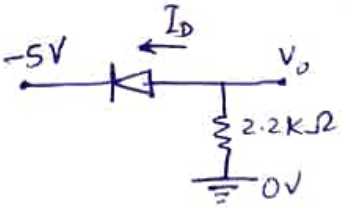
Assignment - I

① (i)



By KVL,

$0 - 2.2K I_D - 0.7 = -5$

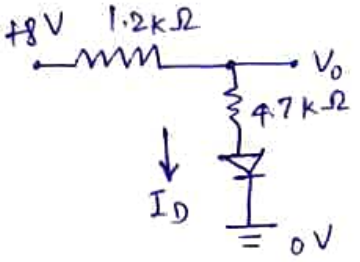
$\Rightarrow I_D = \frac{4.3}{2.2K}$

$= 1.954\ mA$

and, $V_o = -5 + 0.7$

$= -4.3\ V$

(ii)



$8 - 1.2K\ I_D - 4.7K I_D - 0.7 = 0$

$\Rightarrow 8 - I_D(5.9K) = 0.7$

$\Rightarrow I_D(5.9K) = 7.3$

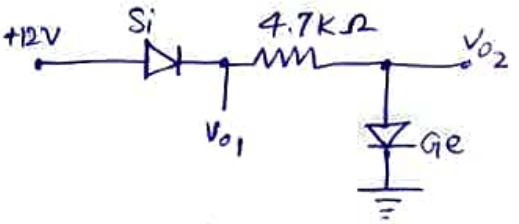
$\Rightarrow I_D = \frac{7.3}{5.9K} = 1.237\ mA$

and,

$8 - 1.2K\left(\frac{7.3}{5.9K}\right) = V_o$

$\Rightarrow V_o = 6.515\ V$

② (a)



$12 - 0.7 - (4.7K) I_D - 0.3 = 0$

$\Rightarrow 11 = 4.7K\ I_D$

$\Rightarrow I_D = \frac{11}{4.7}\ mA$

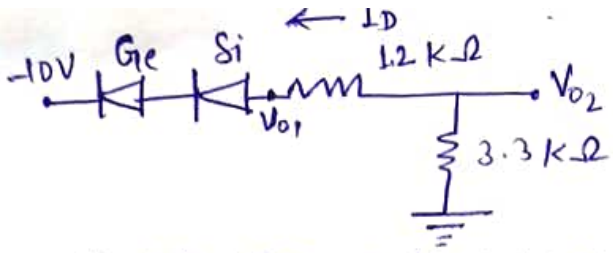
$= 2.34\ mA.$

and, $12 - 0.7 = V_{o1} \Rightarrow V_{o1} = 11.3,$

$\Rightarrow V_{o2} = 12 - 0.7 - 4.7K(I_D)$

$\Rightarrow V_{o2} = 0.3\ V$

(b)



$$-10 + 0.3 + 0.7 + I_D(1.2 + 3.3)k = 0$$

$$\Rightarrow I_D = \frac{9}{4.5k} = 2\,mA$$

and,

$$-10 + 0.3 + 0.7 = V_{O_1}$$

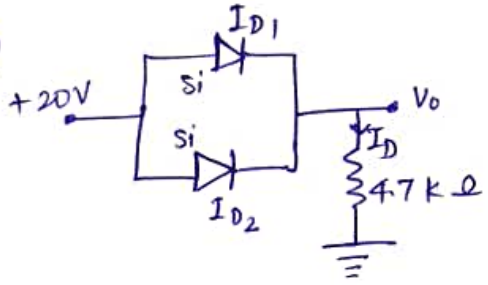
$$\Rightarrow V_{O_1} = -9$$

$$V_{O_1} + 1.2\,(2)\,\frac{k}{k} = V_{O_2}$$

$$\Rightarrow V_{O_2} = -9 + 2.4$$

$$= -6.6\,V$$

(3) (a)



