BRAC UNIVERSITY

Inspiring Excellence

Assignment 2

CSE251

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Sec: 06

Submitted To :

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BRAC UNIVERSITY

Department of Computer Science and Engineering

Assignment 02, Summer 2024

CSE 251: Electronic Devices and Circuits

1.

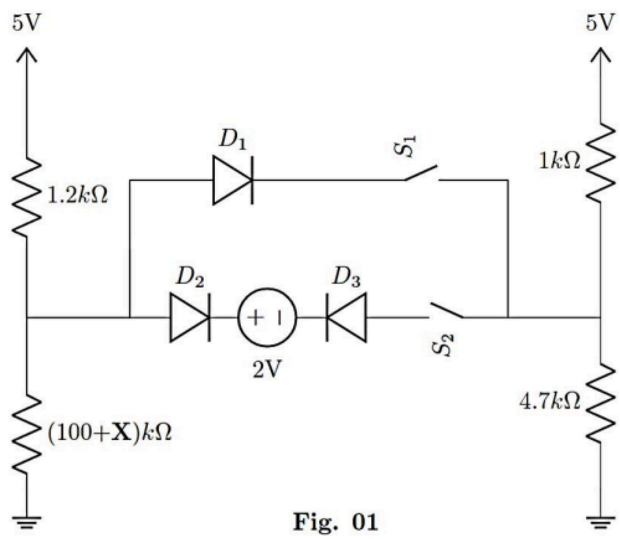


Fig. 01

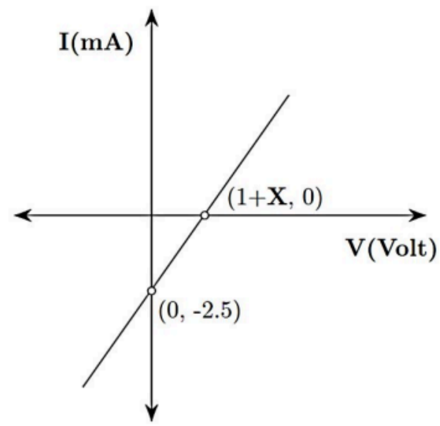


Fig. 02

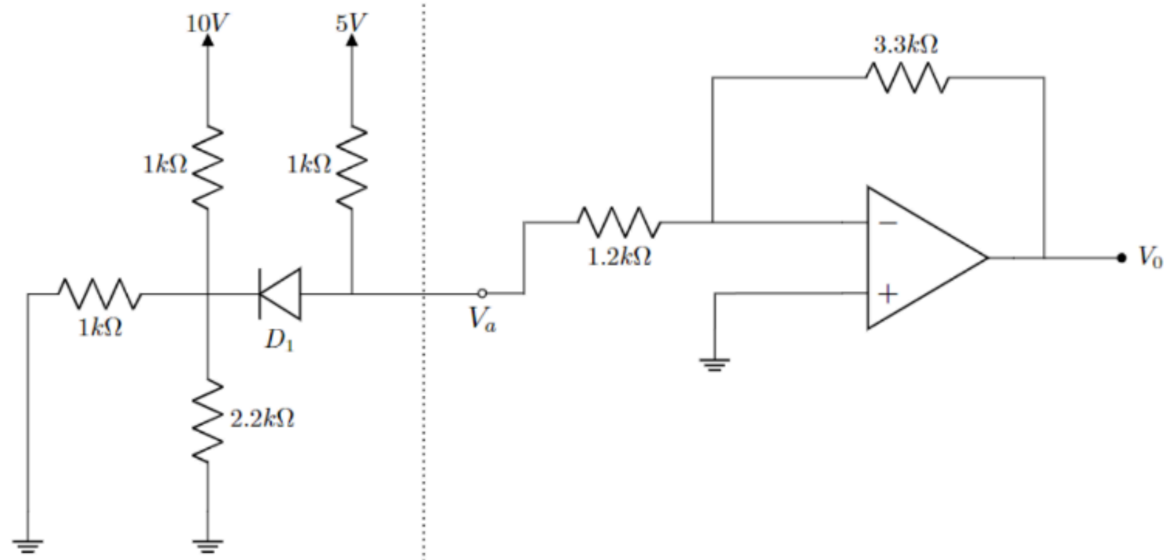
In Fig. 01, a circuit is shown with two ‘off’ switches, S1 and S2. Assume X=last digit of your ID. ($V_{D0} = 0.7V$).

a) If only S1 is ‘on’, determine the current passing through the diode D1. [4]

b) If only S2 is ‘on’, determine the current passing through the diode D2 and D3. [4]

c) Find and draw the unknown component in Fig. 02. [2]

2.



