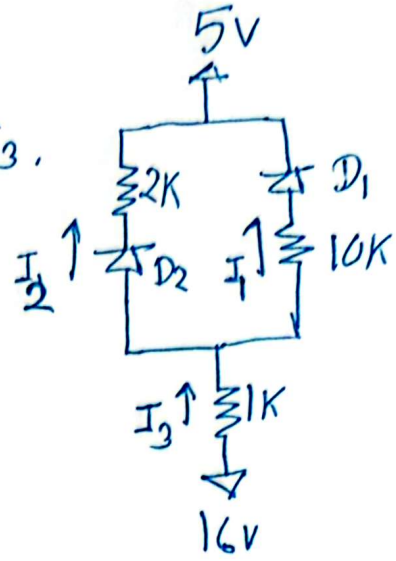
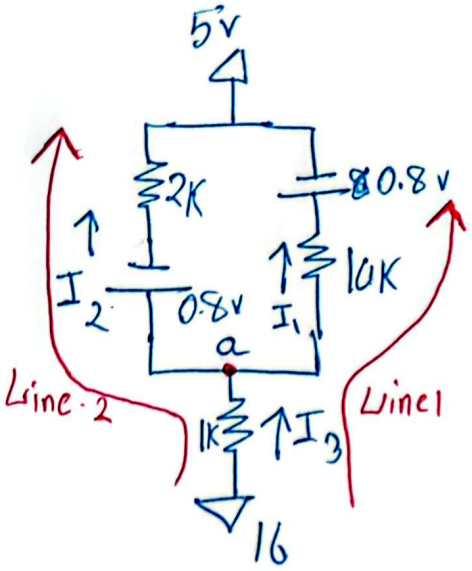
Example - 1

Calculate the values of I_1, I_2, I_3.
Where $V_{D0} = 0.8V$.
[Validate your assumption]



Assume both D_1 & $D_2 \rightarrow$ ON



Line-1

$$16 = I_3 + 10I_1 + 0.8 + 5$$

$$10I_1 + I_3 = 10.2 \quad \text{(i)}$$

Line-2

$$16 = I_3 + 0.8 + 2I_2 + 5$$

$$\Rightarrow 2I_2 + I_3 = 10.2 \quad \text{(ii)}$$

KCL at node a

$$I_3 = I_1 + I_2$$

$$\Rightarrow I_1 + I_2 - I_3 \quad \text{(iii)}$$

Solving eq^n (i), (ii) & (iii)

$$I_1 = 0.6375 \text{ mA}$$
$$I_2 = 3.1875 \text{ mA}$$
$$I_3 = 3.825 \text{ mA}$$

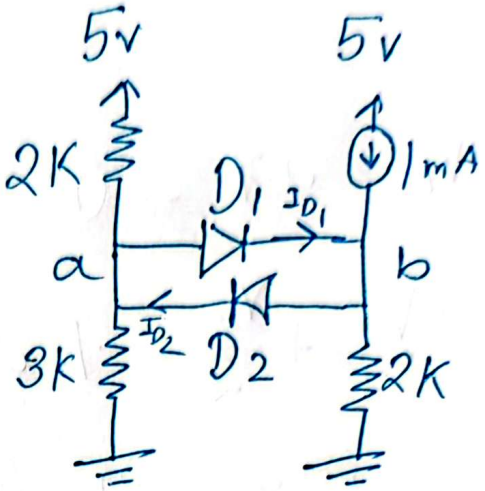
$I_2 > 0$, $I_1 > 0$

~~$I_3 > 0$~~

Assumption is correct

Example -2

Calculate I_{D1} and I_{D2} using method of assumed states.

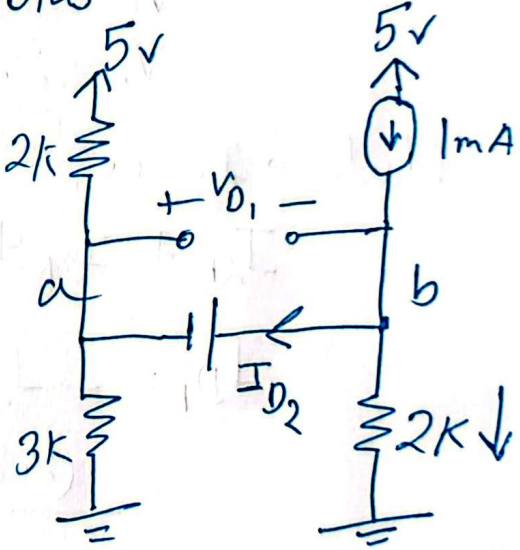


$V_{D_0} = 0.7\,V$

Assume :

