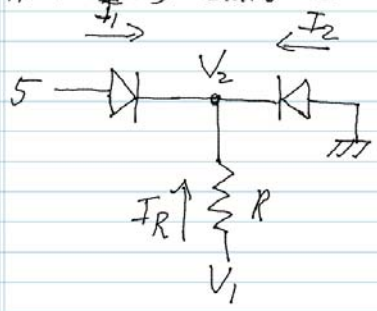
AME 3623 Quiz #3 1/24/13



Knowns:

V_{f1}

V_{f2}

R

Assume $V_{f1} = V_{f2} = 2.5$

(A) What is always true?

$$I_1 + I_2 + I_R = 0$$

$$V_1 - V_2 = I_R R$$

(B) What is I_R as a function of V_1? (Draw)

4 cases

Case 1: Both on

$I_1 > 0$

$I_2 > 0$

$5 - V_2 = V_{f1}$

$0 - V_2 = V_{f2}$

$V_2 = -V_{f2}$

$5 + V_{f2} = V_{f1}$

Can't happa given Assumption!

Case 2: Both off

$I_1 = 0 \quad 5 - V_2 < V_{f_1}$

$I_2 = 0 \quad 0 - V_2 < V_{f_2}$

$I_R = 0$

$V_2 = V_1$

↓

Check: $5 - V_1 < V_{f_1} \rightarrow 5 - V_{f_1} < V_1$

$0 - V_1 < V_{f_2} \rightarrow V_1 > -V_{f_2}$

Given assumptions: $2.5 < V_1 \rightarrow \boxed{V_1 > 2.5}$

$-2.5 < V_1$

Case 3: #1 off, #2 on

$I_1 = 0 \quad 5 - V_2 < V_{f_1}$

$I_2 > 0 \quad 0 - V_2 = V_{f_2}$

$V_2 = -V_{f_2}$

$-I_2 = I_R = \frac{V_1 - V_2}{R} = \frac{V_1 + V_{f_2}}{R}$

Check: $I_2 > 0 \rightarrow -\frac{V_1 + V_{f_2}}{R}$

$\rightarrow -\frac{V_1 + V_{f_2}}{R} > 0 \rightarrow V_1 < -V_{f_2}$ ✓

$5 - V_2 < V_{f_1} \rightarrow 5 + V_{f_2} < V_{f_1}$ Given assumptions, this never happens

Case 4: #1 on, #2 off

$I_1 > 0$ & $5 - V_2 = V_{f1}$

$I_2 = 0$ & $0 - V_2 < V_{f2} \rightarrow V_2 > -V_{f2}$

$V_2 = 5 - V_{f1}$

$$+I_1 = -I_R = -\frac{V_1 - V_2}{R} = \frac{5 - V_{f1} - V_1}{R}$$

Check: $I_1 > 0 \rightarrow \frac{5 - V_{f1} - V_1}{R} > 0$

$\rightarrow V_1 < 5 - V_{f1}$ ✓

$\boxed{V_1 < 2.5 \text{ Volts}}$

$V_2 > -V_{f2} \rightarrow 5 - V_{f1} > -V_{f2}$

$\rightarrow 5 > V_{f1} + (-V_{f2})$

Given Assumptions, this is true

Summary: Case 2 when ~~$V_1 > 0$~~ $V_1 > 2.5$

Case 4 when $V < 2.5$

Cases 1 & 3 never happen

Answer to part B: