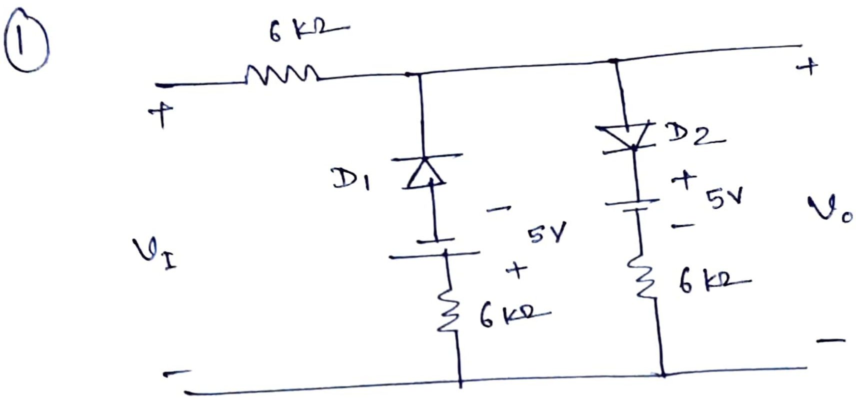
(1)




$V_\gamma = 0$ given.

for, $-5V \le v_I \le 5V$ both $D_1$ and $D_2$ are OFF.

So, $v_o = v_I$ (1)

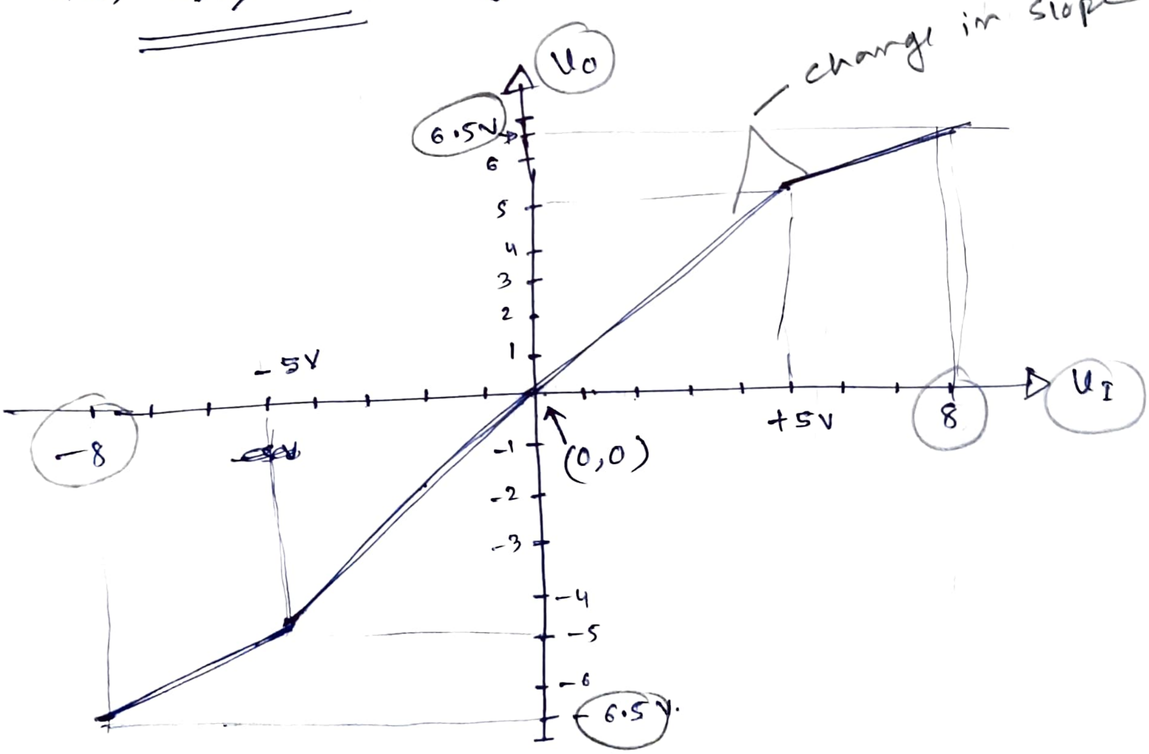
output voltage for three conditions.

for $v_I \le -5V$, $D_1$ is only ON.

