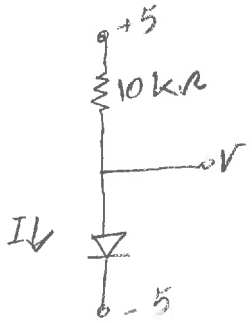
HW #5

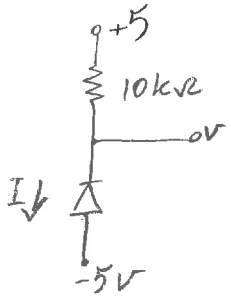
4.2) a)



$I = \frac{5-(-5)}{10k} = 1\,mA$

$V = -5\,V$

b)



$I = 0$

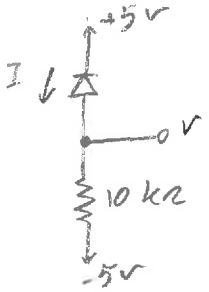
$V = 5\,V$

c)

$I = \frac{5-(-5)}{10k\Omega} = 1\,mA$

$V = 5V$

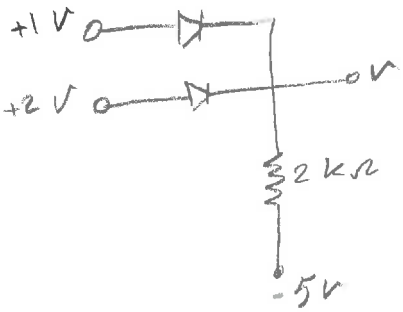
d)



$I = 0$

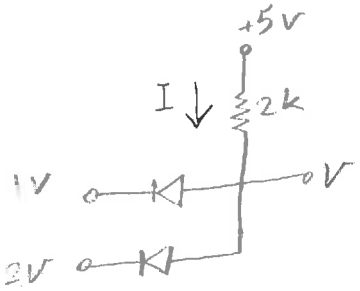
$V = -5V$

4.3)



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

$V = 2\,V$



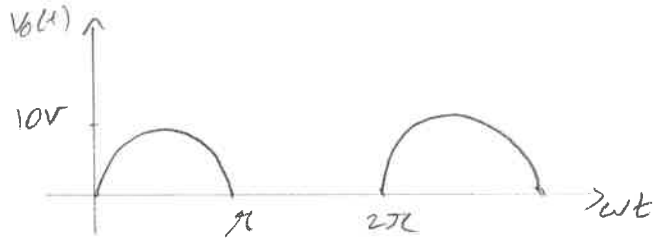
$$I = \frac{5-1}{2\,k\Omega} = 2 \text{ mA}$$

$V = 1\ V$

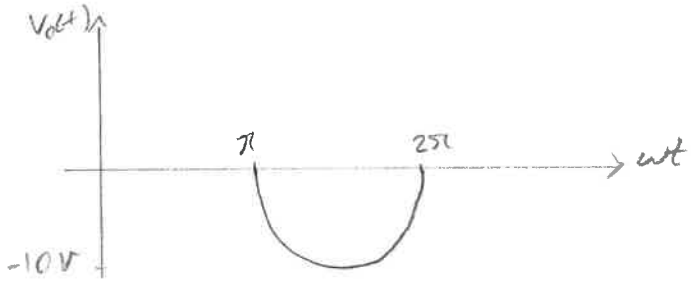
4.4)

$V_s = V_p \sin \omega t$

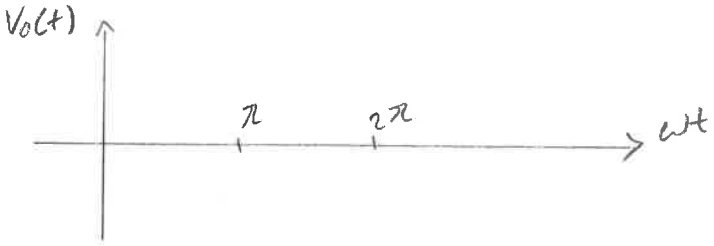
a)



b)

