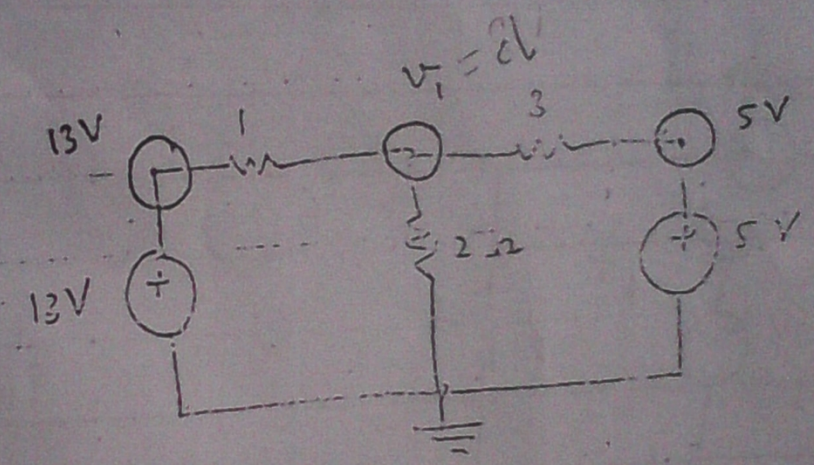
3.2 Nodal Analysis :-

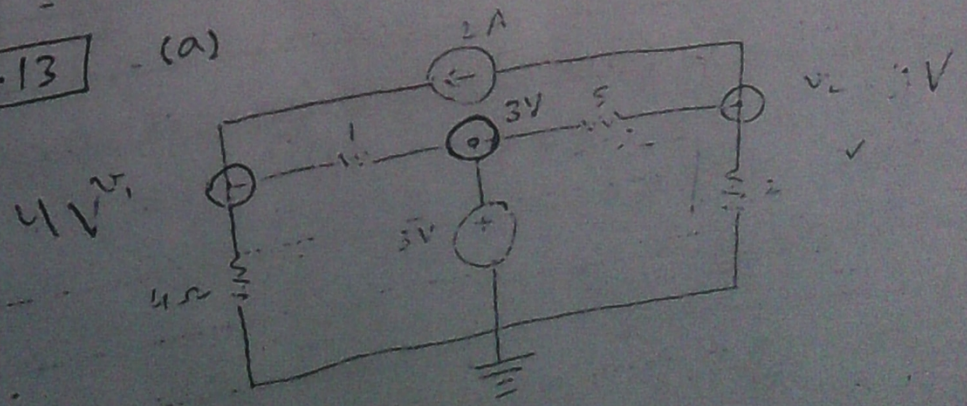
3.12



FOR v_1 :

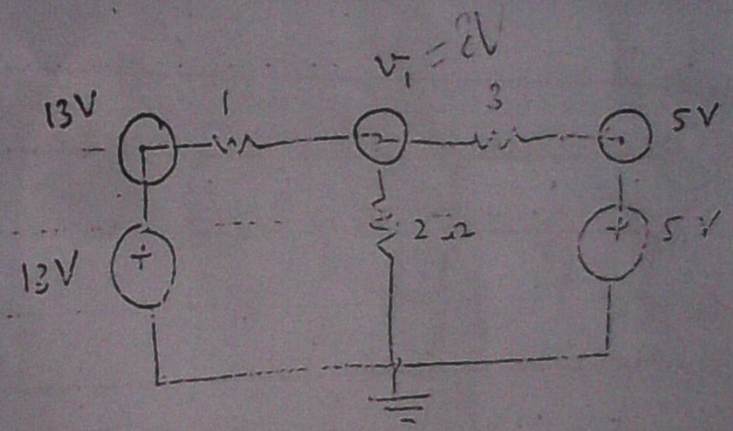
$$\frac{v_1 - 0}{2} + \frac{v_1 - 13}{1} + \frac{v_1 - 5}{3} = 0$$

3.13 (a)



