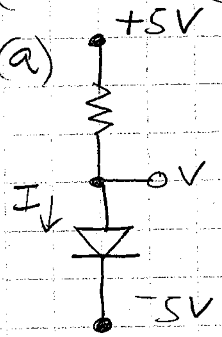
Anthony Mancuso
ECE321
HW-4
10 Sep 2012
(Sedra)

IDEAL DIODES:

(4.2) (Assume $V_D = 0$ and $I_S = 0$)

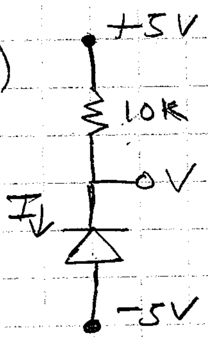
(a)



Diode is forward-biased $\Rightarrow \boxed{V = -5V}$

$$I = \frac{5-(-5)}{10K} = \boxed{1mA}$$

(b)

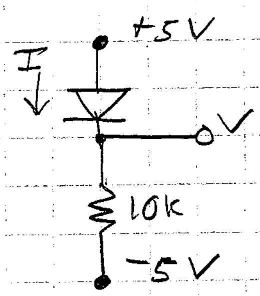


Diode is Reverse-biased

$V = \boxed{+5V}$

$I = \boxed{0A}$

(c)

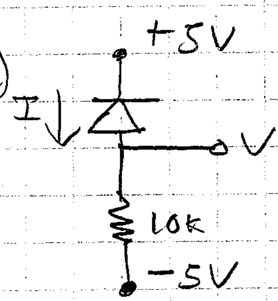


Diode is Forward Biased

$V = \boxed{+5V}$

$$I = \frac{5-(-5)}{10K} = \boxed{1mA}$$

(d)



Diode is Reverse-Biased

$V = \boxed{-5V}$

$I = \boxed{0A}$

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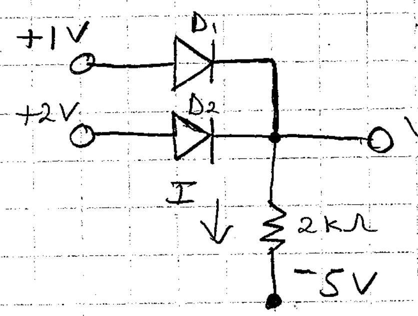
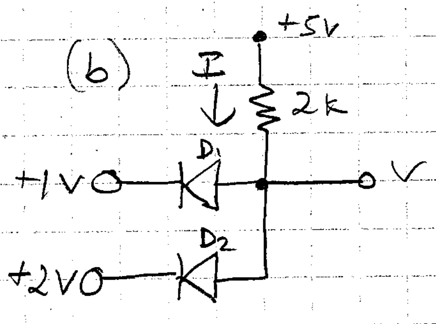
(4.3) (IDEAL DIODES: $V_\gamma = 0$, $I_s = 0$)

(a)


D_1 is reverse-biased
D_2 is forward-biased

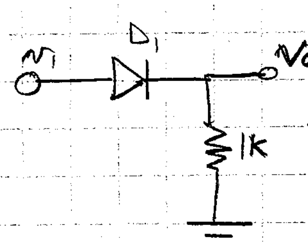
$V = \boxed{+2\ V}$, $I = \frac{2-(-5)}{2k} = \boxed{3.5\ mA}$

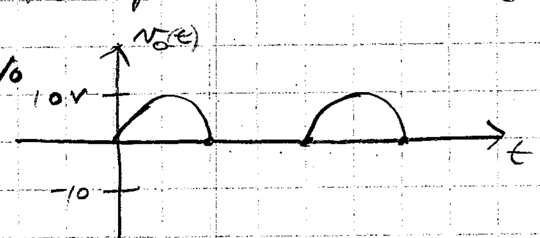
(b)


D_1 is forward-biased
D_2 is reverse-biased

$\boxed{V = +2\ V}$, $I = \frac{5-2}{2k} = \boxed{1.5\ mA}$

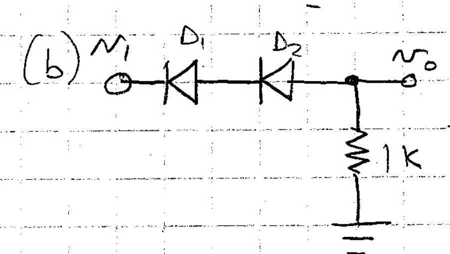
(4.4) $v_1 = 1\ kHz$ 10-V_{peak} sine wave (IDEAL DIODES: $V_\gamma = 0$, $I_s = 0$)

