In the **adjacent** figure we have the following parameters:

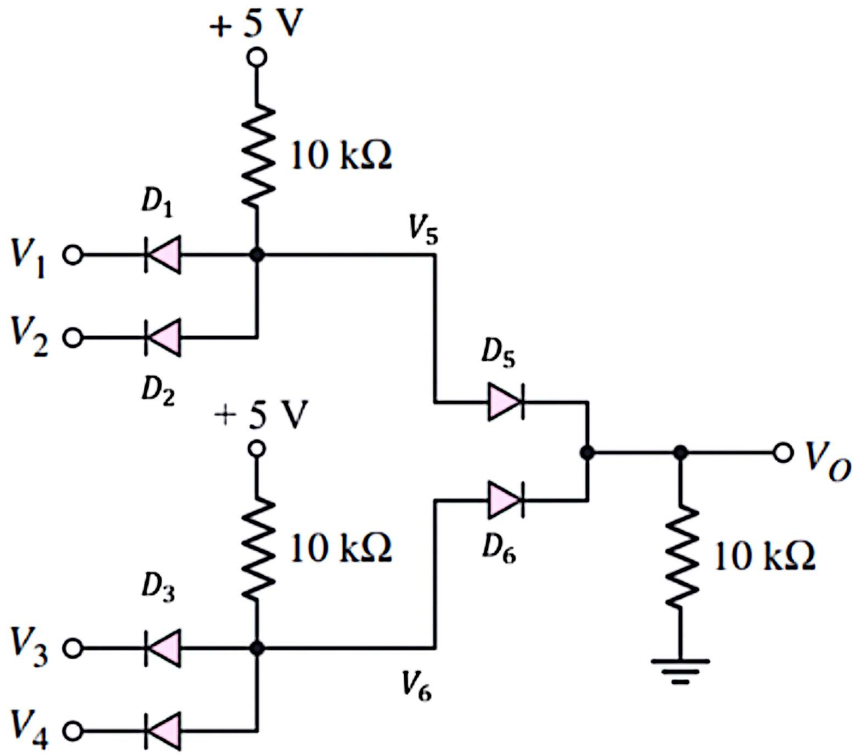
$V_{D1} = 0.3$ V, $V_1 = 2$ **V**

$V_{D2} = 0.5$ V, $V_2 = 1.7$ **V**

$V_{D3} = 0.7$ V, $V_3 = 1.5$ **V**

$V_{D4} = 0.9$ V, $V_4 = 1.1$ **V**

$V_{D5} = V_{D6} = 1.1$ V



a) Draw the IV characteristics of a diode as per the constant voltage drop + resistance model. Indicate the different operating modes in your graph. **[3]**

b) Find V5 and V6. **[3]**

c) Find VO. **[2]**

d) Solve the circuit to get Vo, when V1=7 V , V2 = 8 V and all other voltages remain the same. (**Hint:** Try to obtain V5 by solving the portion of the circuit with diodes D1 and D2, by method of assumed states.) **[1 + 1]**

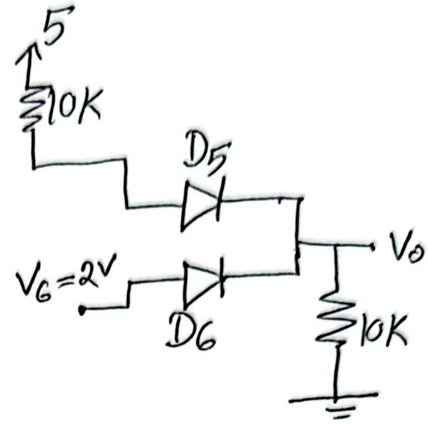
i) $V_5 = \mathrm{Min}(V_1 + V_{D_1}, V_2 + V_{D_2}) = \mathrm{Min}(2.3, 2.2) = 2.2\,V$