3.2 Nodal Analysis :-

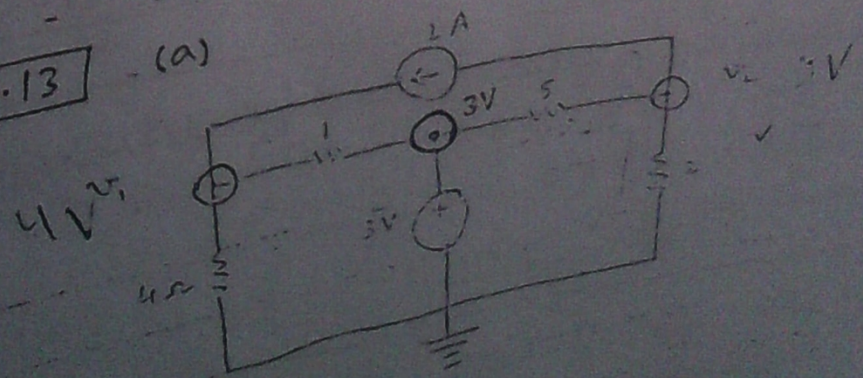
3.12



FEL v_1 :

$$\frac{v_1 - 0}{2} + \frac{v_1 - 13}{1} + \frac{v_1 - 5}{3} = 0$$

3.13 (a)



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"EVERY THING SHOULD BE MADE AS SIMPLE AS POSSIBLE BUT NOT SIMPLER."

Albert Einstein

By: M. Haris Altaf
06-CE-14

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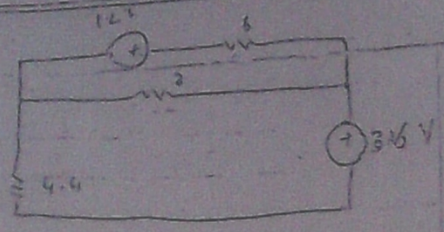
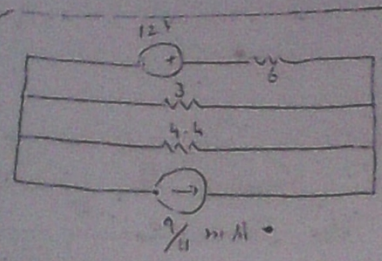
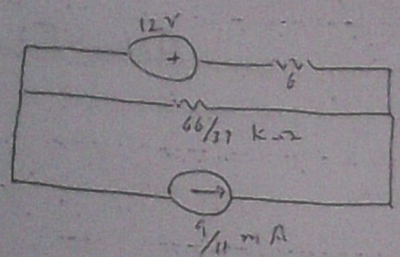
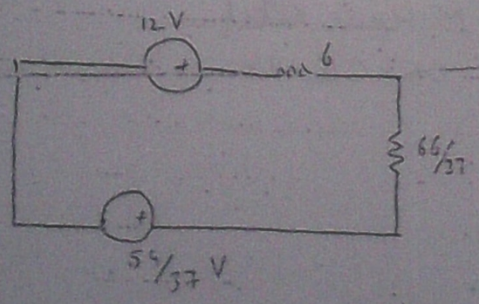
3.2 Nodal

3.12

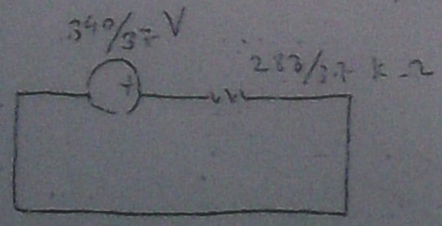








Apply superposition OR



$\frac{65}{48}$ mA ↑

$\because 12 > \frac{54}{37}$

$\therefore P_{12V} = i \cdot V = \frac{65}{48} \times 12 = \frac{65}{4} = 16.25$ mW

(Releasing).

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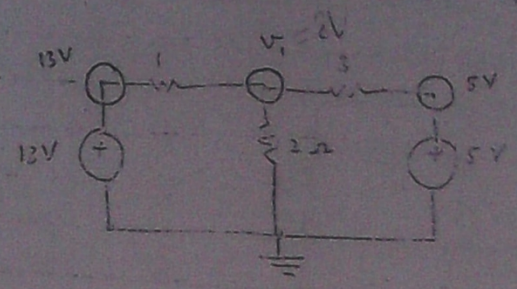
3.2 Nodal Analysis:-

$\boxed{3.12}$



For v_1:

$$\frac{v_1 - 0}{2} + \frac{v_1 - 13}{1} + \frac{v_1 - 5}{3} = 0$$

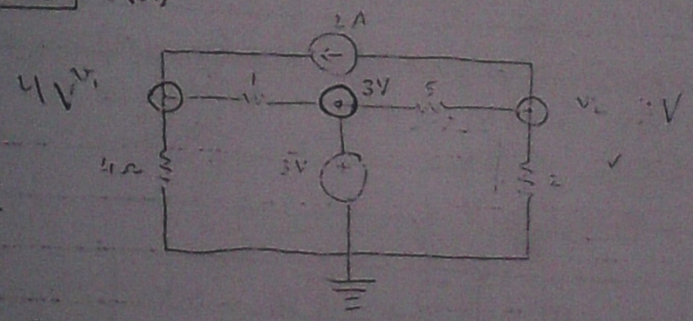
∴ All the equations are generated.

