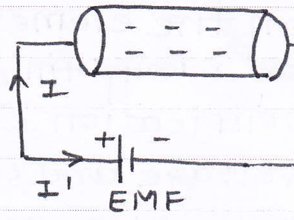
* Power *



I' → Natural current

I → conventional current

→ The Flow of electron is called as current or the time rate of charge is also called As current

$$\boxed{I = \frac{dQ}{dt} \quad C/s \text{ or Amp}} \qquad Q_e = -1.602\times10^{-19}\,C$$

→ To move e^- for one point to another point external Force ReQuired is called Emf (V)

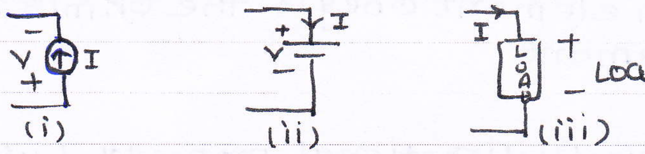
$$\boxed{V = \frac{dW}{dQ} \quad J/C \text{ or Volt}}$$

→ The time rate of Energy called as power.

$$\boxed{P = \frac{dW}{dt} \quad J/sec \text{ or watt} = \frac{dW}{dQ}\cdot\frac{dQ}{dt} = V\cdot I}$$

→ When current enter positive terminal element absorving power.

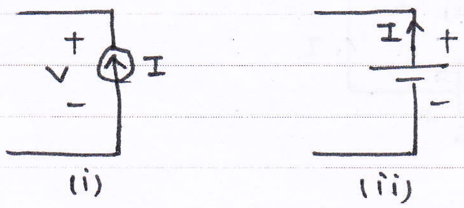
EX. →



All Diagram absorb power.

→ When current leaving from positive terminal called element Deliver power.

EX. →



→ The capacity to do work called Energy

$$W = \int_0^t P\cdot dt \qquad \text{Watt-Sec or Joule.}$$

→ ANY ckt power Absorb = Power Delivers.

* <u>Classification of Elements</u> :→

* <u>Active element</u> :- when the element is capable of delivring Energy independntely For a Long time (approx) ∞ or having property of internal ampiification called Active element.

<u>Example</u> :- (i) Independent voltage and current source

(ii) Dependent Transistor or op-Amp source

→ During discharge capacitor can Deliver energy at short time not a Long time so it is not Active element.

* <u>passive element</u> :→ when the element is not capable of delivering Energy Indepentally the element called passive element.

<u>Example</u> :- R, Bulb, Transformer, ($V_1 I_1 = V_2 I_2$)

CMT ** If V/I ratio ⊕ in Both Direction called Passive else Active **

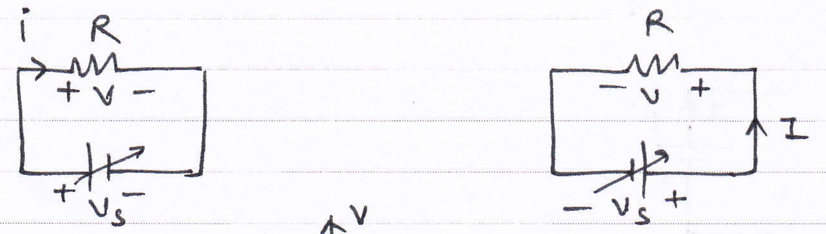
* <u>Bidirectional element</u> :→ when element have properties & characterstic are independent on the Direction of current called Bi-directional (Bi-lateral) element.

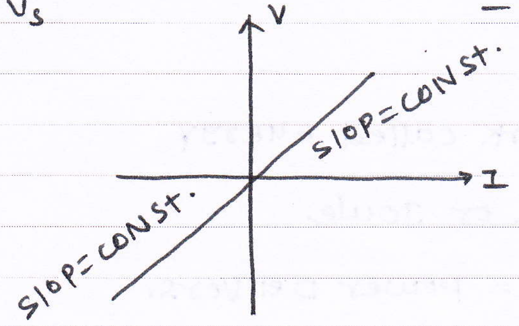
CMT ** when oppsite coordinate Figure same than Bidirectional else Uni-Di.

* <u>Linear element</u> :→ when element obey's the ohm's Law. the element called linear element

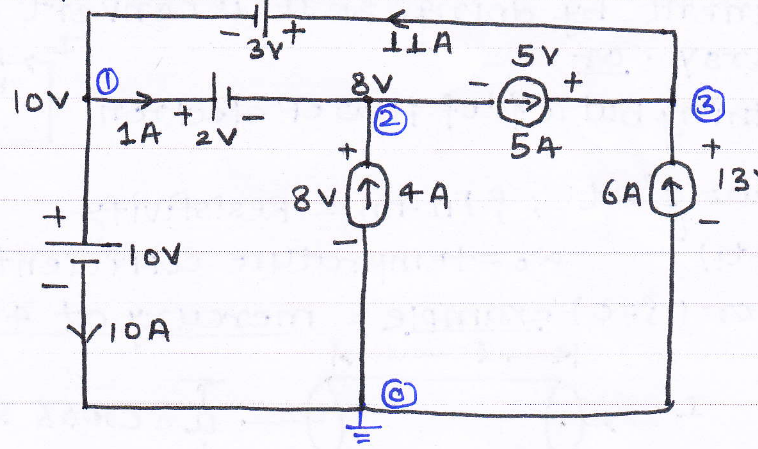
CMT

** Every linear element have Bidirectional property but Not vice-versa **

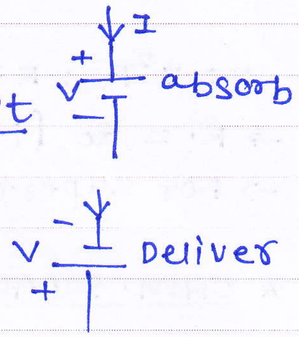




Q.1. Find power of each element of Network shown



concept



Ans:- $P_{10} = 10 \times 10 = 100$ watt (absorb)

$P_{12} = 2 \times 1 = 2$ watt (absorb)

$P_{23} = 5 \times 5 = 25$ watt (Deliver)

$P_{13} = 11 \times 3 = 33$ watt (absorb)

$P_{20} = 8 \times 4 = 32$ watt (Deliver)

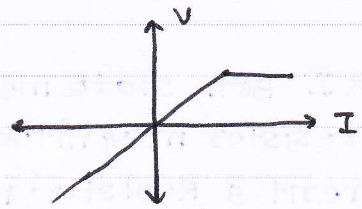
$P_{30} = 13 \times 6 = 78$ watt (Deliver)

Total power absorb $(100 + 2 + 33 = 135$ watt$) =$

Total power Delivez $(32 + 78 + 25 = 135$ watt$)$

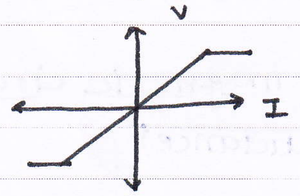
Q.2. Identify given figure type of element.

(a)



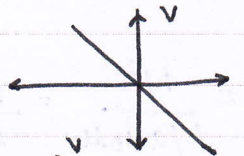
→ passive (V/I ⊕ 1 & 3 Quad.)
→ unidirectional (not same fig 1 & 3 qud.)
→ non linear (slop not const.).

(b)



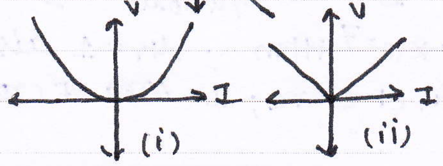
→ passive (V/I ⊕ 1 & 3 Quad)
→ Bidirectional (same fig 1 & 3 Quad)
→ non linear (slop not const)

(c)



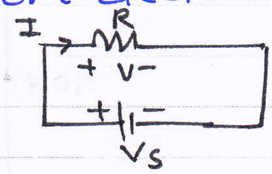
→ Active (V/I = ⊖ 2 & 4 Quad)
→ Bidirectional (same fig 2 & 4 Quad).
→ Linear (slop const.)

(d)



→ Active (V/I ⊕ in 1st & V/I ⊖ 2nd Quad)
→ non linear (slop not const.)
→ unidirectional (not same fig. in oppsite quad)

* **Resistance** * Resistor is a property of Resistor is always oppse a current by doing. so it is convert electrical energy to Heat energy. or
Resistance is nothing but a f^n of flow of electron

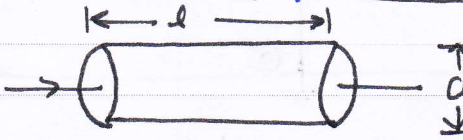


$P = I^2R$; $R = \rho L/A$; $w = I^2Rt$; $\rho\,(\Omega\text{-}m)$ = Resistivity

→ $R_1 = R_0\,[1 + \alpha_0(t_2 - t_1)]$ α_0 = temprature cofficient

→ For superconductor ($\rho = 0$) example :- mercury at 4.15 K temp.

* **OHM'S LAW** :->

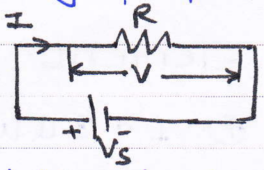


Ohm's Law state that constant temp. and condctivity of material constant current density is directly propotional to electric field Intensity. $J \propto E \Rightarrow J = \sigma E \Rightarrow I/a = \frac{1}{\rho}\cdot\frac{V}{l}$

CMT → $$\boxed{\frac{V}{I} = \frac{\rho l}{a} = R \;;\; J = \frac{I}{a} \;;\; E = \frac{V}{l} \;;\; \sigma = \frac{1}{\rho}\ \text{mho/m or } (\Omega\text{-}m)^{-1}}$$

or

ohm's low state that potential difference Across the element is directly porpotional to current Folowing to element.



$V \propto I \Rightarrow V = IR \Rightarrow R = \frac{V}{I} = \text{const.}$

$I \propto V_S$ (EMF) or V (Voltage drop / P.D) $\propto I$ Both statement valid.

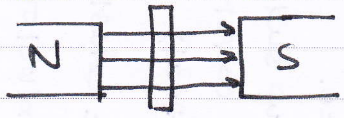
(i) EMF independent on current and resistor magnitude
(ii) potential difference depend on current & Resistor magnitude

* ELECtrical circuit	magnetic circuit. *
→ $I = \frac{V}{R} = \frac{EMF}{R}$	→ $\phi = \frac{mmf}{S\,(\text{Reluctance})}$
→ $I = V/R = V/\frac{\rho l}{a} = EMF/\frac{\rho l}{a}$	→ $\phi = \frac{NI}{l/a\mu_0\mu_r}$
	→ $L = \frac{N^2\mu_0\mu_r a}{l} = \frac{N^2}{l/a\mu_0\mu_r} = \frac{N^2}{S}$
	$\mu_0 = 4\pi\times10^{-7}$ H/m ; $\mu_r = 1$ air

→ peremability is the property of meduim which magnetic field exsit. l = length of core ; a = Area of cross sectional

* Faraday Low :→

* **First Law** :→ When conductor cuts a magnetic lines of Force an emf induced in the conductor.



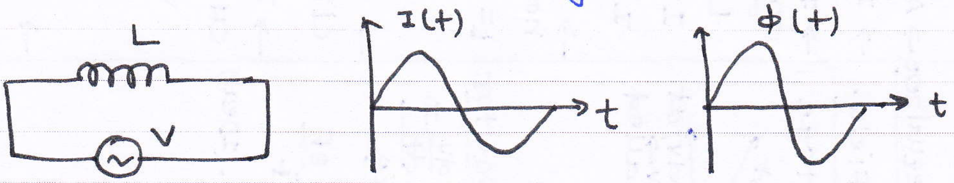
* **Second Law** :→ Emf induced in the conductor is directly propotional to rate of change of Flux.

$e \propto \frac{d\phi}{dt}$ $\Rightarrow$ $e = BLV \sin\theta$

CMT* → $e = \boxed{\text{Dynamic Induced emf (Generator)}}$

B = Flux density, l = length of conductor, Velocity of conductor - V

θ = Angle b/w conductor & magnetic line.



$e \propto \frac{d\phi}{dt}$

CMT *

$$\boxed{e = -N\frac{d\phi}{dt} = \text{Statically induced emf (Transformer).}}$$

→ Due to Lenz's Law

CMT

* Flux linkage $\psi = N\phi = LI$

$V = \frac{d\psi}{dt} = N\frac{d\phi}{dt}$

$V = L\, di/dt$

Capacitor (C)

→ $Q \propto V \Rightarrow Q = CV \Rightarrow C = \frac{Q}{V} \left\{ \frac{\text{Columb}}{\text{Volt}} \text{ or Farad} \right\}$

→ $I = \frac{dQ}{dt} = C\frac{dV}{dt} \Rightarrow V = \frac{1}{C}\int_{-\infty}^{t} I \cdot dt$

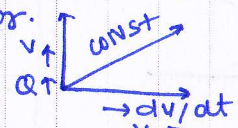
→ $P_{INST.} = V \cdot I = V \cdot C\frac{dV}{dt} \Rightarrow W = \int P_{INST.} \cdot dt = \frac{1}{2}CV^2$

→ Avg. power dissipiation In Ideal capacitor equal zero

→ capacitor storage energy In Form electric Field.

