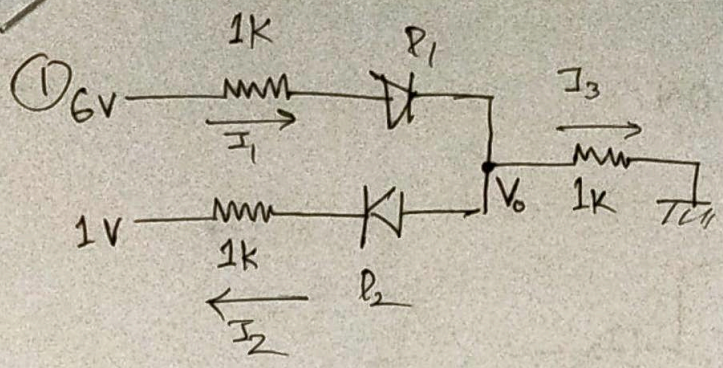
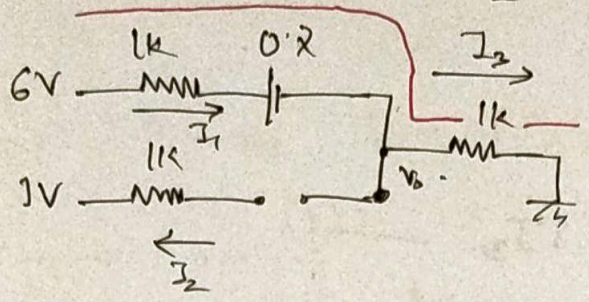
① 

Find I_1, I_2, I_3, V_o. Use CVD model with $V_\gamma = 0.7V$

Soln: Assume D_1 = ON, D_2 = OFF



$I_2 = 0$. [OFF]

$I_1 = I_2 + I_3$ [KCL]

$\therefore I_1 = I_3$

Writing KVL along 6V to GND [Red line]

$6 = 1I_1 + 0.7 + 1I_3 + 0$

$\Rightarrow 2I_1 = 6 - 0.7$ [since $I_1 = I_3$]

$\Rightarrow I_1 = I_3 = 2.65$ mA

$\therefore V_o = 1I_3 = 2.65V$

Now I_1 = +ve, so D_1 assumption correct

But for D_2,

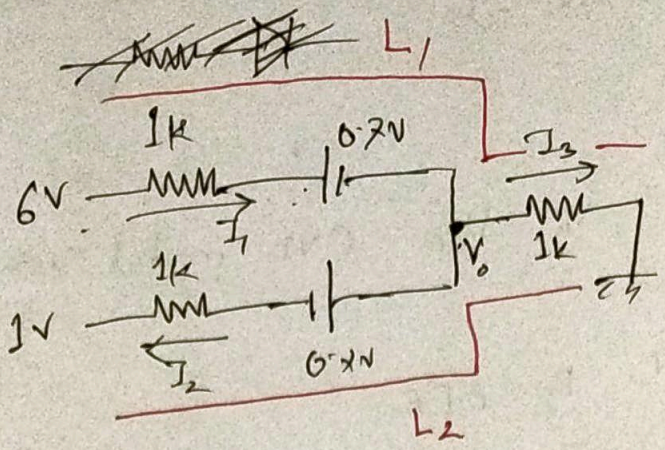
$V_A = V_o = 2.65V$

$V_C = 1V$

$\therefore V_D = 1.65V$

So assumption wrong

Assume $D_1 = ON$, $D_2 = ON$



KVL along L_1

$$6 = 1I_1 + 0.7 + 1I_3 \quad \text{---(I)}$$

KVL along L_2

$$1 = -1I_2 - 0.7 + 1I_3 \quad \text{---(II)}$$

KCL $\Rightarrow$

$$I_1 = I_2 + I_3 \quad \text{---(III)}$$

Solving (I), (II) and (III)