$$20 - 0.7 - I_D\,(4.7k) = 0$$

$$\Rightarrow I_D = \frac{19.3}{4.7k}$$

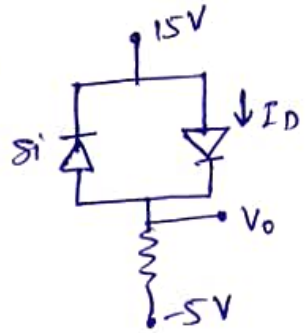
$$= 4.103\,mA$$

$$I_{D_1} = 2.05\,mA$$

and, $20 - 0.7 = V_o$

$$= 19.3\,V$$

(b)



$$15 - 0.7 = V_o$$

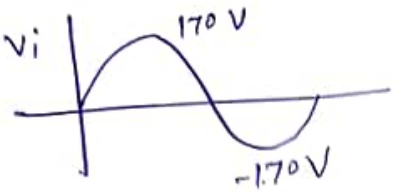
$$= 14.3\,V$$

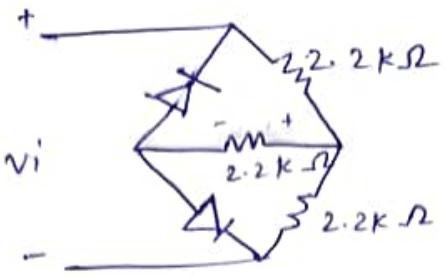
and, $14.3 - 2.2k(I_D) = -5$

$$\Rightarrow 19.3 = 2.2k\,I_D$$

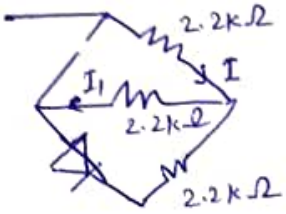
$$\Rightarrow I_D = 8.77\,mA$$

④





For +ve cycle



$I_1 = I_0/2$

$V_i - 2.2 I_0 + V_0 = 0$

$\Rightarrow 170 - 2.2 I_0 - \frac{2.2 I_0}{2} = 0$

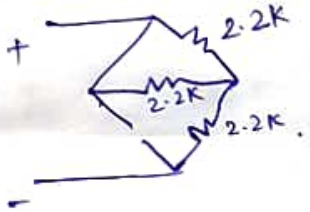
$\Rightarrow 170 = 3.3 I_0$

$\Rightarrow I_0 = 170/3.3 = 51.51$ mA

$V_0 = \frac{2.2}{2} \times 51.51$

$= 56.67$ V

For -ve cycle

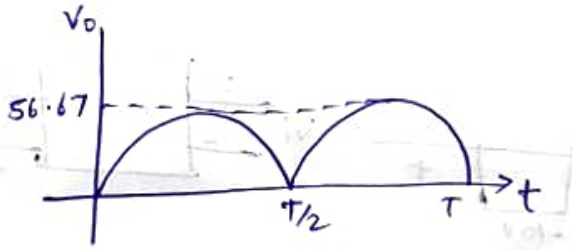


$V_0 = 56.67$ V

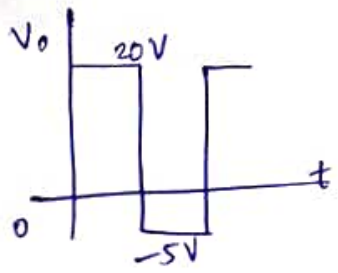
$V_{DC} = 0.636\,(56.67)$

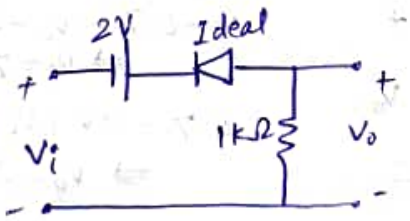
$= 36.042$ V

$= \frac{2 V_m}{\pi}$

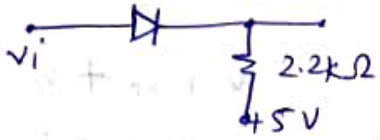


⑤

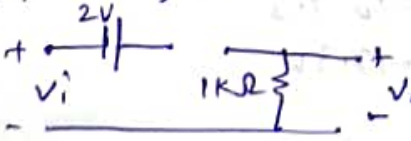




ⓑ

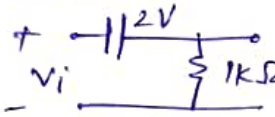


For ⓐ, +ve cycle :