$D_1 \rightarrow$ reverse bias

$D_2 \rightarrow$ Forward bias



$V_b - V_a = 0.7$ — (i)

$\frac{V_b}{2} + \frac{V_a - 5}{2} + \frac{V_a}{3} - 1 = 0$

$\Rightarrow 5V_a + 3V_b = 21$ — (ii)

Solving eqn (i) & (ii)

$V_a = 2.3625$

$V_b = 3.0625$

KCL at b

~~$1 + I_{D_2} = \frac{V_b}{2}$~~ $\quad 1 = I_{D_2} + \frac{V_b}{2}$

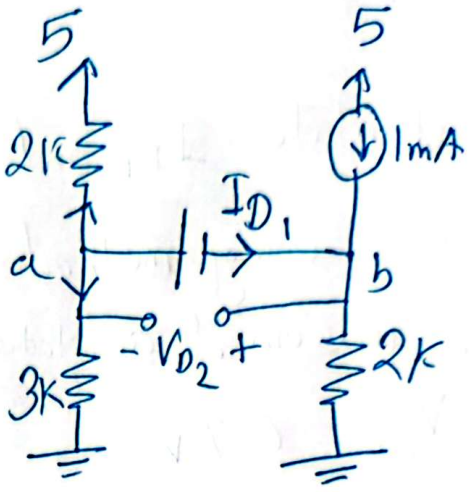
$\Rightarrow I_{D_2} = 1 - \frac{3.0625}{2}$

$\therefore I_{D_2} = -0.53125 < 0$

Wrong Assumption

Assume

$D_1 \rightarrow$ Forward bias $D_2 \rightarrow$ Reverse bias



$$V_a - V_b = 0.7 \quad \text{(i)}$$

$$\frac{V_a - 5}{2} + \frac{V_a}{3} + \frac{V_b}{2} - 1 = 0$$

$$\Rightarrow 5V_a + 3V_b = 21 \quad \text{(ii)}$$

Solving eqn (i) & (ii)