$I_1 = 2.96$ mA

$I_2 = 0.63$ mA

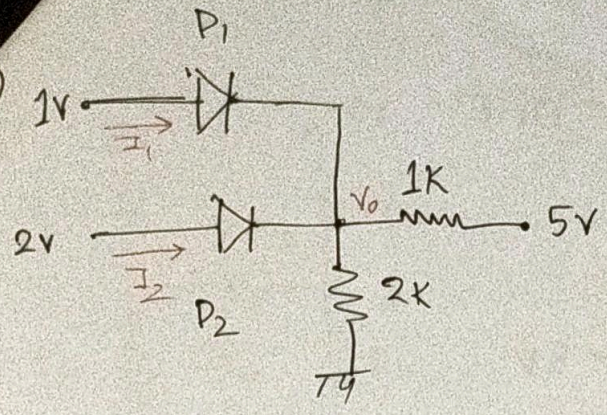
$I_3 = 2.33$ mA

$\therefore V_0 = 1I_3 = 2.33$V

$I_1 = +ve \Rightarrow D_1$ assumption correct ✓

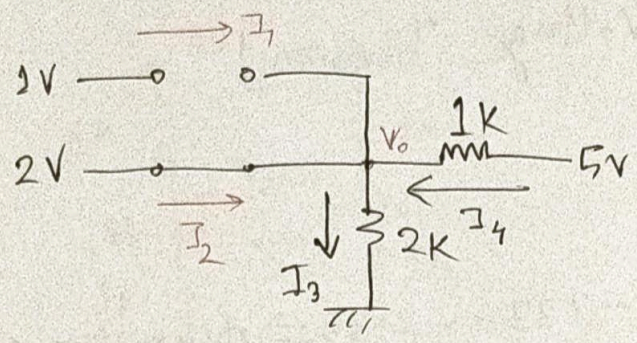
$I_2 = +ve \Rightarrow D_2$ " " ✓

(2)



Find I_1, I_2 and V_o. Assume the diodes are ideal.

Soln: Assume D_1 = OFF, D_2 = ON



$\therefore I_1 = 0$ (OFF)

$\therefore V_o = 2V$

$\therefore I_3 = \frac{V_o}{2} = 1mA, \quad I_4 = \frac{5 - V_o}{1} = \frac{5-2}{1} = 3mA$

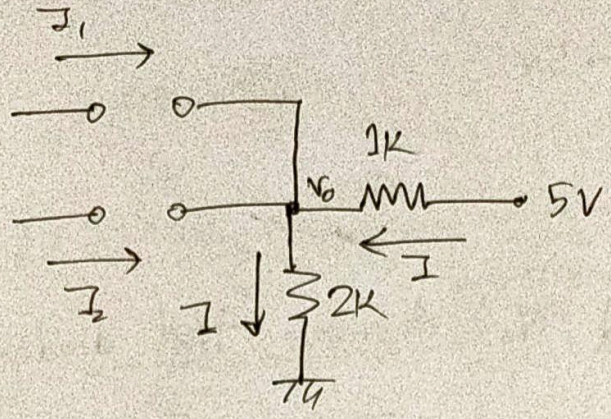
KCL $\Rightarrow I_2 + I_4 = I_3 \Rightarrow I_2 = I_3 - I_4$

$\therefore \boxed{I_2 = -2mA}$

$\therefore$ D_2 assumption wrong

For D_1, $V_D = V_A - V_C = 1 - 2 = -1 \Rightarrow$ Assumption correct

Assume D_1 = OFF, D_2 = OFF



$I_1 = 0$

$I_2 = 0$

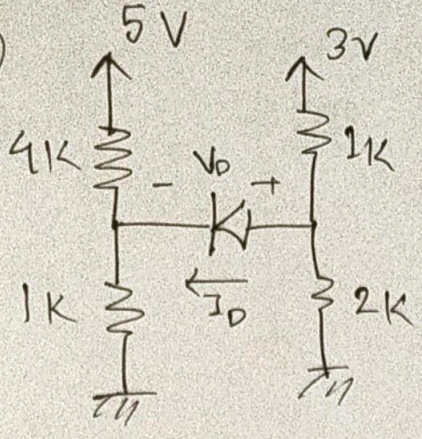
$$V_0 = \frac{2}{2+1} \times 5 \quad \text{[Voltage Division]}$$

$$\Rightarrow V_0 = 3.33V$$

For $D_1 \Rightarrow V_D = V_A - V_C = 1 - 3.33 = -2.33 \Rightarrow$ Assumption correct

