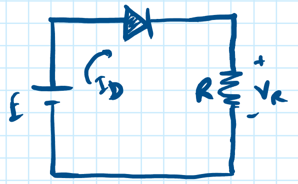
5. Series, Parallel, Series - Parallel Diode Configuration

14 September 2023 08:24

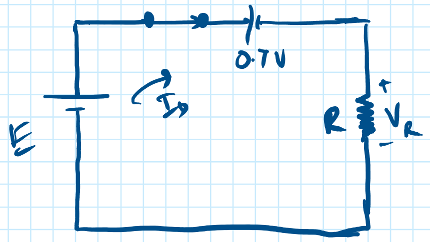
SERIES DIODE CONFIGURATION WITH A RESISTOR

Forward bias



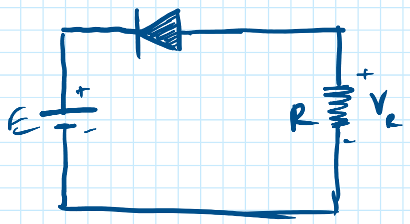
$V_R = E - 0.7$ (for Si diode)

$$\boxed{V_R = E - V_{knee}}$$

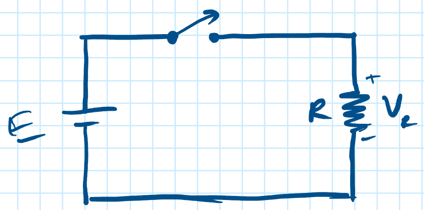


$$\boxed{I_D = \frac{V_R}{R}}$$

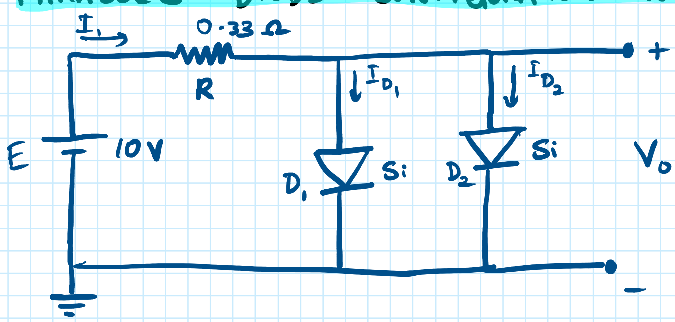
Reverse bias



$$\boxed{I_D = 0}$$



PARALLEL DIODE CONFIGURATION WITH A RESISTOR



NOTE: Voltage drop across all diodes in parallel is the same; current is divided

$$I_1 = I_{D_1} + I_{D_2}$$

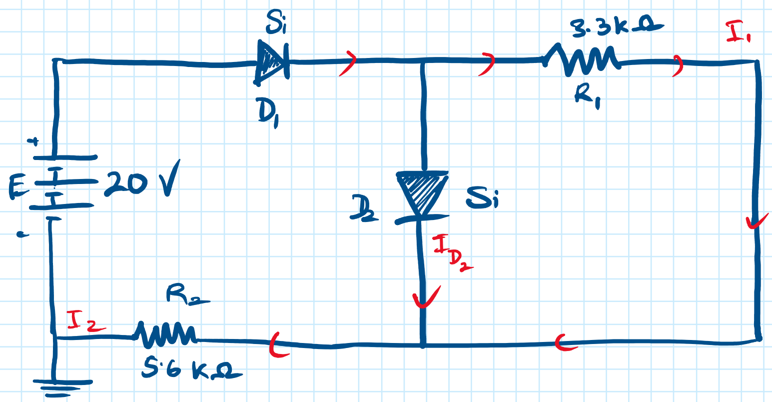
$V_0 = 0.7\ V$ } silicon diode voltage drop

$$I_1 = \frac{V_R}{R} = \frac{10 - 0.7}{0.33 \times 10^3} = \frac{9.3}{0.33 \times 10^3} = 28.18 \times 10^{-3}\ A$$

$$I_1 = \frac{V_R}{R} = \frac{10 - 0.7}{0.33 \times 10^3} = \frac{9.3}{0.33 \times 10^3} = 28.18 \times 10^{-3}\ A$$

$$\underbrace{I_{D_1} = I_{D_2}}_{\text{identical diodes}} = \frac{I_1}{2} = \frac{28.18 \times 10^{-3}}{2} = 14.09 \times 10^{-3}\ A$$

