1/

Applying KVL in i_1,

$10i_1 - 6 + 2(i_1 - i_2) = 0$

$\Rightarrow 12i_1 - 2i_2 = 6$ — (I)

For i_2:

$2(i_2 - i_1) + (1(i_2 - i_3)) + 8 + 4i_2 = 0$

$\Rightarrow -2i_1 + 7i_2 - i_3 = -8$ — (II)

For i_3: $6 + 5i_3 - 8 + 1(i_3 - i_2) = 0$

$\Rightarrow 6i_3 - i_2 = 2$ — (III)

From calc,

$i_1 = 0.329\,A$

$i_2 = -1.025\,A$

$i_3 = 0.162\,A$

Now,

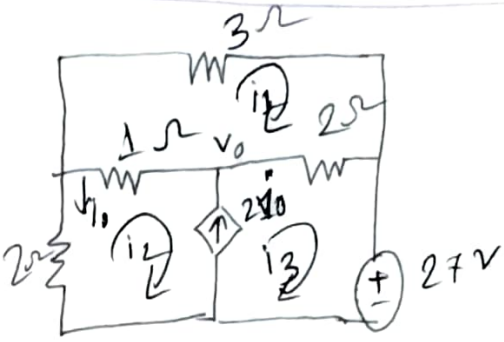
$i_3 = i + i_2$

$\Rightarrow i = i_3 - i_2$

$= 0.162 + 1.025$

$\therefore i = \boxed{1.187\ A}$ Ans

21



Using mesh analysis,

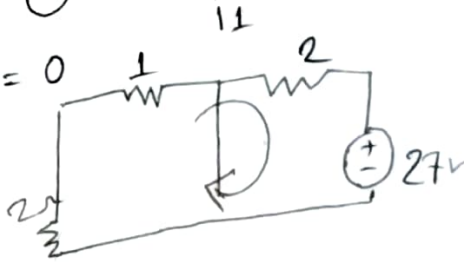
$$i_o = -i_2 \quad \text{—— (I)}$$

Supermesh,

$$2i_o = i_3 - i_2 \quad \text{—— (II)}$$

$$-2i_2 = i_3 - i_2$$

$$\Rightarrow -i_2 - i_3 = 0 \quad \text{(V)}$$



$$2 + 1(i_2 - i_1) + 2(i_3 - i_1) + 27 = 0$$

$$\Rightarrow 29 + i_2 - i_1 + 2i_3 - 2i_1 = 0$$

$$\Rightarrow -3i_1 + i_2 + 2i_3 = -29 \quad \text{—— (III)}$$

From (I), $1(i_1 - i_2) + 3 + 2(i_1 - i_3) = 0$

$$\Rightarrow i_1 - i_2 + 3 + 2i_1 - 2i_3 = 0$$

$$\Rightarrow 3i_1 - i_2 - 2i_3 = -3 \quad \text{— (IV)}$$

(II) + (III) + (IV), $-i_2 - i_3 = 0$

$$-3i_1 + i_2 + 2i_3 = -29$$

$$3i_1 - i_2 - 2i_3 = -3$$

$$-i_2 - i_3 = -32 \quad \text{— (VI)}$$

From (iii) & (v),

$$-i_2 - i_3 = 0$$

$$(+) \quad -i_2 - i_3 = -32$$

$$-2i_2 - 2i_3 = -32$$

$$\Rightarrow -2(-i_2 - i_3) = -32$$

$$\Rightarrow -i_2 - i_3 = \frac{32}{2}$$

$$\Rightarrow -i_2 - i_3 = 16 \qquad \Rightarrow -i_3 =$$

$$\Rightarrow i_3 = -i_2 + 16$$

Putting this in ~~(ii), (vi)~~ (iv)