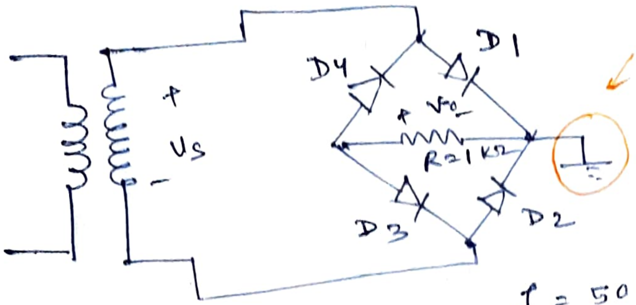
$$v_o = \frac{v_I - (-5V)}{6+6} \times 6 - 5V$$ (1)

$$v_o = \frac{1}{2} v_I - 2.5V$$

for, $v_I \geq 5V$, only $D_2$ is ON, $v_o = \frac{1}{2} v_I + 2.5V.$ (1)



(2)




important for waveform plot of Vo

$V_\gamma = 0.6V.$

$V_s = 5\sin(314t)\ V.$

$\omega t = 314t$

$2\pi f t = 314t$

$f = 50\ Hz$

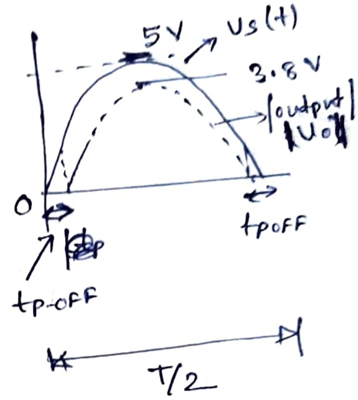
$f = 50Hz$

$T = \frac{1}{50Hz} = 20ms$

$V_s(t) = 5\sin 314t$

for each cycle 2 diodes will be ON, so Voltage drop across diodes $= 2\times0.6V = 1.2V.$

diodes will conduct, only when $V_s > 1.2V.$




Lets find $t_{p-OFF}$

$5\sin 314t_{p-OFF} = 1.2$

$314t_{p-OFF} = \sin^{-1}\left(\frac{1.2}{5}\right)$

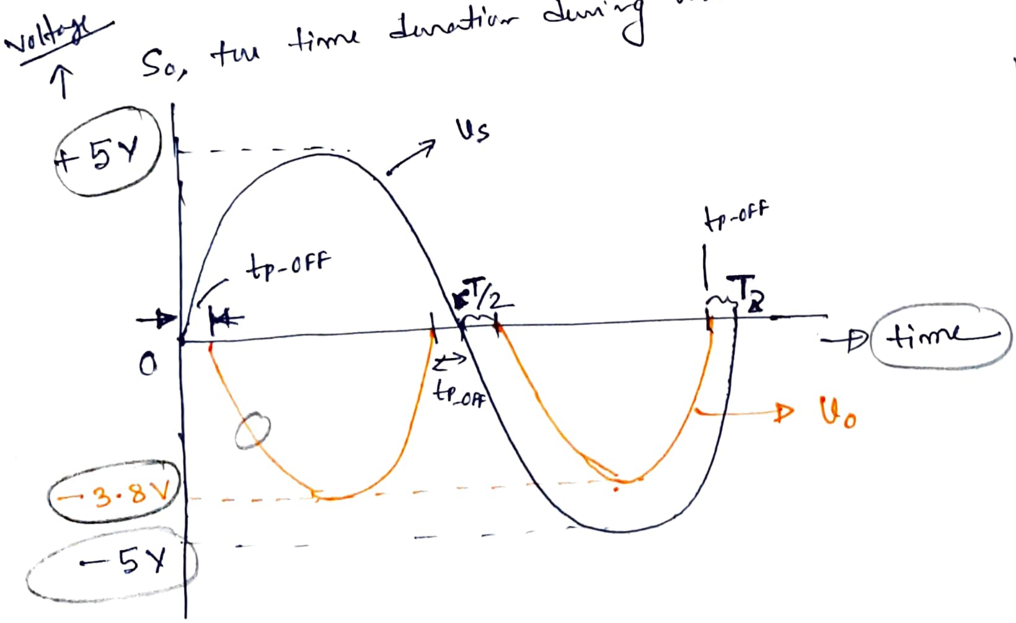
$t_{p-OFF} = \frac{0.237}{314} \approx 0.77\ ms.$

for one time priode (T) of the i/p signal, $t_{p-OFF}$ occurs four time.

