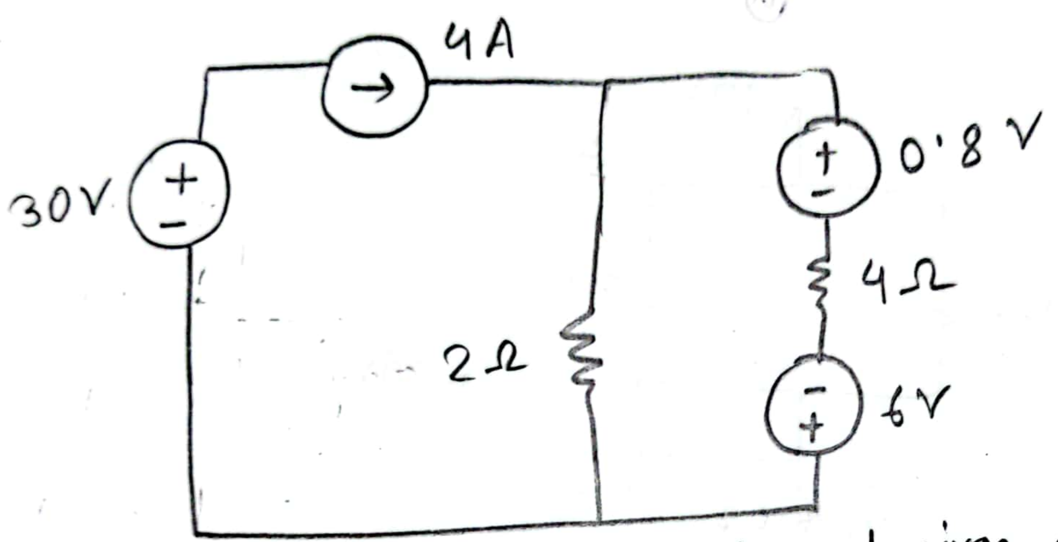


Fig: loop reprentation of given circuit

Ans to Q no 3

i)

$V_x = (10 + 0) = 10V$

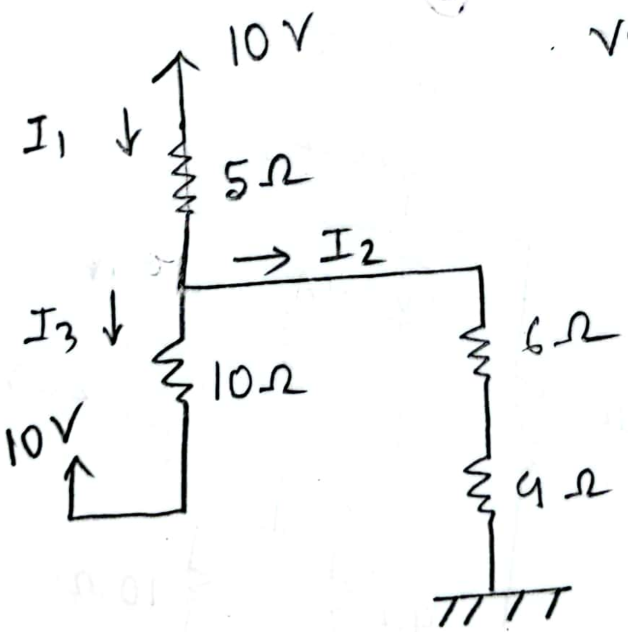


Fig: Alternate reprentation of given circuit

(ii) Applying KCL at node a :

$-I_1 + I_2 + I_3 = 0$ ——— ①

Applying KVL in L1 path :

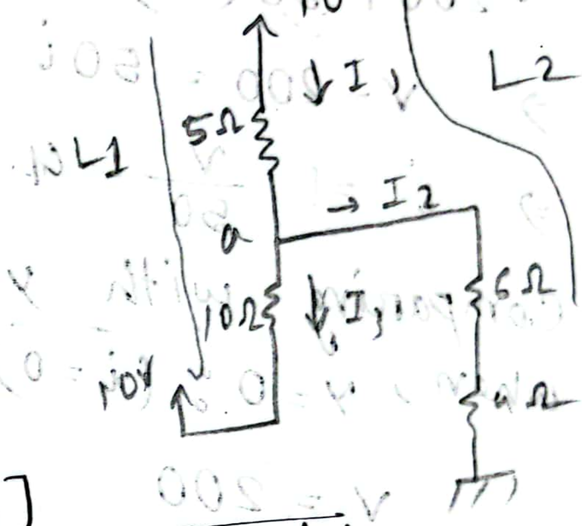


Fig: circuit AR

$5I_1 + 10I_3 = 10 - 10$

$\Rightarrow 5I_1 + 10I_3 = 0$ ——— ②

Applying KVL in L2 path ;