As shown in the figure, a resistor-diode network is constructed and one of its nodes V_a is fed to the ideal Op-Amp to the right side. The Op-Amp has been connected to the saturation voltages V_{sat}^{+} = + 10 V and V_{sat}^{-} = - 10V. Assume that V_D = 0.7 V.

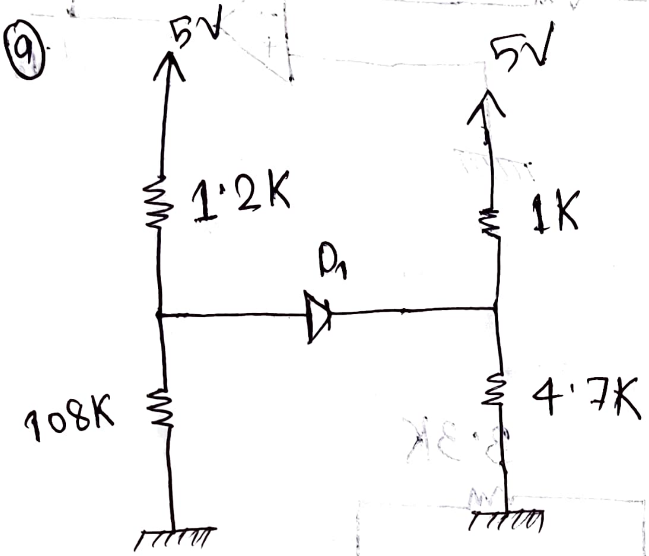
a) Determine whether the diode D1 is conducting or not. [4]

b) Calculate which 1kΩ resistor (left/middle/right) dissipates the least power. [3]

c) Analyze the entire circuit to find what the voltage V_0 should be. [3]

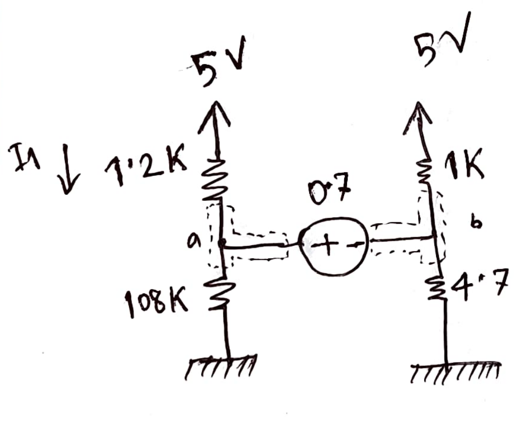
1. My ID = 22201168

(a)



$V_D = 0.7V$

Lets assume the diode is ON,



It's a supper node,

$V_a - V_b = 0.7$

~~Again~~ $\Rightarrow V_a = 0.7 + V_b$ —(1)

$$\frac{V_a - 5}{1.2} + \frac{V_a - 0}{108} + \frac{V_b - 5}{1} + \frac{V_b - 0}{4.7} = 0$$

$$\Rightarrow \frac{V_a}{1.2} - \frac{5}{1.2} + \frac{V_a}{108} + V_b - 5 + \frac{V_b}{4.7} = 0$$

$$\Rightarrow \cancel{\frac{V_a}{1.2} + \frac{V_a}{108} + \frac{V_a}{4.7}}$$

$$\Rightarrow \frac{V_a}{1.2} - \frac{5}{1.2} + \frac{V_a}{108} + V_b - 5 + \frac{V_b}{4.7} = 0$$

$$\Rightarrow \frac{V_a}{1.2} + \frac{V_a}{108} + V_b + \frac{V_b}{4.7} = 5 + \frac{5}{1.2}$$