∴ For finding currents, find currents by Ohm's law and KCL and find voltage drop by Ω's law.

∴ It solved any $\boxed{3.15}$.

$\boxed{3.13}$ (a)

(b) do yourself:-



For v_1:

$$\frac{v_1 - 0}{4} + \frac{v_1 - 3}{1} = 2$$

For v_2: $2 + \frac{v_2 - 3}{5} + \frac{v_2 - 0}{2} = 0$

$\boxed{3.14}$ 2A reversed:- same figure & finding:-

For v_1:

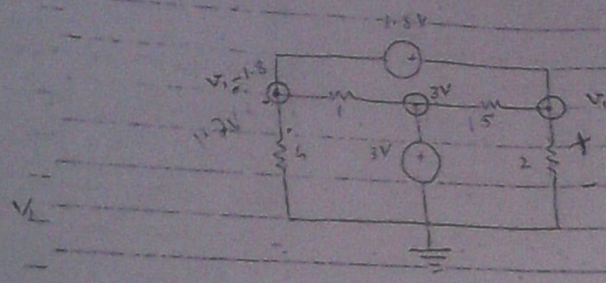
$$2 + \frac{v_1 - 0}{4} + \frac{v_1 - 3}{1} = 0$$

0.8V, 3.7V ✓

For v_2:

$\frac{v_2 - 3}{5} + \frac{v_2 - 0}{2} = 2$

3.15 The fig. will be



For v_1:

$$\frac{v_1-3}{5} + \frac{v_1-0}{2} + \frac{(v_1-1.8)-3}{1} + \frac{(v_1-1.8)-0}{4} = 0$$

$$4(v_1-3) + 10(v_1) + 20(v_1-4.3) + 5(v_1-1.8) = 0$$

$$4v_1 - 12 + 10v_1 + 20v_1 + 5v_1 - 86 - 9 = 0$$

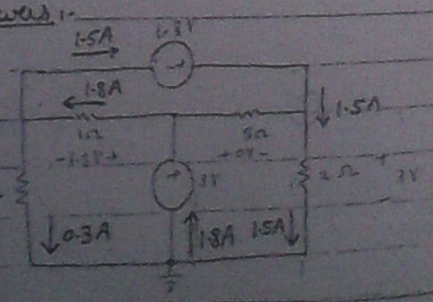
$$39v_1 - 117 = 0$$

$$v_1 = \frac{117}{39} V$$

$$\boxed{v_1 = \frac{117}{39} V} \Rightarrow \boxed{v_1 = 3 V}$$

$$\boxed{v_{2\Omega} = 3V(-)} \quad \boxed{v_{4\Omega} = 1.2V(+)}$$

$\Rightarrow$ For Powers:-



$P_{1.8V} = 1.5 \times 1.8 = 2.7$ W (delivered)

$P_{3V} = 1.8 \times 3 = 5.4$ W (delivered)

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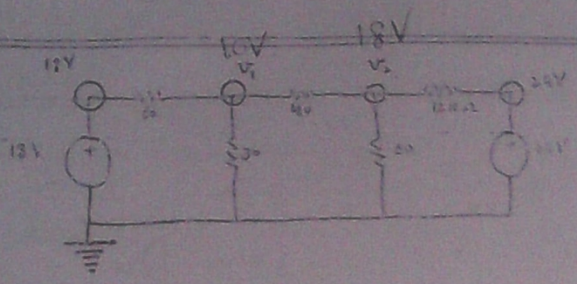
3.16



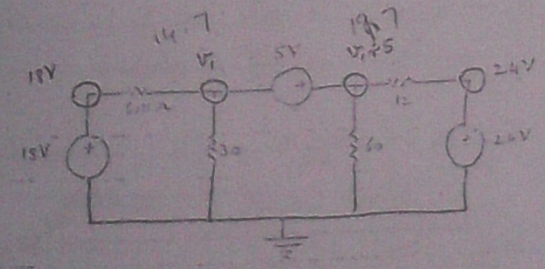
For v_1:

$$\frac{v_1 - 13}{60} + \frac{v_1 - 0}{30} + \frac{v_1 - v_2}{40} = 0$$

For v_2:

$$\frac{v_2 - 24}{12} + \frac{v_2 - 0}{60} + \frac{v_2 - v_1}{40} = 0$$

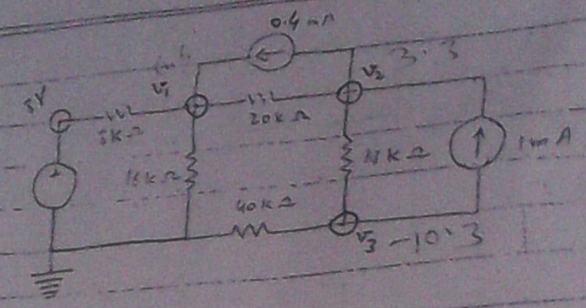
3.17



For v_1:

$$\frac{v_1 - 13}{60} + \frac{v_1 - 0}{30} + \frac{(v_1 + 5) - 24}{12} + \frac{(v_1 + 5) - 0}{60} = 0$$