$5I_1 + 10I_2 = 10 - 0$ [6+4=Rs]

$\Rightarrow 5I_1 + 10I_2 = 10$ ——— ③

Solving eqn 1, 2, 3 we get,

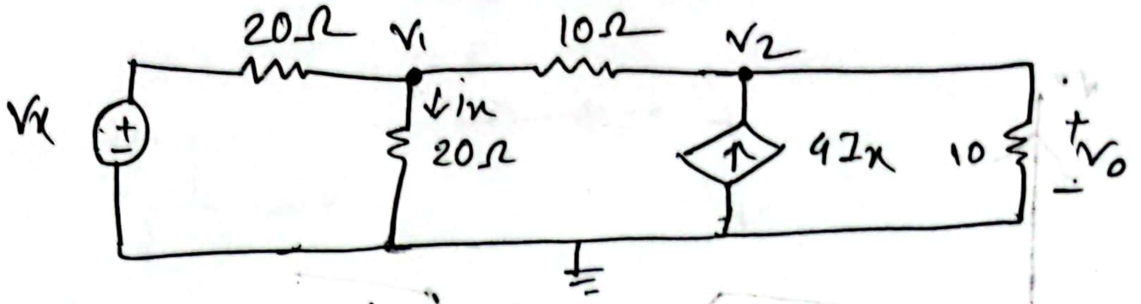
$I_1 = \frac{1}{2}$ A

$I_2 = \frac{3}{4}$ A

$I_3 = -\frac{1}{4}$ A

Ans to Q 4

(4)



Applying KCL at node v_1:

$$\frac{v_1 - v_x}{20} + \frac{v_1}{20} + \frac{v_1 - v_2}{10} = 0$$

$$\Rightarrow v_1 - v_x + v_1 + 2v_1 - 2v_2 = 0$$

$$\Rightarrow 4v_1 - 2v_2 - v_x = 0$$

$$= 4v_1 - 2v_2 - 40 = 0$$

$$\Rightarrow 4v_1 - 2v_2 = 40 \quad \text{—— (1)}$$

$$i_x = \frac{v_1}{20}$$

$$v_x = 40 + 0 = 40\,V$$

Now, KCL at node v_2:

$$\frac{v_2 - v_1}{10} + \frac{v_2}{10} = 4I_x$$

$$\Rightarrow v_2 - v_1 + v_2 = \frac{4\cancel{0} \times v_1}{2\cancel{0}}$$

$$\Rightarrow -3v_1 + 2v_2 = 0 \quad \text{—— (2)}$$

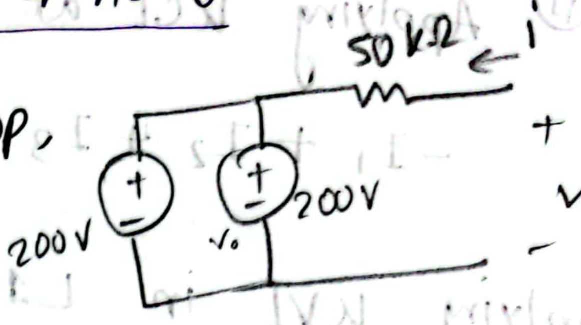
Solving eqn 1 and 2: $V_1 = 40\,V$, $V_2 = 60\,V$

$$\therefore v_o = v_2 = 60\,V$$

(i)

