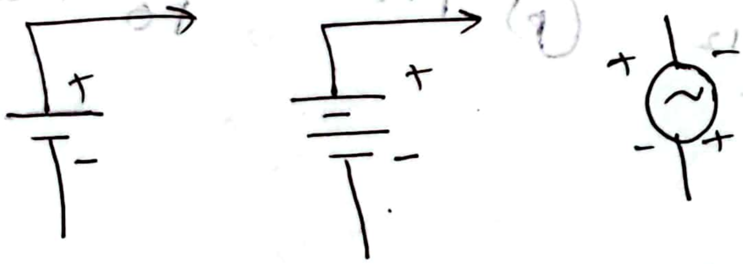

Bashundhara
Exercise Book
Write Your Future
Sadman Sec : A
Electrical Circuits
UIU 011221572

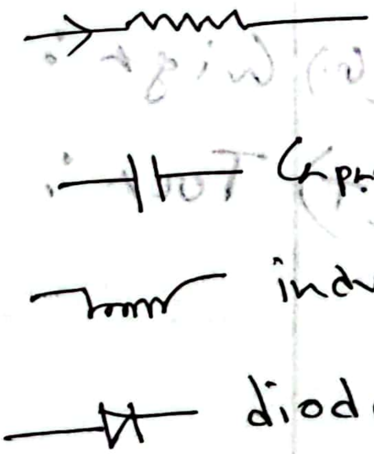
C.W

Circuit

Mid (DC Circuit)

* Basic Elements
* Law :- ohm / Kirchhoff
* Node Analysis
* Mesh Analysis





Charge :-

Electron : -1.6×10^{-19} C

Proton : $+1.6 \times 10^{-19}$ C

Neutron : 0 C

P.T.O

Quantization

Conversion

(k) kilo : 10^3

(M) Mega : 10^6

(G) Giga : 10^9

(T) Tera : 10^{12}

(m) mili : 10^{-3}

(μ) micro : 10^{-6}

(n) nano : 10^{-9}

(p) pico : 10^{-12}

PTO

* $i = \begin{cases} 4\,A, & 0 < t < 1 \\ 4t^2\,A, & t > 1 \end{cases}$

$t = 0\,s$ to $t = 2\,s$

$$q = \int i\,dt$$

$$= \int_0^1 4 \cdot dt + \int_1^2 4t^2 \cdot dt$$

$$= \left[4t\right]_0^1 + \left[\frac{4t^3}{3}\right]_1^2$$

P.T.O.

* Find the change $q(t)$ flowing through a device if the current is :-

(c) $i(t) = 20\cos\left(10t + \frac{\pi}{6}\right)\,\mu A$

$q(0) = 2\,\mu C$

$q = \int i\,dt$

$= \int 20\cos\left(10t + \frac{\pi}{6}\right)$

$= \dfrac{20\sin\left(10t + \frac{\pi}{6}\right)}{10} + C$

$\int \cos(4t)\,dt$

$I = 20\cos(10t + \pi/6)$

$\int \frac{\sin 4t}{4}$

$\int I = \int 20 \boxed{\cos(10t + \pi/6)}\,dt$

$= \frac{\cancel{20}^{2} \sin(10t + \pi/6)}{\cancel{10}} + C$

$\boxed{= 2\sin(10t + \pi/6) + C} = q(t)$

$\boxed{q(0) = 2}$

$2 = \boxed{2 \cdot \sin(10 \cdot 0 + \pi/6) + C}$

$\Rightarrow 2 = 2 \cdot \sin 30^\circ + C$

$2 = 2 \cdot \frac{1}{2} + C$

$\Rightarrow 2 = 1 + C \quad \therefore C = 1$

$q(t) = 2\sin(10t + \pi/6) + 1$

~~q (t)~~

$\int x\cos 4t$

$\cos 4t \cdot \int x\,dx + \int \left\{\frac{d}{dx}(\cos 4x) \cdot \int x\,dx\right\} dx$

$\frac{x^2}{2}\cos 4t + \int \sin 4x \cdot \frac{x^2}{2}\,dx$

Practice
30.1.23

* current, $i = \frac{dq}{dt}$
* charge, $Q = \int_{t_0}^{t} i\,dt$

Example : 1.2

$q = 5t \sin 4\pi t$

$i = \frac{dq}{dt} = \frac{d}{dt}(5t \sin 4\pi t)$

$= 5t \cos 4\pi t \cdot 4\pi + \sin 4\pi t \cdot 5$

$= 20\pi t \cos 4\pi t + 5 \sin 4\pi t$

$t = 0.5$ s

$\therefore i = 10\pi \cos 2\pi + 5 \sin 2\pi$

$= 10\pi + 0$

$= 31.4159$ mA

Practice-1.2

$q = 10 - 10e^{-2t}$, $t = 1$ sec

$i = \frac{dq}{dt}$

$= \frac{d}{dt}(10 - 10e^{-2t})$

$= -10e^{-2t}(-2)$

$= 20e^{-2t}$

$= 20e^{-2\cdot(2)}$

$= 2.707$ mA

P.T.O

Exm: 1.3

$t = 1s$ to $2s$

$i = (3t^2 - t)$

$$Q = \int_{t_0}^{t} i\,dt$$

$$= \int_{1}^{2} (3t^2 - t)$$

$$= \left[\frac{3t^3}{3} - \frac{t^2}{2}\right]_1^2$$

$$= \left(2^3 - \frac{2^2}{2}\right) - \left(1 - \frac{1}{2}\right)$$

$$= 5.5\ C$$

Ans

P.T.O

Practice: 1.3

$$i = \begin{cases} 4\text{ A} & 0 < t < 1 \\ 4t^2\text{ A} & t > 1 \end{cases}$$

$t = 0\text{s}$ to 2s

$$Q = \int i\,dt$$

$$= \int_0^1 4 + \int_1^2 4t^2$$

$$= \left[4t\right]_0^1 + \left[\frac{4t^3}{3}\right]_1^2$$

$$= (4 - 0) + (9.33)$$

$$= 4 + 9.33$$

$$= 13.33\text{ C}$$

Ans

Page 24 Exercises

1.2

(a) $q(t) = (3t + 8)$ mC

$$i = \frac{dq}{dt}$$

$$= \frac{d}{dt}(3t + 8)$$

$$= 3 \text{ mA}$$ Ans

(b) $q(t) = (8t^2 - 4t - 2)$ C

$$i = 16t - 4 \text{ A}$$ Ans

(c) $q(t) = (3e^{-t} - 5e^{-2t})$ nC

$$i = -5e^{-2t} \cdot -2$$

$$= 10e^{-2t} \text{ nA}$$ Ans

P.T.O

(d) $q(t) = 10 \sin 120\pi t \ pC$

$i = 10 \, \overset{\cos}{\cancel{\sin}} \, 120\pi t \cdot 120\pi$

$= 1200\pi \, \overset{\cos}{\cancel{\sin}} \, 120\pi t \ pA$

(e) $q(t) = 20 e^{-4t} \cos 50t \ \mu C$

$i = 20 e^{-4t} (-\sin 50t \cdot 50) + \cos 50t \, (-80 e^{-4t})$ μA

P.T.O

1.3

(a) $i(t) = 3A$ $\qquad q(0) = 2$

$$Q = \int i\,dt \qquad t = 0$$

$$= 3t + C$$

$$3t + C = 2$$

$$\Rightarrow C = 2$$

A

(b) $i(t) = (2t + 5)\ mA$

$$Q = \int i\,dt$$

$$= t^2 + 5t + C$$

$$t^2 + 5t + C = 0$$

$$\Rightarrow C = 0$$

CS CamScanner

(c) $i(t) = 20 \cos\left(10t + \frac{\pi}{6}\right) \mu A$

$q(0) = 2 \mu C$

$$Q = \int 20 \cos\left(10t + \frac{\pi}{6}\right)$$

$$= \frac{20\left\{-\sin\left(10t + \frac{\pi}{6}\right)\right\}}{10} + C$$

$$\frac{20\left\{-\sin\frac{\pi}{6}\right\}}{10} + C = 2$$

$$\Rightarrow 10\left\{-\sin\frac{\pi}{6}\right\} + C = 2$$

$$= C = 2 - 10\left\{-\sin\frac{\pi}{6}\right\}$$

$$= 7$$

A

$$= \cos 40t \cdot \frac{e^{-30t}}{30} - \int \left[-\sin 40t \cdot 40 \cdot \frac{e^{-30t}}{-30} \right]$$

$$= \frac{\cos 40t \cdot e^{-30t}}{30} - \int \left[\frac{-40 \sin 40t \cdot e^{-30t}}{-30} \right] dt$$

*

$$I = \int 10e^{-30t} \cdot \sin 40t \, dt$$

$$= \sin 40t \cdot \int 10e^{-30t} \, dt - \int \left[\frac{d}{dx}(\sin 40t) \cdot \int 10e^{-30t} \, dt \right] dt$$

$$= \sin 40t \cdot \frac{10e^{-30t}}{-30} - \int 40 \cos 40t \cdot \frac{10e^{-30t}}{-30} \, dt$$

$$= \underbrace{-\frac{1}{30} \sin 40 \cdot 10e^{-30t}}_{p} + \frac{40}{30} \int \cos 4t \cdot 10e^{-30t} \, dt$$

$$= p + \frac{40}{30} \left[\cos 40t \int 10e^{-30t} \, dt - \int \left[\frac{d}{dx} \cos 40t \int 10e^{-30t} \, dt \right] dt \right.$$

$$= p + \frac{40}{30}\left[\cos 40t \cdot \frac{10}{-30} e^{-30t} + \int 40 \sin 40t \cdot \frac{10}{-30} e^{-30t}\, dt\right]$$

$$= p + \frac{40}{30}\left[-\frac{1}{3}\cos 40t \cdot e^{-30t} - \frac{40}{30}\underbrace{\int \sin 40t \cdot e^{-30t}\, dt}_{I}\right]$$

$$\underline{I} = p + \frac{4}{3}\left[-\frac{1}{3}\cos 40t \cdot e^{-3t} - \frac{4}{3} I\right]$$

$$I = p - \frac{4}{9}\cos 40t\, e^{-30t} - \frac{16}{9} I$$

$$I + \frac{16}{9} I = p - \frac{4}{9}\cos 40t\, e^{-30t}$$

$$\frac{25}{9} I = \underbrace{p - \frac{4}{9}\cos 40t\; e^{-30t}}_{x}$$

$$\therefore I = \frac{9}{25}(x)$$

C.W 31.7.21

Circuit

Voltage:

$$V = \frac{E}{q} \qquad 1V = 1\ J/C$$

$$dq \to dw$$

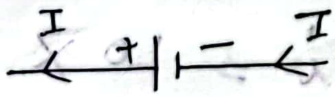
$$1 \to \frac{dw}{dq}$$

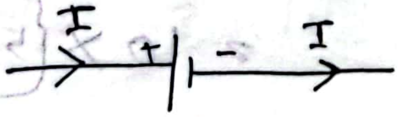
Electrical Power & Energy

$$P = \frac{dw}{dt} = \frac{dw}{dq} \cdot \frac{dq}{dt}$$

$$= V \cdot i$$

$$W = \int_{t_0}^{t} p\,dt = \int_{t_0}^{t} vi\,dt$$

* Cell / Battery :  $P = -vi$

* Resistance :  $P = +vi$

(v) $i = 5\cos 60\pi t$ A

$$\int 5\cos 60\pi t$$

$$= \cancel{5\ 45\pi\ldots} \frac{5\sin 60\pi t}{60\pi}$$

$$V = 10 + 5\int_0^5 5\cos 60\pi t$$

$$= 10 + 5\left[\frac{5\sin 60\pi t}{60\pi}\right]_0^5$$

$$= 10 + 5 \times \frac{5\sin(300\times 180)}{60\pi}$$

$$= 10\ \cancel{\ldots}\ V$$

$$P = vi = 10 \times 5\{\cos 60\pi \times (5\times 10^{-3})\}$$

$$= 10 \times \{5 \times \cos(0.3\pi)\}$$

$$= 10 \times 2.938$$

$$= 29.38\ A$$

~~1.23~~

(a) $i = \frac{dq}{dt}$

$= \frac{d}{dt}(5 \sin 4\pi t)$

$= \cancel{\frac{5 \cos 4\pi t}{4\pi}}$

$= 5 \sin 4\pi t \cdot 4\pi$

$= 20\pi \sin 4\pi t$

$= \{20\pi \sin 4\pi (0.3)\} \times 10^{-3}$ C

$= \{20\pi \times (-0.588)\} \times 10^{-3}$ C

$= -36.945 \times 10^{-3}$ C

$V = -2.427$ V

$\therefore P = 0.01$ W $= 100$ mW

(b) $$\cancel{E = \int_{0}^{0.6} 20\pi \sin 4\pi t \cdot 3\cos 4\pi t \, dt}$$

1.13

(a) $P = v i$

$$= v \cdot \frac{dq}{dt}$$

$$= v \cdot \frac{d}{dt}(5 \sin 4\pi t)$$

$$= 3\cos 4\pi t \cdot 20\pi \cos 4\pi t$$

$$= 60\pi \cos^2 4\pi t$$

$$= 60\pi \cos^2 \left\{ 180 \times (4 \times 0.3) \right\}$$

$$= 60\pi \times 0.65$$

$$= \cancel{122.337 \times 10^{-3}} = 122.52 \text{ mW}$$

$$= \cancel{122.337 \times 10^{-3}}$$

(b)

$$E = \int_0^{0.6} 60\pi \cos^2 4\pi t \, dt$$

$$= 60\pi \int_0^{0.6} \frac{1}{2} \times 2\cos^2 4\pi t \, dt$$

$$= 60\pi \times \frac{1}{2} \int_0^{0.6} 2\cos^2 4\pi t \, dt$$

$$= 30\pi \int_0^{0.6} (1 + \cos 8\pi t) \, dt$$

$$= 30\pi \left[t + \frac{\sin 8\pi t}{8\pi} \right]_0^{0.6}$$

$$= 30\pi \left[0.6 + \frac{\sin(180 \times (8 \times 0.6))}{8\pi} \right]$$

$$= 30\pi \times 0.623$$

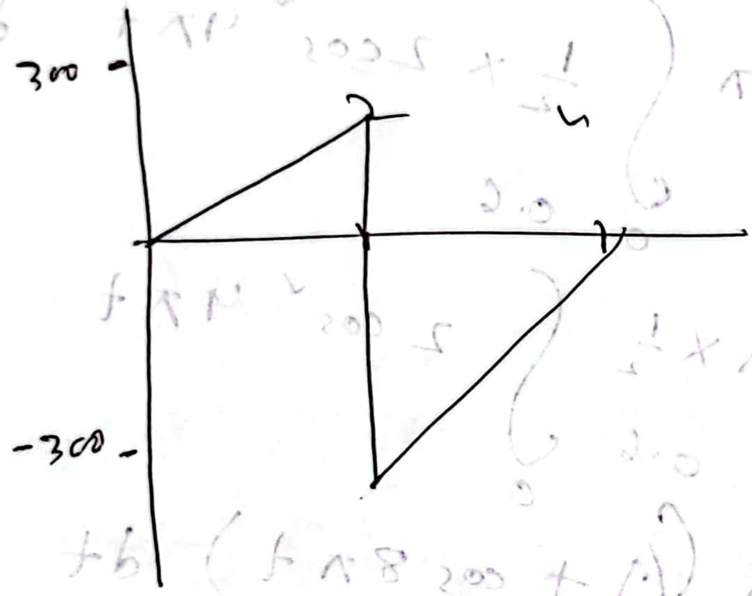
$$= 58.716 \text{ mJ}$$

H.W 4.2.23

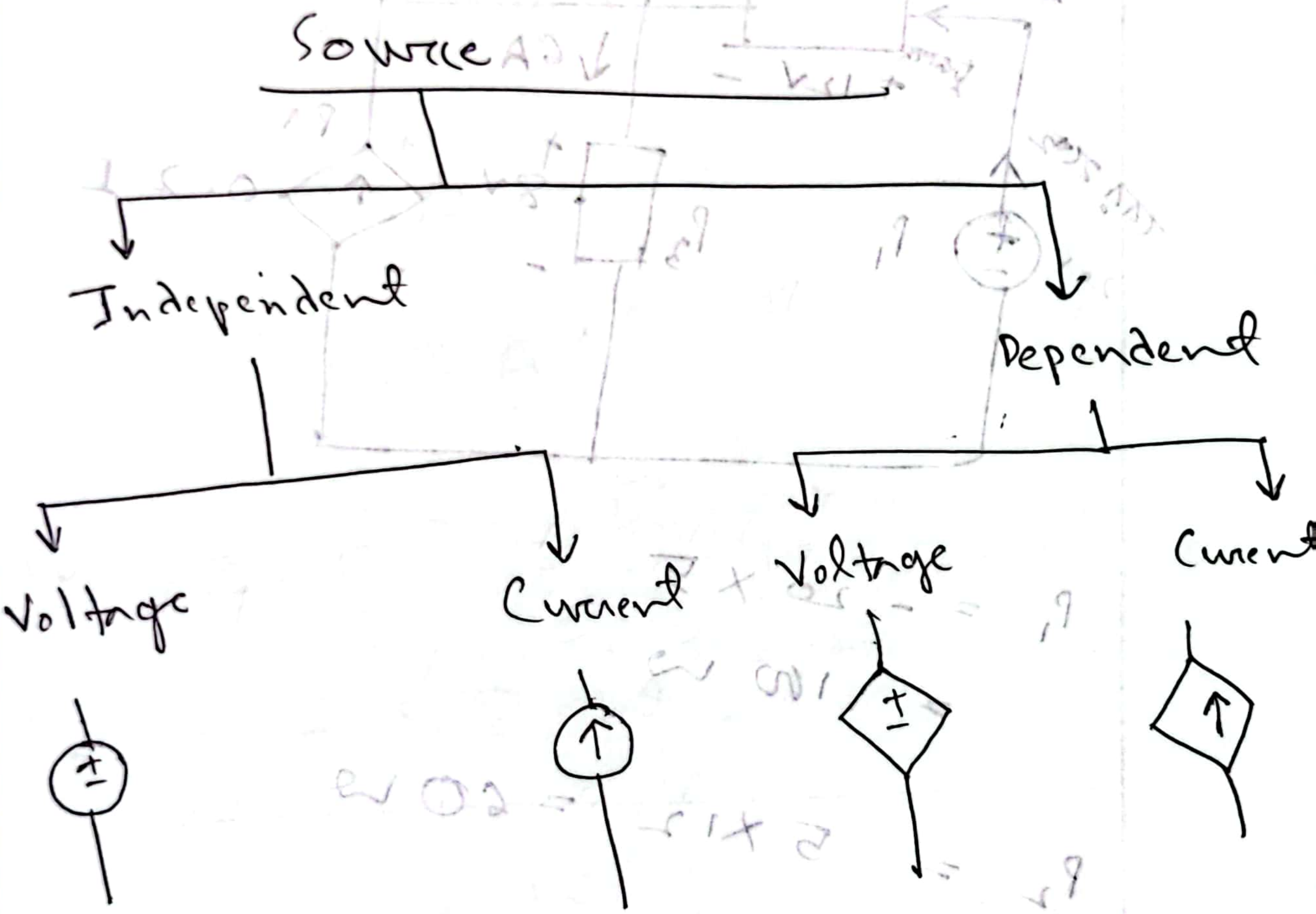
Circuit

1.16

$p = vi \quad E = \int_{t_0}^{t} p \cdot dt$



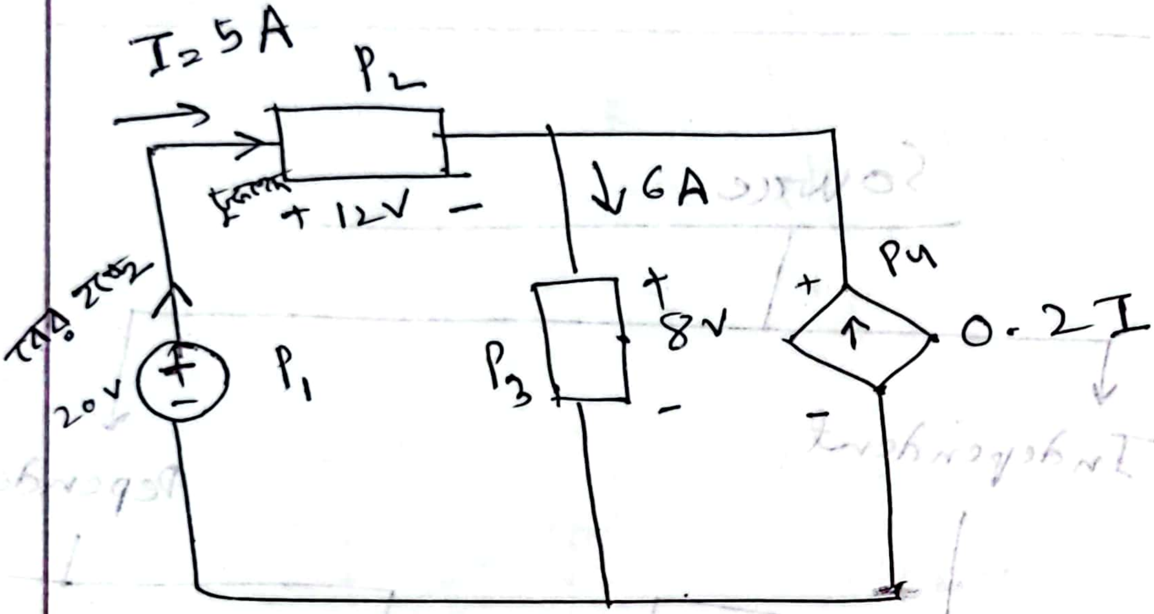
Independent Power Sources :-



Ct : Next week

Chapter - 2

P.T.O



$P_1 = -20 \times 5$

$= 100\ W$

$P_2 = 5 \times 12 = 60\ W$

$P_3 = 6 \times 8 = 48\ W$

$P_4 = -1 \times 8 = -8\ W$

$\Sigma P = -100 + 60 + 48 - 8 = 0$

1.18

$P_1 = -300 \text{ W}$

$P_2 = 100 \text{ W}$

$P_3 = 280 \text{ W}$

$P_4 = -32 \text{ W}$

$P_5 = -48 \text{ W}$

$\Sigma P = 0 \text{ W}$

1.20

$P_1 = -180\ W$

$P_2 = +72\ W$

$P_3 = 3V_0$

$P_4 = +56\ W$

$P_5 = +28\ W$

$P_6 = -30\ W$

$\Sigma P = 3V_0 - 54 = 0$

$\Rightarrow V_0 = \frac{54}{3} = 18$

A

P.T.O.

Chapter-2

Basic Laws

* Ohm Law
* Kirchoff Law
* Nodal Analysis
* Mesh Analysis

Conductor: $T\uparrow$, $R\uparrow$

Semiconductor: $T\uparrow$, $R\downarrow$

$$R = \rho \frac{l}{A}$$

Ohm's law

$$V = iR$$

P.T.O

C.W
7.2.23

EC

Series :- Same current

Parallel :- Same Terminal
↓
Same Voltage

Kirchhoff's Current Law :-

Incoming current = outgoing Current

$\Sigma I = 0$ (Node)

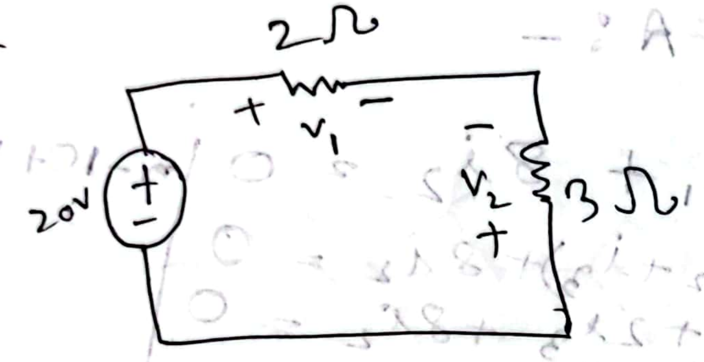
KVL :- (Voltage law)

Voltage produced = voltage Consumed

$\Sigma V = 0$ (Loop)

P.T.O

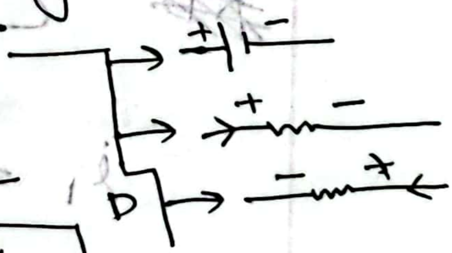
*



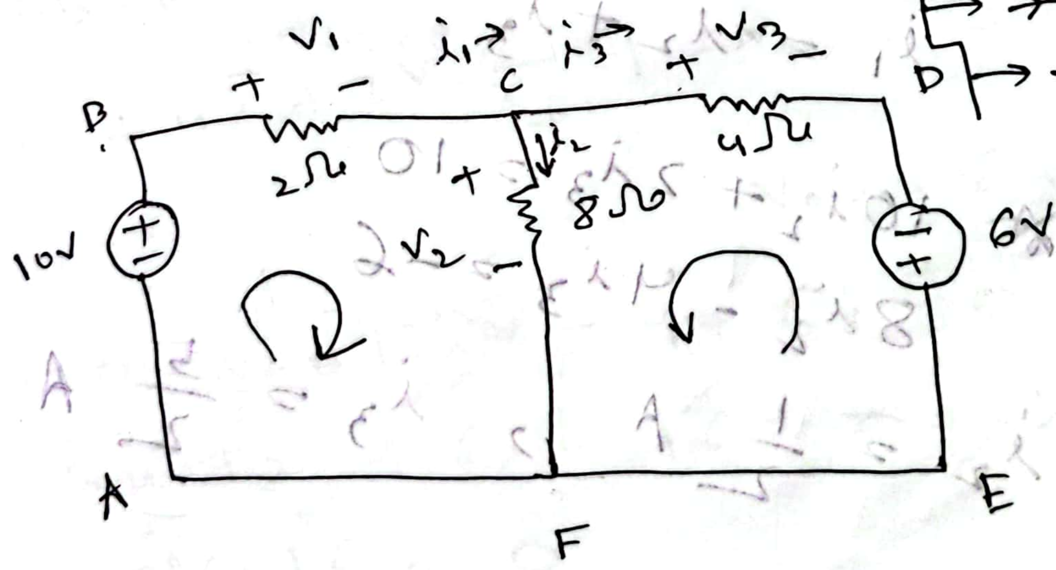
(i) Assign current in all the branches with the direction.

(ii) Name all the necessary nodes.

(iii) Assign voltage polarity.



*



(iv) Apply KVL in Loop in any direction.