3.18



For v_1:

$$\frac{v_1-8}{8}+\frac{v_1-0}{16}+\frac{v_1-v_2}{20}=0.4$$

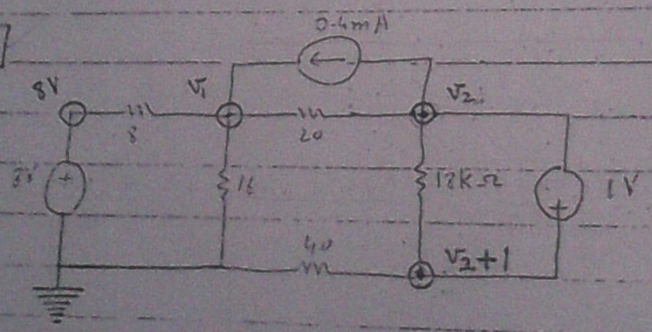
For v_2:

$$\frac{v_2-v_1}{20}+\frac{v_2-v_3}{12}+0.4=1$$

For v_3:

$$1+\frac{v_3-v_2}{12}+\frac{v_3-0}{40}=0$$

3.19



For v_1:

$$\frac{v_1-8}{8}+\frac{v_1-0}{16}+\frac{v_1-v_2}{20}=0.4$$

For v_2:

or $$0.4+\frac{v_2-v_1}{20}+\frac{(v_2+1)-0}{40}=0 \quad \because$$

$$\frac{0.4}{20}+\frac{v_2}{20}-\frac{v_1}{20}+\frac{v_2}{40}+\frac{1}{40}=0 \quad \Rightarrow \quad 8+v_2-v_1+v_2+1=0$$

$\Longrightarrow$ Answer has been verified

∇ No current will flow from v_1 to 12kΩ

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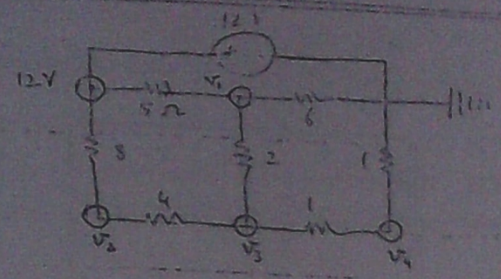
3.20



1.6 For v_1:

06

$$\frac{v_1-12}{5}+\frac{v_1-0}{6}+\frac{v_1-v_3}{2}=0 \quad \text{——— (1)}$$

For v_2:

$$\frac{v_2-12}{8}+\frac{v_2-v_3}{4}=0 \quad \text{——— (2)}$$

For v_3:

$$\frac{v_3-v_2}{4}+\frac{v_3-v_1}{2}+\frac{v_3-v_4}{1}=0 \quad \text{——— (3)}$$

For v_4:

$$\frac{v_4-0}{1}+\frac{v_4-v_3}{1}=0 \quad \text{——— (4)}$$

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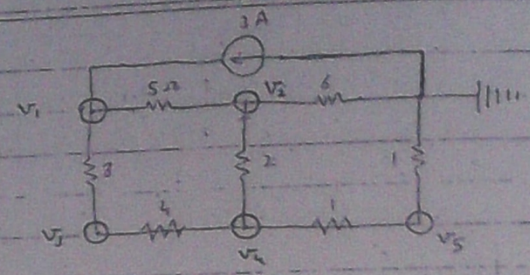
$\boxed{3.21}$