→ when capictance is Independent on voltage magnitude called linear capacitor.

$C = \frac{Q}{V} = \text{CONST.}$ ∴ $V\uparrow 10\%$ ∴ $Q\uparrow 10\%$;

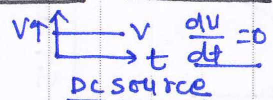


→ when it Depend on voltage magnitude called non linear capacitor:- ex:- varactor Diode

$C = Q/V =$ varible.

→ steady state condition For Dc source capacitor Act As open circuit ⇒ $I = C\frac{dV}{dt}$

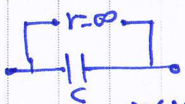
$\boxed{\text{So } I = 0}$



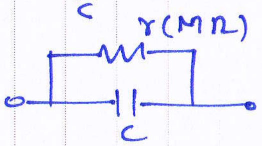
→ capacitor does not allow sudden change of voltage bcs sudden change of voltage it Required infinte curret $I = C\frac{dV}{dt}\Big|_{dt=0}$; $I = \infty$. (IDeal)

(practical):- Finite time constant ($\tau = RC$)

→



IDeal capacitor



Practical capacitor.

Inductor (L).

→ $LI = N\phi$

→ $V = L\,di/dt \Rightarrow I = \frac{1}{L}\int_{-\infty}^{t} V \cdot dt$

→ $P_{INST.} = V \cdot I = L\frac{dI}{dt} \cdot I \Rightarrow W = \int P_{INST} \cdot dt = \frac{1}{2}LI^2$

→ Avg. powerdissipiation In IDEAL Inductor zero

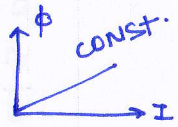
→ Inductor Store energy In Form magnetic field (K.E).

→ Inductance Indepent on current magnitude called linear Inductor or Air core Inductor

$L = V/di/dt = \text{CONST.}$

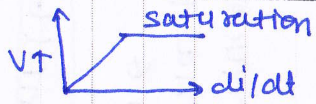
$I\uparrow 10\%$ $\phi\uparrow 10\%$.

$I\uparrow 90\%$ $\phi\uparrow 90\%$.



→ Depend on current magnitude called non linear or Iron core Inductor.

$L = \frac{N\phi}{I}$;



→ Under steady state For Dc source Act short circuit. $V = L\,di/dt \Rightarrow V = 0$.

→ Inductor does not allow sudden change of current bcs it Required ∞ voltage (Practical).

$V = L\,di/dt\big|_{dt\to 0} = \infty$ (IDeal)

or

Practical Finite time CONST ($\tau = L/R$)

→

(IDeal Inductor)

(Practical Inductor).

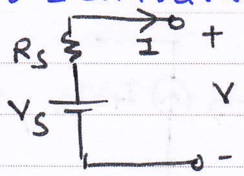
* Voltage source :→

(i) Ideal voltage source delivers energy at specify voltage (V) which is independ on current delivers by source.

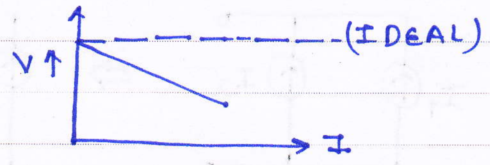
(ii) Internal Resistance of ideal voltage source = zero. ($R_s = 0$).

(iii) practical voltage source delivers energy as specifiy voltage which depend on current delivers by source.

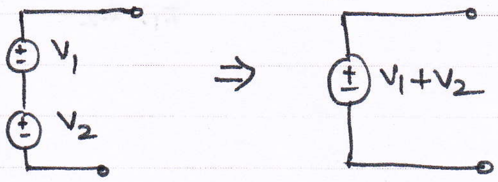
(iv) Independent voltage source does not obey ohm's law. V-I characterstic (non-linear & unidirectional).



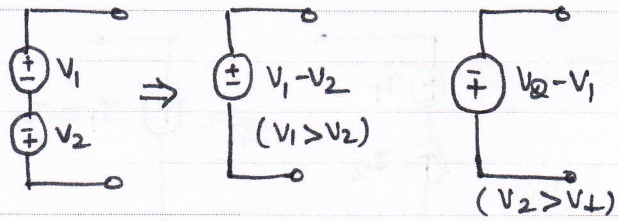
$\Rightarrow \quad V_s = V + I R_s$



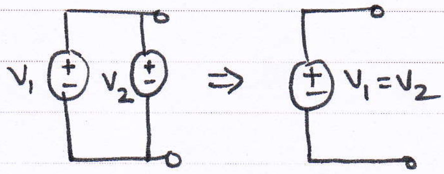
(a)



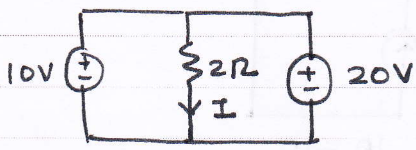
(b).



(c)

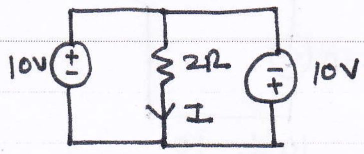


Q. Find current in 2Ω Resistor?



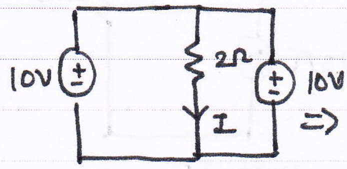
$10 \neq 20$

Not satisfied KVL.



$10 \neq -10$

Not satisfied KVL



$10 = 10$ so $I = 10/2 = 5A$

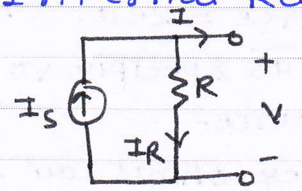
satisfied KVL

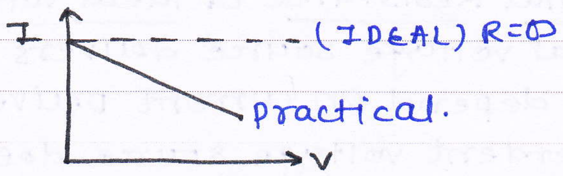
* Current Source *

(i) Ideal current source deliver energy at specified current (I) which is independent on voltage across the source

(ii) Internal Resistance of Ideal current source = infinite.

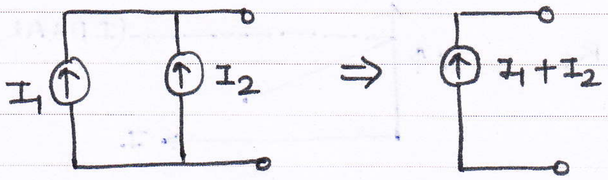
(iii)



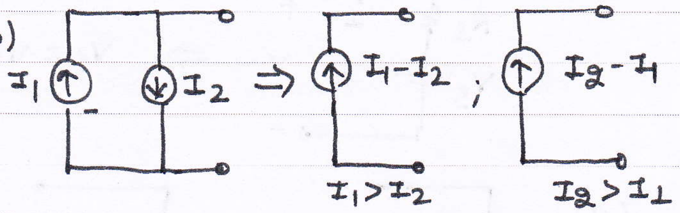


$I_s = I_R + I$.

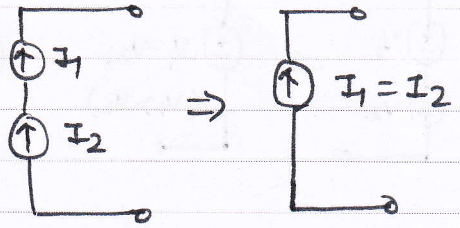
(a)



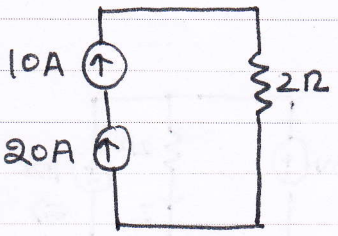
(b)



(c)

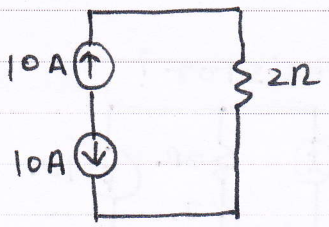


Q. Find current in 2Ω Resistor?



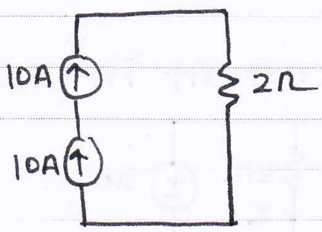
$10 \neq 20$

Not use KCL



$10 \neq -10$

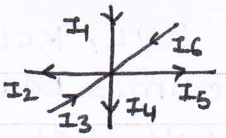
Not use KCL



$10 = 10$

use KCL so $I = 10A$ at 2Ω.

* KCL (Law of conservation charge) :→

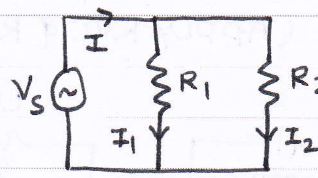


(i) algebric sum of current = 0 at a point.

(ii) when two point element connect common point called simple Node or more than two element called principel Node.

(iii) $I_1 + I_3 + I_6 = I_2 + I_4 + I_5$

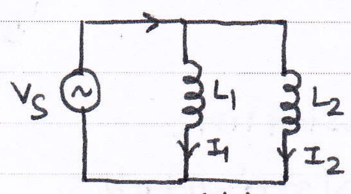
(iv)



(a)

$$R_{eq} = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

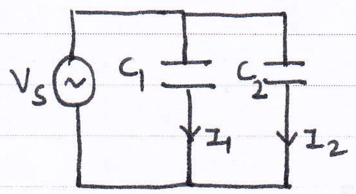
$$I_1 = \frac{I \cdot R_2}{R_1 + R_2} \; ; \; I_2 = \frac{I \cdot R_1}{R_1 + R_2}$$



(b).

$$L_{eq} = \frac{L_1 \cdot L_2}{L_1 + L_2}$$

$$I_1 = \frac{I \cdot L_2}{L_1 + L_2} \; ; \; I_2 = \frac{I \cdot L_1}{L_1 + L_2}$$



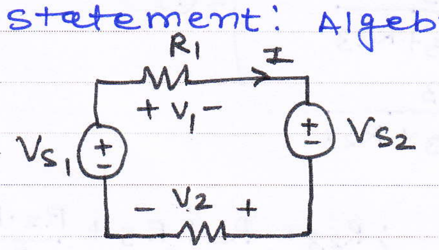
(c)

$$C_{eq} = C_1 + C_2$$

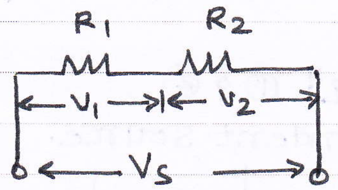
$$I_1 = \frac{I \cdot C_1}{C_1 + C_2} \; ; \; I_2 = \frac{I \cdot C_2}{C_1 + C_2}$$

* KVL (Law of conservation energy) *

(i) statement: Algebric sum of voltage inclosed closed loop is zero.



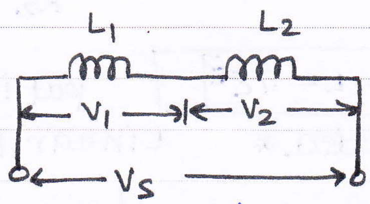
$\Rightarrow$ $V_{s1} = V_1 + V_2 + V_{s2}$



$R_{eq} = R_1 + R_2$

$$V_1 = \frac{V_s \cdot R_1}{R_1 + R_2}$$

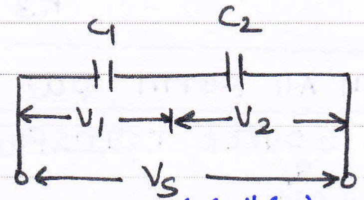
$$V_2 = \frac{V_s \cdot R_2}{R_1 + R_2}$$



$L_{eq} = L_1 + L_2$

$$V_1 = \frac{V_s \cdot L_1}{L_1 + L_2}$$

$$V_2 = \frac{V_s \cdot L_2}{L_1 + L_2}$$



$C_{eq} = (C_1 \| C_2) = \frac{C_1 \cdot C_2}{C_1 + C_2}$

$$V_1 = \frac{V_s \cdot C_2}{C_1 + C_2}$$

$$V_2 = \frac{V_s \cdot C_1}{C_1 + C_2}$$

→ KVL, KCL Fails For distributed parameter

→ ohm's Law apply lumped or distributed parameter

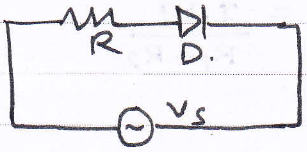
→ KVL, KCL Apply [Lumped + linear/Non linear + uni or Bi Directional + Time varient or time invarient]

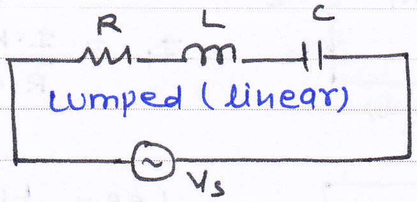
→

* Field theory → Apply Low & High Frequency (Not Apply KVL & KCL)

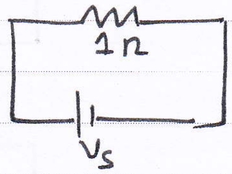
* Network theory → Low Frequency (Apply KVL & KCL).

