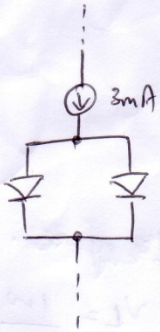
CORRECTIONS TO Q2(b) and (c)

Q2 – Original solutions.



$$\frac{A_{D2}}{A_{D1}} = 5$$

$$I = I_S\left(e^{V/V_T} - 1\right)$$

$$I = Aq\left(\frac{D_p p_n}{L_p} + \frac{D_n n_p}{L_n}\right)\left(e^{V/V_T} - 1\right)$$

$$D_p = \mu_p V_T,\quad D_n = \mu_n V_T,\quad p_n = \frac{n_i^2}{N_D},\quad n_p = \frac{n_i^2}{N_A}$$

$$L_p = \sqrt{D_p \tau_p},\quad L_n = \sqrt{D_n \tau_n}$$

Hence, if the doping level and the fabrication are the same for both diodes, all the parameters above are equivalent.

$$I_{D2} = A_{D2}\,q\left(\frac{D_p p_n}{L_p} + \frac{D_n n_p}{L_n}\right)\left(e^{V/V_T} - 1\right)$$

$$I_{D1} = A_{D1}\,q\left(\frac{D_p p_n}{L_p} + \frac{D_n n_p}{L_n}\right)\left(e^{V/V_T} - 1\right)$$

$$\frac{I_{D1}}{I_{D2}} = \frac{A_{D1}\,q\left(\frac{D_p p_n}{L_p} + \frac{D_n n_p}{L_n}\right)\left(e^{V/V_T} - 1\right)}{A_{D2}\,q\left(\frac{D_p p_n}{L_p} + \frac{D_n n_p}{L_n}\right)\left(e^{V/V_T} - 1\right)} = \frac{1}{5} \#$$

$$T = 300^\circ K,\quad V_T = \frac{kT}{q} = \frac{1.381\times10^{-23}\ J/^\circ K \times 300^\circ K}{1.6\times10^{-19}\ C} = 0.02589\ J/C$$

$$= 0.02589\ \text{Volt}$$

$$= 0.02589\ \frac{J}{As} = 0.02589\ \frac{J\Omega}{VS}$$

$$I_{D1} = \underbrace{A_{D1}\,q\left(\frac{D_p p_n}{L_p} + \frac{D_n n_p}{L_n}\right)}_{I_{SD1}}\left(e^{V/V_T} - 1\right)$$

$$0.6m = 10^{-15}\left(e^{V/V_T} - 1\right)\quad \text{since } I_{D1} = \frac{1}{5}(3m) = 0.6mA$$

$$e^{V/V_T} = 6\times10^{11}$$

$$V = 0.7021\ \text{Volt} \#$$

(3)

(C) The diodes are Silicon based on the 0.7021 V across them when they are forward biased.

Corrected solution to 2(b).

T = 300°K

$V_T = kT/q = 0.02589$ V.

From (a), $I_{D1} / I_{D2} = 1/5$

From the circuit, $I_{D1} + I_{D2} = 3mA$

So, $I_{D1} + 5I_{D1} = 3mA$

$I_{D1} = 0.5$ mA

$0.5 \text{ mA} = 10^{-15} \, (e^{V/V_T} - 1)$

$e^{V/V_T} = 5x10^{11}$

$V/V_T = 26.9379$

Hence, $V_T = 0.6974$ V.

Corrected solution to 2(c).

The diodes are Silicon based on the approximately 0.7 V across them when they are forward biased.