Loop ABCFA :-

$-10 + 2i_1 + 8i_2 = 0$

$-10 + 2(i_2 + i_3) + 8i_2 = 0$

$\Rightarrow -10 + 2i_2 + 2i_3 + 8i_2 = 0$

$\Rightarrow -10 + 10i_2 + 2i_3 = 0$

FEDCF :

$6 - 4i_3 + 8i_2 = 0$

~~AB~~ C point KCL :-

$i_1 = i_2 + i_3$

$10i_2 + 2i_3 = 10$

$8i_2 - 4i_3 = -6$

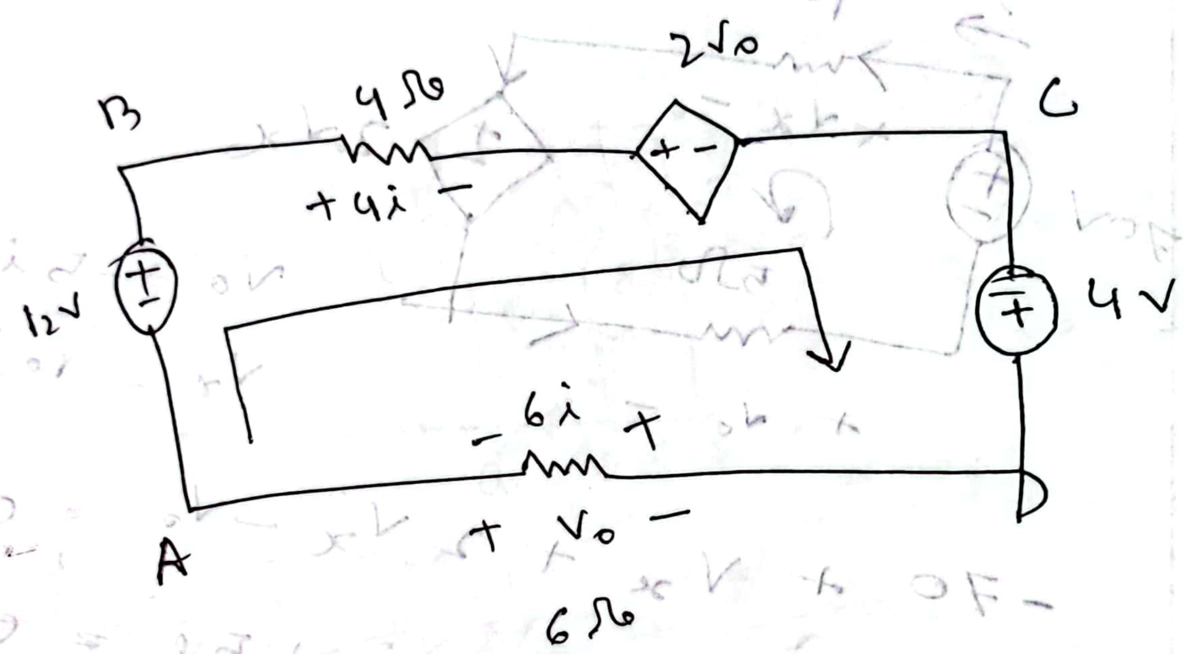
$i_2 = \frac{1}{2}$ A , $i_3 = \frac{5}{2}$ A

$i_1 = 3$ A

$\therefore v_1 = 2i_1 = 6$ V , $v_3 = 4i_3 = 10$ V

$v_2 = 8i_2 = 4$ V

*



ABCDA :-

$$-12 + 4i + 2V_0 - 4 - V_0 = 0$$

$$V_0 = -6i$$

$$\Rightarrow -12 + 4i - 12i - 4 + 6i = 0$$

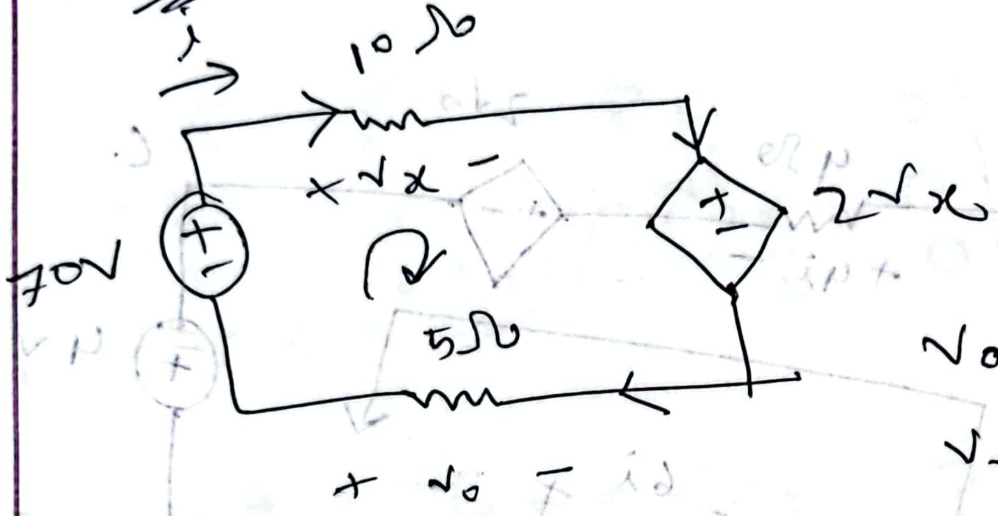
$$\Rightarrow 4i - 12i + 6i - 16 = 0$$

$$\Rightarrow -2i - 16 = 0$$

$$\Rightarrow i = -8A$$

A

* 2.6



$v_o = -5i$

$v_x = 10i$

$$-70 + v_x + 2v_x - v_o = 0$$

$$\Rightarrow -70 + 10i + 20i + 5i = 0$$

$$\Rightarrow 35i = +70$$

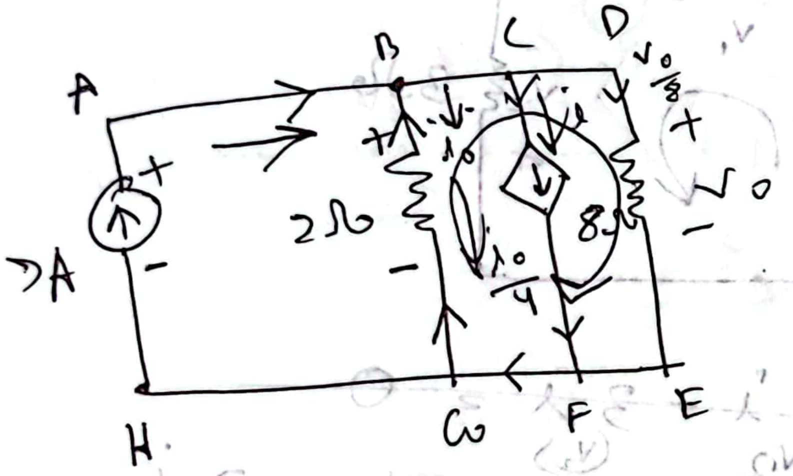
$$\Rightarrow i = +2$$

$v_o = -10V$, $v_x = 20V$

A

17:

2.7



$v_o = 8i$

$i = \frac{v_o}{8}$

KCL:

$$9 = i_o + \frac{i_o}{4} + \frac{v_o}{8}$$

KVL:

BDEGB

$$\frac{v_o}{8} - 2i_o = 0$$

$$\Rightarrow v_o = 2i_o$$

$$= 12\ V$$

$$\Rightarrow i_o + \frac{i_o}{4} + \frac{2i_o}{8} = 9$$

$$\Rightarrow i_o + \frac{i_o}{4} + \frac{i_o}{4} = 9$$

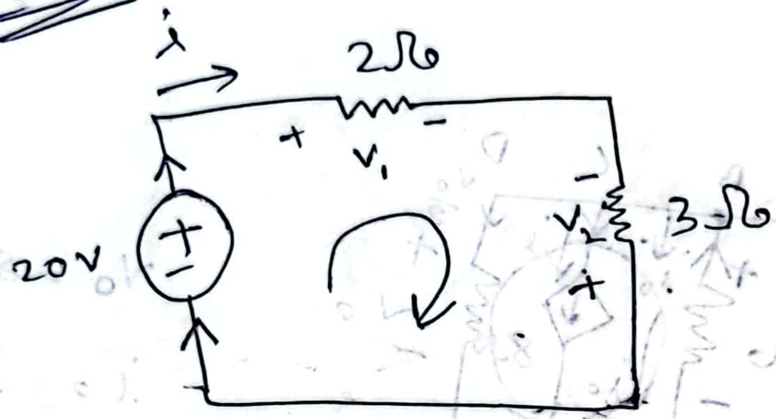
$$i_o + \frac{i_o}{4} + \frac{2i_o}{8} = 9$$

$$\Rightarrow \frac{6i_o}{4} = 9$$

$$\Rightarrow 6i_o = 36$$

$$\Rightarrow i_o = 6\ A$$

Ex. 2.5



KVL

$-20 + \underbrace{2i}_{(v_1)} - \underbrace{3i}_{(v_2)} = 0$

$\Rightarrow$ ~~$-i = 20$~~

$\Rightarrow$ ~~$i = -20$~~

~~$v_1 = -40$ V~~

~~$v_2 = 60$ V~~

$v_1 = 2i$

$v_2 = -3i$

$-20 + v_1 - v_2 = 0$

$\Rightarrow -20 + 2i + 3i = 0$

$\Rightarrow 5i = 20$

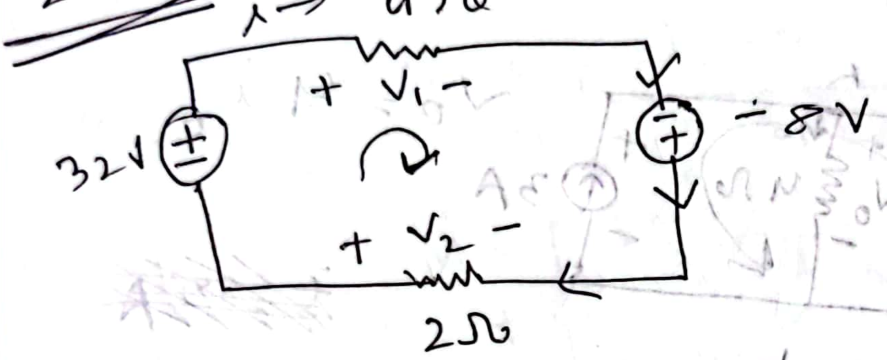
$\Rightarrow i = 4$

$\therefore v_1 = 8$ V

$v_2 = -12$ V

Ans

2.22



$V_1 = 4i$

$V_2 = -2i$

$-32 + V_1 + 8 - V_2 = 0$

$\Rightarrow -32 + 4i + 8 + 2i = 0$

$\Rightarrow 6i - 24 = 0$

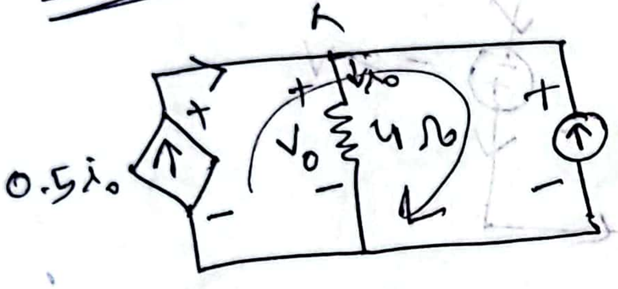
$\Rightarrow i = 4$

$V_1 = 16\,V$

$V_2 = -8\,V$

Ans

Exm 2.7



$v_o = 4 i_o$

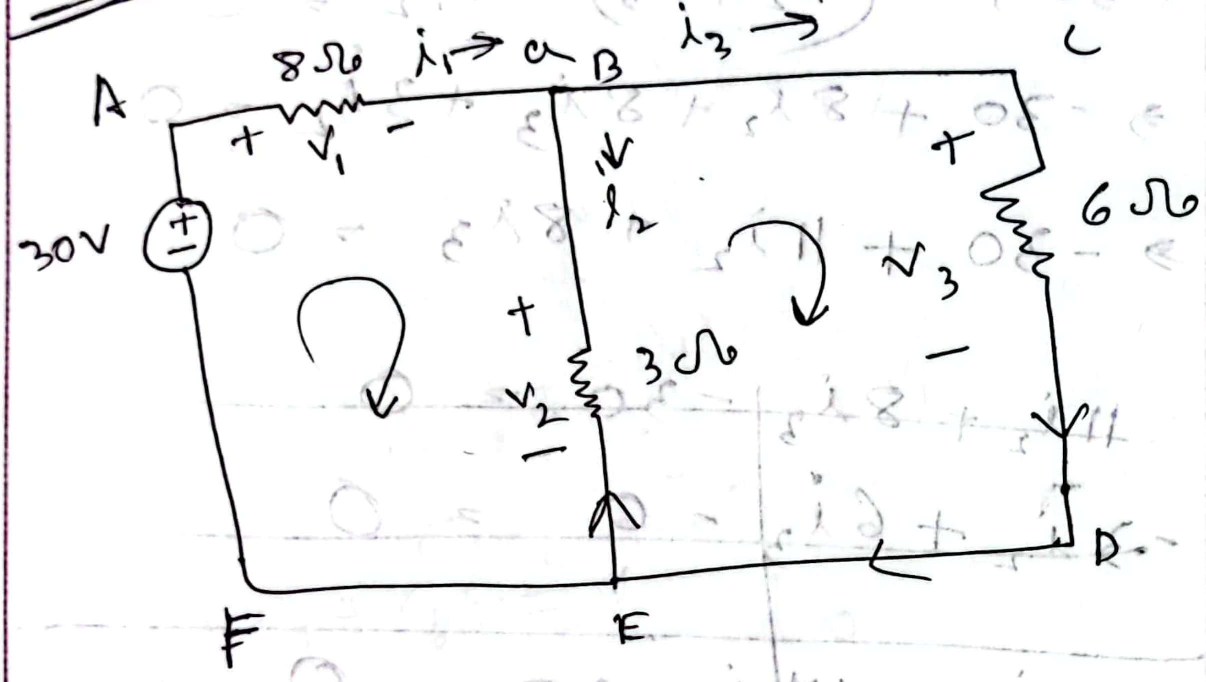
$-0.5 i_o + 3 = 0$

$\Rightarrow i_o = 6$

$v_o = 24\,V$ A

P.T.O

Exm 2.8



ABEFA Loop

$V_1 = 8 i_1$

$-30 + V_1 + V_2 = 0$

$V_2 = 3 i_2$

$\Rightarrow -30 + 8 i_1 + 3 i_2 = 0$

$V_3 = 6 i_3$

BCDEB Loop

$6 i_3 - 3 i_2 = 0$

in, a point KCL,

$i_1 = i_2 + i_3$

P.T.O

$$-30 + 8(i_2 + i_3) + 3i_2 = 0$$

$$\Rightarrow -30 + 8i_2 + 8i_3 + 3i_2 = 0$$

$$\Rightarrow -30 + 11i_2 + 8i_3 = 0$$

$11i_2 + 8i_3$	-30	$= 0$
$-3i_2 + 6i_3$	-0	$= 0$
$8i_2 + 14i_3$	-30	$= 0$

$$11i_2 + 8i_3 = 30$$

$$-3i_2 + 6i_3 = 0$$

$i_2 = 2A$, $i_3 = 1\,A$

$\therefore i_1 = 3\,A$

$\therefore V_1 = 24\,V$

$V_2 = 6V$

$V_3 = 6\,V$

1.15

(a) $q = \int i\,dt$

$= \int_0^2 6e^{-2t}$

$= \left[\frac{6e^{-2t}}{-2}\right]_0^2$

$= 2.945$ mC

(b) $v = 10 \frac{d}{dt} 6e^{-2t}$

$= 10 \cdot 6e^{-2t} \cdot -2$

$= -120 e^{-2t}$

$p = vi = 6e^{-2t} \cdot -120 e^{-2t}$

$= -720 e^{-4t}$

Ans

(c)

$$E = \int P\,dt$$

$$= \int -720 e^{-4t}$$

$$= \left[-720 \cdot \frac{e^{-4t}}{-4} \right]_0^3$$

$$= -179.999$$

C.W
11.2.23

C.T-1

Feb-18

lecture-1, 2

Chapter 2 Part-1

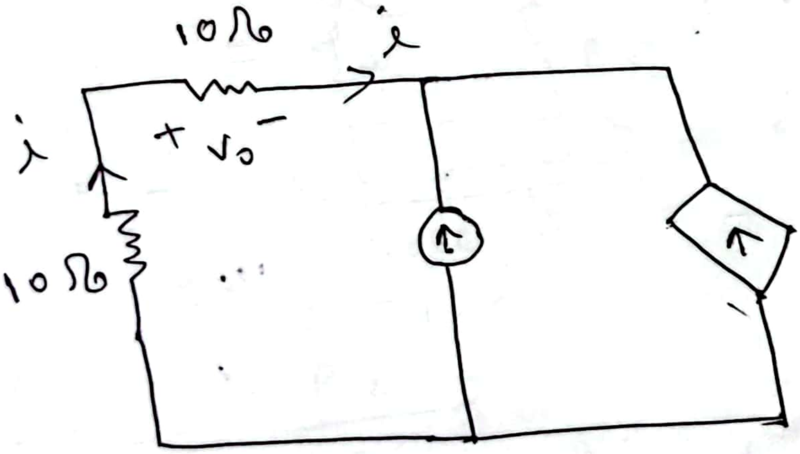
2.22

~~$10i_1 + 10i_1$~~

~~$10i_1 + 10i_1 +$~~

$V_0 = i\,10$

$i_1 = \frac{V_0}{10}$



$V_0 = 10i$

$\therefore i = \frac{V_0}{10}$

$25 + 2V_0 + i = 0$

$\Rightarrow 25 + 2V_0 + \frac{V_0}{10} = 0$

$\Rightarrow V_0 = -11.90\ V$

2.13

B

$i_1 + i_2 = 2$, $i_1 = 12$

$0 = I_2 + 3 + 7$

$I_2 = -10$

$7 + I_4 = I_3$

$2 = I_4 + 4$

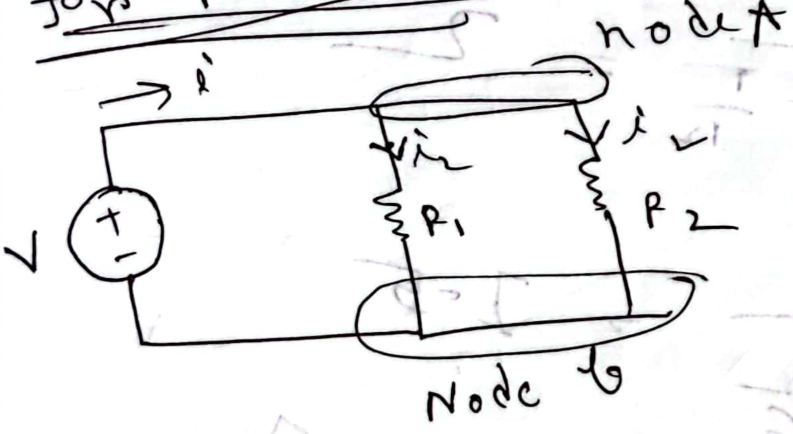
* $$\frac{V_1}{V_2} = \frac{IR_1}{IR_2} = \frac{R_1}{R_2}$$

* $$V_1 = \frac{R_1}{R_1+R_2} V$$

$$V_2 = \frac{R_2}{R_1+R_2} V$$

*

<u>for Parallel:</u>



* $V_1 = i_1 R_1$
& $V_2 = i_2 R_2$

$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

* $$\frac{i_1}{i_2} = \frac{R_2}{R_1}$$

$V = V$
(voltage same)

~~2·70~~

~~4+5+3~~

6Ω

$$\frac{1}{\frac{1}{6}+\frac{1}{4}} = 2.4$$

$$\frac{1}{\frac{1}{2.4}+\frac{1}{12}} = 2$$

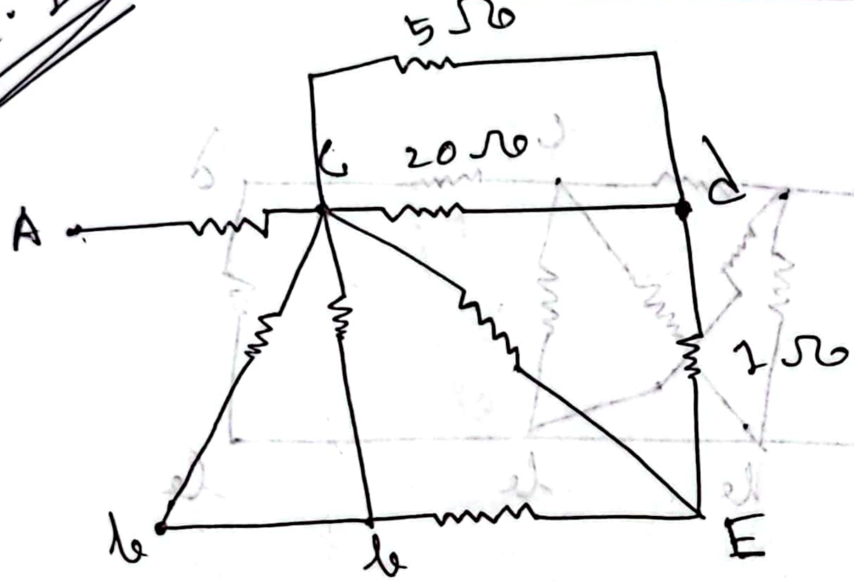
$$\frac{1}{\frac{1}{2}+\frac{1}{6}} = 1.5$$

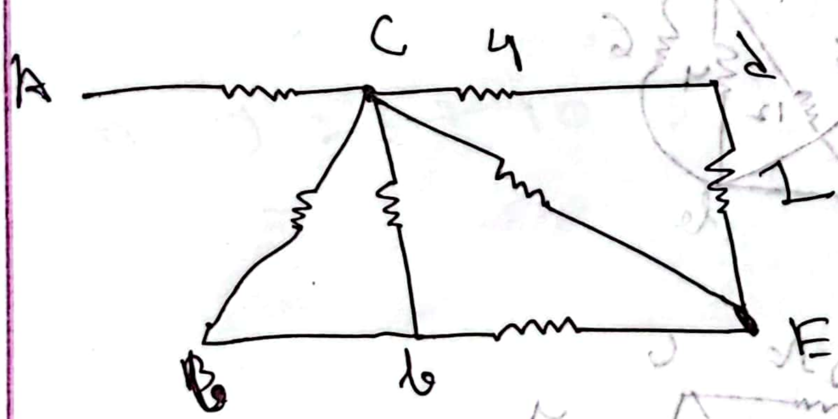
1

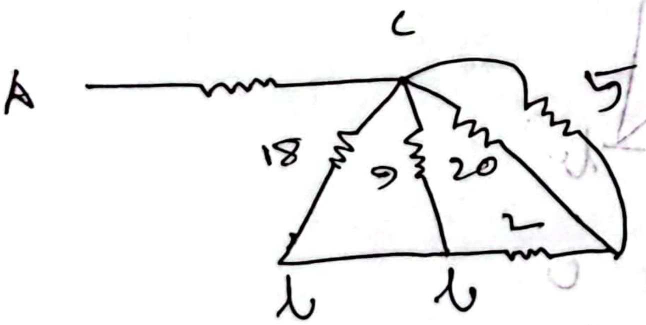
$\cancel{2.875} = 6.$

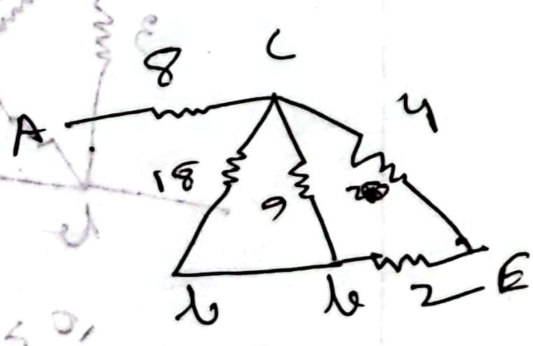
P.P

2.10



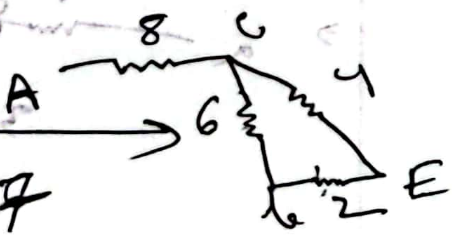






$10.67 \approx 11$

$6+2=8$

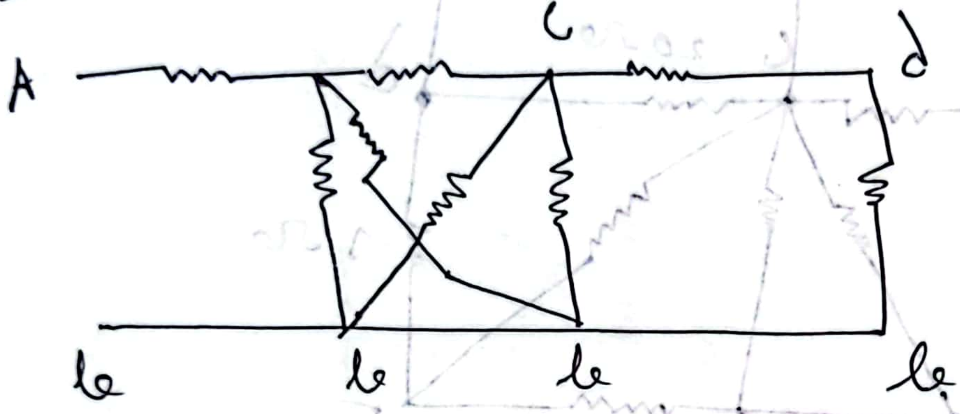


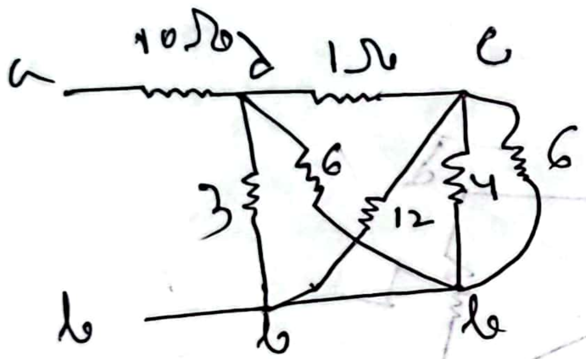
$A \quad \frac{1}{\frac{1}{8}+\frac{1}{4}} = 2.67$

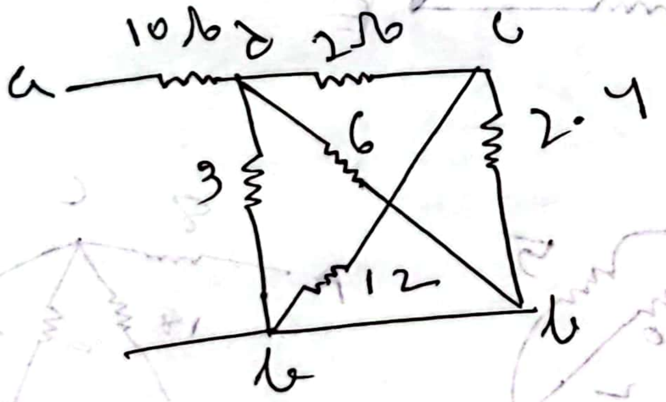
P.T.O

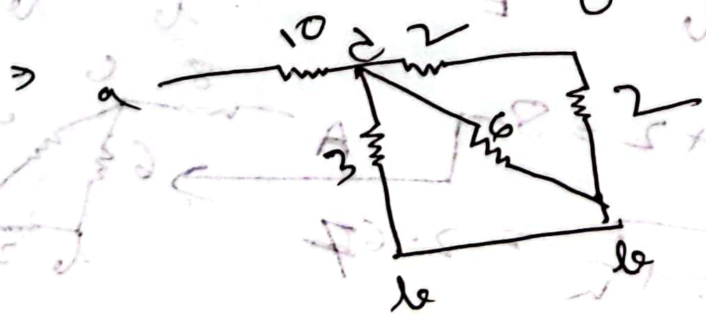
Exm:

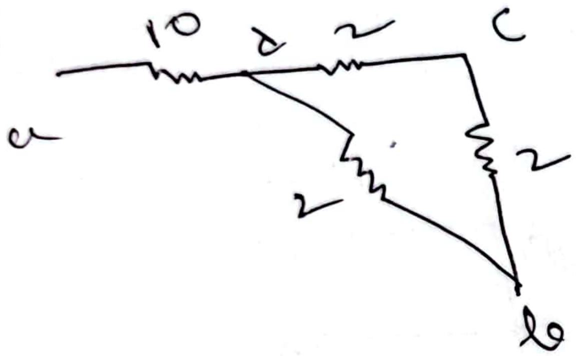
2.10

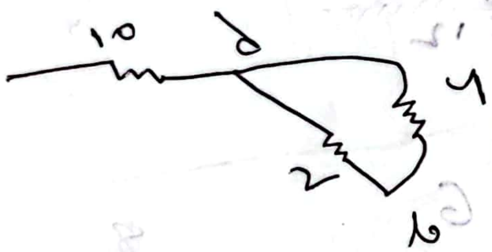

A
c
d
b
b
b
b


10Ω d
1Ω
c
a
3
6
12
4
6
b
b
b


10Ω d
2Ω
c
a
3
6
2.4
12
b
b


10
d
2
a
2
3
6
b
b



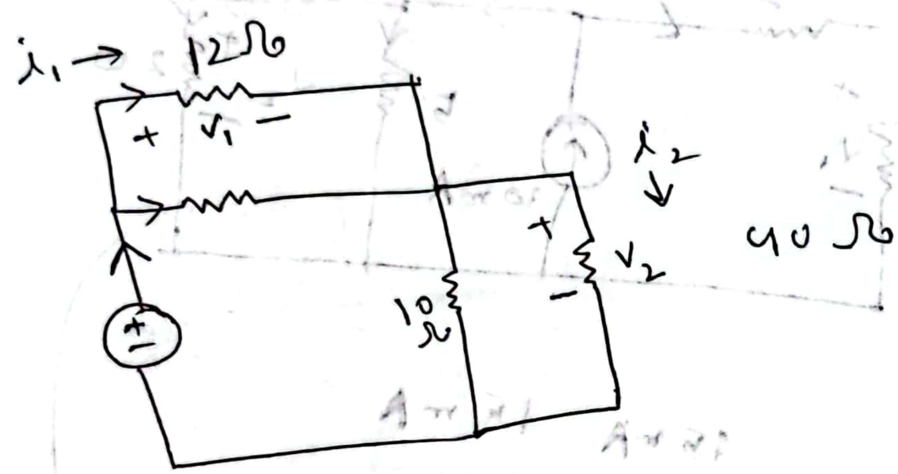


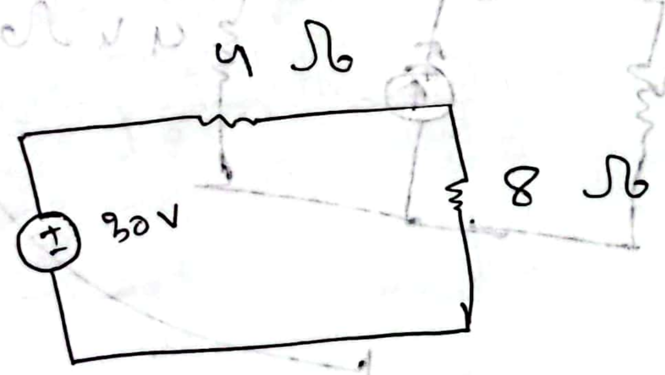
$\Rightarrow 1.33 + 10 \Rightarrow 11.33$

CW 13.2.23

Ec

2.12





$$I = \frac{30}{4+8} = 2.5 \text{ A}$$

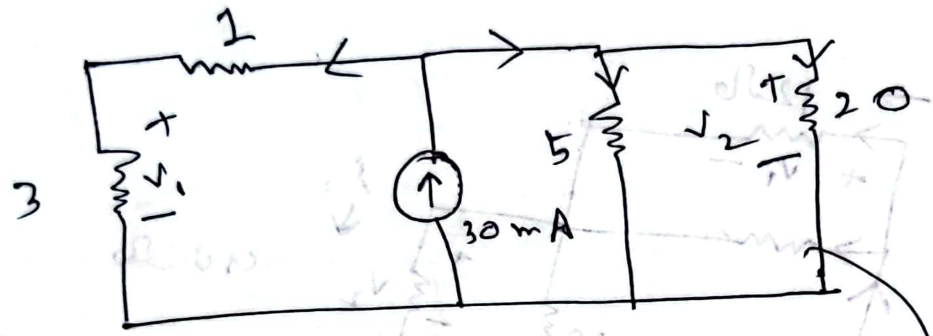
$$i_1 = \frac{1}{1+2} \times 2.5 = 0.833$$