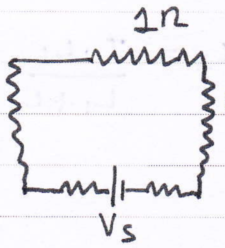
→ Lumped (non-linear)





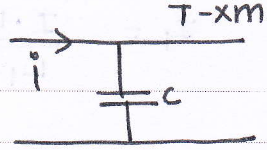
Lumped.





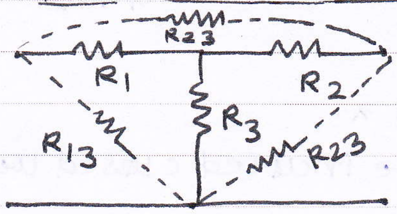
Distributed

T-xmission line



Distributed

* Y-Δ CONVERSION *



Δ to Y.

$$R_1 = \frac{R_{12} \cdot R_{13}}{R_{12} + R_{13} + R_{23}}$$

$$R_2 = \frac{R_{12} \cdot R_{23}}{R_{12} + R_{13} + R_{23}}$$

$$R_3 = \frac{R_{23} \cdot R_{13}}{R_{12} + R_{13} + R_{23}}$$

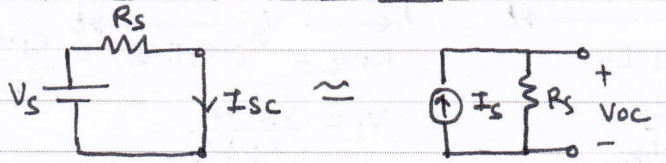
— (1)

Y to Δ

$$R_{12} = R_1 + R_2 + \frac{R_1 \cdot R_2}{R_3} \; ; \; R_{13} = R_1 + R_3 + \frac{R_1 \cdot R_3}{R_2} \; ; \; R_{23} = R_2 + R_3 + \frac{R_2 \cdot R_3}{R_1} \quad -(2)$$

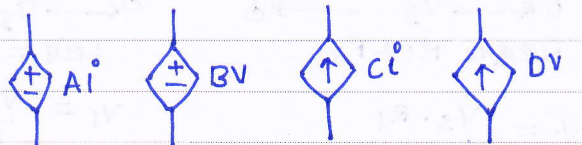
$\boxed{\text{In All Form put } [R = L = 1/C = Z]}$ put in eqn (1) & (2)

* Source Transformation *



$I_s = I_{sc} = V/R_s$; $V_{oc} = V_s = I_s \cdot R_s$.

Linear Dependent Source.



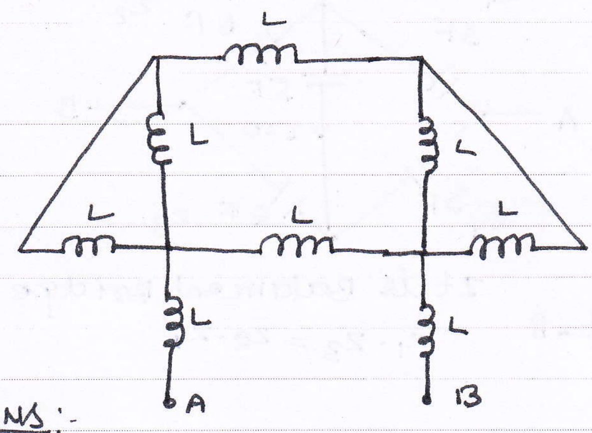
CCVS A → Ω

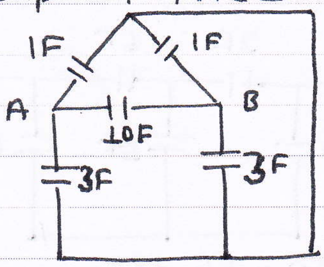
VCVS B → X

CCCS — C → X

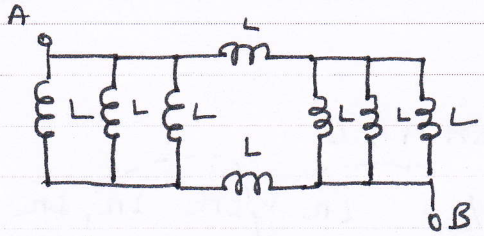
VCCS D → mho

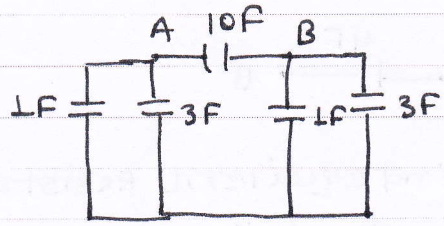
Q.3. Find equal Inductance or capacitance between A & B is

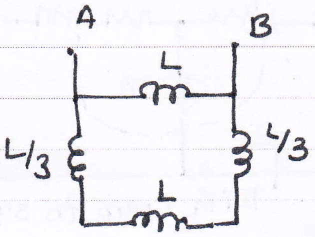


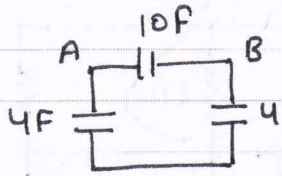


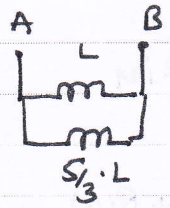
ANS :-

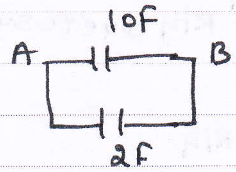


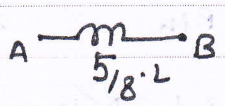


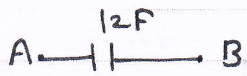




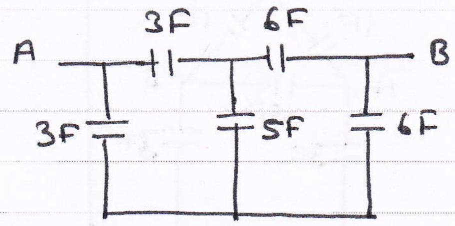




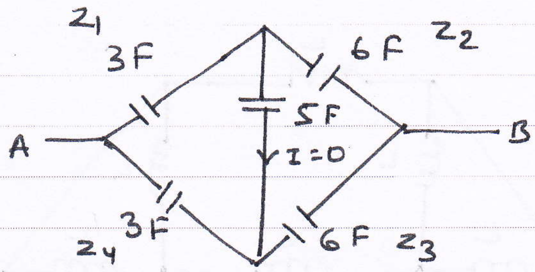




Q.4. Find equilent capacitance b/w A & B.



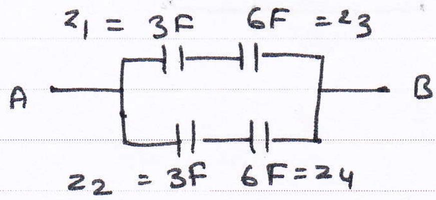
⇒



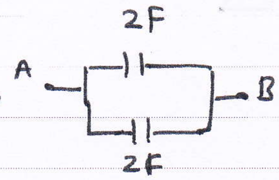
It is Balanced Bridge so

$z_1 \cdot z_3 = z_2 \cdot z_4$

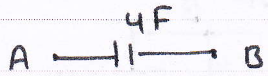
⇒



⇒

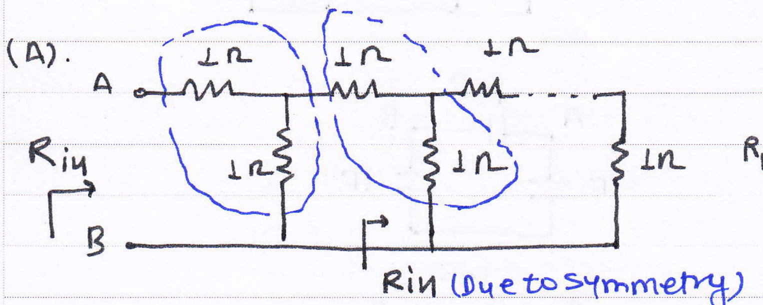


⇒

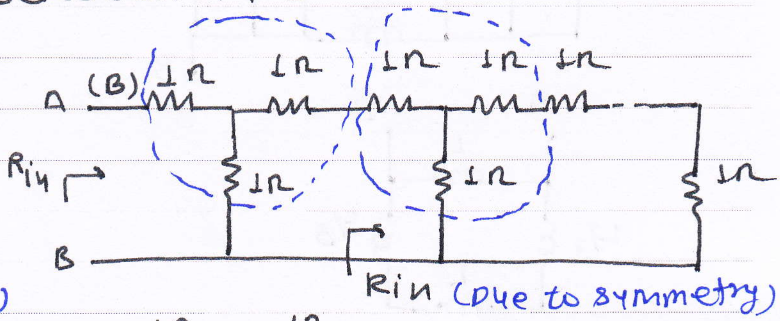


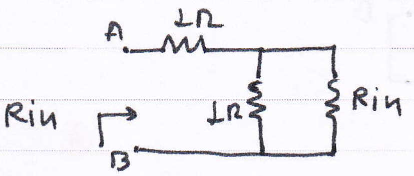
Q.5. Find equilent Resistance between A & B

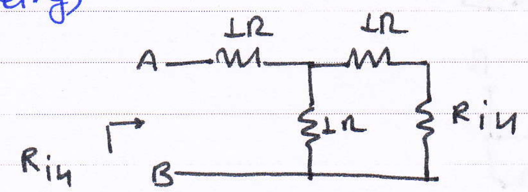
(A).



(B)







$$R_{in} = 1 + \frac{1 \times R_{in}}{1 + R_{in}}$$

$$R_{in}^2 - R_{in} - 1 = 0$$

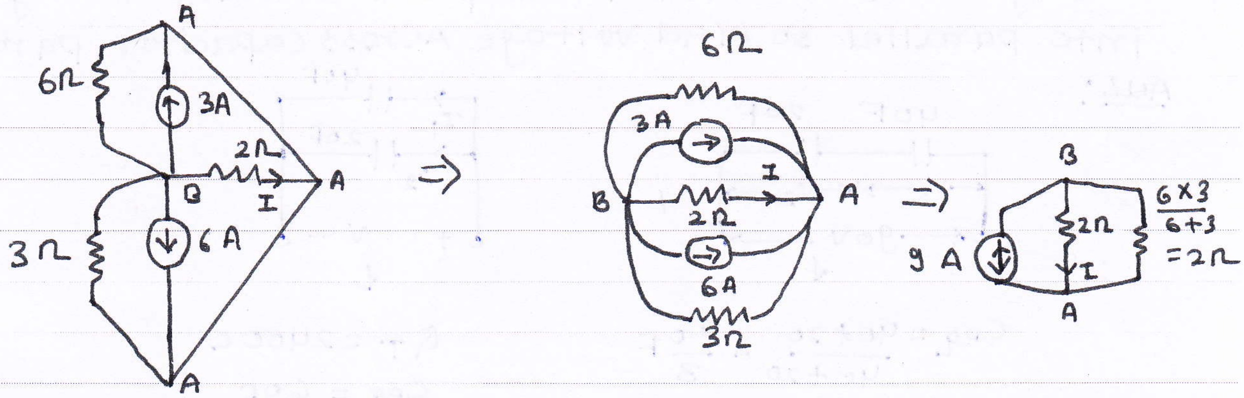
$$R_{in} = \frac{1+\sqrt{5}}{2}\,\Omega \text{ Ans}$$

$$R_{in} = 1 + \frac{1 \times (1 + R_{in})}{1 + 1 + R_{in}} = \frac{3 + 2R_{in}}{2 + R_{in}}$$

$$\cancel{2R_{in}} + R_{in}^2 = 3 + \cancel{2R_{in}}$$

$$R_{in} = \sqrt{3}\ \Omega$$

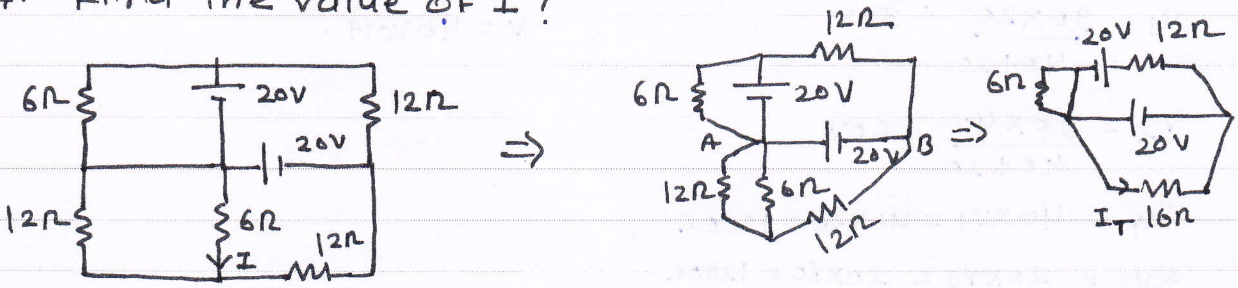
Q.6 Find current in 2Ω Resistor?



