Summer-22

1) $V_{ON} = 2.1V$

$|V_{br}| = 4V$

$I_S = 10nA$

$T = 25°C = 298K$

a) Case:

1	Forward $V_d = 10-5$ $= 5V$	ON $[V_d > V_{ON}]$
2	Reversed $V_d = 5-10$ $= -5V$	Breakdown $[V_d < V_{br}]$ $-5 < -4$
3	Reversed $V_d = -5-2$ $= -7V$	Breakdown $[V_d < V_{br}]$ $-7 < -4$
4	Forward $V_d = -3-(-5)$ $= 2V$	OFF $[V_d < V_{ON}]$ $2 < 2.1$

b) $V_d = 10 - 5 = 5V$

$$I_d = I_s e^{\frac{V_D}{nV_T}}$$

$$= (10 \times 10^{-9}) e^{\frac{5.0}{1 \times 0.0257025}}$$

~~$0.1 \times 10^{54} A$~~.

$$= 3 \times 10^{76} A.$$

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

$$= \frac{1.38 \times 10^{-23} \times 298}{1.6 \times 10^{-19}}$$

~~$0.0257V$~~

$$= 0.0257025V$$

c) $T_1 = 25°C$

$T_2 = $ ~~$(25 + 75)°C$~~

$= 75 - 25°C$

$\therefore \Delta T = (75 - 25)°C = 50°C$

I_s	T	
10nA	25°C	+10
×2 → 20nA	35°C	+10
×2 → 40nA	45°C	+10
×2 → 80nA	55°C	+10
×2 → 160nA	65°C	+10
×2 → 320nA	75°C	