$$V_a = 2.8875$$

$$V_b = 2.1875$$

Node → ~~Da~~ a

$$I_{2K} + I_{3K} + I_{D_1} = 0$$

$$\Rightarrow I_{D_1} = -I_{2K} - I_{3K}$$

$$= -\frac{(2.8875 - 5)}{2} - \frac{(2.8875)}{3}$$

$$= 0.09375 > 0$$

$$V_{D_2} = V_b - V_a$$

$$= 2.1875 - 2.8875$$

$$= -0.7 < 0.7\,V$$

$$\boxed{\begin{aligned} I_{D_1} &> 0 \\ V_{D_2} &< 0.7 \end{aligned}}$$

$$I_{D_1} = 0.09375\ mA$$

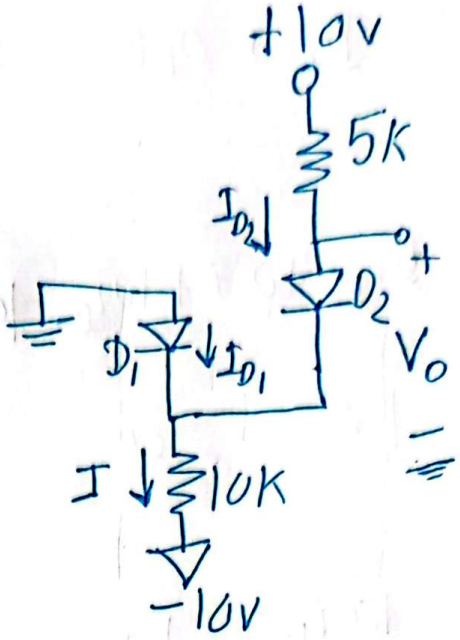
$$I_{D_2} = 0$$

Assumption is correct

Example-3

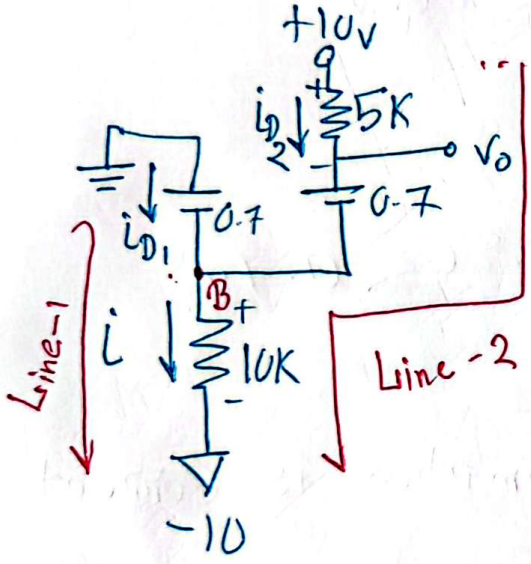
Find the voltage V and I_{D_1} & I_{D_2} ..

$V_{D0} = 0.7\,V$



Assume:

Both $D_1, D_2 \rightarrow$ ON



Line-1

$0 = 0.7 + 10i - 10$

$\Rightarrow i = 0.93\,mA$

Line-2

$10 = 5i_{D_2} + 0.7 + 10i - 10$

$\Rightarrow 5i_{D_2} + 10 \times (0.93) = 19.3$

$\Rightarrow i_{D_2} = 2mA$ $\quad [\because i = 0.93mA]$

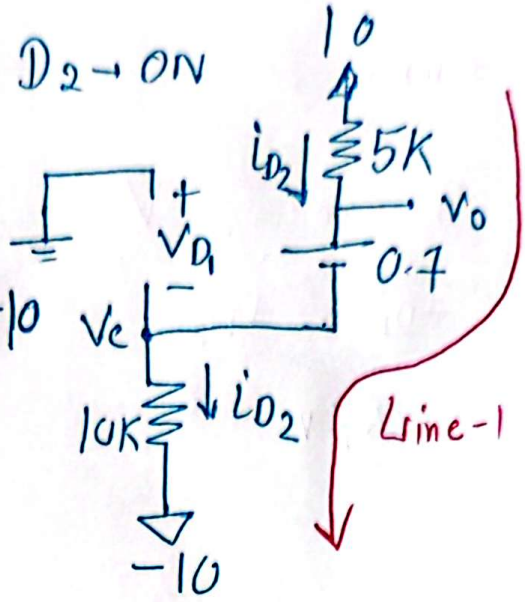
KCL at Node B

$i_{D_1} + i_{D_2} = i$

$\Rightarrow i_{D_1} = 0.93 - 2mA = -1.07 < 0$

Invalid Assumption

Assume : $D_1 \rightarrow$ off $D_2 \rightarrow$ ON



Line-1

$10 = 5i$ $5i_{D_2} + 0.7 + 10i_{D_2} - 10$

$i_{D_2} = 1.286 > 0$

$V_c = 10\, i_{D_2} - 10$

$= 10 \times 1.286 - 10 = 2.86\ V$

$V_{D_1} = V_A - V_c$

$= 0 - 2.86 = -2.86 < 0.7\ V.$

$I_{D_2} > 0$

$V_{D_1} < 0.7$ Assumption is Correct

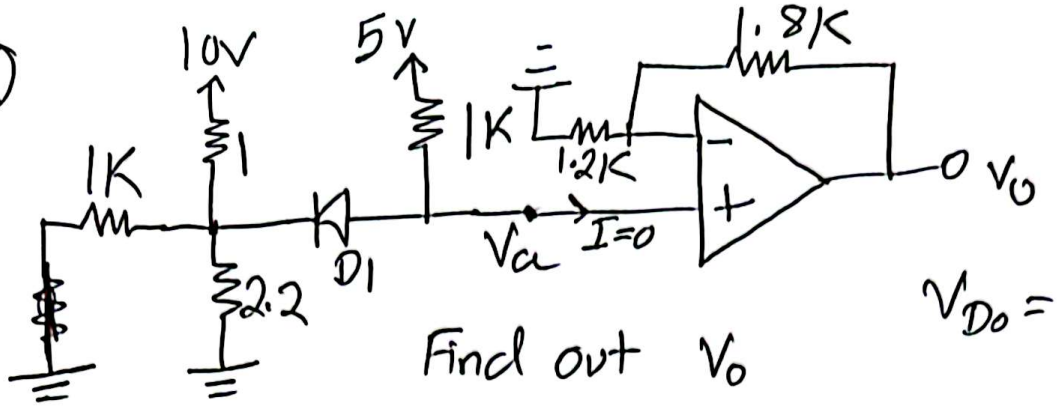
$i_{D_1} = 0$

$i_{D_2} = 1.286\ mA$

$V_o = 0.7 + 10\, i_{D_2} - 10$

$= 3.56\ V$

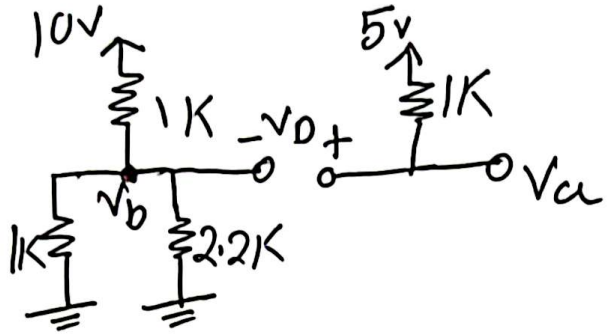
(2)



$V_{D_0} = 0.7V$

Find out V_o

Assume $D_1 \rightarrow$ off



$V_a = 5V$

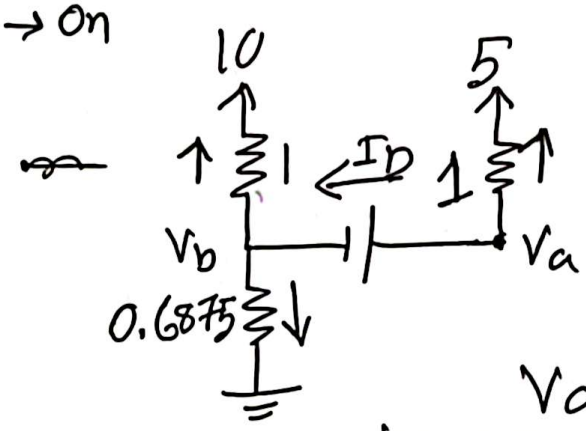
$$V_b = \frac{(1\|2.2)}{(1\|2.2)+1} \times 10$$

$$= 4.07V$$

$$V_D = V_a - V_b = 5 - 4.07 = 0.93V > 0.7V$$

Assumption is incorrect.

$D_1 \rightarrow$ on



Super Node

$$\frac{V_a-5}{1} + \frac{V_b-10}{1} + \frac{V_b-0}{0.6875} = 0 \quad \text{(1)}$$