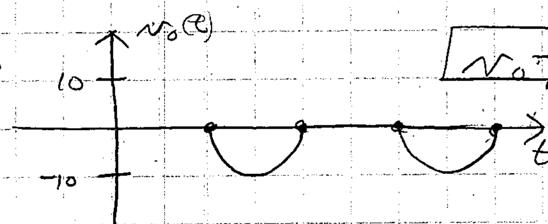
(a)




$\boxed{v_o{}^+p = 10V}$ $\boxed{v_o{}^-p = 0\ V}$

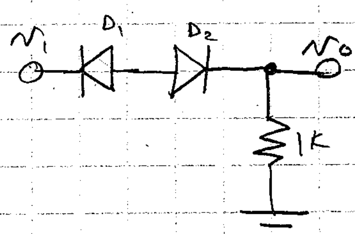
(D_1 forward-biased on positive half of cycle)

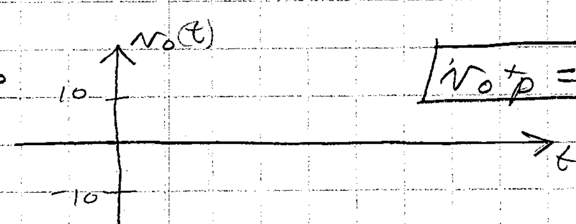
(b)




$\boxed{v_o{}^-p = -10\ V}$ $\boxed{v_o{}^+p = 0V}$

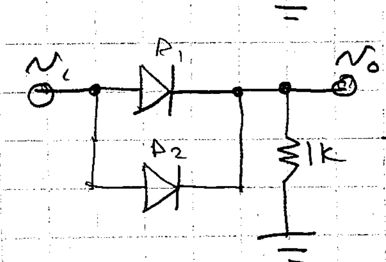
(D_1, D_2 both forward-biased on negative half of cycle)

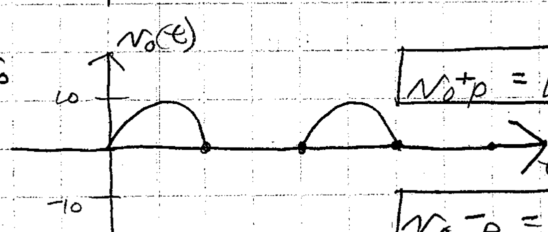
(c)




$\boxed{v_o{}^+p = 0\ V}$ (D_1, D_2 reverse-biased)

$\boxed{v_o{}^-p = 0V}$

(d)




$\boxed{v_o{}^+p = 10\ V}$

$\boxed{v_o{}^-p = 0V}$

(Both D_1 & D_2 forward biased on positive half of cycle)

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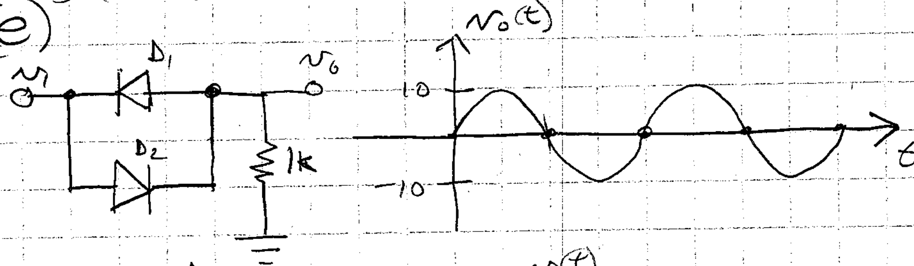
(4.4) (cont.)

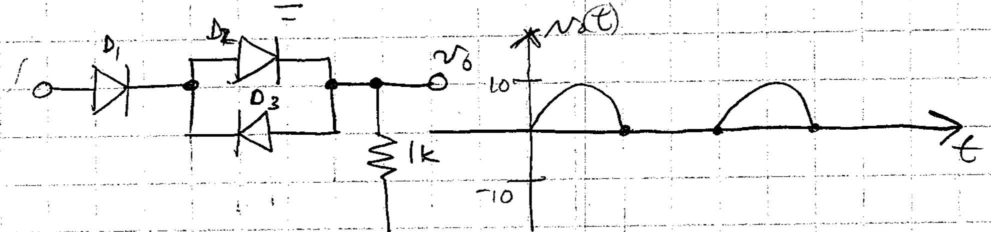
(e)