~~$\Delta V_{ON} =$~~

~~$V_{ON} =$~~

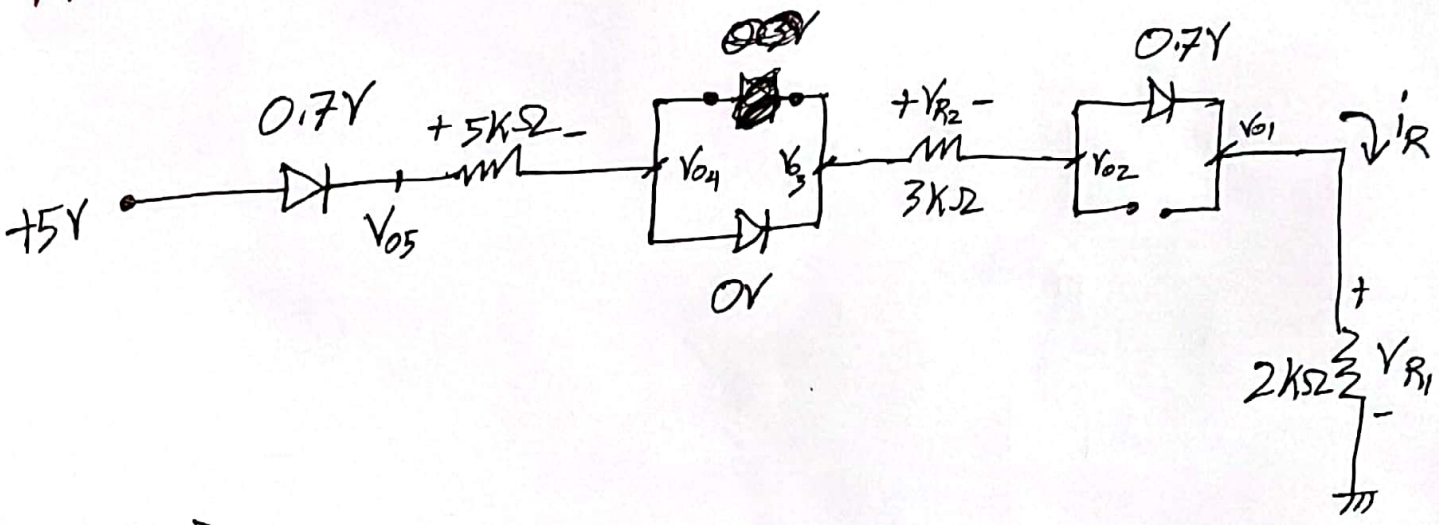
$V_{ON} = 2.1 - \Delta V_{ON}$

$= 2.1 - (2.5 \times 10^{-3} \times 50)$

$= 1.975\ V$

$\uparrow T \quad \downarrow V_{ON}$

#



KVL ⇒

$$-5+0.7+5i_R+0+3i_R+0.7+2i_R=0$$

$i_3=0$, $i_2=0$ | $i_4=i_1=i_R$

or, $-3.6+5i_R+3i_R+2i_R=0$

or, $i_R=\frac{3.6}{10}=0.36mA.$

$\therefore 0.7=5-V_{05}$

or, $V_{05}=5-0.7=4.3V$

$5\times i_R=V_{05}-V_{04}$

or, $1.8=4.3-V_{04}$

or, $V_{04}=4.3-1.8$

$\therefore V_{04}=2.5V$

$V_{R_1}=0.36\times 2$
$=0.72V$

$V_{R_1}=V_{01}-0$

or, $V_{R_1}=V_{01}$

$\therefore V_{01}=0.72V$

$V_{R_2}=3\times 0.36$
$=1.08V$

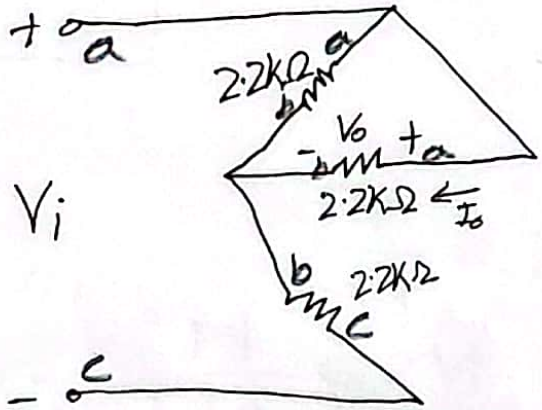
$\therefore 0.7=V_{02}-V_{01}$

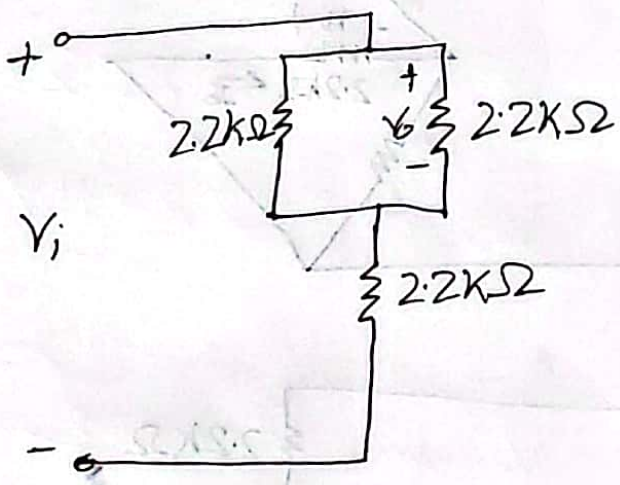
or, $V_{02}=0.7+V_{01}$
$=0.7+0.72$
$=1.42V$

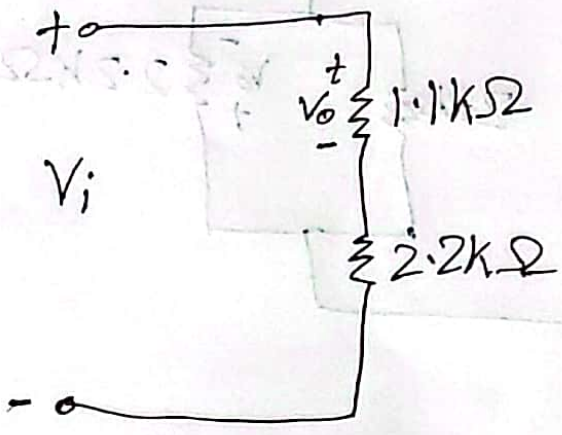
V_{03}
$=V_{R_2}+V_{02}$
$=1.08+1.42$
$=2.5V.$

Mid-Summer-22

2) a) +ve hc,





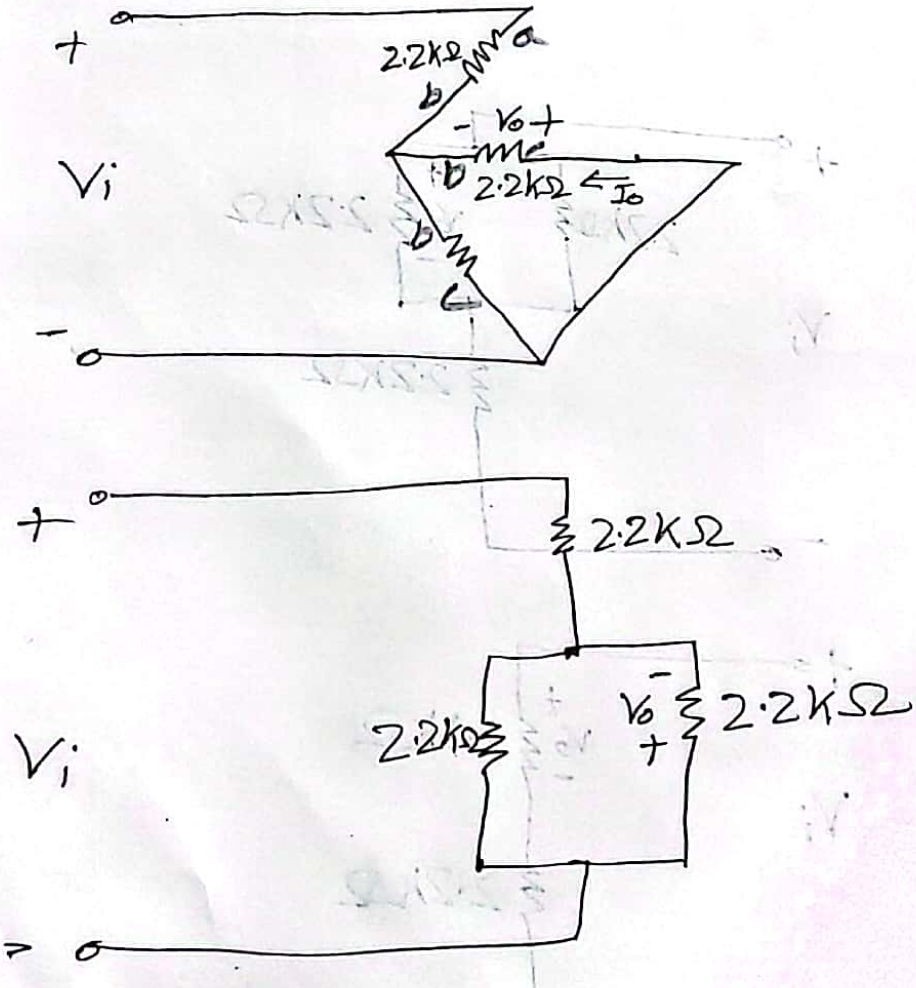


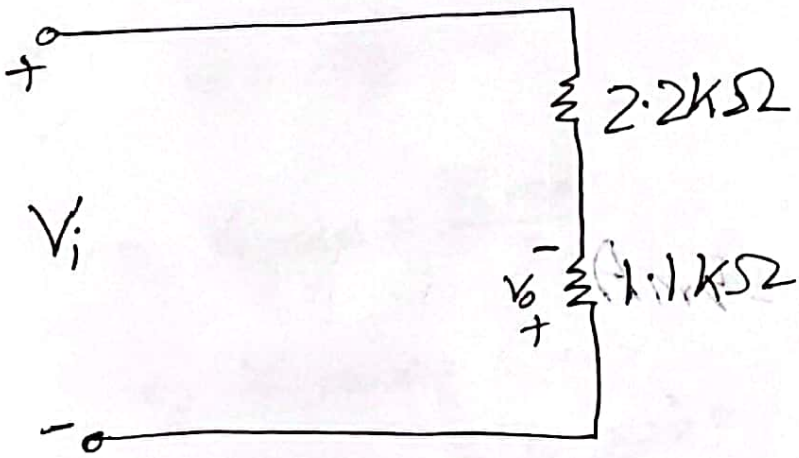
VDR,

$$V_o = \frac{1.1}{1.1+2.2} \times V_i$$

or, $V_o = \frac{V_i}{3}$

-ve hc,

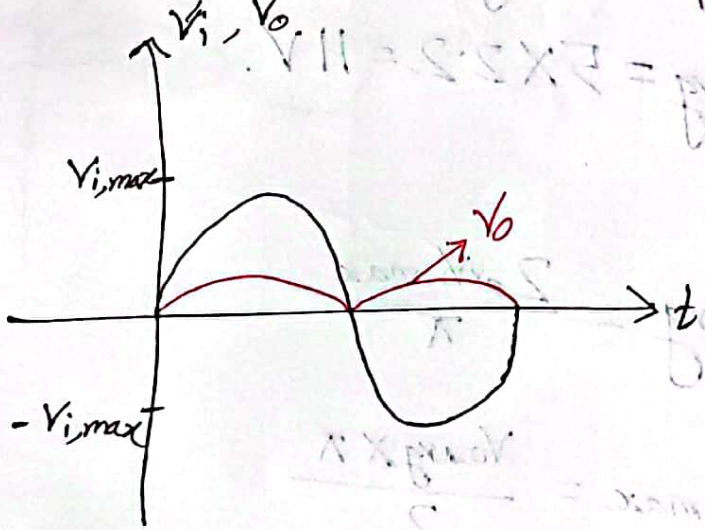




∴ VDR,

$$V_o = -\frac{1 \cdot 1}{1 \cdot 1 + 2 \cdot 2} \times V_i$$

$$= -\frac{V_i}{3}$$



b) Given,

$$I_{o,avg} = 5mA$$