$V_6 = \mathrm{Min}(V_3 + V_{D_3}, V_4 + V_{D_4}) = \mathrm{Min}(2.2, 2) = 2\,V$

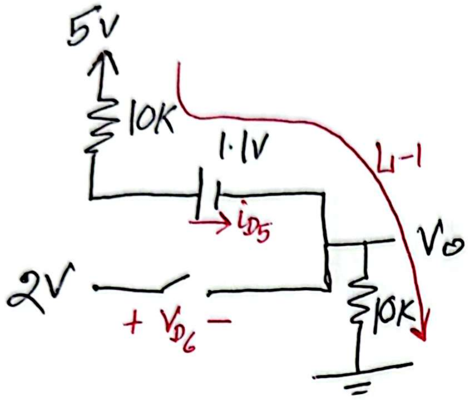
ii) $V_0 = \mathrm{Max}(V_5 - V_{D_5}, V_6 - V_{D_6})$

$= \mathrm{Max}(1.1, 0.9) = 1.1\,V$

iii) For $V_1 = 7V$ & $V_2 = 8V$, D_1 and D_2 are both in reverse bias as both V_1 & V_2 are greater than the 5V supply voltage.



Assume D5→ON, D6→OFF



KVL at L-1

$$5 = 10 i_{D5} + 1.1 + 10 i_{D5}$$

$$i_{D5} = 0.195 > 0$$

$$V_o = 0.195 \times 10 = 1.95V$$

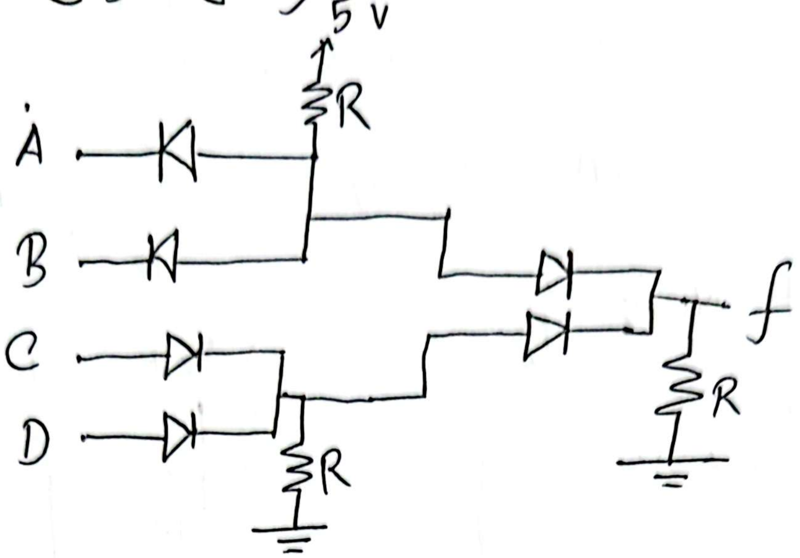
$$V_{D6} = 2 - 1.95 = 0.05 < 1.1\ V$$

Correct Assumption

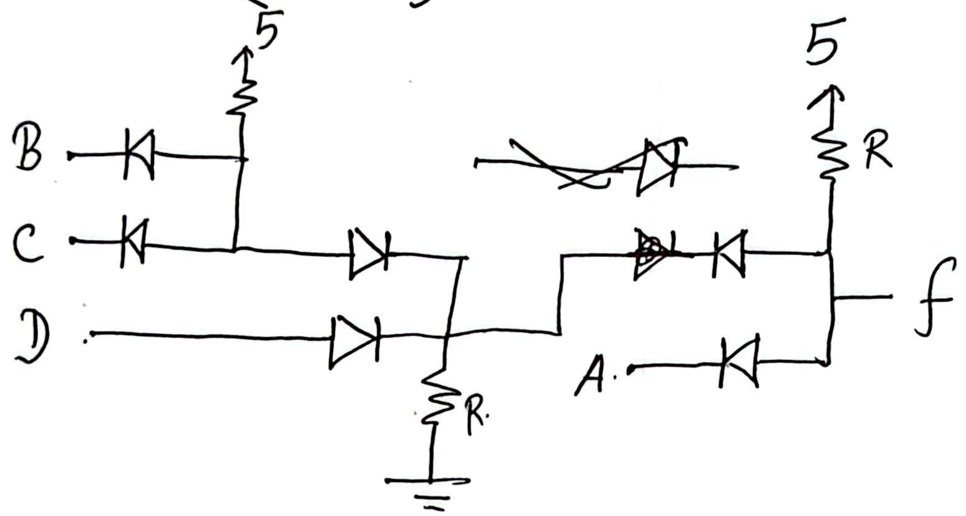
$$\boxed{V_o = 1.95V}$$

Q-2 Implement the following expressions using Diodes

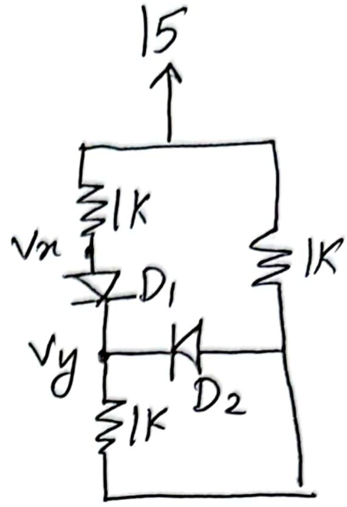
i) $f = (A.B) + (C+D)$