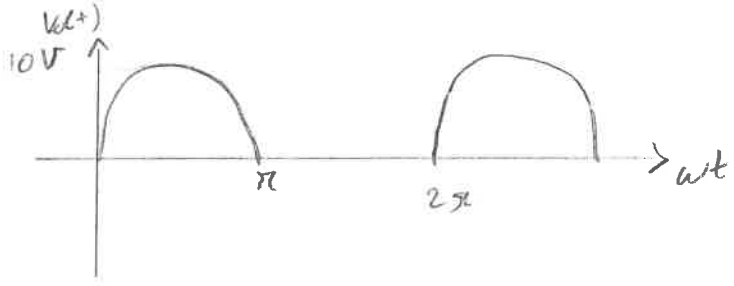


c)

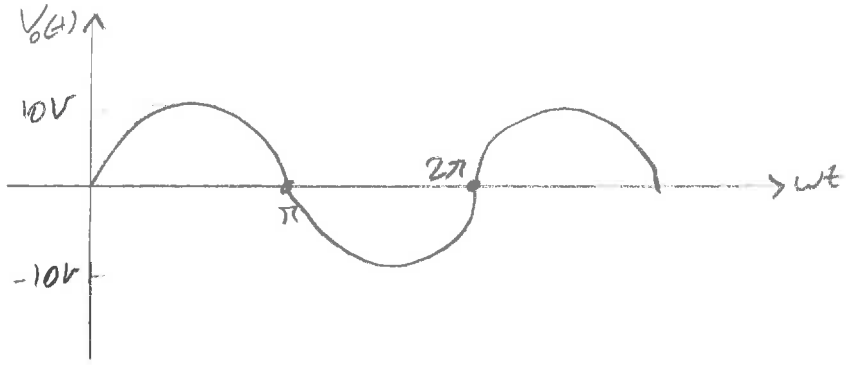


$V_o = 0$

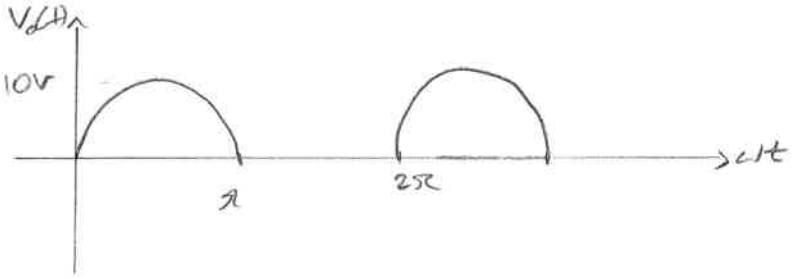
d)



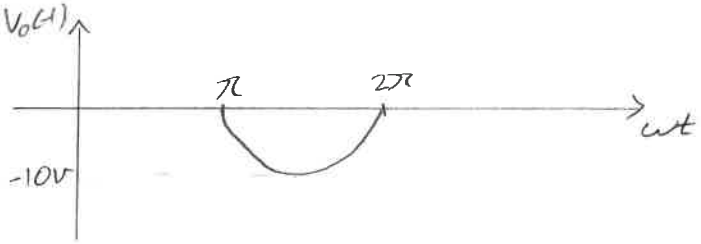
e)



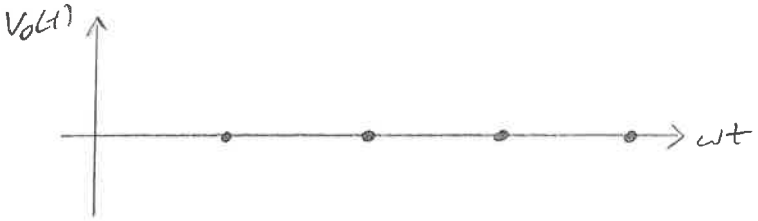
f)



g)