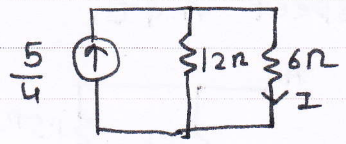
So current Divider Rule $I = \frac{-9 \times 2}{4} = -4.5$ Amp (B→A)

$I = 4.5$ Amp (A→B).

Q.7. Find the value of I?

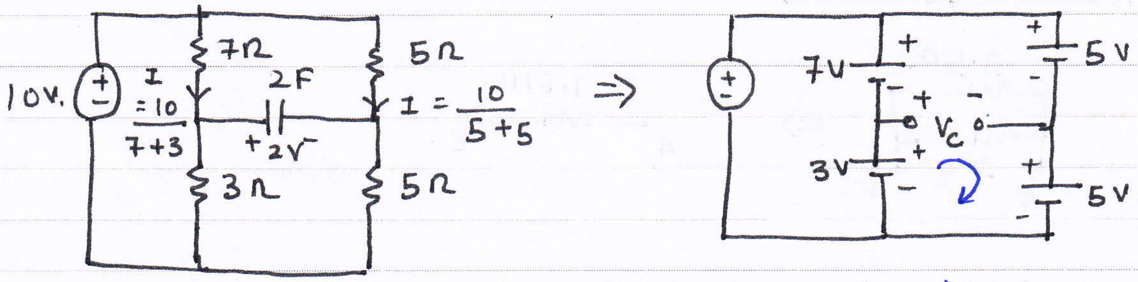


parallel voltage same $I_T = \frac{20}{16} = \frac{5}{4}$ Amp.



$I = \frac{\frac{5}{4} \times 12^{3}}{18} = \frac{15}{18} = \frac{5}{6} = 0.7$ Amp.

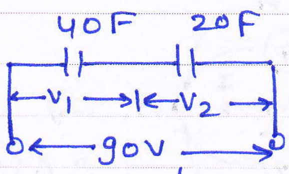
Q.8. Find an energy of given capictor?

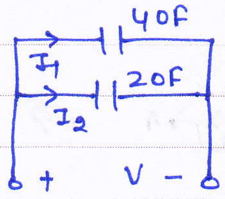


$-3 + V_c + 5 = 0 \Rightarrow$ $V_c = -2V$. ; capacitor energy $= \frac{1}{2}CV^2 = \frac{1}{2} \times 2 \times 4 = 4$ Watt

Q.9. Two capacitor of 40F & 20F Are connected in series to source voltage of 90V. When two capacitor charged Fully & connected into parallel so find voltage Across capacitor parallel connection?

Ans:-





$C_{eq} = \frac{40 \times 20}{40+20} = \frac{40}{3} F$

$Q = C_{eq} \cdot V = \frac{40}{3} \times 90$

$Q = 1200C$

$V_1 = \frac{90 \times 20}{40+20} = 30V$

$V_2 = \frac{90 \times 40}{40+20} = 60V$

$Q_{V_1} = 40 \times V_1 = 40 \times 30 = 1200C$

$Q_{V_2} = 20 \times V_2 = 20 \times 60 = 1200C$

$Q_T = Q_{V_1} + Q_{V_2} = 2400C$

$Q_T = 2400C$

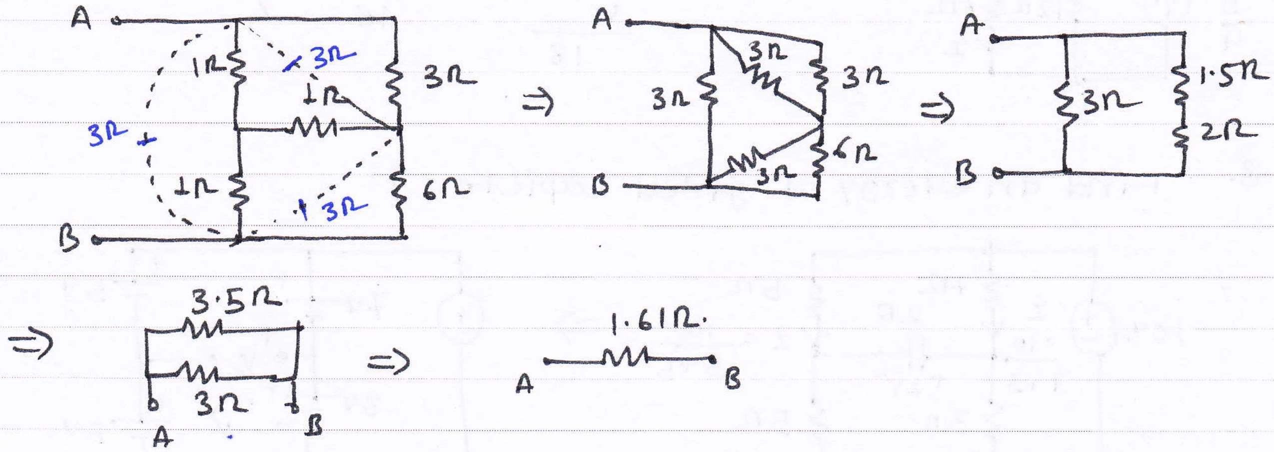
$C_{eq} = 60F$

$Q_T = C_{eq} \cdot V$

$2400 = 60 \times V$

$V = 40 Volt$

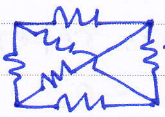
Q.10. Find equilent Resistance with Respect A & B.

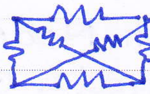


* Mesh Analysis :->

→ mesh Analysis can be Applied only For planner Network

→ A Network Have No cross connection its diagonal element called planner Network


→planner N/w


→ Nonplanner Network.

→ No of KVL or mesh equation = $e = b - N + 1 = b - N + 1 = b - (N-1)$ (N = Pirnipel Node.)

*** procedure ***

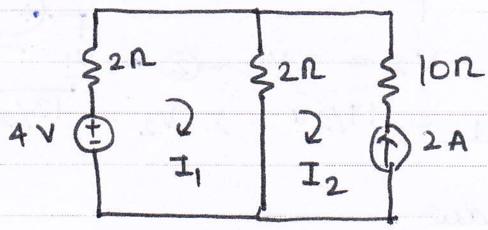
(a) IDentify total No of Mesh in the given Network by $e = b-(N-1)$

(b) assign current Direction For each mesh (clockwise) ↻I

(c) Devolp KVL eq^n For each mesh.

(d) By solving KVL eq^n find Loop current.

ex:->



$N = 2, b = 3$

(a) No of mesh eq^n $= b-(N-1) = 3-(2-1) = 2$

(b) take Direction of current in loop clockwi

(c) Apply KVL in 1st loop & 2nd loop

$-4 + 2I_1 + 2(I_1 - I_2) = 0$ —①

$10I_2 + 2(I_2 - I_1) = 0$ —②

$I_2 = -2A$ —③

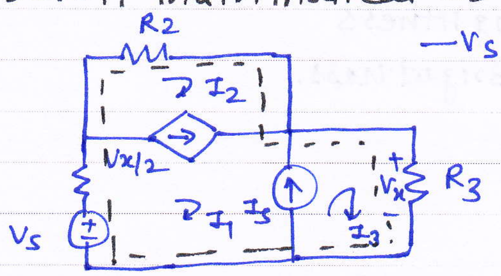
so soluation eq^n ①, ② & ③ $I_2 = -2A$, $I_1 = 0A$.

*** Supermesh *** When current source branch is common for two mesh. it is possible to find soluation super mesh technique.

IMT**

Mesh = KVL + Ohm's Law
Supermesh = KVL + KCL + Ohm's Law

Ex. Devolp mathmatical eq^n For Network shown



$-V_s + R_1 I_1 + R_2 I_2 + R_3 I_3 = 0$ (KVL)

$I_1 - I_2 = \frac{V_x}{2}$ (KCL)

$I_1 - I_3 = -I_s$ (KCL)

* Nodal Analysis *

CMT * it can applied linear or non planner or planner Network

* procedure :->

(a) IDentifiy total NO of Nodes in the given Network = e = (N-1)

(b) Assign voltage at each Node one Node take reference Node

CMT -> refrence Node potential = Ground potential = 0 .

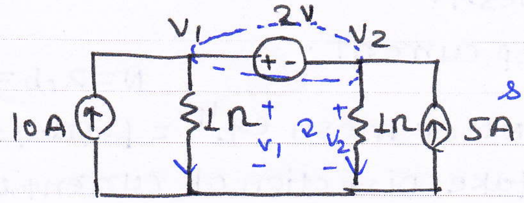
(c) Devolp KCL equation of each non-reference Node.

(d) solving KCL equation find Node voltages.

* Super Node *

when IDeal voltage source connected between two non-reference Node and find sol^n by super Node method.

ex :-



V_1 & V_2 common point due to super Node

so $\frac{V_1}{1} + \frac{V_2}{1} = 10+5$ —①

$V_1 - V_2 = 2V$ —② ←

2V, + V_1, + V_2

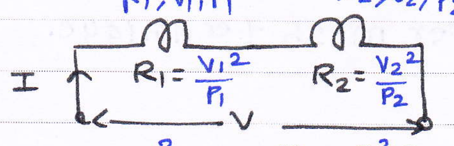
$V_1 = 17/2\,V$; $V_2 = 13/2\,V.$

CMT **

Node = KCL + Ω Low
super Node = KCL + KVL + Ω Law

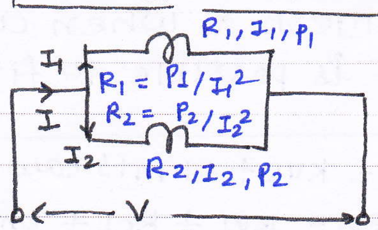
* Bulb brightness *

series connected Bulb



$P_1 = I^2 R_1$, $P_2 = I^2 R_2$

parallel connected Bulb



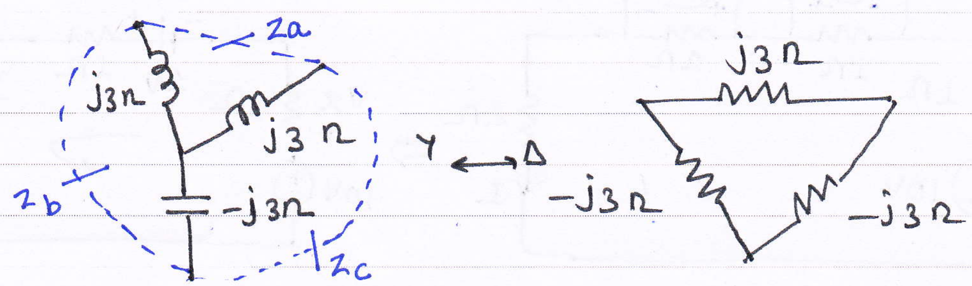
$P_1 = \frac{V^2}{R_1}$, $P_2 = \frac{V^2}{R_2}$

when voltage Rating same :-

(a) series Low rating Bulb more Brightness

(b) parallel High rating Bulb more Brigutness.

Q.12. Identify element Y-Δ conversion given Y connection.