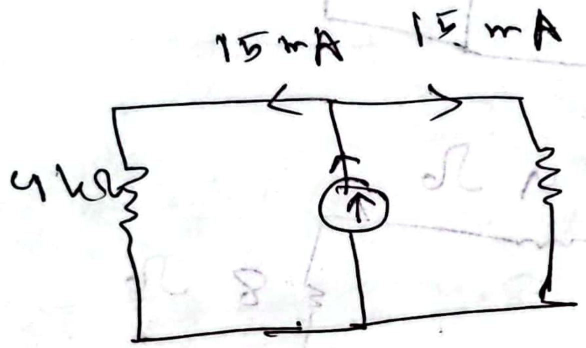
$$i_2 = \frac{1}{1+4} \times 2.5 \qquad R \rightarrow 1:4$$

$$= \frac{1}{5} \times 2.5 \qquad I \rightarrow 4:1$$

$=$

*





1 : 4

4 : 1

2

$\frac{1}{1+4} \times 15$

$\frac{4}{1+4} \times 15$

2

2

$V_1 = 3 \times 15$

$= 45\ V$

$V_2 = 3 \times 20$

$= 60\ V$

$P = (30) \times (60\ W)$

$= 1800\ mW$

P.T.O

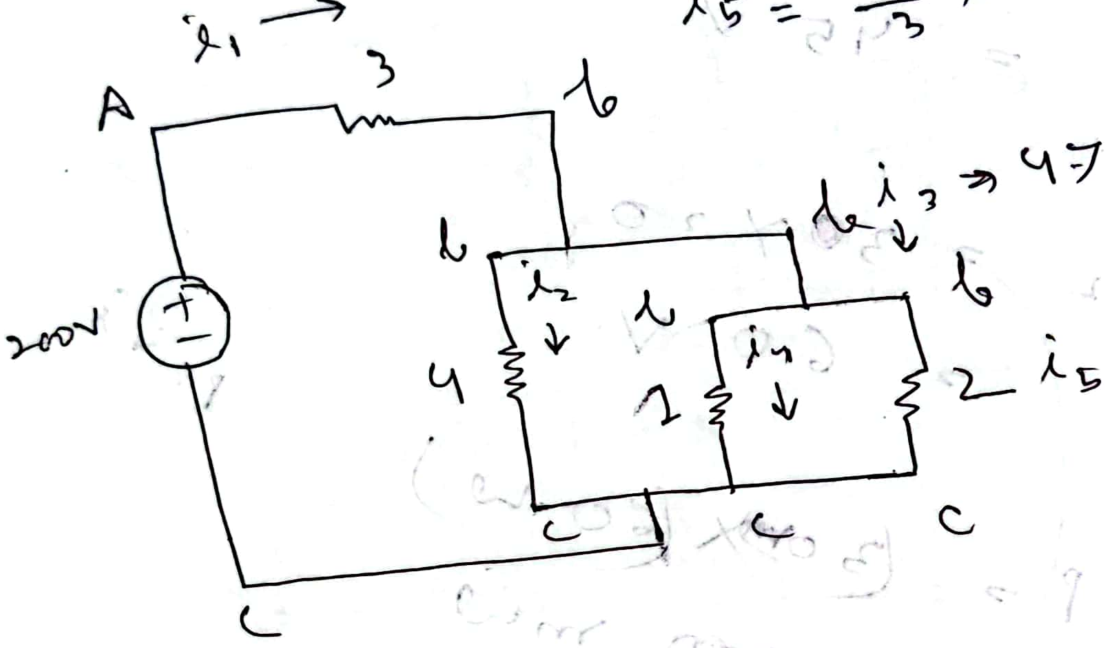
$R \rightarrow 1 : 2$

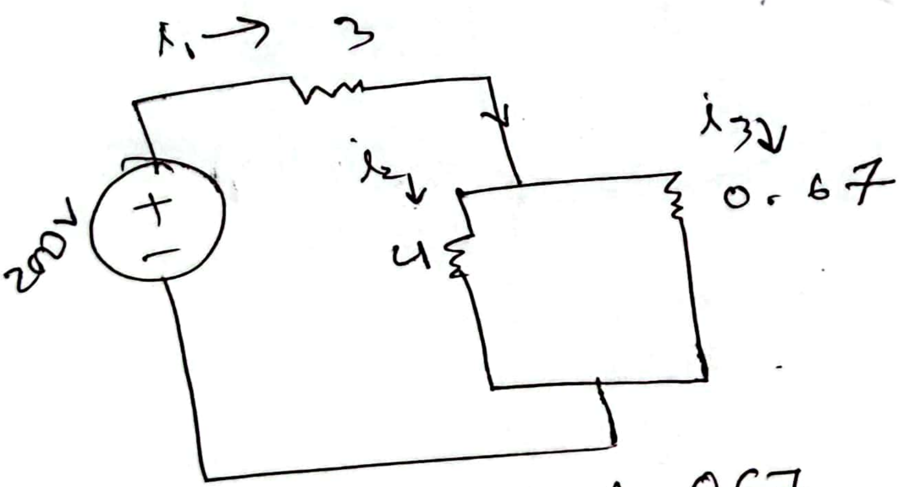
$I \rightarrow 2 : 1$

2.31

$i_4 = \frac{2}{3} \times 47.96$

$i_5 = \frac{1}{3} \times 47.96$





$4 : 0.67$

$0.67 : 4$

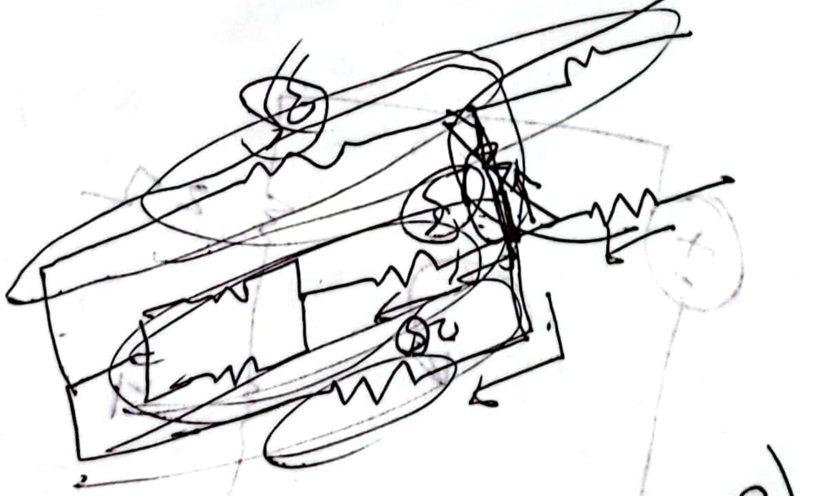
$i_2 = \frac{0.67}{4+0.67} \times 56$

$= 8.04$ A

$= \frac{4}{4.67} \times 56$

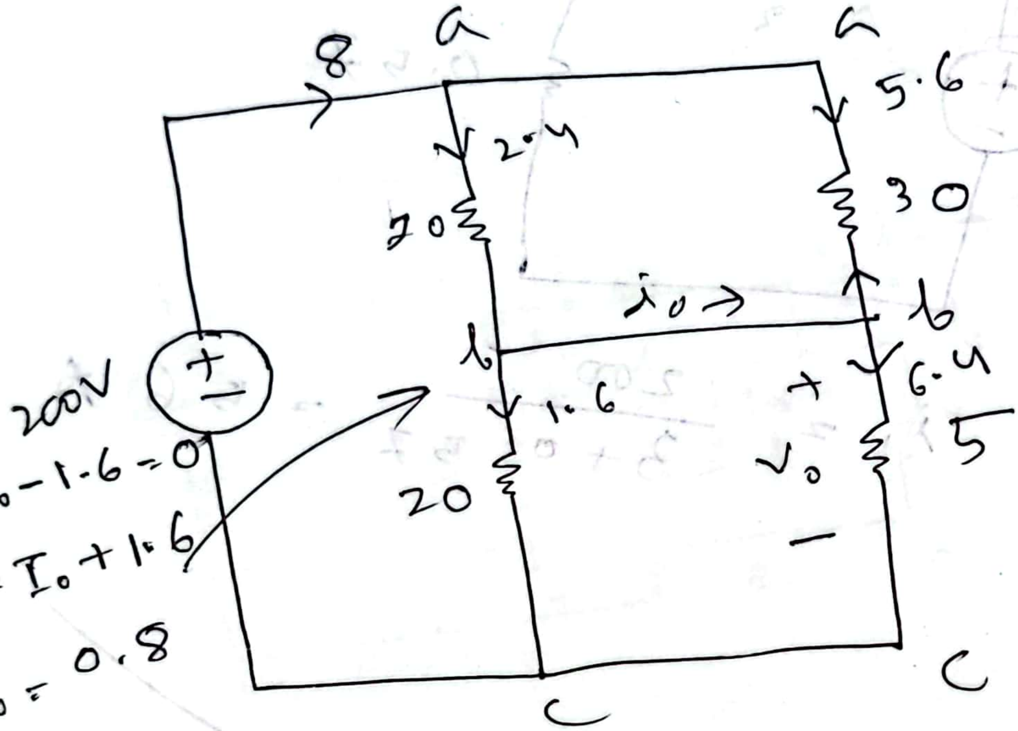
$= 47.96$ A

$$i_1 = \frac{200}{3+0.57} = 56\ A$$



P.T.O

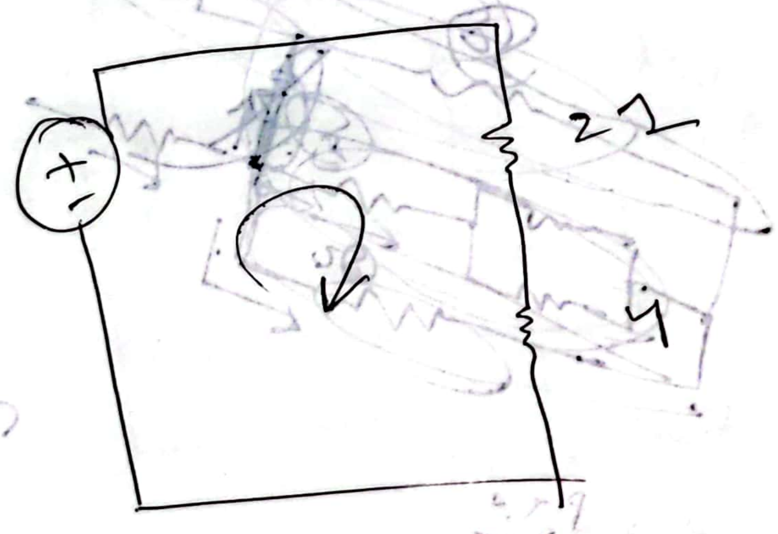
2.35



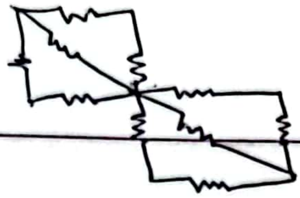
$2.4 - i_0 - 1.6 = 0$

$\Rightarrow 2.4 = I_0 + 1.6$

$\Rightarrow I_0 = 0.8$



$I_0 = \dfrac{200}{25} = 8\text{ A}$



70   30

7 : 3 

3 : 7

$\Rightarrow \frac{3}{10} \times 8$ | $\frac{7}{10} \times 8$

$= 2.4$ A | $= 5.6$

R :⇒ 20 : 5

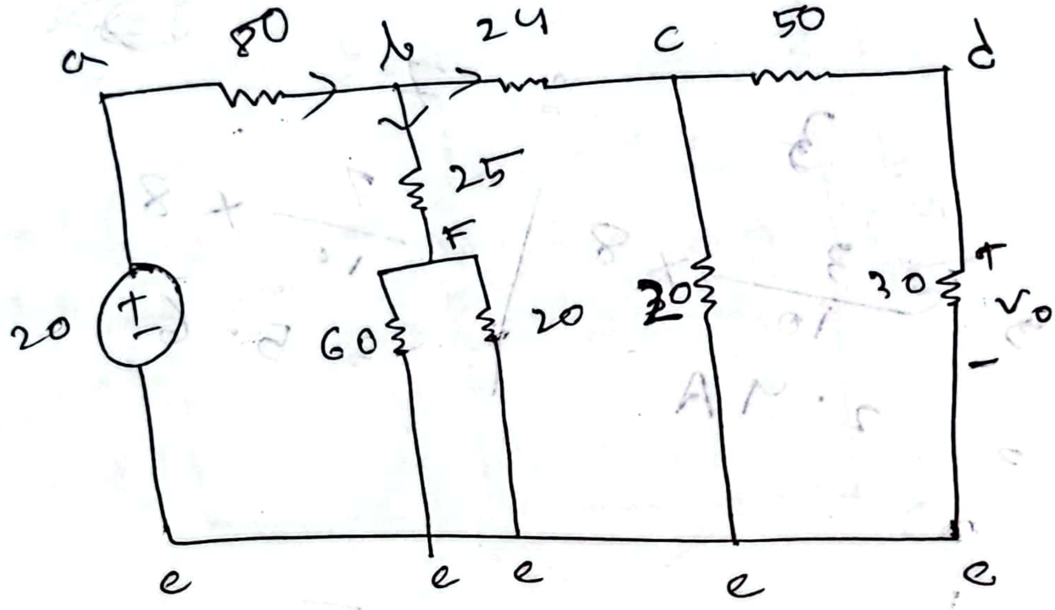
4 : 1

I 1 : 4

$\Rightarrow \frac{1}{5} \times 8$ | $\frac{4}{5} \times 8$

$= 1.6$ | $= 6.4$

2.36

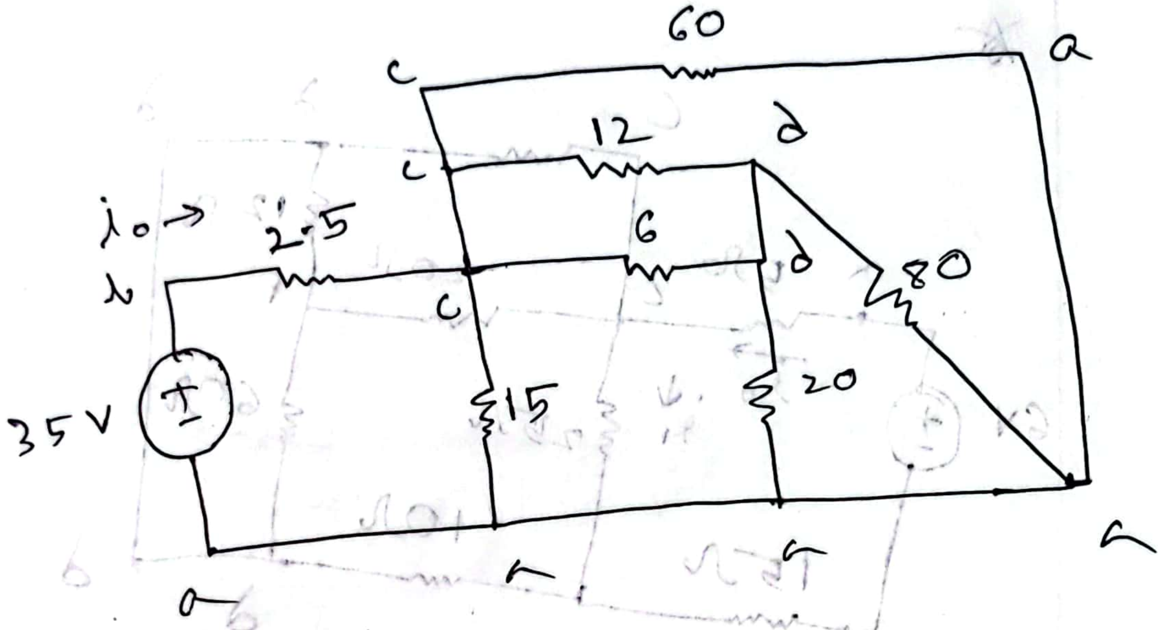


$R = 100\,\Omega$

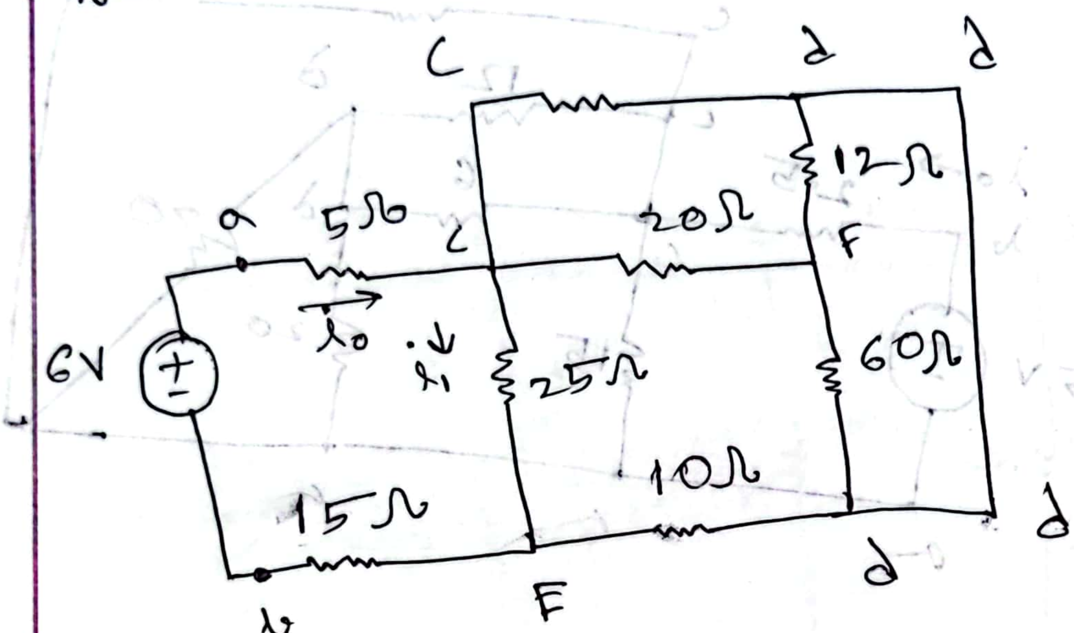
$$I = \frac{V}{R} = \frac{20}{100} = 0.2 \text{ A}$$

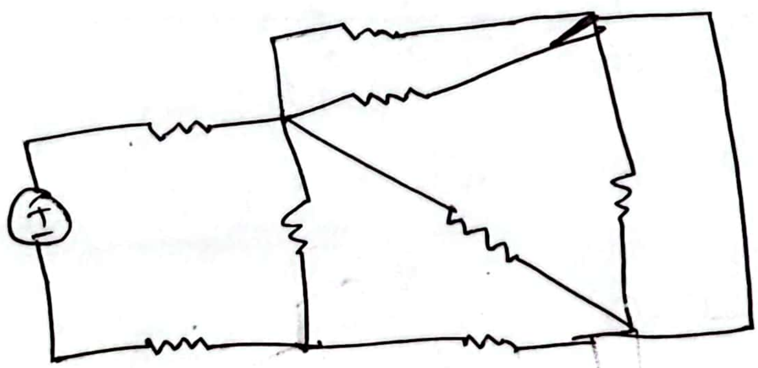
CW 14.2.23

EC

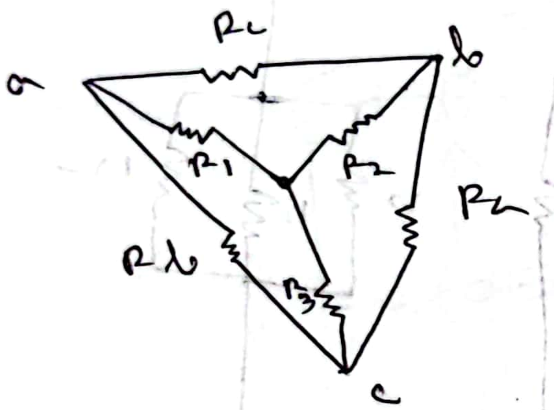


*


c
d
d
12Ω
a
5Ω
c
20Ω
F
i_0
i_1
6V
25Ω
60Ω
10Ω
15Ω
d
b
F
d



* Formula

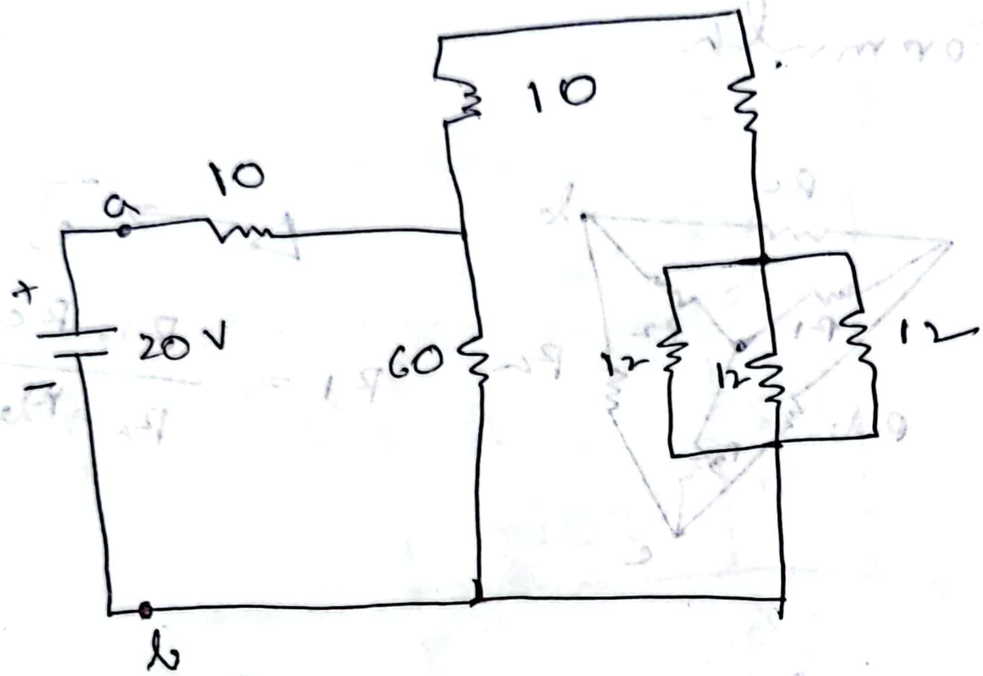


$\Delta \longrightarrow Y$

$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c}$$

$Y \longrightarrow \Delta$

$$R_a = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1}$$



2.17

$V_3 = -10\ V$ Ans

$V_2 + V_3 + 12 = 0$

$\Rightarrow V_2 - 10 + 12 = 0$

$\Rightarrow V_2 = -2$ Ans

$-24 + V_1 - V_2 = 0$

$\Rightarrow V_1 - 22 = 0$

$\Rightarrow V_1 = 22$ Ans

2.18

$-30 + 3i - 10 + 5i + 8 = 0$

$\Rightarrow -40 + 8i + 8 = 0$

$\Rightarrow -32 + 8i = 0$

$\Rightarrow i = 4$ A

$\cancel{V = IR}$

$\cancel{I = \frac{V}{R}}$

$-V_{ab} + 20 + 8 = 0$

$V_{ab} = 28$ V

$V = IR$

$= 20$

A

$P = Vi$

$6 - 3 - 1 - I_0 = 0$

$\Rightarrow 2 = I_0$

$\Rightarrow I_0 = 2$

$\Rightarrow 5 \times 2 = 10V = V$

$$\boxed{\begin{array}{l} \cancel{V_0 = 10V} \\ \\ -7 + V_p + 10 = 0 \\ \\ \Rightarrow V_p = -3 \end{array}}$$

A

$\cancel{\#} + 1 + 0 \quad 1 + 0 \rightarrow 1$

$0 + 1 = 0$ ~~[illegible]~~

$1 \downarrow 1$

$$\frac{(-1)^n + 1}{2}$$

$-v_0 + 5 - 10 \Rightarrow$

$\Rightarrow -v_0 - 5 \Rightarrow 0$

$\Rightarrow v_0 = -5V$

$x^n \Rightarrow \frac{x^{n+1}}{n+1}$

$-7 + v_p - 5 \rightarrow 0 \Rightarrow$

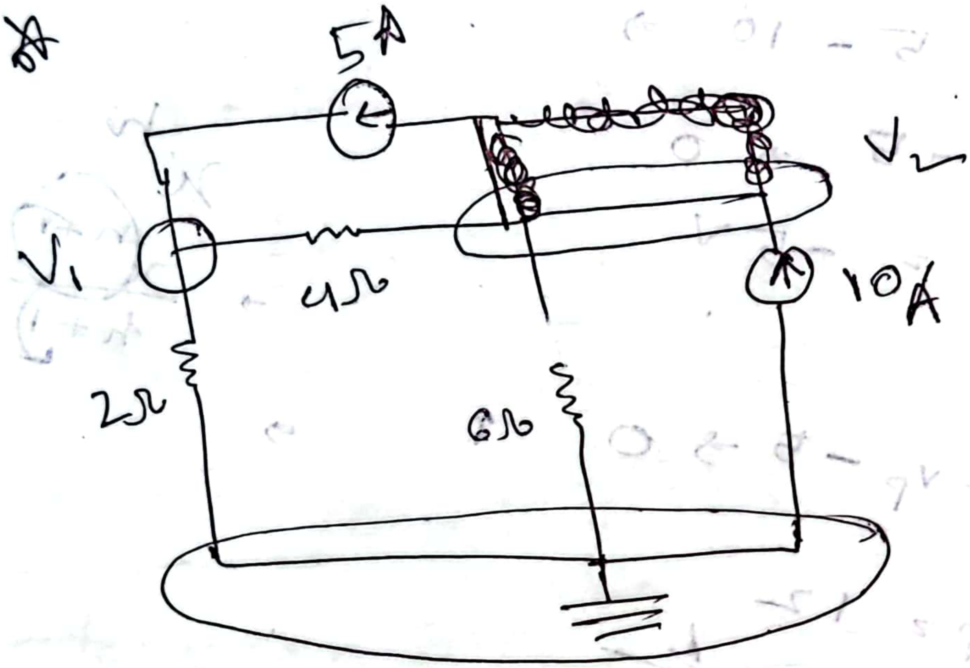
$\Rightarrow v_p = 12$

$q = \int i\,dt$

GW

EC

Node Analaisys



V_1:

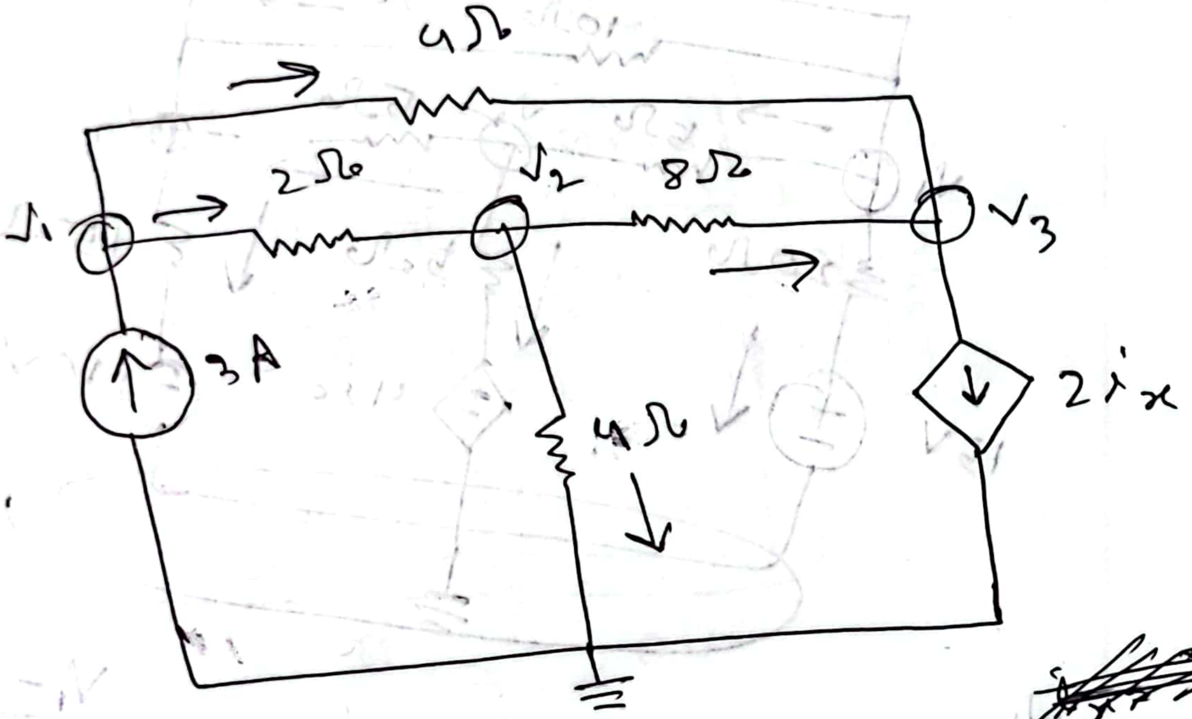
$$\frac{V_1-0}{2}+\frac{V_1-V_2}{4}=5$$

V_2:

$$5+\frac{V_2-0}{6}=10+\frac{V_1-V_2}{4}$$

$$\Rightarrow -3V_1+5V_2=60$$

$$i_x = \frac{V_1 - V_2}{2} \qquad V = IR$$



V_1

$$3 = \frac{V_1 - V_3}{4} + \frac{V_1 - V_2}{2}$$

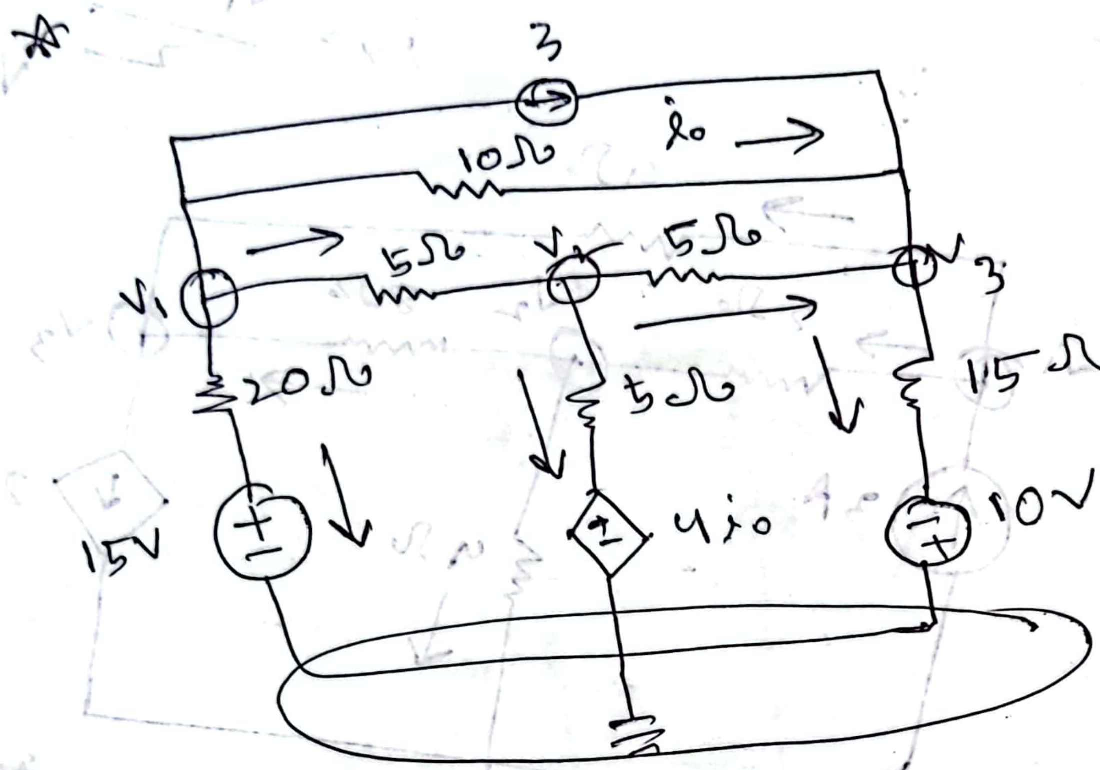
V_2

$$\frac{V_1 - V_2}{2} = \frac{V_2 - 0}{4} + \frac{V_2 - V_3}{8}$$

V_3:

$$\frac{V_2 - V_3}{8} + \frac{V_1 - V_3}{4} = 2i_x$$

$$i_o = \frac{V_1 - V_3}{10}$$



$\underline{V_1}$

$$3 + \frac{V_1 - V_3}{10} + \frac{V_1 - V_2}{5} + \frac{V_1 - 15}{20} = 0$$

$\underline{V_2}$

$$\frac{V_1 - V_2}{5} = \frac{V_2 - 4i_o}{5} + \frac{V_2 - V_3}{5}$$

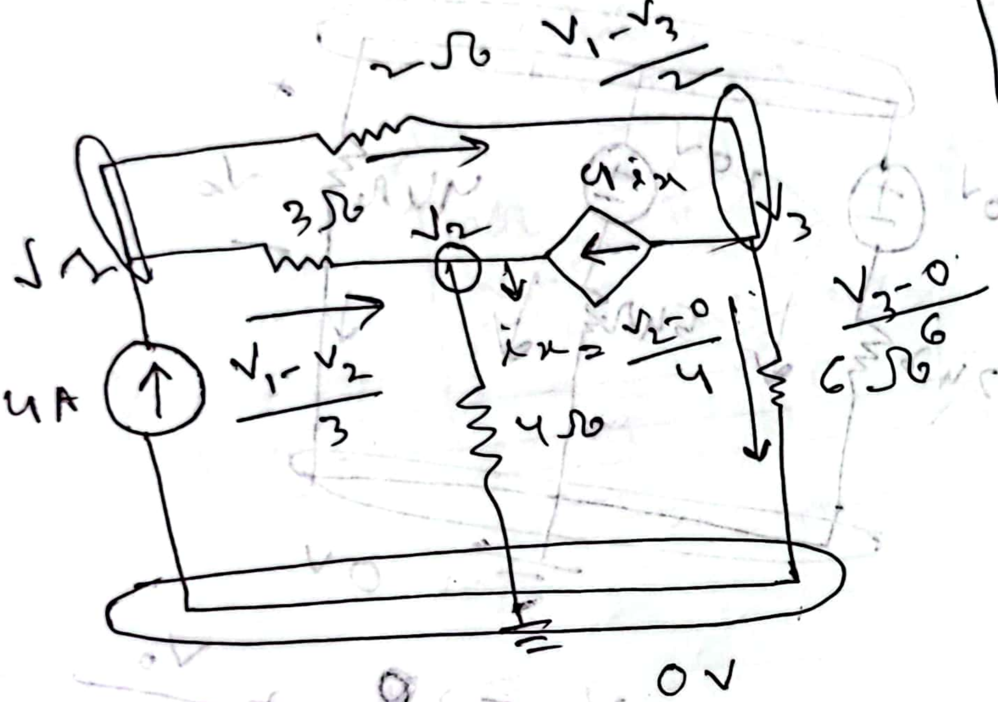
$\underline{V_3}$

$$3 + \frac{V_1 - V_3}{10} + \frac{V_2 - V_3}{5} = \frac{V_3 - (-10)}{15}$$

CW 25.2.23

EC

$$\boxed{i = \frac{\Delta V}{R}}$$



V_1:

$$4 = \frac{V_1 - V_2}{3} + \frac{V_1 - V_3}{2}$$

$$\boxed{i_x = \frac{V_2}{4}}$$

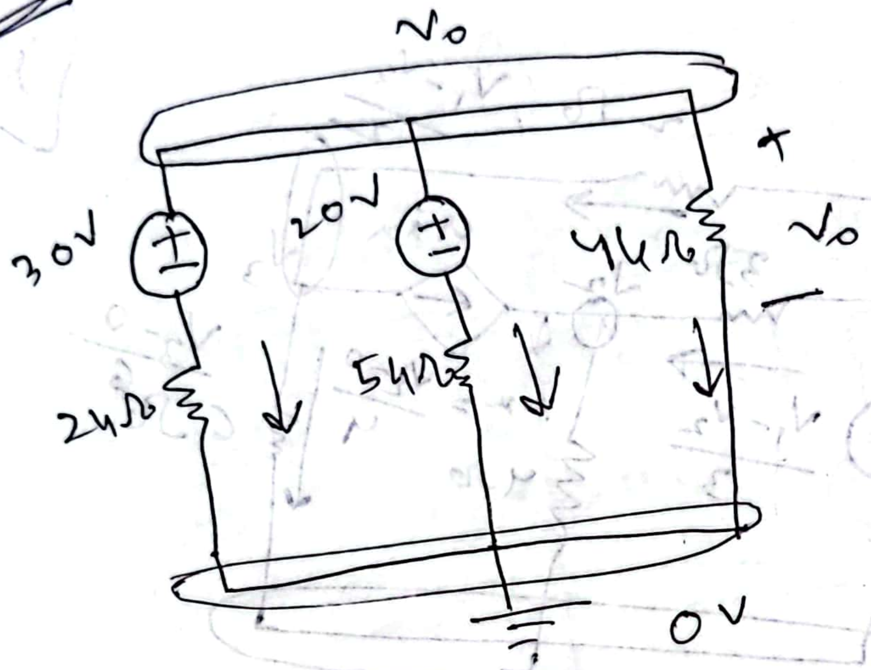
V_2:

$$\frac{V_1 - V_3}{3} + 4i_x = \frac{V_2}{4}$$

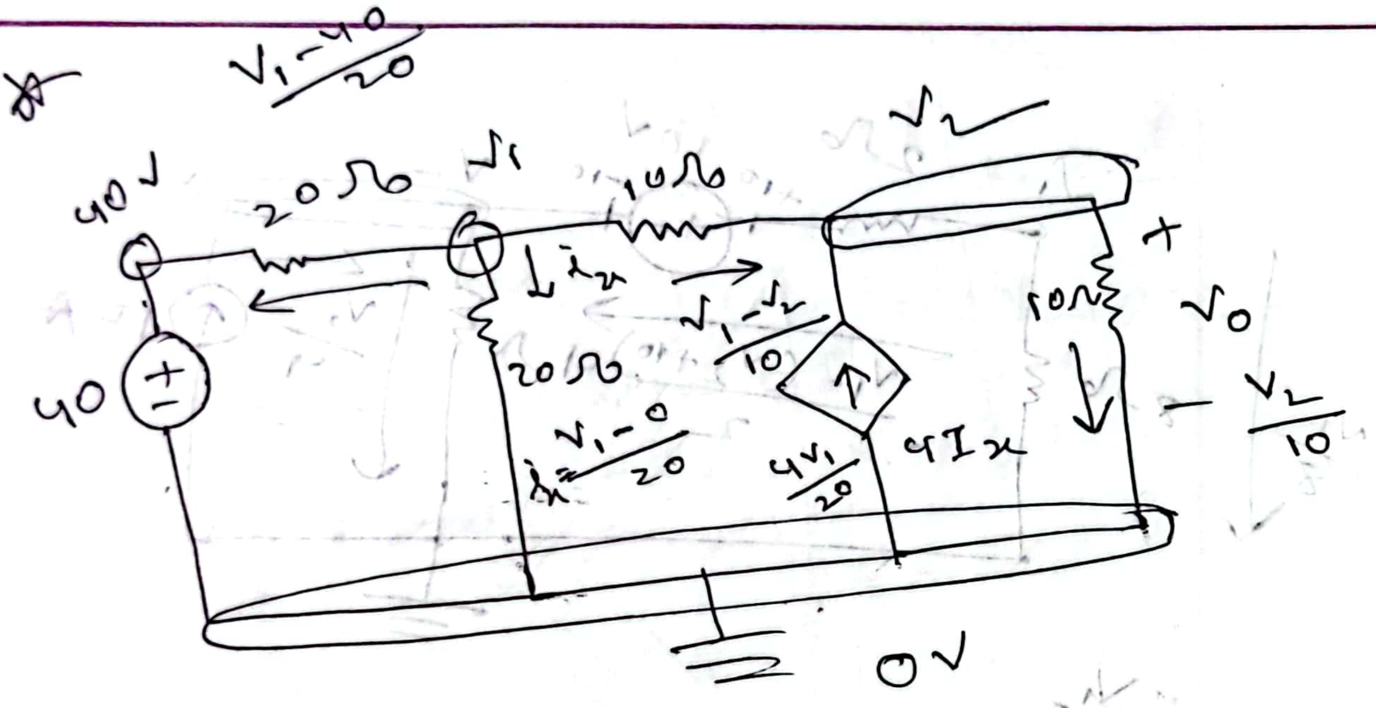
V_3:

$$\frac{V_1 - V_3}{2} = 4i_x + \frac{V_3}{6}$$

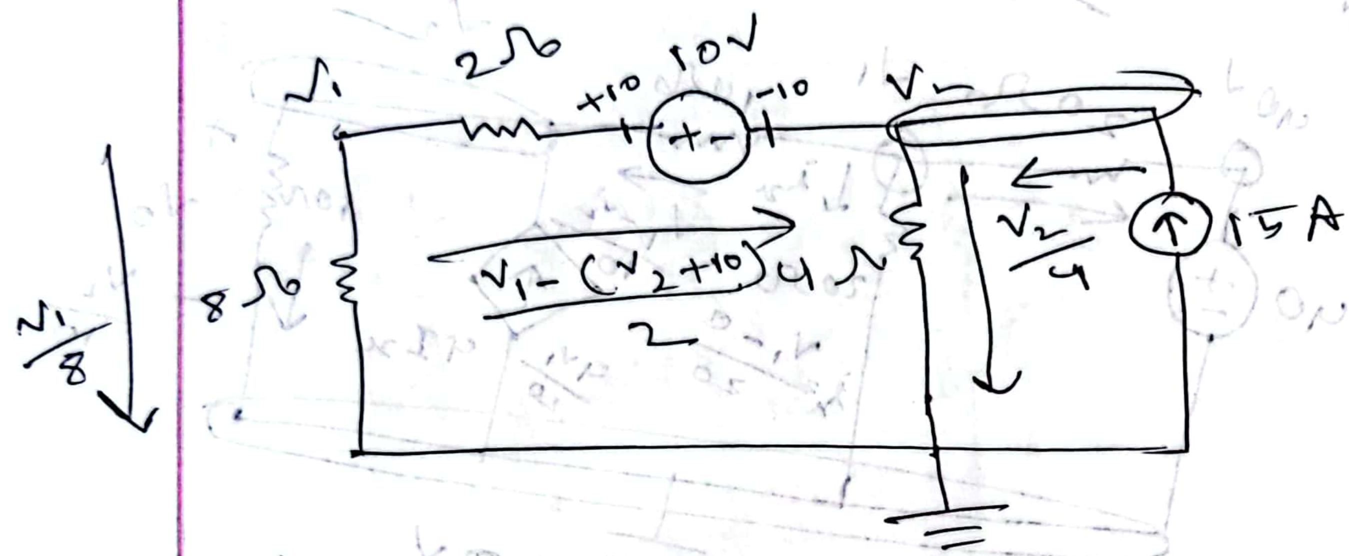
3.5



$$\frac{V_0 - 30}{2K} + \frac{V_0 - 20}{5K} + \frac{V_0}{4K} = 0$$


$\frac{V_1-40}{20}$
40 V
20 Ω
V_1
10 Ω
V_2
40
i_x
$\frac{V_1-V_2}{10}$
20 Ω
10 Ω
V_0
+
−
$\frac{V_2}{10}$
$i_x = \frac{V_1-0}{20}$
$\frac{4V_1}{20}$
$4I_x$
0 V

P.T.O



V_1

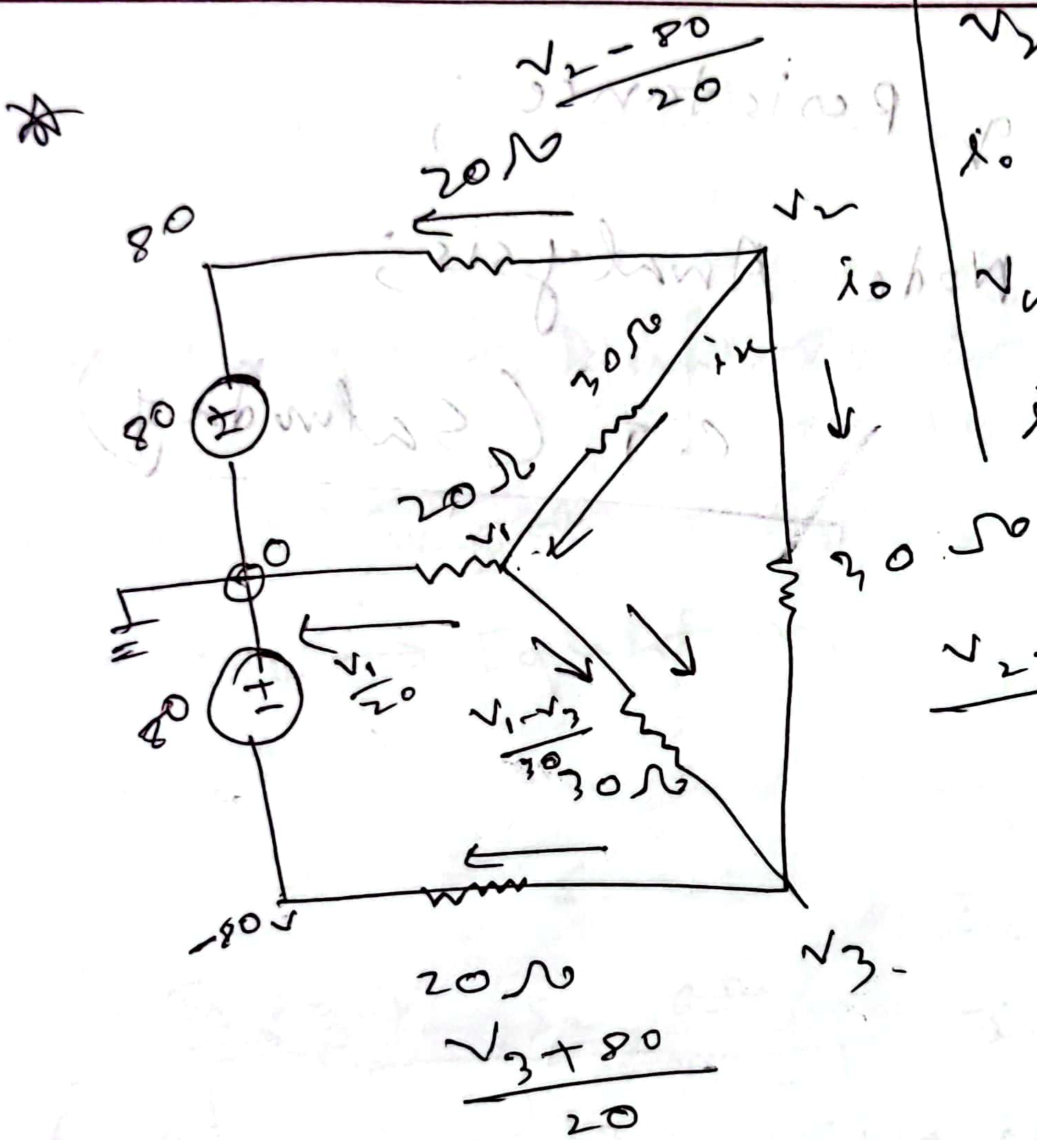
$$\frac{V_1}{8}+\frac{V_1-V_2-10}{2}=0$$

V_2

$$\frac{V_1-V_2-10}{2}+15=\frac{V_2}{4}$$

P.T.O

*



$V_x = V_1$

$i_0 = \frac{V_2 - V_3}{30}$

$V_{ab} = V_2 - V_3$

$i_x = \frac{V_2 - V_1}{30}$

30Ω

$\frac{V_2 - V_3}{30}$

(i) $\frac{V_1}{20} + \frac{V_1 - V_3}{30} = \frac{V_2 - V_1}{30}$

(ii) $\frac{V_2 - 80}{20} + \frac{V_2 - V_1}{30} + \frac{V_2 - V_3}{30} = 0$

(iii) $\frac{V_1 - V_3}{30} + \frac{V_2 - V_3}{30} = \frac{V_3 + 80}{20}$

C.W 28.2.23

EC

Node Analysis → Node → KCL → Node Voltage

Mesh Analysis → Mesh → KVL → Mesh Current

→ Mesh Current

→ KVL → Equation

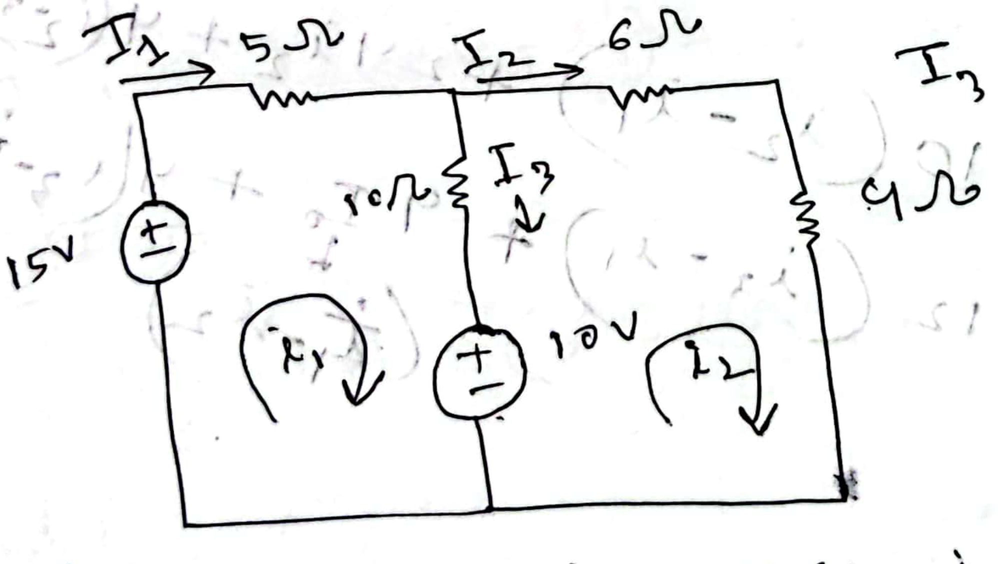
→ Solve

$I_1 = i_1$

$I_2 = i_2$

$I_3 = i_1 - i_2$

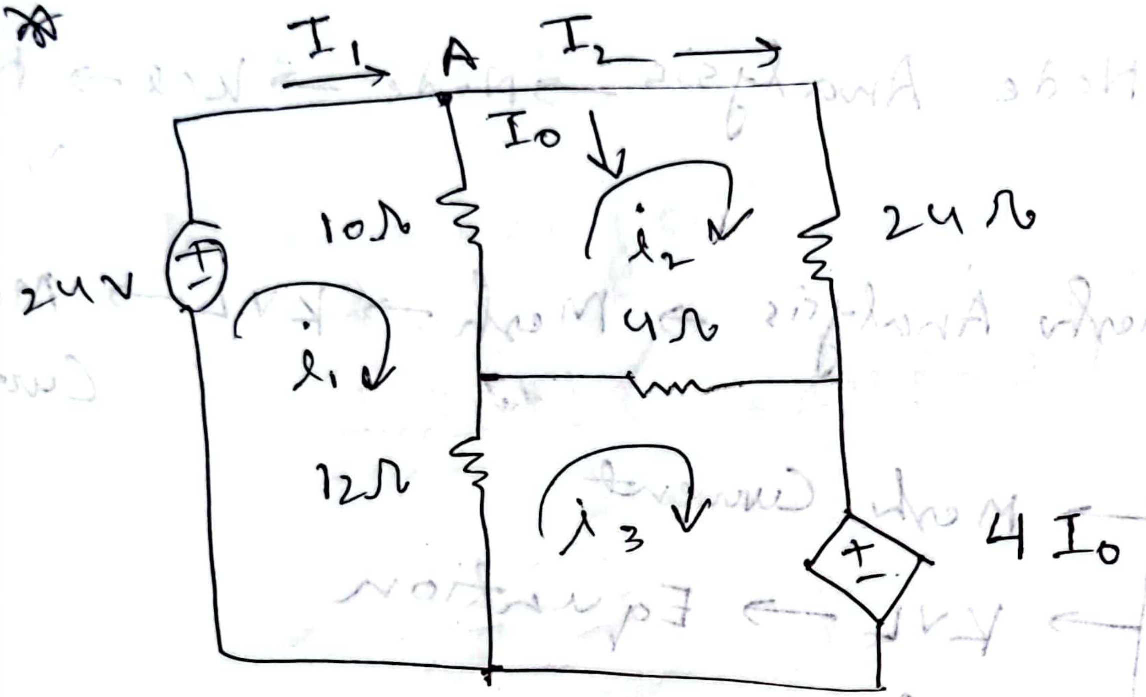
*



Mesh 1 : ⇒ $-15 + 5i_1 + 10(i_1 - i_2) + 10 = 0$

Mesh 2 : ⇒ $-10 + 10(i_2 - i_1) + 6i_2 + 4i_2 = 0$

*



<u>for:</u>

$$-24 + 10(i_1 - i_2) + 12(i_1 - i_3) = 0$$

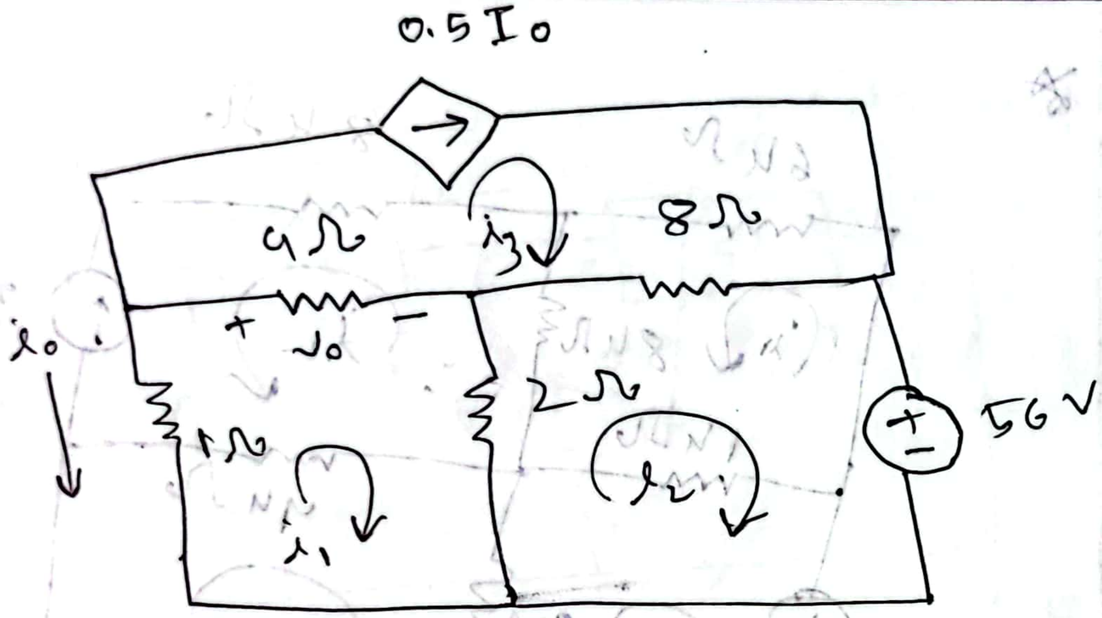
* $10(i_2 - i_1) + 24i_2 + 4(i_2 - i_3) = 0$

* $12(i_3 - i_1) + 4\frac{I_o}{2} + 4(i_3 - i_2) = 0$

$(i_1 - i_2)$

p.t.o.