So, the time duration during which diods are conduting $= T - 4t_{p-OFF}$

$= 20 - 4\times0.77$

$\boxed{= 16.92\ ms}$




PIV of diode $D_3 = |V_{s\,max}| - V_\gamma = 5 - 0.6$

$\boxed{= 4.4V}$

(3) n-type Semiconductor $n >> p$

$n \approx N_D$

resistivity $\rho = 0.65 \ \Omega\text{-cm}$

Conductivity $\sigma = \frac{1}{\rho} = \frac{1}{0.65} = 1.538 \ (\Omega\text{-cm})^{-1}$

$\sigma = N_D \, q \cdot \mu_n$ ; $\mu_n = 1250 \ cm^2/V\text{-}s$

$N_D = \frac{\sigma}{q \times \mu_n} = \frac{1.538}{1.6 \times 10^{-19} \times 1250}$

$\boxed{N_D = 7.69 \times 10^{15} \ cm^{-3}}$

$J = \sigma E$

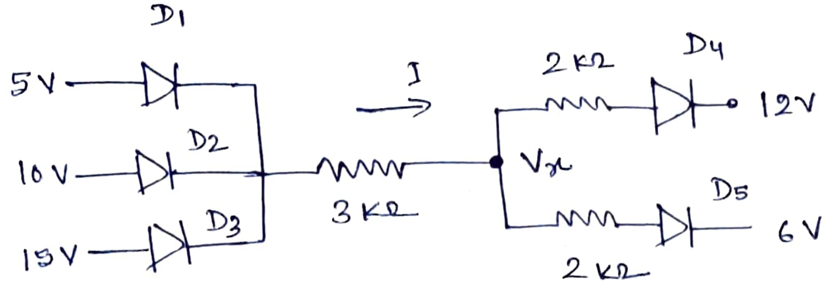
$160 \ A/cm^2 = 1.538 \times E$

$E = \frac{160}{1.538} = \boxed{104.03 \ V/cm}$

S h

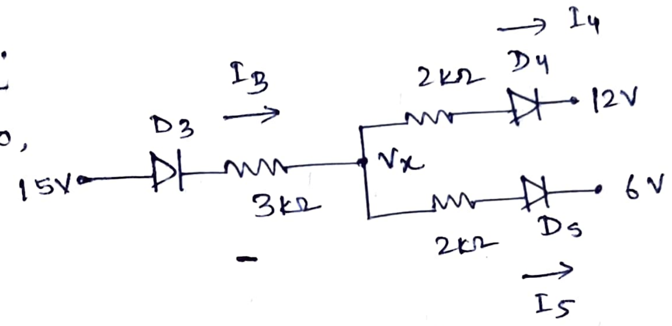
A a

(4)




for $D_1$, $D_2$ and $D_3$, cathode is common and $V_\gamma = 0$ given, so only $D_3$ will be ON.

then ckt. reduces to,




Assuming, $D_4$ and $D_5$ both are in ON state,

KCL at ~~Vx~~ node 'x', ~~15 − Vx~~ $I_3 = I_4 + I_5$

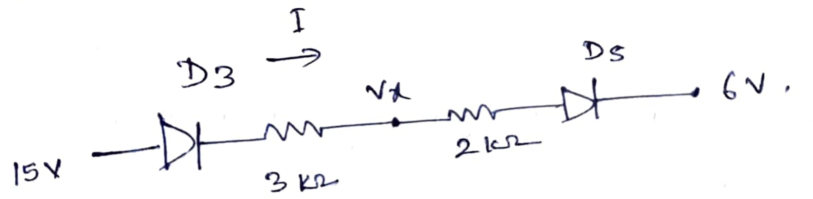
$$\therefore \frac{15 - V_x}{3} = \frac{V_x - 12}{2} + \frac{V_x - 6}{2}$$

$$V_x = 10.5\,V$$

for our assumption to be true, $V_x > 12\,V$.