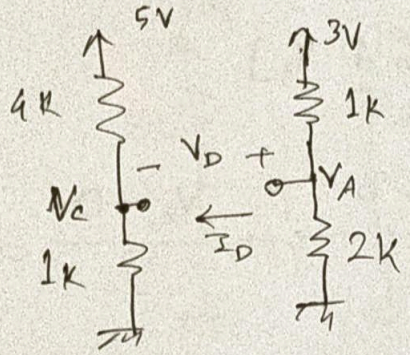
For $D_2 \Rightarrow V_D = V_A - V_C = 2 - 3.33 = -1.33 \Rightarrow$

(3)



Find V_D and I_D. Use CVD with $V_\gamma = 0.2V$.

Soln: Assume diode OFF



$\therefore I_D = 0$

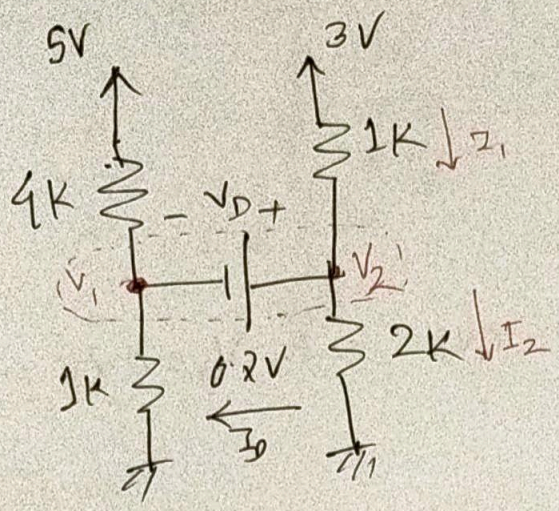
$$V_A = \frac{2}{2+1} \times 3 = 2V \quad [\text{Voltage division}]$$

$$V_C = \frac{1}{4+1} \times 5 = 1V \quad [\quad " \quad "\ ]$$

$\therefore V_D = V_A - V_C = 2 - 1 = 1V$

$\therefore$ Assumption wrong!

So, the diode would be on!



$\therefore V_D = 0.2V$

Super node equation (V_1 and V_2)

$$\frac{V_1 - 5}{4} + \frac{V_1 - 0}{1} + \frac{V_2 - 3}{1} + \frac{V_2 - 0}{2} = 0 \quad \text{---(i)}$$

$$V_2 - V_1 = 0.2 \quad \text{---(ii)}$$

solving (i) and (ii)

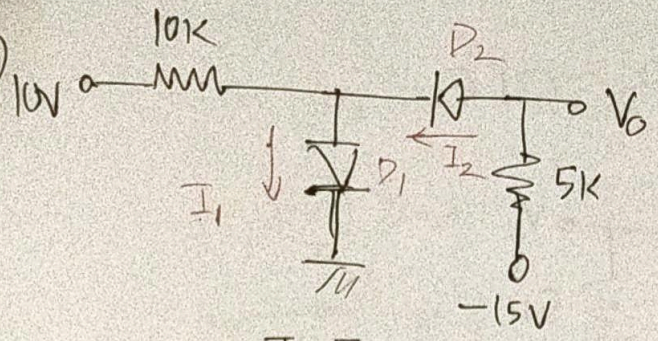
$V_1 = ~~1.636V~~ \; 1.163\,V$

$V_2 = 1.863\,V$

$I_1 = \frac{3 - V_2}{1} = 1.137\ mA, \quad I_2 = \frac{V_2 - 0}{2} = 0.932\ mA$

$\therefore I_D = I_1 - I_2$ [KCL] $= 0.205\ mA$ [correct assumption]