$$\Rightarrow \frac{91 V_a}{108} + \frac{57 V_b}{47} = \frac{55}{6}$$

$$\Rightarrow \frac{91(0.7 + V_b)}{108} + \frac{57 V_b}{47} = \frac{55}{6}$$

$$\Rightarrow \frac{63.7}{108} + \frac{91 V_b}{108} + \frac{57 V_b}{47} = \frac{55}{6}$$

$$\Rightarrow 2.055 V_b = 8.57$$

$$\therefore \boxed{V_b = 4.17}$$

$$\therefore V_a = 0.7 + 4.17 = 4.87$$

$$\therefore \boxed{V_a = 4.87}$$

In V_a node,

$$\Rightarrow I_1 = I_D + I_L$$

$$\Rightarrow I_D = I_1 - I_2$$

$$= \frac{5-4.87}{1.2} - \left(\frac{4.87}{108}\right)$$

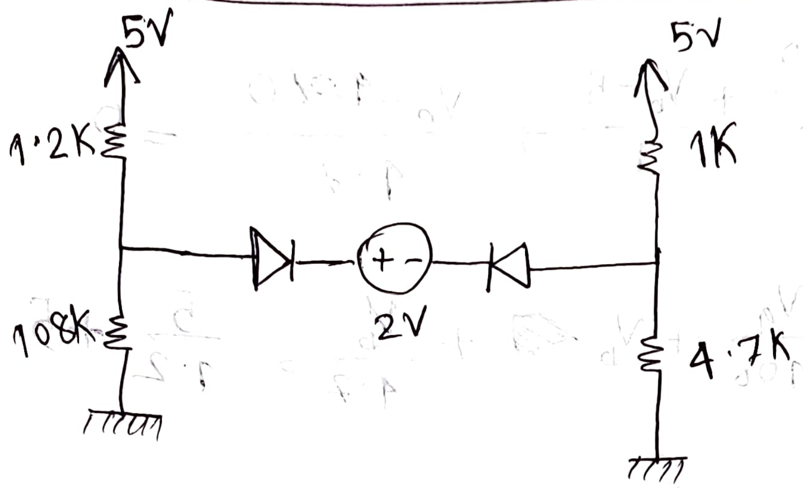
$$= 0.1083 - 0.0487$$

$$= 0.0596 \text{ mA}$$

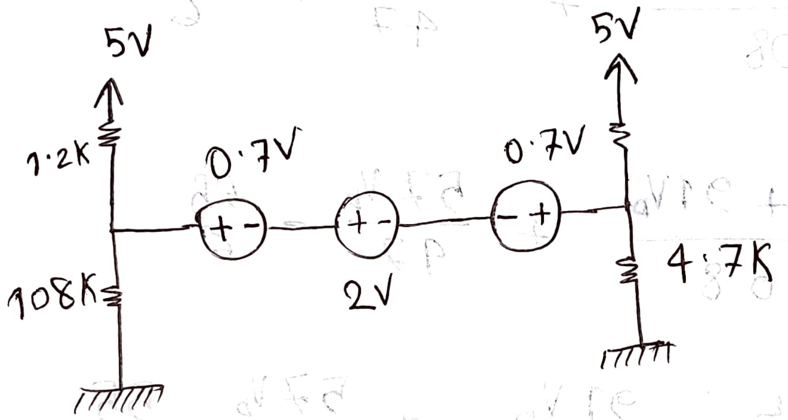
$\therefore$ If only S1 is on, the current passing through the diode is 0.0596 mA

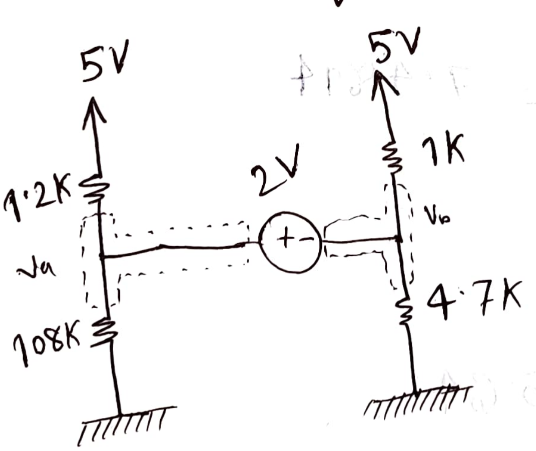
(Ans)

