

Assignment - 3

a)

$$1. T_C = 25^\circ C$$

$$T_K = T_C + 273^\circ = 25 + 273 = 298 K$$

Thermal Voltage: $K = 1.38 \times 10^{-23} \text{ J/K}$

$$V_T = \frac{kT}{q} = \frac{(1.38 \times 10^{-23}) \times 298}{1.6 \times 10^{-19}} = \frac{4.1124 \times 10^{-21}}{1.6 \times 10^{-19}} \approx 2.57 \times 10^{-2} V = 2.57 \text{ mV}$$

b) $I_S = 40 \text{ nA} = 40 \times 10^{-9} \text{ A}$, $n = 2$

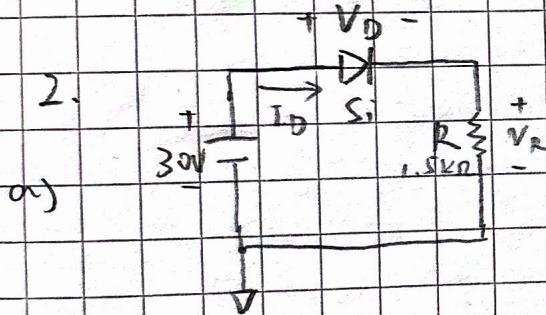
$$V_D = 0.5V, V_T = 0.0257 V$$

$$I_D = I_S (e^{V_D/nV_T} - 1)$$

$$= 40 \times 10^{-9} \times (e^{0.5/2 \cdot 0.0257} - 1)$$

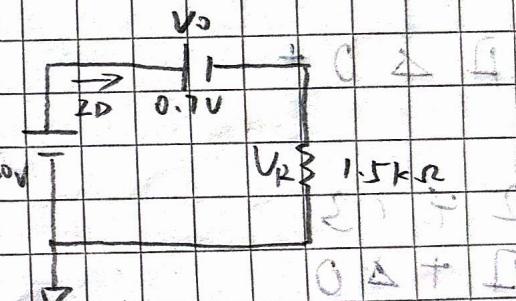
$$\approx 0.67 \times 10^{-3} \text{ A} = 0.67 \text{ mA}$$

2.



$$E = V_Si$$

$$30V > 0.7V$$



$$V_D = 0.7V$$

$$V_R = 30V - 0.7V = 29.3V$$

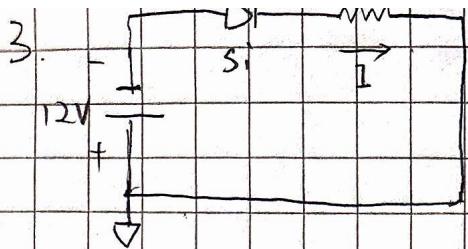
$$I_D = I_R = \frac{V_R}{R} = \frac{29.3V}{1.5k\Omega} \approx 19.5 \text{ mA}$$

b) Ideal model: $V_D = 0V$

$$V_R = 30V \quad I_D = I_R = \frac{V_R}{R} = \frac{30V}{1.5k\Omega} = 20 \text{ mA}$$

c) Yes. The ideal model gives a close result

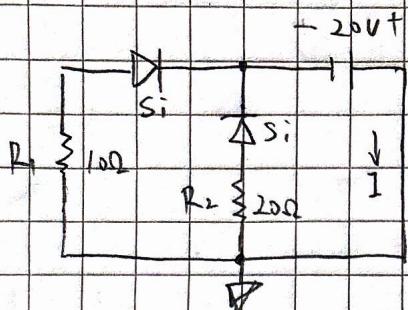
for high-voltage circuits. (like 30V vs. 0.7V).



a) The diode is reverse-biased

No current flow

$$I = 0$$



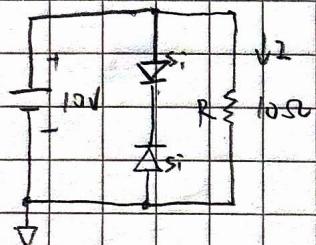
b) $E = +20V$ Parallel

$$V_{R1} = V_{R2} = -20 + 0.7 = -19.3V$$

$$I_{R1} = \frac{0 - (-19.3)}{10} = 1.93A$$

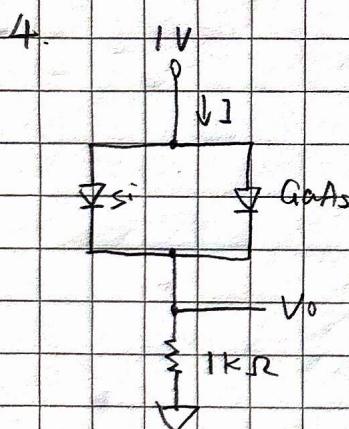
$$I_{R2} = \frac{0 - (-19.3)}{20} = 0.965A$$

$$I = I_{R1} + I_{R2} = 1.93 + 0.965 = 2.895A$$



c) The two diodes are connected in opposite directions. One diode is reverse-biased. So the middle branch is open.

$$V_R = 10V \quad I = \frac{10V}{10\Omega} = 1A$$

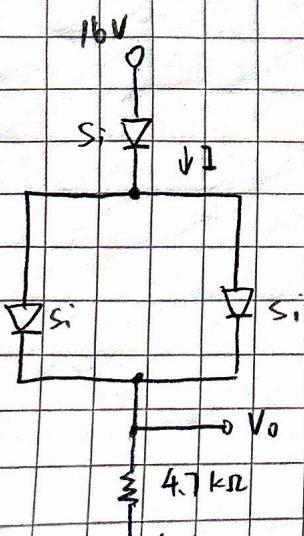


$$a) 1V > 0.7V \text{ (Si)} \quad \checkmark$$

$$1V < 1.2V \text{ (GaAs)}$$

$$V_0 = 1 - 0.7 = 0.3V$$

$$I = \frac{V_0 - 0}{1k\Omega} = \frac{0.3}{1000} = 0.3mA$$



b) 16V through two Si diodes drops

top + one of the parallel diodes.

$$V_0 = 16V - 0.7 - 0.7 = 14.6V$$

$$V_R = V_0 - (-4V) = 14.6 + 4 = 18.6V$$

$$I = \frac{18.6}{4.7k\Omega} \approx 3.96mA$$