

$$I_D = \frac{10 - V_{Dn}}{10k} = \frac{10 - 0.6}{10,000} = 0.940 \text{ mA} \rightarrow \text{diode is on}$$

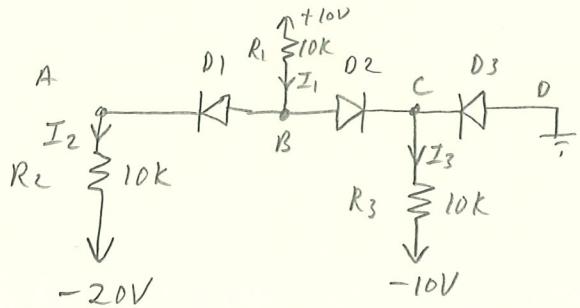
2) Multiple Diode Circuits

For analysis by hand \rightarrow use simplified diode models

\rightarrow PSPICE uses numerical solving techniques

Ex 3.8, p. 105

\rightarrow use the CVD model to solve the circuit



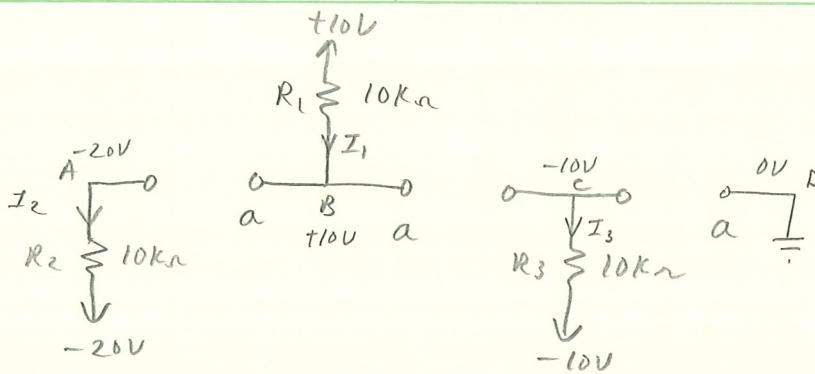
Possible Diode States : "1" = on, "0" = off

D ₁	D ₂	D ₃
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

$2^n = 2^3 = 8$ possible solutions

solution

\rightarrow 1st assume all diodes are off and solve for (I_{D1}, V_{D1}) , (I_{D2}, V_{D2}) and (I_{D3}, V_{D3})



$$I_1 = I_2 = I_3 = 0A$$

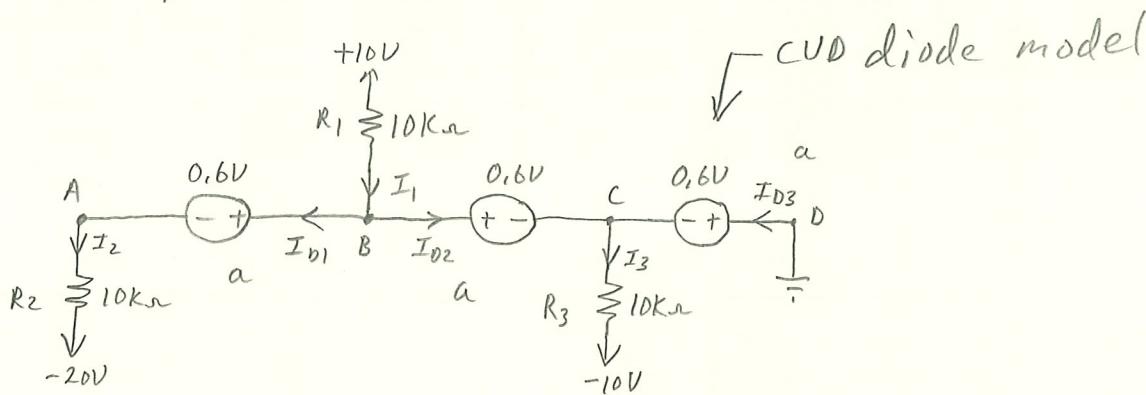
$V_B = +10V, V_A = -20V \rightarrow D1$ is forward biased

$V_B = +10V, V_C = -10V \rightarrow D2$ is forward biased

$V_D = 0V, V_C = -10V \rightarrow D3$ is forward biased

} 1st assumption was incorrect

→ Second step → assume D_1, D_2, D_3 are on:



solving

$$V_C = 0 - 0.6V = -0.6V$$

$$V_B = V_C + 0.6V = -0.6 + 0.6 = 0V$$

$$V_A = V_B - 0.6V = 0 - 0.6 = -0.6V$$

$$I_1 = \frac{10 - 0}{10K} = 1mA$$

$$I_2 = \frac{V_A - -20V}{10K} = \frac{-0.6 - -20}{10K} = 1.94mA$$

$$I_3 = \frac{V_C - -10}{10K} = \frac{-0.6 - -10}{10K} = 0.94mA$$

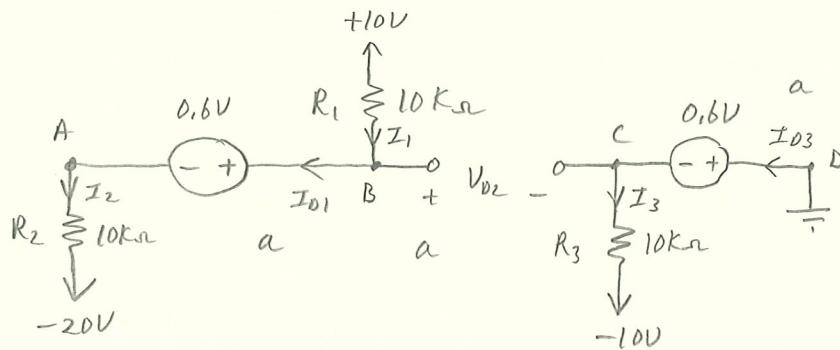
$$I_{D1} = I_2 = 1.94 \text{ mA} \rightarrow D_1 \text{ is on}$$

$$I_{D2} = I_1 - I_{D1} = 1 \text{ mA} - 1.94 \text{ mA} = -0.94 \text{ mA} \times \rightarrow D_2 \text{ must be off}$$

$$I_{D3} = I_3 - I_{D2} = 0.94 \text{ mA} - -0.94 \text{ mA} = 1.88 \text{ mA} \rightarrow D_3 \text{ is on}$$