(b)



Let's assume that both of the diode is on,





$V_a - V_b = 2$

$\therefore V_a = 2 + V_b \quad -(1)$

$$\frac{V_a-5}{1.2}+\frac{V_a-0}{108}+\frac{V_b-5}{1}+\frac{V_b-0}{4.7}=0$$

$$\Rightarrow \frac{V_a}{1.2}+\frac{V_a}{108}+V_b+\frac{V_b}{4.7}=\frac{5}{1.2}+5=\frac{55}{6}$$

$$\Rightarrow \frac{91V_a}{108}+\frac{57V_b}{47}=\frac{55}{6}$$

$$\Rightarrow \frac{91(2+V_b)}{108}+\frac{57V_b}{47}=\frac{55}{6}$$

$$\Rightarrow \frac{182+91V_b}{108}+\frac{57V_b}{47}=\frac{55}{6}$$

$$\Rightarrow \frac{182}{108}+\frac{91V_b}{108}+\frac{57V_b}{47}=\frac{55}{6}$$

$$\Rightarrow 2.055V_b=7.4814$$

$$\Rightarrow V_b=3.64$$

$$\therefore V_a=2+V_b=5.64$$

At a, node,

$$I_1 = I_D + I_2$$

$$\Rightarrow I_D = I_1 - I_2$$

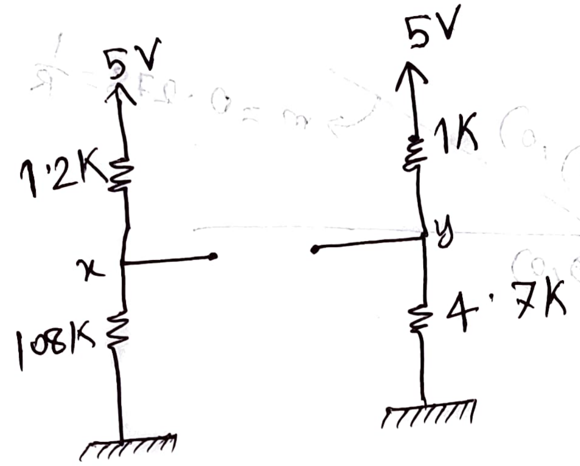
$$= \frac{5 - 5.64}{1.2} - \frac{5.64 - 0}{108}$$

$$= -0.53 - 0.052$$

$$= -0.582 < 0$$

$\therefore$ Assumption Wrong!

Let's assume that both of the diode is off.



$$5-0 = 1.2 I_1 + 108 I_1$$

$$\Rightarrow I_1 = 0.045 \, mA$$

$$\therefore \frac{V_x - 0}{108} = 0.045$$

$$\Rightarrow V_x = 4.86$$

$$5-0 = 1 I_2 + 4.7 I_2$$

$$\Rightarrow I_2 = 0.877 \, mA$$

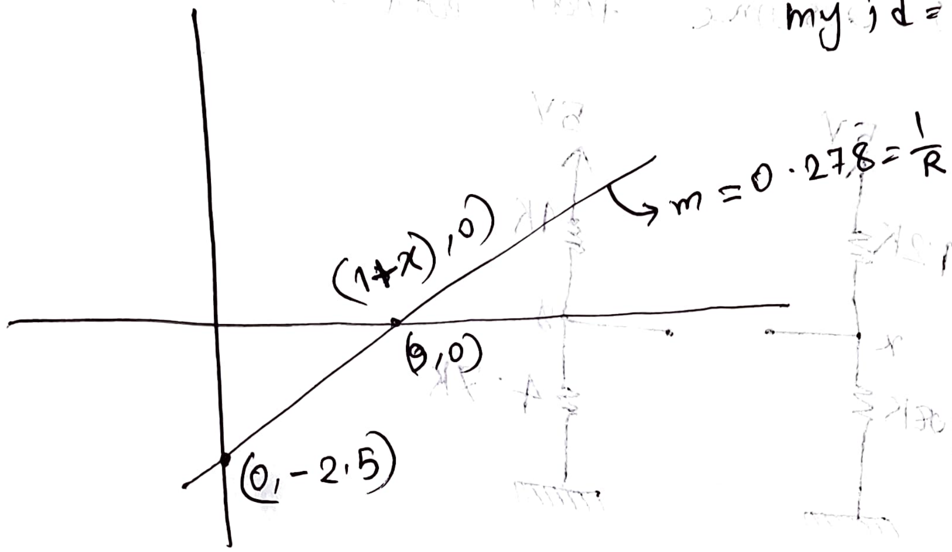
$$\frac{V_y - 0}{4.7} = 0.877$$

$$\Rightarrow V_y = 4.122$$

There will be no current flowing through D_2 and D_3 while the S2 is on.