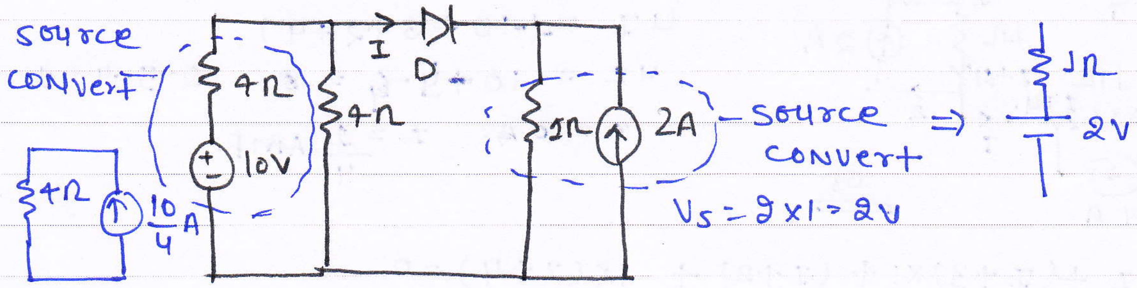


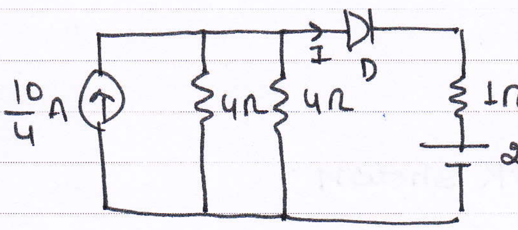
$$Z_a = j3 + j3 + \frac{j3 \times j3}{-j3} = j3\Omega \quad \text{(Inductor)}$$

$$Z_b = j3 - j3 + \frac{j3 \times -j3}{j3} = -j3\Omega \quad \text{(capacitor)}$$

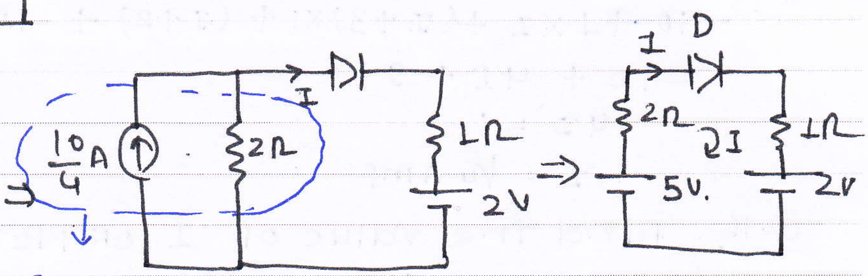
$$Z_c = j3 - j3 + \frac{j3 \times -j3}{j3} = -j3\Omega \quad \text{(capacitor)}$$

Q.13. Find current through Ideal diode is: I = ?





$$\frac{4 \times 4}{4+4} = 2\Omega$$



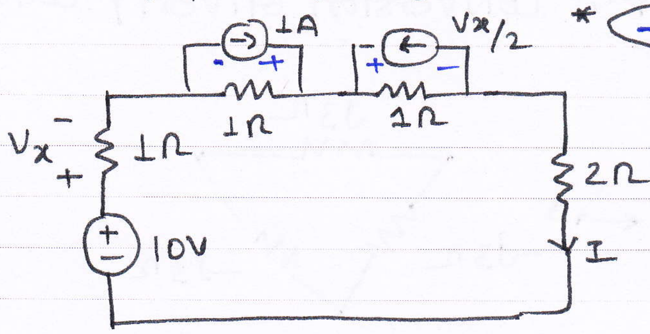
Source convert

$$V = \frac{10}{4} \times 2 = 5 \text{ volt}$$

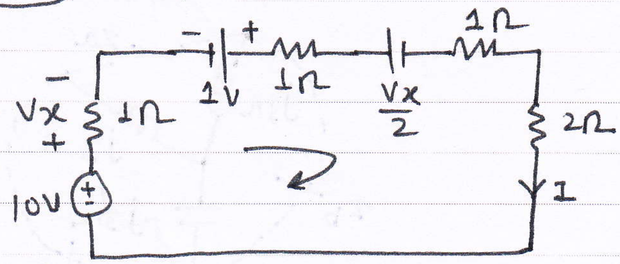
$$I = \frac{5-2}{3} = 1A.$$

Q.14. Find current of 2Ω Resistor on Given N/W

* (- ⟶ +) → cmt



⇒



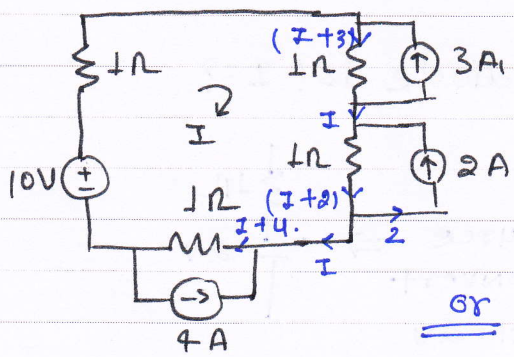
$-10 + 5I - 1 + \frac{V_x}{2} = 0$; $V_x = I$

$-10 + 5I - 1 + \frac{I}{2} = 0$

$\boxed{I = 2A}$

* Good

Q.15 Find the value of I of the Network shown:



$-10 + 1 \times I + I+3 + I+2 + I+4 = 0$

$4I = 1$

$-10 + 4 \times I + (1 \times 3) + [1(\times 2)] + (1 \times +4) = 0$

$4I = -(-10 + 3 + 2 + 4)$

$4I = 10 + 5 - 6 = 8$ $10 - 5 - 4 = 1$

$I = 2A.$ $I = \frac{1}{4}$ Amp.

or

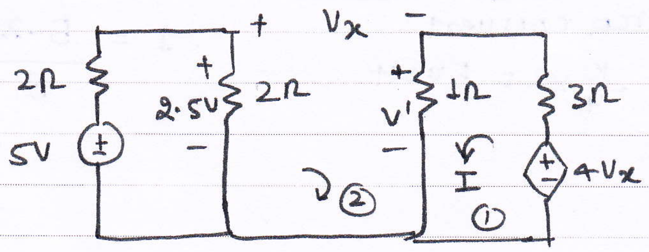
$-10 + 1 \times I + (I+3) \times 1 + (I+2) + 1 \times (I+4) = 0$

$-10 + 4I + 9 = 0$

$4I = 1$

$I = 1/4$ Amp

Q.16. Find the value of I of Network shown.



From ①

$I = \frac{4V_x}{4} = V_x$

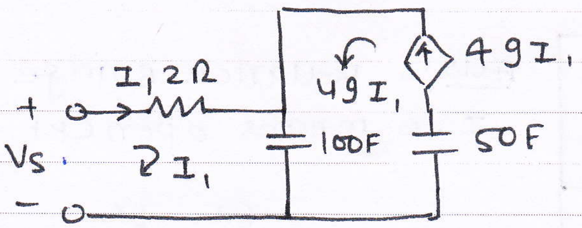
$V' = 1 \times I = I$

From ② $-2.5 + V_x + I = 0$

$2I = 2.5$

$I = 1.25$ A.

Q.17. Find equilent capacitance w.r.t A & B



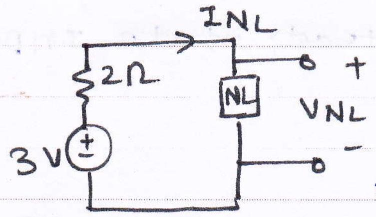
$$V_s = 2I_1 + \frac{1}{100}\int 50 I_1\,dt$$

$$V_s = 2I_1 + \frac{1}{2}\int I_1\,dt \quad -①$$

General eq^n $V_s = R I_1 + \frac{1}{C_{eq}}\int I_1\,dt \quad -②$ compare $\boxed{C_{eq} = 2F}$

Q.18. A Practical DC source of 3V with internal Resistance of 2Ω is connected to non linear resistor. the character stic of Non linear Resistor given by $V_{NL} = I_{NL}^2$ Find power dissipiation in non-linear Resistor?

Ans:-



$$-3 + 2I_{NL} + V_{NL} = 0$$

$$-3 + 2I_{NL} + I_{NL}^2 = 0$$

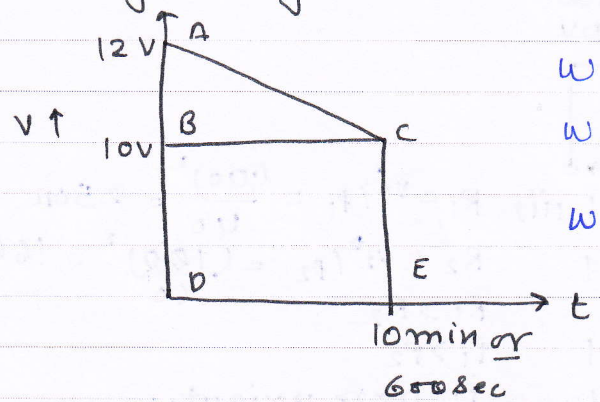
$$I_{NL} = -3A,\ 1A$$

so $I_{NL} = 1A$

power dissipiation (power absorb)

$$P_{NL} = V_{NL} \times I_{NL} = I_{NL}^3 = 1\text{ watt}$$

Q.19 A fully charged mobile is good for 10min talk time during battery deivers A constant current of 2Amp. Find energy of the battery during talktime in Given characterstic:

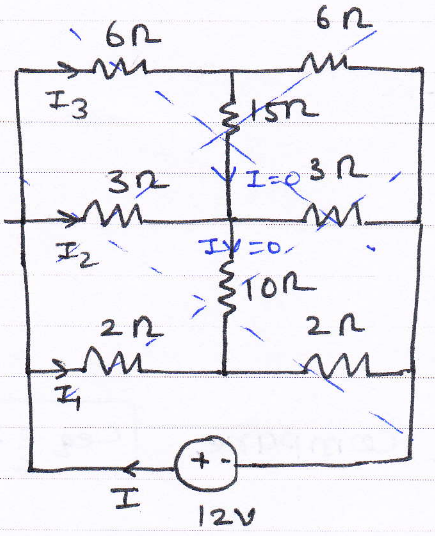


$$W = (\triangle ABC + \square BCDE) \times 2$$

$$W = \left(\frac{1}{2} \times 600 \times 2 + 10 \times 600\right) \times 2$$

$$W = 6600 \times 2 = 13.2\text{ kJ}$$

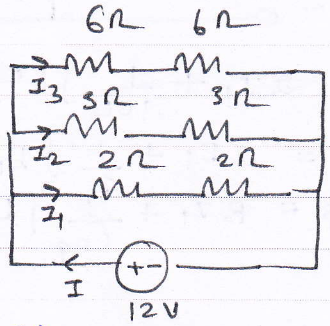
Q.20. Find the value of I shown Fig.



<u>Ans</u>:- Ballance Bridge

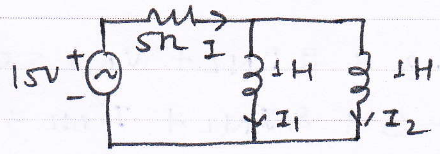
I = 0 means open ckt

⇒



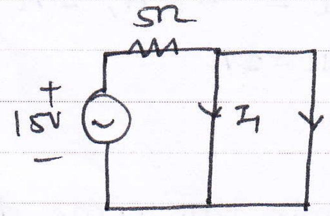
$I = I_1 + I_2 + I_3 = \frac{12}{6+6} + \frac{12}{3+3} + \frac{12}{2+2} = 1+3+2 = 6\,A.$

Q.21 Find steady state current I_1, I_2 in steady state condition.



at steady state Inductor behave short ckt.

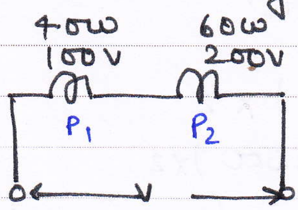
⇒

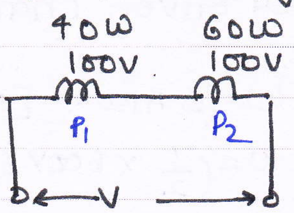


$I_1 = I_2 \Rightarrow 15/_{3+2} = \frac{15}{5} = 3A = I_1 + I_2$

$I_1 = I_2 = 1.5A.$

Q.22. Following connection which give more brightness.





<u>Ans</u> (i) $R_1 = \frac{P}{I^2} = \frac{V^2}{P}$

$R_1 = V_1^2/P_1 = (100)^2/40 = 250\Omega$

$R_2 = V_2^2/P_2 = (200)^2/60 = 666.7\Omega$

$R_2 > R_1$; so $P_2 > P_1$ ∴ P_2 more Brigut

(ii) $R_1 = V_1^2/P_1 = \frac{(100)^2}{40} = 250\Omega$

$R_2 = V_2^2/P_2 = \frac{(100)^2}{60} = 166.66\Omega$

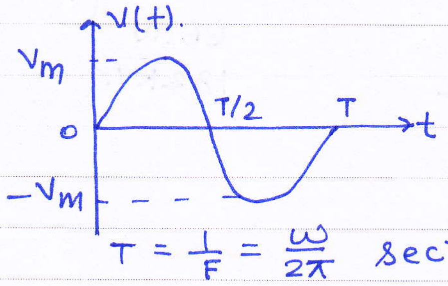
$R_1 > R_2$

$P_1 > P_2$

P_1 more Brigut.

* STEADY STATE AC CIRUIT *

Advantage of sine waves: → 1. It is easy to handle mathmatical problem like differenctial or Integral, re write in term of sine funcution by Fourier Analysis.
2. it is easy to generate in laboratery.