We know,

$$\therefore I_o = \frac{V_o}{2.2}$$

$$\text{or, } I_{o,avg} = \frac{V_{o,avg}}{2.2}$$

$$\text{or, } V_{o,avg} = I_{o,avg} \times 2.2$$

$$\therefore V_{o,avg} = 5 \times 2.2 = 11V.$$

$$\therefore V_{o,avg} = \frac{2 \times V_{o,max}}{\pi}$$

$$\text{or, } V_{o,max} = \frac{V_{o,avg} \times \pi}{2}$$

$$\therefore V_{o,max} = \frac{11 \times \pi}{2} = 17.278V$$

c) $V_o = \frac{V_i}{3}$

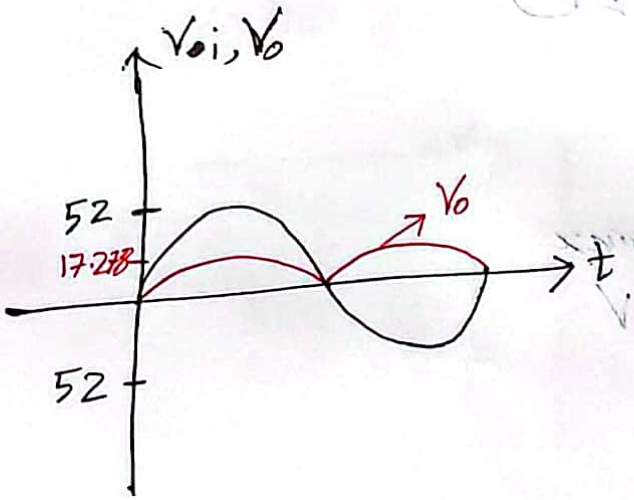
or, $V_{o,max} = \frac{V_{i,max}}{3}$

or, $V_{i,max} = V_{o,max} \times 3$

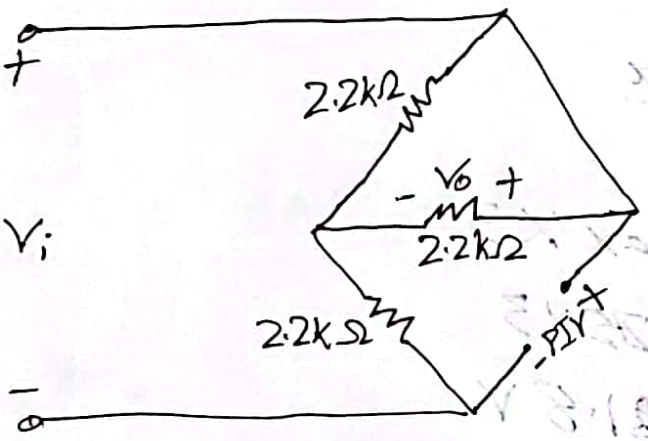
$= 17.28 \times 3$

$= 51.8\ V$

$\approx 52V$



d)



+hc,

$$-V_i + PIV = 0$$

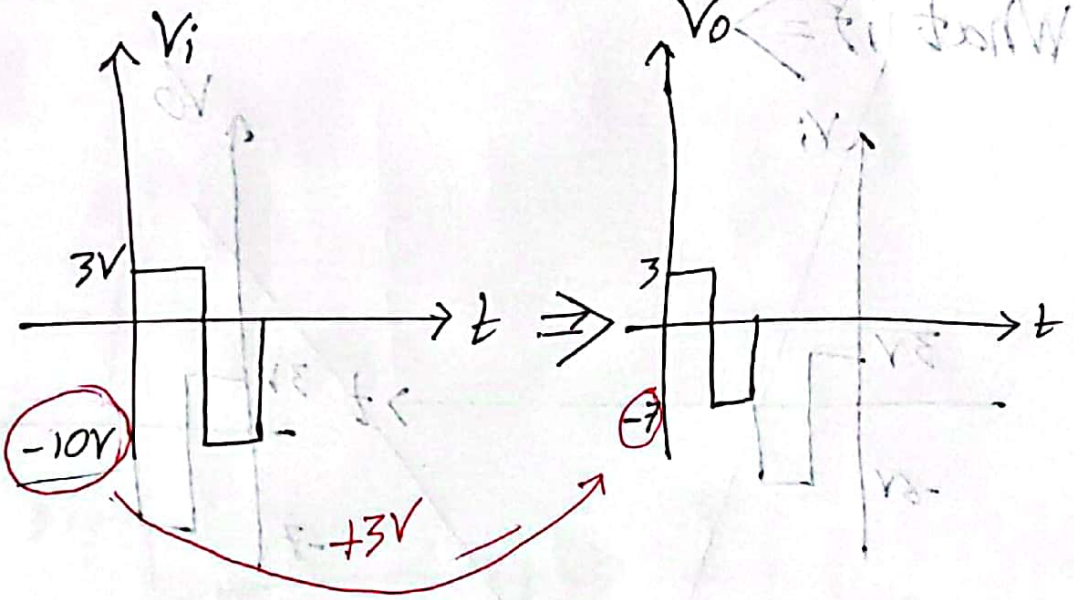
or, $PIV = V_i$

or, $PIV = V_{i,max}$

or, $PIV = 52V$

Clippers:

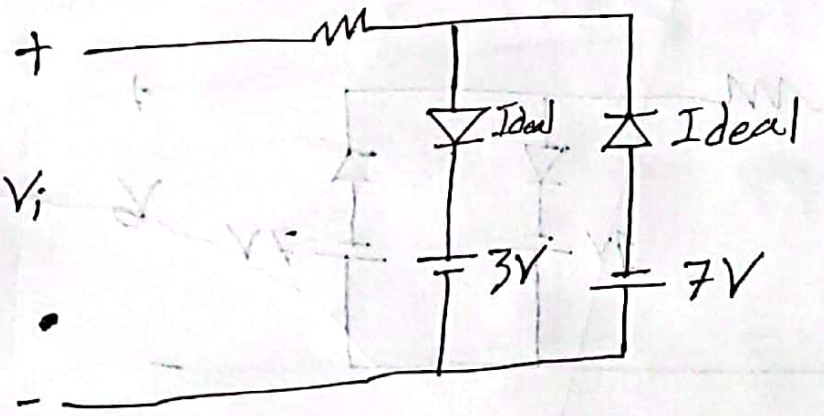
3)a)



$V_o = V_i \rightarrow$ R Biased

↓

+ve nc



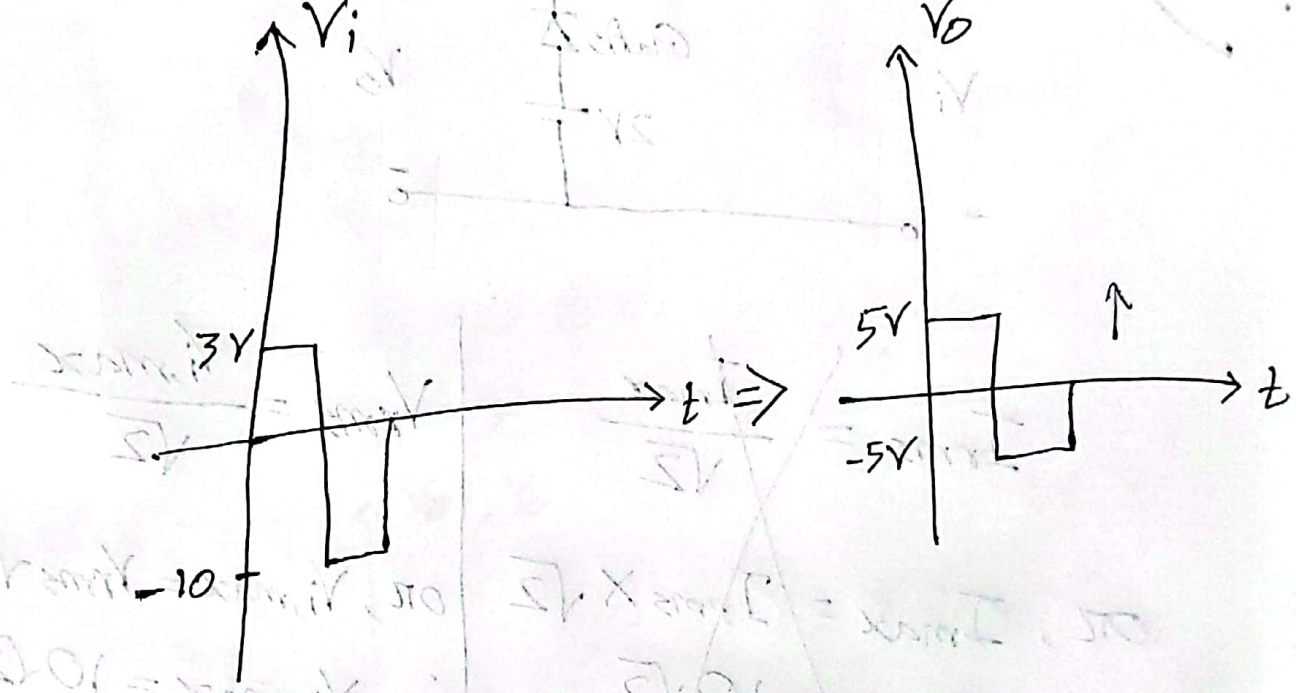
+ve nc, KVL $\Rightarrow$ $V_o - 3 - 0 = 0$