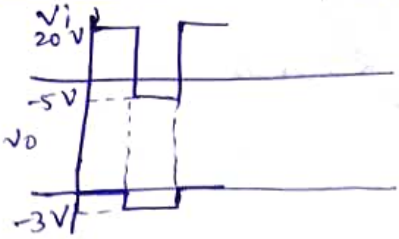
$V_0 = 0$

-ve cycle:



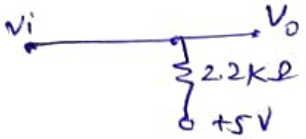
$-5+2V = V_o$

$\Rightarrow V_o = -3V$



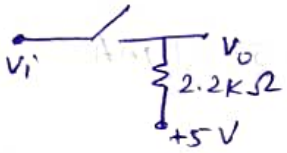
For (b)

+ve cycle:

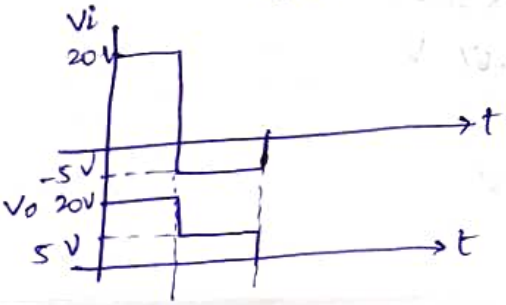


$V_o = V_i = 20V$

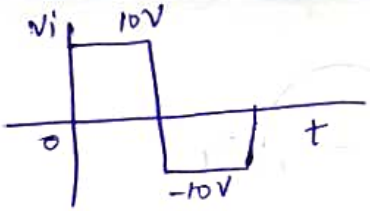
-ve cycle:

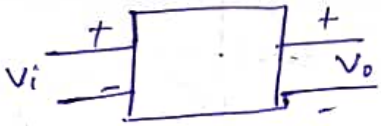


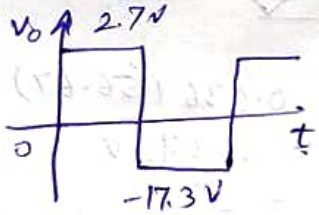
$V_o = 5V$



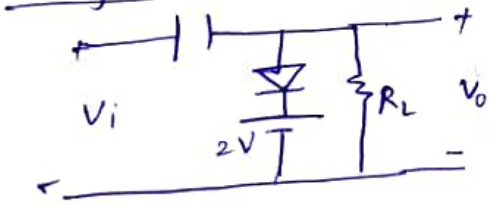
(6)







+ve cycle:



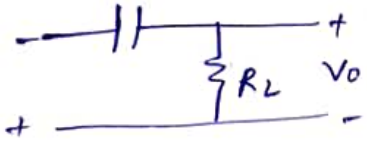
$10 - 0.7 - V_c - 2V = 0$

$\Rightarrow V_c = 7.3V$

$-0.7 - 2V + V_o = 0$

$\Rightarrow V_o = 2.7V$

-ve cycle



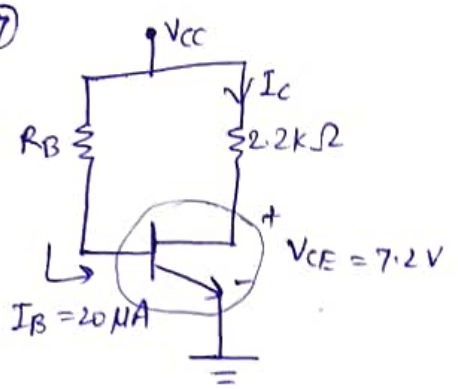
$V + V_o + V_c = 0$

$V_o = -V - V_c$

$= -10 - 7.3$

$= -17.3V$

(7)



$I_B + I_C = I_E$

$I_C = 4\,mA - 0.02\,mA$

$= 3.98\,mA$

$V_{cc} - 2.2 \times 3.98 - 7.2 = 0$

$\Rightarrow V_{cc} = 15.956\,V$

$\therefore \beta = \frac{3.98 \times 10^{-3}}{20 \times 10^{-6}} \quad \left(\because \beta = \frac{I_C}{I_B}\right)$

$= 199$

and,

$V_{cc} - I_B R_B - V_{BE} = 0$

$R_B = \frac{V_{cc} - V_{BE}}{20 \times 10^{-6}}$

$= \frac{1.6 - 0.7}{20 \times 10^{-6}} = 765\,k\Omega$.