(c)

my id = 22201168



the equation of the straight line is,

$\cancel{0+2.5}$

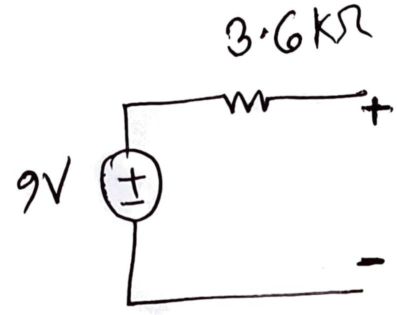
$$\frac{y-0}{0+2.5} = \frac{x-9}{9-0}$$

$$\Rightarrow 9y = 2.5x - 22.5$$

$\Rightarrow$ ~~[illegible]~~

$$\therefore y = 0.278x - 2.5$$

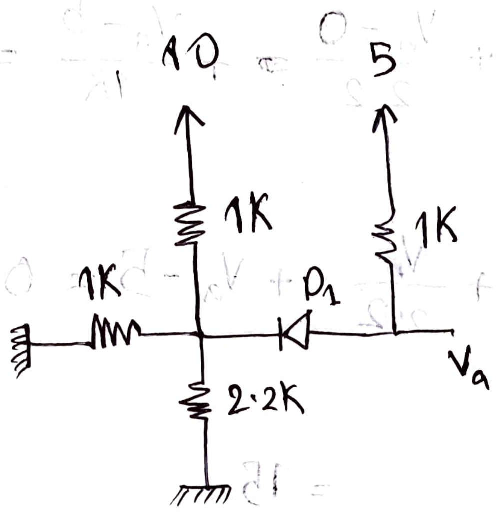
The unknow component will be a voltage source with series resistance.



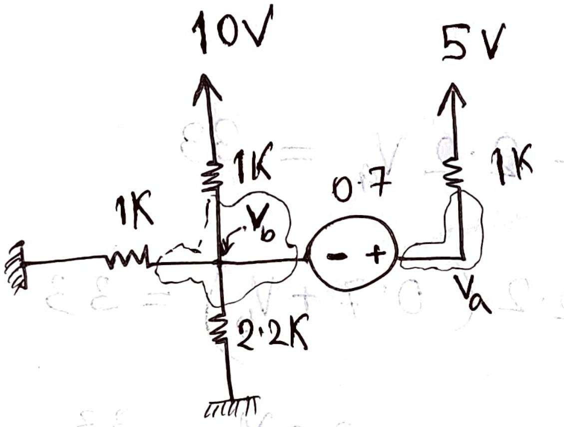
(Ans)

2.

ⓐ



Lets assume that the diode is ON,



There is 3 node in this circuit. V_a, V_b and ground.

V_a and V_b is in a super node.

$V_a - V_b = 0.7$

$\Rightarrow V_a = 0.7 + V_b$ —— ①

$$\frac{V_b-10}{1}+\frac{V_b-0}{1}+\frac{V_b-0}{2.2}+\frac{V_a-5}{1K}=0$$

$$\Rightarrow V_b-10+V_b+\frac{V_b}{2.2}+V_a-5=0$$

$$\Rightarrow 2V_b+\frac{V_b}{2.2}+V_a=15$$

$$\Rightarrow \frac{4.4V_b+V_b+2.2V_a}{2.2}=15$$

$$\Rightarrow 5.4V_b+2.2V_a=33$$

$$\Rightarrow 5.4V_b+2.2(0.7+V_b)=33$$

$$\Rightarrow 5.4V_b+1.54+2.2V_b=33$$

$$\Rightarrow 7.4V_b=31.46$$

$$\therefore V_b=4.139\approx 4.14$$

$$\therefore V_a=0.7+V_b=4.84$$

$\therefore$ the current passing through $D_1 = 5 - 4.84$

$= \cancel{0.9}$

$= 0.16\ mA$

$\therefore I_1 > 0$

$\therefore$ The diode is conducting.