For v_1:

$$\frac{v_1 - v_2}{5} + \frac{v_1 - v_3}{3} = 3$$

For v_2:

$$\frac{v_2 - v_1}{5} + \frac{v_2 - 0}{6} + \frac{v_2 - v_4}{2} = 0$$

For v_3:

$$\frac{v_3 - v_1}{3} + \frac{v_3 - v_4}{4} = 0$$

For v_4:

$$\frac{v_4 - v_2}{2} + \frac{v_4 - v_3}{4} + \frac{v_4 - v_5}{1} = 0$$

For v_5:

$$\frac{v_5 - v_4}{1} + \frac{v_5 - 0}{1} = 0$$

$$\boxed{v_{3A} = v_1 - 0}$$

* So, emphasize to find v_1 on

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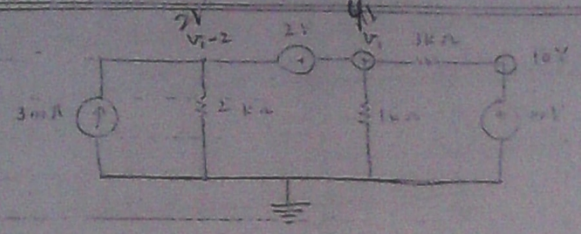
3.22



For V_1:

$$\frac{V_1-10}{3}+\frac{V_1-0}{1}+\frac{(V_1-2)-0}{2}=3 \quad (1)$$

$$-2V_1-20+6V_1+3V_1-6=18$$

$$11V_1=44$$

$$\boxed{V_1=4\,V}$$

$$\boxed{V_{3mA}=(V_1-2)-0}$$

And

$$\boxed{P_{3mA}=V_{3mA}\times 3mA}$$

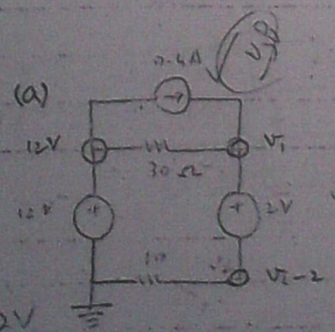
So

$$V_{3mA}=4-2=2$$

$$\boxed{V_{3mA}=2\,V}$$

$$\boxed{P_{3mA}=2\times 3m=6\,mW \text{ (absorbing)}}$$

3.23 (a)



$V_1-V_2=2V$

$V_1=V_2-2V$

For V_1:

$$\frac{V_1-12}{30}+\frac{(V_1-2)-0}{10}=0.4$$

$$V_1-12+3V_1-6=12$$

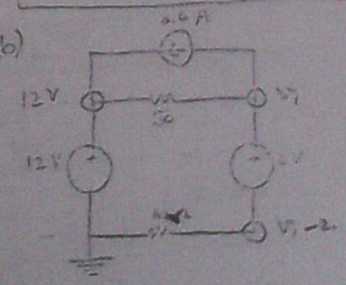
$$4V_1=30$$

$$\boxed{V_1=7.5\,V}$$

$$V_{0.4A}=12-7.5=4.5\,V\ (+-)$$

$$P_{0.4A}=4.5\times 0.4=1.2\,W \text{ (absorbing)}$$

3.23 (b)



For V_1:

$$\frac{V_1-12}{30}+\frac{(V_1-2)-0}{10}-0.6=0$$

$$V_1-12+3V_1-6-18=0$$

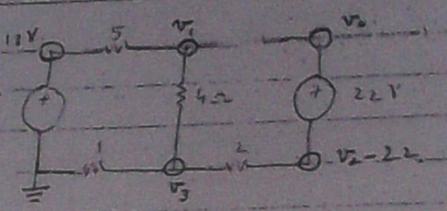
$$4V_1=6$$

$$\boxed{V_1=1.5\,V}$$

$$V_{0.6A}=12-1.5=10.5\,V\ (+-)$$

$$P_{0.6A}=10.5\times 0.6=6.3\,W \text{ (absorbing)}$$

3.24



For v_1 :

$$\frac{v_1-18}{5}+\frac{v_1-v_3}{4}+\frac{v_1-v_2}{3}=0$$

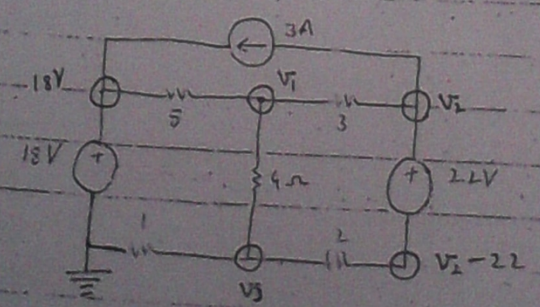
For v_2 :

$$\frac{v_2-v_1}{3}+\frac{(v_2-22}{2}-v_3=0$$

For v_3 :

$$\frac{v_3-0}{1}+\frac{v_3-v_1}{4}+\frac{v_3-(v_2-22)}{2}=0$$

3.25



For v_1 :

$$\frac{v_1-18}{5}+\frac{v_1-v_3}{4}+\frac{v_1-v_2}{3}=0$$

For v_2 :