Series - Parallel Diode Configuration



Hint: Note that both diodes are forward biased.

$$20 - 0.7 - 0.7 - 5.6(I_2) = 0$$

$$-5.6 I_2 = -20 + 0.7 + 0.7$$

$$I_2 = 3.321 \times 10^{-3}\ A$$

$$I_1 = \frac{V_{D_2}}{R_1} = \frac{0.7}{3.3 \times 10^3} = 0.212 \times 10^{-3}\ A$$

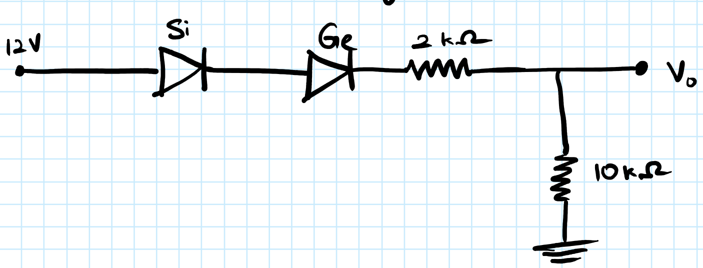
$$I_2 = I_1 + I_{D_2}$$

$$3.321 \times 10^{-3} = 0.212 \times 10^{-3} + I_{D_2}$$

$$I_{D_2} = 3.109 \times 10^{-3}\ A$$

Problems

Q: Determine the level of V_o

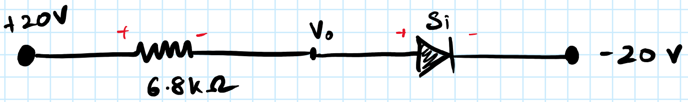


Soln $12 - 0.7 - 0.3 - 2\times10^3(I) - 10\times10^3(I) = 0$

$$-12\times10^3(I) = -11$$

$$I = 0.916\times10^{-3}$$

Q



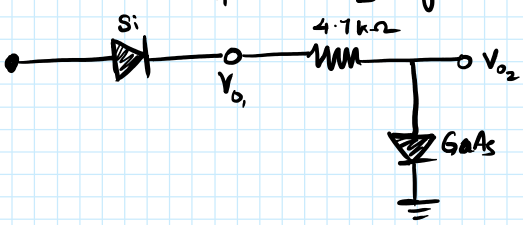
$$40 - 6.8kI - 0.7 = 0$$

$$I = \frac{39.3}{6.8\times10^3} = \underline{\underline{5.78\ mA}}$$

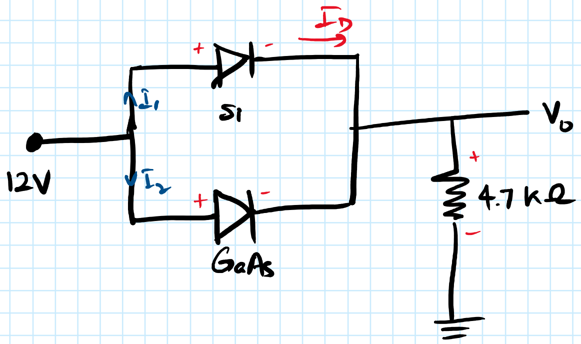
$$V_o = 20 - 6.8(5.78\times10^{-3})$$

$$= 20 - (39.304\times10^{-3}) = 20 - 0.0393 = \underline{\underline{19.961\ V}}$$

Q. Determine V_{o_1} and V_{o_2} for the networks



Q

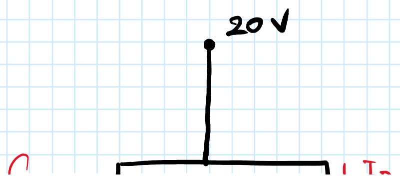


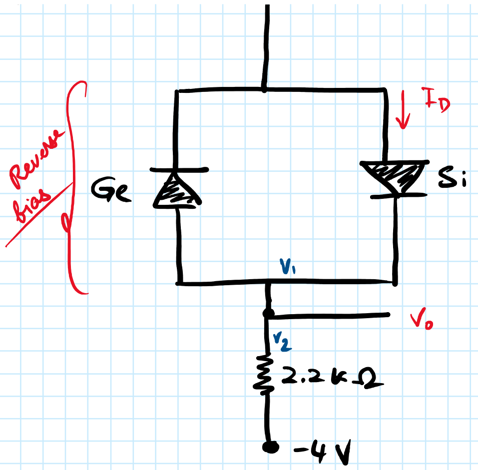
$$V_o = 12 - 0.7 = 11.3V$$

$$12 - 0.7 - 4.7(I) = 0$$

$$I = \frac{11.3}{4.7\times10^3} = \underline{\underline{2.404\times10^{-3}\ A}}$$