↓
note: error in book

→ 3rd step: D₁ on, D₂ off and D₃ on

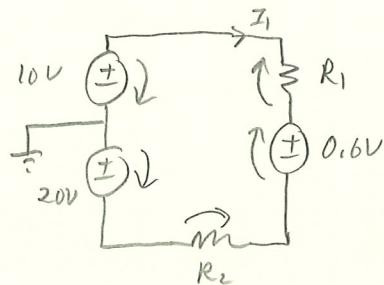


$$V_c = V_0 - 0.6V = -0.6V$$

$$I_3 = \frac{V_c - -10}{10K} = \frac{-0.6 + 10}{10K} = 0.940 \text{ mA} = I_{D3} > 0 \rightarrow D_3 \text{ is on}$$

$$I_1 = I_{D1} = I_2$$

solve for I₁:



$$\text{KVL: } -10V - 20V + I_1 R_2 + 0.6V + I_1 R_1 = 0$$

$$10 + 20 - 0.6 = I_1 (R_1 + R_2) = I_1 (10k + 10k)$$

$$I_1 = \frac{29.4}{20k} = 1.47 \text{ mA} > 0 : D_1 \text{ is on}$$

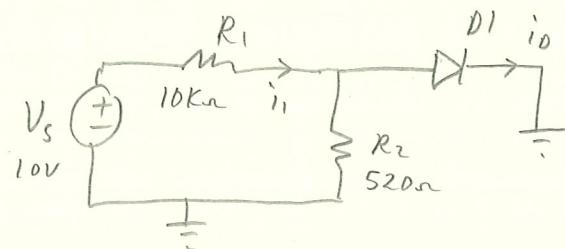
$$V_B = 10 - I_1 R_1 = 10 - (1.47 \text{ mA})(10k) = -4.7V$$

$$V_{D2} = V_B - V_C = -4.7 - -0.6 = -4.1V < 0 : D_2 \text{ is off}$$

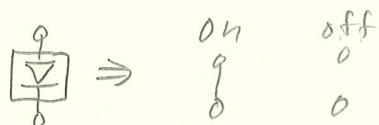
Q-points: D₁: (1.47mA, 0.6V), D₂: (0mA, -4.10V), D₃: (0.940mA, 0.6V)

2) Differences in using different diode models

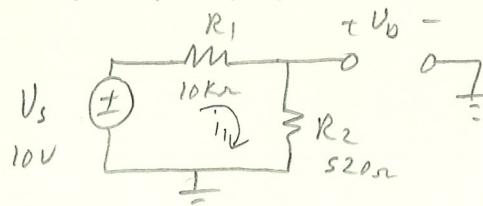
Consider:



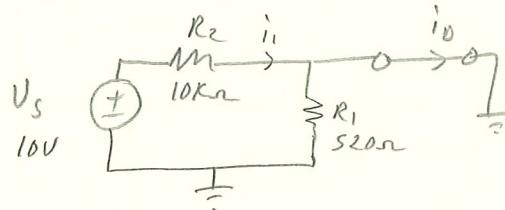
Solve using ideal diode



i) assume diode is off



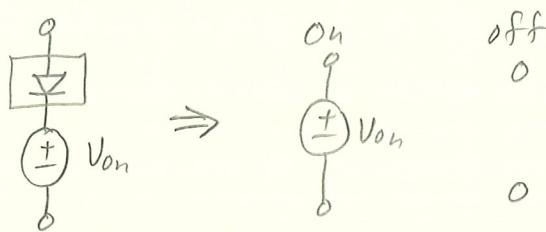
$$V_D = \frac{V_s R_2}{R_1 + R_2} = \frac{10(520)}{10,000 + 520} = 0.494V > 0 \rightarrow \text{diode is on}$$



$$i_D = i_1 = \frac{V_s}{R_2} = \frac{10}{10k} = 1mA$$

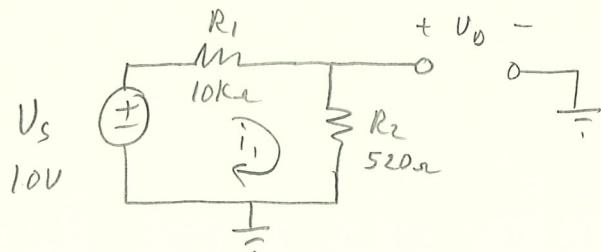
Q-point for D1 is (1mA, 0V)

Solve using the constant voltage drop model



$$\text{use } V_{on} = 0.6V$$

, assume diode is off:



$$V_b = \frac{V_s R_2}{R_1 + R_2} = \frac{10 \times 520}{10000 + 520} = 0.494V < V_{on} \rightarrow \text{diode is off}$$

Result

ideal diode model \rightarrow diode is on

CVD diode model \rightarrow diode is off

\rightarrow CVD diode model is more accurate than the ideal diode model