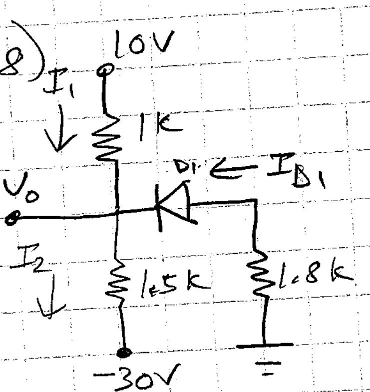
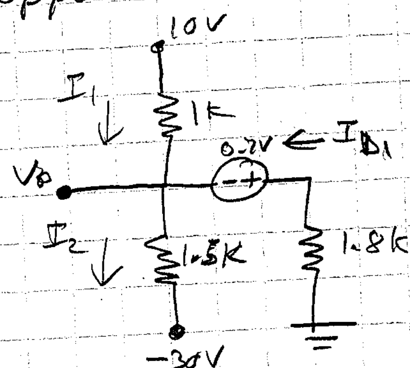
Anthony Mancuso
ECE 321
HW-2
30 Aug 2012

(1.28)



$V_\gamma = 0.7V$

Suppose D_1 is forward biased:



$$KCL: -\left(\frac{10 - V_o}{1k}\right) + \frac{V_o - (-30)}{1.5k} - \left(\frac{0-(V_o+0.7)}{1.8k}\right) = 0$$

$$9V_o - 90 + 6V_o + 180 + 5V_o + 3.5 = 0$$

$$20V_o = 93.5$$

$$V_o = \boxed{-4.675V}$$

$$I_{D1} = \frac{0-(-4.675+0.7)}{1.8k} = \boxed{2.21mA} = I_{1.8}$$

$\therefore$ D_1 is forward-biased.

$$I_{1.5k} = \frac{-4.675-(-30)}{1.5k} = \boxed{16.88\bar{3}mA} = I$$

$$I_{1k} = \frac{10-(-4.675)}{1k} = \boxed{14.675mA} = I_1$$

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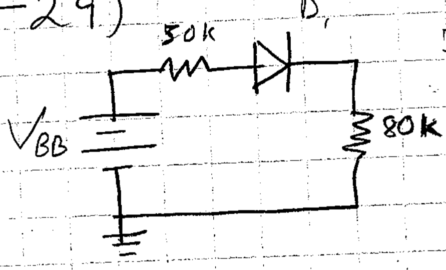
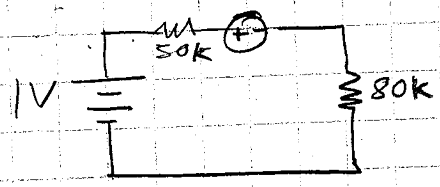
(1-29)



$I_S = 10nA$
V_γ not given
Let $V_\gamma = 0$

(a) $V_{BB} = 1V$, Suppose D_1 is forward-biased:



KVL: $-1V + (50k)I_D + 80k(I_D) = 0$

$(130k)I_D = 1V$

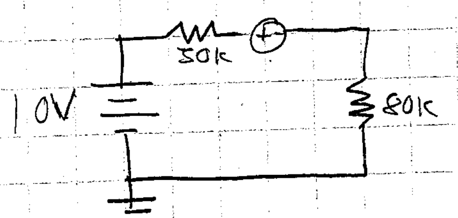
$I_D = \boxed{7.69\mu A}$

$I_D = 7.69\mu A = I_S\left(e^{\frac{V_D}{V_{TH}}} - 1\right)$

$V_D = 26mV \ln\left(\frac{7.69\mu A}{10nA} + 1\right) = \boxed{172mV}$

I_D and V_D positive $\therefore$ D_1 is forward-biased.

(b) $V_{BB} = 10V$, Suppose D_1 is forward-biased:



KVL: $-10V + (50k)I_D + (80k)I_D = 0$

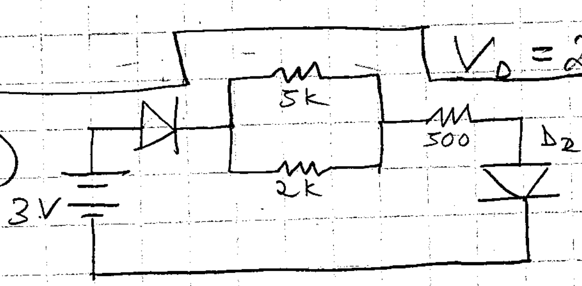
$(130k)I_D = 10V$

$I_D = \boxed{76.9\mu A}$

$V_D = 26mV \ln\left(\frac{76.9\mu A}{10nA} + 1\right) = \boxed{232\ mV}$

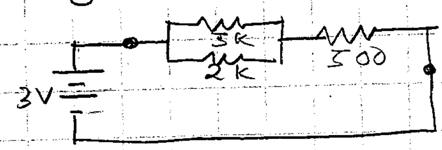
$\therefore$ D_1 is forward-biased

(1-31)