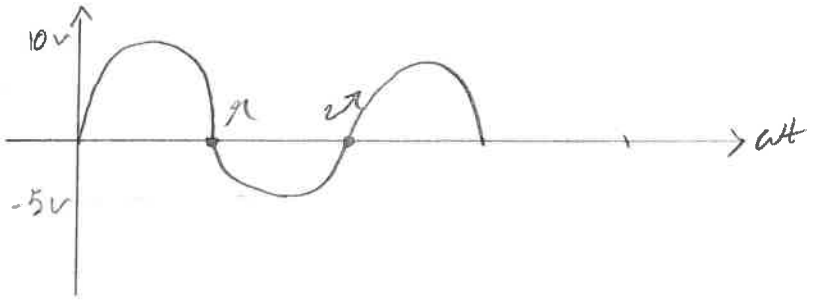


h)



$V = 0V$

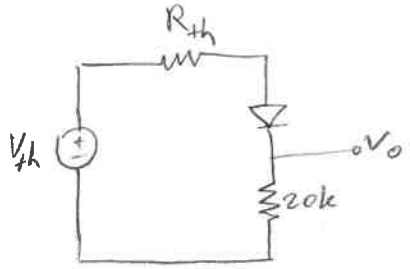
i)



4.10)

a) $R_{th} = 20k \parallel 10k = 6.67\ k\Omega$

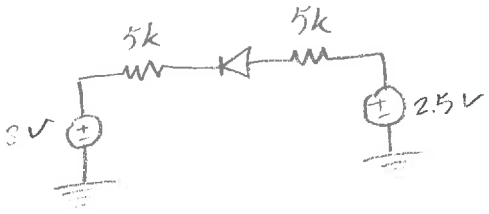
$V_{th} = 6V \times \frac{20k}{30k} = 4V$



$$V_o = \left(\frac{20k}{20k + R_{th}}\right) \times 4k = 3V$$

$$I = \frac{4V}{20k + R_{th}} = \frac{4}{20k + 6.67k\Omega} = 150\ \mu A$$

b)



$I = 0\ A$

$V_D = -0.5\ V$

4.16)

$V = +3V \Rightarrow D_2$ is off, D_1 is on $\Rightarrow$ Red lamp is on

$V = 0V \Rightarrow D_1$ and D_2 are off $\Rightarrow$ Neither is on

$V = -3V \Rightarrow D_2$ is on, D_1 is off $\Rightarrow$ Green lamp is on

4.17)

$$V_T = \frac{KT}{q} \qquad K = 1.38 \times 10^{-23} \qquad q = 1.6 \times 10^{-19}\ C$$

$$V_T(-40^\circ C) = \frac{1.38 \times 10^{-23} \times (273 - 40)}{1.6 \times 10^{-19}} = 20.1\ mV$$

$$V_T(0^\circ C) = \frac{K \times 273}{q} = 23.5\ mV$$

$$V_T(+40^\circ C) = \frac{K \times (273 + 40)}{q} = 27\ mV$$

$$V_T(+150^\circ C) = \frac{k \times (273+150)}{q} = 36.48 \text{ mV}$$

if $V_T = 25 \text{ mV} \Rightarrow T = \frac{25 \text{ mV} \times q}{k} = 289.9^\circ k \simeq 17^\circ C$

4.18)

$$I_D = I_S (e^{V_D/V_T} - 1)$$

$$100 I_S = I_S (e^{\frac{V_D}{0.026}} - 1) \Rightarrow V_D = 0.179 \text{ V}$$

$$I_D = I_S (e^{\frac{V_D}{V_T}} - 1) = I_S (e^{\frac{0.7}{0.026}} - 1) = 4.92 \times 10^{11} I_S$$

4.19)

$$I_S = \frac{I_D}{(e^{V_D/V_T} - 1)} = \frac{1 \text{ mA}}{(e^{\frac{0.7}{0.026}} - 1)} = 2.03 \times 10^{-15} \text{ A}$$

$$V_D = 0.5 \text{ V} \Rightarrow I_D = (2.03 \times 10^{-15})(e^{\frac{0.5}{0.026}} - 1) = 0.456 \mu A$$