*



$i_3 = 0.5 I_0$, $I_0 = -i_1$

Mesh 1:

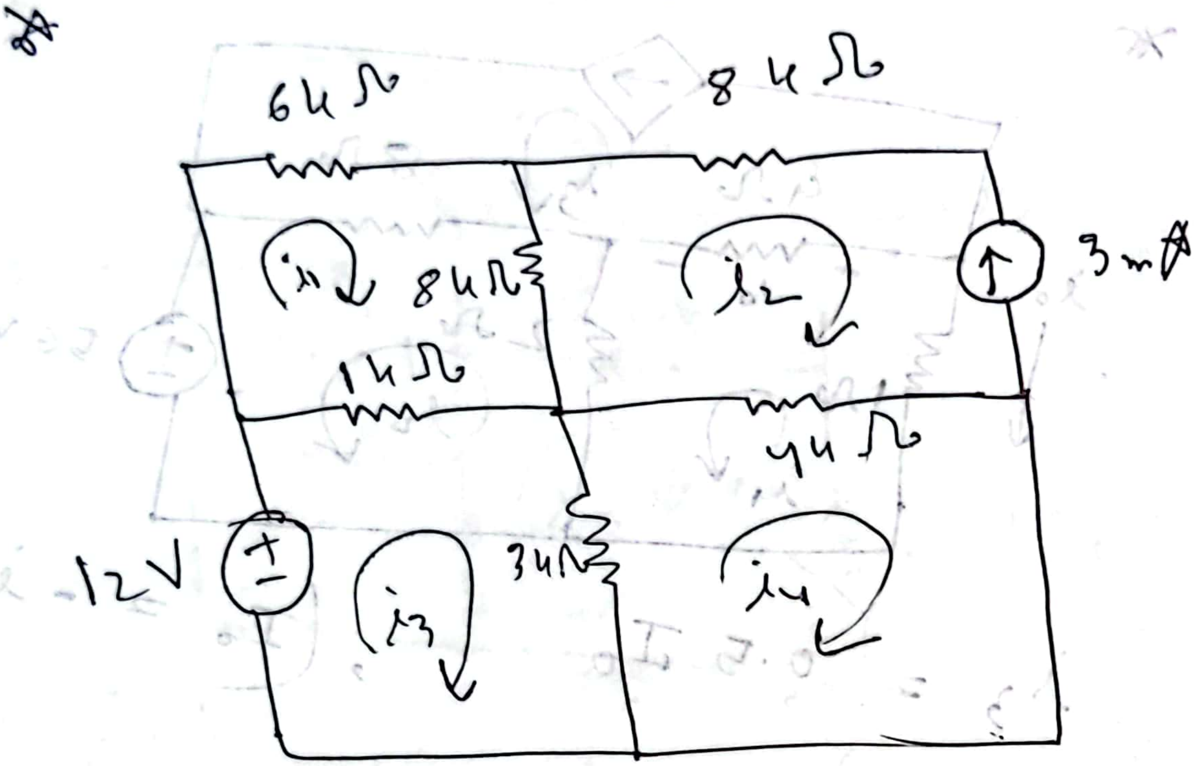
$1 i_1 + 4(i_1 - i_3) + 2(i_1 - i_2) = 0$

Mesh 2:

$2(i_2 - i_1) + 8(i_2 - i_3) + 56 = 0$

Mesh 3:

$i_3 = -0.5 i_1$



$i_2 = -3\,mA$

Mesh: 2

$6k\,i_1 + 8k(i_1 - i_2) + 1k(i_1 - i_3) = 0$

Mesh-3:

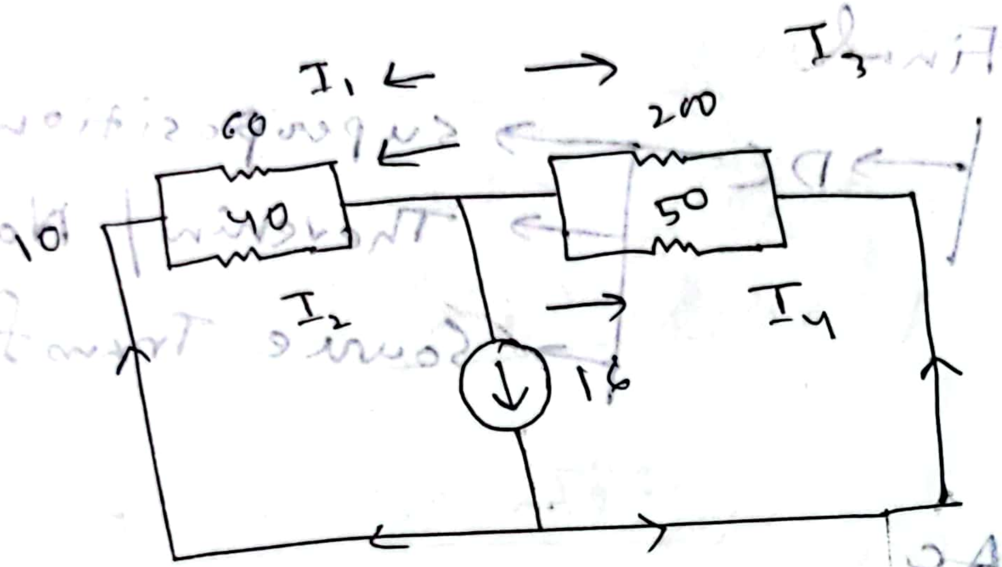
$-12 + 1k(i_3 - i_1) + 3k(i_3 - i_4$

Mesh-4:-

$3k(i_4 - i_3) + 4k(i_4 - i_2) = 0$

$I_1 = -$

$I_2 = -$

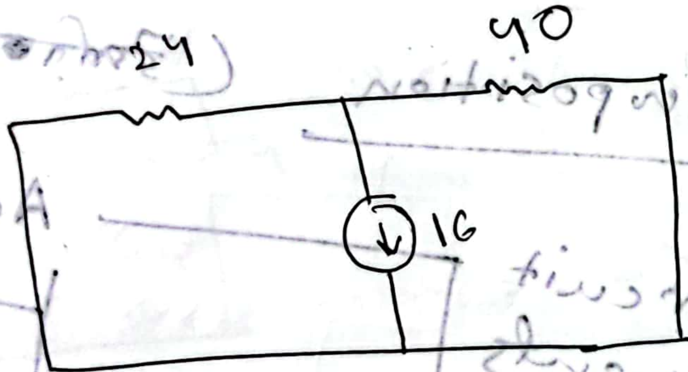


$60 : 40$

$40 : 60$

$\frac{40}{100} \times 10$

$\frac{60}{100} \times 10$



$24 : 40 \ \Omega$

$40 : 24 \ A$

$\frac{40}{40+24} \times 16 \Rightarrow 10$

$\frac{24}{40+24} \times 16 \Rightarrow 6$

Final

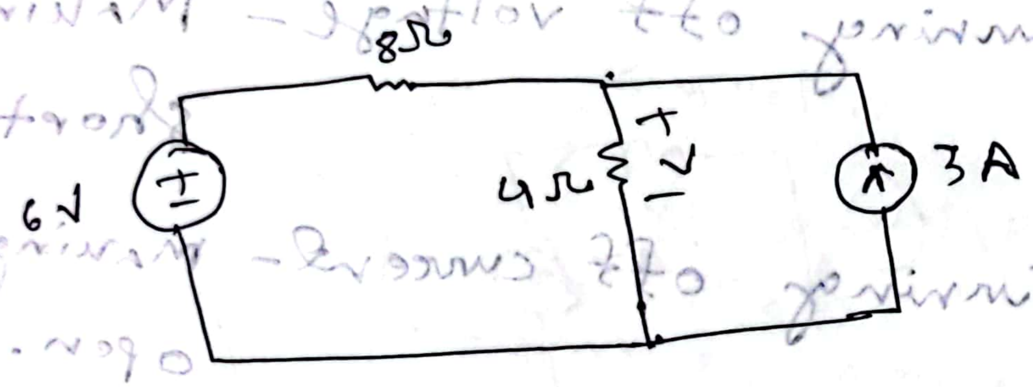
- DC
  - superposition
  - Thevenin / Norton
  - Source Transform

AC

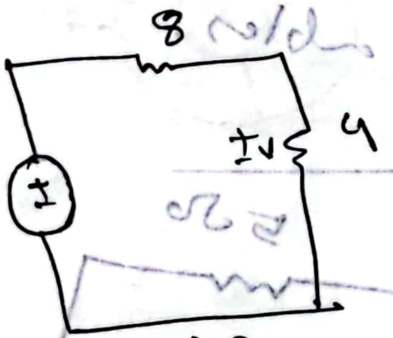
~~CW~~

Superposition (উপরিপাতন)

Circuit Elements
- Active Element
  - Generate Power
  - source
- Passive Element
  - Dissipates Power
  - Resistance.



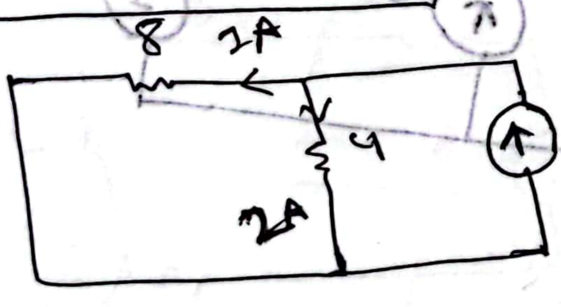
6V on ⇒ 3A off:



$$V_1 = \frac{6}{12} \times 4$$

$$= 2V$$

3A ON ⇒ 6V off:



$$V_2 = 8V$$

8 : 4

2 : 1

1 : 2

$\frac{1}{3} \times 3$ | $\frac{2}{3} \times 3 = 2A$

$= 1A$

$$V = V_1 + V_2$$

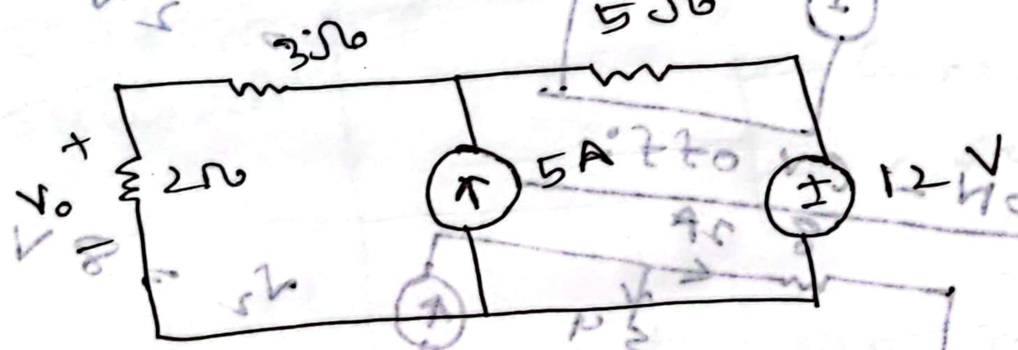
$$= (2 + 8)$$

$$= 12V$$

* Turning off voltage – Making it short

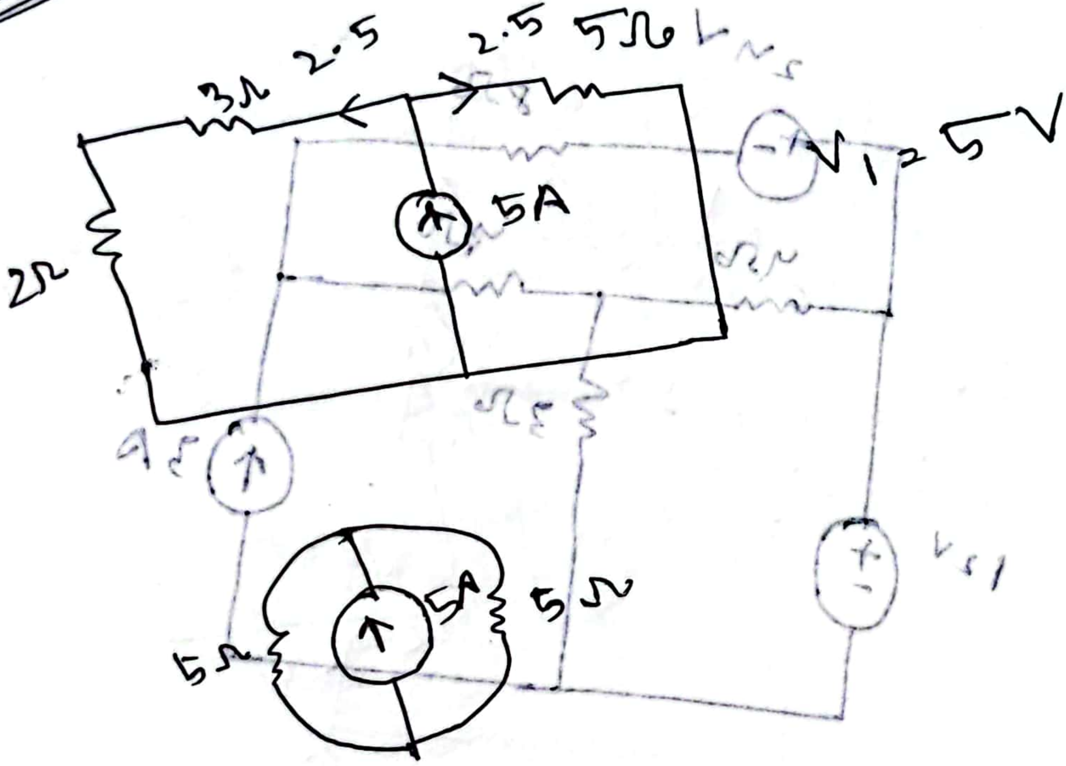
* Turning off current – Making it open.

* Dependent sources are left intact because they are controlled by circuit variables.

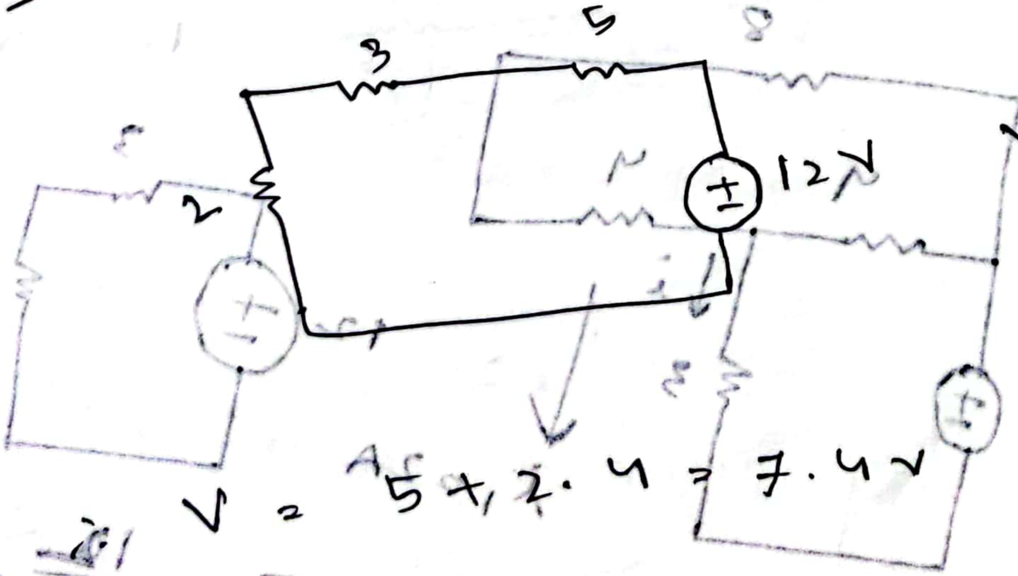


PT:

5A ON



12V ON

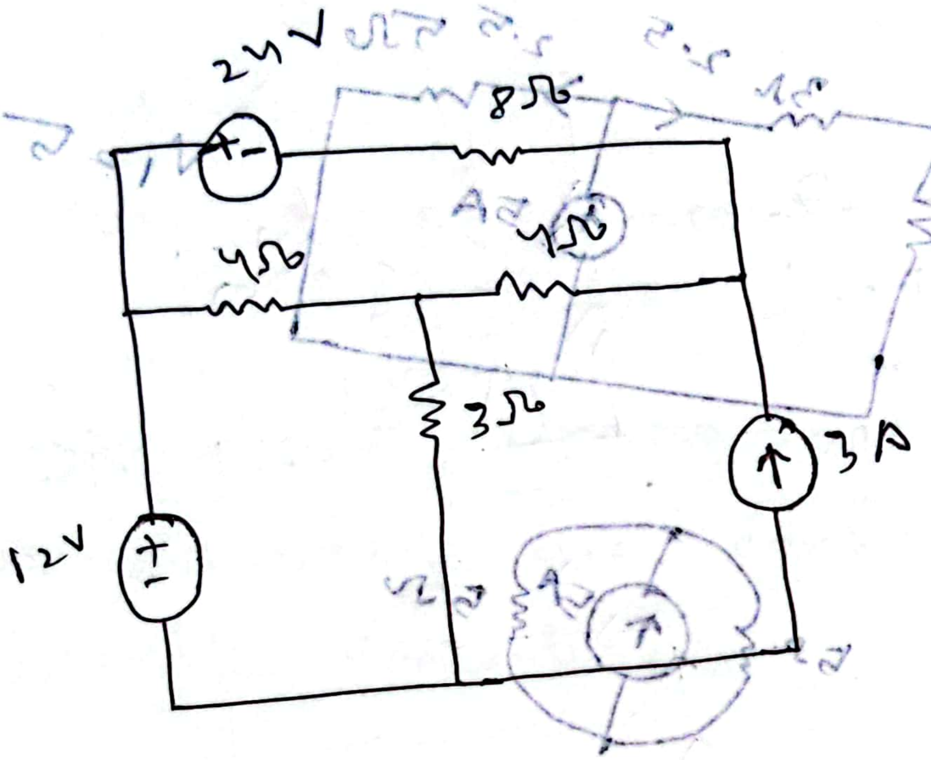


$V_2 = \frac{12}{10} \times 2$

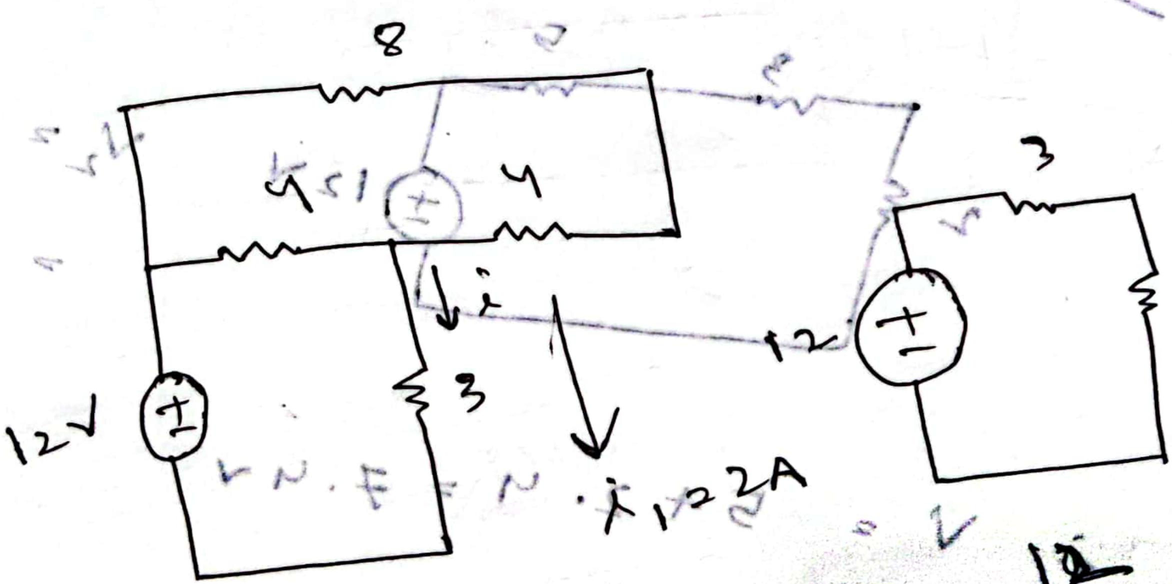
$= 2.4V$

$V = 5 + 2.4 = 7.4V$

*

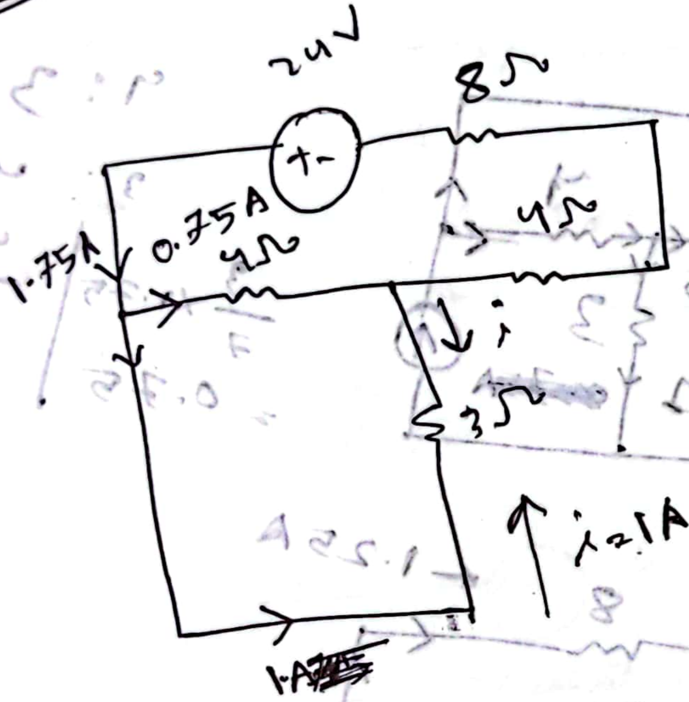


~~12 V on~~



$$I_1 = \frac{12}{6} = 2A$$

24V on



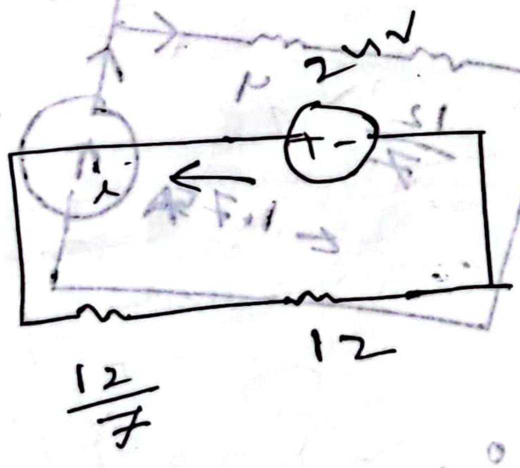
$i = 1A$

$4:3$

$3:4$

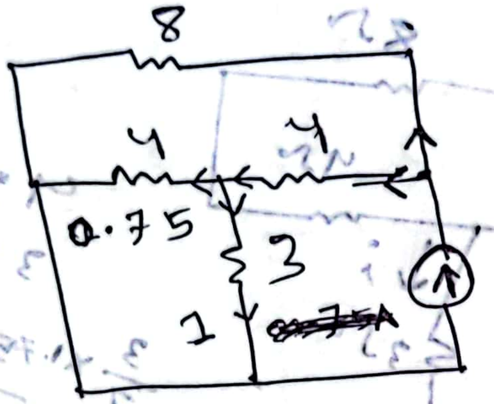
$\frac{3}{7} \times 1.75 = 0.75$

$\frac{4}{7} \times 1.75 = 1 A$



$$i = \frac{V}{R} = \frac{24}{\frac{12}{7} + 12} = 1.75 A$$

3A ON



$4 : 3$

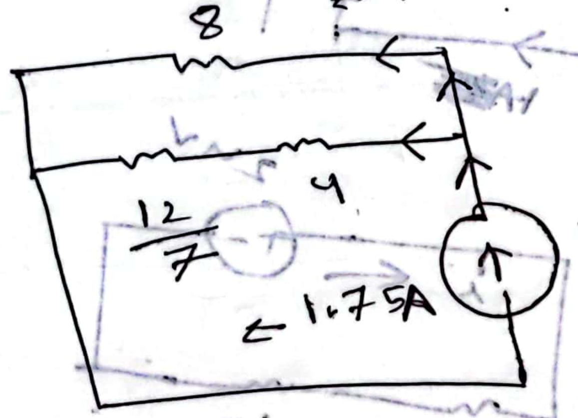
$3 : 4$

$\frac{3}{7} \times 1.75 = 0.75$

$\frac{4}{7} \times 1.75 = 1$

$i = 1A$

$\leftarrow 1.25A$



$\frac{12}{7} + 4 = \frac{40}{7}$

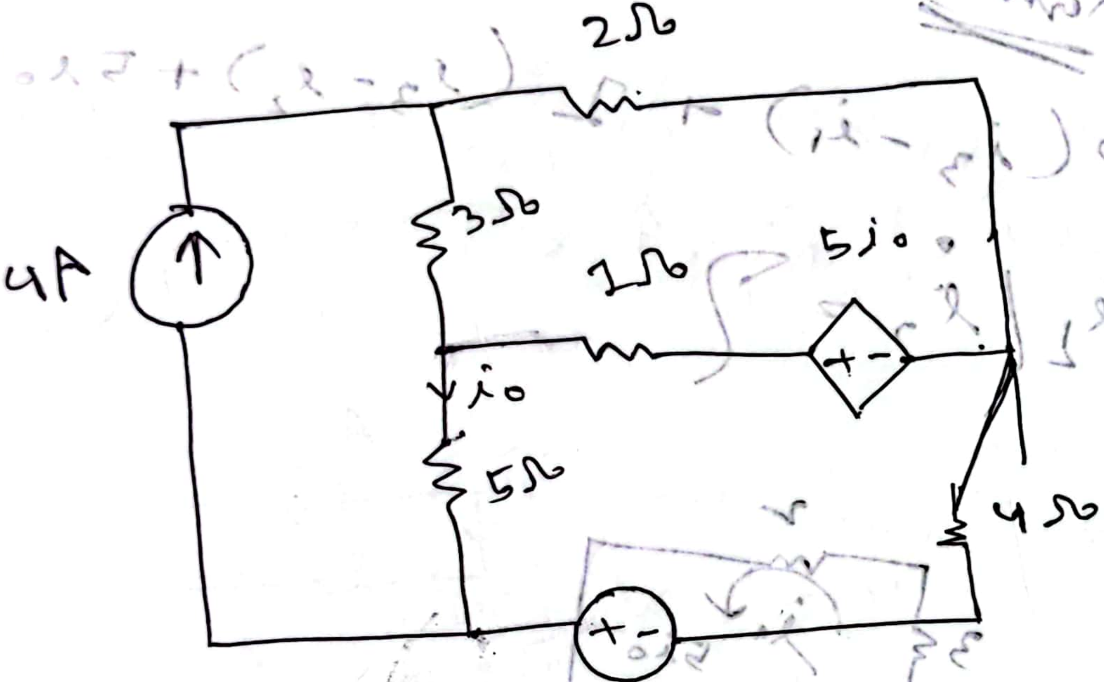
$8 : \frac{40}{7}$

$\frac{40}{7} : 8$

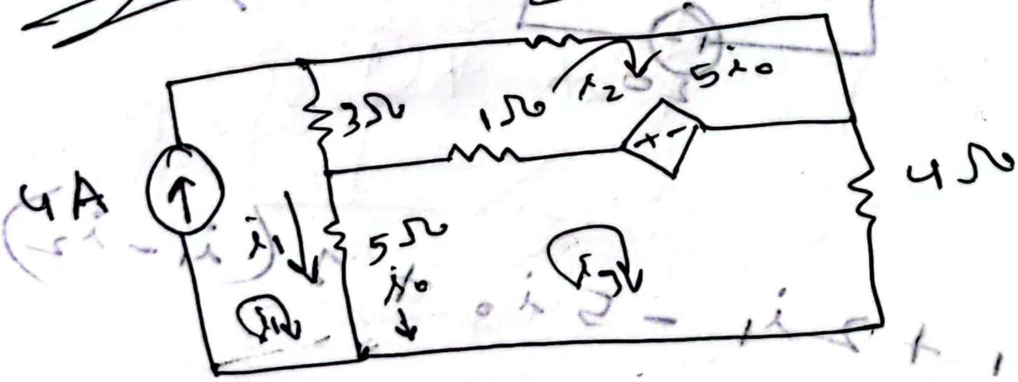
$= \frac{\frac{40}{7}}{\frac{96}{7}} \times 3 = 1.25$