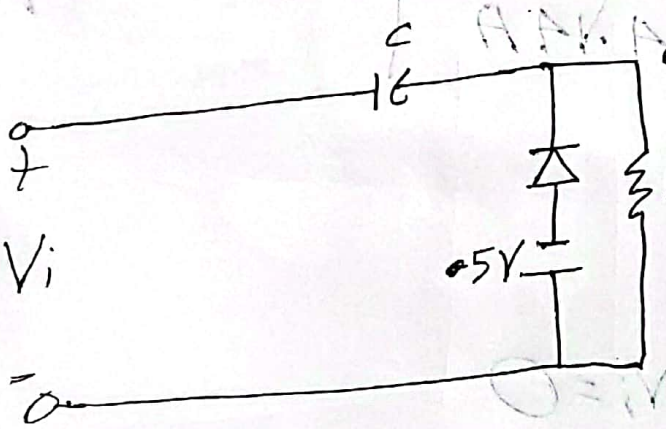
$\therefore V_o = 3V$

-ve nc, KVL $\Rightarrow$ $V_o + 7 = 0$

$\therefore V_o = -7V$

Clamper:



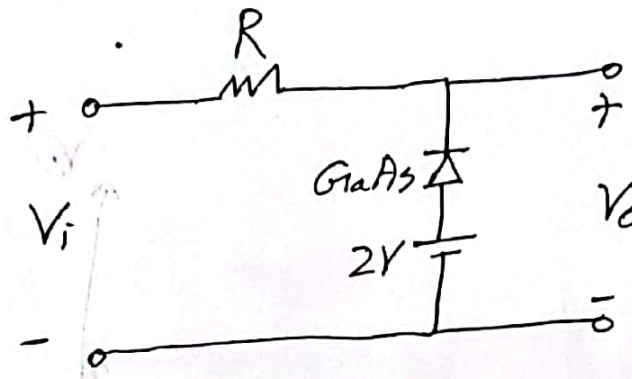


$V_i(P\text{-}P) = V_o(P\text{-}P)$

$\Rightarrow (3 - (-10)) = 5 - (-x)$

$\Rightarrow x =$

3) b)