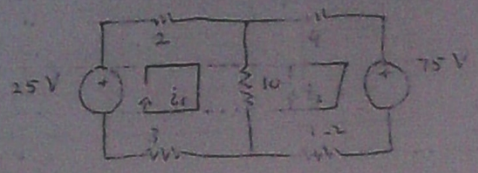
$$\frac{v_2-v_1}{3}+\frac{(v_2-22)-v_3}{2}+3=0$$

For v_3 :

$$\frac{v_3-0}{1}+\frac{v_3-v_1}{4}+\frac{v_3-(v_2-22)}{2}=0$$

3.3 Loop Analysis :-

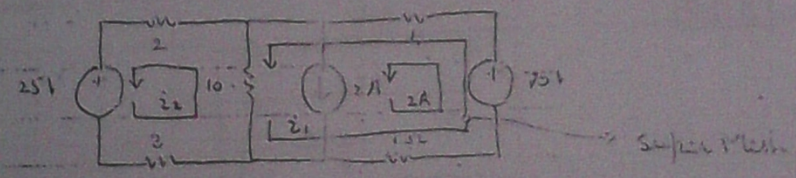
3.26



loop I: $25 = 2i_1 + 3i_1 + 10(i_1 - i_2)$

loop II: $75 + 4i_2 + i_2 + 10(i_2 - i_1) = 0$

3.27



loop I: $25 + 2i_2 + 3i_2 + 10(i_2 - i_1) = 0$ —— (1)

loop II: $10(i_1 - i_2) + (i_1 + 2) + 4(i_1 + 2) = 75$ —— (2)

from (1) & (2) we get

$2i_1 - 3i_2 = 5$ —— (3)

$3i_1 - 2i_2 = 13$ —— (4)

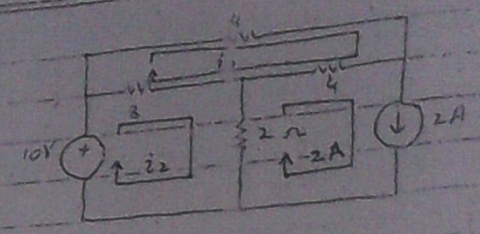
from (3) & (4)