$\frac{8}{\frac{96}{7}} \times 3 = 1.75\ A$

$$\boxed{I = 2 - 1 + 1 = 2A}$$



4A ON



$i_o = i_1 - i_3$

$i_1 = 4$

i_2

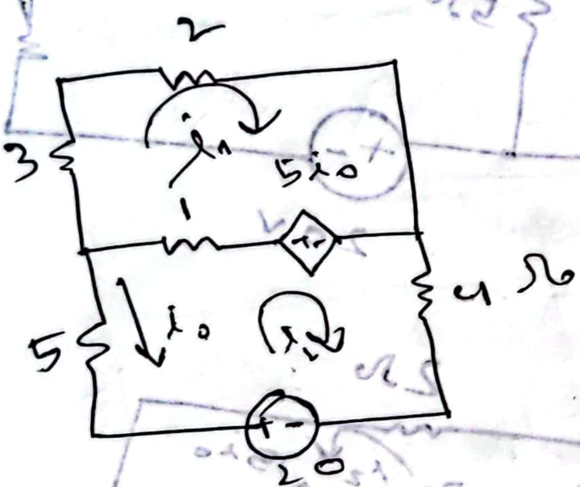
$3(i_2 - i_1) + 2 i_2 - 5 i_o + 1(i_2 - i_3) = 0$

p.T.O

Mesh - 3

$5(i_3 - i_1) + 1(i_3 - i_2) + 5i_0 + 4i_{3} ...$

i_2



$i_0 = -i_2$

i_1

$3i_1 + 2i_1 - 5i_0 + 1(i_1 - i_2) = 0$

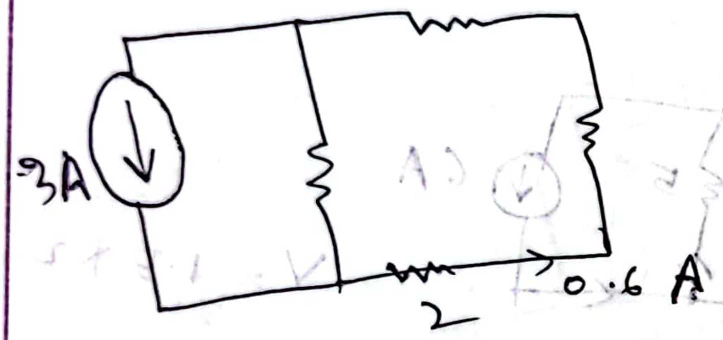
i_2

$5i_2 + 1(i_2 - i_1) + 5i_0 + 4(i_2) - 20 = ...$

CW

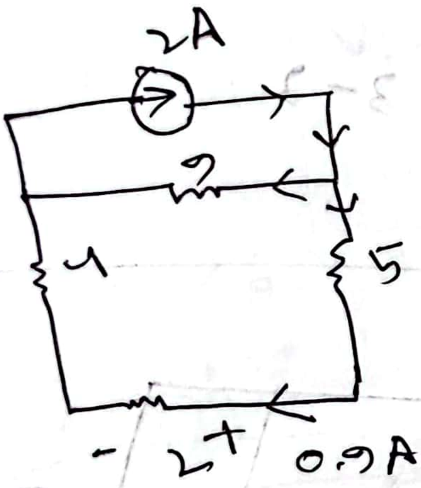
Superposition

EC



$\therefore V = 2 \times 0.6$

$= 1.2$

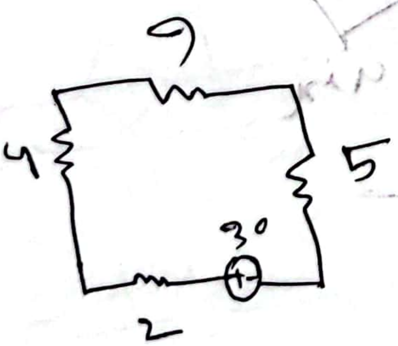


V 9 : 11

11 : 9

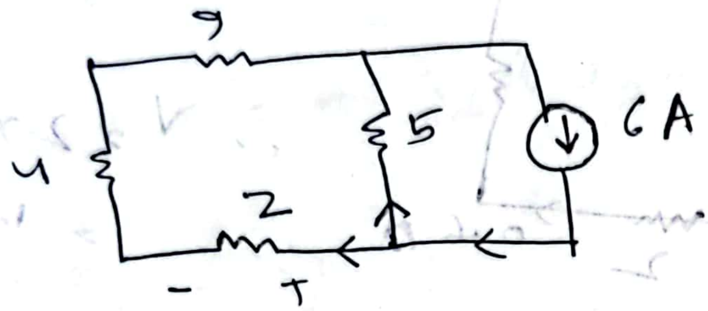
$\frac{9}{20} \times 2$

$\therefore V = 2 \times 0.9 = 1.8\ V$



$I = \frac{30}{20} = 1.5$

$V = 1.5 \times 2 = 3\ V$

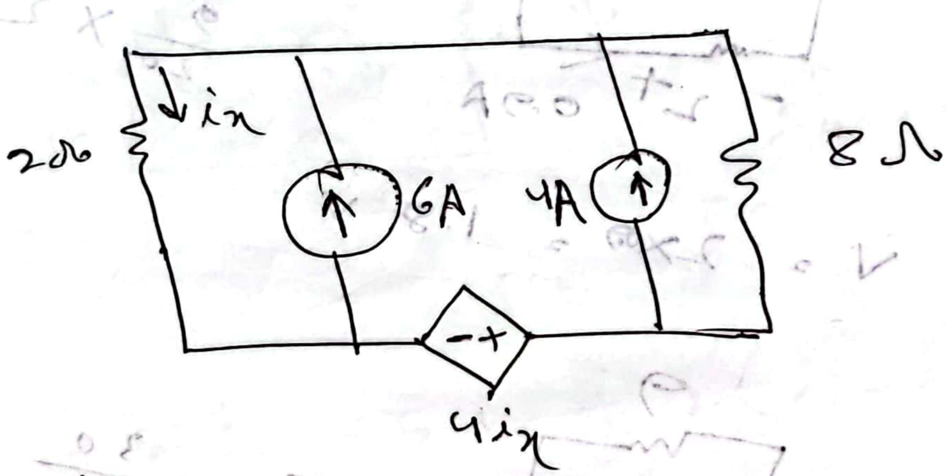


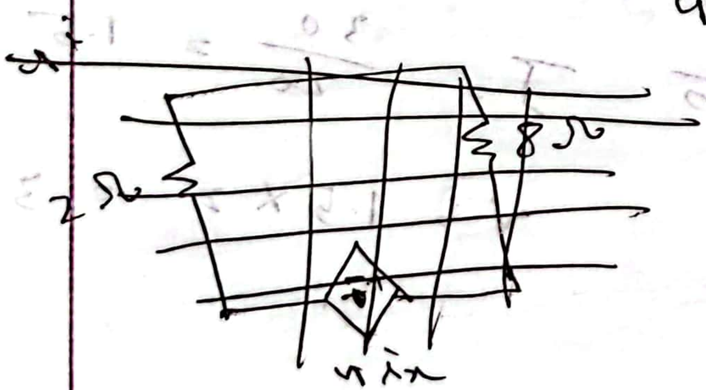
$V = 1.5 \times 2$

$= 3\ V$

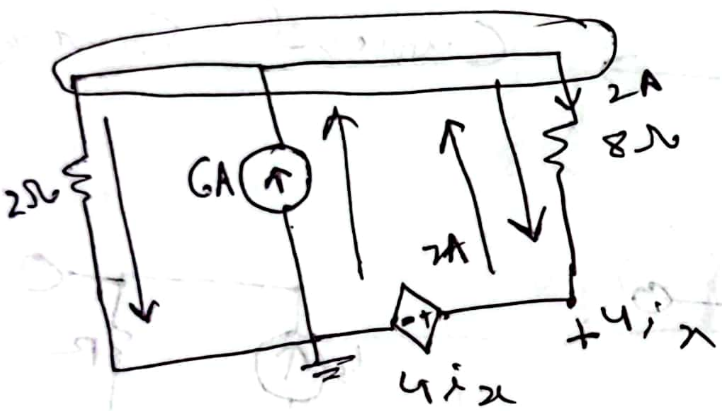
$V = 1.2 - 1.8 - 3 - 3$

$= -6.6\ V$





V_1



$$i_x = \frac{V_1}{2}$$

$$6 = \frac{V_1}{2} + \frac{V_1 - 4i_x}{8}$$

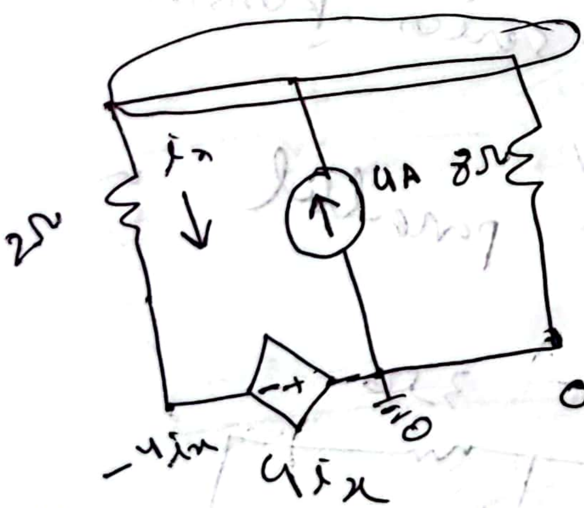
$$\Rightarrow V_1 = 16\,V$$

$$\frac{V_1 - 4i_x}{8}$$

$$= \frac{V_1 - 32}{8}$$

$$= -2A$$

V_1



$$4 = \frac{V_1 + 4i_x}{2} + \frac{V_1}{8}$$

$$\Rightarrow V_1 = -10.67$$

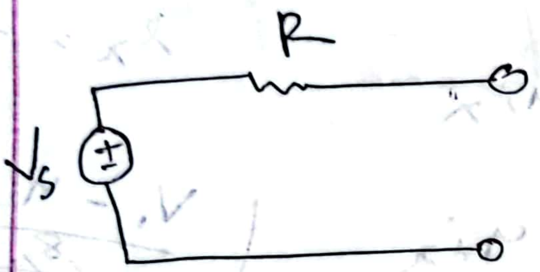
$$V = -16 - 10.67$$

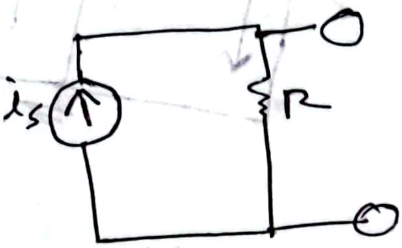
$$= -26.67$$

C.W
27.3.23

Source Transformation

Voltage Source ⟷ Current Source





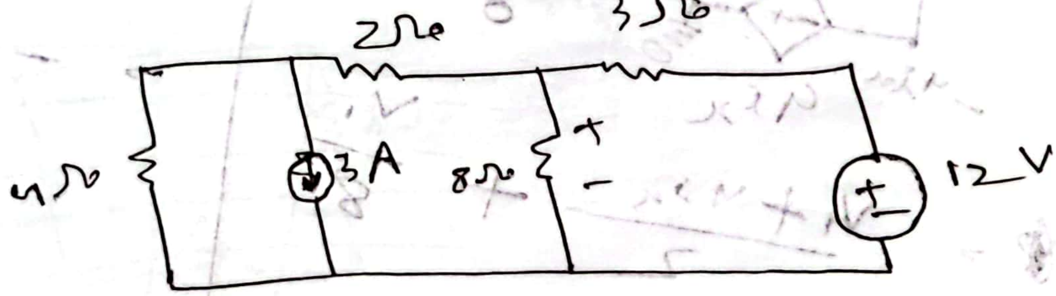
$$i_s = \frac{V_s}{R}$$

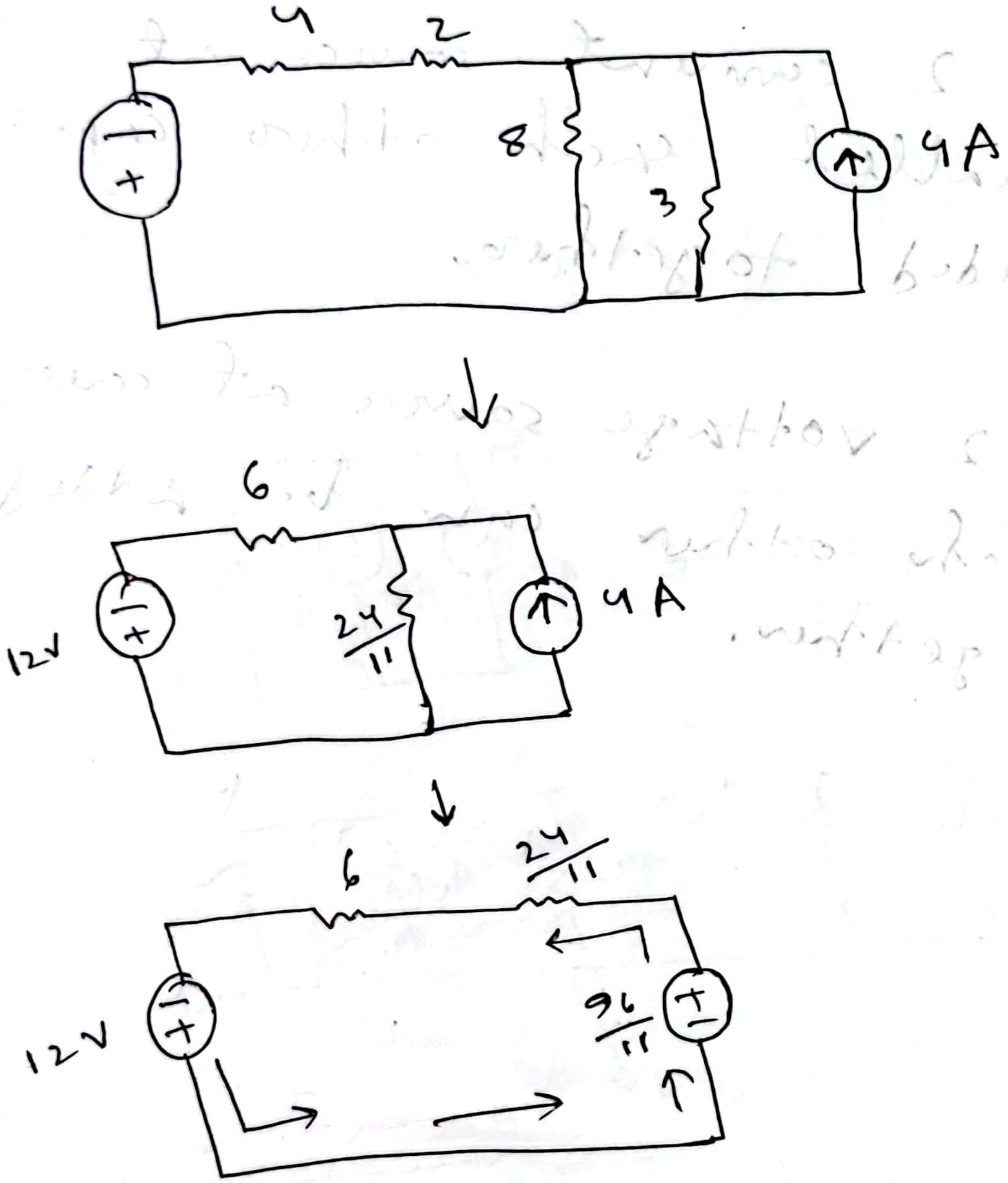
$$V_s = i_s R$$

Voltage source series Resistance

↓

Current in parallel in

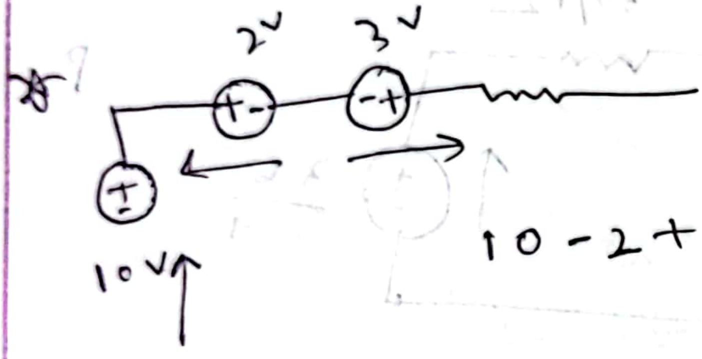




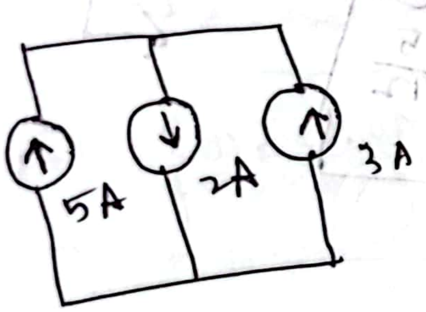
$$I = \frac{12 + \frac{96}{11}}{6 + \frac{24}{11}}$$

* 2 current source at parallel each other can be added together.

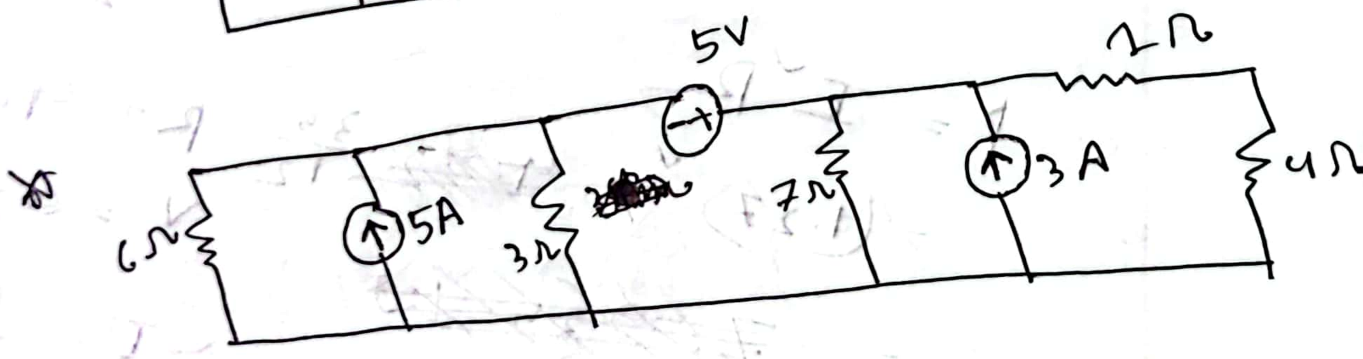
* 2 voltage source at series to each other can be added together.



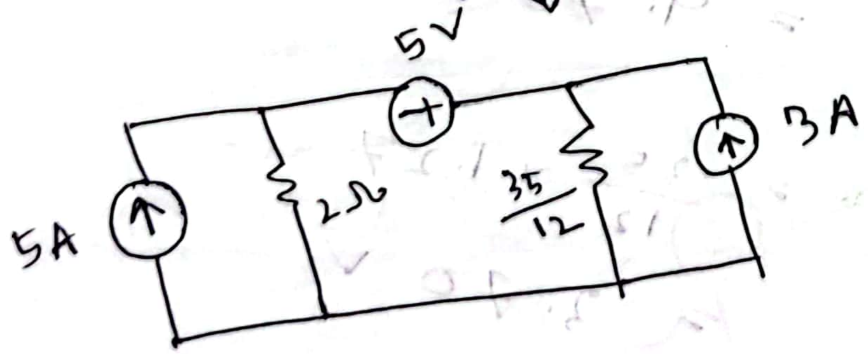
$10 - 2 + 3 = 11\,V$



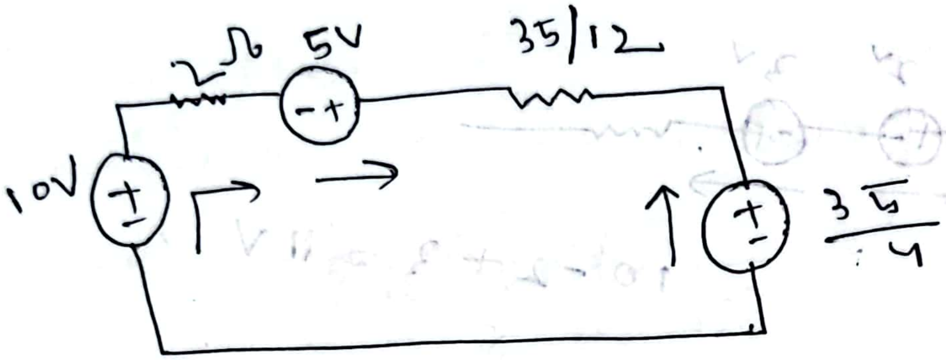
$5 - 2 + 3 = 6\,A$



↓



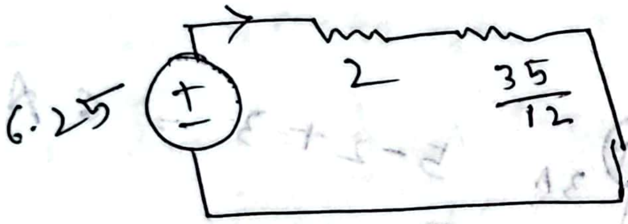
P.T.O



$P = \frac{V^2}{R}$

$10 + 5 - \frac{35}{4}$

$= 6.25\,V$



$2 + \frac{35}{12}$

$R = 4.92\,\Omega$

$V = 6.25\,V$

$\therefore I = \frac{6.25}{4.92}$

$= 1.27\,A$

$\therefore P = I^2 R$

$= (1.27)^2 \times \frac{35}{12}$

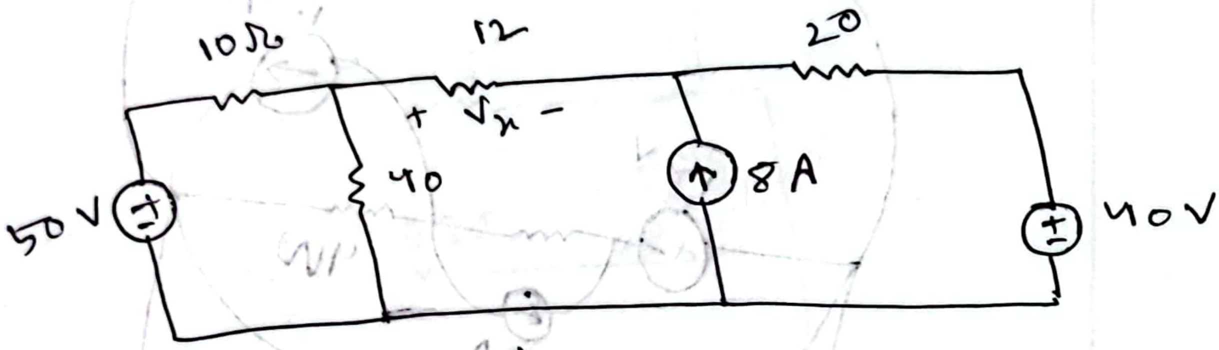
$=$

$= 4.70\,W$

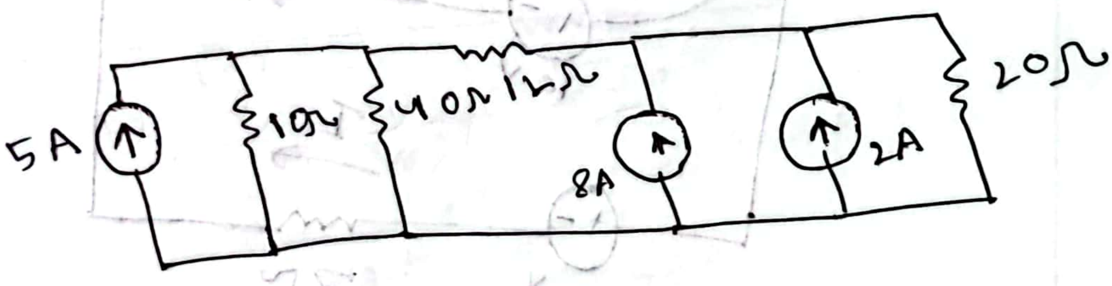
$V_{\frac{35}{12}\Omega} = \frac{35}{12} \times 1.27$

$= 3.70\,V$

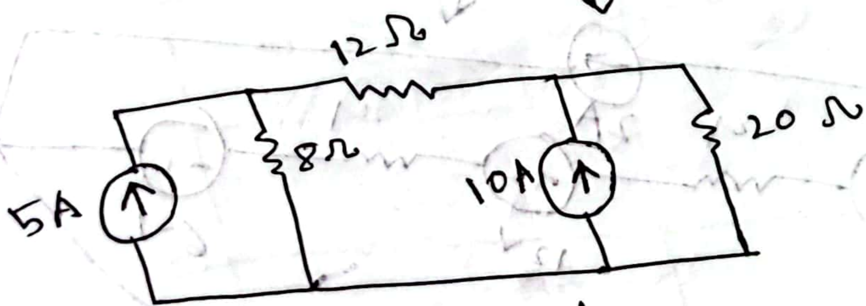
$\therefore P = \frac{(3.70)^2}{35/12} = 4.69\,W$



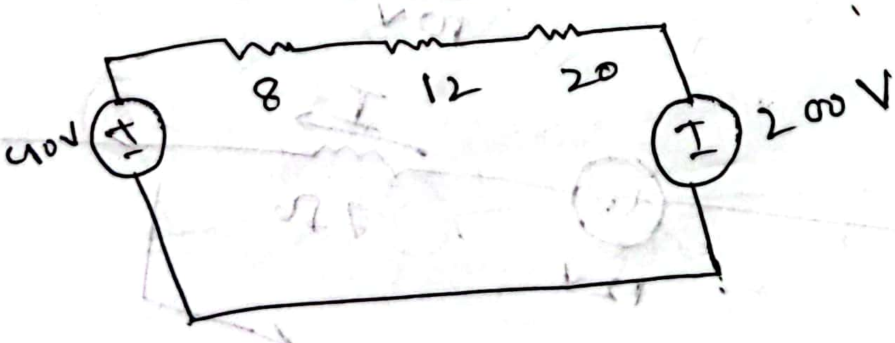
10Ω
12
20
+ V_x −
40
8A
50V
40V



5A
10Ω
40Ω
12Ω
8A
2A
20Ω

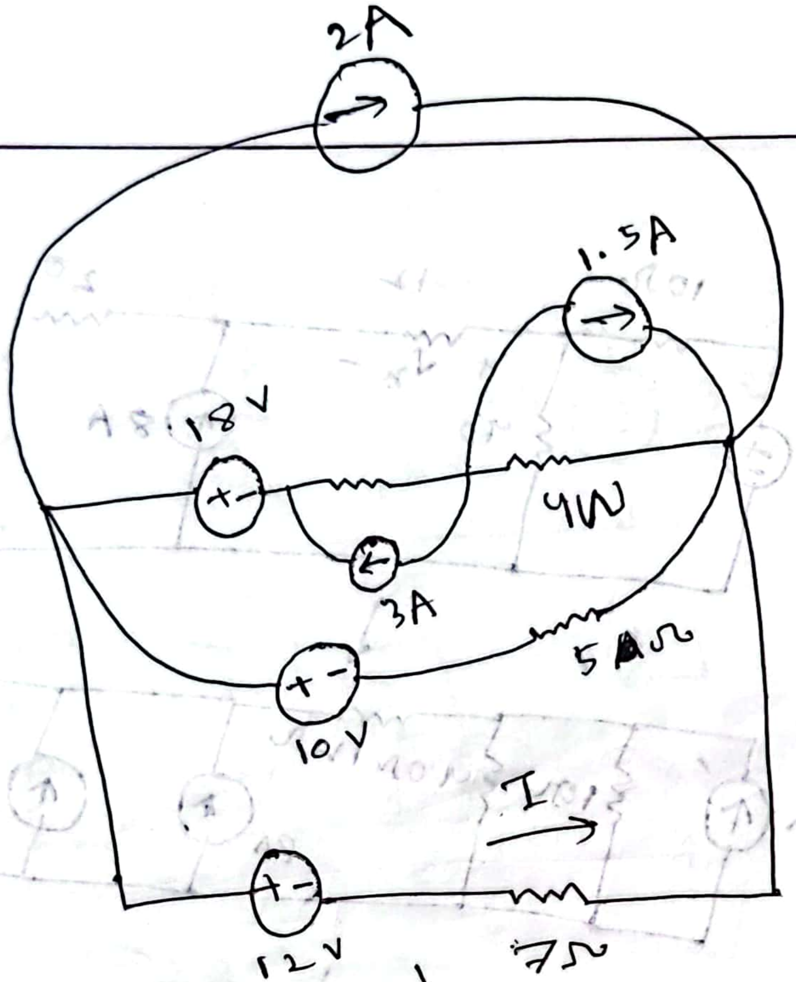


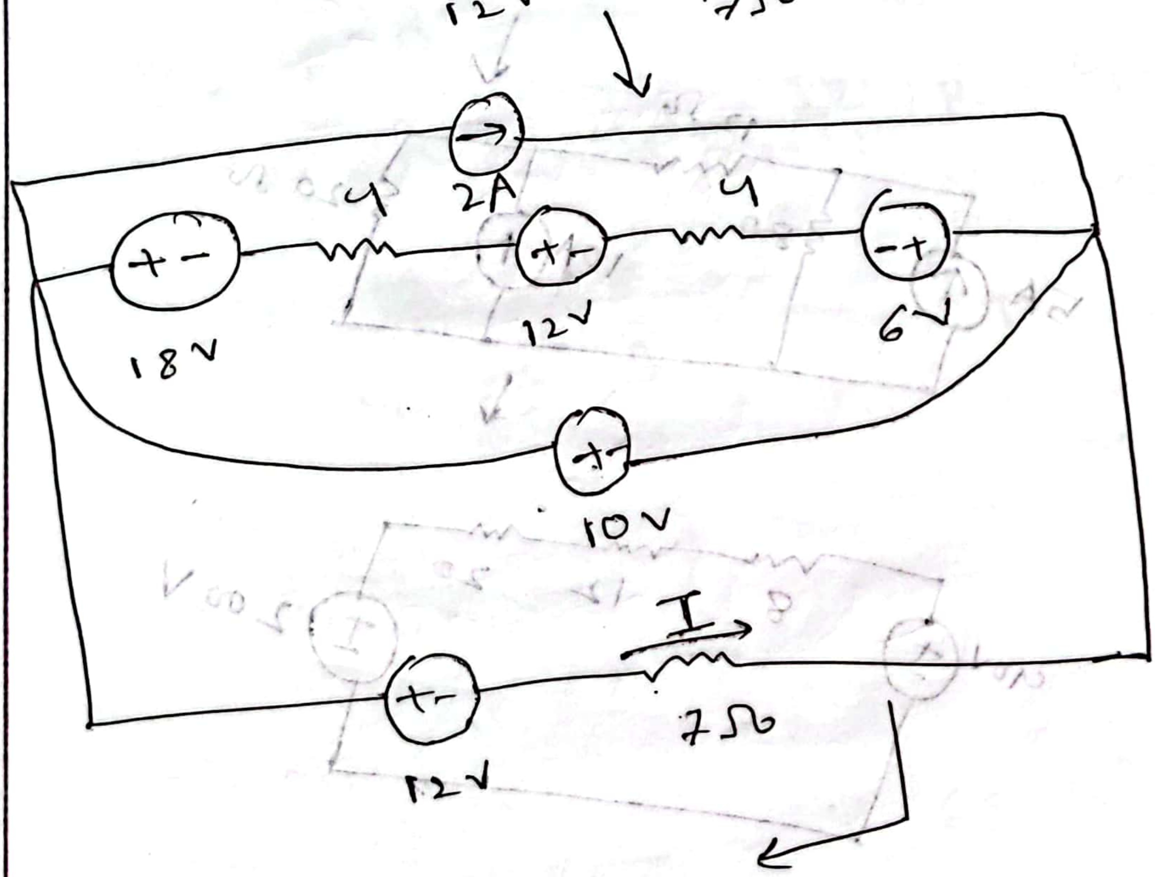
12Ω
8Ω
10A
20Ω
5A



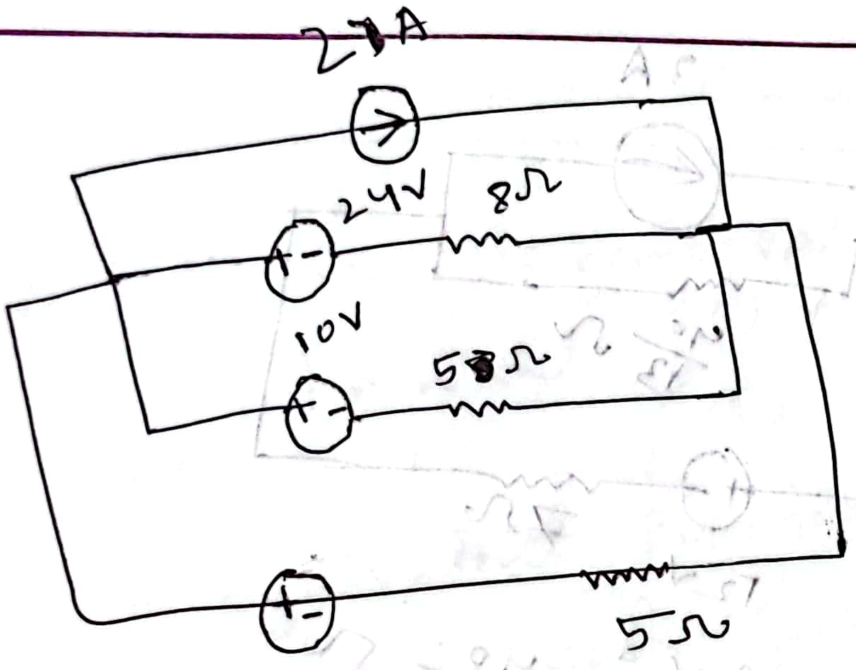
8
12
20
40V
200V

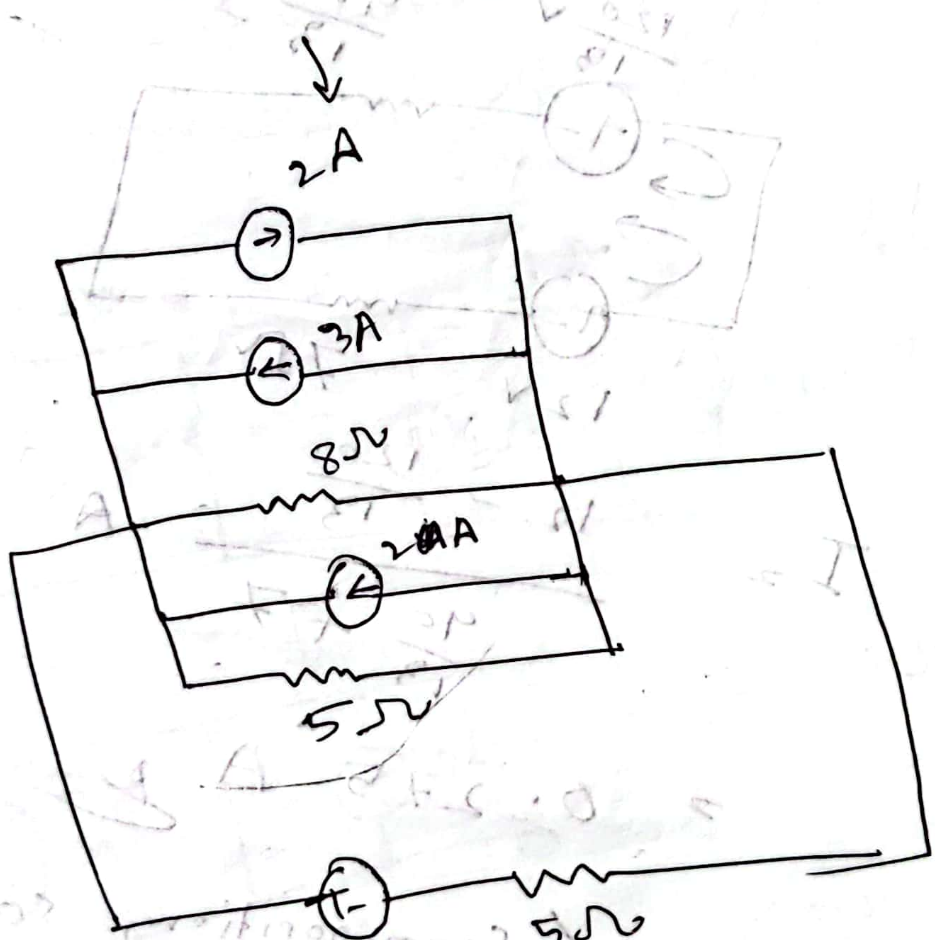
P.T.O.