~~$-i_2 - (-i_2 + 16) = 0$~~

~~$\Rightarrow -i_2 + i_2$~~ ~~$-i_2 - (-i_2$~~

$$3i_1 - i_2 - 2(-i_2 + 16) = -3$$

$$\Rightarrow 3i_1 - i_2 + 2i_2 - 32 = -3$$

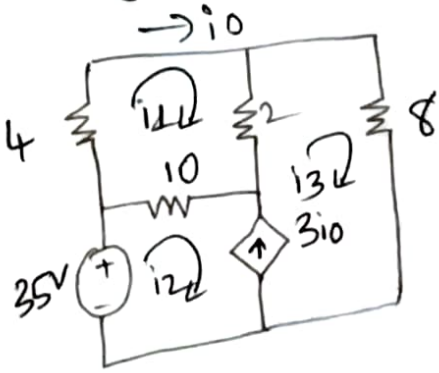
$$\Rightarrow 3i_1 + i_2 = -35$$

From Calc,

$V_1 = 36$ & $V_o = \boxed{57\ V}$ Ans

$$i_o = \frac{V_1}{2} = \boxed{18A}$$ Ans

3/ Using mesh analysis,



$i_o = i_1$

Supermesh,

$-35 + 10i_2 - 10i_1 + 2i_3 - 2i_1 + 8i_3 = 0$

$\Rightarrow -12i_1 + 10i_2 + 10i_3 = 35$ — (I)

Also, $i_3 - i_2 = 3i_o$ — (II)

$\Rightarrow i_o = i_1$ — (III)

From loop i_1,

$2i_1 - 2i_3 + 10i_1 - 10i_2 + 4i_1 = 0$

$\Rightarrow 16i_1 - 10i_2 - 2i_3 = 0$ — (IV)

From calc,

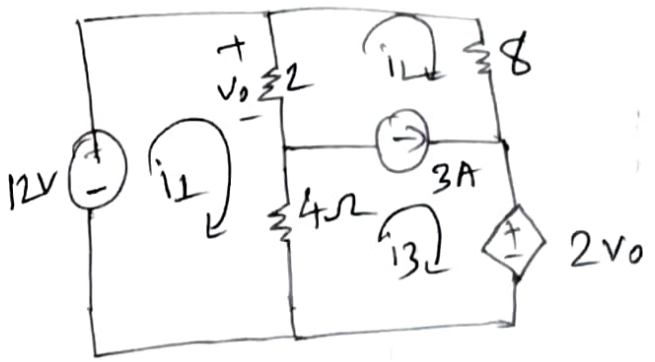
$i_1 = 1.0096\,A$,

$i_2 = 0.8413\,A$ &

$i_3 = 3.8401\,A$.

So, $i_0 = i_1 = \boxed{1.0096\,A}$ Ans

4/



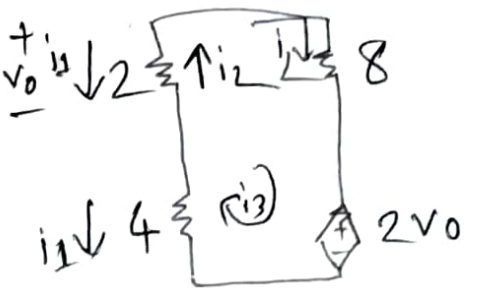
From i_1,

$$v_0 + 4(i_1 - i_3) - 12 = 0$$

$$\Rightarrow v_0 = 2(i_1 - i_2) \quad \text{— (1)}$$

So, $2(i_1 - i_2) + 4(i_1 - i_3) = i_2$

Supermesh:



$$8i_2 + 2v_o + 4(i_3 - i_1) + 2(i_2 - i_1) = 0$$

$$-4i_1 - 2i_1 + (8+2)i_2 + 4i_3 + 2v_o = 0$$

but, $v_o = 2(i_1 - i_2)$ from (1),

So, $-6i_1 + 10i_2 + 4i_3 + 2 \times 2(i_1 + i_2) = 0$

$$\Rightarrow i_1 = 3i_2 + 2i_3 \quad \text{---} \quad (11)$$

From (11) $\Rightarrow i_3 - i_2 = 3$

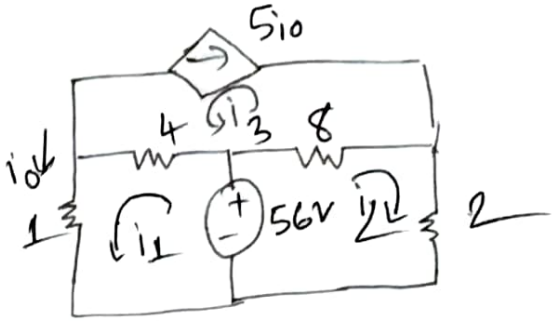
$$6i_1 - 2i_2 - 4i_3 = 12$$

using calculator we get,

$i_1 = \boxed{3.5A}$, $i_2 = \boxed{-0.5A}$ & $i_3 = \boxed{2.5A}$

Ans

5/ using mesh,



$$-56 + 4(i_1 - i_3) + 1 \cdot i_1 = 0$$

$$\Rightarrow 5i_1 - 4i_3 = 56 \quad \text{---} \quad (1)$$

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

$$10i_2 + 8i_3 = 56 \quad \text{---} \quad (11)$$

$i_3 = -0.5 i_0 = -0.5 i_1$

as, $i_0 = i_1$

so, $0.5 i_1 + i_3 = 0$ — (iii)

From calc,

$i_1 = 8A$, $i_2 = 8.8A$ & $i_3 = -4A$

Powers,

$P_{1\Omega} = i_1^2 (1) = 8^2 \times 1 =$ **64W**

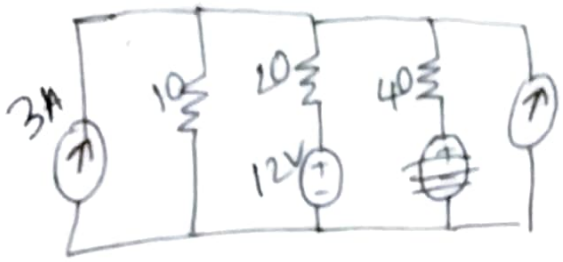
$P_{4\Omega} = (i_1 - i_3)^2 \times 4 = (0.8)^2 \times 4 =$ **2.56W**

$P_{8\Omega} = (i_2 + i_3)^2 \times 8 = (8-4)^2 \times 8 =$ **128W**

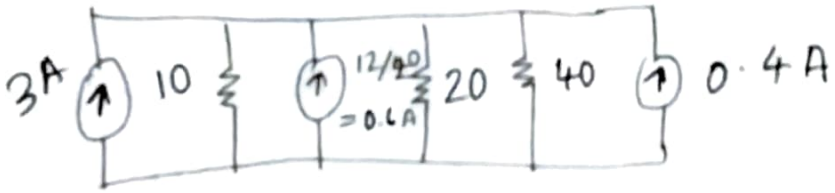
$P_{2\Omega} = (i_2)^2 \times 2 = (8.8)^2 \times 2 =$ **154.88W**

Ans

6/ Applying source transformation to 16V & 4Ω



Now in 12V & 20Ω.



Now combining current sources & resistances.