(8) $I_E = I_C + I_B$

$= \beta I_B + I_B \quad -(1)$

$I_C = \alpha I_E + I_{CB_0} \quad -(2)$

$I_C = \alpha (I_C + I_B) + I_{CB_0}$

$\Rightarrow I_C (1-\alpha) = \alpha I_B + I_{CB_0}$

$\Rightarrow I_C = \frac{\alpha}{1-\alpha} I_B + \frac{1}{1-\alpha} I_{CB_0}$

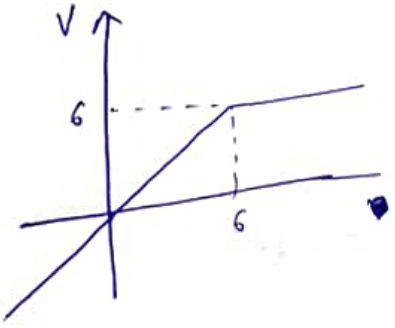
$= \beta I_B + (\beta + 1) I_{CB_0}$

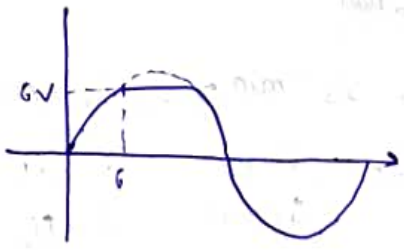
$= 100 \times 1 \times 10^{-3} + (101)\, 5 \times 10^{-6}$

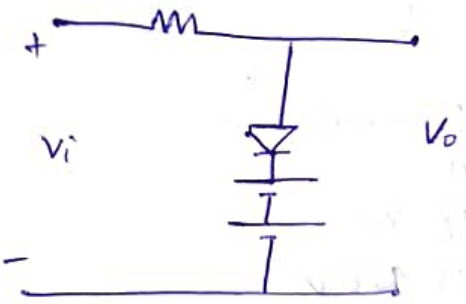
$= 100 + 101 \times 5 \times 10^{-3}$

$= 100.505\,mA$.

(9)







In +ve cycle :

For $V_i < 6$

output follows the input

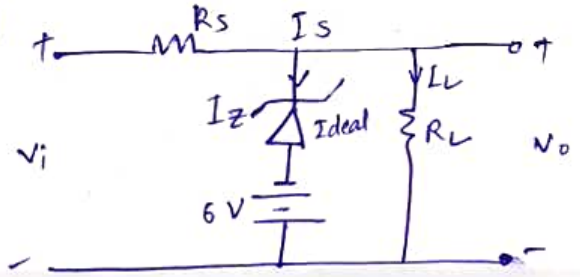
For $V_i > 6$

Output → constant

In -ve cycle

ouput follows the input.

(10)



R_L from 240Ω to 2kΩ

$V_{in,min} = 21V$

$V_{in,max} = 27V$

$V_{s,min} = 2.4V$

$V_{s,max} = 34 V$

$V_Z = 18.0 V$

$I_{Z,min} = 15 mA$

$V_{in} = (24 \pm 3) V$

$$I_S = I_Z + I_L$$
$$I_S = \frac{V_i - V_Z}{R_S}$$
$$V_Z = I_L R_L$$

$$I_{L,min} = \frac{V_Z}{R_{L,max}} = 9.3 mA$$

$$I_{L,max} = \frac{V_Z}{R_{L,min}} = 77.5 mA$$

For $V_{s,min}$, $I_s = min \Rightarrow I_Z, I_L = min.$

$$\Rightarrow R_S = \frac{V_{s,min}}{I_{s,min}} = \frac{2.4 \times 10^3}{15 \times 1.6} = 93.765 \Omega$$

$$\Rightarrow R_S = 93.765 \Omega.$$