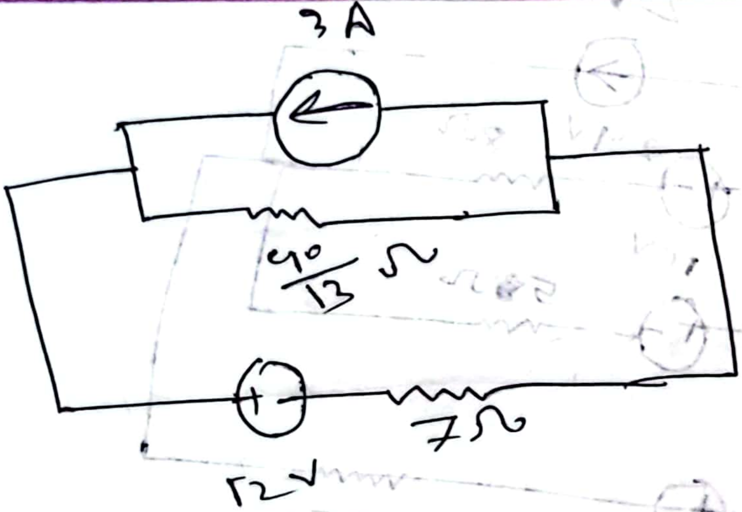


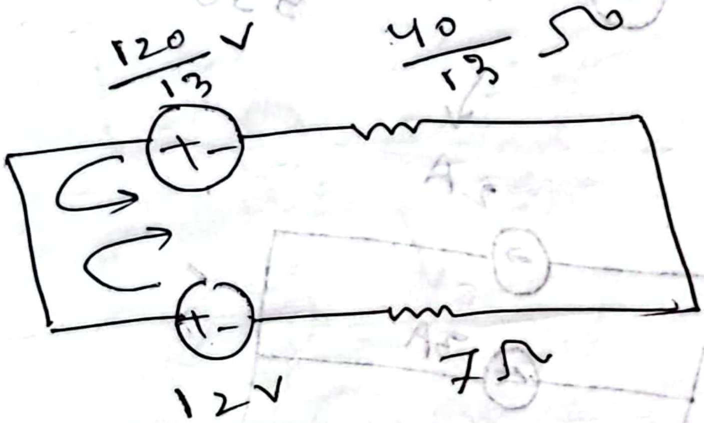
P.T.O





P.T.O





$$I = \frac{12 - \frac{120}{13}}{\frac{40}{13} + 7} A$$

$$= 0.275 A$$

CT ⇒ 9 (Superposition, source transfor

4/4/23

CW 2.4.23

EC

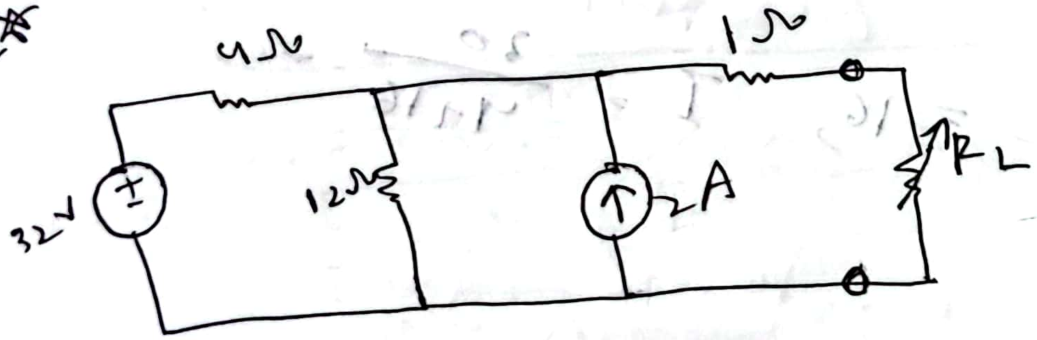
Thevenin & Norton Circuit

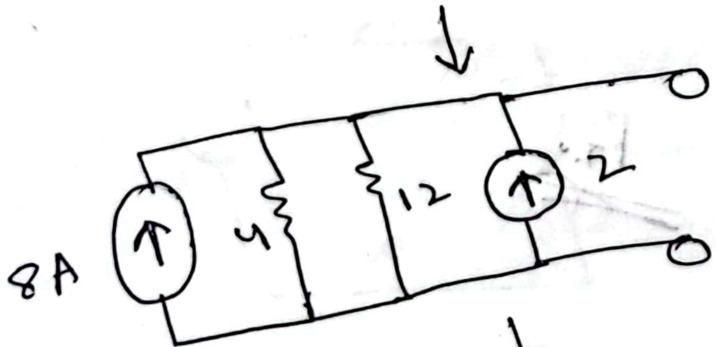
V_{th} :- open circuit voltage at the terminal

R_{th} :- Equivalent Resistance seen from the terminal with all the sources turned off.

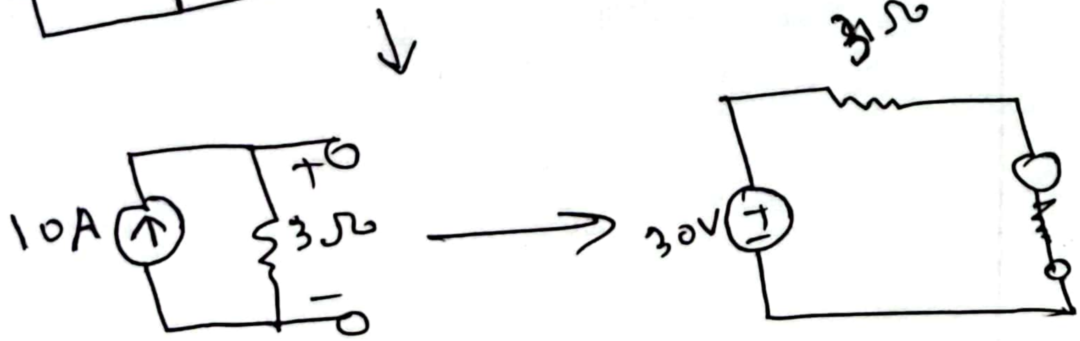
4.9

$R_L = 6, 16, 36$

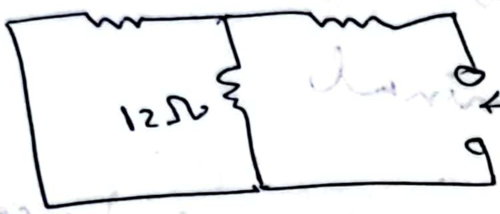




1Ω বাদে



R th



$$R_p = \frac{4 \times 12}{4+12}$$
$$= 3\,\Omega$$

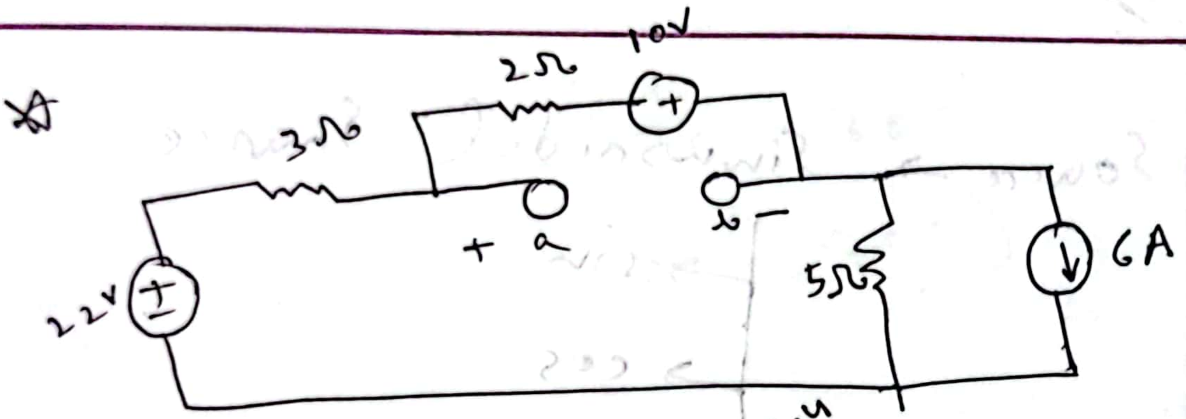
$$R_s = 3+1$$
$$= 4\,\Omega$$

$\rightarrow R_{Eq} = 4\,\Omega$

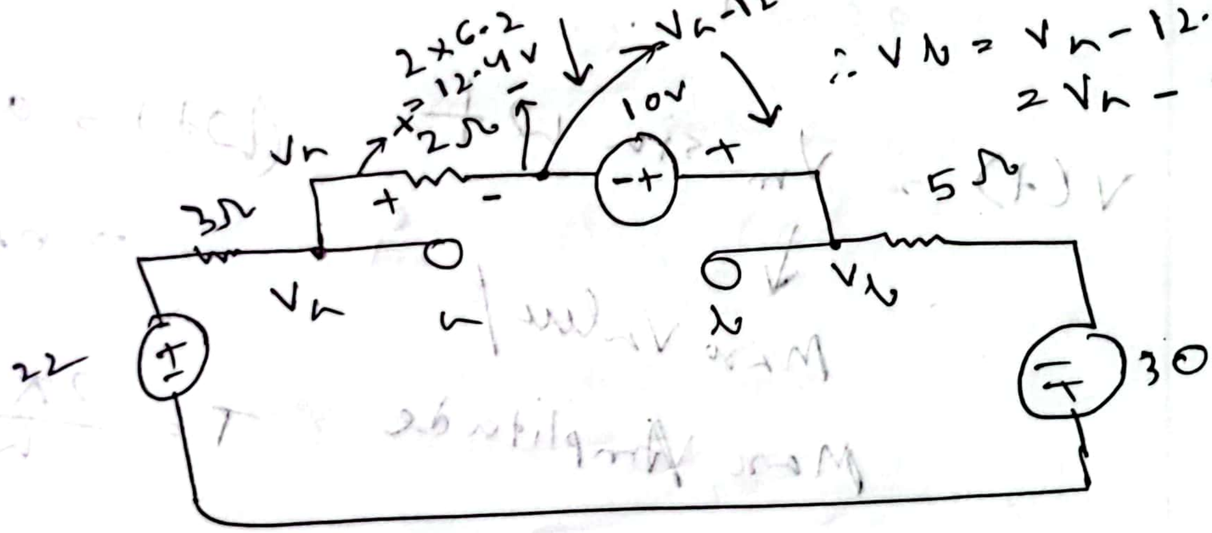
$R_L = 6, \quad I = \frac{30}{4+6} =$

$R_L = 16, \quad I = \frac{30}{4+16}$

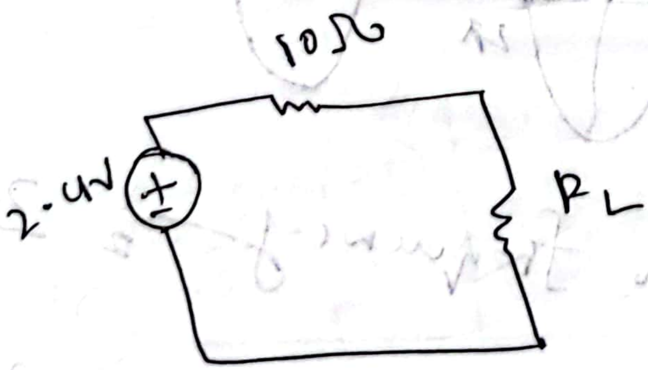
P.T.O



$\therefore V_b = V_a - 12.4 + 10V$
$= V_a - 2.4V$



$$I = \frac{22+10+30}{3+2+5} = 6.2\ A$$



CW 8.04.23

Chapter-9

AC Circuit

Source → Sinusoidal Source

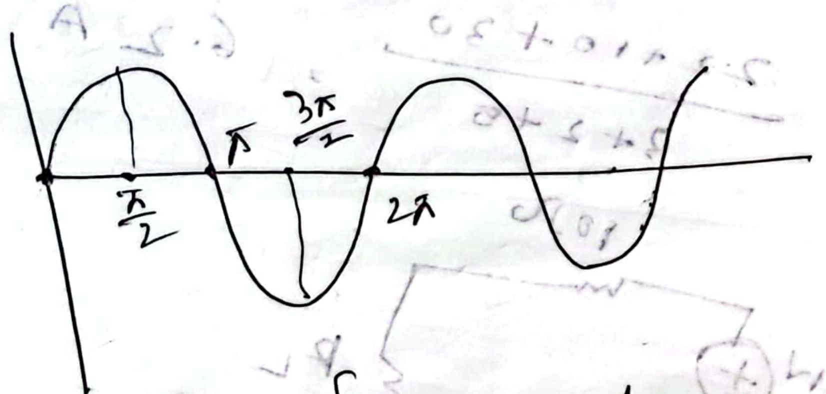
→ sin

→ cos

$v(t) = V_m \sin \omega t$ (ωt) → angle → radian

V_m → Max Value / Max Amplitude

$T = \frac{2\pi}{\omega}$



ω = angular frequency $= \frac{2\pi}{T}$

$= 2\pi f$

$v_1 = V_m \sin(\omega t + 30^\circ)$

$v_2 = V_m \sin(\omega t - 30^\circ)$

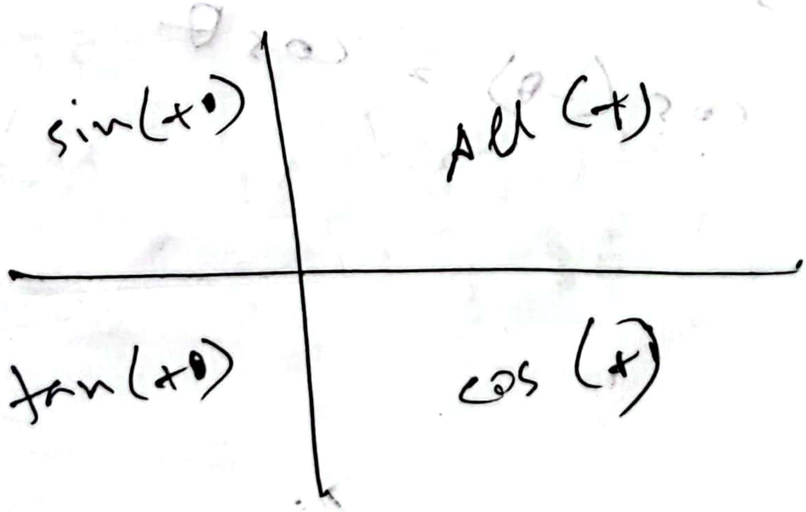
$\phi_1 = 30^\circ, \quad \phi_2 = -30^\circ$

v_1 leads v_2 by 60°

v_2 lags v_1 by 60°

$\Delta\phi = \phi_1 - \phi_2 = 30-(-30)$

$= 60^\circ$



sin → 90° এর বিজোড় গুণিতক → cos

sin → 90° " জোড় " → sine

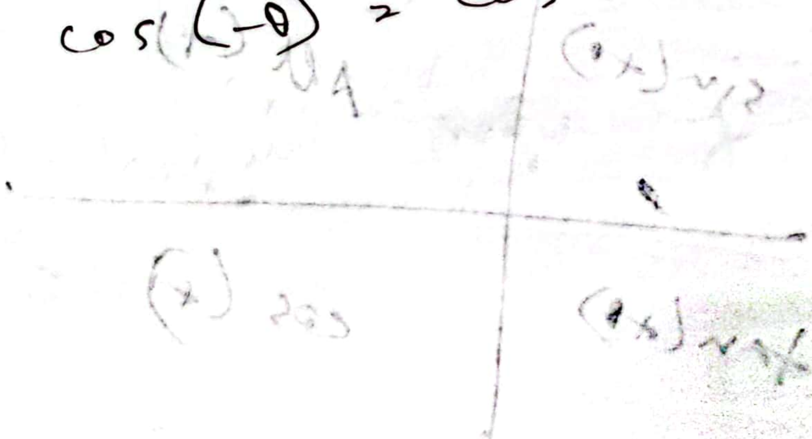
$$\sin(\omega t \pm 90^\circ) = \pm \cos \omega t$$

$$\cos(\omega t \pm 90^\circ) = \mp \sin \omega t$$

$$\sin(\omega t \pm 180^\circ) = -\sin \omega t$$

$$\cos(\omega t \pm 180^\circ) = -\cos \omega t$$

* $\sin(-\theta) = -\sin\theta$
* $\cos(-\theta) = \cos\theta$



$$v_1 = -10 \cos(\omega t + 50^\circ)$$

$$v_2 = 12 \sin(\omega t - 10^\circ)$$

$$v_1 = 10 \sin(\omega t + 50 - 90^\circ)$$

$$= 10 \sin(\omega t - 40^\circ)$$

$$\phi_1 = -40^\circ, \quad \phi_2 = -10^\circ$$

$$\Delta\phi = \phi_2 - \phi_1$$

$$= (-10) - (-40^\circ)$$

$$= 30^\circ$$

v_2 leads v_1 by 30°

v_1 lags v_2 by 30°

9.2

$i_1 = -4 \sin(377t + 55^\circ)$

$i_1 = 4 \cos(377t + 55^\circ + 90^\circ)$

$= 4 \cos(377t + 145^\circ)$

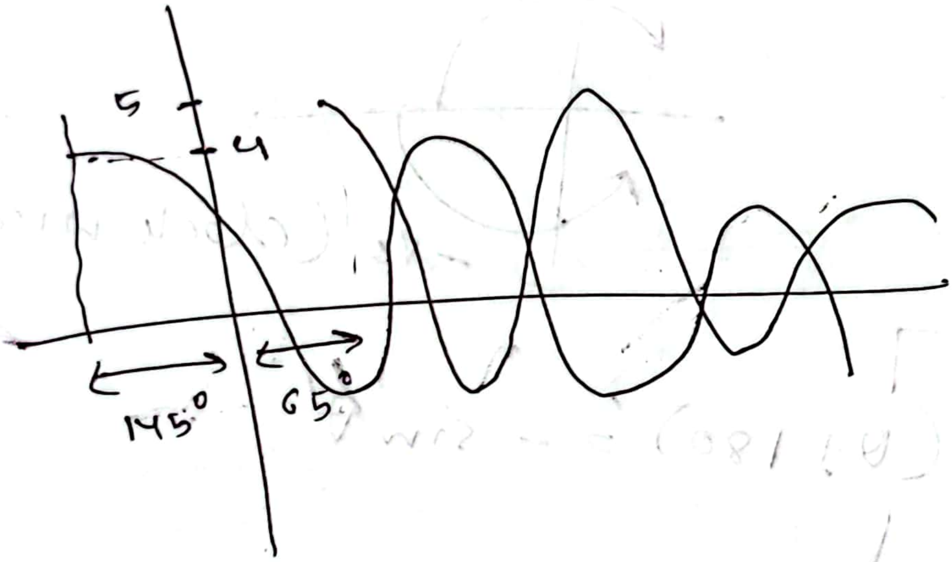
$i_2 = 5 \cos(377 - 65^\circ)$

$\therefore \phi_1 = 145^\circ, \quad \phi_2 = -65^\circ$

$\Delta\phi = 145 + 65 \qquad \phi_1 > \phi_2$

$= 210^\circ$

$\therefore i_1$ leads i_2 with 210°



9.6

$v_1 = 4\cos(377t + 10°)$

$v_2 = -20\cos 377t$

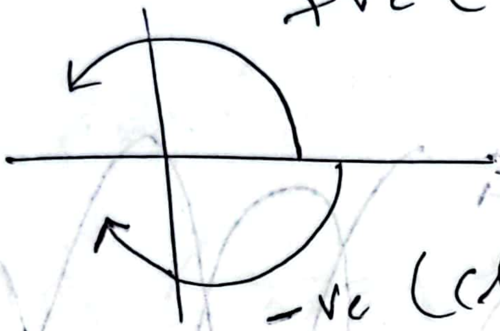
$= 20\cos(377t + 180°)$

$\phi_1 = 10°; \quad \phi_2 = 180° \quad \phi_2 > \phi_1$

v_2 leads v_1 with $180 - 10°$

$= 170°$

+ve (anti clockwise)



-ve (clock wise)

$\sin(180+\theta)$

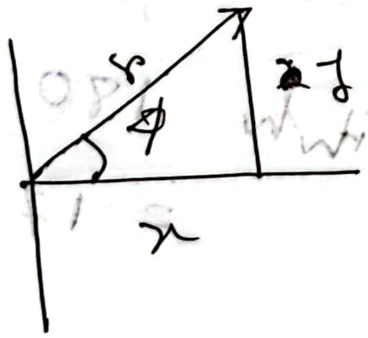
* $\sin(\theta \pm 180) = -\sin\theta$

$\sin(-180+\theta)$

* $\cos(\theta \pm 180^\circ) = -\cos\theta$

* $\sin(\theta \pm 90^\circ) = \pm\cos\theta$

* $\cos(\theta \pm 90^\circ) = \mp\sin\theta$



$r = \sqrt{x^2+y^2}$

$\tan\phi = \frac{y}{x}$

$\phi = \tan^{-1}\frac{y}{x}$

$x = r\cos\theta$

$y = r\sin\theta$

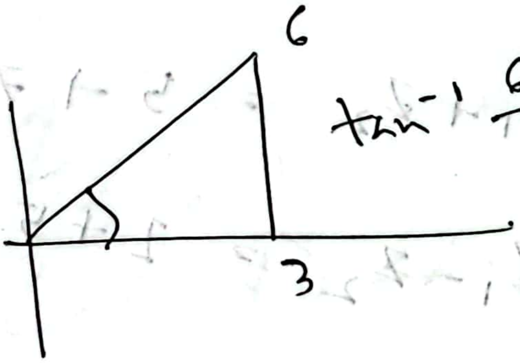
CamScanner

$v_1 = -10 \cos\theta$

$= 10 \sin(\theta - 90^\circ)$

$= 10 \sin(\omega t + 50^\circ - 90^\circ)$

* Phasor



$\tan^{-1}\frac{6}{3} = 63^\circ$

$3 + 6j$

$r\angle\phi$

$r = \sqrt{3^2 + 6^2}$

$= \sqrt{45}$

$\sqrt{45}\angle 63^\circ$

$\sqrt{45}\, e^{j63^\circ}$

$\boxed{e^{j\theta} = \cos\theta + j\sin\theta}$ → Euler formula

$$\boxed{\begin{array}{l} e^{j\pi} = \cos\pi + j\sin\pi = -1 \\ e^{j\pi} = -1, \quad e^{j\pi} + 1 = 0 \end{array}}$$

Re = Real
Im = Imaginary

$Z_1 = 3+6i$

$= \sqrt{45} \angle 63^\circ$

$Z_2 = 2+i$

$= \sqrt{5} \angle 26^\circ$

$Z_1 + Z_2 = 5+7i$

$Z_1 - Z_2 = 1+5i$

$Z_1 Z_2 = \sqrt{45}\cdot\sqrt{5} \angle 63^\circ + 27^\circ$

$\frac{Z_1}{Z_2} = \frac{\sqrt{45}}{\sqrt{5}} \angle 63^\circ - 27^\circ$

$\frac{1}{Z_1} = \frac{1}{\sqrt{45}} \angle -63$

$\sqrt{Z_1} = \sqrt{(\sqrt{45})} \angle \frac{63^\circ}{2}$

$\cos\theta = Re(e^{j\theta})$

$\sin\theta = Im(e^{j\theta})$

$$v(t) = V_m \cos(\omega t + \phi)$$

$$\downarrow$$

→ $$V(t) = V_m \, Re\left(e^{j(\omega t + \phi)}\right)$$

→ $$v(t) = V_m \, Re\left[e^{j\omega t} \cdot e^{j\phi}\right]$$

→ $$V(t) = V \, Re\left[e^{j\phi}\right] \quad \left[V = V_m Re\left[e^{j\omega t}\right]\right]$$

→ $$V(t) = V \angle \phi$$

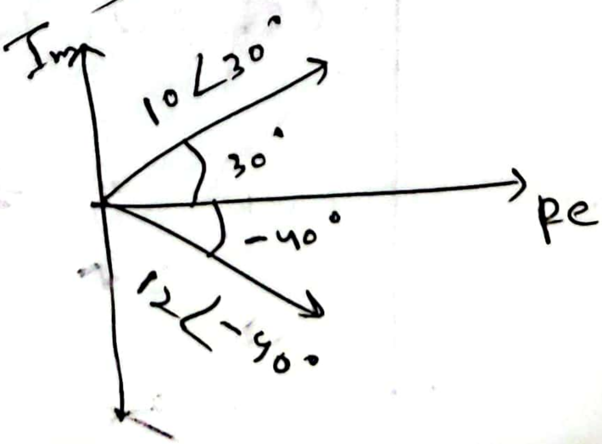
$$v(t) = V_m \cos(\omega t + \phi) \leftrightarrow V = V_m \angle \phi$$

$$V_1(t) = 10 \cos(5t + 30^\circ)$$

$$= 10 \angle 30^\circ$$

$$V_2(t) = 12 \cos(6t - 40^\circ)$$

$$= 12 \angle -40^\circ$$



CW 11.4.23

AC

Time Domain Representation	Phasor Domain Representation
$V_m \cos(\omega t + \phi)$	$V_m \angle \phi$
$V_m \sin(\omega t + \phi)$	$V_m \angle \phi - 90^\circ$

$$v(t) \longrightarrow V$$

$$\frac{dv}{dt} \longrightarrow j\omega V$$

$$\int v\,dt \longrightarrow \frac{V}{j\omega}$$

$4 \angle 30^\circ + 5 \angle 90^\circ$

$= 8 \angle 35^\circ$ [from calculator]

P.T.O.