using KCL, $3A + 0.6A + 0.4A = \boxed{4A}$

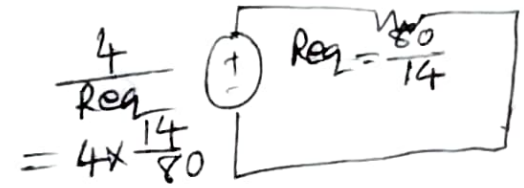
& all parallel resistors,

$$\frac{1}{Req} = (10^{-1}) + (20^{-1}) + (40^{-1})$$

$$\therefore Req = \boxed{5.714\ \Omega}$$

Now the circuit is,

applying source transformation,

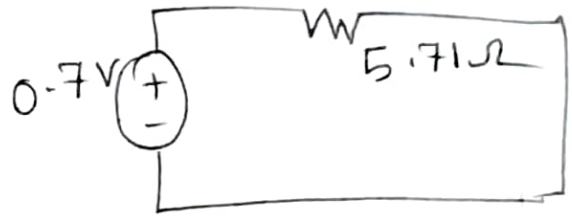


$= 4 \times \frac{14}{80}$

$= 0.7V$

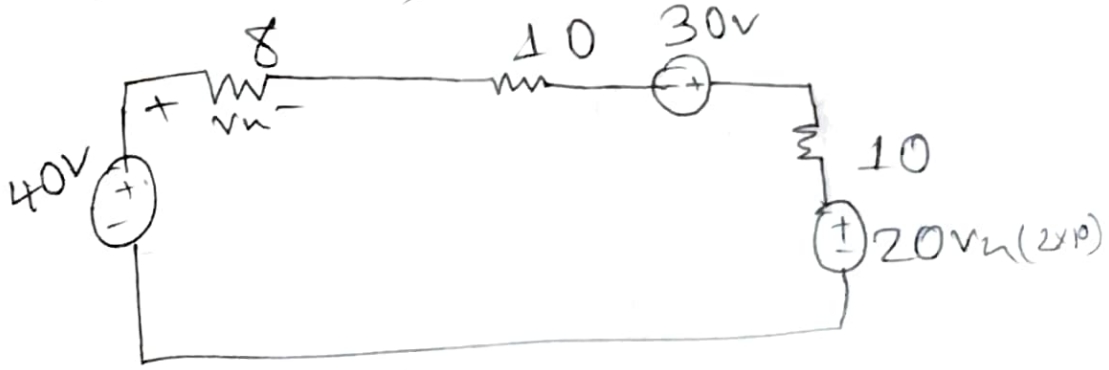
$\frac{80}{14} = 5.71$

So the final circuit is,



Ans

7/ Using source transformation on 3A & 10Ω,



Now, $\frac{40 - Vn + 30 - 20Vn}{20} = i$

$\Rightarrow \frac{70 - 21Vn}{20} = \frac{Vn}{8}$

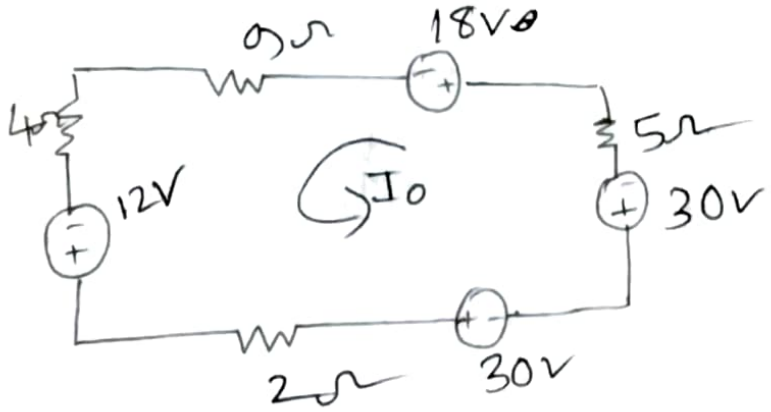
$\therefore Vn = \boxed{3.11V}$ Ans

8/ Using source transformation,

$E_1 = 3 \times 4 = 12V$, $R_1 = 4\Omega$

$E_2 = 9 \times 2 = 18V$, $R_2 = 3\Omega$

$E_3 = 5 \times 6 = 30V$, $R_3 = 5\Omega$



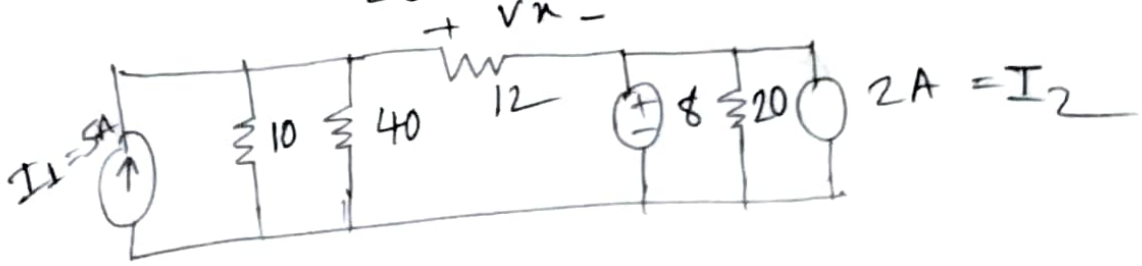
$$I_0 = \left(\frac{12 - 30 - 30 - 18}{4 + 2 + 5 + 9} \right) = -3.3A$$

