G-A

(1) (i) (a) non-linear circuits

(ii) (c) equivalent Voltage Source and impedance in series.

(iii) (b) capacitive (Not Sure)

(iv) (a) 0 $\left[\lim_{s\to\infty} sF(s)\right]$

(v) (b) frequency domain response only

(vi) (d) All of the above

(vii)

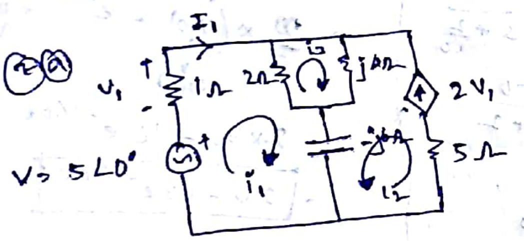
(viii) (d) AD - BC = 1

(ix) (d) A or less

(x) (d) R = 0.

Group-B

2(a)



$\therefore$ From loop 1,

$$5\angle 0^\circ = I_1\times 1 + 2(I_1 - I_3) + (-j6)(I_1 + I_2)$$

$$\boxed{I_2 = 2}$$

$$2(I_3 - I_1) + j4(I_3 + I_2) = 0$$

or $2I_3 - 2I_1 + j4I_3 + j8 = 0$

or $\boxed{-2I_1 + I_3(2+j4) = -j8}$

$$5\times 1 + j\times 0 = I_1 + 2I_1 - 2I_3 - j6I_1 - j12$$

or $5 = I_1(3+j6) - 2I_3 - j12$

or $\boxed{(3+j6)I_1 - 2I_3 = 5 + j12}$

$$\therefore \begin{bmatrix} -2 & 2+j4 \\ 3+j6 & -2 \end{bmatrix} \begin{bmatrix} I_1 \\ I_3 \end{bmatrix} = \begin{bmatrix} -j8 \\ 5+j12 \end{bmatrix}$$

i.e. $\Delta = (-2)(-2) - (2+j4)(3+j6)$

$= 4 - (6 + j^2 24 + 12j + 12j)$

$= 4 - 6 + 24 + 24j$

$= \boxed{22 + 24j}$

$$\Delta_1 = \begin{vmatrix} -j8 & 2+j4 \\ 5+j12 & -2 \end{vmatrix}$$

i.e. $\Delta_1 = 16j - (2+j4)(5+j12)$

$= 16j - (10 + 24j + 20j - 48)$

$= 16j - 10 - 44j + 48$

$= \boxed{38 - 28j}$

$$\begin{array}{r} 44 \\ 16 \\ \hline 28 \end{array}$$

$\therefore\ i_1 = \dfrac{38 - 28j}{22+24j} = \boxed{\dfrac{19-14j}{11+12j}}$

$\therefore$ Current through $-j6\Omega = i_1 + i_2$

$= \dfrac{19-14j}{11+12j} + 2$

$= \dfrac{19 - 14j + 22 + 24j}{11+12j}$

$= \boxed{\dfrac{41 + 10j}{11+12j}}$

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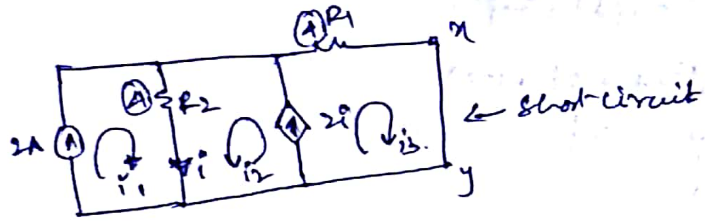


In loop 1,

$\boxed{i_1 = 2A}$

In loop 2, $\boxed{i_2 = 2i}$

$i_1 + i_2 = i$

$i_1 + 2i = i$

$\Rightarrow i_1 = i - 2i$

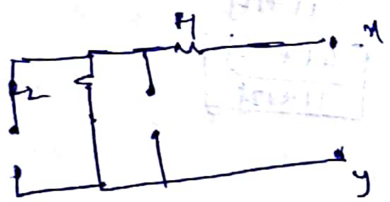
$2 = -i$

$\Rightarrow \boxed{i = -2}$

For loop 3,

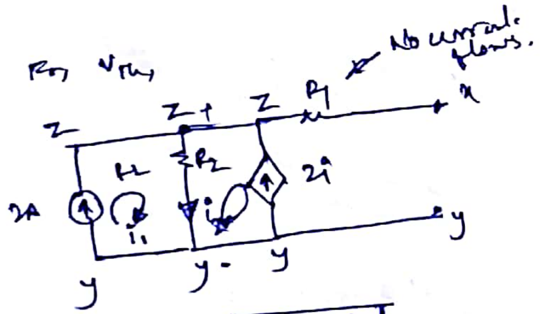
$\boxed{i_3 = -4A}$

For R_{th},



$\therefore R_{th} = 4 + 4 = 8\Omega$

For V_{th},



$V_{xy} = (V_x - V_z) + (V_z - V_y)$

$\therefore \boxed{V_z = V_x}$

$\Rightarrow V_{xy} = \boxed{iR_2}$

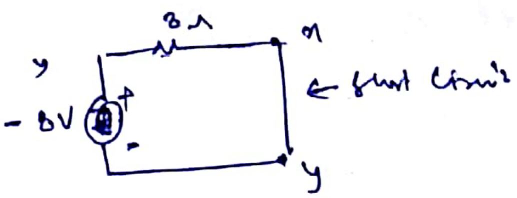
$\Rightarrow \boxed{i_1 = 2A}$ $\boxed{i_2 = 2i}$

$i = i_1 + i_2$

$\Rightarrow i = 2 + 2i$

$\Rightarrow \boxed{i = -2A}$

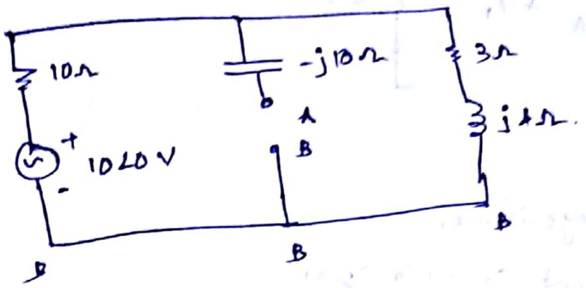
$\therefore V_{th} = -2 \times 4 = \boxed{-8\,V}$



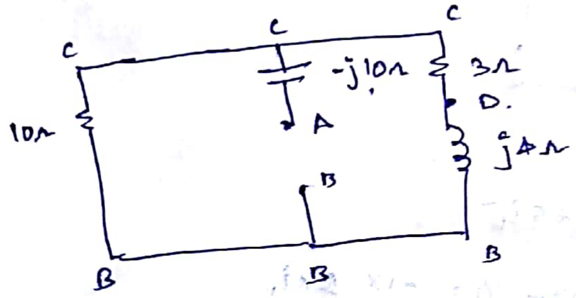
$\therefore I = \frac{-8}{8} = \boxed{-1A}$

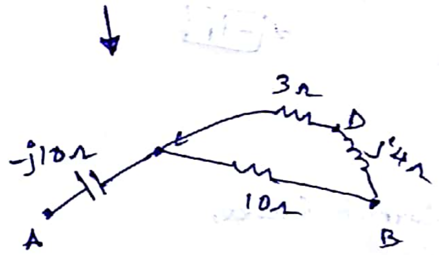
$\boxed{\text{from y to x}}$

A)(3)(a)



For R_{th},





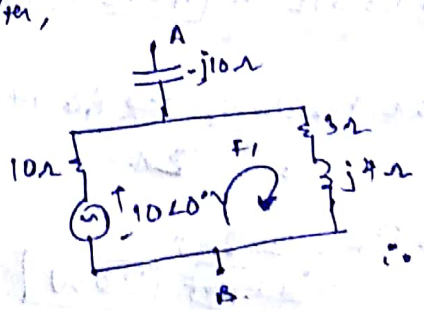
$$\therefore R_{eq} = -j10\Omega + \frac{(3\Omega + j4)\times(10)}{10 + 3\Omega + j4}$$

$$= -j10\Omega + \frac{30 + j40}{13 + j4}$$

$$= \frac{-j130 + 40 + 30 + j40}{13 + j4}$$

$$= \boxed{\frac{70 - j90}{13 + j4}} \quad \text{(Ans)}$$

Now, for V_{th},



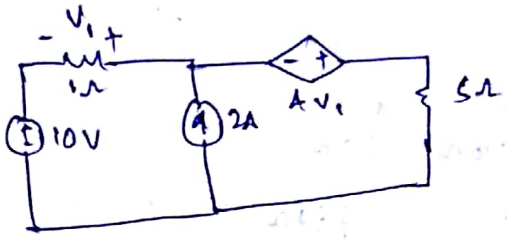
$$\therefore I_1 = \frac{10}{13 + j4}$$

$$\therefore V_{AB} = 10 - 10 \times \frac{10}{13 + j4}$$

$$= 10 - \frac{100}{13 + j4}$$

$$= \boxed{\frac{30 + j40}{13 + j4}} \quad \text{(Ans)}$$

(1) (3)(b).



Now, using only voltage source,

current source is open circuited.

~~i_1 10V~~

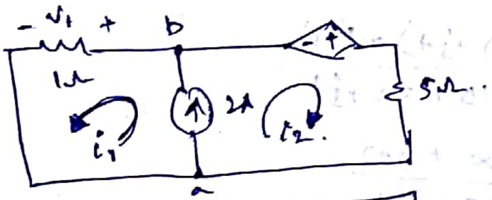
$10 = i_1 \times 1 - 4V_1 + 5i_1$

or $10 = 6i_1 - 4V_1$ Now, $V_1 = -1 \times 1 \times i_1$ $= \boxed{-i_1}$

or $10 = 6i_1 + 4i_1$

or $\boxed{i_1 = 1A}$

Now, with only ~~voltage~~ current source,



~~$i_1 = 2A$~~ $\boxed{i_1 + i_2 = 2A}$

$V_{ba} = V_1$ (From the figure)

$= \boxed{i_1}$

$\therefore V_1 + 4V_1 = 5i_2$

or $5V_1 = 5i_2$

~~or $i_2 = V_1 = 2A$~~. $5i_1 = 5i_2$ or, $\boxed{i_1 = i_2 = 2/2 = 1A}$

$\therefore$ total current through 5Ω resistor is ~~I^2R $i_1 i_2$~~ $1+1$

$= 2A$

$\therefore$ Power $= i^2R = \dfrac{2 \times 2 \times 5}{~~4 \times R W~~}$ $\boxed{20W}$

Group - C

(Ans) (a) 'Gate' signal is a type of signal which restricts the function within a bound (say from T_1 to T_2) when represented in time domain the gate signal is defined as,

$$G_{T_1,T_2} = \begin{cases} a & T_1 \le T \le T_2 \\ 0 & \text{otherwise} \end{cases}$$

(constant. If a = 1 the unit gate signal)

Alternatively, gate signal is also defined as,

$$\boxed{G_{T_1,T_2} = u(t-T_1) - u(t-T_2)}$$

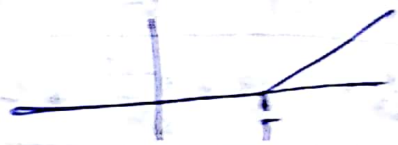
step function.

Ramp function is defined as

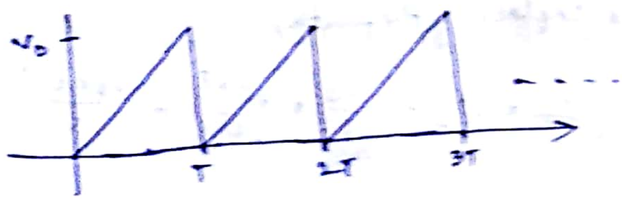
$$r(t) = \begin{cases} t, & t \ge 0 \\ 0, & \text{otherwise} \end{cases}$$

Now, delay time is T

$$\therefore r(t) = \begin{cases} t - T, & T \ge T \\ 0, & \text{otherwise} \end{cases}$$



(b) (a)



from the figure we can see that the ~~time~~ time period of the function is T

∴ we can find the fundamental ~~i~~ explore and then find for the whole ~~a~~ function.

Now, the equation is,

$$y = mx + c$$

$$\Rightarrow f(t) = \frac{V_0}{T} \times t + 0 \quad [\cancel{\text{since}}\ y\text{-intercept} = 0]$$

$$\Rightarrow \boxed{f(t) = \frac{V_0}{T} t}$$

~~$\therefore$ Required function is, f(t~~

$$\therefore F(s) = L\{f(t)\, g(0,T)\}$$

$$= L\{f(t)\,(u(t) - u(t-T))\}$$

$$= L\left\{\frac{V_0}{T} t\, u(t) - \frac{V_0}{T} t\, u(t-T)\right\}$$

$$\cancel{\Rightarrow F(s) = \frac{V_0}{T}}$$

$$\Rightarrow F(s) = \frac{V_0}{T} \times L\{t\,u(t)\} - \frac{V_0}{T} \times L\{(t - T + T)\,u(t-T)\}$$

$$= \frac{V_0}{T} \times \frac{1}{s^2} - \frac{V_0}{T} \times \left(L\{(t-T)\,u(t-T)\} + L\{T\,u(t-T)\}\right)$$

$$= \frac{V_0}{T} \times \frac{1}{s^2} - \left(\frac{V_0}{T} \times \frac{e^{-sT}}{s^2} + \frac{V_0}{\cancel{T}} \times \cancel{T} \times \frac{e^{-sT}}{s}\right)$$

$$= \boxed{\frac{V_0}{T} \times \frac{1}{s^2} - \frac{V_0}{T} \times \frac{e^{-sT}}{s^2} - \frac{V_0 \times e^{-sT}}{s}}$$

$$\cancel{= \frac{V_0}{s}\left(\frac{1}{sT}\right)} -$$

Now, for the whole laplace of the function,

$$F(s) = \left(\frac{V_0}{T} \times \frac{1}{s^2} - \frac{V_0}{T} \times \frac{e^{-sT}}{s^2} - \frac{V_0 \times e^{-sT}}{s}\right) \times \frac{1}{1 - e^{-sT}}$$

$\downarrow$

wholefunc

(A).

(a)(4)(c) Impulse function is a function which is defined as:-

$$\delta(t) = \begin{cases} \infty & t = 0 \\ 0 & \text{otherwise.} \end{cases}$$

So, the value is '∞' at $t=0$ and 0 otherwise.

~~if $\delta(t)=1$ then it is known as unit impulse function.~~

unit Step function $= u(t) = \begin{cases} 1 & t \geq 0 \\ 0 & \text{otherwise.} \end{cases}$

Now, $L\{u(t)\} = L\{a\}$

$= \boxed{\frac{1}{s}}$

Now, $L\{\frac{d\,u(t)}{dt}\} = s \times L\{u(t)\}$ $[u(0)=0]$

$= s \times \frac{1}{s} = \boxed{1} = 1$

equal to the Laplace of impulse function

$$L\{\delta(t)\} = \int_{0^-}^{\infty} \delta(t)\, e^{-st}\, dt$$

$$= \int_{0^-}^{0^+} \delta(t)\, e^{-st}\, dt$$

$=$ [Now acc. to shifting property.

$\int_{0^-}^{0^+} \delta(t) f(t)\, dt = f(0)$]

$\therefore L\{\delta(t)\} = e^{-0}$

$= \boxed{1}$

Hence Proved

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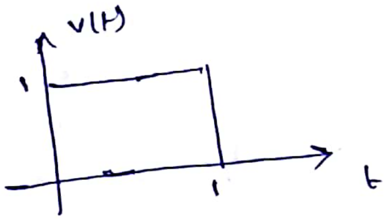
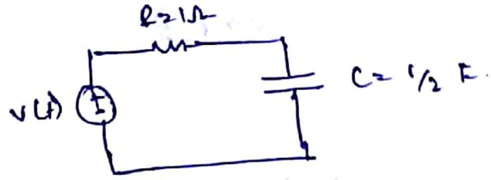
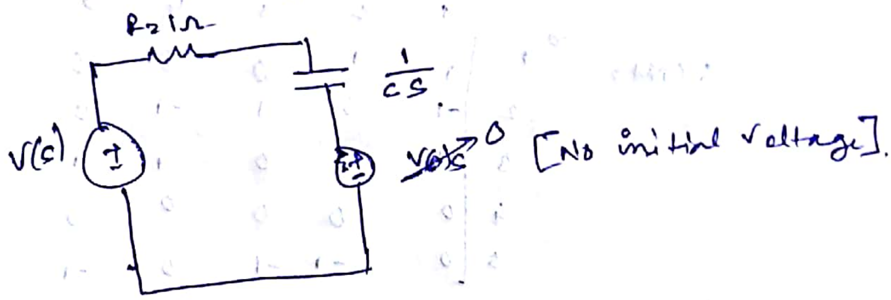
(1)(5)(a)

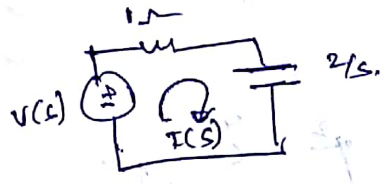




Now, Converting the Circuit to s-domain,
we get,



∴ Circuit is,



Now, $V(s) = L\{ \cancel{u(t)} g(0,1)\}$

$= L\{u(t) - u(t-1)\}$

$= L\{u(t)\} - L\{u(t-1)\}$

$= \cancel{\frac{1}{s} - \frac{e^{-t}}{s}} \quad \frac{1}{s} - \frac{e^{-s}}{s}$

Now, Applying KVL,
we get,

$V(s) = I(s) \times 1 + \frac{2}{s} \times I(s)$

$\Rightarrow I(s) = \frac{V(s)}{1 + 2/s} = \frac{\frac{1}{s} - \frac{e^{-s}}{s}}{1 + \frac{2}{s}}$

$= \frac{1 - e^{-s}}{s+2}$

$I(s) = \boxed{\frac{1}{s+2} - \frac{e^{-s}}{s+2}}$

$\therefore I(t) = L^{-1}\{I(s)\}$

$= L^{-1}\{\frac{1}{s+2}\} - L^{-1}\{\frac{e^{-s}}{s+2}\}$ $\boxed{\cancel{e^{-2t} - e^{-2t} u(t-1)}}$

$= \cancel{e^{-2t} - e^{-2(t-1)}}$ (Ans)

$= \cancel{e^{-2t} - e^{-2(t+1)}}$ (A)

$=$

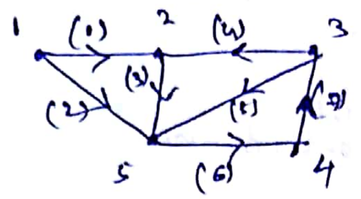
$\boxed{i(t) = e^{-2t} - e^{-2(t-1)} u(t-1)}$

(A)

Group-D

(1)

(a)(b)(a)

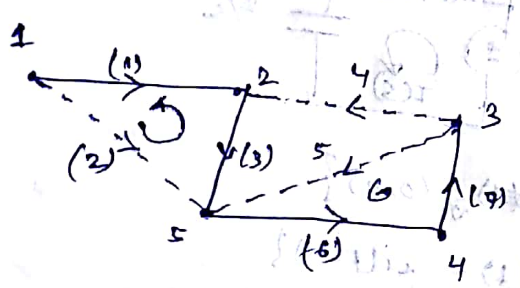


$$\therefore \text{CNM} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{ccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array} \\ \begin{bmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 1 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & -1 & 1 \\ 0 & -1 & -1 & 0 & -1 & 1 & 0 \end{bmatrix} \end{array}$$

(a)(b).

(2)(a)

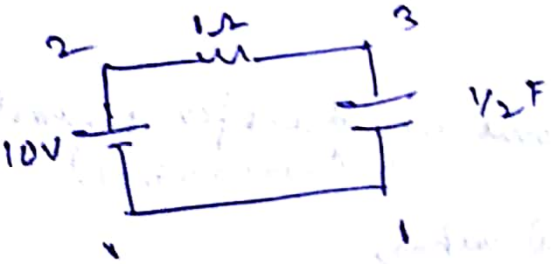
V=



$$\therefore \text{Tie-set} = \begin{array}{c} \\ 2 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{ccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array} \\ \begin{bmatrix} -1 & 1 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 \end{bmatrix} \end{array}$$

$$\text{Cutset} = \begin{array}{c} \\ 1 \\ 3 \\ 6 \\ 7 \end{array} \begin{array}{c} \begin{array}{ccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{array} \\ \begin{bmatrix} & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \end{bmatrix} \end{array}$$

7(a)



$\tau = RC = 0.5$
$Z_1 = 0.5/10 = 0.05$
$Z_2 = 0.5 \times 10 = 5.$

Plot

V	2	1	DC	10
R	2	3	1	
C	3	1	0.5	

.PLOT TRAN 0.05 5 V(C)

.END

(1)(7)(b)

• Print :- • Print tells ~~Pspice~~ Pspice to print the value in the form of a table.

• PRINT (output variable)

gets printed.

• Plot :- • Plot tells pspice to plot the output variable in a graph.

• AC :- Tells pspice to vary the freq. of AC in the circuit.

• AC DEC → Vary in the form of Decades

LIN → Vary Linearly

OCT → Vary in powers of 2

(1)(8)(a) ABCD parameters also known as transfer parameters (transmission) are the parameters defined such that,

V_1 and I_1 are considered dependent whereas V_2 and I_2 are considered independent.

These parameters provide a measure of how a ~~circuit~~ circuit transmits voltage or current from source to load.

$$\boxed{\begin{aligned} V_1 &= A V_2 - B I_2 \\ I_1 &= C V_2 - D I_2 \end{aligned}}$$

A = Open circuit voltage ratio ($I_2 = 0$)

C = Negative open-circuit transfer admittance ($I_2 = 0$)

B = Negative short circuit transfer impedance ($V_2 = 0$)

D = Negative short circuit current ratio ($V_2 = 0$)

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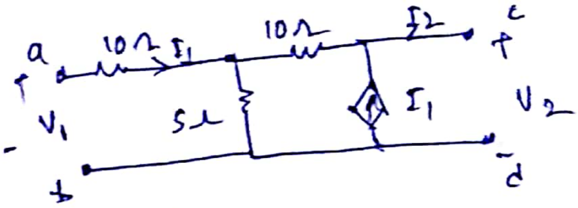
1 (3) (b)

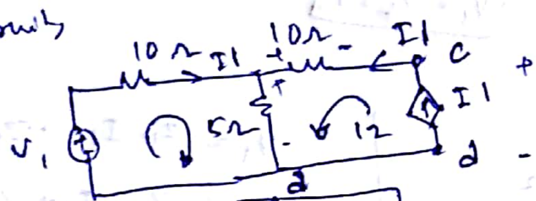


$\therefore V_1 = z_{11} I_1 + z_{12} I_2$

$V_2 = z_{21} I_1 + z_{22} I_2$

Now, let, $I_2 = 0$,

$\therefore$ Circuit



$\boxed{I_2 = I_1}$

$\Rightarrow V_1 = 10 I_1 + 5(I_1 + I_1)$

$\Rightarrow V_1 = 10 I_1 + 10 I_1$

$\Rightarrow \boxed{V_1 = 20 I_1}$

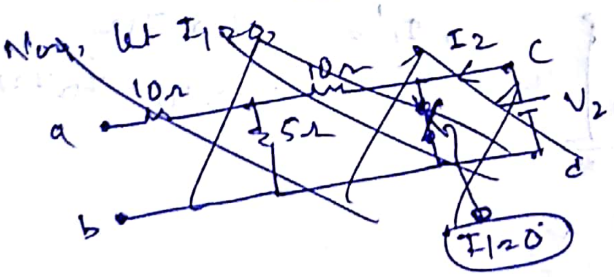
$\therefore \boxed{\frac{V_1}{I_1} = z_{11} = 20.}$

$\therefore V_{cd} + 10 I_1 + 5(I_1 + I_1) = 0$

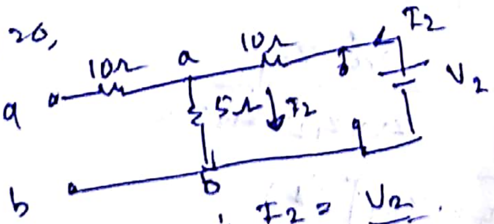
$\Rightarrow V_{cd} = -20 I_1$

$\Rightarrow \boxed{\frac{V_2}{I_1} = -20} = z_{21}$

~~Now, let $I_1 = 0$,~~



Now, let $I_1 = 0$,



$\therefore I_2 = \frac{V_2}{15}$.

$\Rightarrow \frac{V_2}{I_2} = z_{22} = 15$

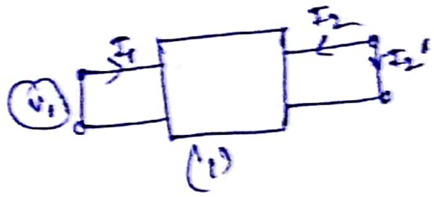
$\therefore \boxed{V_1 = -5 \times I_2}$

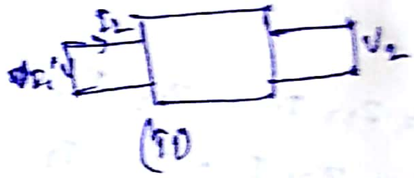
$\Rightarrow \boxed{\frac{V_1}{I_2} = z_{12} = -5}$

$\therefore Z = \begin{bmatrix} 20 & -5 \\ -20 & 15 \end{bmatrix}$

(A).

(1) (3)(c) reciprocity





Note: $\boxed{I_2' = I_1'}$ for reciprocity.

$\boxed{V_1 = V_2 = V_s}$

(I)

$V_1 = Z_{11} I_1 + Z_{12} I_2$

$V_2 = Z_{21} I_1 + Z_{22} I_2$

$V_1 = V_s$

$V_2 = 0$

$\boxed{I_2 = -I_2'}$

$V_s = Z_{11} I_1 - Z_{12} I_2'$

$0 = Z_{21} I_1 - Z_{22} I_2'$

$\boxed{I_1 = \frac{Z_{22}}{Z_{21}} I_2'}$

$\therefore V_s = \left(\frac{Z_{11} \times Z_{22}}{Z_{21}} - Z_{12}\right) I_2'$

$\boxed{I_2' = \frac{V_s \times Z_{21}}{Z_{11} \times Z_{22} - Z_{12} Z_{21}}}$

(II)

$V_1 = Z_{11} I_1 + Z_{12} I_2$

$V_2 = Z_{21} I_1 + Z_{22} I_2$

$V_1 = 0$

$V_2 = V_s$

$I_1 = -I_1'$

$0 = -Z_{11} I_1' + Z_{12} I_2$

$I_2 = \frac{Z_{11}}{Z_{12}} I_1'$

$V_s = Z_{21} I_1 + Z_{22} I_2$

$V_s = \left(\frac{Z_{22} Z_{11}}{Z_{12}} - Z_{21}\right) I_1'$

$I_1' = \frac{V_s \times Z_{12}}{Z_{22} Z_{11} - Z_{12} Z_{21}}$

$\therefore I_2' = I_1'$

$\frac{\cancel{V_s} Z_{12}}{Z_{11} Z_{22} - Z_{12} Z_{21}} = \frac{\cancel{V_s} Z_{21}}{Z_{22} Z_{11} - Z_{12} Z_{21}}$

$\boxed{Z_{12} = Z_{21}}$ (A)