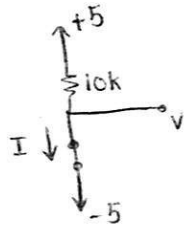
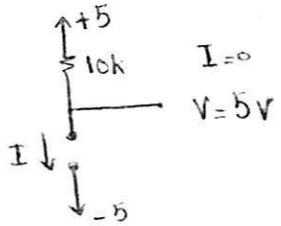
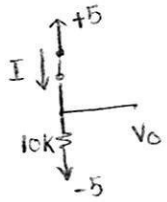
4.2

a) 

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

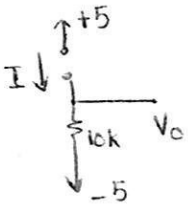
$V = -5$

b) 

c) 

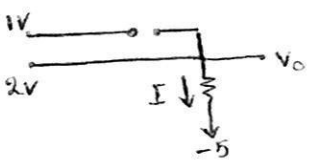
$V = 5V$

$i = 1mA$

d) 

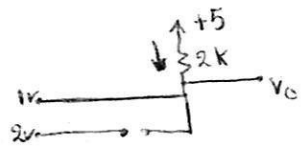
$V_o = -5V$

4.3

a) 

$V_o = 2V$

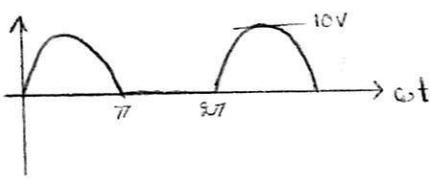
$i = 3.5\,mA$

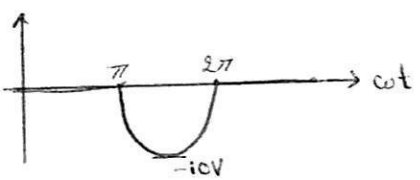
b) 

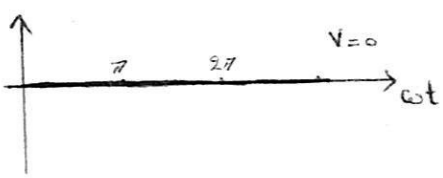
$V_o = 1V$

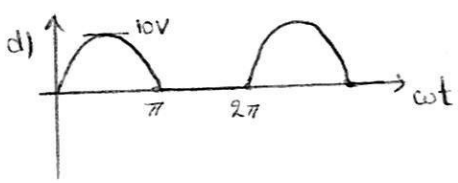
$i = 2mA$

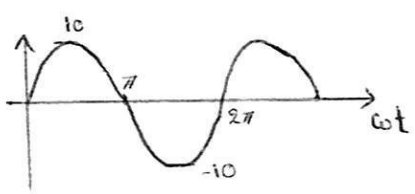
4.4 $V_s = V_p \sin \omega t$

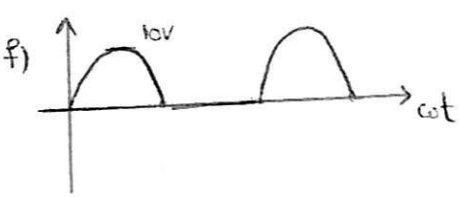
a) 

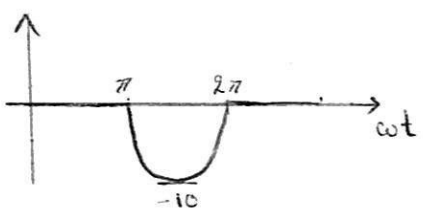
b) 

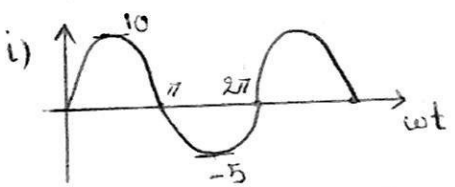
c) h) 

d) 

e) 

f) 

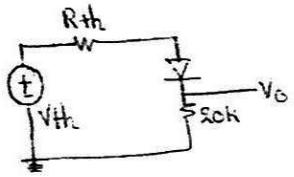
g) 

i) 

4.10

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

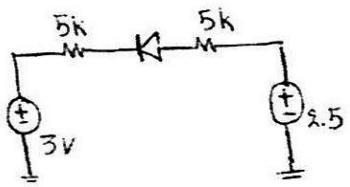
$V_{th} = 6V \times \frac{20k}{30k} = 4V$



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

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

b)



$I = 0$

The voltage across the diode is $-0.5V$

4.16 $V = +3V \longrightarrow D_2$ is off and D_1 is on $\longrightarrow$ Red lamp is on.

$V = 0\,V \longrightarrow D_1$ & D_2 are off $\longrightarrow$ Neither is on.

$V = -3V \longrightarrow D_2$ is on and D_1 is off $\longrightarrow$ Green lamp is on.

4.17 $V_T = \frac{kT}{q}$

$k = 1.38 \times 10^{-23}$

$q = 1.6 \times 10^{-19} C$

$T = -210^\circ C \longrightarrow V_T = 20.11mV$

$T = 0^\circ C \longrightarrow V_T = 23.56mV$

$T = 40^\circ C \longrightarrow V_T = 27.01mV$

$T = 150^\circ C \longrightarrow V_T = 36.50mV$

$V_T = 25mV \quad V_T = \frac{kT}{q} \longrightarrow T = \frac{V_T q}{k} \longrightarrow T = 290K = 17^\circ C$

4.18

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

$1000 I_S = I_S(e^{V_D/V_T} - 1) \longrightarrow V_D = 0.179V$

$V_T = 0.025$

$I_D = I_S(e^{0.7/0.025} - 1) = (4927 \times 10^{19}) I_S$

4.19 @ room temperature $V_D = 0.7V$

$$I_S = \frac{I_D}{(e^{V_D/V_T} - 1)} = \frac{1mA}{(e^{0.7/0.0259} - 1)} = 1.83 \times 10^{-15} A$$

$V_D = 0.5V \longrightarrow I_D = (1.83 \times 10^{-15})(e^{0.5/0.0259} - 1) \longrightarrow I_D = 243.11\,pA$