$I_{SD1} = 1nA$
$I_{SD2} = 4nA$
V_γ not given $\Rightarrow$ Let $V_\gamma = 0$

Assume D_1 and D_2 are forward biased:



KVL: $-3V + 1.428k I_D + 500 I_D = 0$

$1.928k I_D = 3 \Rightarrow I_D = 1.5\bar{5}mA$

$V_D = 26mV \ln\left(\frac{1.5\bar{5}mA}{4nA} + 1\right) = \boxed{335mV} = V_0$ $\therefore$ D_1 and D_2 are forward-biased

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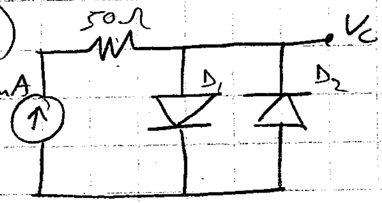
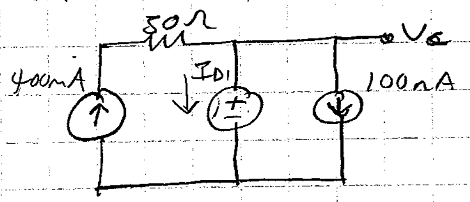
(1.32)



$I_{SD1} = 175nA$
$I_{SD2} = 100nA$

Assume D_1 is forward-biased and D_2 is reverse-biased.



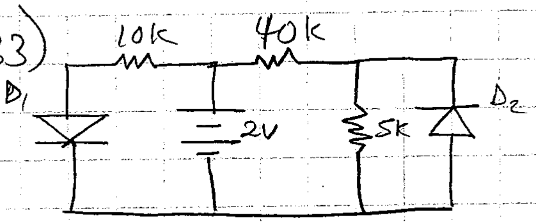
KCL: $-400mA + I_{D1} + 100nA = 0$

$$I_{D1} \approx 400mA$$

$$V_{D1} = 26mV \ln\left(\frac{400mA}{175nA} + 1\right) = 381mV = V_C$$

∴ D_1 is forward-biased and D_2 is reverse-biased

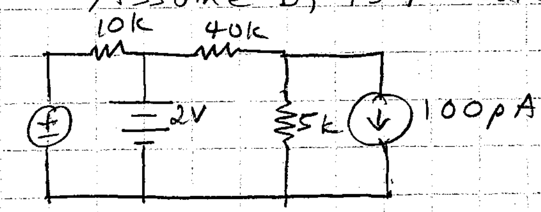
(1.33)