$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

or, $I_{max} = I_{rms} \times \sqrt{2}$

or, $I_{max} = 10\sqrt{2}$

$\therefore I_{max} = 14.14\ A$

$$V_{rms} = \frac{V_{i,max}}{\sqrt{2}}$$

or, $V_{i,max} = V_{rms}\sqrt{2}$

$\therefore V_{i,max} = 10\sqrt{2}$

$= 14.14\ V$

+ve hc, RB,

KVL, $V_o - V_i = 0$

or, $V_o = V_i$

or, $V_{o,max} = V_{i,max}$

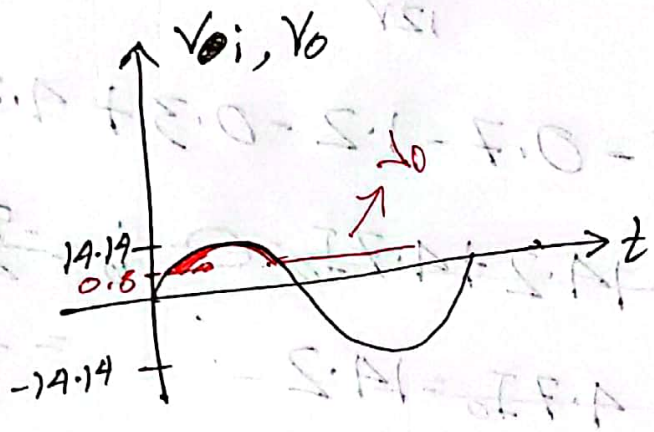
$\therefore V_{o,max} = 14.14\ V$

-ve nc, FB,

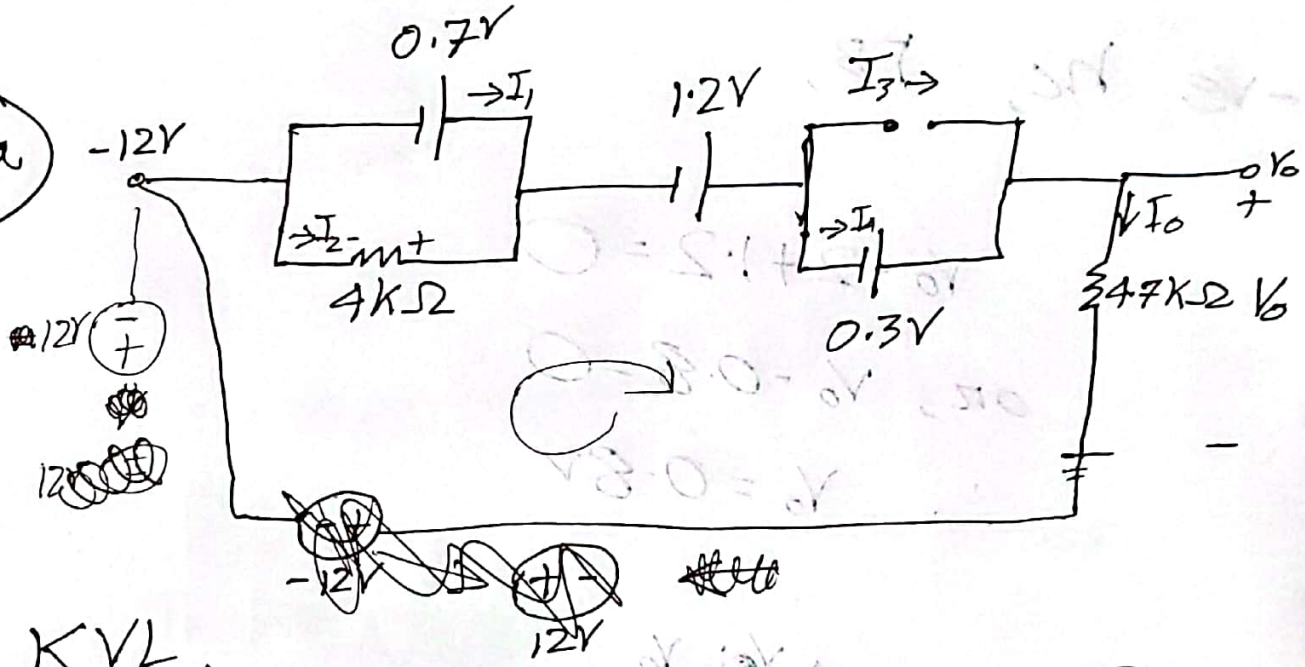
$$V_o + 2 + 1.2 = 0$$

or, $V_o - 0.8 = 0$

$\therefore \quad V_o = 0.8V$



4) a)



KVL,

$$12 - 0.7 - 1.2 - 0.3 + 4.7I_o = 0$$

or, ~~$14.2 + 4.7I_o = 0$~~ $\quad i_o = \frac{-9.8}{4.7}$

$= -2.085mA$

or, ~~$4.7I_o = 14.2$~~

$\therefore$ ~~$I_o = 3.028mA$~~

$\therefore$ ~~$I_1 = I_o$~~

$$I_2 = -\frac{0.7}{4} = -0.175mA.$$

$$\therefore I_1 = I_o - I_2 = -2.08mA - (-0.175)$$

$= 3.02mA - 0.175mA$

$= -1.905mA.$

$I_3 = 0mA$

$\therefore I_4 = I_o = 3.02mA$

$\therefore V_6 = I_o \times 4.7$

-2.085

$= 3.02 \times 4.7$

$= 14.194V - 9.7995V$