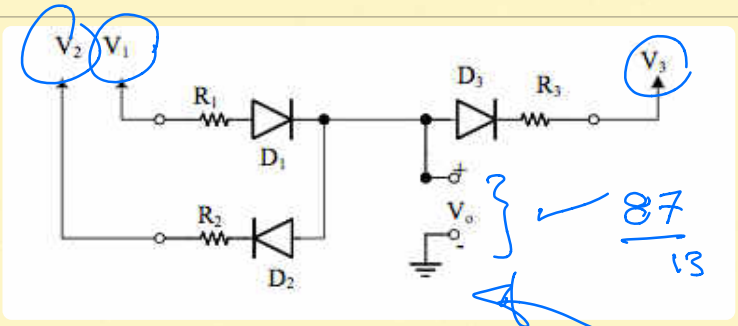
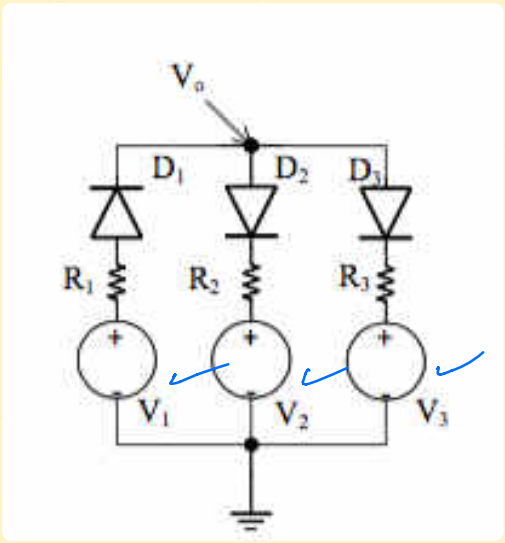
Solution by Ewad Gad



The circuit can be represented as shown below.



Assume all diodes to be ON

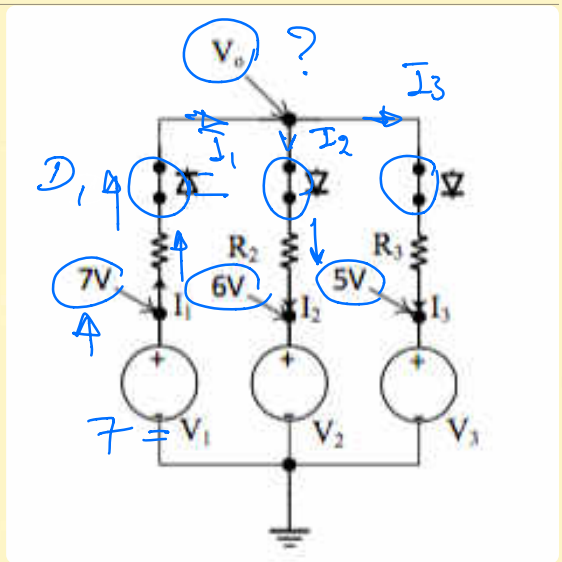
D_1 D_2 D_3 ON

KCL @ node V_o

$$I_1 = I_2 + I_3$$

$$\frac{7 - V_o}{R_1} = \frac{V_o - 6}{R_2} + \frac{V_o - 5}{R_3}$$

$$V_o = \frac{87}{13} V \approx 6.7 V$$



$7 - V_o$

$I_1 = \frac{V_o - 0.3}{R_1} = \frac{0.3}{R_1} > 0$ ON is correct for D_1

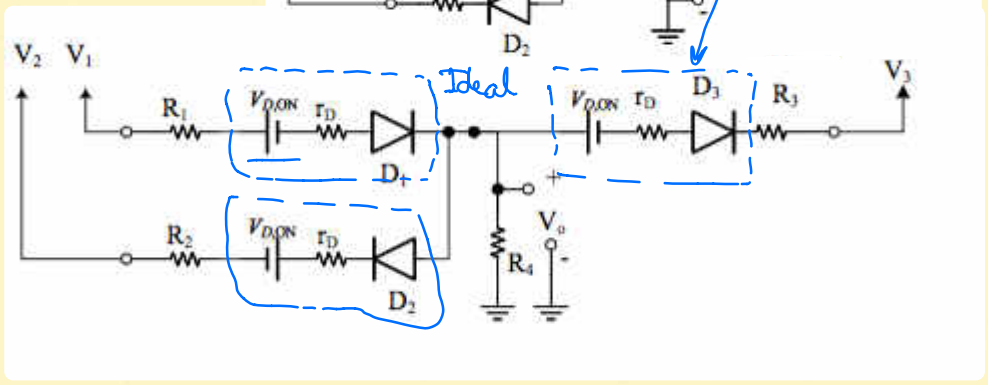
$I_2 = \frac{V_o - 6}{R_2} > 0$ ON is correct for D_2