$$\boxed{i_1 = \frac{29}{5}\,A, \quad i_2 = \frac{11}{5}\,A}$$

$i_{10\Omega} = i_1 - i_2 = \frac{18}{5} = 3.6\,A$

$V_{10\Omega} = i_{10\Omega} \times R = 3.6 \times 10 = 36\,V\,(\pm)$

3.28

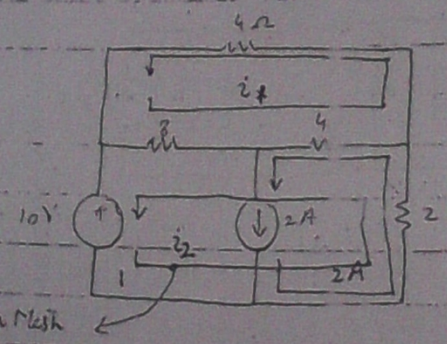


loop I: $4i_1 + 3(i_1 - i_2) + 4(i_1 - 2) = 0$

loop II: $3(i_2 - i_1) + 2(i_2 - 2) = 10$

~~loop III~~

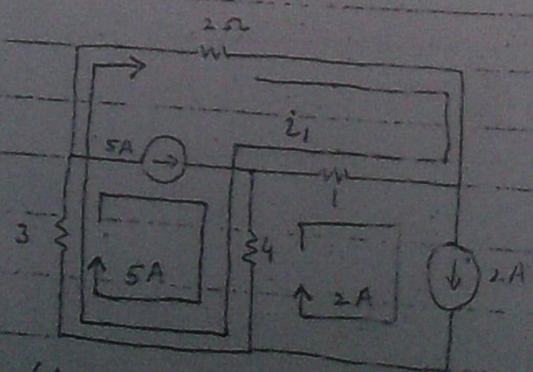
3.29



loop I: $4i_1 + 8(i_1 - 2) + 4(i_1 - (i_2 + 2)) = 0$

loop II: $10 + 3(i_2 - i_1) + 2(i_2 + 2) + 4((i_2 + 2) - i_1) =$

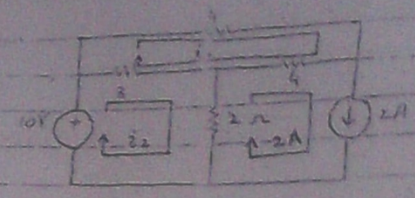
3.30



$2i_1 + (i_1 - 2) + 4((i_1 + 5) - 2) + 3(i_1 + 5) = 0$

$\boxed{i_1 = -2.5\ A}$

3.28

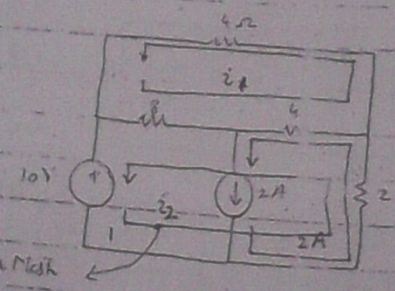


loop I: $4i_1 + 3(i_1 - i_2) + 4(i_1 - 2) = 0$

loop II: $3(i_2 - i_1) + 2(i_2 - 2) = 10$

~~loop III~~

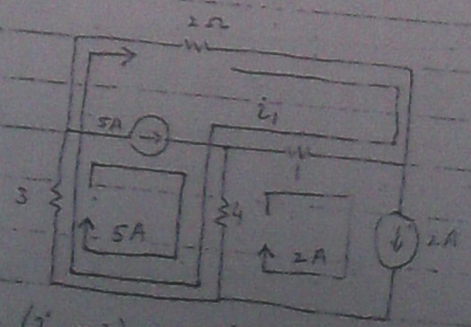
3.29



loop I: $4i_1 + 8(i_1 - i_2) + 4(i_1 - (i_2 + 2)) = 0$

loop II: $10 + 3(i_2 - i_1) + 2(i_2 + 2) + 4((i_2 + 2) - i_1) = 0$

3.30

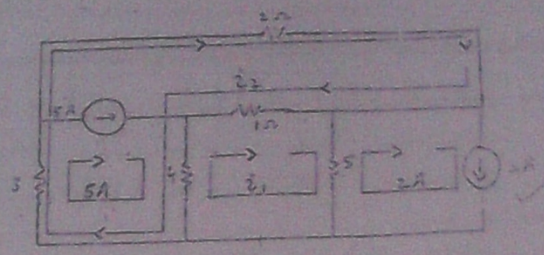


$2i_1 + (i_1 - 2) + 4((i_1 + 5) - 2) + 3(i_1 + 5) = 0$

$\boxed{i_1 = -2.5\ A}$

$i_{4\Omega} = -2.5 + 5 - 2 = 0.5\ A$ $\boxed{P_{4\Omega} = 1\ W}$

3.31



both are different meshes

$$4(i_1-(i_2+5)) + (i_1-i_2) + 5(i_1-2) = 0$$

$$2i_1 - i_2 = 6 \quad \text{——} \quad (1)$$

$$4((i_2+5)-i_1) + (i_2-i_1) + 2i_2 + 3(i_2+5) = 0$$

$$i_1 - 2i_2 = 7 \quad \text{——} \quad (2)$$

from (1) & (2)

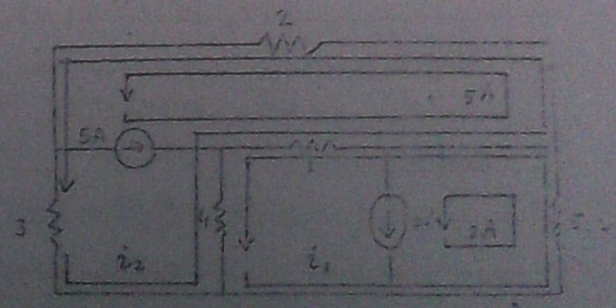
$i_1 = \frac{5}{3}$ A	$i_2 = -\frac{8}{3}$ A

$$i_{4\Omega} = (i_2+5) - i_1 = -\frac{8}{3} + 5 - \frac{5}{3} = \frac{2}{3} \text{ A } (\downarrow)$$

$$\boxed{i_{4\Omega} = \frac{2}{3} \text{ A } (\downarrow)}$$

<u>Another Method</u>

<u>For concept :-</u>



$$4(i_1 - i_2) + (i_1 - (i_2 + 5)) + 5(i_1 + 2) = 0$$

$$2i_1 - i_2 + 1 = 0 \quad \text{—— (1)}$$

$$4(i_2 - i_1) + ((i_2 + 5) - i_1) + 2(i_2 + 5) + 3i_2 = 0$$

$$2i_2 - i_1 + 3 = 0 \quad \text{—— (2)}$$

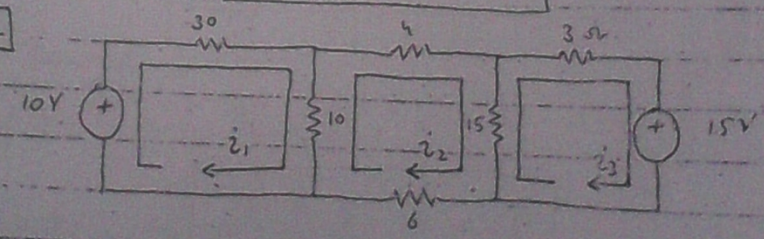
from (1) & (2)