$$V_a - V_b = 0.7V$$

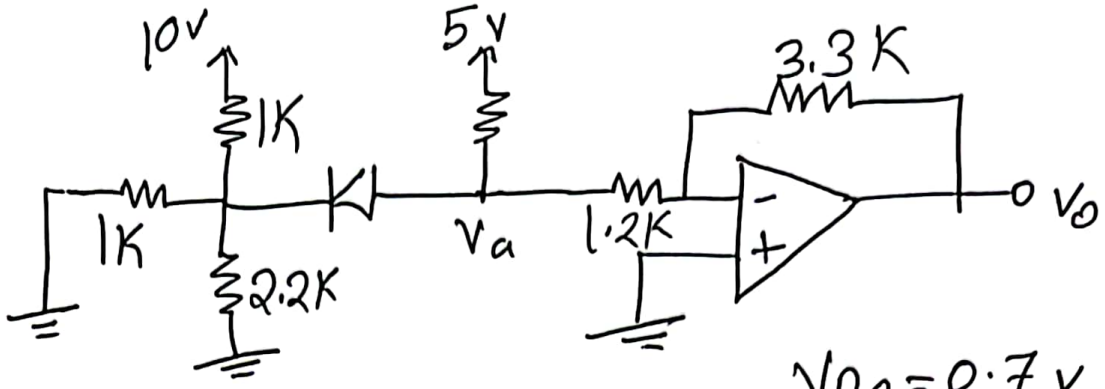
$$\boxed{V_a = 4.84}$$

$$I_D = \frac{5 - V_a}{1} = 0.16\ mA > 0 \rightarrow \text{Correct Assumption}$$

$$\therefore V_o = \left(1 + \frac{1.8}{1.2}\right) \times 4.84$$

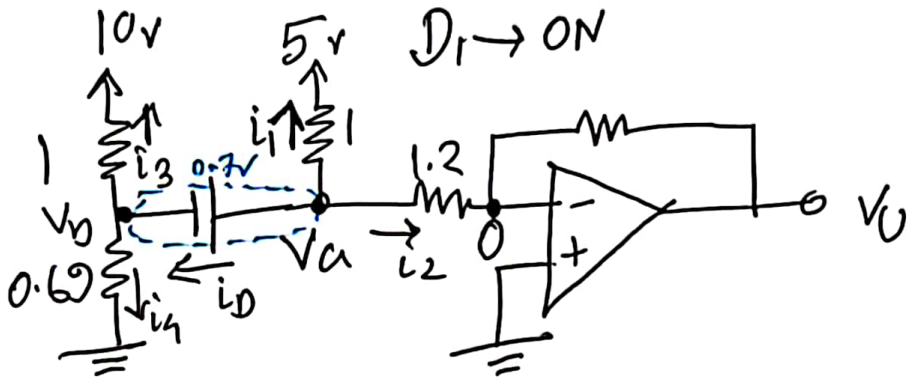
$$= 12.1\ V$$

③



$V_{D0} = 0.7\,V$

Find out V_o



$$\frac{V_a-5}{1}+\frac{V_a-0}{1.2}+\frac{V_b-10}{1}+\frac{V_a-0}{0.69}=0 \quad \text{—(i)}$$

$$V_a - V_b = 0.7V \quad \text{—(ii)}$$

$$V_a = 3.9\,V$$

$$V_b = 3.2\,V$$

KCL at Node V_a

$$i_1 + i_2 + i_D = 0$$

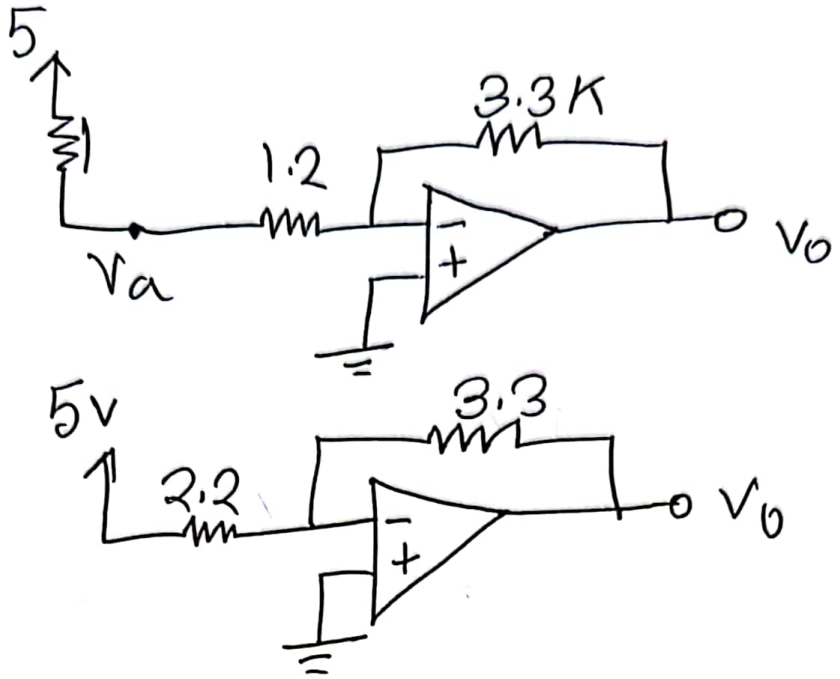
$$\Rightarrow \frac{3.9-5}{1}+\frac{3.9-0}{1.2}+I_D=0$$

$$\Rightarrow -1.1 + 3.25 + I_D = 0$$

$$\therefore I_D = -2.15\,mA < 0\,mA$$

So Assumption is incorrect

So D_1 is off



$$V_o = -\frac{R_f}{R_1} \times V_{in}$$

$$= -\frac{3.3}{2.2} \times 5$$

$$= \text{[illegible]}$$

$$= -7.5v$$