Ans to the q. no 5

Applying KVL on the right loop,



$-200 + 50(-i) + v = 0$

$\Rightarrow v - 200 = 50i$

$\Rightarrow i = \frac{v}{50} - 4$

Comparing with $y = mx + c$,

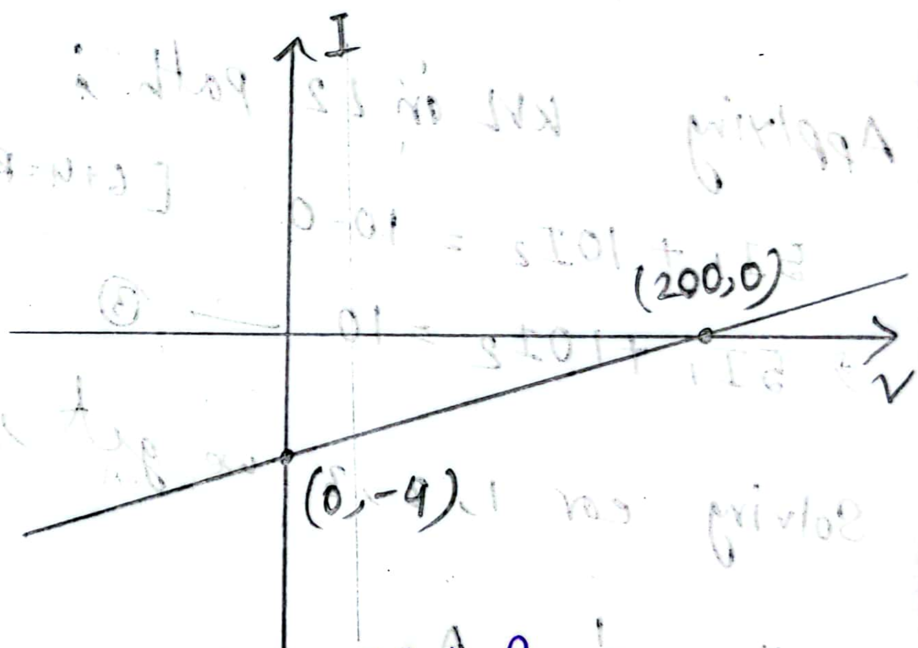
when, $y = 0$; $(i = 0)$

$v = 200$

Again, $c = -4$

or, when, $v = 0$,

$i = -4 \text{ mA}$



ii) (a) 100 kΩ

Here, $i = \frac{v}{100} - \frac{V_o = 200}{100}$

So, $c = -200/100 = -2$

And when $i = 0$,

$v = 200 \text{ V}$

(b) 200 kΩ

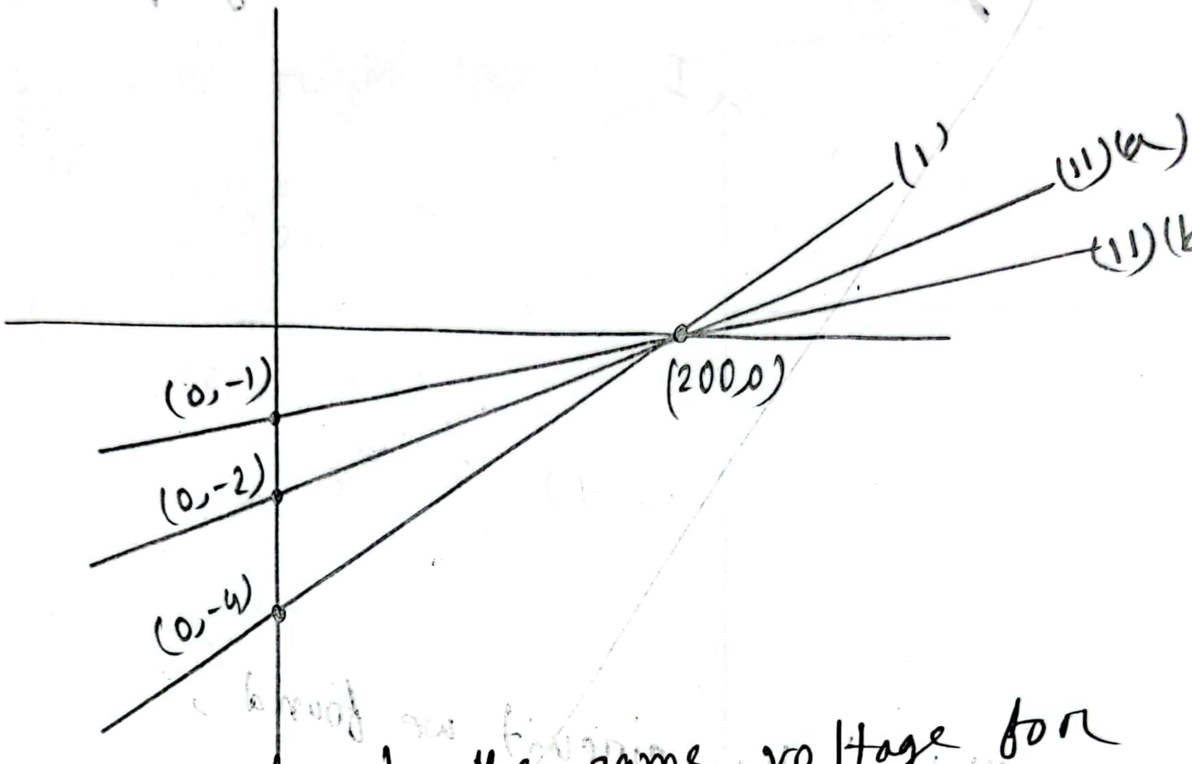
Here, $i = \frac{v}{200} - \frac{200}{200}$