ii) $f = (B.C+D).A$

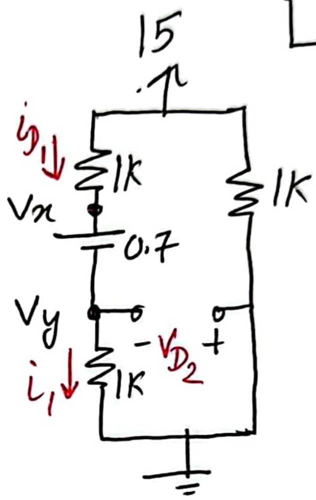


Q-3 Analyze the circuit to calculate V_x, V_y, I_{D_1} & I_{D_2}.
Use $V_{D0} = 0.7v$ for both diodes



Assuming D_1 ON & D_2 Off

KCL at Node V_y



$$i_{D_1} = i_1$$

$$\Rightarrow \frac{15-0.7-V_y}{1} = \frac{V_y - 0}{1}$$

$$\Rightarrow V_y = 7.15$$

$$I_{D_1} = \frac{15-0.7-7.15}{1}$$

$$= 7.15\,mA > 0$$

$$V_{D_2} = 0 - V_y = -7.15 < 0.7$$

Assumption is correct

$$V_x - V_y = 0.7$$

$$\Rightarrow V_x = 7.85$$

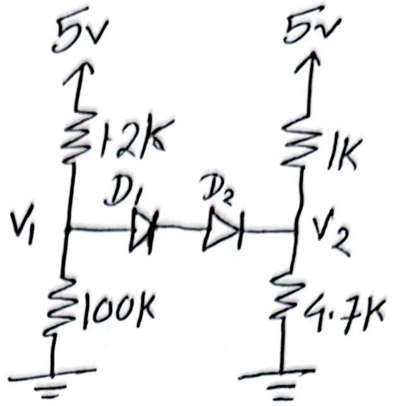
$$I_{D_2} = 0\,mA$$

$$\boxed{\begin{aligned} V_x &= 7.85\,V \\ V_y &= 7.15\,V \\ I_{D_1} &= 7.15\,mA \\ I_{D_2} &= 0\,mA \end{aligned}}$$

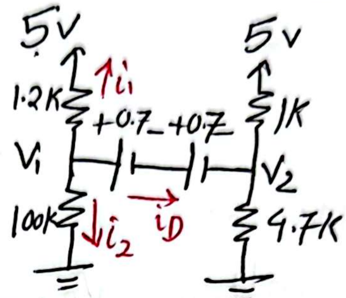
Q-4

Find the current passing through $100K\Omega$ resistor.