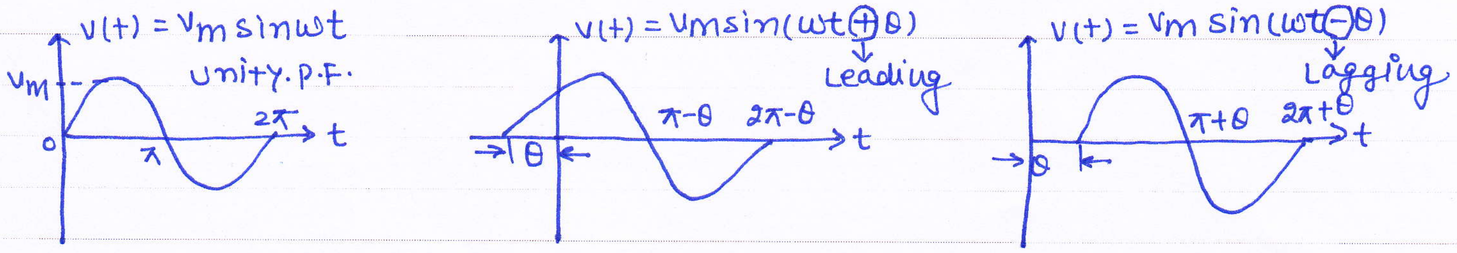
$v(t) = V_m \sin\omega t$

V_m = peak or maximum value.

ω = Augular frequency

$\omega T = 2\pi$ = Argument (rad).

$T = \frac{1}{F} = \frac{\omega}{2\pi}$ sec^{-1} or Hz.



Rms value (Root mean SQUARE): →

1. Rms value is defined based on Heating effect of the waveform.
2. The voltage at which Heat dissipiation in Ac ckt equal Heat dissipiation in Dc ckt at equal resistance and time. ($W_{AC} = W_{DC} = I^2Rt$).

$$V_{Rms} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} v^2 \, d\omega t} = \sqrt{\frac{1}{T}\int_0^{T} v^2 . dt}$$

Average value:

1. It is based on charge transfer in ckt
2. the voltage at which charge transfer in AC circuit equal to charge Transfer in Dc circuit. at same Resistance and time. ($Q_{AC} = Q_{DC} = It$)

*3. Find Avg. value of symmetric wave consider Half cycle else used full cycle.

4. Average value of complete cycle of symmetric wave equal to zero.

→ To identify about shape of the waveform Form Factor and peak Factor concept are introduced.

Power system

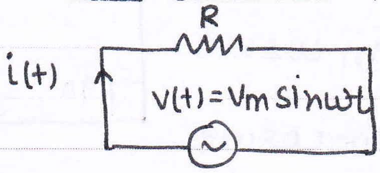
$$\text{Form Factor} = \frac{V_{Rms}}{V_{avg}} = \frac{V_m/\sqrt{2}}{2V_m/\pi} = 1.11$$

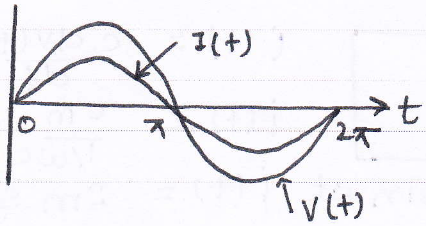
11 KV
33 KV
66 KV
132 KV.

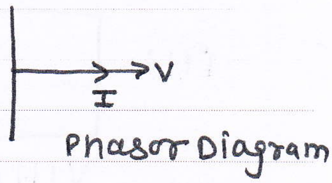
F.F.

$$\text{peak Factor} = \frac{V_m}{V_{Rms}} = \frac{V_m}{V_m/\sqrt{2}} = \sqrt{2}$$

* A.C. Source Across Resistor *







* $P(t) = V(t) \cdot I(t) = V_m \sin\omega t \cdot I_m \sin\omega t = V_m I_m \sin^2\omega t$ $\left\{ \sin^2\omega t = \frac{1-\cos 2\omega t}{2} \right.$

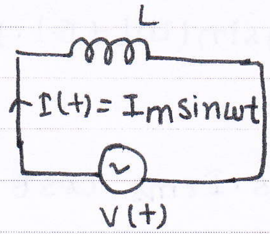
$$\boxed{P(t) = \frac{V_m I_m}{2}[1-\cos 2\omega t]}$$

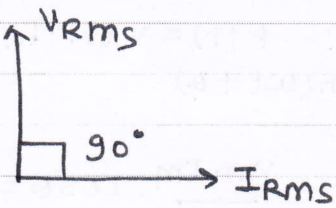
* $\boxed{\begin{array}{l} F = 50\,HZ \text{ (wave)} \\ F_P = 2\times 50 = 100\ HZ \\ \text{of power.} \end{array}}$

$$P_{avg} = \frac{1}{2\pi}\int_0^{2\pi} P(t)\cdot d\omega t = \frac{V_m I_m}{2}$$

* $$\boxed{P_{avg} = \frac{V_m I_m}{2} = \frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}} = V_{Rms} \cdot I_{Rms}.}$$

* AC Source Across inductor (L) *





$I(t) = I_m \sin\omega t$ — ①

$V(t) = L\frac{di(t)}{dt}$

$V(t) = \omega L I_m \cos\omega t$

$V = V_m \sin(\omega t + 90°)$ ②

$P(t) = V(t) \cdot I(t) = I_m \sin\omega t \cdot V_m \sin(\omega t + 90°)$

* $$\boxed{P(t) = \frac{V_m \cdot I_m}{2}\sin 2\omega t}$$

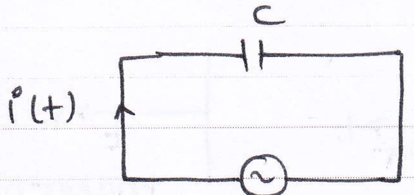
$\boxed{\begin{array}{l} F = 50 Hz \\ F_P = 100 HZ. \end{array}}$

$P_{avg} = \frac{1}{2\pi}\int_0^{2\pi} P(t)\cdot d\omega t \Rightarrow$ * $\boxed{P_{avg} = 0}$

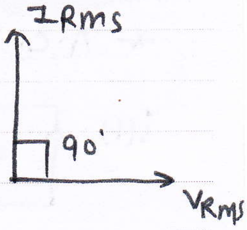
→ Phasor Diagram take Rms value. In series circuit I is Reference and parallel circuit V take reference.

→ In ⊕ Half cycle inductor take Energy from source and ⊖ Half cycle taken source from inductor.

* A.C. Source Across capacitor (C):



$V(t) = V_m \sin\omega t$



$$i(t) = C\frac{dv(t)}{dt} = \omega C V_m \cos\omega t$$

$$i(t) = \frac{V_m}{1/\omega C}\cos\omega t = I_m \cos\omega t$$

$$i(t) = I_m \sin(\omega t + 90^\circ)$$

$$P(t) = V(t)\cdot I(t) = V_m \sin\omega t \cdot I_m \cos\omega t = \frac{V_m I_m}{2}\sin 2\omega t$$

* $\boxed{P(t) = \frac{V_m I_m}{2}\sin 2\omega t}$

* $\boxed{\begin{array}{l} F = 50\,Hz \\ F_P = 100\,Hz \end{array}}$

$$P_{avg} = \frac{1}{2\pi}\int_0^{2\pi} P(\omega t)\cdot d\omega t = 0$$

* $\boxed{P_{avg} = 0}$

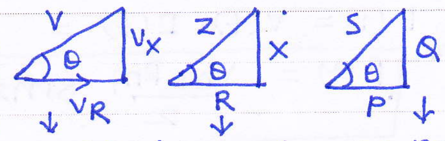
* POWER *

*→ Instaneous power :- $P(t) = V(t)\cdot I(t) = V_m \sin(\omega t + \theta)\cdot I_m \sin\omega t$

$$P(t) = V_m I_m \sin\omega t \cdot \sin(\omega t + \theta)$$

$$P_{avg} = \frac{1}{2\pi}\int_0^{2\pi} P(t)\cdot d\omega t = \frac{V_m \cdot I_m}{2}\cdot\cos\theta = V_{rms}\cdot I_{rms}\cdot\cos\theta$$

power Factor = $\cos\theta = \frac{V_R}{V} = \frac{R}{Z} = \frac{P}{S} \Rightarrow$



Voltage + Impedance + Power triangle.

*→ power Factor Angel indicated position of current phasor with Respect to voltage phasor.

*→ (watt) P = Active power / True power / Real power / Avg. power / effective power

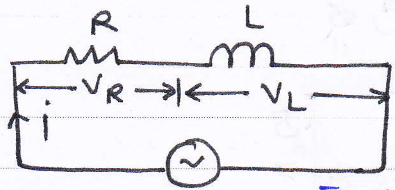
Q (VAR) = Volt Ampeare Reactive / Inductive Reactive power.

S (VA) = Volt Ampeare / Apperiant power / complex. power.

$P = I^2R = VI\cos\theta$; $Q = I^2X = VI\sin\theta$, $S = I^2Z = VI^* = P + jQ$

*→ $P_L = VI{\downarrow}\cos\theta{\uparrow}$ For unity p.F the losses are (VI) Low.

* R–L Series circuit:

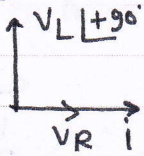


BY KVL $\quad \bar{V} = \bar{V_R} + j\bar{V_L}$

$V = V_R \angle 0° + V_L \angle +90°$

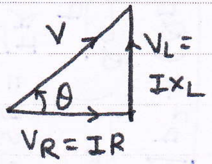
$IZ = IR + jIX_L$

$\boxed{Z = R + jX_L}\ \Omega$



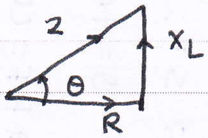
$V = \sqrt{V_R^2 + V_L^2}$

$\theta = \tan^{-1}\left(\frac{V_L}{V_R}\right)$



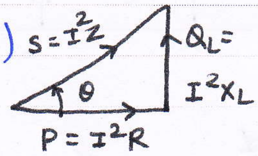
$Z = \sqrt{R^2 + X_L^2}$

$\theta = \tan^{-1}\left(\frac{X_L}{R}\right)$



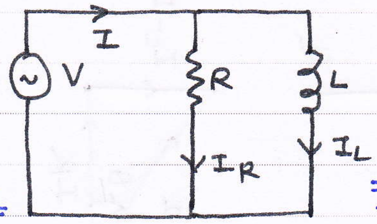
$S = \sqrt{P^2 + Q^2}$

$\theta = \tan^{-1}(Q/P)$



$\cos\theta = \frac{V_R}{V} = \frac{R}{Z} = \frac{P}{S}$ (power Factor) (Lead)

* R–L parallel circuit.



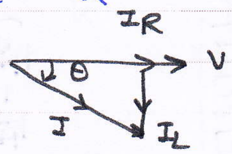
BY KCL $\quad \bar{I} = \bar{I_R} + j\bar{I_L}$

$I = I_R \angle 0° + I_L \angle -90°$

$V/Z = V/R - jV/X_L$

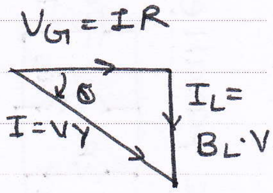
$VY = VG - jVB_L$

$\boxed{Y = G - jB_L \quad \Omega^{-1}(\text{mho})}$



$I = \sqrt{I_R^2 + I_L^2}$

$\theta = \tan^{-1}\left(-\frac{I_L}{I_R}\right)$

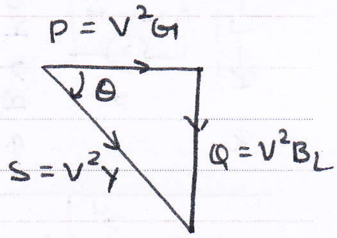


$Y = \sqrt{G^2 + B_L^2}$

$\theta = \tan^{-1}\left(-\frac{B_L}{G}\right)$

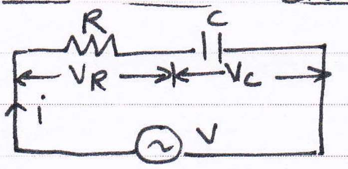
$S = \sqrt{P^2 + Q^2}$

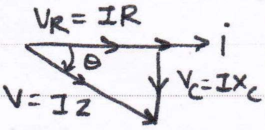
$\theta = \tan^{-1}(-Q/P)$



$\cos\theta = \frac{I_R}{I} = \frac{G}{Y} = \frac{P}{S}$ (Lag.) (power Factor)

* RC - series circuit

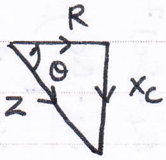




$V = V_R \angle 0° + V_C \angle -90°$

$IZ = IR - jIX_C$

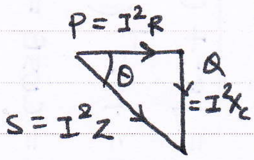
$Z = R - jX_C \ (\Omega)$



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

$\theta = \tan^{-1}(-X_C/R)$

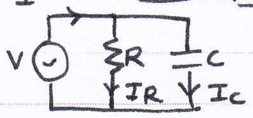
$V = \sqrt{V_R^2 + V_C^2}$

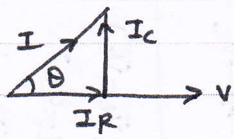


$\theta = \tan^{-1}(-V_C/V_R)$

$\theta = \tan^{-1}(-Q/P)$; $\cos\theta = \frac{V_R}{V} = \frac{R}{Z} = \frac{P}{S}$ (Lead)

* RC- parallel circuit.