$c = -1$

when $i = 0$,

$v = 200 \text{ V}$

Plotting these cases in a graph



Here, we have found the same voltage for all the resistors. However different points for current i. The reason is, from KVL we found,

$V = V_0 + IR$ and $i = \frac{V}{R} - \frac{V_0}{R}$

So when we are finding v when $y = i = 0$,

$v = V_0$; which shows it doesn't depend on resistance.

Again, when $v = x = 0$, $i = -\frac{V_0}{R}$ where i is clearly depended on resistance.

Again, in the results slopes $m_1 > m_{11(a)} > m_{11(b)}$

and, we know $m = \frac{1}{R}$ which mean this

graph also potrays that,

$$\frac{1}{R_1} > \frac{1}{R_{11(a)}} > \frac{1}{R_{11}(b)} = R_1 < R_{11(a)} < R_{11(b)}$$

$$= 50 < 100 < 200 \ k\Omega$$

which is true.

Ans to q no 6.

(a)

Region AB: This device V_d acts like a current source with constant -5 mA current supply. ($V \leq -5v$, $I = -5mA$)

Region BC: Here, the device acts like a resistor where, $m = \frac{\Delta y}{\Delta x} = 1$

$$\therefore R = \frac{1}{1} = 1 \ k\Omega$$

CD region : It acts like a / This device can be modelled either as voltage source + Rs or current source with parallel to Resistor.

In CD region, $m = \frac{\Delta y}{\Delta x} = \frac{1}{3}$

$\therefore R = \frac{1}{1/3} = 3 \ k\Omega$

$\therefore$ For (C || Rp) :

$i = \frac{v}{3} + I_0$ [compared with $y = mx + c$]

or, $y = mx + c$

$\Rightarrow y = \frac{1}{3}x + c$

Now, putting point D (10, 6) in this eq,

$6 = \frac{10}{3} + c$

$\Rightarrow c = 2.67$

Hence, $y = \frac{1}{3}x + 2.67$

~~Now, when, y = 0 so~~

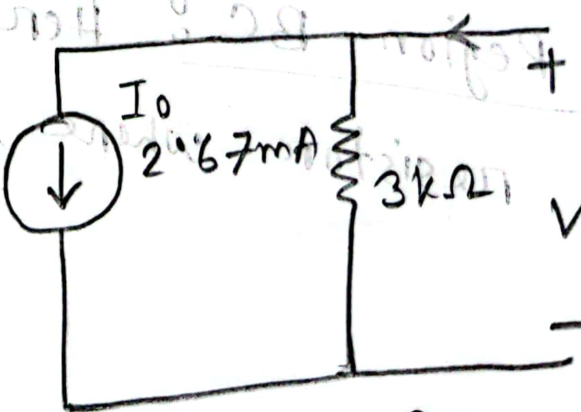


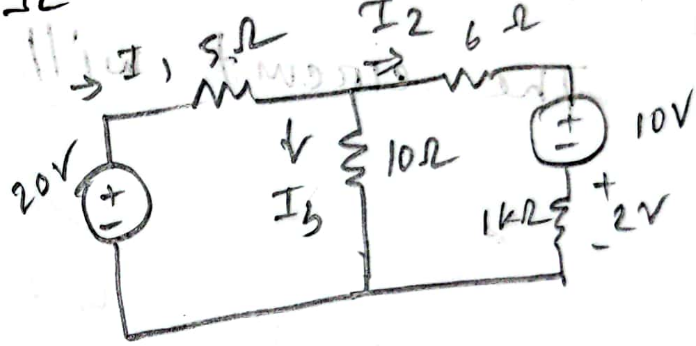
Figure : C.S + RP model

(b)