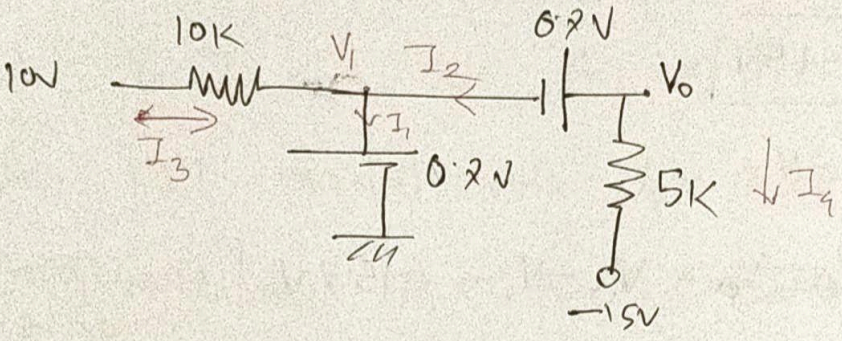
(5)



[Neaman: 2·55]

Find I_1, I_2. Use CVD model with $V_\gamma = 0.7V$.

Soln: Assume $D_1 = ON$, $D_2 = ON$.



$V_1 = 0.7V$

$V_0 = V_1 + 0.7V = 1.4V$

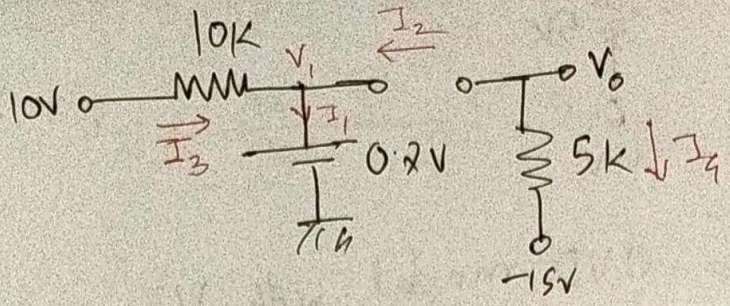
$I_3 = \frac{10 - 0.7}{10} = 0.93mA$

$I_4 = \frac{1.4 - (-15)}{5} = 3.28mA$

From KCL, $I_2 = -I_4 = -3.28mA$ [Assumption wrong for D_2]

$I_1 = I_3 + I_2 = -2.35mA$ [Assumption wrong for D_1]

Assume $D_1 = ON$, $D_2 = OFF$



Open CKT $\Rightarrow I_2 = 0$

$I_4 = 0$

$\therefore \boxed{V_o = -15V}$

$V_1 = 0.2V$

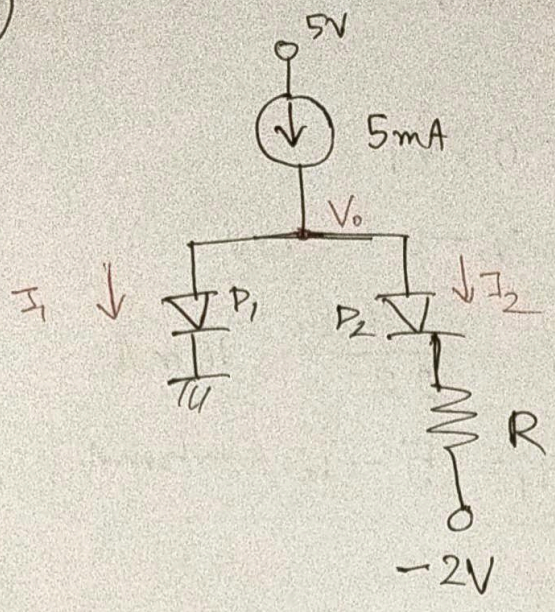
$\therefore V_{D_2} = \cancel{V_0 - V_0} = V_o - V_1 = -15.2V$ [Assumption correct for D_2]

$I_3 = \frac{10 - V_1}{10} = \frac{10 - 0.2}{10} = 0.98mA$

$I_1 - I_3 = 0.98mA$ [KCL] [Assumption correct for D_1]