so, $D_4$ is OFF

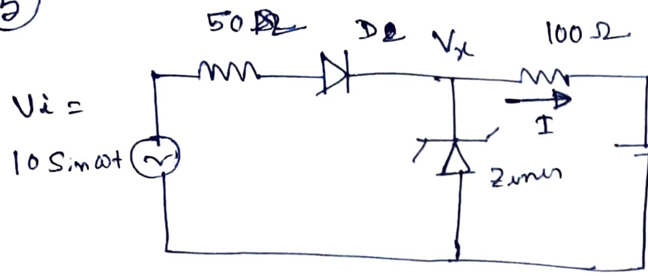
then the ckt further reduces to




$$\text{So, } I = \frac{15 - 6}{3 + 2} = \boxed{1.8\ mA.}$$

Ans.

(5)

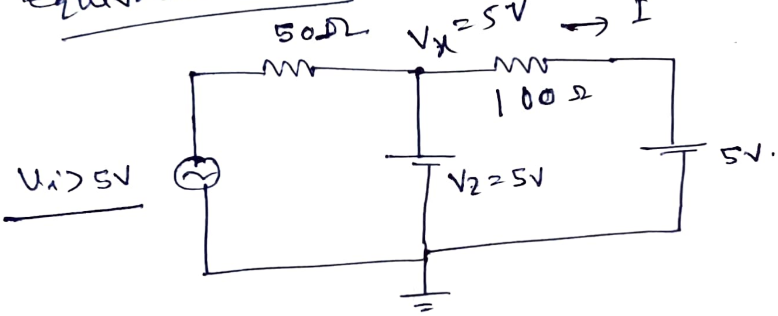



if, $V_i < 5V$, then both diodes are OFF, $I = 0$, $V_x = 5V$.

When, $V_i > 5V$, then diode D is ON.

and Zener diode is in breakdown.

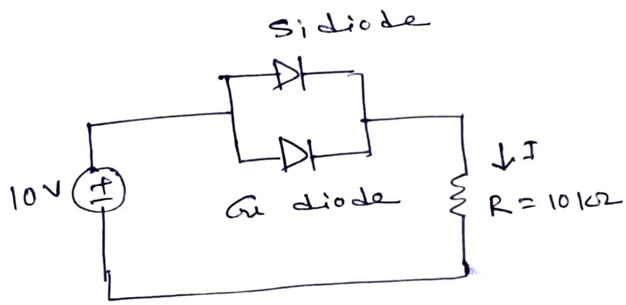
equivalent ckt




again here,

$I = 0$

(6)



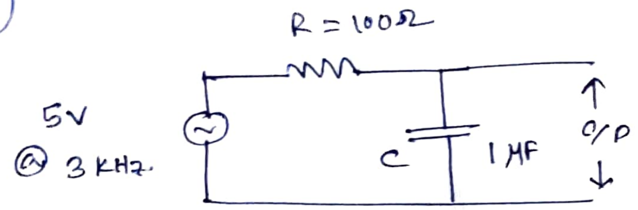

$V_{\gamma_{Si}} = 0.7V$, $V_{\gamma - Ge} = 0.3V$.

So, both diods are in forward bias.

but as, $V_{\gamma - Ge} = 0.3V$. ~~eqv ckt~~, Ge diode will be conducting most of current.

$$I = \frac{(10 - 0.3)V}{10\ k\Omega} = 0.97\ mA.$$

(7)




$$\text{Cut-off freq} = \frac{1}{2\pi RC} = \frac{1}{2\pi \times 100 \times 1 \times 10^{-6}} = 1.592 \times 10^{3}\ \text{Hz}$$

$$= 1.592\ \text{KHz.} \quad \text{Ans}$$

$$V_{out} \text{ at } 3\text{KHz} = \frac{|X_c|}{\sqrt{R^2 + X_c^2}} \times V_{in}$$

$$X_c = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 3 \times 10^{3} \times 1 \times 10^{-6}}$$

$$X_c = 53.07\ \Omega.$$

$$V_{out\ 3\text{KHz}} = \frac{53.07}{\sqrt{100^2 + 53.07^2}} = 0.46\ \text{V}. \quad \text{Ans}$$