$V_{D0} = 0.7V$



Assuming D_1 ON, D_2 ON



$$\frac{V_1-5}{1.2}+\frac{V_1-0}{100}+\frac{V_2-5}{1}+\frac{V_2-0}{4.7}=0$$

Format Approach

$$\boxed{V_1\left(\frac{1}{1.2}+\frac{1}{100}\right)+V_2\left(1+\frac{1}{4.7}\right)-\frac{5}{1.2}-\frac{5}{1}=0} \cdots (i)$$

$$V_1 - V_2 = 1.4 \cdots (ii)$$

$V_1 = 5.28$

$V_2 = 3.88$

KCL at V_1

$$i_1 + i_2 + i_D = 0$$

$$i_D = -i_1 - i_2 = \cancel{\frac{V_1-5}{1.2}}$$

$$= -0.233 - 0.052$$

$$= -0.285 < 0$$

$$i_1 = \frac{5.28-5}{1.2} = 0.233\,mA$$

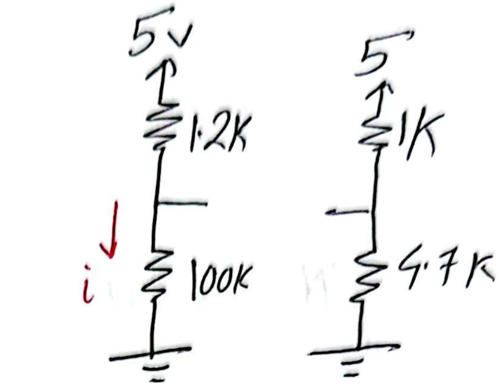
$$i_2 = \frac{5.28}{100} = 0.052\,mA$$

Assumption is wrong

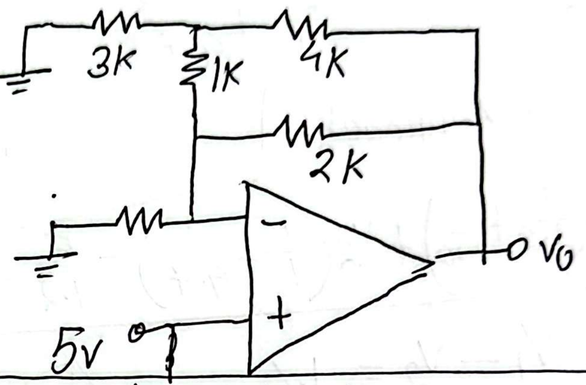
Assuming D_1 & D_2 → Off

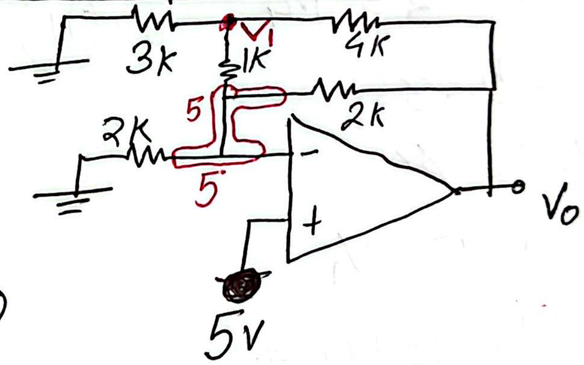
$$i = \frac{5}{1.2 + 100}$$

$= 0.049\ mA$



(85) Determine the output voltage V_o.