So, $\boxed{V_o = -15V}$ Ans

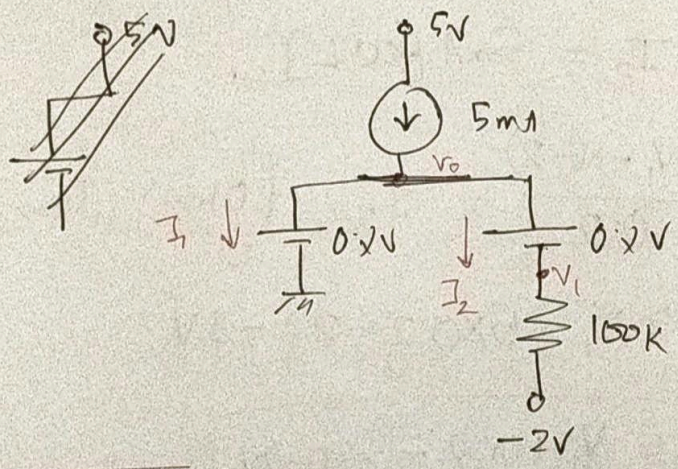
(6)



Find V_o, I_1 and I_2 for (a) $R = 100K$, (b) ~~$R = 1K$~~ $R = 0.2K$.

Use CVD model with $V_\gamma = 0.2V$.

Soln: (a) assume $D_1 = ON$, $D_2 = ON$



$\boxed{V_o = 0.2V}$

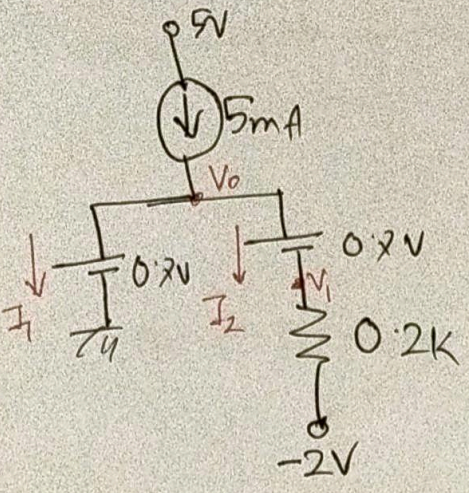
$V_1 = V_o - 0.2 = 0V$

$\therefore \boxed{I_2 = \frac{0-(-2)}{100} = 0.02mA}$

$\boxed{I_1 = 5 - I_2 \text{ [KCL]} = 4.98mA}$

Since I_1 and I_2 both are positive, Assumption correct.

(b) Assume $D_1 = ON$, $D_2 = ON$



$V_o = 0.2V$

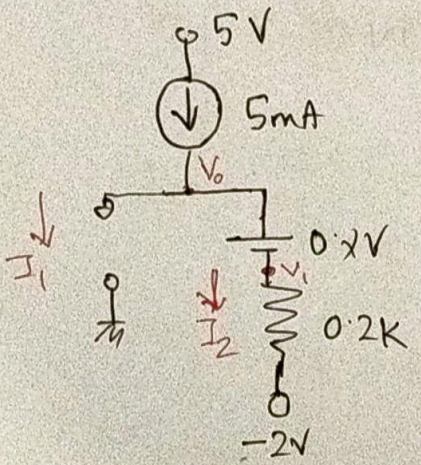
$V_1 = V_o - 0.2 = 0V$

$I_2 = \frac{0-(-2)}{0.2} = 10mA$

$\therefore I_1 = 5 - I_2 = -5mA$

Since current through D_1 is negative, assumption wrong.

Assume $D_1 = OFF$, $D_2 = ON$



$I_1 = 0\ mA$

$I_2 = 5mA$ [KCL]

$\frac{V_1 - (-2)}{0.2} = I_2$ [Ohm's law]

$\Rightarrow V_1 = 5 \times 0.2 - 2 = -1V$

$V_o = V_1 + 0.2 = -0.3V$

Since $V_D = -0.3V$ for D_1 and $V_D < 0.2V$, assumption for D_1 correct.

$I_1 = +ve \Rightarrow$ Assumption for D_2 correct.