$$V_0 = I_0 \times 2 = (-3.3) \times 2 = \boxed{-6.6V}$$

9/ Using source transformation, Ans

$I_1 = \frac{50}{10} = 5A$, $R_1 = 10\Omega$

$I_2 = \frac{40}{20} = 2A$, $R_2 = 20\Omega$



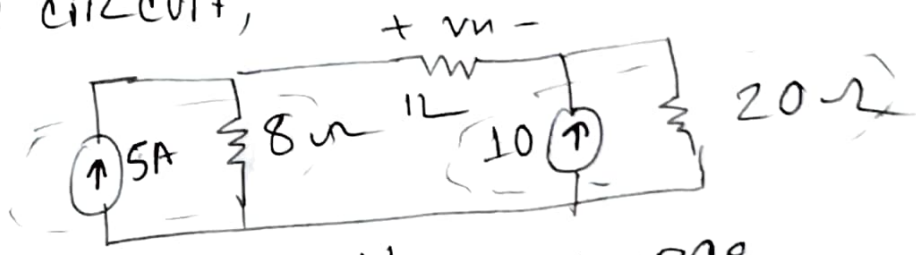
Now,

$$R_1 = \left(10^{-1} + 40^{-1} \right)^{-1}$$

$$R_1 = 8\Omega$$

$$I_0 = 8 + 2 = 10\,A$$

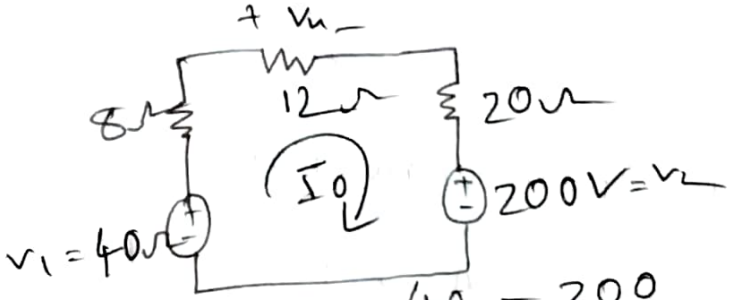
new circuit,



Current to voltage source,

$$V_1 = 5 \times 8 = 40V \,, \quad R_1 = 8\Omega$$

$$V_2 = 10 \times 20 = 200V \,, \quad R_2 = 20\Omega$$

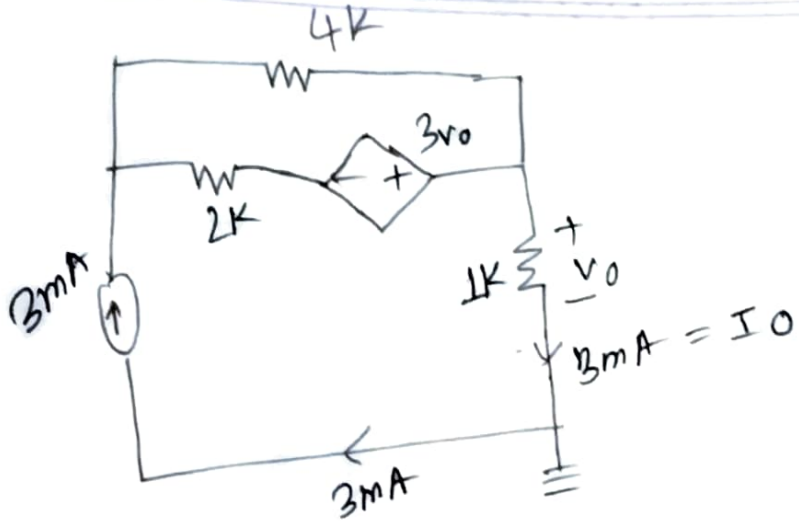


$$I_0 = \frac{40 - 200}{8 + 12 + 20} = -4\,A$$

$$V_{12} = I_0 \times 12 = -4 \times 12 = \boxed{48V}$$

Ans

10/



by nodal analysis,

$$V_o = I_o \times 1 = 3 \times 1 = \boxed{3\,V}$$

Ans