KCL at V_-

$$\frac{5-0}{2} + \frac{5-V_o}{2} + \frac{5-V_1}{1} = 0$$

$\Rightarrow 5 + 5 - V_o + 10 - 2V_1 = 0$

$\Rightarrow V_o + 2V_1 = 20 \quad \cdots (i)$

KCL at V_1

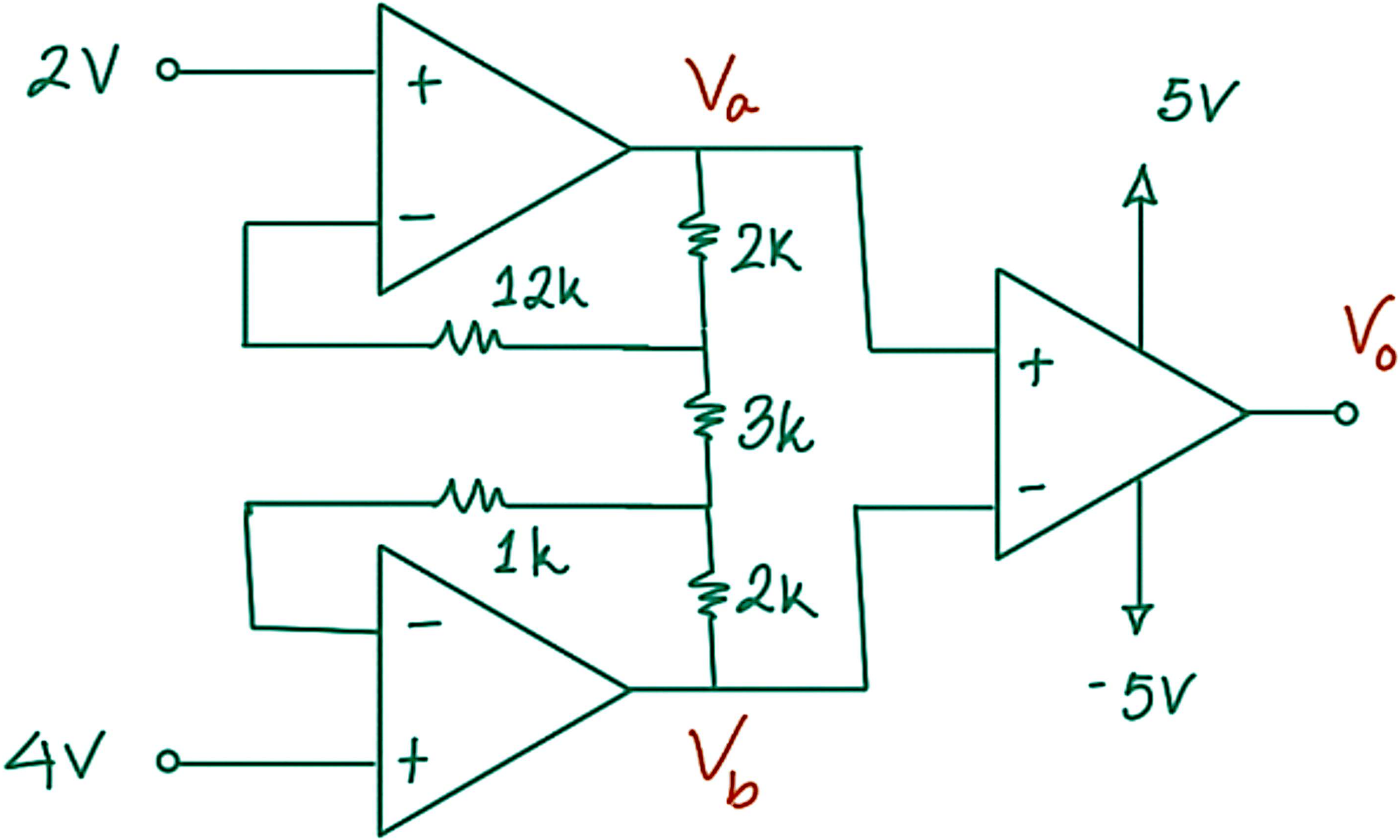
$$\frac{V_1}{3} + \frac{V_1 - V_o}{4} + \frac{V_1 - 5}{1} = 0$$

$\Rightarrow 4V_1 + 3V_1 - 3V_o + 12V_1 - 60 = 0$

$\Rightarrow -3V_o + 19V_1 = 60 \quad \cdots (ii)$

Solving eq^N (i) & (ii)

$$\boxed{V_o = 10.4\ V}$$



2V
+
−
Va
2K
12k
3k
1k
2k
−
+
4V
Vb
5V
+
−
Vo
-5V