

Assignment - 3

1. a) $T_c = 25^\circ\text{C}$

$$T_K = T_C + 273 = 25 + 273 = 298 \text{ K}$$

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

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

$$= 25.7 \text{ mV}$$

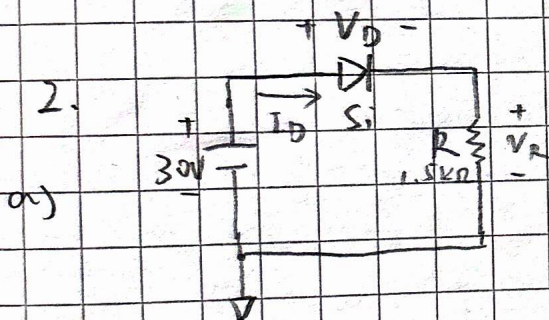
b) $I_s = 40 \text{ nA} = 40 \times 10^{-9} \text{ A}$, $n = 2$

$$V_D = 0.5 \text{ V}, \quad V_T = 0.0257 \text{ V}$$

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

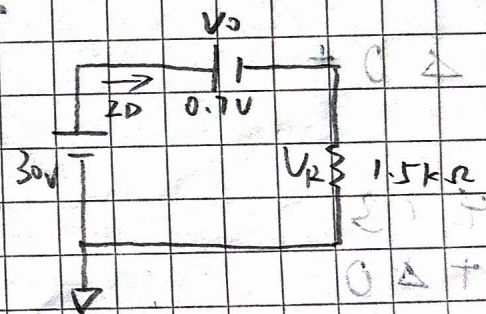
$$= 40 \times 10^{-9} \times (e^{0.5/2 \cdot 0.0257} - 1)$$

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



$$E > V_{Si}$$

$$30\text{V} > 0.7\text{V}$$



$$V_D = 0.7 \text{ V}$$

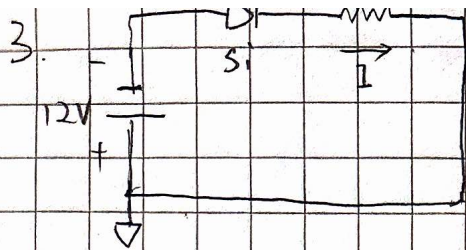
$$V_R = 30\text{V} - 0.7\text{V} = 29.3 \text{ V}$$

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

b) Ideal model: $V_D = 0 \text{ V}$

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

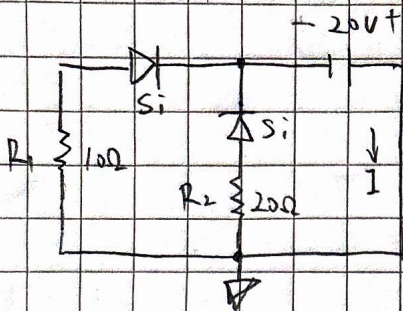
c) Yes. The ideal model gives a close result for high-voltage circuits. (like 30V vs. 0.7V).



a) The diode is reverse-biased

No current flow

$$I = 0$$



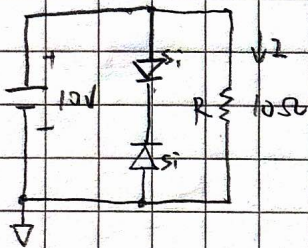
b) $E = -20V$ Parallel

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

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

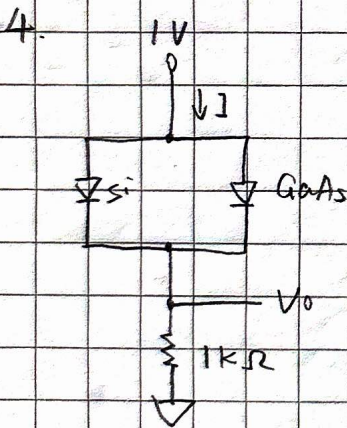
$$I_{R2} = \frac{0 - (-19.3)}{20} = 0.965A$$

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



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

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

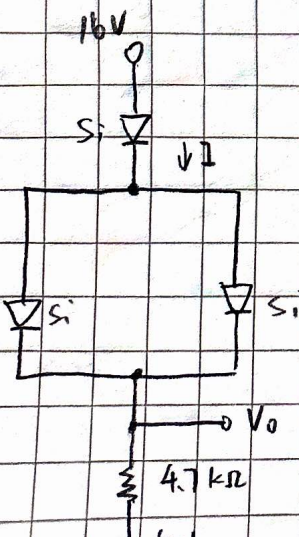


a) $1V > 0.7V$ (Si) \checkmark

$1V < 1.2V$ (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.

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

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

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