* $4i + 8\int i\,dt - 3\frac{di}{dt} = 50\cos(2t+75^\circ)$

$\Rightarrow 4I + 8\frac{I}{jw} - 3\cdot jwI = 50\angle 75^\circ$

$$I = \frac{50\angle 75^\circ}{4 + \frac{8}{jw} - 3jw}$$

$$= \frac{50\angle 75^\circ}{4 + 8(-j)\cdot\frac{1}{2} - 3j(2)}$$

$$= \frac{50\angle 75^\circ}{4 - 4j - 6j}$$

$= 4.64\angle 143.199^\circ$

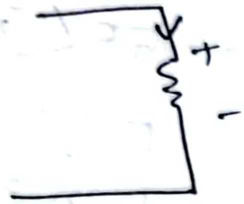
$= \boxed{4.64\cos(2t + 143.199^\circ)}$

$$\boxed{\begin{aligned} i &= \sqrt{-1} \\ i^2 &= -1 \\ i &= \frac{-1}{i} \\ -i &= \frac{1}{i} \end{aligned}}$$

$$\text{Impedance} = \frac{V}{I}$$

Resistor (R)

$R = 7\Omega$, $i(t) = 5\cos(\omega t + 20°)$



$V = IR$

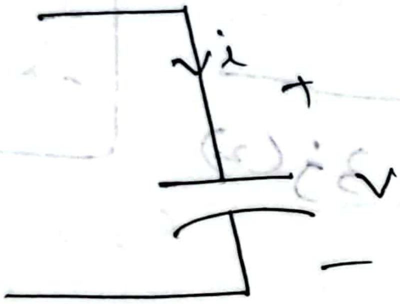
$v(t) = 35\cos(\omega t + 20°)$

$i = 5\angle 20°$

$v = 35\angle 20°$

$$\boxed{R = \frac{V}{I}}$$

Capacitor (C)

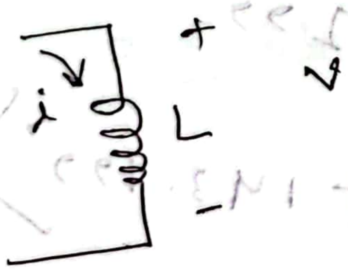


$$i(t) = C\frac{dv(t)}{dt}$$

$$I = Cj\omega V$$

$$\boxed{\Rightarrow \frac{V}{I} = \frac{1}{Cj\omega}}$$

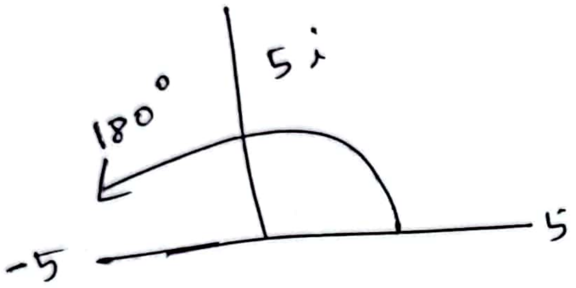
Inductor: (L)

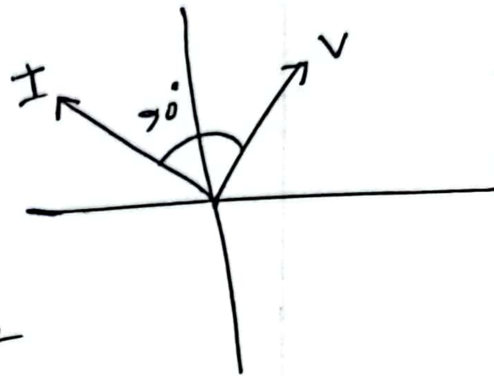


$$v(t) = L\frac{di(t)}{dt}$$

$$V = Lj\omega I$$

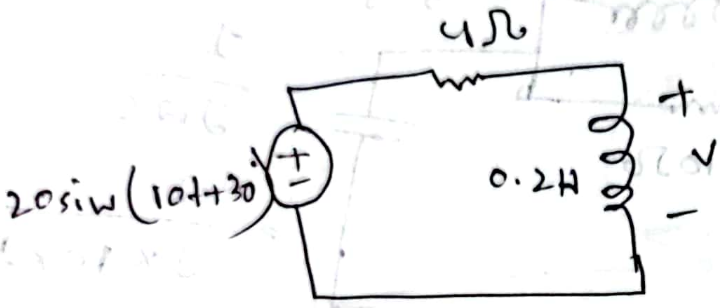
$$\boxed{\frac{V}{I} = Lj\omega}$$





$$i = \sqrt{-1} = (-1)^{\frac{1}{2}}$$

$i \rightarrow 90° \rightarrow$ Anti clock wise



$j\omega L$

$= j \times 10 \times 0.2$

$= 2j$

$$i(t) = \frac{20\angle -60^\circ}{4 + 2j}$$

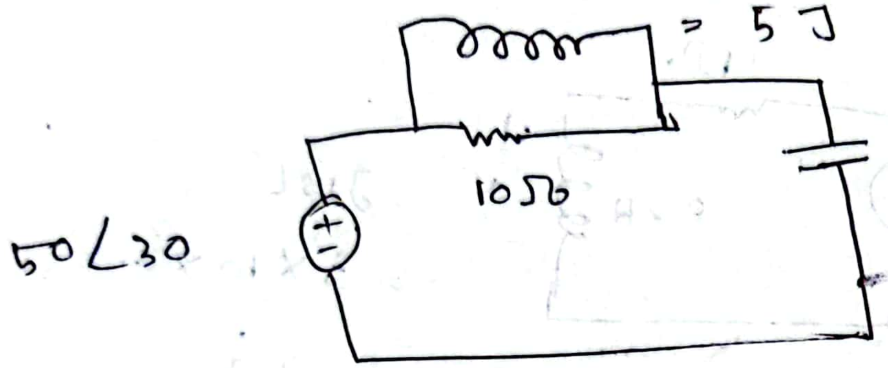
$$= 4.47 \angle -86.5$$

$$i(t) = 4.47 \cos(10t - 86.5^\circ)$$

$$V = 4.47 \angle -86.5 \times 2j$$

$$= 8.94 \angle 3.5$$

$j\omega L$



$j \times 10 \times 0.5$
$= 5j$

$\frac{1}{j\omega C}$

$= \frac{1}{j \times 10 \times \frac{1}{20}}$

$= -2j$

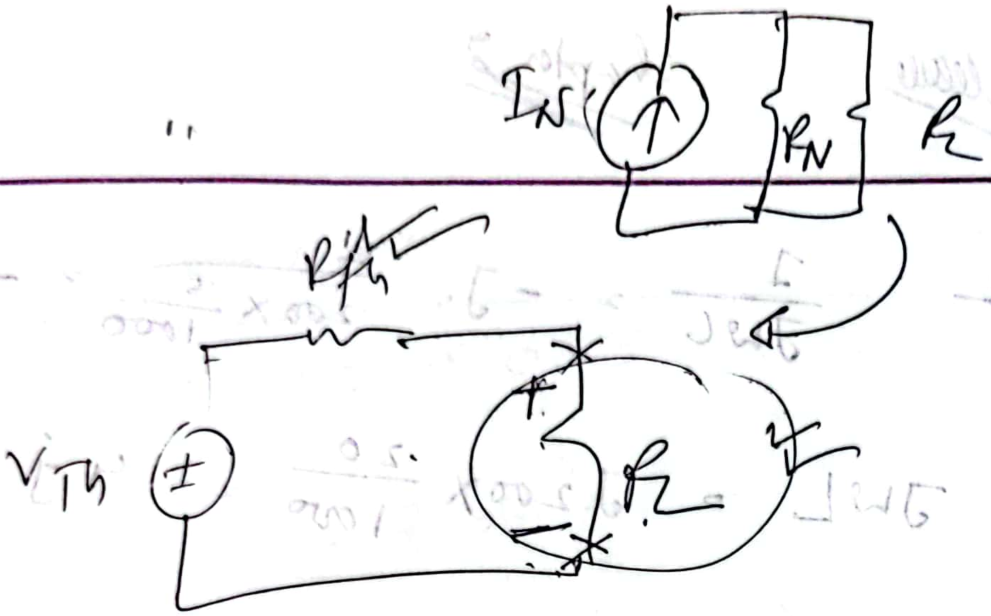
$$Z = \frac{5j \times 10}{10 + 5j} - 2j$$

$$= 2.83 \angle 45^\circ$$

$$i = \frac{V}{Z} = \frac{50 \angle 30}{2.83 \angle 45^\circ}$$

$$= 17.67 \angle -15^\circ$$

$$i = \frac{Z_1}{Z_1 + Z_2} \times i(t)$$



$\therefore \boxed{R_{Th} = R_L}$

$$I = \frac{V_{Th}}{R_{Th}+R_L}$$

$$\frac{d(P_{R_L})}{dR_L} = 0$$

$$P_{R_L} = I^2 R_L = \left(\frac{V_{Th}}{R_{Th}+R_L}\right)^2 \times R_L$$

$R_{Th} = R_L$

$$P_{R_L} = \frac{V_{Th}^2}{4R_L^2} \times R_L = \frac{V_{Th}^2}{4R_L}$$

$$\frac{1}{jwC} = -j \cdot \frac{1}{200\times\frac{5}{1000}} = -j$$

$$jwL = j\,200\times\frac{20}{1000} = 4j$$

$$Z = 10+4j-j = 10+3j$$

$$\therefore I = \frac{50\angle 0}{10+3j} =$$

$$= 4.789\angle -16.699^\circ \text{ A}$$

9.44

$$5\text{ mF} = -j\,\cancel{200}\,\frac{1}{200\times\frac{5}{1000}} = -j$$

$$10\text{ mH} = j\,200\,\frac{10}{1000} = 2j$$

$$\frac{(3-j)\times 2j}{3-j+2j} = \frac{(1.2+1.6i)\times 4}{1.2+1.6i+4}$$

$$= 1.189+0.865i+5$$

$$= 6.189+0.865i$$

$$\therefore i = \frac{50\angle 0^\circ}{6.189 + 0.85i}$$

$$= 8\angle -7.96^\circ \text{ A}$$

$$i = 8\cos(200t - 7.96^\circ) \text{ A}$$

9.41

$1F = \frac{1}{j\omega c} = -j \quad \frac{1}{1} = -j$

$1H = j\omega L = j \qquad V = 25\angle 0^\circ$

$$\frac{(1+j)\times(-j)}{1+j-j} = 1 - i + 1 = 2 - i$$

$$\therefore i = \frac{25\angle 0}{2-i} = 10 + 5i$$

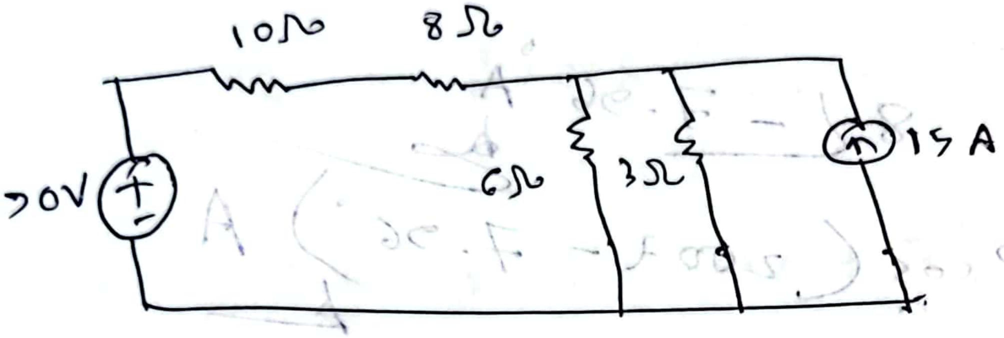
$$\therefore \; 1+j \;\Big|\; -j \Rightarrow \frac{1+j}{1+j-j} \times (10+5i)$$

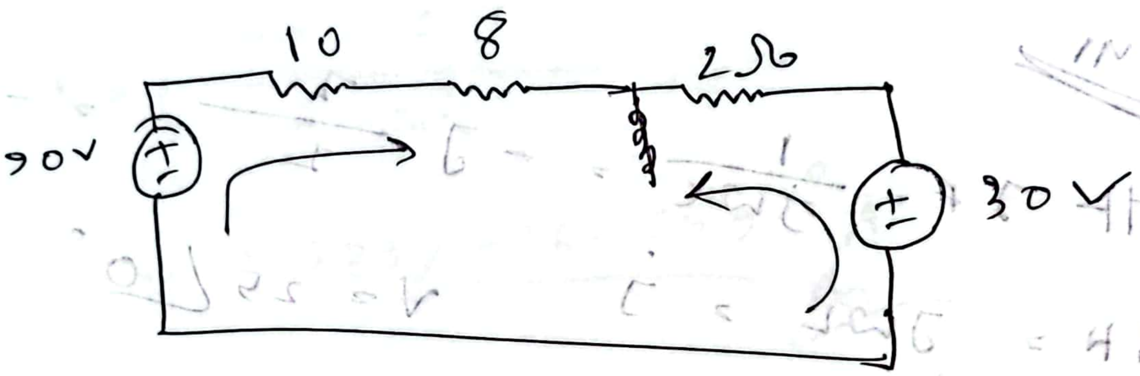
$$= 5 + 15i$$

$$\therefore V = (5+15i)\times(-i) = 15 - 5i$$

$$= 15.81\angle -18.43^\circ$$

4.23





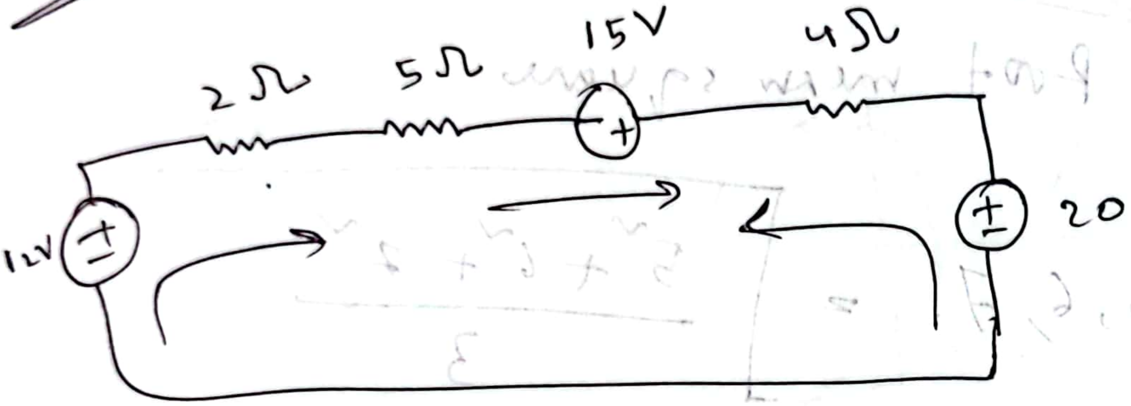
$$\therefore I = \frac{90-30}{10+8+2}$$

$$= 3A$$

$$\therefore P = I^2 R = 3^2 8 = 9 \cdot 8$$

$$= 72 W$$

4.26



$$\therefore I = \frac{12+15-20}{2+5+4}$$

$$= 0.6363 \text{ A}$$

C.W 29.4.23

ES

RMS

Root mean square

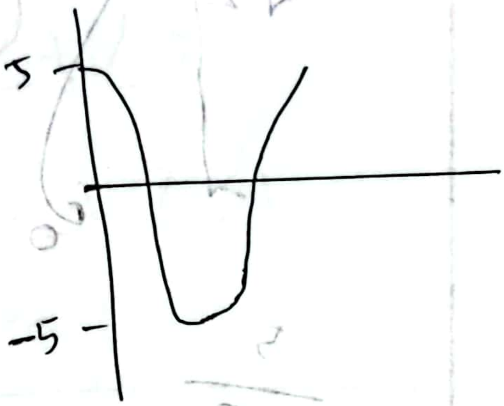
$$5, 6, 7 = \sqrt{\frac{5^2+6^2+7^2}{3}}$$

$$x(t), \quad Avg = \frac{1}{T}\int_0^T x(t)\,dt$$

$$RMS = \sqrt{\frac{1}{T}\int_0^T x^2(t)\,dt}$$

Ans-2

$i(t) = 5\cos 20\pi t$



$W = \frac{2\pi}{T}$

$\frac{2\pi}{T} = 20\pi$

$\therefore T = 0.1$

$$I_{rms} = \sqrt{\frac{1}{T}\int_0^T i^2(t)\, dt}$$

$$= \sqrt{\frac{1}{T}\int_0^T 25\cos^2 20\pi t \; dt}$$

$$= 5\sqrt{\frac{1}{T}\int_0^T \cos^2 20\pi t \; dt}$$

$$= 5\sqrt{\frac{1}{2T}\int_0^T (2\cos^2 20\pi t)\, dt}$$

P.T.O.

$$2\cos^2\theta = 1 + \cos 2\theta$$

$$2\sin^2\theta = 1 - \cos 2\theta$$

$$= \frac{5}{\sqrt{2}} \sqrt{\frac{1}{T}\int_0^T (1 + \cos 4\omega t)\, dt}$$

$$= \frac{5}{\sqrt{2}}$$

$$x(t) = A\cos\omega t$$

$$= A\cos\omega t$$

$$x_{rms} = \frac{A}{\sqrt{2}}$$

* Full cycle intregation of pure sin/cos wave is zero.

$y = mx$

$\Rightarrow i = 5t$

$\Delta y = 10 \quad \frac{10}{2} = 5$

$\Delta x = 2$

Exm. 11.7

$$i(t) = \begin{cases} 5t, & 0 < t < 2 \\ -10, & 2 < t < 4 \end{cases}$$

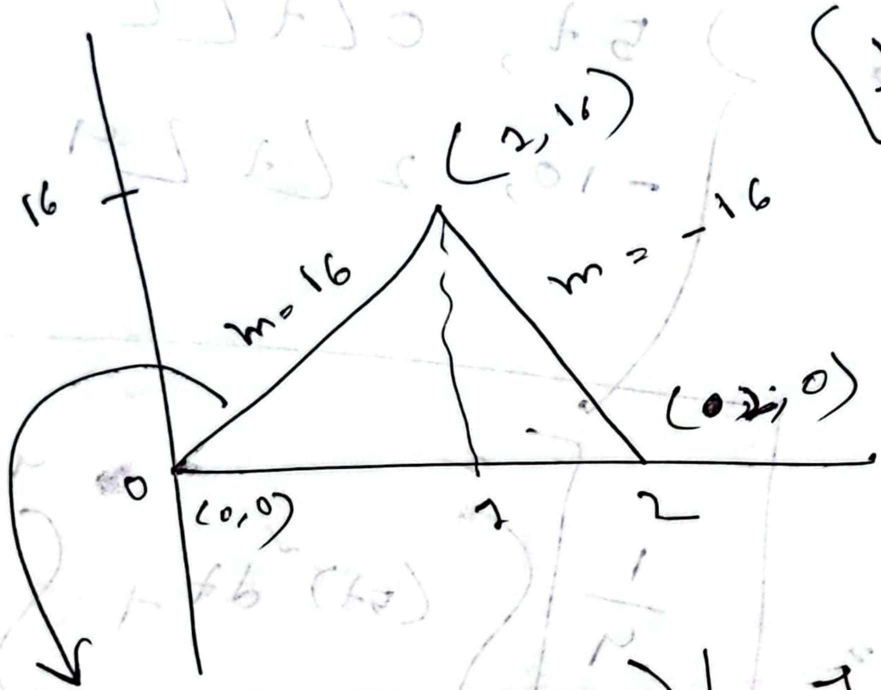
$$i(t)_{rms} = \sqrt{\frac{1}{4}\left[\int_0^2 (5t)^2 \, dt + \int_2^4 (-10)^2 \, dt\right]}$$

$$= \frac{1}{2}\sqrt{25\left[\frac{t^3}{3}\right]_0^2 + 100\left[t\right]_2^4}$$

PT.

$i(t)$

$\left[\frac{16}{2} = 16\right]$



$y - y_1 = m(x - x_1)$

$\Rightarrow y - 0 = 16(x - 0)$

$\Rightarrow y = 16x$

$\Rightarrow i = 16t$

$y - 0 = -16(x-2)$

$\Rightarrow y = -16x + 32$

$\Rightarrow i = -16t + 32$

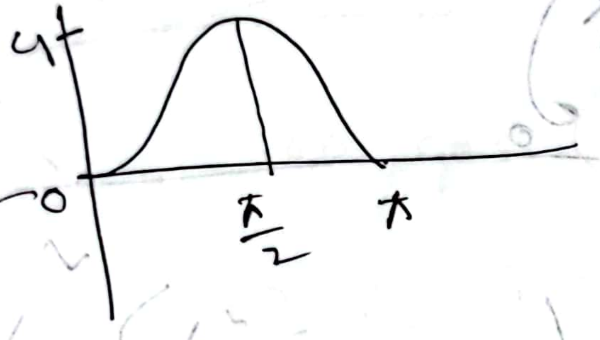
$$i(t) = \begin{cases} 16t, & 0 < t < 1 \\ -16t + 32, & 1 < t < 2 \end{cases}$$

CamScanner

Chapter-9
CT

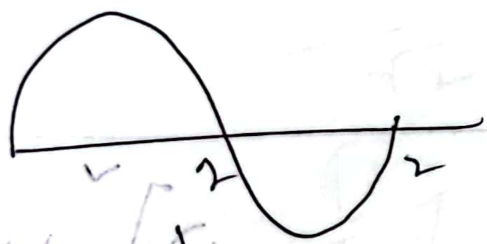
Ass-2

next class



sin/cos

$\sin^2/\cos^2$



sin

$\sin^2$

$T = 1$

$T = 2$

$i(t) = 4 \sin^2 t$

$$\boxed{\begin{aligned} T &= 2\pi \\ \omega &= \frac{2\pi}{T} \\ \omega &= 1 \end{aligned}}$$

for representing $\sin^2$ we just give the value of

P.T.O.

$$I_{rms} = \sqrt{\frac{1}{\pi}\int_0^{\pi} (4\sin^2 t)^2\, dt}$$

$$= \frac{1}{\sqrt{\pi}}\sqrt{\int_0^{\pi} (2\cdot 2\sin^2 t)^2\, dt}$$

$$= \frac{1}{\sqrt{\pi}}\sqrt{\int_0^{\pi} \left[2(1-\cos 2t)\right]^2\, dt}$$

$$= \frac{2}{\sqrt{\pi}}\sqrt{\int_0^{\pi} (1 - 2\cos 2t + \cos^2 2t)\, dt}$$

$$= \frac{2}{\sqrt{\pi}}\sqrt{[t]_0^{\pi} - \left[\frac{2\sin 2t}{2}\right]_0^{\pi} + \dots}$$

$$= 1.382\ A$$

$$\int_0^{\pi} \frac{1}{2}\cdot 2\cos^2 2t\, dt$$

complexe power:

$$v(t) = 60 \cos(\omega t - 10^\circ)$$

$$V = 60 \angle -30^\circ$$

$$V_{rms} = \frac{60}{\sqrt{2}} \angle -10^\circ$$

$$i(t) = 1.5 \angle 50^\circ$$

$$i_{rms} = \frac{1.5}{\sqrt{2}} \angle 50^\circ$$

$$(i_{rms})^* = \frac{1.5}{\sqrt{2}} \angle -50^\circ$$

$$P = V_{rms} \cdot (I_{rms})^*$$

$$= \left(\frac{60}{\sqrt{2}} \angle -10\right) \cdot \left(\frac{1.5}{\sqrt{2}} \angle -50^\circ\right)$$

Power in AC circuits

Complex power, $S = V_{rms} (I_{rms})^*$

$= P + jQ$

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

Real power, $P = Re(S) = S\cos(\phi_v - \phi_i)$

Reactive ", $Q = Im(S)$

$= S\sin(\phi_v - \phi_i)$

EC Asi 2

8

Wave : 1

$$v(t) = \begin{cases} 10 \sin \omega t, & 0 < t < \pi \\ 0, & \pi < t < 2\pi \end{cases}$$

$$V_{rms} = \sqrt{\frac{1}{T} \int_0^T v^2(t)\, dt}$$

$$= \sqrt{\frac{1}{2\pi} \left[\int_0^{\pi} (10 \sin \omega t)^2\, dt + \int_{\pi}^{2\pi} 0^2\, dt \right]}$$

$$= 5 \text{ V}$$

$$\therefore P = \frac{V^2}{R} = \frac{25}{10} = 2.5 \text{ watt}$$

Wave : 2

$$v(t) = \{ 100 \sin t, \quad 0 < t < \pi \}$$

$$\therefore V_{rms} = \sqrt{\frac{1}{\pi} \int_0^{\pi} (100 \sin \omega t)^2\, dt}$$

$$= 70.71 \text{ V} \quad \therefore P = \frac{V^2}{R} = \frac{(70.71)^2}{10}$$

$$= 499.99 \text{ W}$$

CamScanner

real P, ~~active P~~

$P_{avg}, P = (I_{rms})^2 \times R$

$= \left(\frac{1.95}{\sqrt{2}}\right)^2 \times 8.19$

$= 15.57$ watt

App power, $S = V_{rms} I_{rms}$

$= \frac{16}{\sqrt{2}} \times \frac{1.95}{\sqrt{2}}$

$= 15.6$ VA

$\therefore$ Reactive P, $Q = \sqrt{S^2 - P^2}$

$= 0.96$ VAR

Complex Power $= (V^P_{rms}) \times (I^P_{rms})^*$

$= \left(\frac{16}{\sqrt{2}} \angle 45^\circ\right) \times \left(\frac{1.95}{\sqrt{2}} \angle -39.61\right)$

$= \cancel{15.53 i}$ $15.53 + 1.465 i$

$= 15.6 \angle 5.39^\circ$ Ans

Ans 8

$$v(t) = \begin{cases} V_m \sin t & 0 < t < \pi \\ 0, & \pi < t < 2\pi \end{cases}$$

$$V^2_{rms} = \frac{1}{T}\int_0^T v^2(t)\, dt$$

$$= \frac{1}{2\pi}\int_0^{\pi} (V_m \sin t)^2\, dt$$

$$= \frac{1}{2\pi}\left[\frac{V_m^2}{2}\left(1 - \cos 2t\right)\right]_0^{\pi}$$

$$= \frac{1}{2\pi} \cdot \left[\frac{V_m^2}{2}\left(1 - \cos 2t\right)\right]_0^{\pi}$$

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

$$2.5 = \frac{\frac{V_m^2}{2\pi}}{10} \Rightarrow \frac{V_m^2}{2\pi} = 25$$

$$\Rightarrow V_m^2 = 50\pi$$

$$\Rightarrow V_m =$$

Formula

$$\sin(\omega t \pm 180^\circ) = -\sin \omega t$$

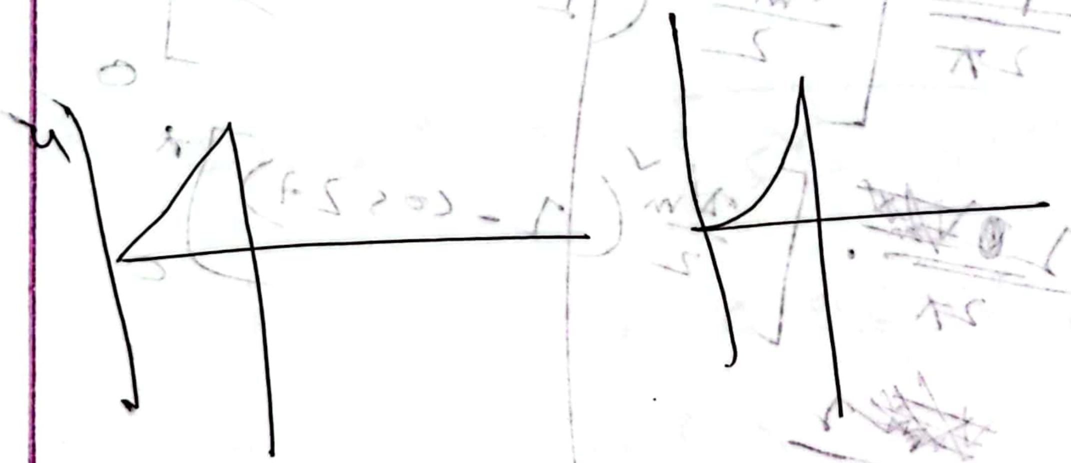
$$\cos(\omega t \pm 180^\circ) = -\cos \omega t$$

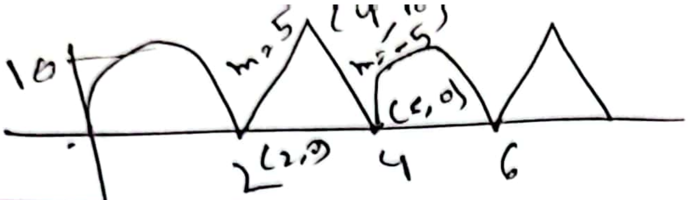
$$\sin(\omega t \pm 90^\circ) = \pm \cos \omega t$$

$$\cos(\omega t \pm 90^\circ) = \mp \sin \omega t$$

☆ $\sin(-\theta) = -\sin\theta$

☆ $\cos(-\theta) = \cos\theta$





$$* \; V_{rms} = \sqrt{\frac{1}{\pi}\int_0^{\pi} (100 \sin t)^2 \, dt}$$

$$* \quad i(t) = \begin{cases} 10 \sin \frac{\pi t}{2} & 0 < t < 2 \\ \cancel{10t \quad 2 < t < 4} & \\ -10t & 4 < t < 6 \end{cases}$$

$T = 2$

$w = \frac{2\pi}{T} = \frac{\pi}{2}$

$$\Rightarrow \begin{cases} y - 0 = 5(x-2) \\ y = 5x - 10 \end{cases} \qquad y - 0 = -5(x-6)$$

$$\Rightarrow y = -5x + 30$$

$$\Rightarrow 5t - 10 \quad 2 < t < 4 \qquad -5t + 30 \quad 4 < t < 6$$

$$i(t) = \sqrt{\frac{1}{6}\int_0^2 \left(10 \sin \frac{\pi}{2} t\right)^2 dt + \int_2^4 (5t-10)^2 dt + \int_4^6 (-5t+30)^2 dt}$$