$v_o +p = 10V$

$v_o -p = 10V$

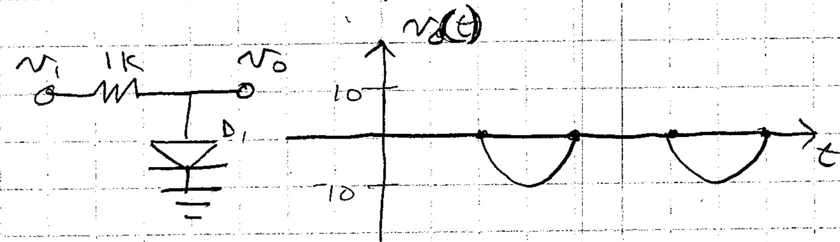
(f)



$v_o +p = 10V$

$v_o -p = 0V$

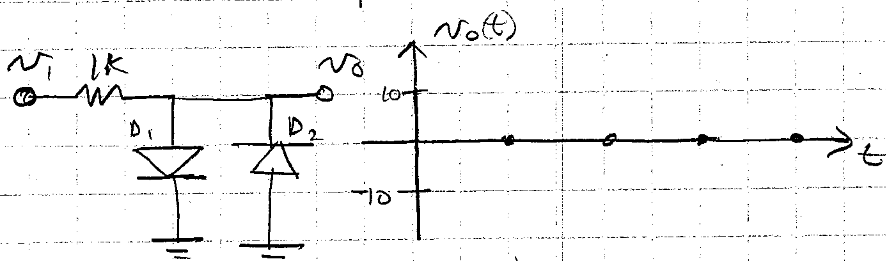
(g)



$v_o +p = 0V$

$v_o -p = -10V$

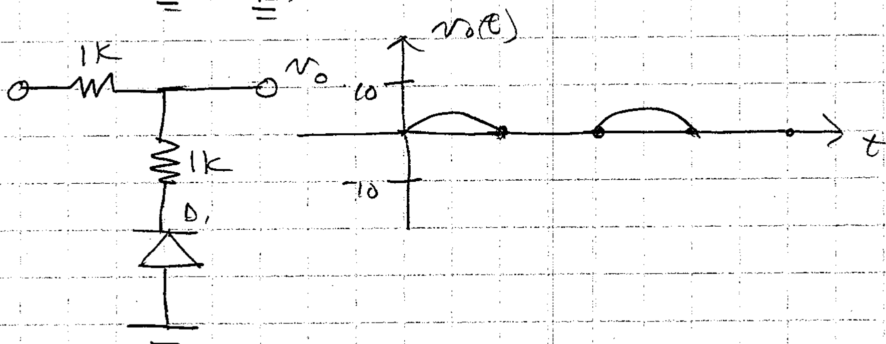
(h)



$v_o +p = 0V$

$v_o -p = 0V$

(i)



$v_o +p = 5V$

$v_o -p = 0V$

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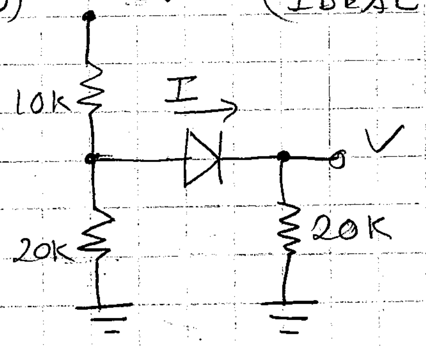
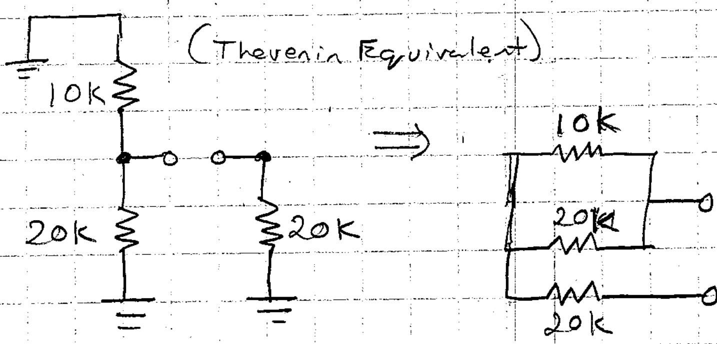
(4.10) (IDEAL DIODES, $V_J=0$, $I_S=0$)

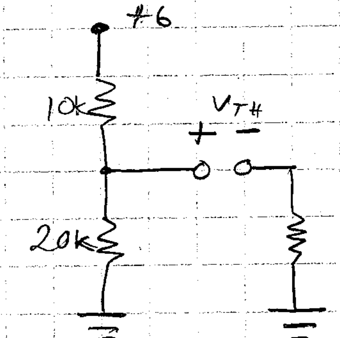
(a)