When, $V_D = 2V$, the operating region is BC where: [It acts like a resistor]

$$m = \frac{4-(-5)}{4-(-5)} = 1$$

$$\therefore R = 1\,k\Omega = 1000\,\Omega$$



$$\text{Value of } I_2 = \frac{V}{R}$$

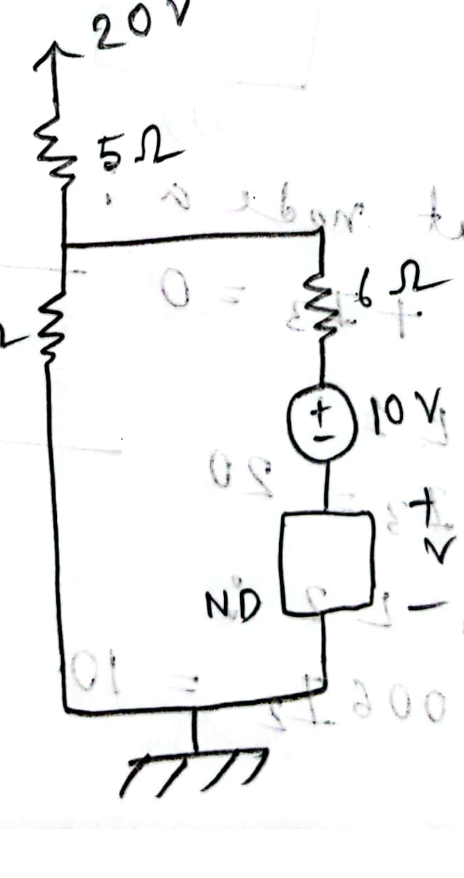
$$= \frac{2}{1000}$$

$$= 2 \times 10^{-3} A$$

$$= 2\,mA$$

(c)

Alternative representation of the circuit shown in fig 1(a):

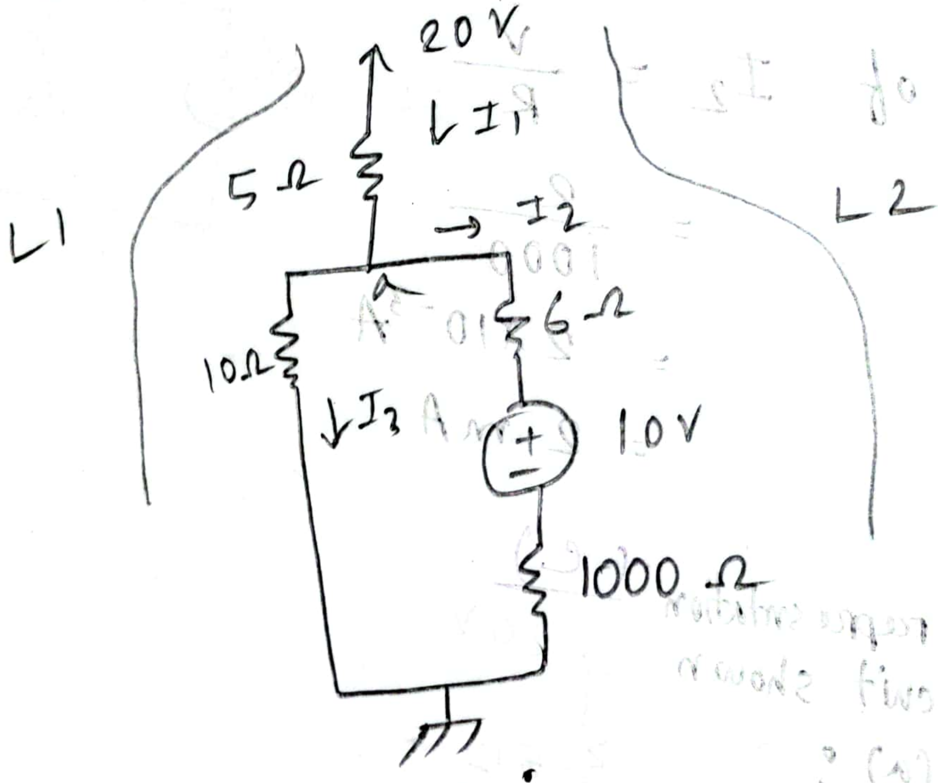


(d)

If ND acts like BC portion of graph which is a resistor ; ~~the circuit~~ :

$$m = \frac{\Delta y}{\Delta x} = 1 \; ; \; R = 1 \, k\Omega$$

The circuit will look like :



Applying KCL at node a :

$$-I_1 + I_2 + I_3 = 0 \quad \text{—— (1)}$$

Apply KVL in L1 :

$$5I_1 + 10I_3 = 20 \quad \text{—— (2)}$$

Apply KVL in L2 :

$$5I_1 + 1006I_2 = 10 \quad \text{—— (3)}$$

Solving the equations :

$I_1 = 1.335A$, $I_2 = 3.302 \times 10^{-3}$ A

$I_3 = 1.332$ A .