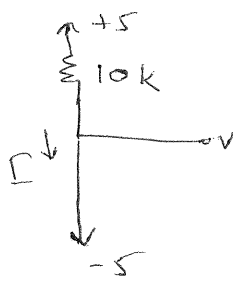


HW #4 4.2, 4.3, 4.4, 4.10, 4.16, 4.17, 4.18, 4.19

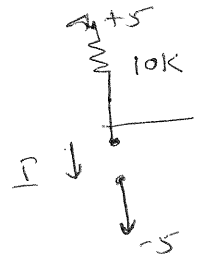
4.2) a)



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

$$v = -5$$

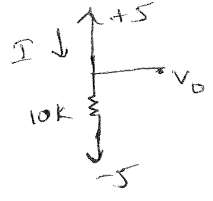
b)



$$I = 0$$

$$v = 5V$$

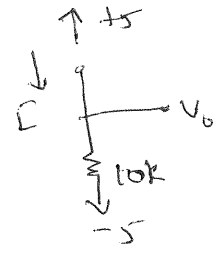
c)



$$v = 5V$$

$$i = 1mA$$

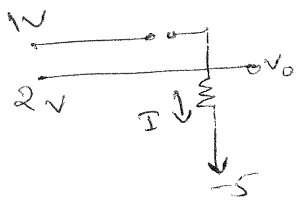
(d)



$$I = 0$$

$$v_o = -5V$$

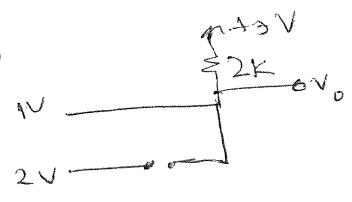
4.3)



$$v_o = 2V$$

$$i = 3.5mA$$

b)



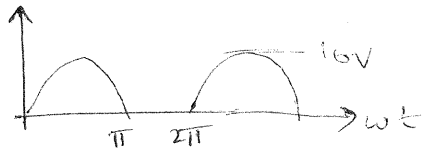
$$v_o = 1V$$

$$i = 2mA$$

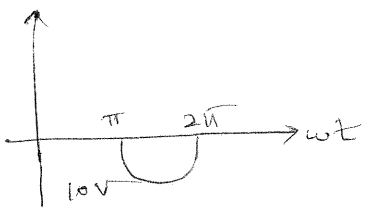
4.4)

$$v_s = v_p \sin \omega t$$

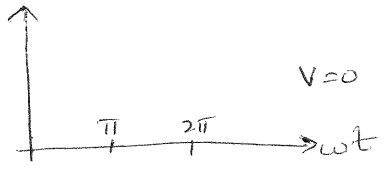
a)



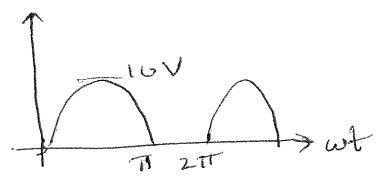
b)



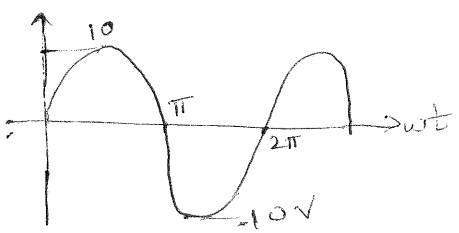
c)



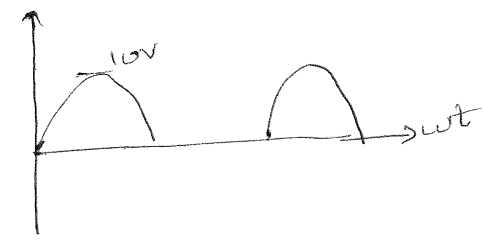
d)

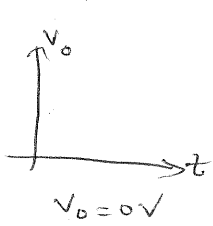
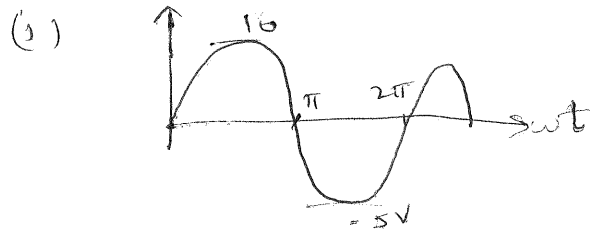
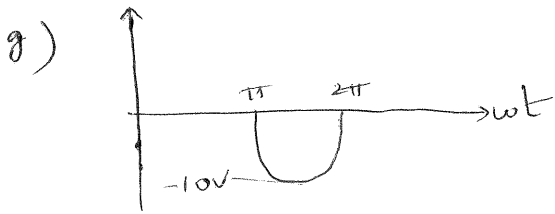


e)



f)

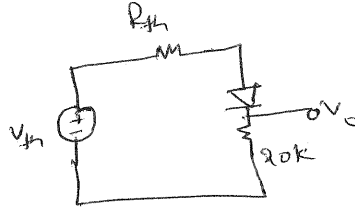




4.10) (a)

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

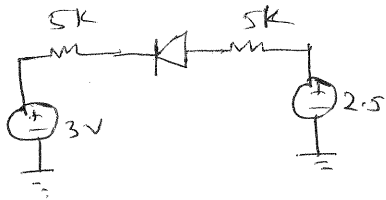
$$V_{th} = 6V \times \frac{20k}{30k} = 4V$$



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

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

(b)



$$I = 0$$

The voltage across the diode is  $-0.5V$

4.16)

$V = +3V \rightarrow D_2$  is off &  $D_1$  is on  $\rightarrow$  Red lamp is on

$V = 0V \rightarrow D_1$  &  $D_2$  are off  $\rightarrow$  Neither is on

$V = -3V \rightarrow D_2$  is on &  $D_1$  is off  $\rightarrow$  Green lamp is on

4.17)

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

$$k = 1.58 \times 10^{-23}$$

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

$$T = -40^\circ C \rightarrow V_T = 20.11mV$$

$$T = \rightarrow V_T = 23.56mV$$

$$V_T = 25mV$$

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

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

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

$$T = \frac{V_T q}{k} \rightarrow T = 230K = 17^\circ C$$

4.18)

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

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

$$V_T = 0.025$$

$$I_D = I_S \left[ e^{0.1/0.025} - 1 \right] = (492.7 \times 10^{19}) I_S$$

$$4.19) I_S = I_D / (e^{V_D/V_T} - 1) = \frac{1mA}{(e^{0.1/0.025} - 1)} = 1.83 \times 10^{-15} A$$

$$V_D = 0.5V \rightarrow I_D = (1.83 \times 10^{-15}) (e^{0.5/0.025} - 1) \rightarrow I_D = 443.1 \mu A$$

$$0.335 \mu A$$