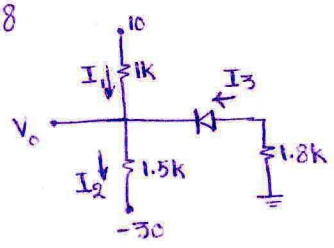
University of New Mexico
Department of Electrical and Computer Engineering

ECE 321 – Electronics I (Fall 2012) **Homework Solution # 2**

1.28



Assumption: Diode is forward biased

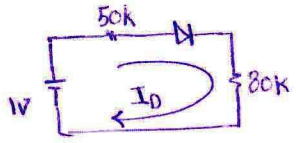
$V_D = 0.7\,V$

$I_3 * (1.8K) + 0.7 + V_o = 0 \Rightarrow I_3 = \frac{-V_o - 0.7V}{1.8K}$

$I_1 + I_3 - I_2 = 0$

$\frac{10 - V_o}{1K} + \frac{-V_o - 0.7}{1.8K} - \frac{V_o - (-30)}{1.5K} = 0 \Rightarrow V_o = -4.675\,V \Rightarrow I_3 > 0 \rightarrow$ D is forward biased

1.29



a) $V_{BB} = 1$

KVL: $1V = I_D(50K) + 26mV * Ln\left(\frac{I_D}{10nA} + 1\right) + I_D(80K) \Rightarrow I_D = 6.4\,\mu A$

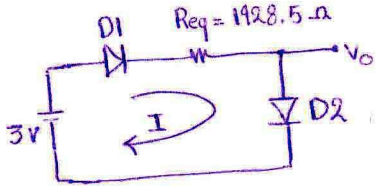
$V_D = V_T Ln\left(\frac{I_D}{I_S} + 1\right) = 26mV * Ln\left(\frac{6.4\mu A}{10nA} + 1\right) = 168.4\,mV$

b) $V_{BB} = 10V$

KVL: $10V = I_D(50K) + 26mV * Ln\left(\frac{I_D}{10nA} + 1\right) + I_D(80K) \Rightarrow I_D = 75.1\,\mu A$

$V_D = V_T Ln\left(\frac{I_D}{I_S} + 1\right) = 26mV * Ln\left(\frac{75.1\mu A}{10nA} + 1\right) = 232.04\,mV$

1.31



KVL: $3V = V_T Ln\left(\frac{I}{I_{S1}} + 1\right) + 1928.5I + V_T Ln\left(\frac{I}{I_{S2}} + 1\right)$

$I_{S1} = 1nA$

$I_{S2} = 4nA$ $\longrightarrow I = 1.196\,mA$

$V_o = V_{D2} = 26mV * Ln\left(\frac{1.196mA}{4nA} + 1\right) = 327.9\,mV$

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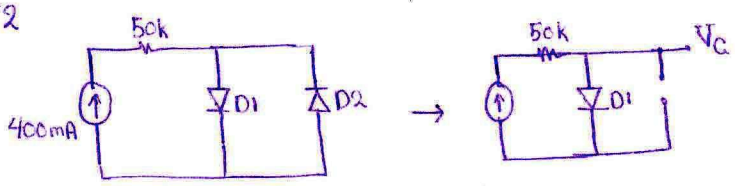
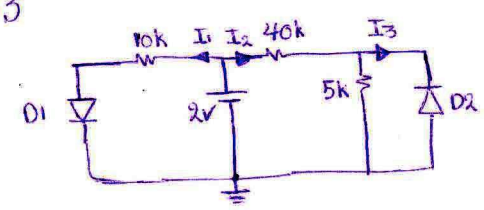
1-32



$$V_{D1} = 26mV * Ln\left(\frac{400mA}{175nA}+1\right) = 0.381\,V$$

1-33



$$2V = 10k * I_1 + 26mV * Ln\left(\frac{I_1}{100pA}+1\right) \longrightarrow I_1 = 163\mu A$$

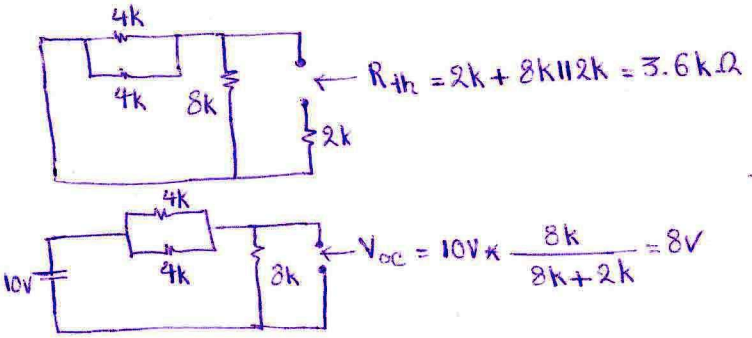
$$V_{D1} = 26mV * Ln\left(\frac{163\mu A}{100pA}+1\right) = 371.88mV$$

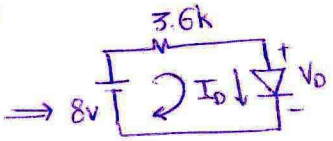
D2 is reverse biased hence $I_3 = 100pA$

$$2V = 40k * I_2 + 50k * (I_2 - 100pA) \longrightarrow I_2 = 44.4\mu A$$

$$I_{5k} = I_2 - I_3 \simeq 44.4\mu A$$

1.34



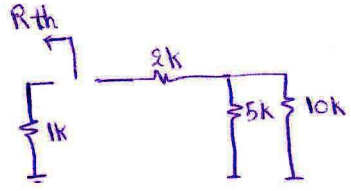


$$8V = I_D(3.6k) + 26mV * Ln\left(\frac{I_D}{1nA}+1\right) \Rightarrow$$

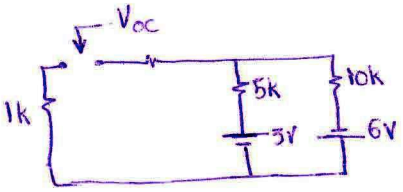
$$I_D = 2.117\,mA$$

$$V_D = 26mV\,Ln\left(\frac{2.117mA}{1nA}+1\right) \Rightarrow V_D = 373.7\,mV$$

1.36

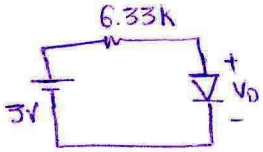


$R_{th} = 6.33k\Omega$



$V_{oc} = 3\,V$

$\Rightarrow$



$$3V = I_D * (6.33k) + 26mV * Ln\left(\frac{I_D}{22\mu A}+1\right)$$

$$I_D = 451.4\mu A$$

$$V_D = 141.0\,mV$$