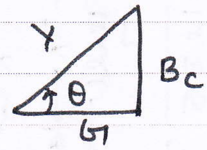


$I = I_R \angle 0° + I_C \angle +90°$

$V/Z = V/R + jV/X_C$

$VY = VG + jVB_C$

$Y = G + jB_C = \Omega^{-1}(\text{mho})$

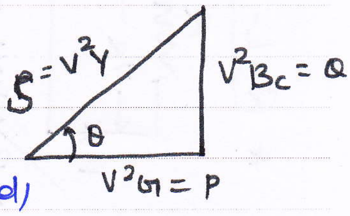


$Y = \sqrt{G^2 + B_C^2}$; $\theta = \tan^{-1}\left(\frac{B_C}{G}\right)$

$I = \sqrt{I_R^2 + I_C^2}$

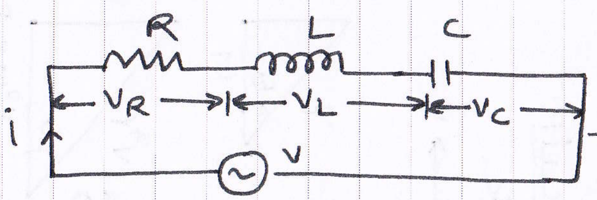
$\theta = \tan^{-1}(I_C/I_R)$

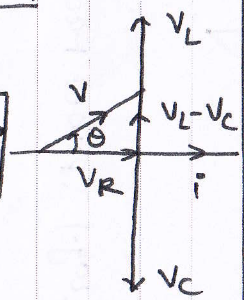
$\theta = \tan^{-1}(Q/P)$



$\cos\theta = \frac{I_R}{I} = \frac{G}{Y} = \frac{P}{S}$ (Lead)

* R-L-C series circuit





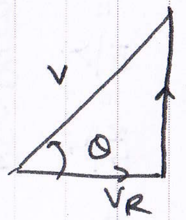
→ BY KVL ⇒ $\bar{V} = \bar{V_R} + j(\bar{V_L} - \bar{V_C})$

$V = V_R\angle 0^\circ + V_L\angle 90^\circ + V_C\angle -90^\circ$

$IZ = I[R + j(X_L - X_C)]$

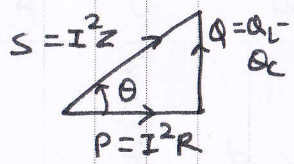
→ $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$\theta = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$



→ $V = \sqrt{V_R^2 + (V_L - V_C)^2}$

$\theta = \tan^{-1}\left(\frac{V_L - V_C}{V_R}\right)$



→ $S = \sqrt{P^2 + (Q_L - Q_C)^2}$

$\theta = \tan^{-1}\left(\frac{Q_L - Q_C}{P}\right)$

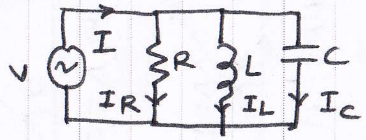
→ $P.F = \cos\theta = \frac{V_R}{V} = \frac{R}{Z} = \frac{P}{S}$

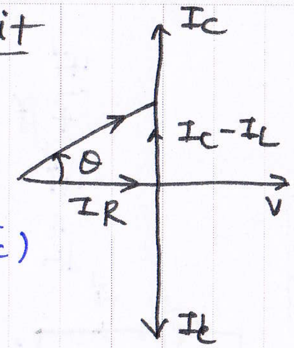
(i) $V_L > V_C$ (Lag.)

(ii) $V_C > V_L$ (Lead.)

(iii) $V_L = V_C$ (unity)

* R-L-C parallel circuit





→ BY KCL ⇒ $\bar{I} = \bar{I_R} + j(\bar{I_L} - \bar{I_C})$

$I = I_R\angle 0^\circ + I_L\angle -90^\circ + I_C\angle 90^\circ$

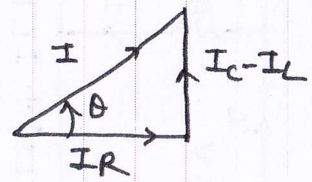
$\frac{V}{Z} = \frac{V}{R} + \frac{jV}{X_C} - j\frac{V}{X_L}$

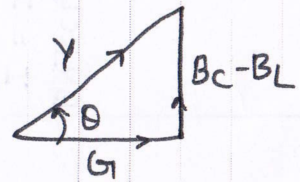
$\cancel{V}Y = \cancel{V}[G + j(B_C - B_L)]$

→ $Y = G + j(B_C - B_L)$

$Y = \sqrt{G^2 + (B_C - B_L)^2}$

$\theta = \tan^{-1}\left(\frac{B_C - B_L}{G}\right)$



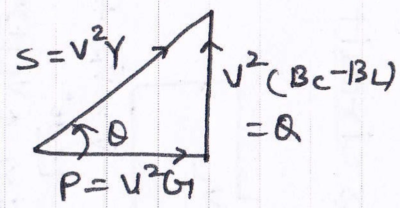


→ $I = \sqrt{I_R^2 + (I_L - I_C)^2}$

$\theta = \tan^{-1}\left(\frac{I_L - I_C}{I_R}\right)$

→ $S = \sqrt{P^2 + (Q_C - Q_L)^2}$

$\theta = \tan^{-1}\left(\frac{Q_C - Q_L}{P}\right)$



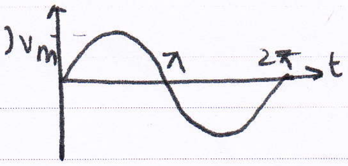
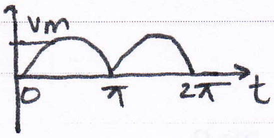
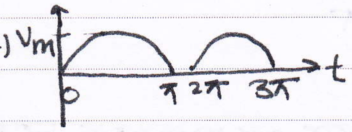
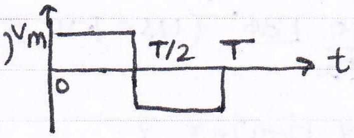
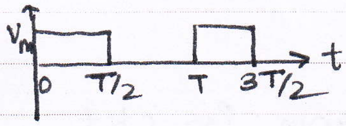
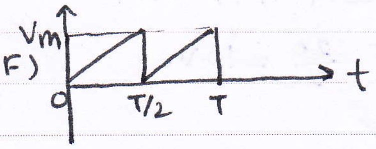
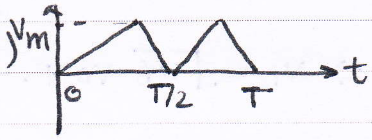
→ $P.F = \cos\theta = \frac{I_R}{I} = \frac{G}{Y} = \frac{P}{S}$

(i) $I_C > I_L$ (Lead)

(ii) $I_L > I_C$ (Lag.)

(iii) $I_C = I_L$ (unity).

Q.1 Find the Average value or Rms value of Given waveform.

	Vavg	VRms	F.F & P.F
(a) 	$V_{avg} = \frac{1}{\pi}\int_0^{\pi} V_m \sin\omega t \cdot d\omega t = \frac{2V_m}{\pi}$	$V_{Rms} = V_m/\sqrt{2}$	F.F = 1.11 P.F = 1.41
(b) 	$V_{avg} = \frac{2V_m}{\pi}$	$V_{Rms} = V_m/\sqrt{2}$	F.F = 1.11 P.F = 1.41
(c) 	$V_{avg} = \frac{V_m}{\pi}$	$V_{Rms} = V_m/2$	F.F = 1.57 P.F = 2
(d) 	$V_{avg} = V_m$	$V_{Rms} = V_m$	F.F = 1 P.F = 1
(e) 	$V_{avg} = \frac{V_m}{2}$	$V_{Rms} = V_m/\sqrt{2}$	F.F = $\sqrt{2}$ P.F = $\sqrt{2}$
(F) 	$V_{avg} = V_m/2$	$V_{Rms} = V_m/\sqrt{3}$	F.F = $\frac{2}{\sqrt{3}}$ P.F = $\sqrt{3}$
(g) 	$V_{avg} = V_m/2$	$V_{Rms} = V_m/\sqrt{3}$	F.F = $\frac{2}{\sqrt{3}}$ P.F = $\sqrt{3}$

$$\text{Form Factor} = \frac{V_{Rms}}{V_{avg}} \; ; \; \text{Peak Factor} = \frac{V_m}{V_{Rms}}$$

Q.2. Find Rms value of following function

$V(t) = 3 + \sin 3t + \cos t$

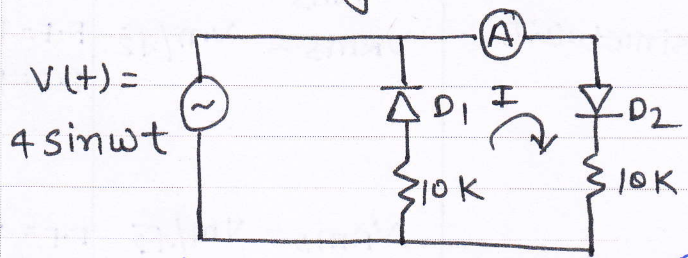
Ans:- $V_{Rms} = \sqrt{(3)^2 + \left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2} = \sqrt{10}$

Q.3. Find power dissipiation in the Resistor at $V_{Rms} = V_m/\sqrt{2}$

Ans: $P_{av} = \frac{V_{Rms}^2}{R}$; $P_{peak} = \frac{V_m^2}{R}$

$P_{av} = \frac{(V_m/\sqrt{2})^2}{R} = \frac{V_m^2}{2R}$

Q.4. When the N/W is having ideal diode, resistor avg. value of indicating ammeter. Find Reading of Ammeter.



Ans:- it work Half wave Rectifier

$$I_{av} = \frac{V_{avg}}{R} = \frac{V_m/\pi}{R} = \frac{4/\pi}{10K} = \frac{0.4}{\pi} \text{ mA.}$$

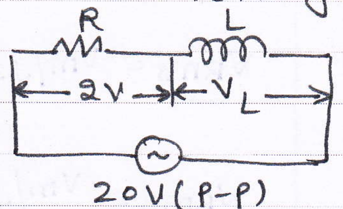
Q.5. $V(t) = 10 \sin(\omega t + 30^\circ)$ present in vector or phasor Form?

Ans: Vector Form: $\rightarrow 10\angle 30^\circ$; phasor Form $\rightarrow \frac{10}{\sqrt{2}} \angle 30^\circ$ (use KVL & KCL).

Q.6. $V = 10\angle 30^\circ$; $i = 5\angle 10^\circ$ Find complex power ?

Ans:- $S = VI^* = 10\angle 30^\circ * 5\angle -10^\circ = 50\angle 20^\circ$

Q.7. Find voltage Across inductor shown in ckt



$V(P-P) = 20V$. $V_m = \frac{20}{2} = 10V$.

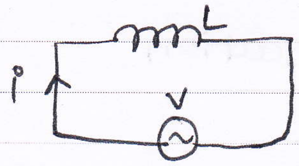
$V = 10/\sqrt{2}$

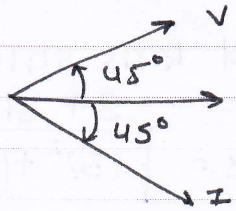
Ans:- $V = \sqrt{V_R^2 + V_L^2} \Rightarrow 10/\sqrt{2} = \sqrt{4 + V_L^2} \Rightarrow V_L = \sqrt{46}$ Volt.

Q.8. $V(t) = 9 \sin(t + 45^\circ)$; $I(t) = 3 \sin(t - 45^\circ)$

Find circuit element For given voltage and current equations!

Ans:-





V lead I

$\theta = 90^\circ$

so element L.

$$X_L = \frac{V}{I} = \frac{9/\sqrt{2}}{3/\sqrt{2}} = 3 \; ; \quad \omega = 1$$

$X_L = \omega L = 3$

$L \times 1 = 3 \Rightarrow L = 3H.$

Q.9. Find circuit element for given voltage and current eq^n.

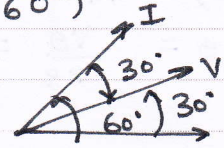
$V(t) = 9\sin(t+30^\circ)$; $I(t) = 3\sin(2t+60^\circ)$

Ans:→ It is not possible to desgin the circuit element becouse frequency of voltage and current are unequal.

$w_V = 1$; $w_I = 2$; $w_V \neq w_I$

Q.10. Find Active and Reactive power by using voltage & current eq^n.