Q





$$20 - 0.7 - 2.2k(I) - 4 = 0$$

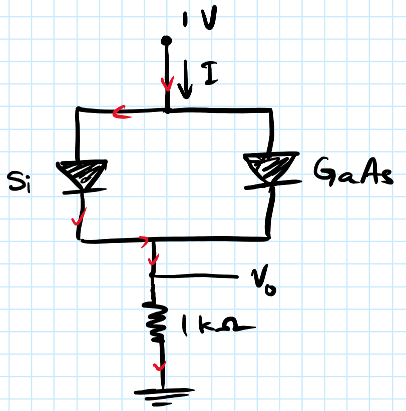
$$-2.2k\,I = -15.3$$

$$I = \frac{15.3}{2.2k} = 6.945 \times 10^{-3}\ A$$

$$V_0 = 20 - 0.7 = 19.3\,V$$

$$I_D = \frac{20-(-4)-0.7}{2.2k} = \frac{24-0.7}{2.2\times10^3} = \underline{\underline{10.59 \times 10^{-3}\,A}}$$

Q $I,\ V_o = ?$



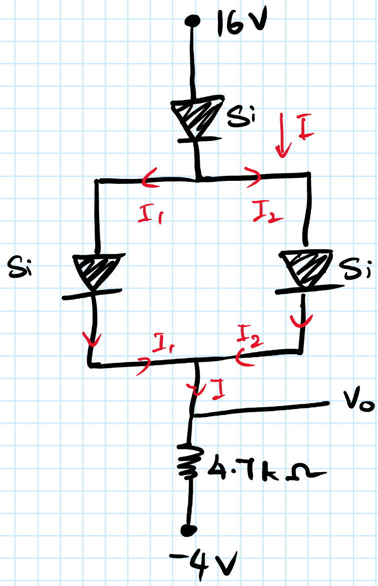
$$V_o = 1 - 0.7 = \underline{\underline{0.3\,V}}$$

$$1 - 0.7 - 10^3 I = 0$$

$$I = 0.3 \times 10^{-3}\ A$$

$$= \underline{\underline{0.3\,mA}}$$

Q



$$V_0 = 16 - 0.7 - 0.7$$

$$= \underline{\underline{14.6\,V}}$$

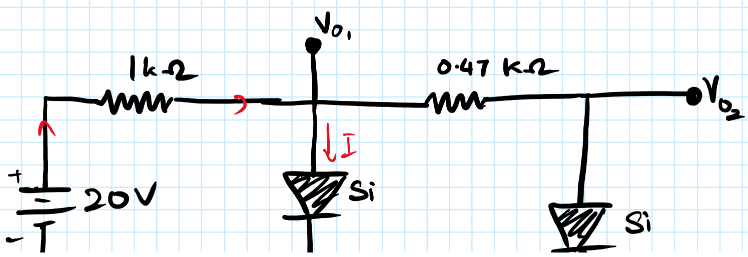
$$20 - 0.7 - 0.7 - 4.7k(I) = 0$$

$$I = \frac{18.6}{4.7\times10^3}$$

$$= \underline{\underline{3.957\ mA}}$$

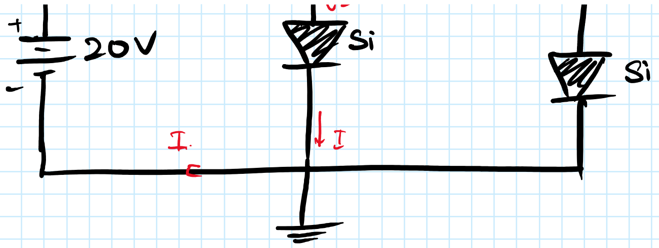
$$I_1 = I_2 = \underline{\underline{1.978\ mA}}$$

Q



$$20 - 1kI - 0.7 = 0$$

$$I = \underline{\underline{19.3\ mA}}$$



$V_{o_2} = 0.7\ V$

$I = 19.3\ mA$

$V_{o_1} = 20 - 10^3(19.3 \times 10^{-3})$

$= 0.7\ V$