So each R-C stage will provide 60°. phase shift.

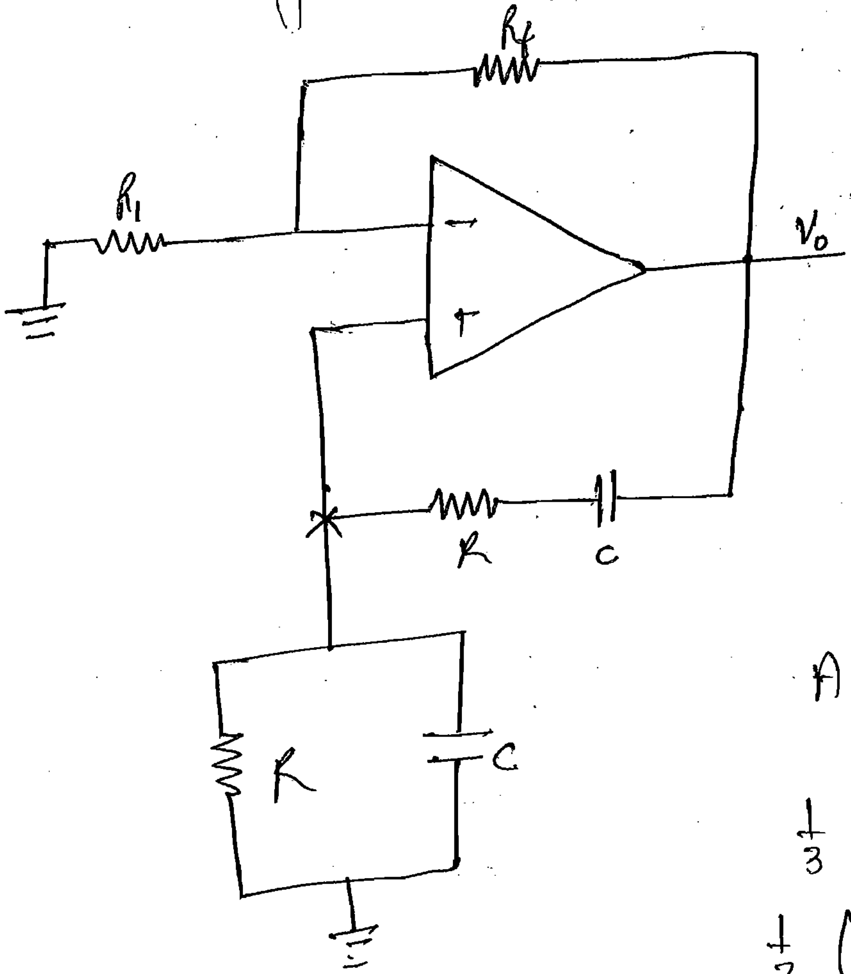
Expression for R-C phase shift:-

$$\boxed{f_0 = \frac{1}{2\pi RC\sqrt{6 + 4\frac{R_c}{R}}}}$$

when we can not use transistor then $R_c = 0$

$$\boxed{f_0 = \frac{1}{2\pi RC\sqrt{6}}}$$

* Wein's Bridge Oscillator:-



$A = 1 + \frac{R_f}{R_1}$

$\frac{1}{3} A \geq 1$

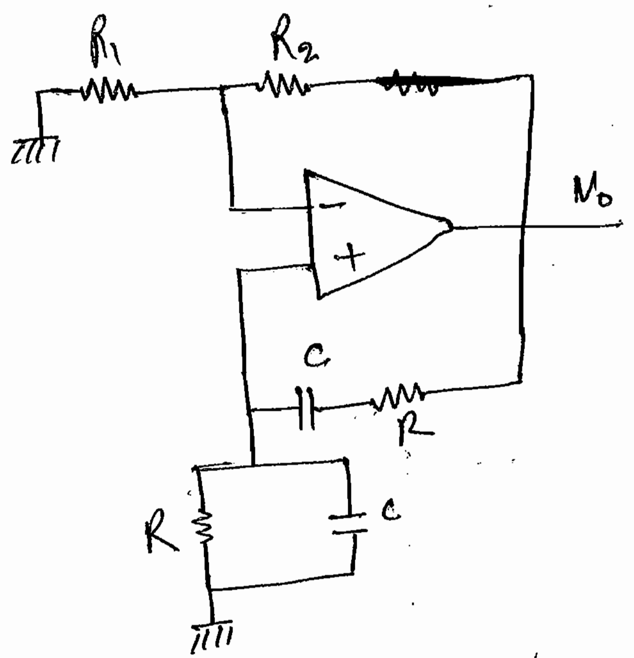
$\frac{1}{3}\left(1 + \frac{R_f}{R_1}\right) \geq 1$

$$\omega = \frac{1}{RC} \quad , \quad f = \frac{1}{2\pi RC}$$

So $$\boxed{f_0 = \frac{1}{2\pi RC}}$$

B.A.
Q. 59

Sol^n



$C = 0.01 \mu f$

$R_1 = 12 k\Omega$

$f_0 = 300 Hz$

$$\because \quad f_0 = \frac{1}{2\pi RC}$$

$$R = \frac{1}{2\pi f_0 C} = \frac{1}{2\pi \times 3000 \times 0.01 \mu F}$$

$$= \frac{10^8}{\cancel{300} \times 2\pi} = \frac{10^6}{6\pi}$$

$$= \cancel{530 k\Omega}. \quad 53 \times 10^3 \Omega$$

$$\boxed{R = 53 K\Omega}$$

$\frac{1}{3} A \geq 1$

$\frac{1}{3}\left(1+\frac{R_2}{R_1}\right) = 1$ (Worst Case)

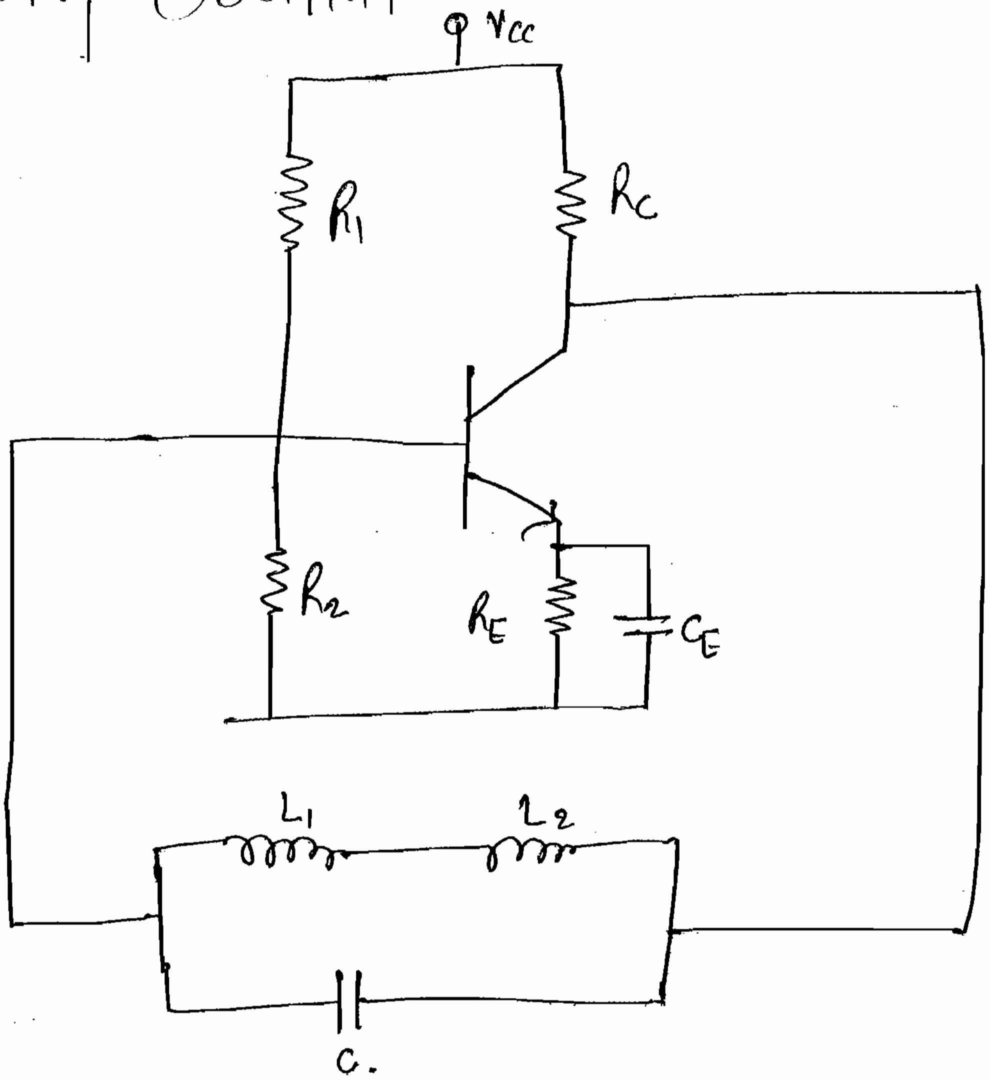
$1+\frac{R_2}{R_1} = 3$

$\frac{R_2}{R_1} = 2$

$\frac{R_2}{12} = 2$

$\boxed{R_2 = 24}$ Ans

* Heartly Oscillator :-



The output of C.E. Configuration provides a phase shift of 180° additional ~~phase shift~~ ~~it~~ tank circuit is used so that it can provide a phase shift of 180°. To provide sustained oscillation.

$$X_L = X_C$$

$$\omega L = \frac{1}{\omega C}$$

$$\omega^2 = \frac{1}{L \cdot C}$$

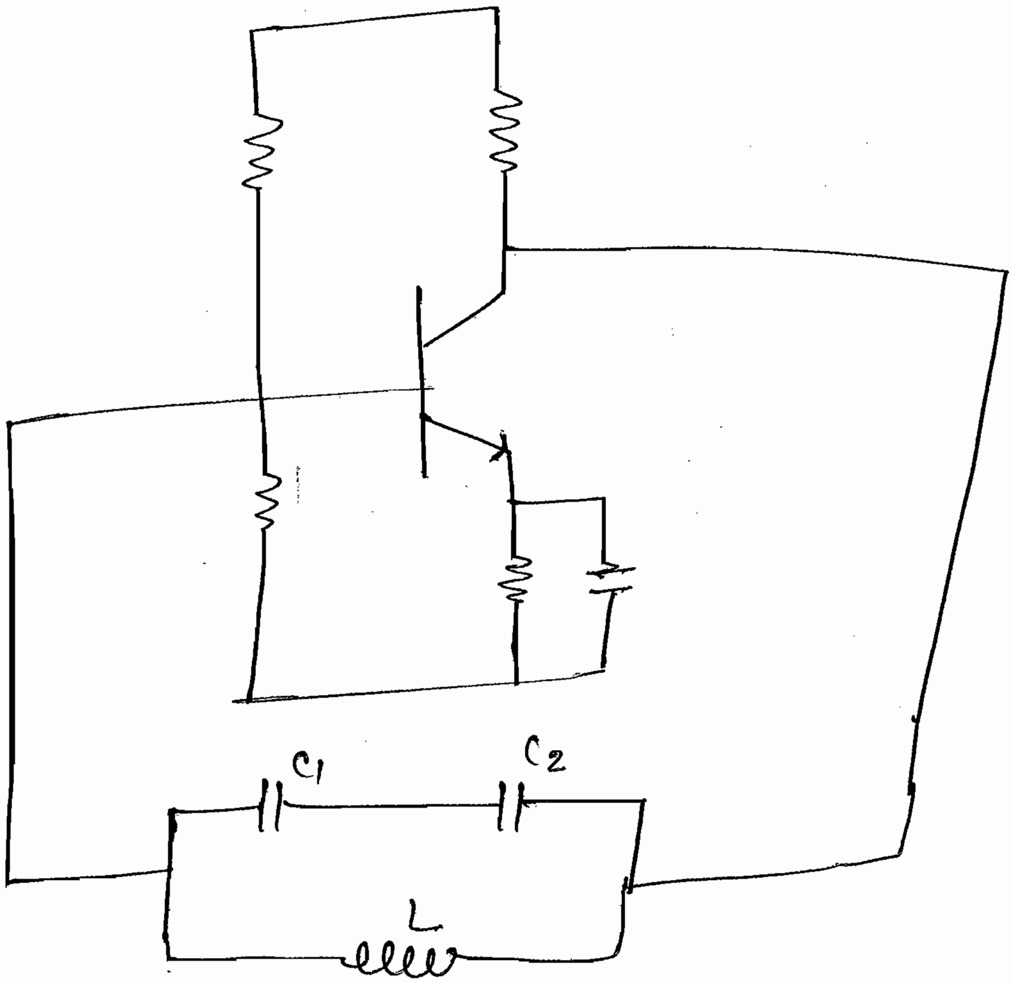
$$\omega = \frac{1}{\sqrt{LC}}$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$f_0 = \frac{1}{2\pi\sqrt{L_{eq.} C_{eq.}}}$$

$$\boxed{f_0 = \frac{1}{2\pi\sqrt{(L_1+L_2)C}}}$$

Collpits Oscillator :-



$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$$

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{L_{eq}}\cdot\frac{1}{C}}$$

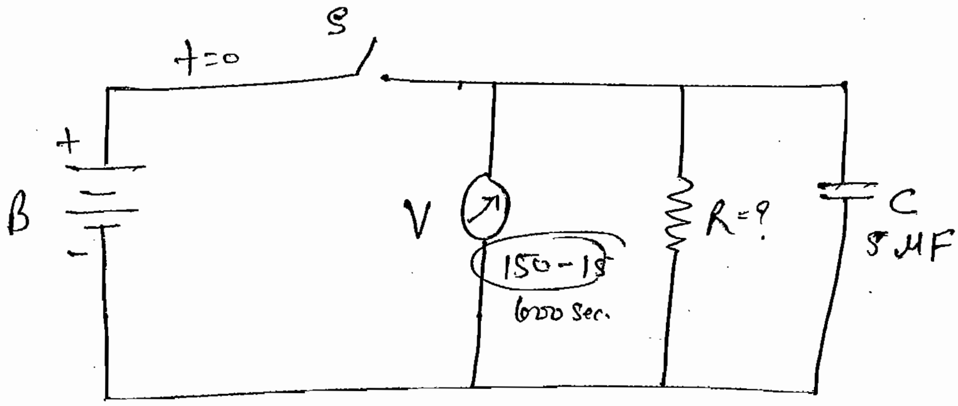
$$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{L_{eq}}\cdot\frac{1}{C_{eq}}}$$

$$\boxed{f_0 = \frac{1}{2\pi}\sqrt{\left(\frac{1}{C_1}+\frac{1}{C_2}\right)\frac{1}{L}}}$$

RC phase Shift	$f_0 = \frac{1}{2\pi RC\sqrt{6+4\frac{R_c}{R}}}$
Hein's Bridge	$f_0 = \frac{1}{2\pi RC}$
Heartly	$f_0 = \frac{1}{2\pi\sqrt{(L_1+L_2)C}}$
Collpits	$f_0 = \frac{1}{2\pi\sqrt{\left(\frac{1}{C_1}+\frac{1}{C_2}\right)\frac{1}{L}}}$

Net-2013
B.A. Q. 85

Sol^n



$$\omega = \frac{1}{RC}$$

$$T = \frac{1}{\omega} = RC \quad \left\{ \text{time} \propto \frac{1}{\text{cut-off freq.}} \right\}$$

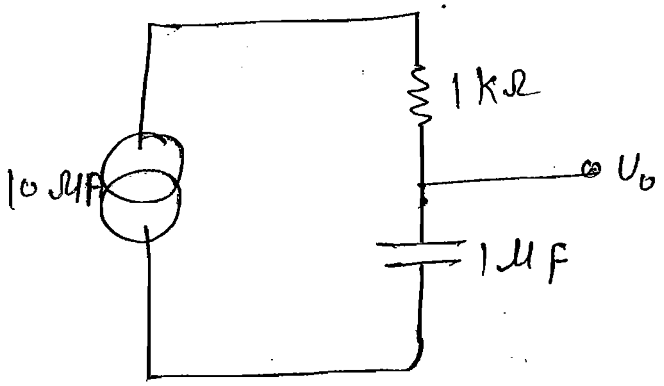
$$\boxed{T = RC}$$

$$R = \frac{1000}{5\mu F} = 2\times10^{8} \approx 10^{8}\ \Omega$$

B-F1

Q. 77

Sol^n



$$T = RC$$
$$= 1\,k\Omega \times 1\,\mu F = 1 \times 10^{-3} = 1 \text{ milisecon.}$$

A

B.A.

Q. 85

Second Method

$V = 15$

$T = 1000$

$C = 5\,\mu F$

$R = ?$

$Q = CV$

$Q = 5\,\mu F \times 15$

$= 75\,\mu C$

$Q = it$

$i = \frac{Q}{t} = \frac{75\,\mu C}{1000}$

$I = 75\,m.A.$

$R = \frac{15}{75} \times 10^9 = 2 \times 10^8.$

Ans

* Consenses Theorem :-

$$Y = AB + BC + \bar{A}C$$

$$Y = AB + BC(A+\bar{A}) + \bar{A}C$$

$$= AB + ABC + \bar{A}BC + \bar{A}C$$

$$= AB[1+C] + \bar{A}C[B+1]$$

$$\boxed{Y = AB + \bar{A}C}$$

Steps:-

1. Total no. of variable is use = 3
2. Every variable must be repeated twice.
3. Select to the term which one is the compliment of other which is ans.

Q. Find the minimise expression $y = AB + \bar{B}C + AC$

Soln

$$\boxed{y = AB + \bar{B}C}$$

Q. $y = AB + B\bar{C} + AC$

Soln

$$\boxed{y = B\bar{C} + AC}$$

Q. $y = \bar{A}\bar{B} + \bar{B}\bar{C} + A\bar{C}$

Soln $y = \bar{A}\bar{B} + A\bar{C}$ An

Q. $Y = A\bar{B} + \bar{A}\bar{C} + \bar{B}\bar{C}$

Sol^n $\boxed{Y = A\bar{B} + \bar{A}\bar{C}}$

Q. $Y = (A+B)(B+C)(\bar{A}+C)$

Sol^n $\boxed{Y = (A+B)(\bar{A}+C)}$

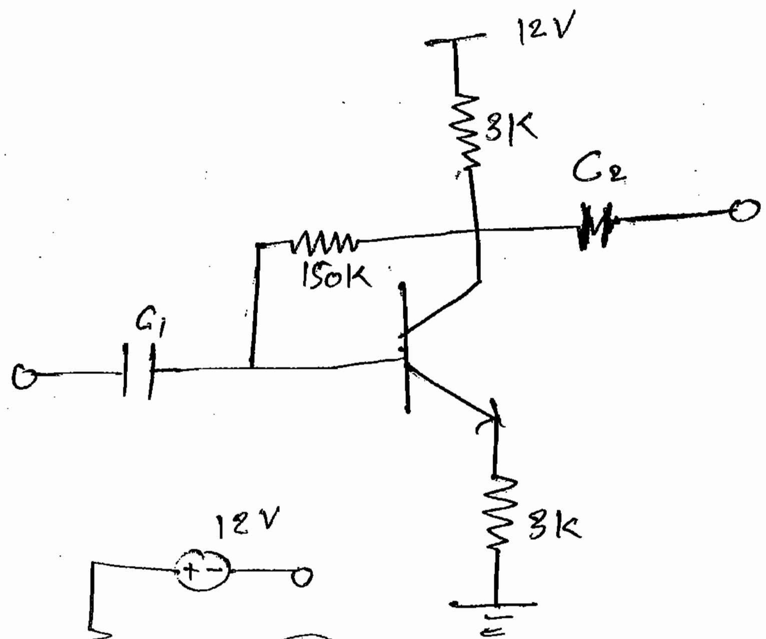
Q. $Y = (\bar{x}+\bar{y})(\bar{y}+\bar{z})(x+\bar{z})$

Sol^n $\boxed{Y = (\bar{x}+\bar{y})(x+\bar{z})}$ Ans

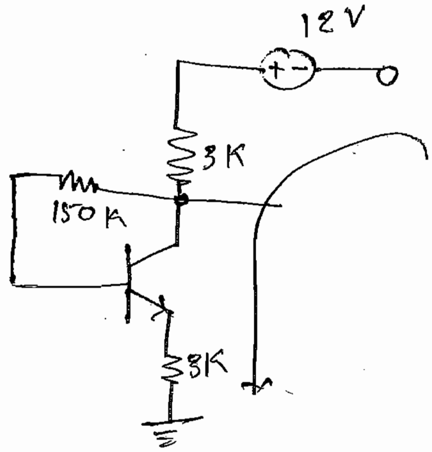
D.U.

Q. The current gain in the transistor $\beta = 100$ the value of collector current I_c is ?

(a)



Sol^n



$$-12 + (I_e + I_B)3K + I_B \times 150K + V_{BE} + I_E \times 3K = 0$$

$$(I_e + I_B)\,3K + I_B\,150K + (I_B + I_c)3K = 11.3$$

$$I_c\,3K + I_B\,3K + I_B\,150K + I_B\,3K + I_c\,3K = 11.3$$

$$I_c\,6K + I_B\,156K = 11.3$$

$$\beta I_B\,6K + I_B\,156K = 11.3$$

$$100 \times 6K I_B + 156K\,I_B = 11.3$$

$$756\,I_B = 11.3$$

$$I_B = \frac{11.3}{756} = 0.014\ m.A.$$

$$I_C = \beta I_B$$

$$= 100 \times 0.014\ m.A.$$

$$= 1.4\ m.A.\ \text{Ans}$$

Q. In order to measure a maximum of 1 V with a resolution of 1 milivolt using n-bit analog to digital converter determine n-bit ?

Sol^n

resolution = 1 m.V

$$V_r = 1V$$

$$\text{reso} = \frac{V_r}{2^n - 1}$$

$$\Rightarrow 1\,m.V. = \frac{1}{2^n - 1}$$

$$2^n - 1 = \frac{1}{1\,m.V.}$$

$$2^n - 1 = 1000$$

$$2^n = 1001$$

$$2^n \approx 2^{10}$$

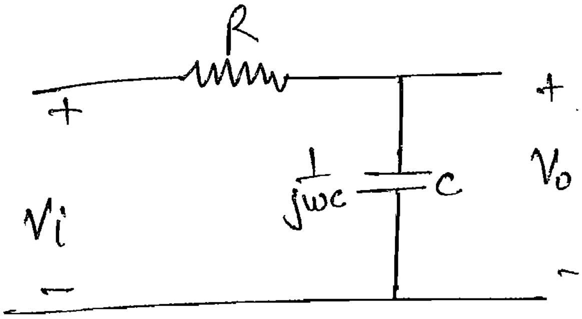
$$\boxed{n = 10}$$

Q. A low pass-filter formed by simble R-C circuit at the cut-off angular frequency. the voltage gain and the phase of output voltage relative to input voltage respectivily are -

(a) $0.71 \angle +45^\circ$ (b) $0.71, -45^\circ$ (c) $0.5 \angle -90$

(d) $0.5 \angle +90^\circ$

Sol



low - pass filter

$$V_o = \frac{V_i \times \frac{1}{j\omega C}}{R + \frac{1}{j\omega C}}$$

$$\frac{V_o}{V_i} = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{1}{1 + j\omega RC}$$

$$\left|\frac{V_o}{V_i}\right| = \frac{1}{\sqrt{1 + \omega^2 R^2 C^2}} = \frac{1}{\sqrt{1 + (\omega RC)^2}}$$

$$= \frac{1}{\sqrt{1 + \left(\frac{\omega}{\frac{1}{RC}}\right)^2}} = \frac{1}{\sqrt{1 + \left(\frac{\omega}{\omega_c}\right)^2}}$$

$$\omega = \omega_c$$

$$\left|\frac{V_o}{V_i}\right| = \frac{1}{\sqrt{1+1}} = \frac{1}{\sqrt{2}} = 0.707$$

$$\frac{V_o}{V_i} = \frac{1}{1+j\omega RC}$$

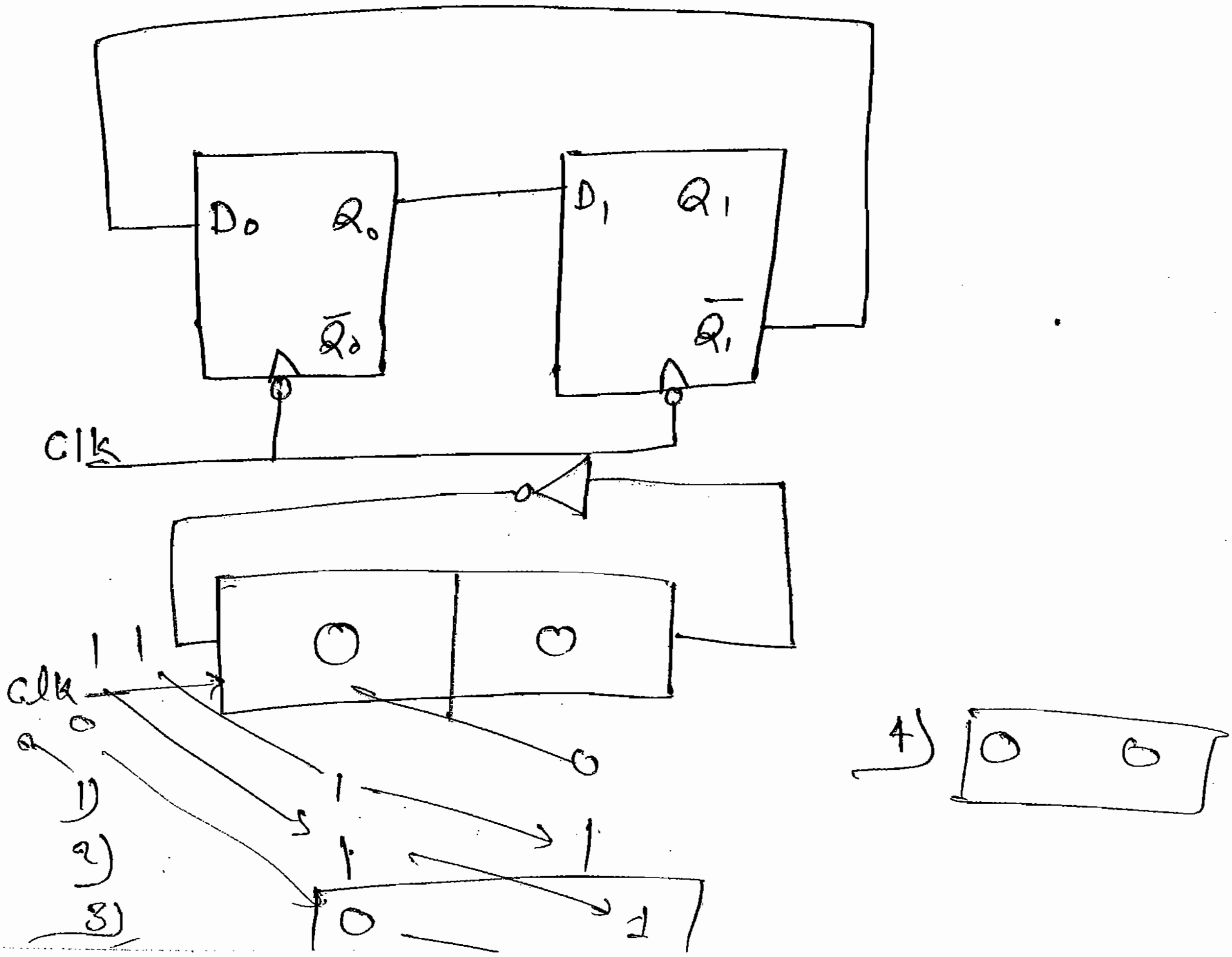
$$\angle\frac{V_o}{V_i} = -\tan^{-1}(\omega RC) = -\tan^{-1}\left(\frac{\omega}{\frac{1}{RC}}\right)$$

$$= -\tan^{-1}\left(\frac{\omega}{\omega_c}\right) = -\tan^{-1}\left(\frac{\omega}{\omega}\right)$$

$$= -\tan^{-1}(1) = -\tan^{-1}(\tan 45^\circ)$$

$$= -45^\circ$$ Ans

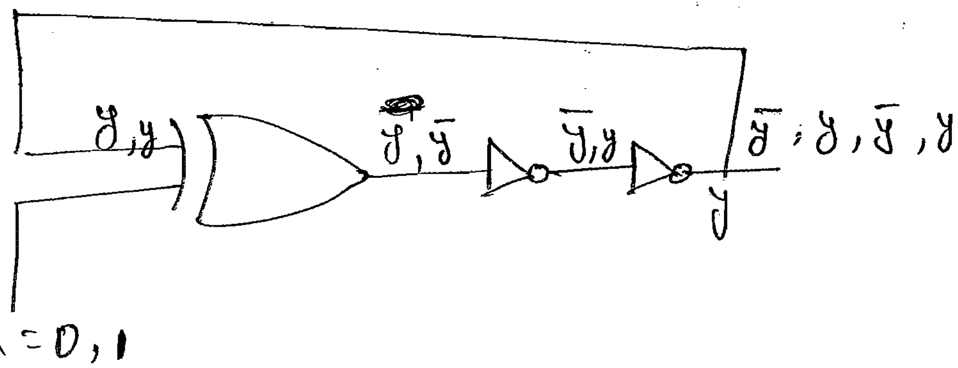
Digital
B.A.
(1)



~~335 / 4~~

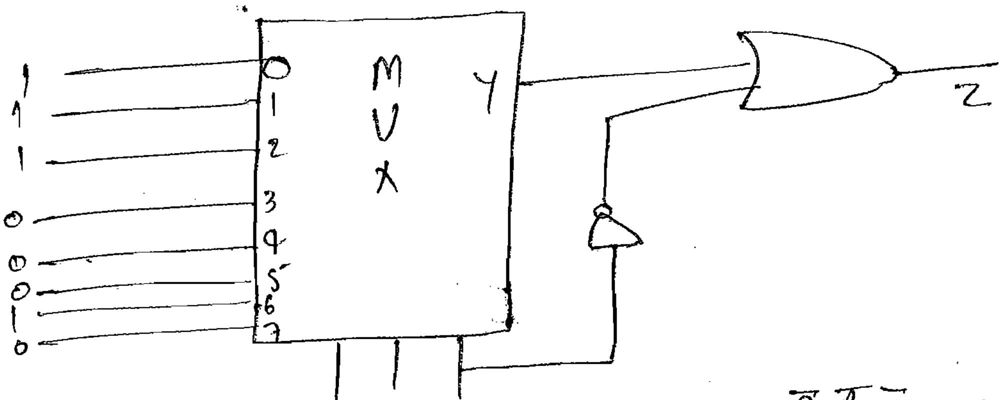
$$4\,\overline{)\,335}$$
32
15
12
3

(2)



So $\boxed{X = 1}$

(3)



A	B	C
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

$\bar{A}\bar{B}\bar{C}.1 + \bar{A}\bar{B}C.1 + \bar{A}B\bar{C}$

$+ AB\bar{C}.1 = Z$

$Z = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C}$

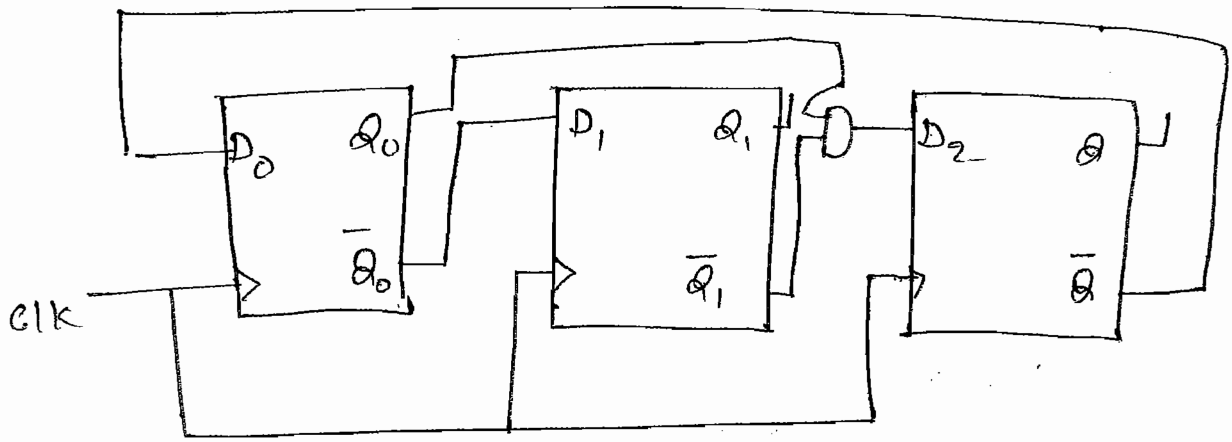
$+ AB\bar{C} + \bar{C}$

$= \bar{A}\bar{B} + \bar{A}B\bar{C} + AB\bar{C} +$

$= \bar{A}\bar{B} + \bar{C}[1 + AB + \bar{A}B$

$$\boxed{Z = \bar{A}\bar{B} + \bar{C}}$$

(4)



$D_1 = \bar{Q_0}$

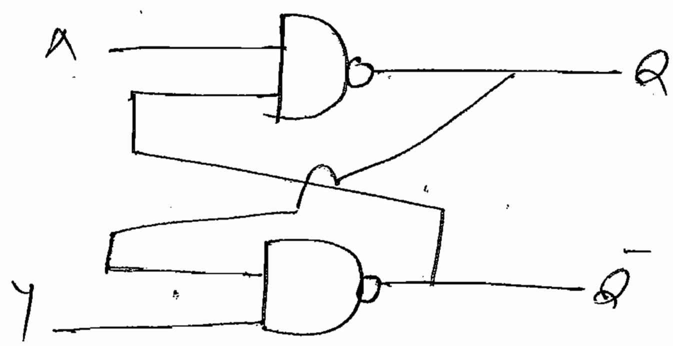
$D_0 = \bar{Q_2}$

$D_2 = \bar{Q_0}\,\bar{Q_1}$

	D_0	D_1	D_2	Q_0	Q_1	Q_2
x	1	1	0	0	0	0
1)	1	0	0	1	1	0
2)	1	0	1	1	0	0
3)	0	0	1	1	0	1
4)	0	1	0	0	0	1
5)	1	1	0	0	1	0
				1	1	0

mod - 5

(5)



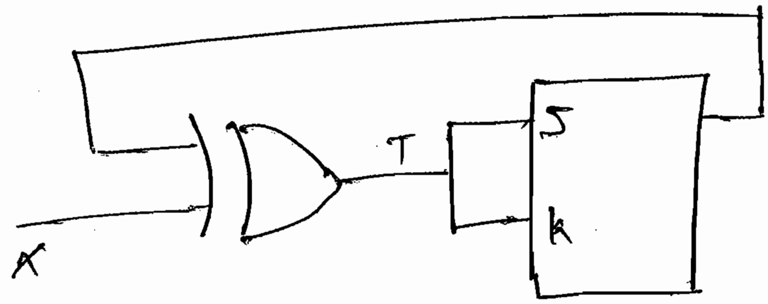
X = 0, Y = 0 invalid (a)

(6)

C \ AB	00	01	11	10
1	1	1	X	0
0	0	0	X	0

$\boxed{Y = C\bar{A}}$

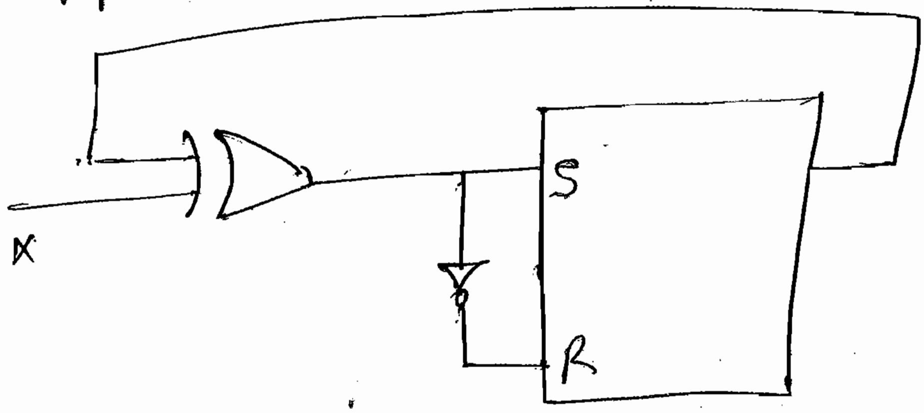
<u>Q</u>: Identify the flip-flop.



$T = x \oplus Q$

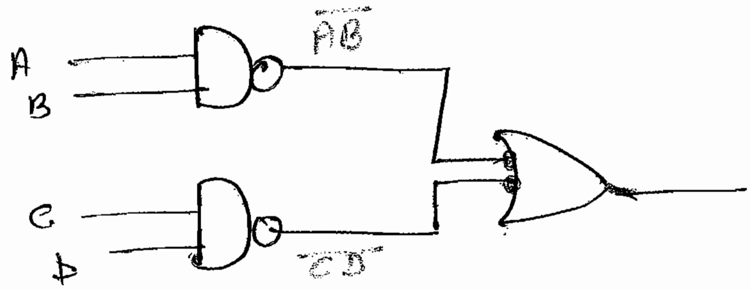
So $\boxed{x = D}$

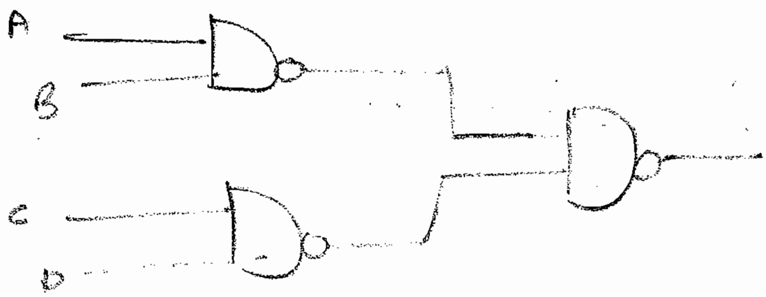
Q. Identify



T- flip-flop.

Q. 9





So min^n no. of nand gate required = 3.

~~* fil~~

* Flip - Flop Conversion :-

Steps -

1. Identify the flip-flop which is required.
2. Draw the characteristic table.
3. Develop the exitation table for the given ~~required~~ flip-flop. Minimise by K-map.
4. Impliment by logic gates.

① Convert JK to T- flip-flop :-

T	Q_n	Q_{n+1}	J K
0	0	0	0 X
0	1	1	X 0
1	0	1	1 X
1	1	0	X 1

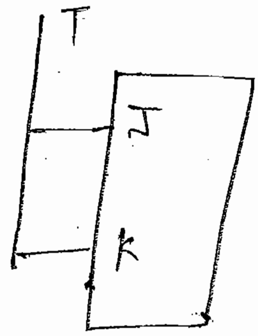
Q_n	Q_{n+1}	S R	J K
0	0	0 X	0 X
0	1	1 0	1 X
1	0	0 1	X 1
1	1	X 0	X 0

T \ Q_n	0	1
0	0	X
1	1	X

$$\boxed{J = T}$$

T \ Q_n	0	1
0	X	0
1	X	1

$$\boxed{K = T}$$



T - flip - flop

* Convert JK to D flip-flop :-

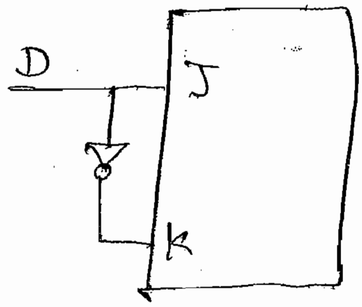
D	Q_n	Q_{n+1}	J K
0	0	0	0 X
0	1	0	X 1
1	0	1	1 X
1	1	1	X 0

D \ Q_n	0	1
0	0	X
1	1	X

$\boxed{J = D}$

D \ Q_n	0	1
0	X	1
1	X	0

$\boxed{K = \bar{D}}$



* Convert D to T flip-flop :

T	Q_n	Q_{n+1}	D $(= Q_{n+1})$
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

$T \backslash Q_n$	0	1
0	0	1
1	1	0

$$D = \bar{T} Q_n + T \bar{Q}_n$$

$$\boxed{D = T \oplus Q_n}$$

So $\boxed{T = D \oplus Q_n}$

* Point To be remember :-

$JK \longrightarrow T$

$J = T$
$K = T$

$JK \longrightarrow D$

$J = D$
$K = \overline{D}$

$SR \longrightarrow D$

$S = D$
$R = \overline{D}$

$D \longrightarrow T$

$D = T \oplus Q_n$

$T \longrightarrow D$

$T = D \oplus Q_n$

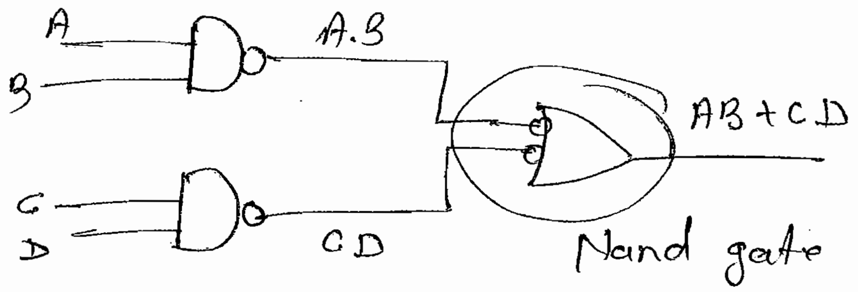
* Steps for identificantion

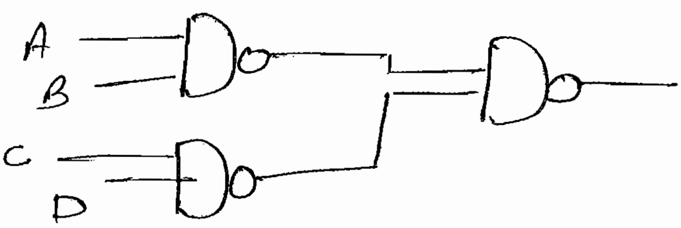
(I) Draw the circuit diagram by using ordinary gate

(II) Substitude bubble infront of AND Gate and input of OR Gate so that bubble is balanced.

(III) Replace every gate by Nand gate. it gives minm no. of nand gate.

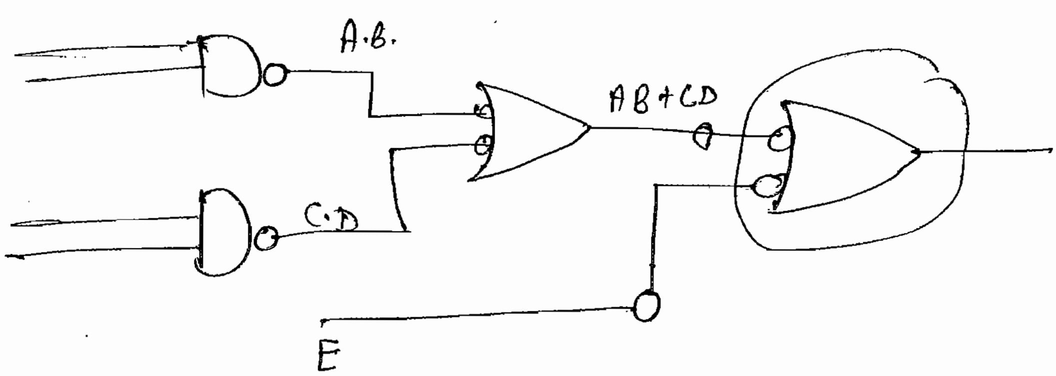
Ex -

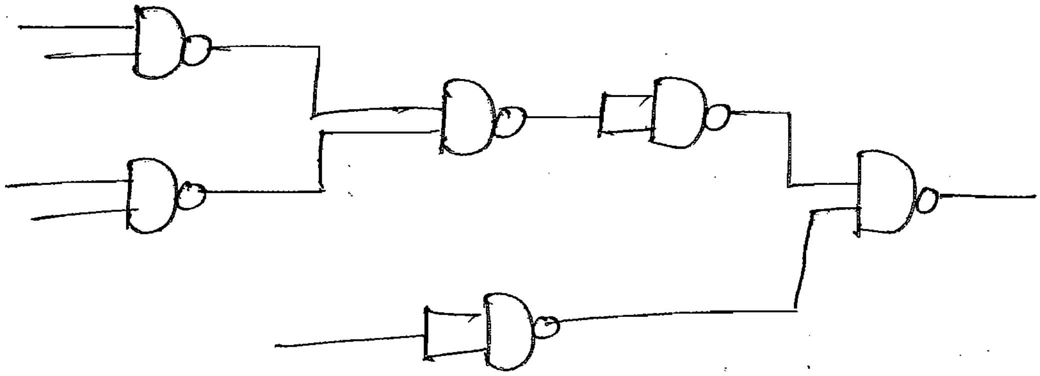




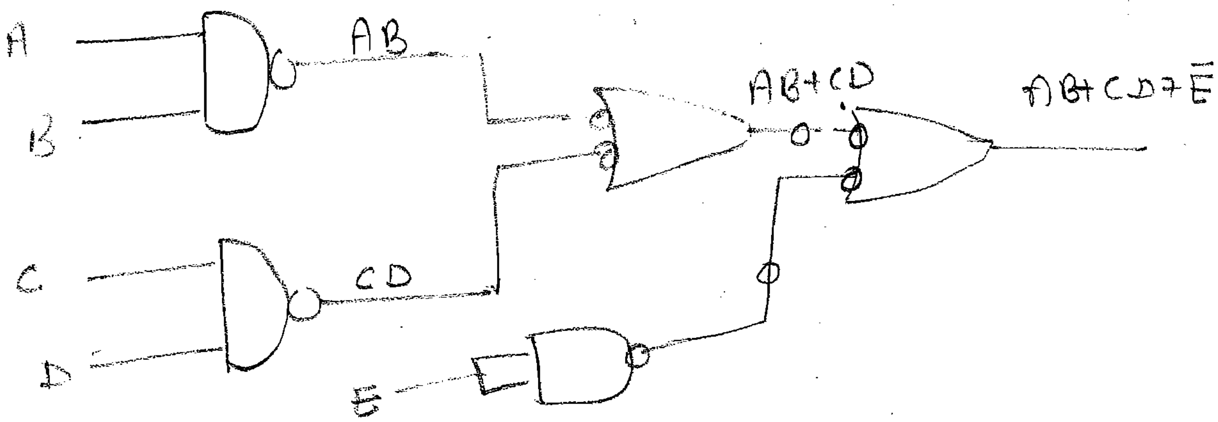
= (3)

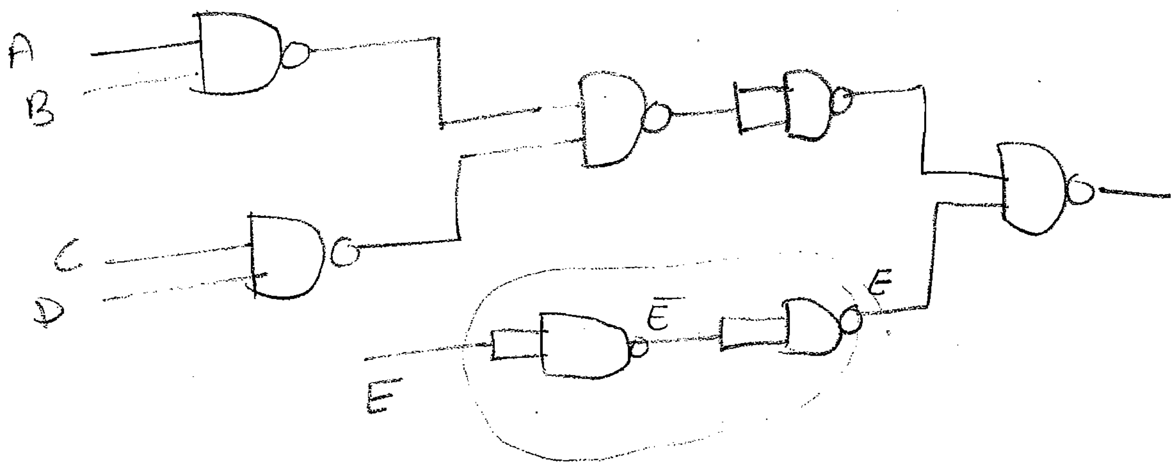
Q. $y = AB + CD + E$

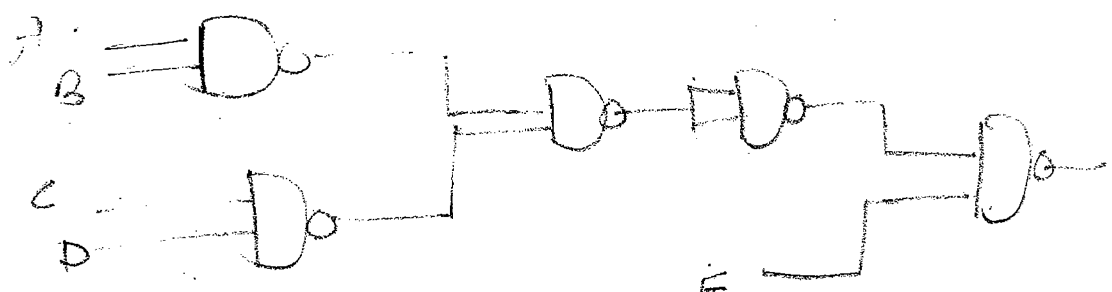




Q. $Y = AB + CD + \bar{E}$







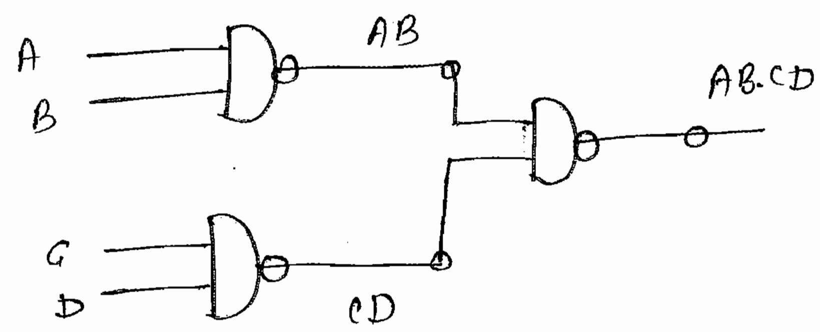
* Steps for identification minimum no. of Nor gate. ⇒

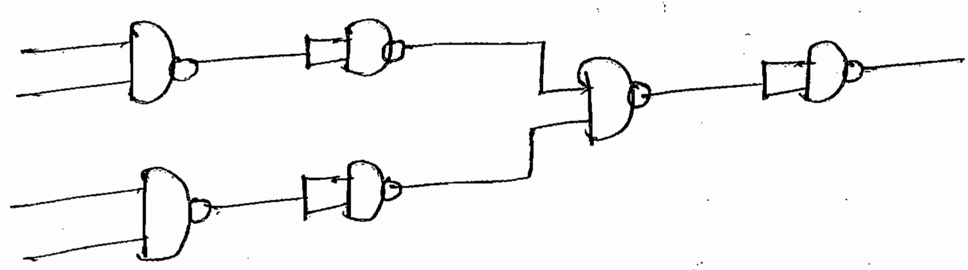
(I) Draw the circuit diagram by using ordinary gates.

(II) Substitude bubble at the infront of OR-ga[te] and at the input of AND-gate.

(III) Replace every gate by NOR-gate it will give minimum no. of nor gate.

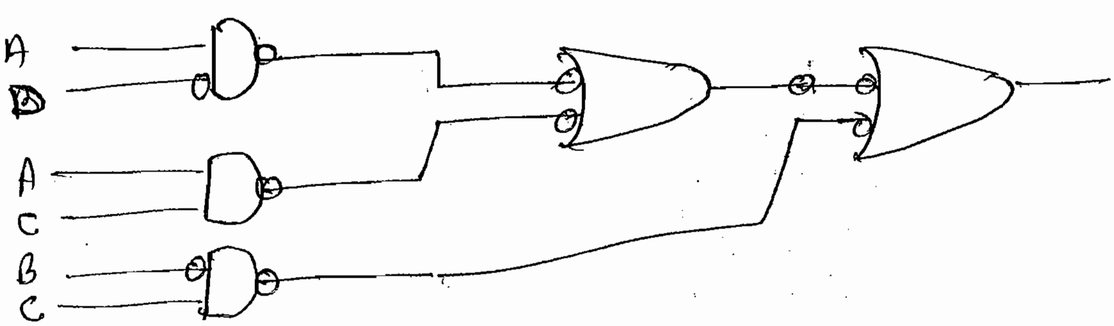
Q.I





= 6 Ans

Q. II



12

F F F F

1111 1111 1111 1111

-ve

0000 0000 0000 0000 1's

+1 2's

1

13

6 0000

36 → 5 0001 → Ans

35 4 0010

33 3 0011

34 2 0100

33 1 0101

32 16 → 0 0110

15 0111

14 1000

13 1001

12 1010

11 1011

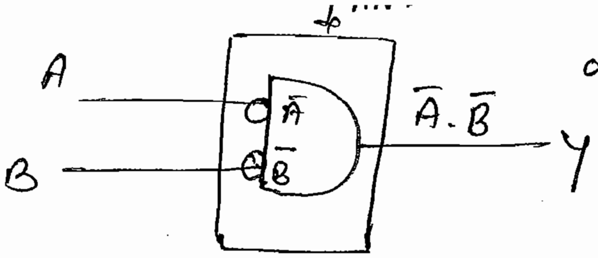
10 1100

9 1101

8 1110

7 1111

(14)



duality -

$\bar{A} + \bar{B}$

↑

OR

- ve logic

for +ve logic

$$\boxed{Y = \bar{A} + \bar{B}} \leftarrow \text{OR - } \underline{\text{Gate}}$$

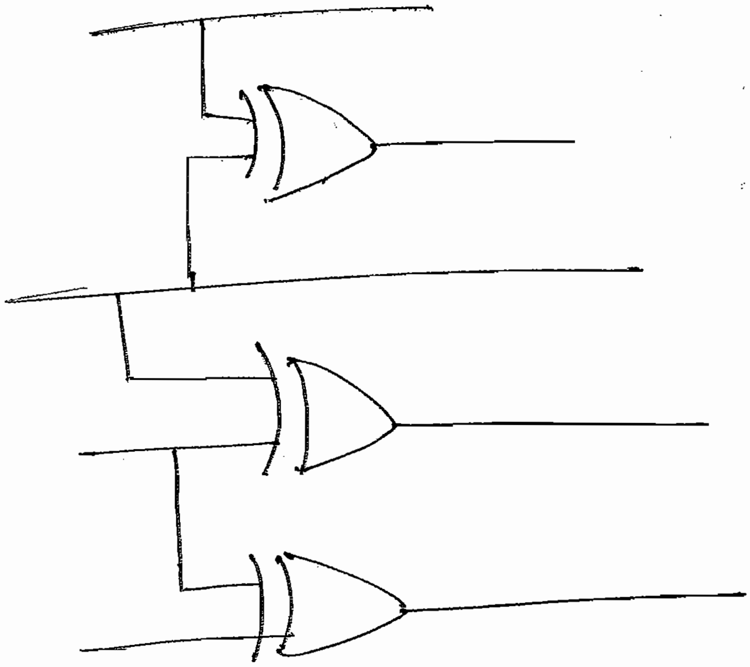
(15)

$$f(A,B,C,D,E) = C + \bar{D}E$$

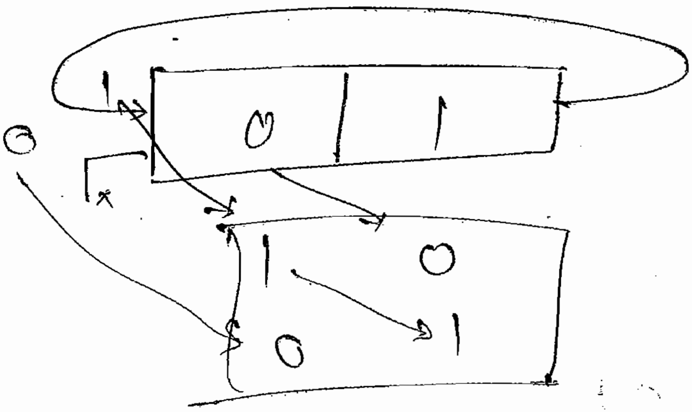
	A	B	B	D	D
1	0	0	0	0	0
		0	0	0	1
		0	0	1	0
		0	0	1	1
		0	1	0	0
		0	1	0	ϕ
		0	1	ϕ	D
		0	1	1	1
		1	0	0	0
		1	0	0	1
		1	0	1	0
		1	0	1	1
		1	1	0	0
		1	1	0	1
		1	1	1	0
ϕ	0	1	1	1	1

= (4).

(18)



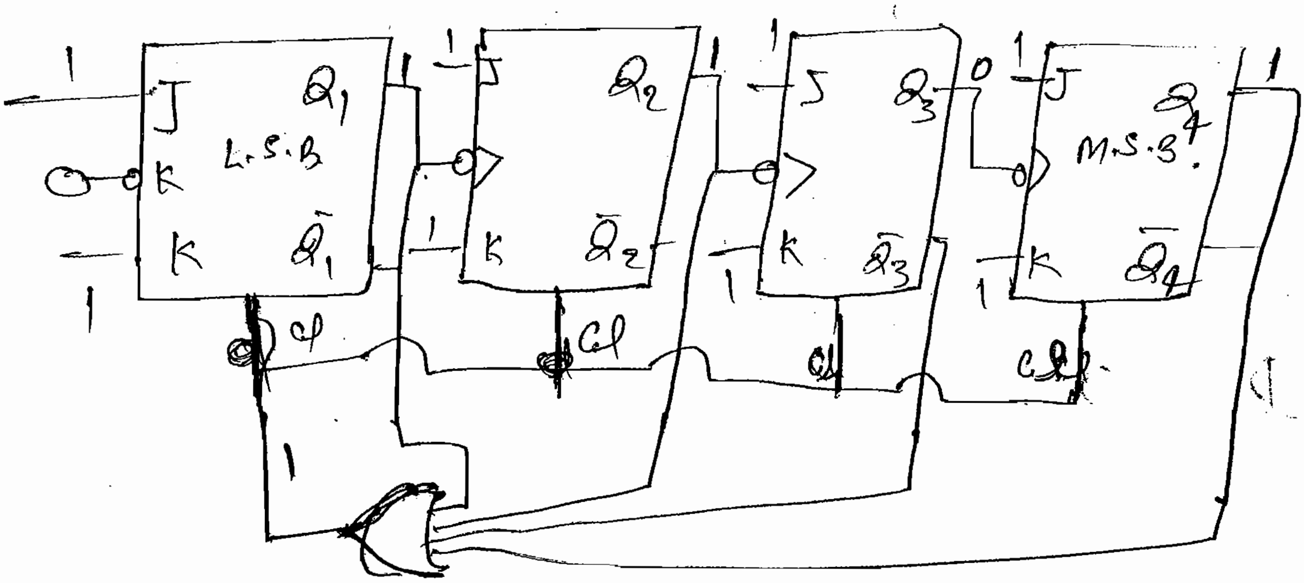
(23)



mod 2 Counter

(22)

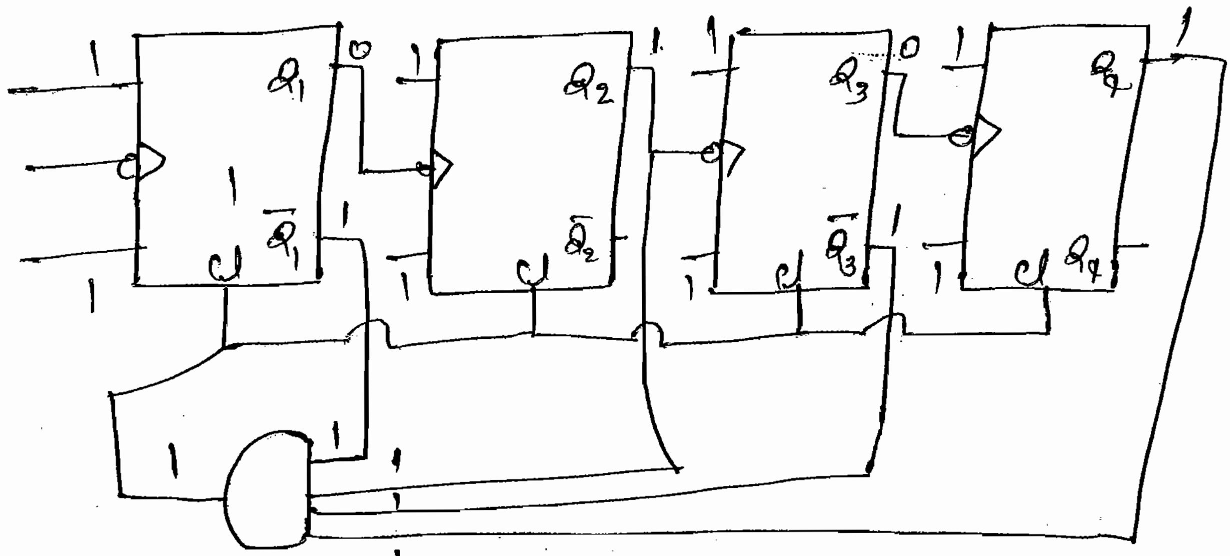
$4 = 2^4 = 16$



Q_4	Q_3	Q_2	Q_1
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1
1	0	1	0
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	0
1	1	1	1

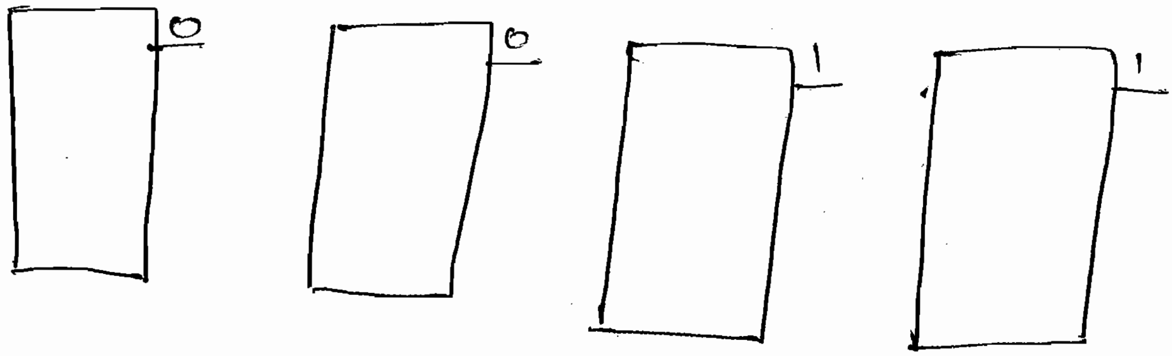
X

Q For the given circuit diagram Identify the ~~gate~~ mod.

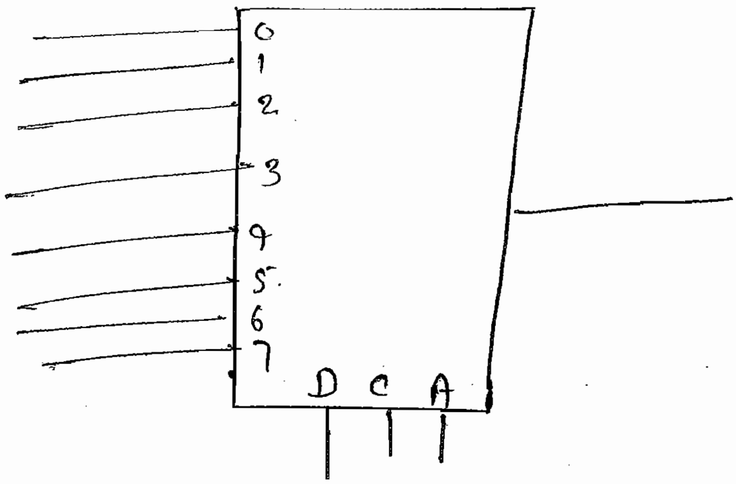


mod 10 –

Q. Draw the circuit diagram for mod - 12 up Counter by using all zero inputs.



Q.16



D	C	A
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

A	B	C	D	
0	0	0	0	
0	0	0	1	— 0
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	— 0
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	→ 1
1	0	1	1	→ 1
1	1	0	0	
1	1	0	1	→ 1
1	1	1	0	→ 1
1	1	1	1	→ 1

$$f(A, B, C, D) = AC + ABD + ACD$$

11   111   111

11   111   111

	I_0	I_1	I_2	I_3	I_4	I_5
$\bar{B}$				1	0	0
B				1	0	1
				1	0	B

Ans

(26)

F A

1111 1010

0000 0101 1's

+1 2s

0000 0110

= +6 Ans

(30)

1011 0110

100 1's No compliment

+1 2's

101 6

−5

$6 + (-5) = +1$

So (a) 0001

27

$(7E)_H$ & $(5F)_H$

$$
\begin{array}{r}
0111\ \ 1110 \\
+\ 0101\ \ 1111 \\
\hline
\underbrace{0010}_{2}\ \ \underbrace{0001}_{1}
\end{array}
$$

EXOR

0001 0000

0000 0000

0 0 0 0 0 0 0 0 X

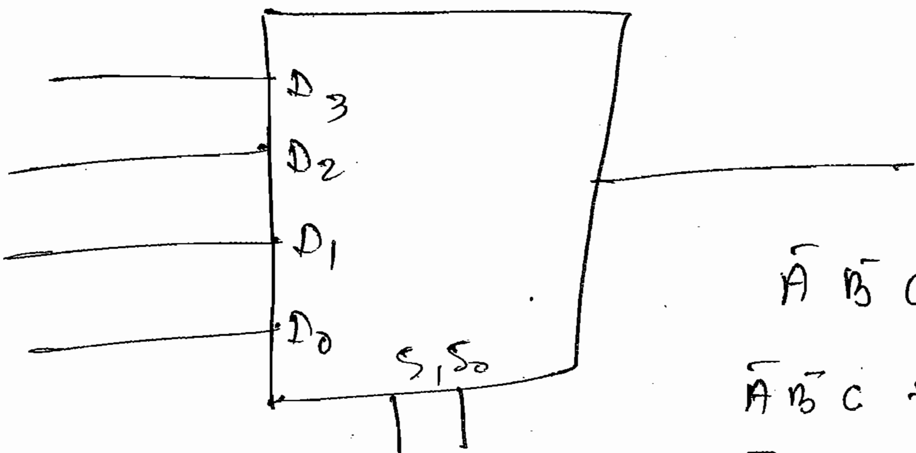
0 0 0 0 0 0 0 0 X X

0 0 0 0 0 0 0 0 X

0 0 1 0 0 0 0 1 X

0 0 1 0000 1 0000

39



A	B
0	0
0	1
1	0
1	1

$\bar A \bar B C + \bar A B + A \bar B + AB$

$\bar A \bar B C + \bar A B + A \bar B + AB$

$\bar A [B + \bar B C] + A [\bar B + B]$

$\bar A [B + C] + A$

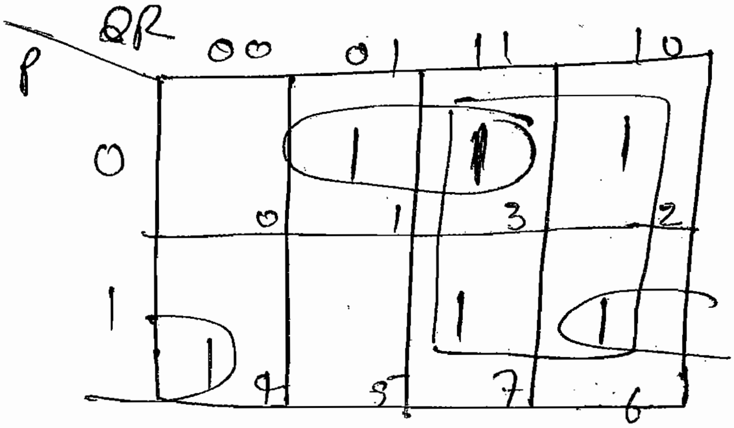
$\bar A B + \bar A C + A$

$\bar A B + \bar A C + A$

$\bar A B + A + C$

$A + B + C$

Q. 35



$$= \bar{P}R + P\bar{R} + Q$$

$$= P \oplus R + Q$$

one exor and 1 OR

(38) 15-bit (d)

(39)

10011

1100 1's

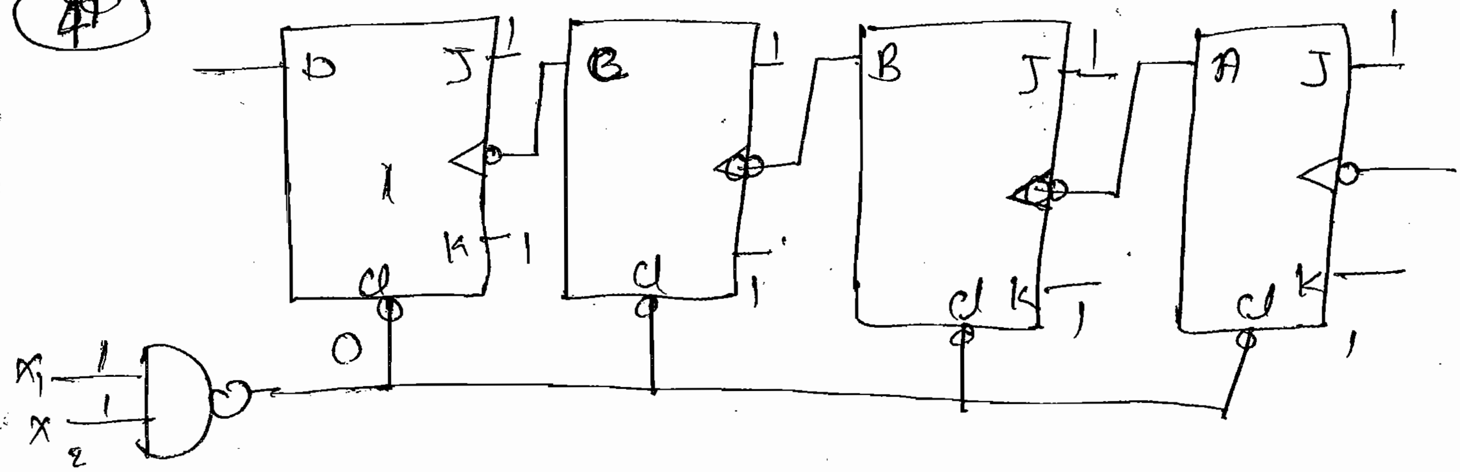
~~11~~ 01 2's

-ve

1101

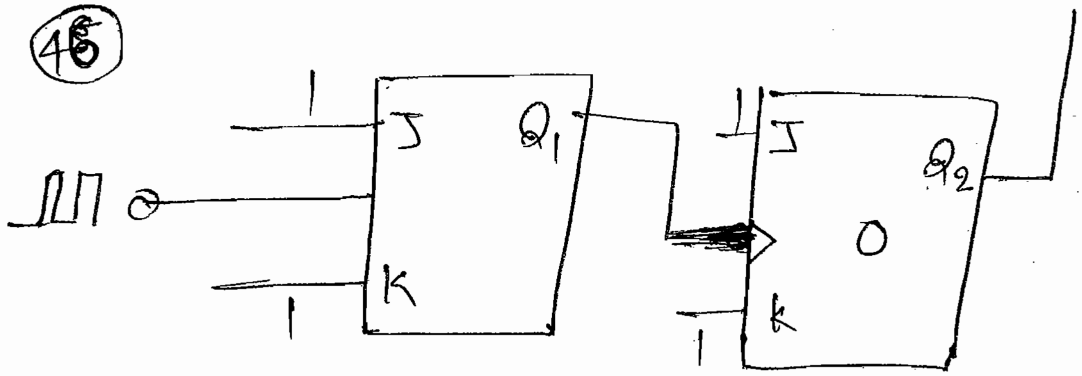
−13 Ans

(40)



D C B A
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

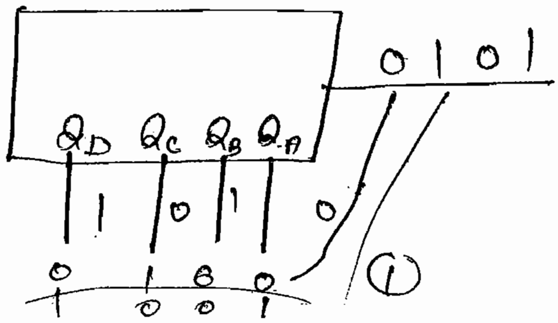
(46)



	Q_2 MSB	Q_1 LSB
1	0	0
4 ~~0~~	0	1
3	1	0
2	1	1

← Ans

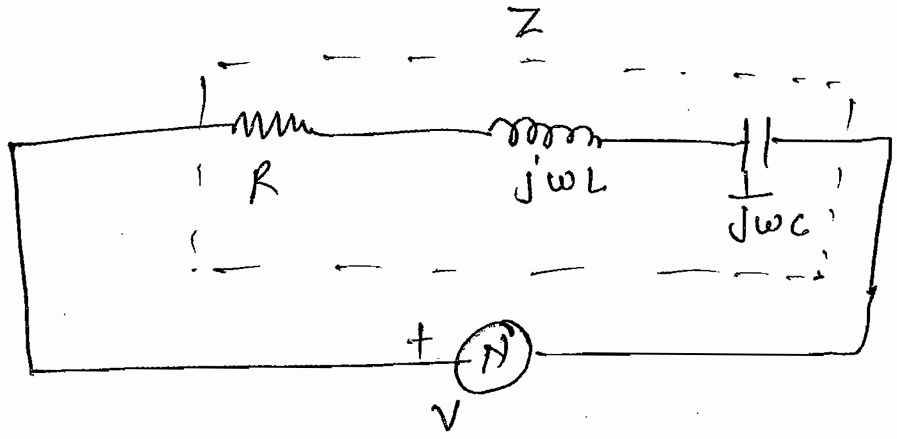
(47)



1001

* Resonance :-

Series RLC Network :-



$$Z = R + j\omega L + \frac{1}{j\omega C}$$

$$= R + j\omega L - \frac{1}{\omega C}$$

$$= R + j\left(\omega L - \frac{1}{\omega C}\right)$$

$$|Z| = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

At resonance ~~Series~~

$$\omega L = \frac{1}{\omega C}$$

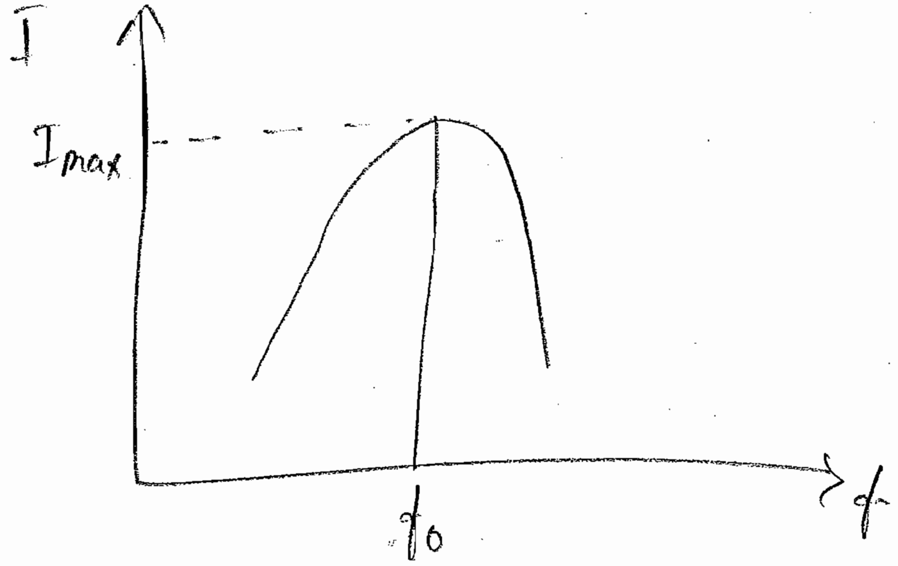
$$Z = \sqrt{R^2}$$

$$\boxed{Z_{min} = R_{min}}$$

$$I = \frac{V}{Z}$$

$$\boxed{I = \frac{V}{R_{min}}}$$ ← maximum

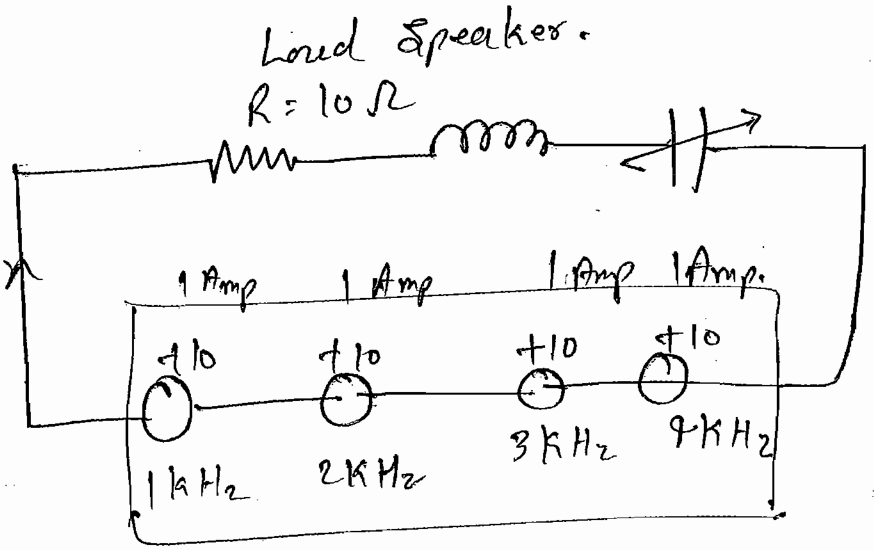
I_{max} at Resonance freq.



$$\boxed{Z = \sqrt{R^2 + \left(\omega_L - \frac{1}{\omega_C}\right)^2}}$$

<u>Use of Resonance</u> :-

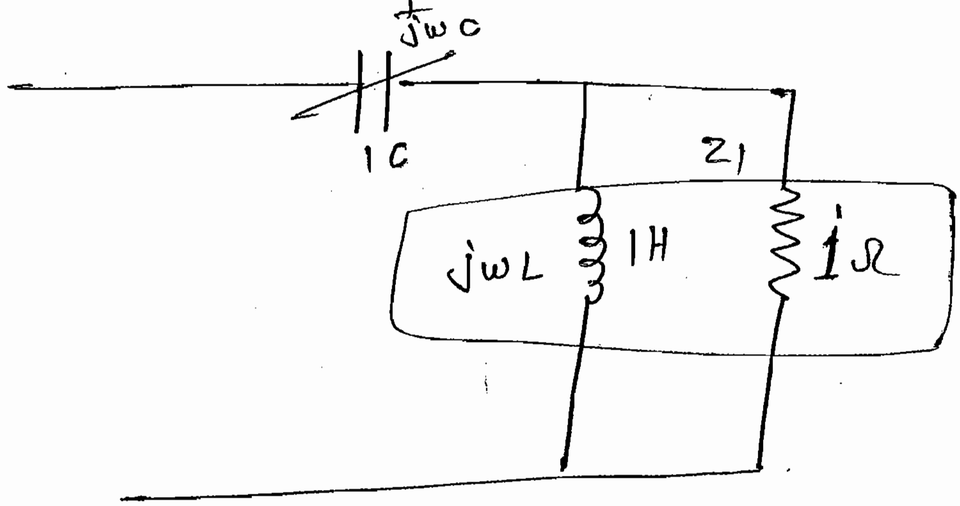
It is used to select only a single frequency by neglecting all other frequencies.



To calculate the resonance freq. of any circuit equate imaginary component of expression to zero.

Q. For the given circuit diagram determine the resonance frequency.

Sol^n



$$Z_1 = \frac{1 \times j\omega}{1+j\omega}$$

So $\quad Z = Z_1 + \frac{1}{j\omega c}$

$$= \frac{j\omega}{1+j\omega} + \frac{1}{j\omega} \qquad = \frac{(j\omega)^2 + 1 + j\omega}{j\omega(1+j\omega)}$$

$$= \frac{1 + j\omega - \omega^2}{j\omega(1+j\omega)}$$

$$= \frac{-j(1-\omega^2) + j\omega}{\omega(1+j\omega)}$$

$$= \frac{-j(1-\omega^2) + j\omega \quad (1-j\omega)}{\omega(1+j\omega)(1-j\omega)}$$

$$= \frac{-j[(1-\omega^2) + j\omega - j\omega(1-\omega^2) + \omega^2]}{\omega(1+\omega^2)}$$

$$= \frac{-j(1-\omega^2) + \omega - \omega(1-\omega^2) - j\omega^2}{\omega(1+\omega^2)}$$

$$= \frac{\omega - \omega(1-\omega^2) - j[1 \cancel{-\omega^2} \cancel{+\omega^2}]}{\omega(1+\omega^2)}$$

$$= \frac{\omega - \omega(1-\omega^2) - j}{\omega(1+\omega^2)}$$

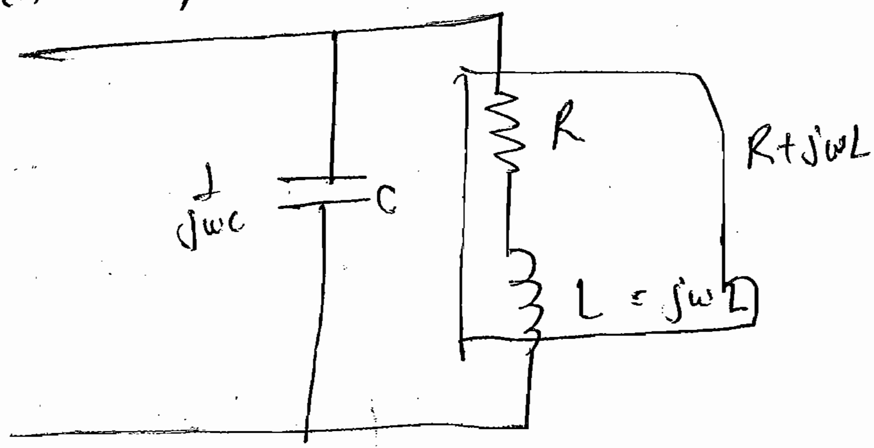
$$= \frac{\omega - \omega(1-\omega^2)}{\omega(1+\omega^2)} - \frac{j\,1}{\omega(1+\omega^2)}$$

So $\frac{-1}{\omega(1+\omega^2)} = 0$

$-1 \neq 0$ not possible

So Resonant freq. does not exist.

Q. For the given circuit diagram calculate given frequency. (Resonance).



for simplicity

Conductance (Y) $= j\omega C + \frac{1}{R + j\omega L}$

$$= \frac{\{j\omega C[R + j\omega L] + 1\}(R - j\omega L)}{(R + j\omega L)(R - j\omega L)}$$

$$= \frac{[j\omega C[R + j\omega L] + 1][R - j\omega L]}{R^2 + \omega^2 L^2}$$

$$= \frac{j\omega RC\,[R + j\omega] + R + \omega^2 LC\,(1 + j\omega L) - j\omega}{(R^2 + \omega^2 L^2)}$$

$$= \frac{j\omega R^2 C - \omega^2 RC + R + \omega^2 RLC + j\omega^2 L^2 C - j\omega}{R^2 + (\omega L)^2}$$

equating imaginary part to zero.

$$\frac{j\,[\omega R^2 C + \omega^2 L^2 C - \omega L]}{R^2 + (\omega L)^2} = 0$$

$$\frac{R^2 C + \omega^2 L^2 C - L}{R^2 + (\omega L)^2} = 0$$

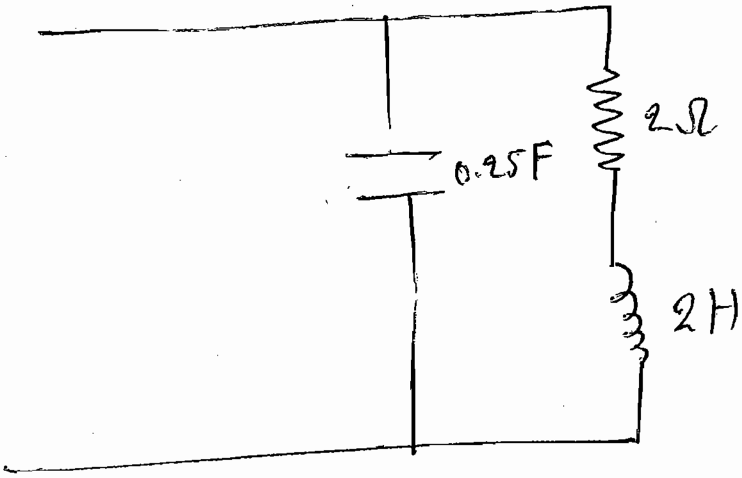
$$R^2 C + \omega^2 L^2 C - L = 0$$

$$\omega^2 L^2 C = L - R^2 C$$

$$\omega^2 = \frac{\cancel{L}}{\cancel{L^2} C} - \frac{R^2 \cancel{C}}{L^2 \cancel{C}}$$

$$\boxed{\omega = \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}}$$ Ans

Q. Calculate the resonance freq.



(a) 1.41
(b) ~~1~~
(c) 2
(d) 1.73

Soln

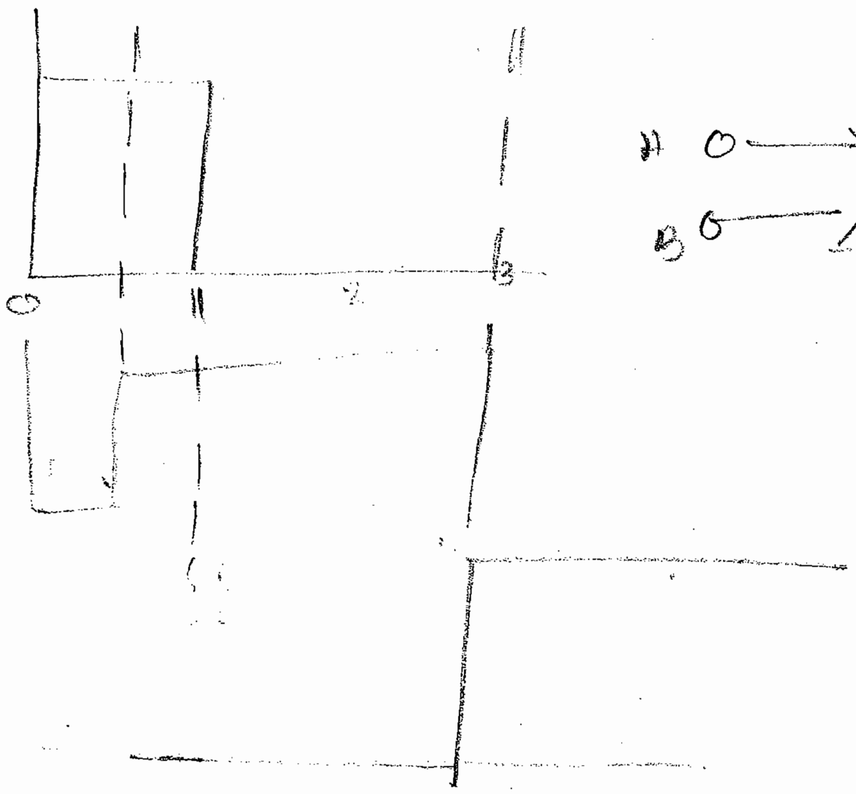
Normal $\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{2 \times 0.25}} = 1.41$

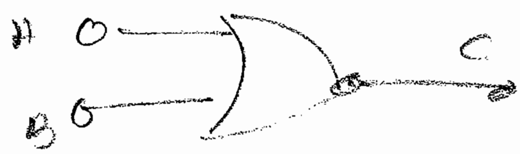
But it is not right

$$\omega = \sqrt{\frac{1}{LC} - \frac{R^2}{c^2}} = 1$$

Digital

68



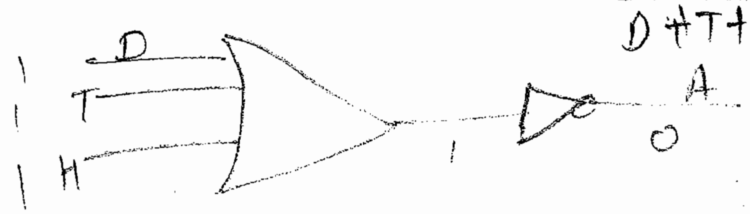


9?

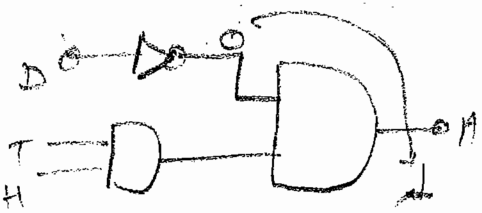
Q1

(a)

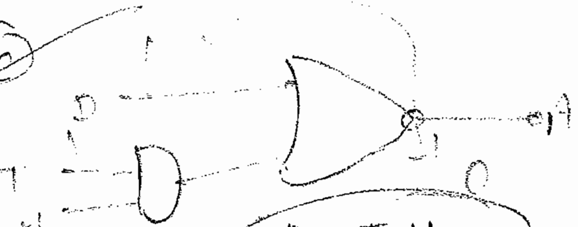
$D+T+H$



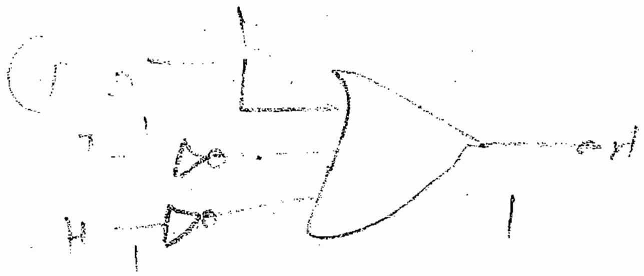
(b)



(c)



$D+T.H$



T → 1 , <

$A=0$

H → , <

D 1 ← on the door . .

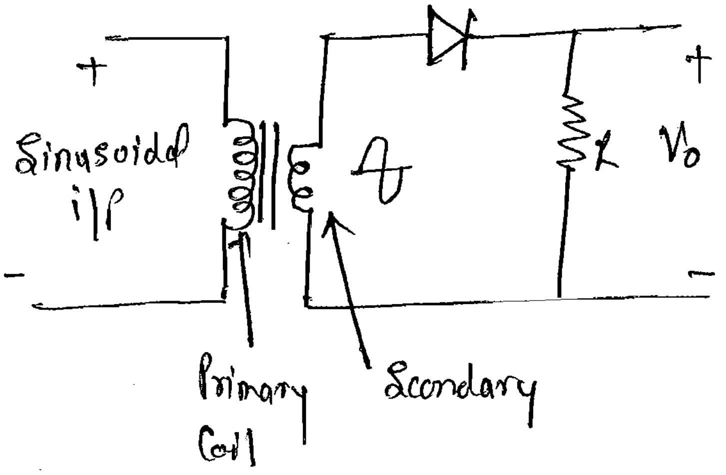
D or T and humidity

1 1 1 → $A=0$

$D+T.H$

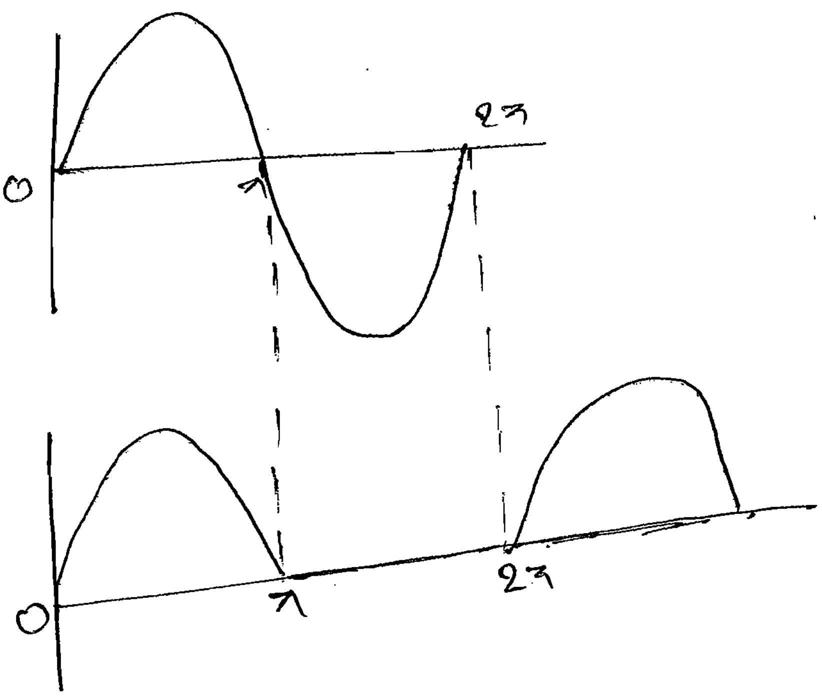
Q2 (a)

* Half - Wave Rectifier :-



Step-up- transformer increases the amplitude of applied i/p and reproduces at secondary of the transformer.

If the applied i/p whose amplitude is decrease, it called as step down transformer



* D.C. Value or Average value :-

$$= \frac{1}{2\pi} \int_0^{2\pi} f(x)\, dx$$

$$= \frac{1}{2\pi} \int_0^{2\pi} V_m \sin\theta \, d\theta .$$

$$= \frac{1}{2\pi}\int_0^{\pi} V_m \sin\theta\, d\theta + \frac{1}{2\pi}\int_{\pi}^{2\pi} 0\, d\theta$$

$$= \frac{V_m}{2\pi}\int_0^{\pi} \sin\theta\, d\theta = \frac{V_m}{2\pi}\left[-\cos\theta\right]_0^{\pi}$$

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

So Average value of halfwave rectifier $= \frac{V_m}{\pi}$

Average value of Full wave Rectifier :-
dc value

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

* Root mean Square Value :-

Power is also called as mean square value of function.

$$= \sqrt{\frac{1}{2\pi}\int_0^{2\pi} f(x)\, dx}$$

$$= \sqrt{\frac{1}{2\pi}\left[\int_0^{\pi} f(x)\, dx + \int_{\pi}^{2\pi} 0 \cdot dx\right]}$$

$$= \sqrt{\frac{1}{2\pi}\int_0^{\pi} (V_m \sin\theta)^2\, d\theta}$$

$$= \sqrt{\frac{1}{2\pi}\int_0^{\pi} V_m^2 \sin^2\theta\, d\theta}$$

$$= V_m \sqrt{\frac{1}{2\pi} \int_0^{\pi} \sin^2\theta \, d\theta}$$

$$= \frac{V_m}{2} \sqrt{\frac{1}{\pi} \int_0^{\pi} 1 - \cos 2\theta \, d\theta}$$

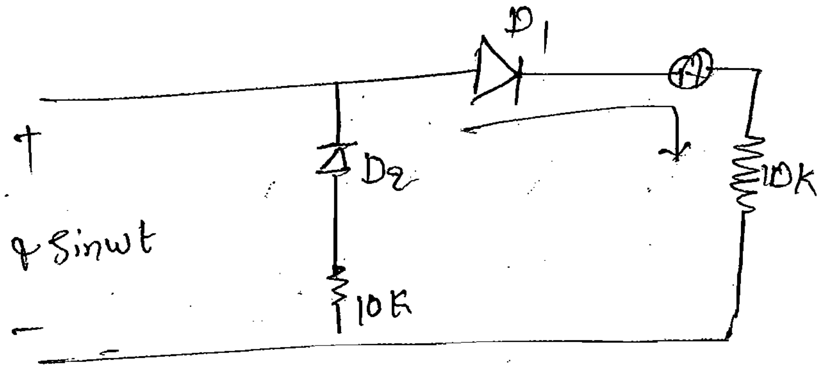
$$= \frac{V_m}{2} \sqrt{\frac{1}{\pi} \left[\theta - \frac{\sin 2\theta}{2}\right]_0^{\pi}}$$

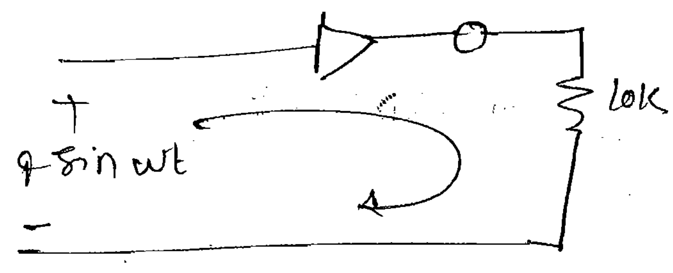
$$= \frac{V_m}{2} \sqrt{\frac{1}{\cancel{\pi}} (\cancel{\pi} - 0)}$$

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

$$\left.\begin{aligned} &\text{H.W.R.} \Rightarrow V_{rms} = \frac{V_m}{2} \\ &\text{F.W.R.} \Rightarrow V_{rms} = \frac{V_m}{\sqrt{2}} \end{aligned}\right\} \text{H.W.}$$

Q.3





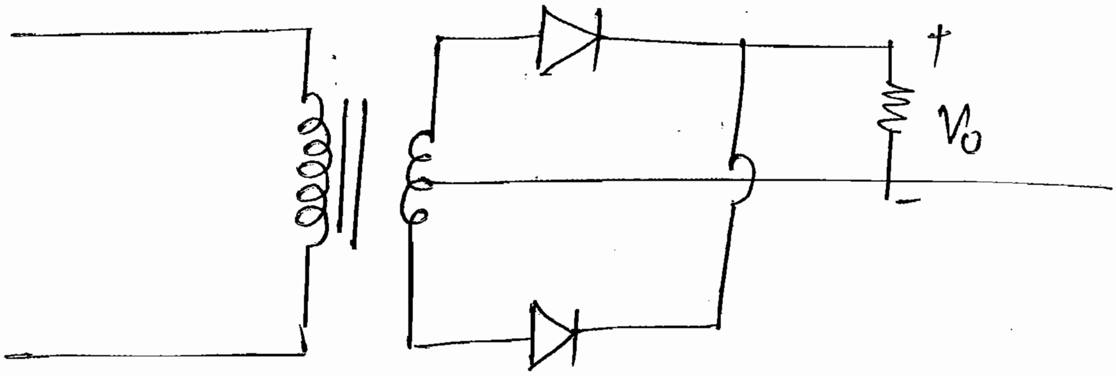
$$V_{ave} = \frac{V_m}{\pi} = \frac{4}{\pi}$$

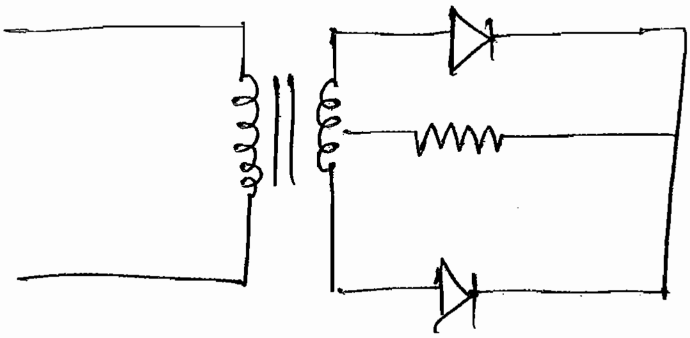
$$I_{ave} = \frac{\frac{4}{\pi}}{10}$$

$$\boxed{I_{ave} = \frac{0.4}{\pi}}$$

* Full Wave Rectifier :-

(33)





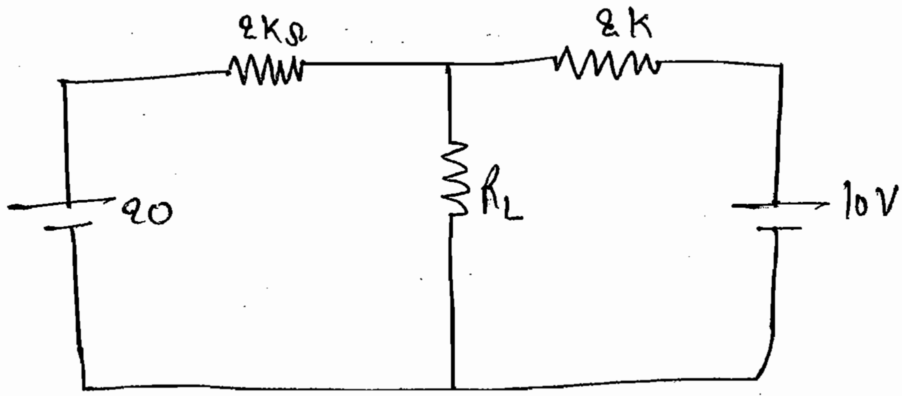
(31) $V_m = 10$

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

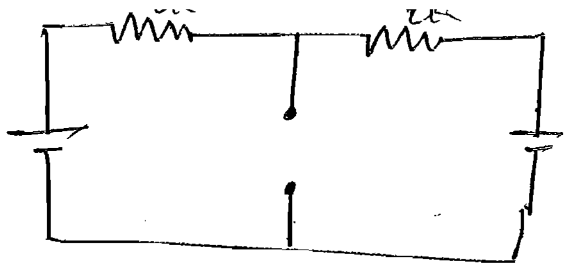
$= \frac{20}{\pi}$

$I_{av.} = \frac{V_{ave}}{R} = \frac{20}{\pi} = \frac{20}{\pi}$ m.A. Ans

(32)



=>



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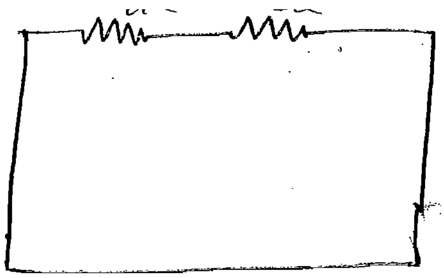

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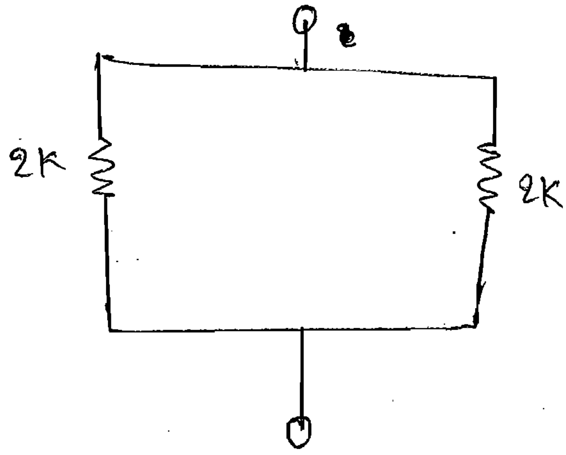
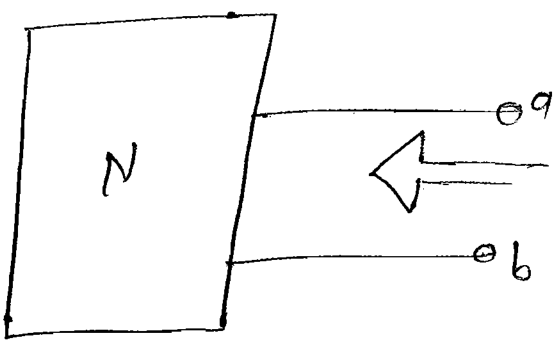
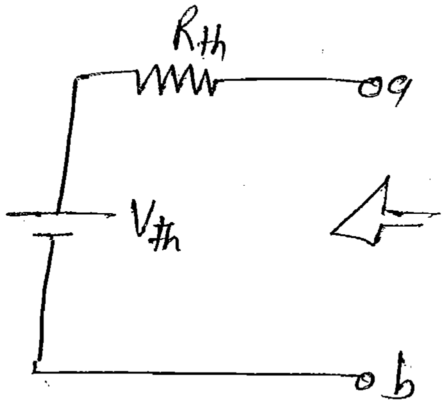


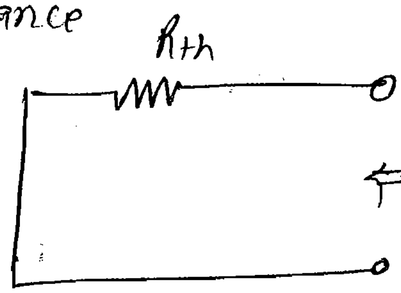
* Thevenin's Theorem :-





V_{th} = Open circuit voltage = V_{oc}.

For thevenin's Resistance

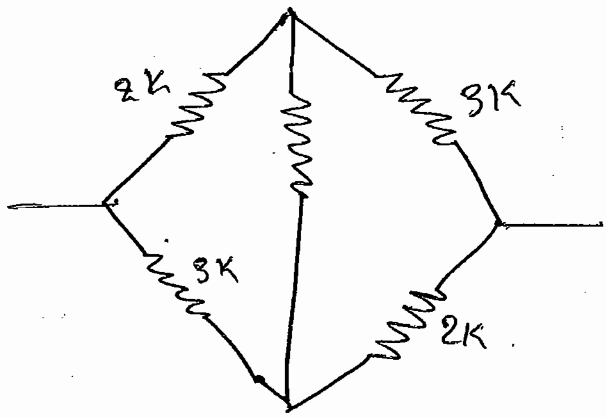


Voltage = 0

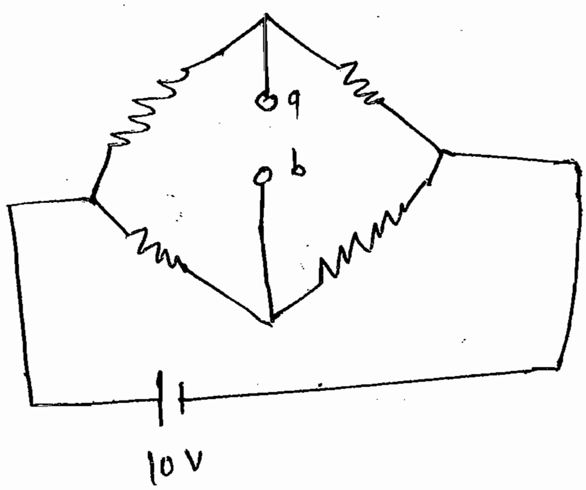
$I_{source} = 0$

To calculate thevenin's resistance ~~and~~ short the voltage source and open the current source.

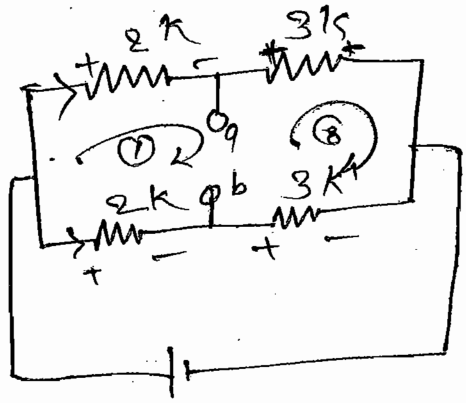
Q. for the given circuit diagram calculatate thevenin voltage and thevenin's Resistance



Sol^n



⇒



$I_1 = \frac{V}{R} = \frac{10}{5}$ 2 m.A

$I_2 = \frac{10}{5} = 2$ m.A.

loop - ①

$+I_1 \times 2K + V_{th} - I_2 . 3K = 0$

$V_{th} = I_2 \times 3K - I_1 \times 2K$

$V_{th} = 2 \times 3 - 2 \times 2$

$= 6 - 4$

$\boxed{V_{th} = 2 \text{ V}}$

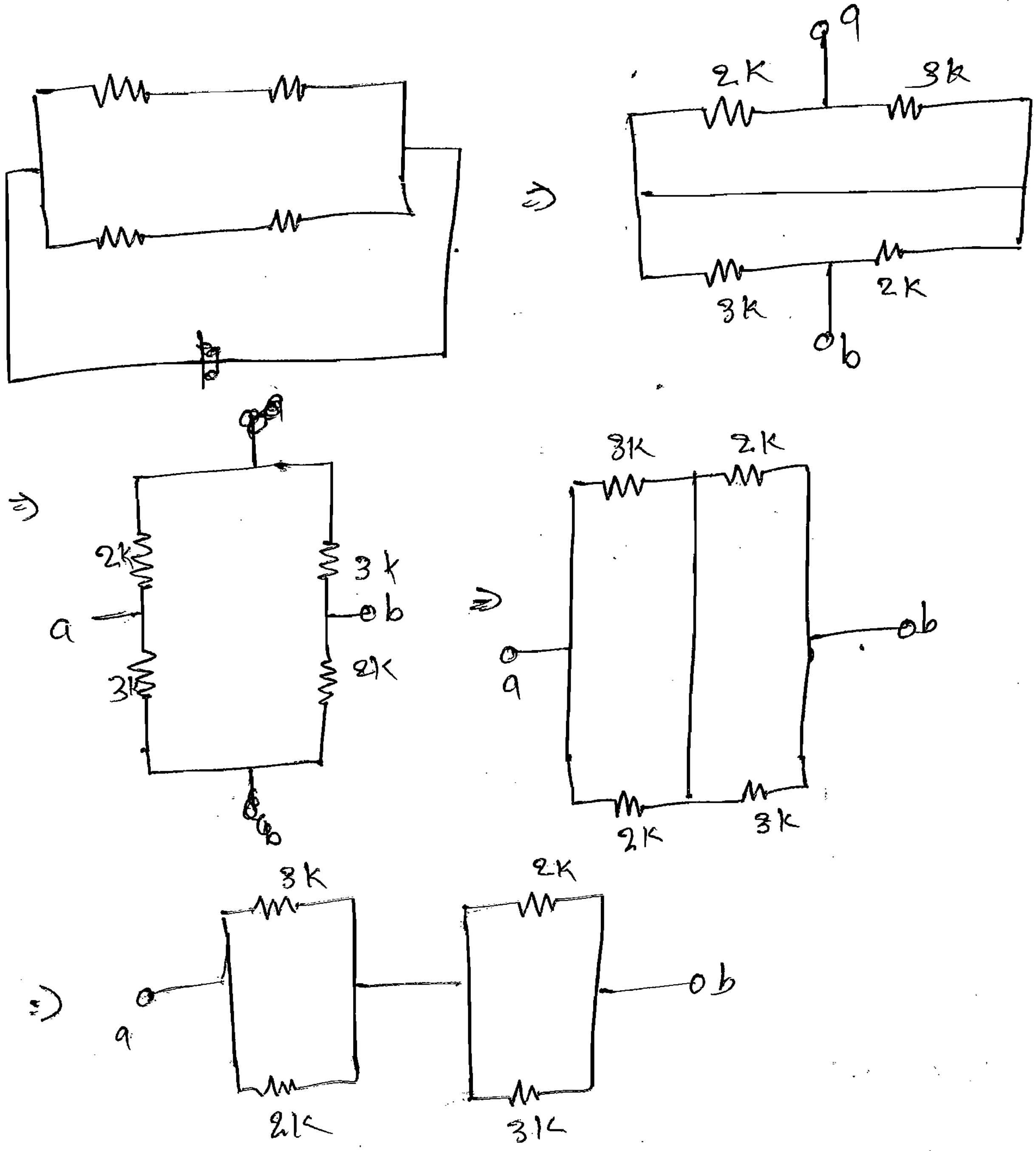
loop ②

$-V_{th} + I_1 3K - I_2 2K = 0$

$V_{th} = V_1 \times 3K - I_2 \times 2K$

$\boxed{V_{th} = 2 \text{ V}}$

To calculate thevenin's Resistance -

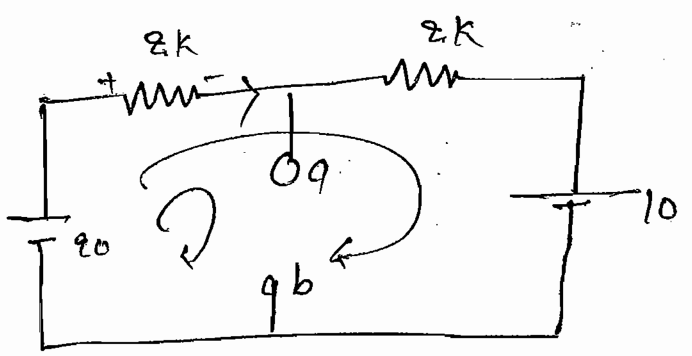


$$\Rightarrow \quad R_{th} = \frac{3\times 2}{3+2} + \frac{3\times 2}{3+2}$$

$$= \frac{6}{5} + \frac{6}{5}$$

$$\boxed{R_{th} = \frac{12}{5}\,\Omega}$$

Q.32



$$-20 + I \times 2k + I \times 2k + 10 = 0$$

$$I \cdot 4k = 10$$

$$\boxed{I = 2.5\ mA}$$

$$\cancel{-V_{th} + I \times 2k + 10 = 0}$$

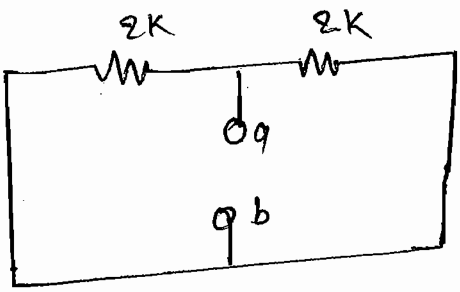
$$\cancel{V_{th} = 10 + 1.2k}$$

$$=$$

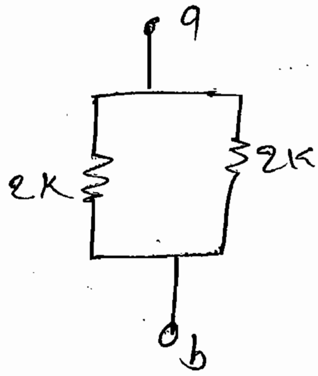
$$-V_{th} + I \times 2K + 10 = 0$$

$$V_{th} = 10 + I \times 2K$$

$$10 + 5 = 15\ V$$



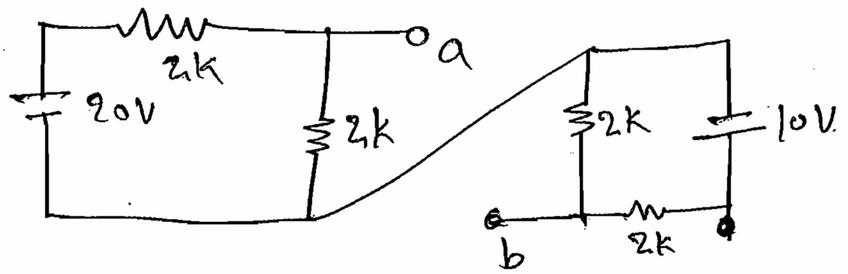
$\Rightarrow$

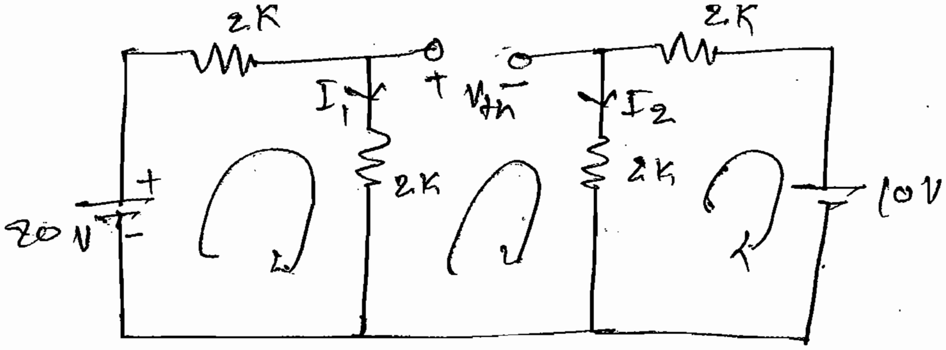


$$R_{th} = \frac{2 \times 2}{2 + 2} = \frac{\cancel{4}}{\cancel{4}}$$

$$\boxed{R_{th} = 1\Omega}$$

Q. For the given circuit diagram calculate Thevenin Voltage and thevenin resistance.





$$-10 + I_2 \cdot 2k + I_2 \cdot 2k = 0$$

$$I_2 = \frac{10}{4k} = 2.5\text{ m.A}$$

$$-20 + I_1 \cdot 2k + I_1 \cdot 2k = 0$$

$$I_1 = \frac{20}{4k} = 5\text{ m.A}$$

$$V_{th} + I_2 \cdot 2k - 2k \times I_1 = 0$$

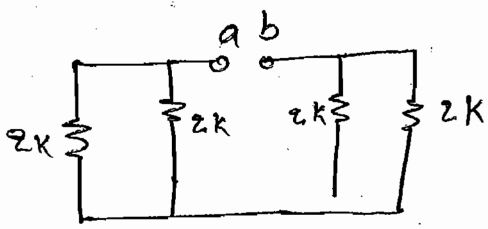
$$V_{th} = 2k \times I_1 - I_2 \times 2k$$

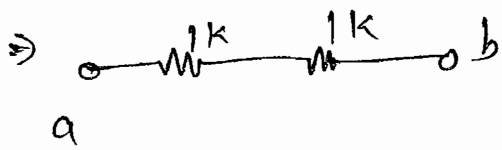
$$= 2k \times 5 - 2.5 \times 2$$

$$= 10 - 5$$

$$\boxed{V_{th} = 5\text{ V}}$$

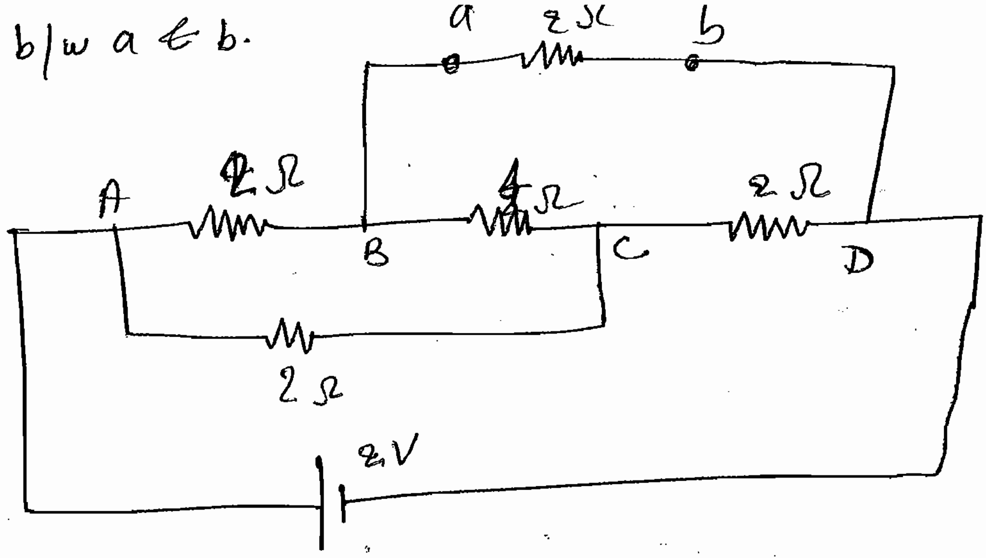
for R_{TH}





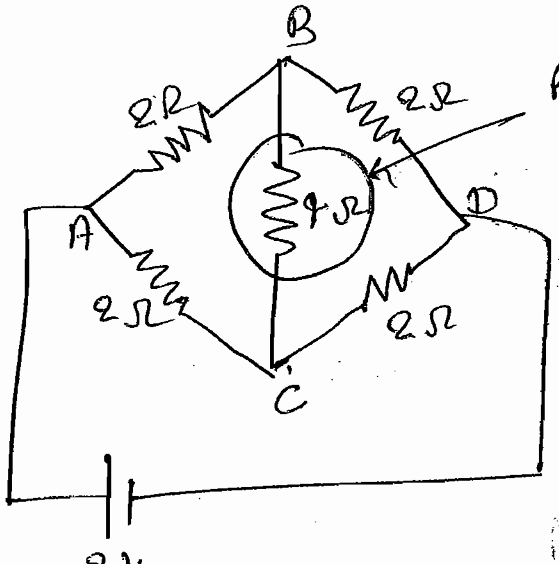
$$\boxed{R_{TH} = 2K}$$

(64) find v b/w a & b.

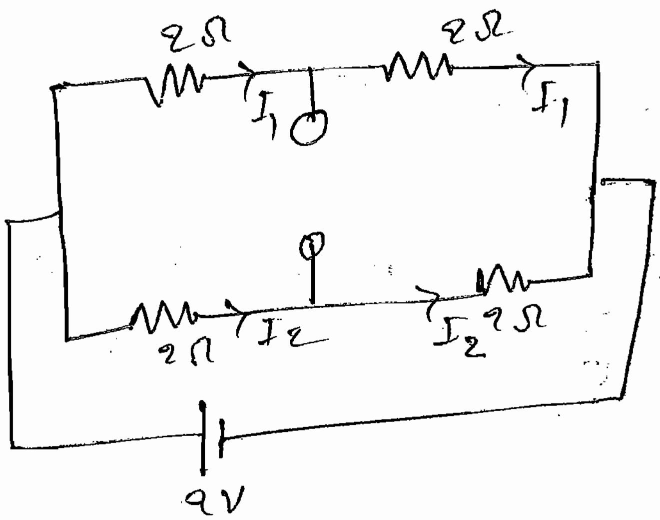


Sol^n

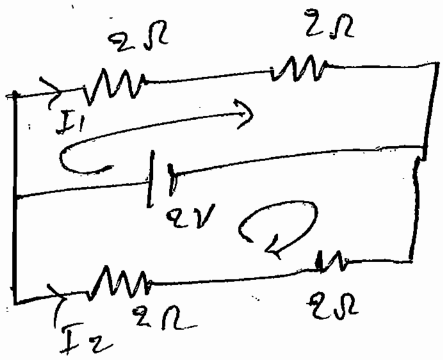
$\frac{2K}{2K} = \frac{2K}{2K}$



It is ideal wheatstone Bridge. So current flow through galvanometer is 0 so no current flow through 4Ω so we remove it.



⇒

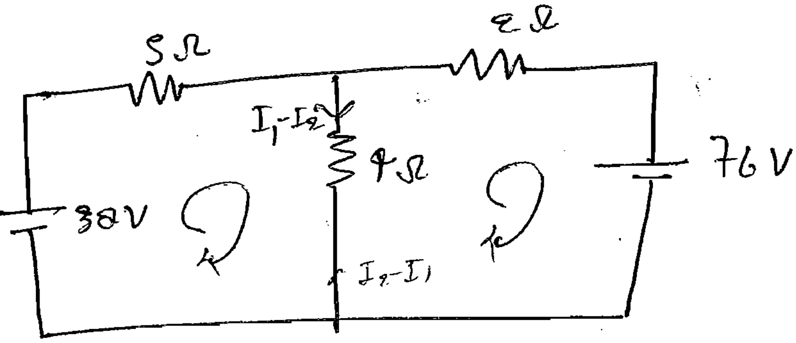


$-2 + I_1 \cdot 2 + I_1 \cdot 2 = 0$

$I_1 = \frac{2}{4} = 0.5$ mA

So $\boxed{I_2 = 0.5\,\text{m.A}}$

37



$$-38 + I_1 \times 5 + (I_1 - I_2)\, 4\Omega = 0$$

$$9I_1 - 4I_2 = 38 \quad — ① \times 6$$

$$+76 + 2I_2 + 4(I_2 - I_1) = 0$$

$$-4I_1 + 6I_2 = -76$$

$$4I_1 - 6I_2 = 76 \quad — ② \times 4$$

$$54 I_1 - 24 I_2 = 38 \times 6$$

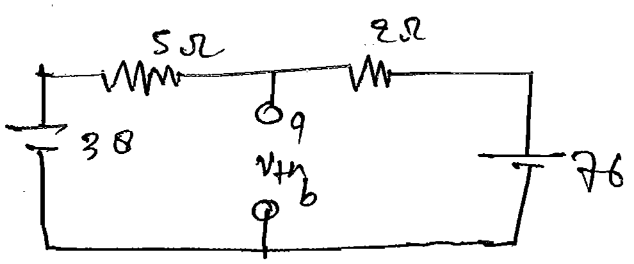
$$16 I_1 - 24 I_2 = 76 \times 4 = \cancel{304}$$

$$38 I_1 = 38 \times 6 - 76 \times 4$$

$$\boxed{I_1 = 2}$$

$$\boxed{I_2 = -16}$$

Hence ~~[illegible]~~



$$-38 + 5I_1 + 2I_1 + 76 = 0$$

$$I_1 = \frac{-38}{7}$$

$-38 + 5I_1 + V_{th} = 0$

$V_{th} = -5I_1 + 38$

$= -5 \times -\frac{35}{7} - 38$

$= \frac{5 \times 38 + 7 \times 38}{7}$

$\boxed{V_{th} = 6.5\ V.}$

$-V_{th} + 2I_1 + 76 = 0$

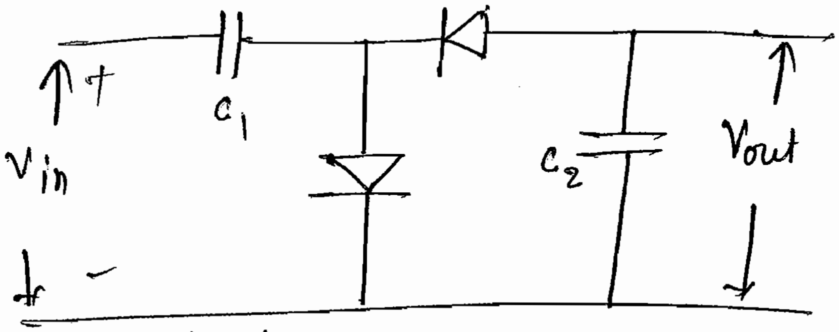
$-V_{th} = -76 - 2I_1$

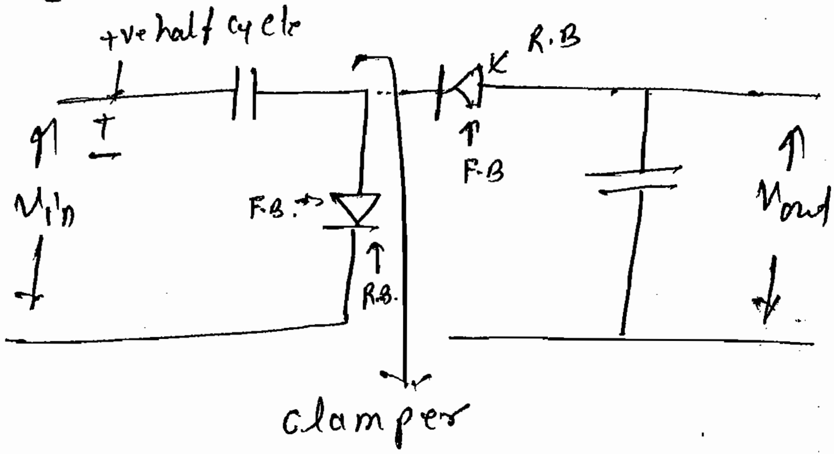
$V_{th} = 76 + 2 \times \left(-\frac{38}{7}\right)$

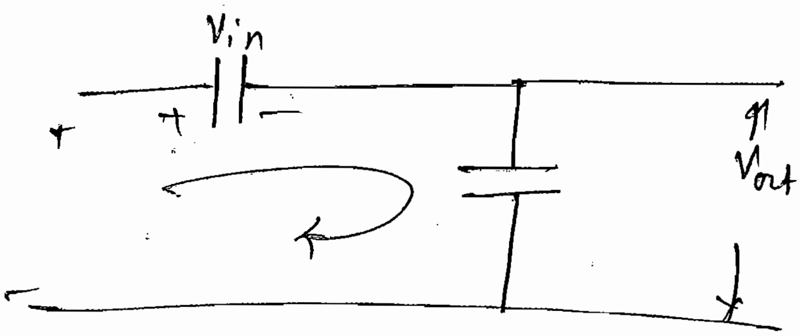
$V_{th} = 76 - \frac{76}{7}$

$\boxed{V_{th} = 6.5\ V}$

Q.34



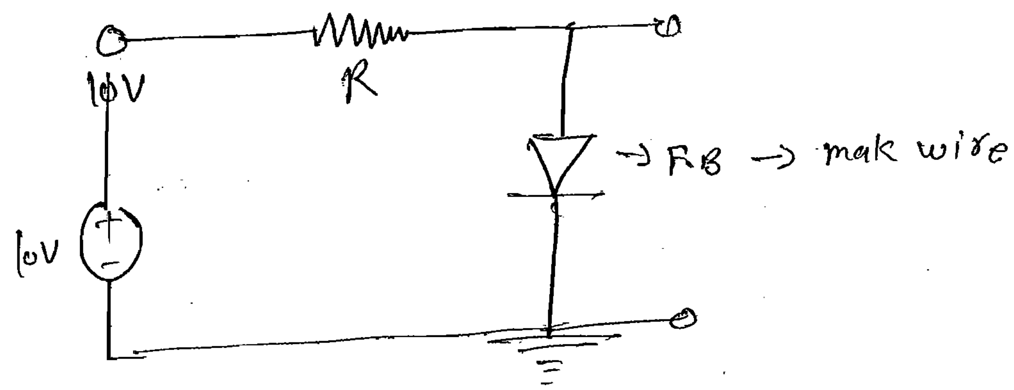




$+V_{in} + V_{in} - V_{out} = 0$

$\boxed{V_{out} = 2V_{in}.}$

(41)



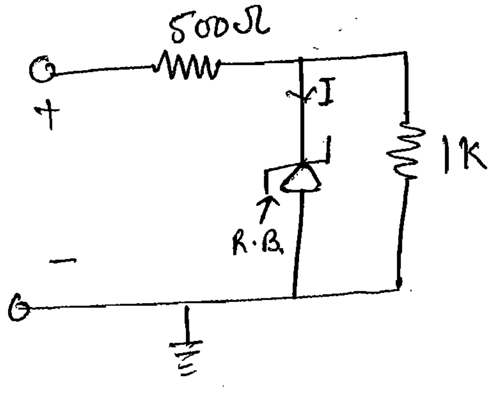
$-10 + IR = 0$

$R = \frac{10}{I}$

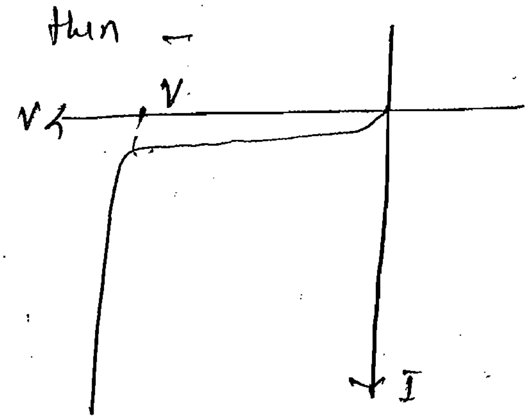
$R = \frac{10}{10} = 1$

$\boxed{R = 1\,k\Omega}$

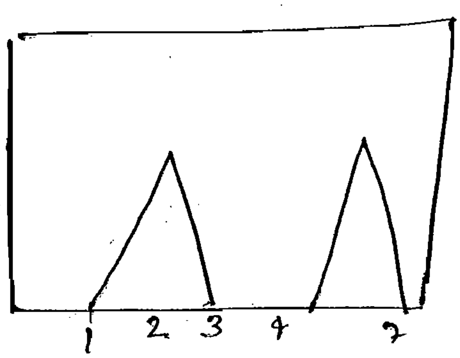
Q.70



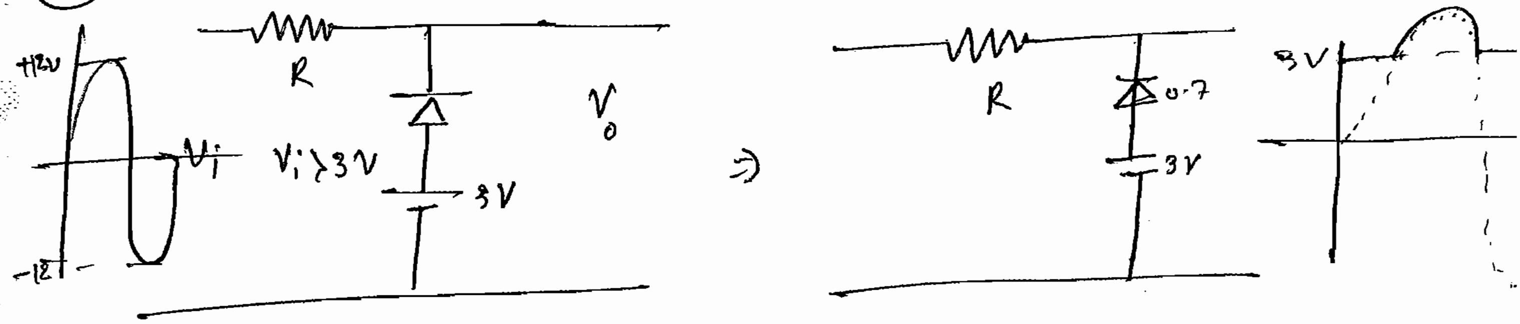
When Zener is R.B. then -

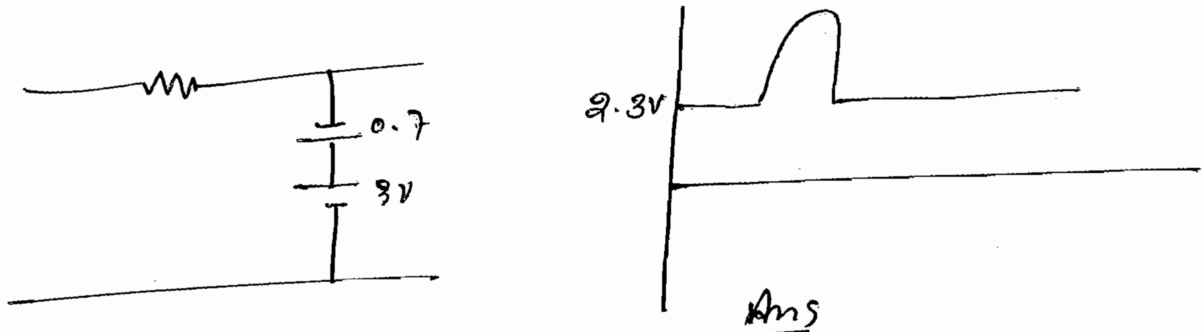


(a)



(39)





Ans

(95)

$$\therefore \frac{O/P}{I/P} = \text{gain}$$

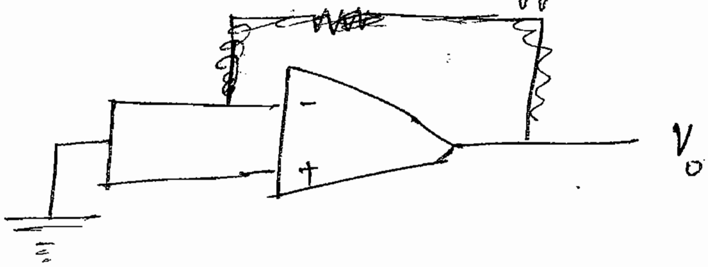
$$20 \log\left(\frac{O/P}{1\,m.V.}\right) = -50\,dB.$$

$$\log\left(\frac{O/P}{I/P}\right) = \frac{-50}{20} = -2.5$$

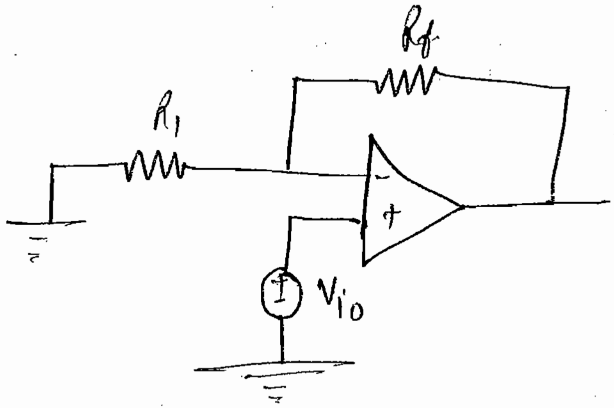
$$O/P = 1\,m.V \times 10^{-2.5}$$

$=$

When no input is applied some output voltage is achived called output offset voltage. (V_{oo}).



To Cancel the output offset voltage some input is applied in non-inverting terminal is called as input offset voltage. (V_{io})



$$\frac{V_{oo}}{i_o} = \left(1+\frac{R_f}{R_1}\right)$$

$$V_{oo} = \pm V_{io}\left(1+\frac{R_f}{R_1}\right)$$

* CMRR (Comon mode Rejection Ratio) :-

$$\frac{V_o}{V_i} = A = \frac{V_o}{V_d}$$

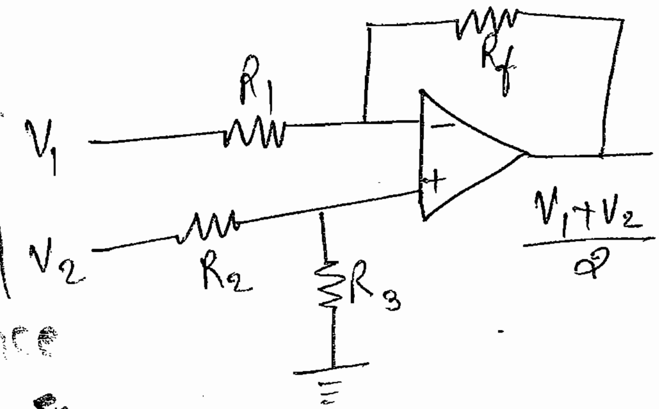
$$\boxed{V_o = A_d V_d}$$

A_d : differential gain

V_d : differential input voltage

Ex-

due to closer two signal produces interference pattern. So difference of the input inters.



The ideal value of CMRR is must be ∞.

$$V_o = A_d V_d + A_c V_c \qquad \frac{V_1+V_2}{2}$$

$$\boxed{CMRR = \frac{A_d}{A_c} = \infty}$$

Q. For the given output voltage relation calculate CMRR.

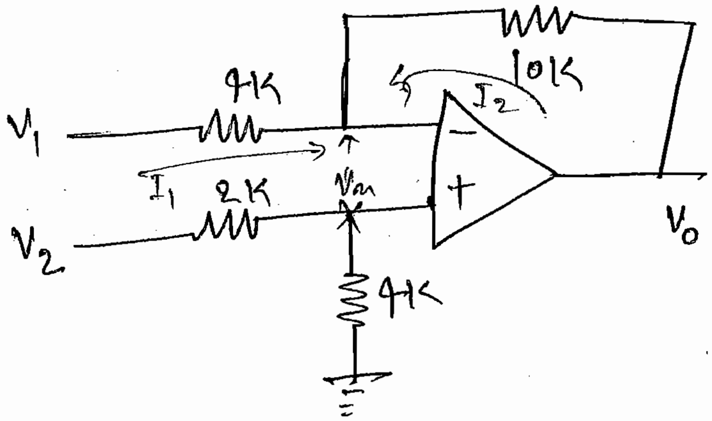
Sol^n

$$V_o = 10(V_2 - V_1)$$

$$V_o = A_d V_d + A_c V_c$$

$$CMRR = \frac{A_d}{A_c} = \frac{10}{0} = \infty$$

Q. For the given circuit ~~of~~ diagram calculate CMRR.



$V_0 = A_d V_d + A_c V_c$

$$V_a = \frac{V_2 R_2}{R_1 + R_2} = \frac{V_2 \times 4K}{4+2} = \frac{4V_2}{6} = \frac{2}{3}V_2$$

$i_1 + i_2 = 0$

$$\frac{V_1 - V_a}{\cancel{4K}} + \frac{V_0 - V_a}{\cancel{10K}_{2.5}} = 0$$

$$\frac{V_0 - V_a}{2.5} = -(V_1 - V_a) = V_a - V_1$$

$V_0 - V_a = 2.5V_a - 2.5V_1$

$V_0 = 3.5V_a - 2.5V_1$

$$V_0 = 3.5 \times \frac{2V_2}{3} - 2.5V_1$$

$$V_0 = \frac{7}{3}V_2 - \frac{5}{2}V_1$$

$$V_c = \frac{V_2 + V_1}{2} \Rightarrow 2V_c = \cancel{V_1} + V_2 \quad \text{—— (I)}$$

$$V_d = \frac{V_2 - V_1}{\cancel{2}} \Rightarrow V_d = V_2 - \cancel{V_1} \quad \text{—— (II)}$$

$2V_c + V_d = 2V_2$

$$\Rightarrow \boxed{V_2 = V_c + \frac{V_d}{2}} \text{—— (III)}$$

(I) − (II)

$$2V_c = V_1 + \cancel{V_2}$$
$$V_d = \cancel{V_2} - V_1$$

$$2V_c - V_d = 2V_1$$

$$\boxed{V_1 = V_c - \frac{V_d}{2}} \quad \text{—(IV)}$$

$$V_0 = \frac{7}{3}V_2 - \frac{5}{2}V_1$$

$$V_0 = \frac{7}{3}\left(V_c + \frac{V_d}{2}\right) - \frac{5}{2}\left(V_c - \frac{V_d}{2}\right)$$

$$\cancel{V_0 = V_c\left(\frac{7}{3}\right.}$$

$$V_0 = \left(\frac{7}{6}V_d - \frac{5}{4}V_d\right) + \left(\frac{7}{3}V_c - \frac{5V_c}{2}\right)$$

$$V_0 = V_d\left(\frac{7}{6} + \frac{5}{4}\right) + V_c\left(\frac{7}{3} - \frac{5}{2}\right)$$

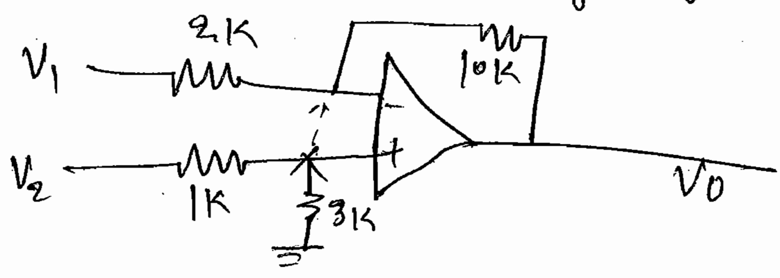
$$V_0 = V_d\left(\frac{29}{12}\right) + V_c\left(\frac{-1}{6}\right)$$

$$CMRR = \frac{A_d}{A_c} = \frac{\frac{29}{12}}{-1/6} = -\frac{29}{2} \quad \text{Ans}$$

$$= -14.5$$

$$= 14.5$$

Q. Determine CMRR of given circuit-



$$V_{a1} = \frac{V_2 \times 3K}{3K + 1K} = \frac{3V_2}{4}$$

$$\frac{V_0 - V_{a1}}{10K} + \frac{V_1 - V_{a1}}{2K} = 0$$

$$\frac{V_0 - \frac{3V_2}{4}}{\underset{5}{\cancel{10K}}} + \frac{V_1 - \frac{3V_2}{4}}{\cancel{2K}} = 0$$

$$V_0 = -5V_1 + \frac{15V_2}{4} + \frac{3V_2}{4}$$

$$\boxed{V_0 = -5V_1 + \frac{9}{2}V_2}$$

$$V_c = \frac{V_1 + V_2}{2}, \quad V_d = V_2 - V_1$$

$$V_1 = V_c - \frac{V_d}{2}$$

$$V_2 = V_c + \frac{V_d}{2}$$

$$V_0 = -5\left(V_c - \frac{V_d}{2}\right) + \frac{9}{2}\left(V_c + \frac{V_d}{2}\right)$$

$$V_0 = (-5V_c + 4.5V_c) + \left(\frac{5}{2}V_d + \frac{9}{4}V_d\right)$$

$$\boxed{V_0 = -0.5\,V_c + \frac{19}{4}V_d}$$

$$CMRR = \frac{A_d}{A_c} = \frac{19/4}{-1/2} = \frac{19}{2}$$

Q.34

Soln

$A_d = 20000$

CMRR = 80dB

$CMRR = \left| \frac{A_d}{A_c} \right|$

$CMRR = 20 \log \left| \frac{A_d}{A_c} \right| = \cancel{80}\ 4$

$\Rightarrow \log \frac{A_d}{A_c} = 4$

$\Rightarrow \frac{A_d}{A_c} = 10^4$

$\Rightarrow 20000 = 10^4 A_c$

$A_c = \frac{2\cancel{0000}}{1\cancel{0000}}$

$\boxed{A_c = 2}$ A

Q.42

Soln

$\text{gain} = \frac{V_o}{V_{in}} = \frac{1500}{1.5} = 1000$

$20 \log 1000 = 60$

Power

Actual gain $= \frac{P_o}{P_{in}}$

$A_{dB} = 10 \log \frac{P_o}{P_{in}}$

$= 10 \log \frac{V_o^2 / R_L}{V_{in}^2 / R} = 20 \log ($

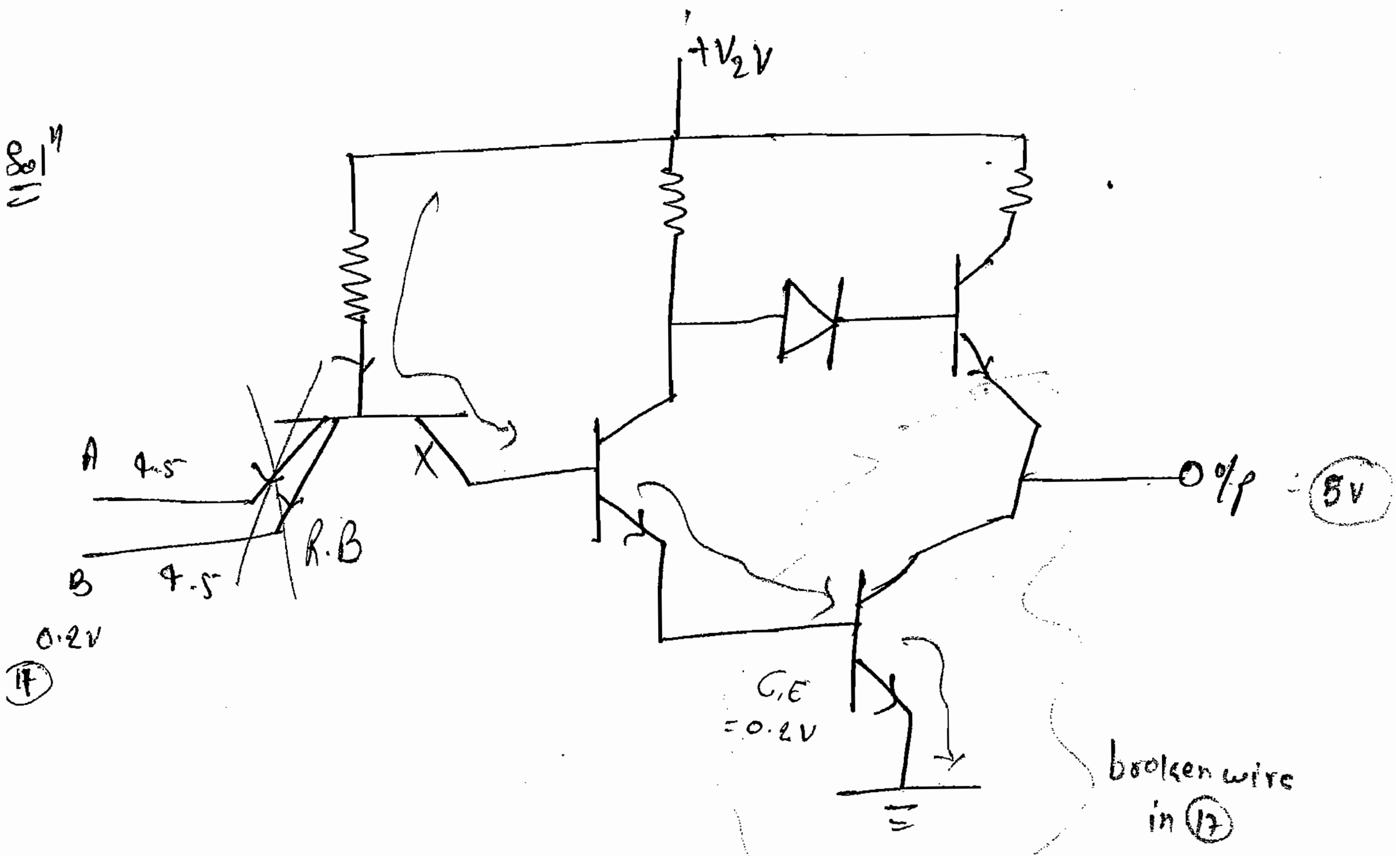
$$A = \frac{P_o}{P_{in}} = \frac{1500}{1.5} = 100$$

$$A_{dB} = 10 \log 100$$

$$= 20 \quad \underline{\underline{A}}$$

Q. 16

Sol^n



Ans = 0.2 V.

(17)

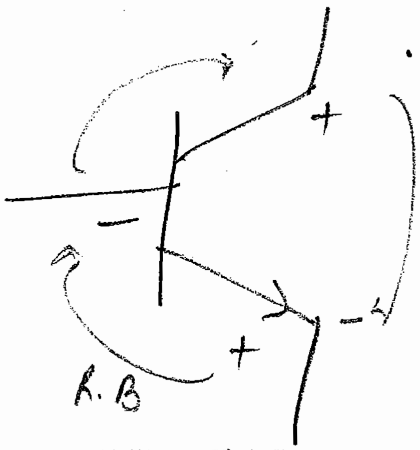
5V.

	C.C.	C.B.	C.E.
A_I	$\frac{I_E}{I_B} > 1$	$\frac{I_C}{I_E} \le 1$	$A > 1$
A_V	$A_V = \frac{V_{EC}}{V_{BC}} \approx 1$	$A_V = \frac{V_{CB}}{V_{EB}} > 1$	$A_V = \frac{V_{CE}}{V_{BE}} > 1$ 0.7
R_{in}	high	low	medium
R_o	low	high	medium.

$$V_{CE} - V_{BE} - V_{CB} = 0$$

$$V_{CE} = V_{CB} + \underset{0.7}{V_{BE}}$$

$$V_{CE} \approx V_{CB}$$



urate.

~~Q.25~~

halfwave Rectifier

$$r = \sqrt{\frac{I_{rms}^2}{I_{dc}^2} - 1}$$

$$r = \sqrt{\left(\frac{\frac{\cancel{I_m}}{2}}{\frac{\cancel{I_m}}{\pi}}\right)^2 - 1}$$

$$r = \sqrt{\frac{\pi^2}{2^2} - 1}$$

$$\boxed{r = 1.2}$$ A

Full wave Rectifier :-

$$\gamma = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$$

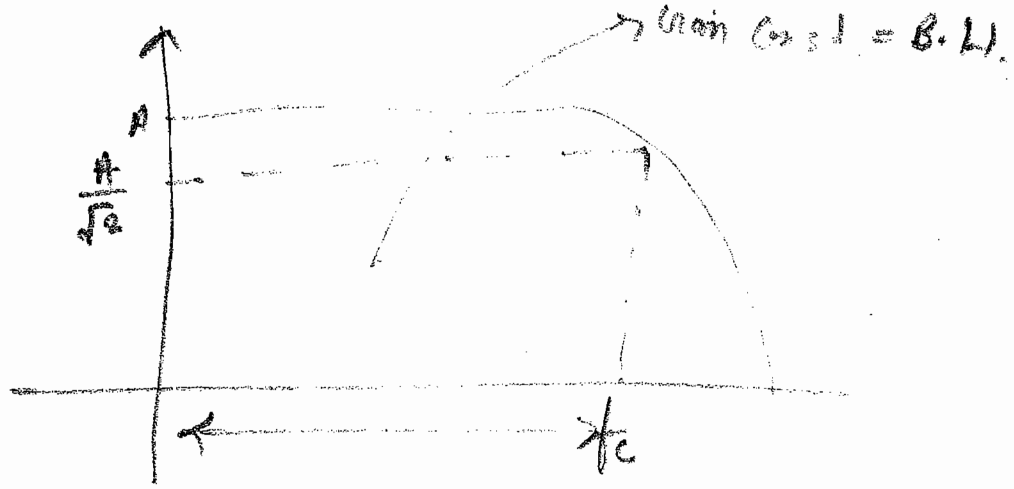
$$= \sqrt{\frac{\left(\frac{I_m}{\sqrt{2}}\right)^2}{\left(\frac{2I_m}{\pi}\right)^2} - 1}$$

$$= \sqrt{\frac{\frac{1}{2}}{\frac{4}{\pi^2}} - 1}$$

$$= \sqrt{\frac{\pi^2}{8} - 1}$$

$$= 0.48$$

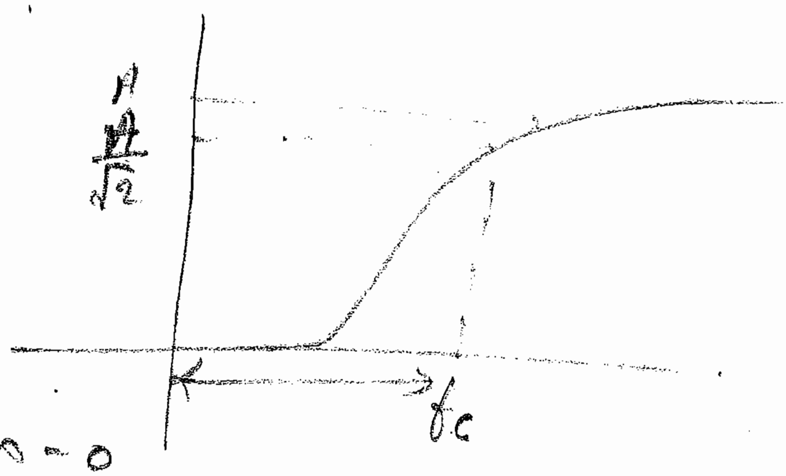
(43)



Those group of frequencies where gain is approximately constant is called as B.W.

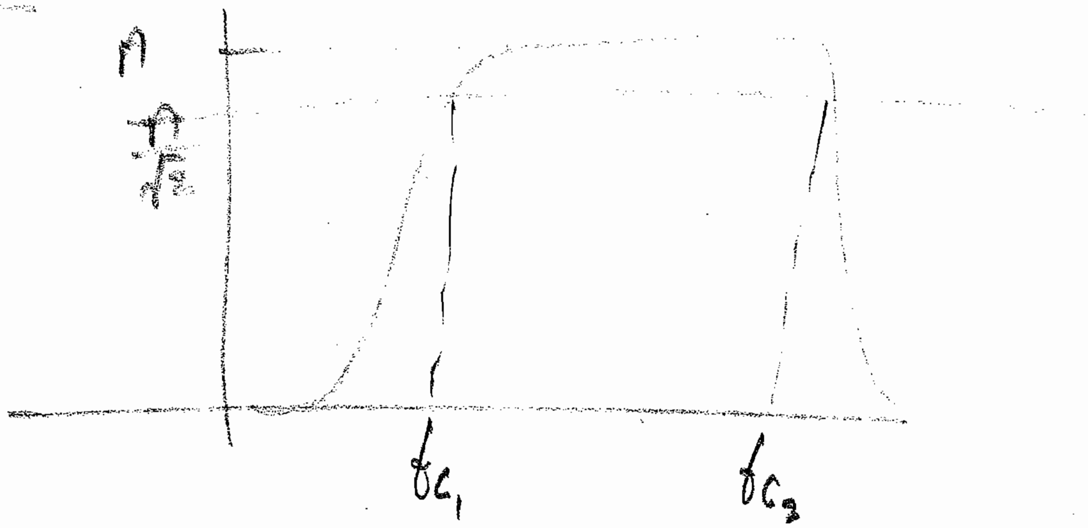
$B.W = \dfrac{\text{upper cut of freq.} - \text{lower cut of freq.}}{} = f_c - 0 = f_c$

High pass filter :-



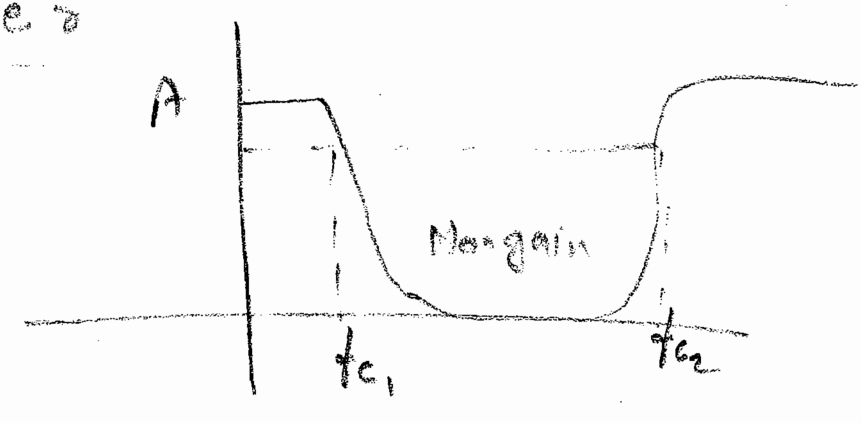
$B.W = \infty - 0$
$= \infty$

Band Pass



$B.W = f_{c_2} - f_{c_1}$

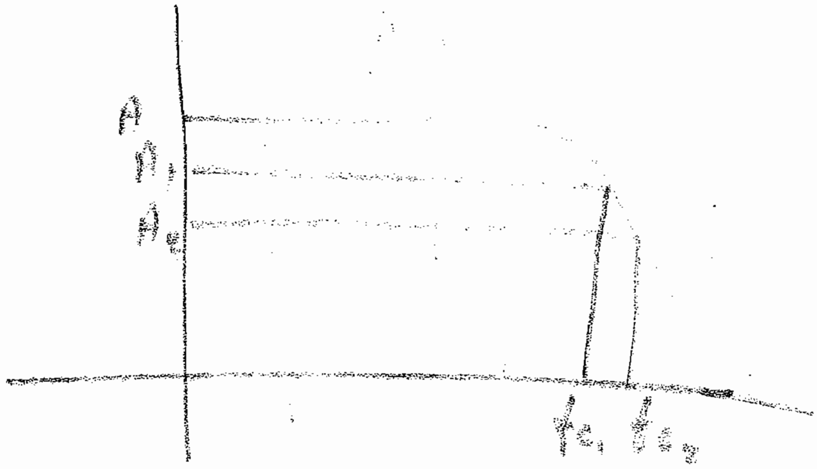
Band Reject filter



$B_W = \infty - 0$

$B.W = \infty$

Gain × Bandwith product always constant



$A_1 \times f_{c_1} = \text{Cons}$

$A_2 \times f_{c_2} = \text{Cons}$

$A \downarrow \quad f_{c_1} \downarrow$

$A \uparrow \quad f_{c_2} \uparrow$

Pg. 75
Q. 99 (C)

Pg. 10
Q. 93

$A = 100$, feedback $= 9.9\%$

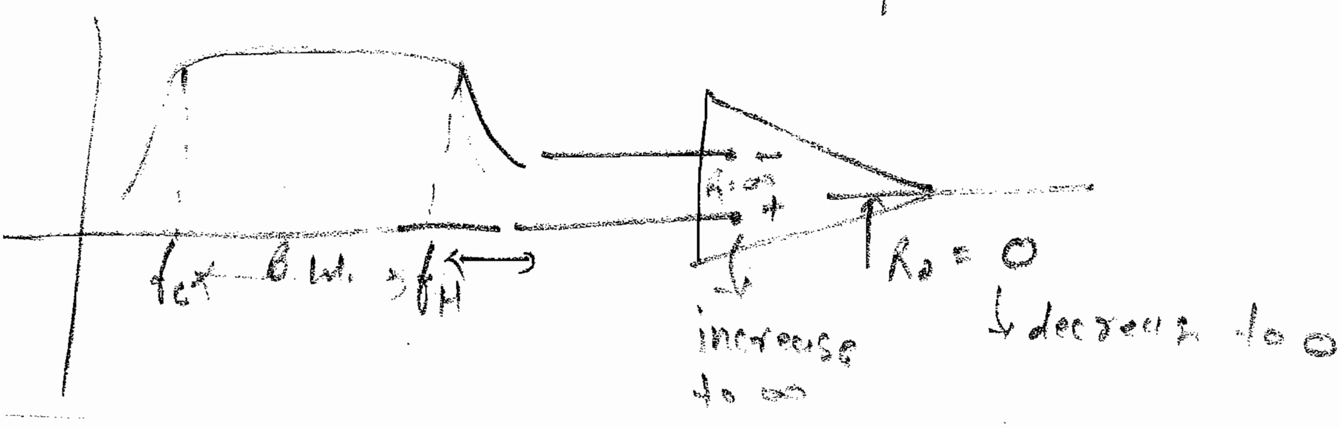
$$\beta = \frac{9.9}{100} = \underline{\underline{0.099}}, \quad f_c = 20\,Hz$$

$$f_H = 2000\,Hz$$

$$\text{Gain} = \frac{A}{1+A\beta}$$

$$= \frac{100}{1+100\times 0.099} = \frac{1000}{100} = 10$$

So Gain is decrease by 100 times.



$$\text{Gain} = f_H * (1 + A\beta)$$

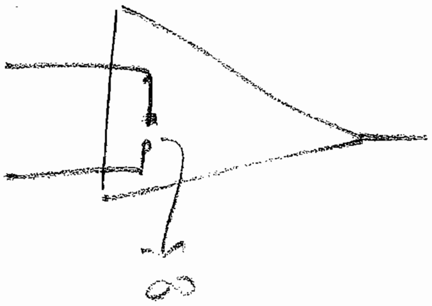
$$= 1000 \times (1 + 1000 \times 0.009)$$

$$= 1000 \times (1 + 9)$$

$$100$$

(97) $\beta = 0.1$

$$A_{CL} = \frac{A}{1 + A\beta} = \frac{500}{1 + 50} = \frac{500}{51} = 9.8$$

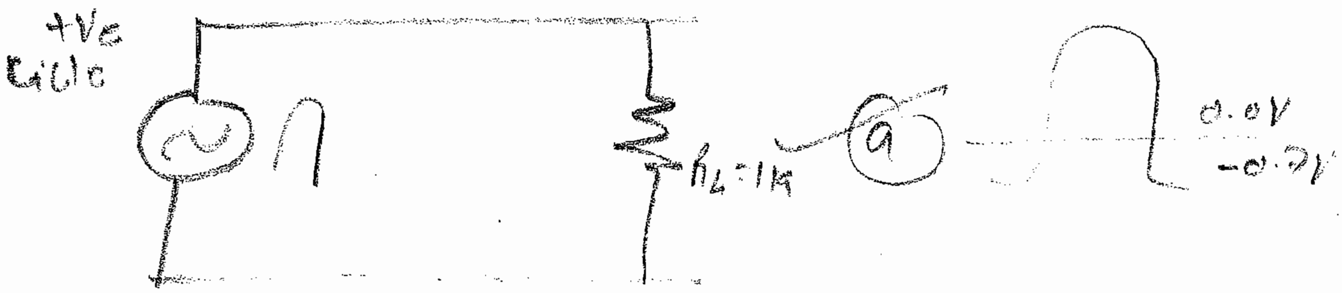


$$\text{Gain} = R_{in} \cdot (1 + A\beta)$$

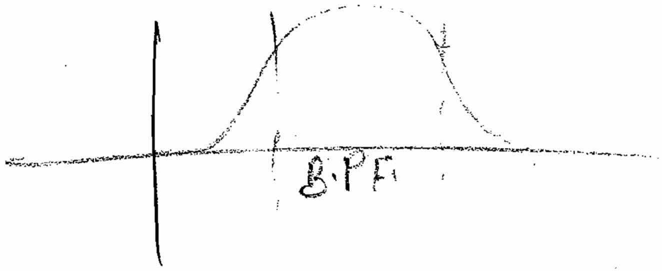
$$= 200\,K \times (51)$$

$$= 10200\,K$$

(78)



(77) Second method



for any LC circuit cut-off freq. is given by resonance freq.

$$f = \frac{1}{2\pi\sqrt{LC}} \qquad \omega = \frac{1}{\sqrt{LC}}$$