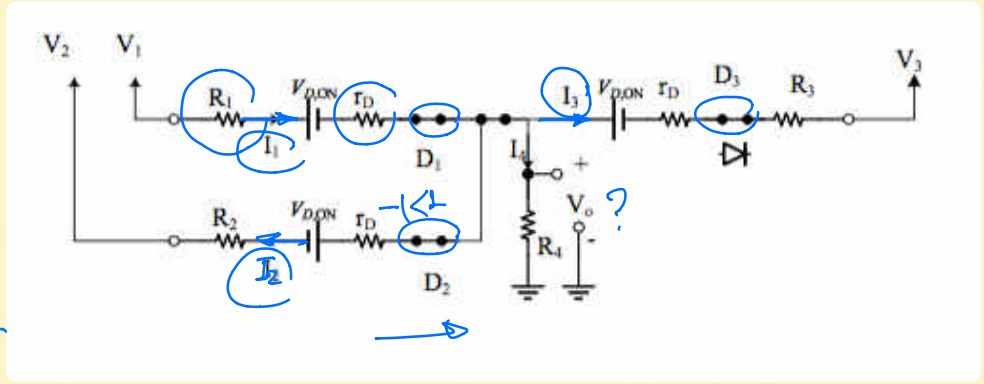
$I_3 > 0$ D_3 is correct

Real $\equiv$ $V_{D,ON}$ r_D ideal

Part II

D_1, D_2, D_3 ON



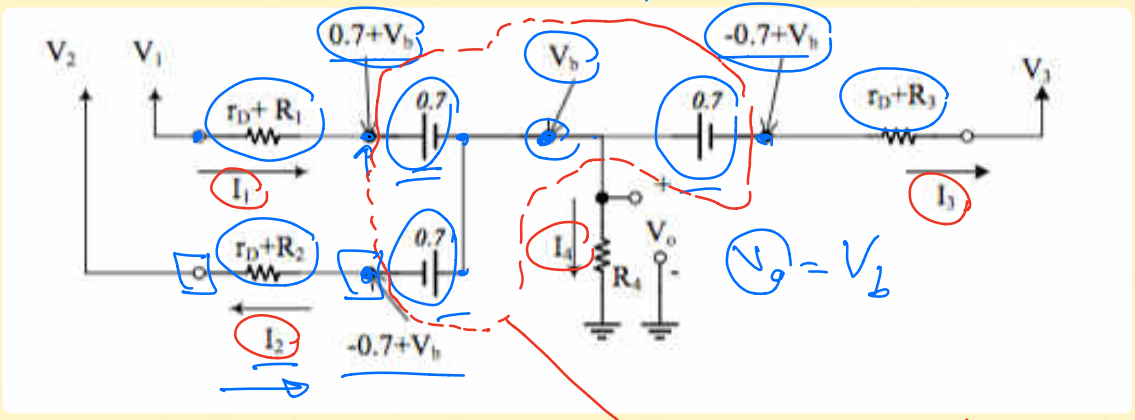


KCL @ Supernode $I_1 = I_2 + I_3 + I_4$

$$\frac{V_1 - (0.7 + V_b)}{R_1 + r_D} = \frac{V_b - 0.7 - V_2}{R_2 + r_D} + \frac{V_b - 0.7 - V_3}{R_3 + r_D} + \frac{V_b}{}$$

$r_D = 0.1\ k\Omega$

$R_1, R_2, R_3, V_1, V_2, V_3, R_4$



Supernode

$V_b = 5.416$ V

Validate I_1 , I_2 , I_3

$I_1 = \frac{V_1 - (0.7+V_b)}{R_1 + r_D} = 0.8$ mA ✓ ON for D1 OK

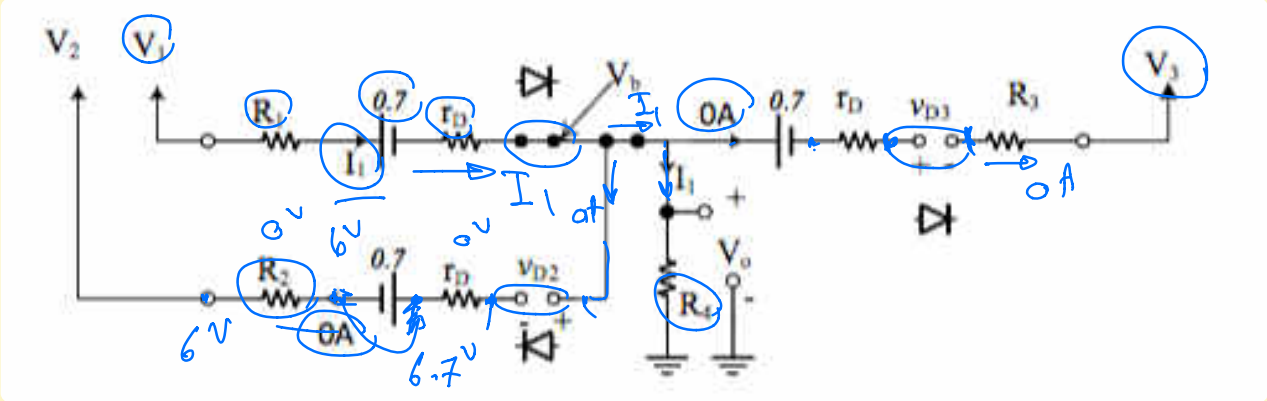
$I_2 =$ (−0.25 mA) ON is Not ok

$I_3 = \frac{V_b - 0.7 - V_3}{R_3 + r_D} = -0.02$ mA ON is Not ok

$V_o = V_b = 5.416$ V

make another assumption

D_1 ON , (D_2 and D_3) OFF



$$-V_1 + 0.7 + (R_1 + r_D) I_1 + R_4 I_1 = 0$$

$$I_1 = \frac{V_1 - 0.7}{R_1 + r_D + R_4} = 1.03 \text{ mA}$$

Analysis

$$V_o = I_1 \times R_4 = 1.03 \times 5 \text{ k}\Omega = 5.16 \text{ V}$$

Validate

$I_1 > 0$ from Anode to Cathode of D_1

D_1 is ON

? $v_{D_2} < 0$ $v_{D_3} < 0$? if D_2 & D_3 OFF

$$v_{D_2} = V_b - 6.7 = 5.416 - 6.7 < 0$$

v_{D_2} is < 0 & D_2 is OFF indeed

$$v_{D_3} = V_b - 0.7 - V_3 = 5.416 - 0.7 - 5 < 0$$

$v_{D_3} < 0$ D_3 is OFF