(Thevenin Equivalent)



$R_{TH} = 26.66\,k$



$V_{TH} = 4\,V$

∴ Diode is forward biased

$$I = \left(\frac{20k}{40k}\right)\frac{6}{20k} = \boxed{150\,\mu A}$$

$$V = (20k)(150\,\mu A) = \boxed{3\,V}$$

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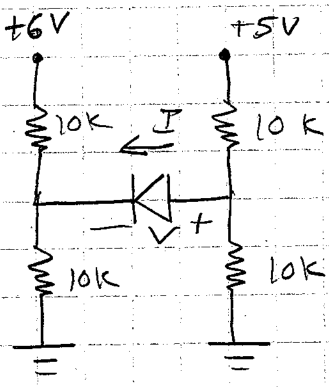
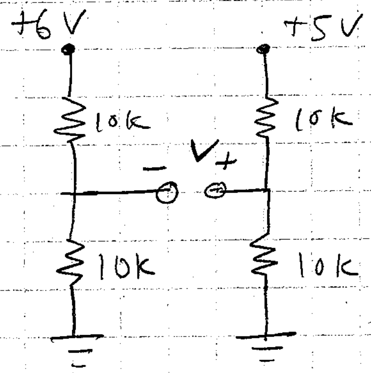
(4.10) (b)

IDEAL DIODES: $V_\gamma = 0,\ I_S = 0$





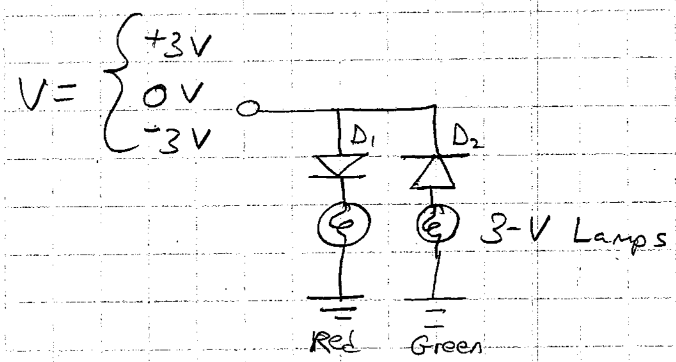
$V_{TH} = 2.5V - 3V = -0.5V$

$\therefore$ Diode is reverse biased

$\boxed{V_D = -0.5V}$

$\boxed{I_D = 0A}$

(4.16)



For $V = +3$: Red lamp will illuminate, green will be off

$V = 0$: Both lamps will be off

$V = -3$: Green lamp will illuminate, red will be off

(4.17) $T = -40°C \Rightarrow V_{TH(-40)} = \dfrac{kT}{q} = \dfrac{(1.38066\times10^{-23}\ J/K)(40K)}{1.602\times10^{-19}\ C} = \boxed{2.01mV}$

$V_{TH(0°C)} = \dfrac{k(273K)}{q} = \boxed{23.5mV}$

$V_{TH(40°C)} = \dfrac{k(313K)}{q} = \boxed{27.0mV}$

$V_{TH(150°C)} = \dfrac{k(423K)}{q} = \boxed{36.5mV}$

$25mV = \dfrac{kT}{q} \Rightarrow T = \dfrac{(25mV)q}{k} = \boxed{290.1K} = \boxed{17.1°C}$

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(4.18) $V_D = V_{TH} \ln\left(\frac{I_D}{I_S} + 1\right)$

Let $I_D = 1000 I_S \Rightarrow V_D = V_{TH} \ln(1000+1)$

$V_D = \boxed{(6.91)(V_{TH})}$

If $V_{TH} = 26mV$: $V_D = \boxed{179.6mV}$

At $V_D = 0.7V$: $I_D = \boxed{I_S\left(e^{0.7/V_{TH}} - 1\right)}$

If $V_{TH} = 26mV$: $I_D = I_S\left(e^{0.7/26mV} - 1\right) = \boxed{4.93\times10^{11}\ I_S}$

(4.19) $V_\gamma = 0.7V$, $I_{FB} = 1mA$, $V_D = 0.5V$

Diode is off, $\therefore$ only I_S can flow.

$I_D = I_S\left(e^{V_D/V_{TH}} - 1\right)$

Using given values for forward biased condition, $V_{TH} = 26mV$:

$1mA = I_S\left(e^{0.7/0.026} - 1\right)$

$I_S = 1mA\left(e^{0.5/0.026} - 1\right)^{-1} = \boxed{4.45pA}$