(Ans)

(b) $P_{left} = \Delta V I$

$= (V_b - 0)\ \dfrac{V_b - 0}{1000}$

$= \dfrac{(4.14)^2}{1000}$

$= 0.017139 \approx 0.1714$ Watt

$P_{middle} = \Delta V I$

$= (10 - 4.14)\ \dfrac{(10-4.14)}{1000}$

$= 0.034339 \approx 0.03434$ Watt

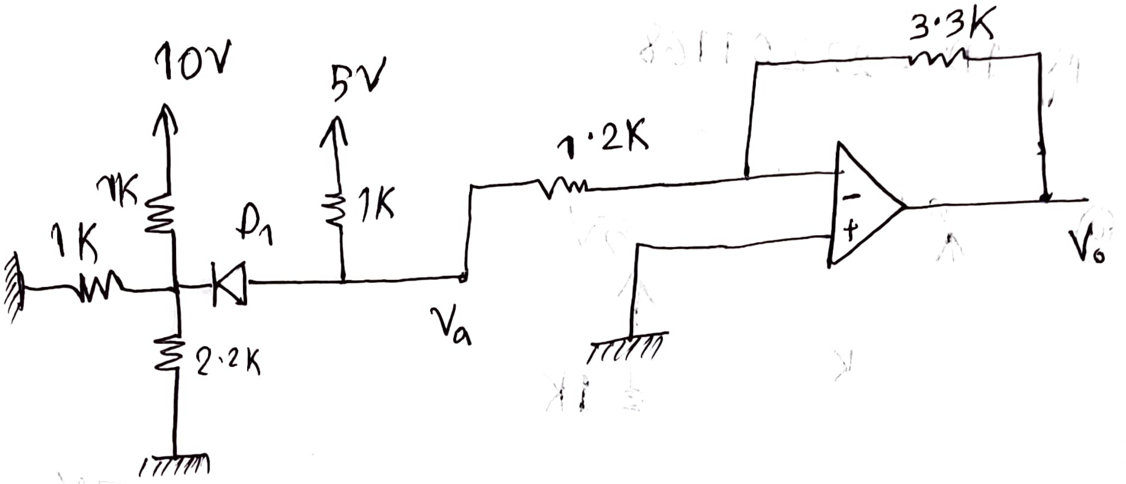
$P_{right} = \Delta V I$

$= (5 - 4.84)\ \dfrac{(5-4.89)}{1000}$

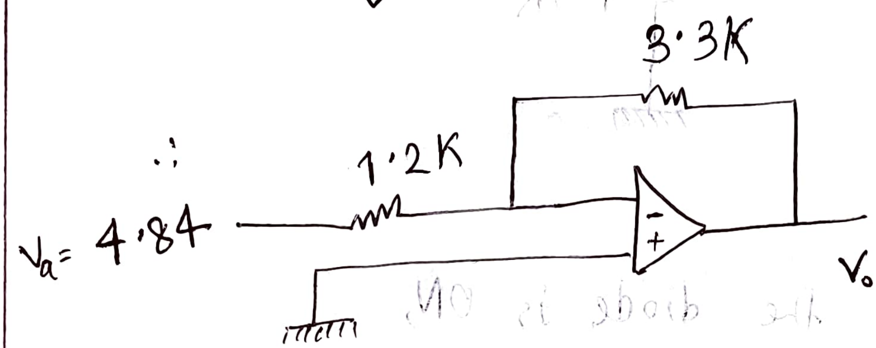
$= 0.0000256$ watt

$\therefore$ The right 1K resistance will ~~dis~~ dissipates the least power. (Ans)

(c)



$\Downarrow$



$\therefore V_{out} = -\left(\frac{R_f}{R_1}\right) V_{in}$

$= -\left(\frac{3.3}{1.2}\right) \times 4.84$

$= -13.31\,V$

(Ans)