$I_{SD1} = I_{SD2} = 100pA$

Assume D_1 is forward biased and D_2 is reverse-biased

Assum $V_\gamma = 0$



$$I_{D1} = \frac{2V}{10k} = 200\mu A$$

$$V_{D1} = 26mV \ln\left(\frac{200\mu A}{100pA} + 1\right) = \boxed{377.2mV}$$

$$KCL: -\left(\frac{2 - V_X}{40k}\right) + \frac{V_X}{5k} + 100pA = 0$$

$$-2 + V_X + 8V_X + (40k)(100pA) = 0$$

$$9V_X = 1.99$$

$$V_X = 222mV$$

$$I_{5k} = \frac{V_X}{5k} = \boxed{44.44\mu A}$$

$$I_{D1} = \frac{2 - 377.2mV}{10k} = \boxed{162.28\mu A}$$

∴ D_1 is forward-biased and D_2 is reverse-biased

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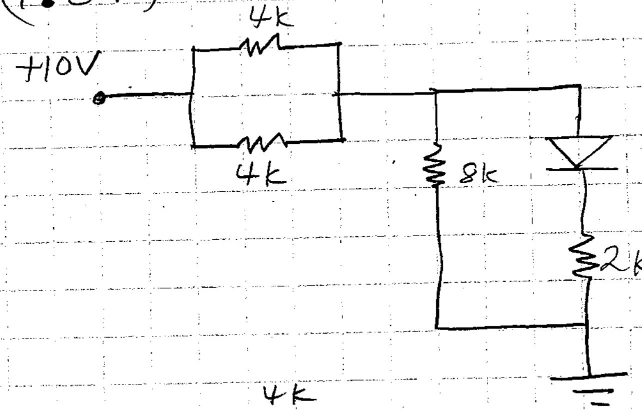
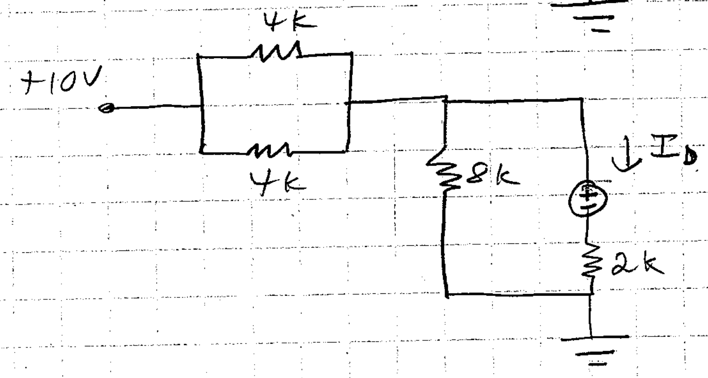
(1.34)



$I_S = 1\,nA$

Assume forward-biased
V_γ not given, assume $V_\gamma = 0$



$$I_D = \left(\frac{8k}{8k+2k}\right)\frac{10V}{4k\,//\,4k + 8k\,//\,2k}$$

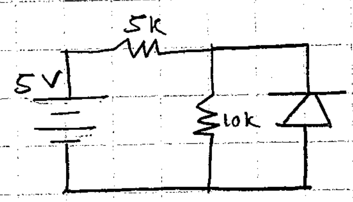
$$I_D = \boxed{2.2\overline{2}\ mA}$$

$$V_D = 26mV \ln\left(\frac{2.2\overline{2}mA}{1nA} + 1\right)$$

$$V_D = \boxed{380\,mV}$$

$\therefore$ Di is forward-biased

(1.35)



$C_{jo} = 100\,fF$
$V_{bi} = 0.72\,V$

I_s not given
$\Rightarrow$ Assume $I_s = 0$

$$V_R = \left(\frac{10k}{15k}\right) 5V = 3.3\overline{3}\,V$$

(reverse diode voltage)

$$C_j = \frac{C_{jo}}{\left(1 + \frac{V_R}{V_{bi}}\right)^{1/2}} = \frac{100fF}{\left(1 + \frac{3.3\overline{3}V}{0.72V}\right)^{1/2}} = \boxed{17.76\,fF}$$

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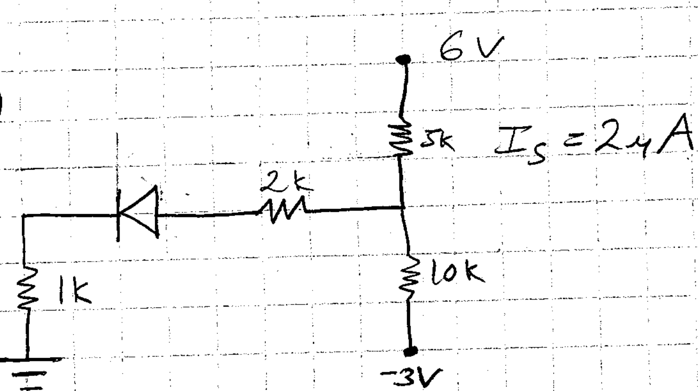
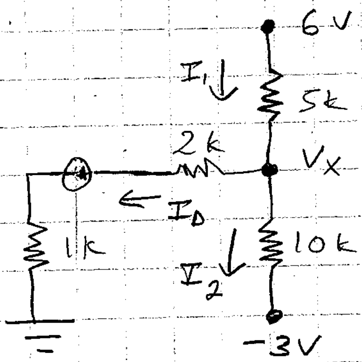
(1-36)



Assume D is forward biased.
V_γ not given. Assume $V_\gamma = 0$



$$\text{KCL: } -\left(\frac{6-V_x}{5k}\right) + \frac{V_x}{3k} + \frac{V_x-(-3)}{10k} = 0$$

$$-36 + 6V_x + 10V_x + 3V_x + 9 = 0$$

$$19V_x = 27 \Rightarrow V_x = 1.42V$$

$$I_D = \frac{1.42V}{3k} = \boxed{474\mu A}$$

$$V_D = 26mV \ln\left(\frac{474\mu A}{2\mu A} + 1\right) = \boxed{142.3\,mV}$$