$V(t) = 9\sin(t+30^\circ)$; $I(t) = 3\sin(t+60^\circ)$



Ans: Active power $P = VI\cos\theta$

$P = \frac{9}{\sqrt{2}} \times \frac{3}{\sqrt{2}} \cos 30^\circ = \frac{27\sqrt{3}}{4}$ watt

Reactive power $Q = VI\sin\theta$

$Q = 9/\sqrt{2} \times 3/\sqrt{2} \times \sin 30^\circ = 27/4$ VAR (Volt-Amp-Reactive).

or

$Z = V/I = \frac{9/\sqrt{2}}{3/\sqrt{2}} = 3\Omega$

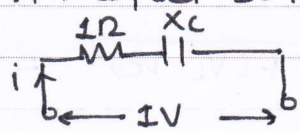
$\cos\theta = R/Z = R/3 = \cos 30^\circ$ $\therefore R = 3\sqrt{3}/2\ \Omega$

$Z^2 = X_C^2 + R^2 \Rightarrow 9 - 27/4 = X_C^2$ $\therefore X_C = 3/2\ \Omega$.

power $P = I^2R = \left(\frac{3}{\sqrt{2}}\right)^2 \times \frac{3\sqrt{3}}{2} = \frac{27\sqrt{3}}{4}$ watt $\therefore Q = I^2X_C = (3/\sqrt{2})^2 \times 3/2$

$Q = 27/4$ VAR.

Q.11 Find Angel of current with Respect source voltage when power dissipiation 500 mw.



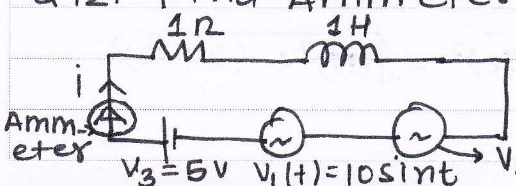
$P = I^2R = \frac{V^2}{Z^2} \times R$

$500 \times 10^{-3} = \frac{1}{\sqrt{1+X_C^2}} \times 1 \Rightarrow X_C = 1\Omega$

so $Z = R - jX_C = 1 - j1$ $\therefore \theta = \tan^{-1}(-X_C/R) = \tan^{-1}\left(\frac{-1}{1}\right) = -45^\circ$

$I = \frac{V}{Z\angle -45^\circ} = \frac{1}{\sqrt{2}} \angle 45^\circ$

Q.12. Find Ammeter Reading in the circuit shown



Ans: only 1 voltage source Active at a time.

For V_1: $X_{L1} = \omega L$ ∴ $V_1(t) = 10\sin t$ ∴ $\omega = 1$ ∴ $V_m = 10$ ∴ $V = 10/\sqrt{2}$

$X_{L1} = 1 \times 1 = 1\Omega$

$Z_1 = \sqrt{R^2 + X_L^2} = \sqrt{1^2+1^2} = \sqrt{2}$

$I_1 = \frac{V_1}{Z_1} = \frac{10}{\sqrt{2}\times\sqrt{2}} = 5A$

For V_2 ∴ $V_2(t) = 10\sqrt{5}\sin 2t$ ∴ $\omega = 2$ ∴ $V = 10\sqrt{5}/\sqrt{2}$

$X_{L2} = \omega L = 2\Omega$

$Z_2 = \sqrt{R^2 + X_L^2} = \sqrt{1^2+2^2} = \sqrt{5}$

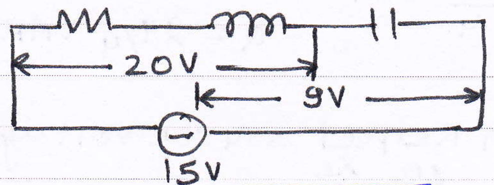
$I_2 = \frac{V_2}{Z_2} = \frac{10\cancel{\sqrt{5}}}{\sqrt{2}\times\cancel{\sqrt{5}}} = \frac{10}{\sqrt{2}} A$

For $V_3 = 5V$. $\omega = 0$; $X_L = 0$ so $Z = R = 1\Omega$

$I_3 = \frac{V_3}{R} = \frac{5}{1} = 5A$

So Ammeter Reading $I = \sqrt{I_1^2 + I_2^2 + I_3^2} = \sqrt{(5)^2 + \left(\frac{10}{\sqrt{2}}\right)^2 + (5)^2} = 10A.$

Q.13. Find voltage Across capacitor shown in Fig.



$\bar{V}_L - \bar{V}_C = 9V$

$\bar{V}_R + \bar{V}_L = 20V$

Ans:- $V = \sqrt{V_R^2 + (V_L - V_C)^2} = 15 = \sqrt{V_R^2 + (9V)^2}$

$V_R = 12$ Volt.

∴ $20 = \sqrt{V_R^2 + V_L^2}$ ∴ ⇒ $20 = \sqrt{(12)^2 + V_L^2}$ ∴ $V_L = 16$ Volt.

(i) $V_L > V_C$

$V_L - V_C = 9$

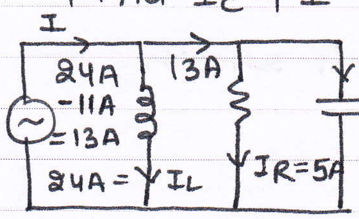
$V_C = 16 - 9 = 7$ Volt.

(ii) $V_C > V_L$

$V_C - V_L = 9$

$V_C = 9 + 16 = 25$ Volt

Q.14. Find I_C & I of the circuit shown:



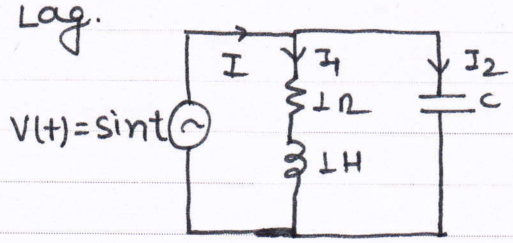
Ans:- $(13)^2 = \sqrt{I_R^2 + I_C^2} = \sqrt{25 + I_C^2}$

$I_C = 12A$

∴ $I = \sqrt{I_R^2 + (I_L - I_C)^2} = \sqrt{(5)^2 + (24-12)^2}$

$= \sqrt{25 + 144} = 13A = I$

Q.15. Find capacitance of capacitor then power factor of circuit is 0.8 Lag.



Ans:→ $\omega = 1$, $\cos\theta = 0.8$; $X_L = \omega L = 1 \times 1 = 1\Omega$ ∴ $X_C = \frac{1}{\omega C} = \frac{1}{C}$

$$Y_{eq} = Y_1 + Y_2 = \frac{R_1}{R_1^2 + X_L^2} - j\frac{X_L}{R_1^2 + X_L^2} + \frac{j}{X_C}$$

$$Y_{eq} = \frac{1}{1+1} - j\frac{1}{1+1} + jC = \frac{1}{2} + j\left(C - \frac{1}{2}\right)$$

$$\cos\theta = \frac{G}{\sqrt{G^2 + (B_C - B_L)^2}} = \frac{1/2}{\sqrt{(1/2)^2 + (C - 1/2)^2}} = 0.8 = \frac{8}{10}$$

$$(1/2)^2 + (C - 1/2)^2 = \frac{100}{64} \times \frac{1}{4} = \frac{100}{256}$$

$$(C - 1/2)^2 = \frac{100}{256} - \frac{1}{4} = \frac{9}{64}$$

$$C - 1/2 = \frac{3}{8}$$

$$C = \frac{3}{8} + \frac{1}{2} = \frac{7}{8}\ F.$$

imp *** CMT

A.C → KVL, KCL → Phasor sum
D.C → KVL, KCL → Airthmatic sum.

* **super position theorm :→** "In any linear bi-directional circuit Having more than 1 Independent source, the Response In Any one of the Branch equal to algebric sum of the Response caused by Individual sources while the rest of the source are replaced by its internal resistance".

Note

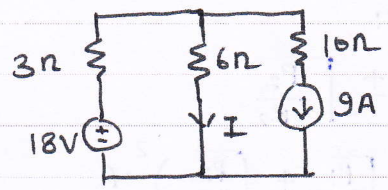
1. → while Applying superposition theorm depended source is Replaced by Neither open nor short circuit but Independed source voltage Replaced by short circuit but current source Replaced by open circuit.

2. → when Network is having linear bidirectional elements with respect to Homogenity principel if Excitation is multiplied by constant K. the Response of each element also multiplied by K.

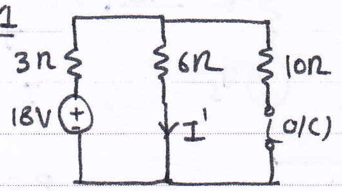
3. → If the circuit Have No active Independ source than than voltage Across it terminal = 0 = V_{th}.

point 1, 2 & 3 Are same For all theorm.

Q.1. Find the value of I by superposition theorm :→

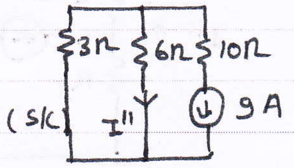


case-1



$I' = 18/9 = 2\,A$

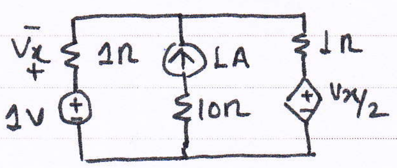
case-2



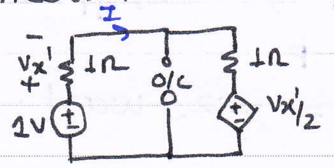
$I'' = -9 \times 3/9 = -3\,A$

so $I = I' + I'' = 2 - 3 = -1\,A$.

Q.2 Find V_x by super position theorm:



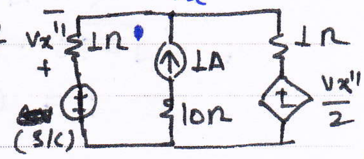
case-1



$V_x' = I \times 1 = I$; $-1 + 2I + V_x/2 = 0$

$5/2\, I = 1$; $I = \frac{2}{5}\,A = V_x'$

case-2



$\frac{Va}{1} + \frac{Va - V_x''/2}{1} = 1$; $Va = -V_x''$

$V_x'' = -2/5\,V$.

$V_x = V_x'' + V_x' = \frac{2}{5} - \frac{2}{5} = 0$.

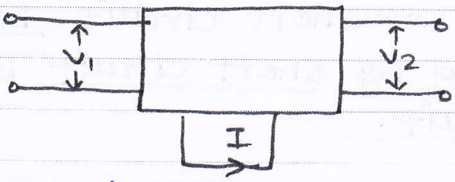
Q.3 In the circuit If source voltages Increased by 10%. Find varation of power in Resistor R.

Ans:- case-1 NO.1 ∴ $V_s = V$; $R = R$; $P = V^2/R$

case-2 NO.2 $V_s = 1.1V$; $R = R$: $P = \frac{(1.1V)^2}{R} = 1.21P$

21% increased power.

Q.4. Find I when $V_1 = 10V$; $V_2 = -15V$.



V_1	V_2	I
2V	0	4A
0	3V	-2A

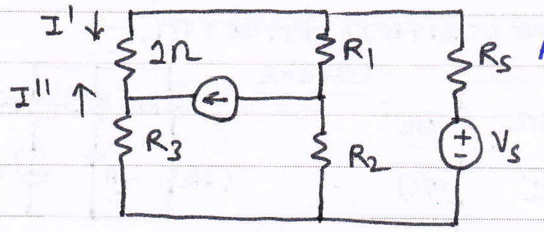
Ans:- It is superposition theorm because one source take at a time

$V_1 = 2V$ than $I_1 = 4A$ so $V_1 = 10V$ so $I_1 = 4 \times 5 = 20A$

$V_2 = 3V$ than $I_2 = -2A$ so $V_2 = -15V$ so $I_2 = -2 \times -5 = 10A$

total $I = I' + I'' = 10 + 20 = 30A$.

Q.5. In the CKT shown power dissipation in the 1Ω Resistor is 576 watt when voltage source Acting Alone and P.D in 1Ω resistor 1 watt when current source Acting Alone find total Power dissipiation in 1Ω Resistor?



Ans :→ $P = I^2R$; $I = \pm\sqrt{P/R}$

$I = I' + I''$

$I = \pm\sqrt{\frac{P1}{R1}} \pm \sqrt{\frac{P_2}{R_2}}$

$P = I^2R = \left(\pm\sqrt{\frac{P_1}{R_1}} \pm \sqrt{\frac{P_2}{I_2}}\right)^2 \cdot R$

when $R = R_1 = R_2$ so $= 1Ω$

$P = \left(\pm\sqrt{P'} \pm \sqrt{P''}\right)^2 \Rightarrow \sqrt{P^2} = \pm\sqrt{P_1'} \pm \sqrt{P''}$

$= (\sqrt{576} - \sqrt{1})^2 = P$

$P = (24-1)^2 = 529$ watt.