$$\boxed{i_1 = -\frac{5}{3}\,A} \quad \boxed{i_2 = -\frac{7}{3}\,A}$$

$$i_{4\Omega} = i_2 - i_1 = -\frac{7}{3} + \frac{5}{3} = -\frac{2}{3}\,A\ (\uparrow)$$

$$\boxed{i_{4\Omega} = \frac{2}{3}\,A\ (\downarrow)}$$

3.32



loop I:

$$30i_1 + 10(i_1 - i_2) = 10$$

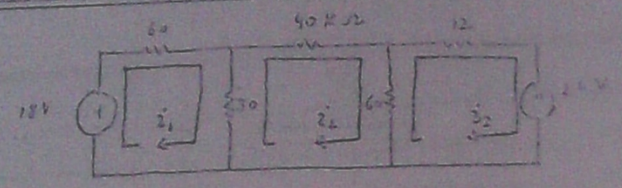
loop II:

$$4i_2 + 10(i_2 - i_1) + 6i_2 + 15(i_2 - i_3) = 0$$

loop III:

$$15(i_3 - i_2) + 3i_3 + 15 = 0$$

3.33



loop I :

$$60 i_1 + 30(i_1 - i_2) = 18$$

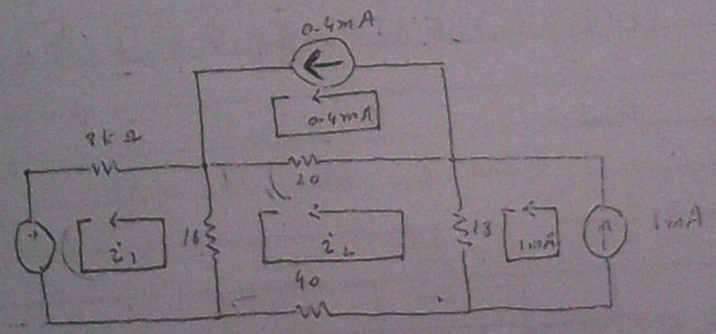
loop II :

$$40 i_2 + 30(i_2 - i_1) + 60(i_2 - i_3) = 0$$

loop III :

$$12 i_3 + 60(i_3 - i_2) + 24 = 0$$

3.34



loop I :

$$8 + 3 i_1 + 16(i_1 - i_2) = 0$$

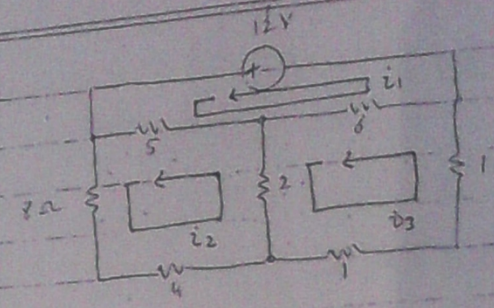
loop II :

$$16(i_2 - i_1) + 40 i_2 + 18(i_2 - 1) + 20(i_2 - 0.4) = 0$$

Hint :-

1st find the current through 20 kΩ then find v_{20k} then find the voltage across 0.4 mA source then find the power by 0.4 mA source.

3.35



loop I:

$$5(i_1 - i_2) + 6(i_1 - i_3) = 12$$

loop II:

$$5(i_2 - i_1) + 8i_2 + 4i_2 + 2(i_2 - i_3) = 0$$

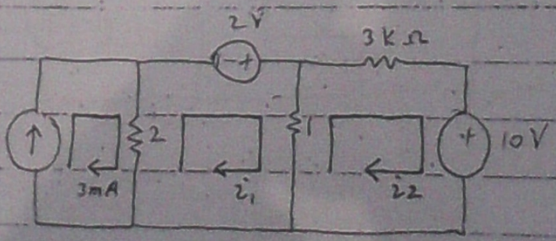
loop III:

$$2(i_3 - i_2) + 6(i_3 - i_1) + i_3 + i_3 = 0$$

Hint:-

Find i_1 then $R_{eq} = \frac{12}{i_1}$

3.36



loop II:

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

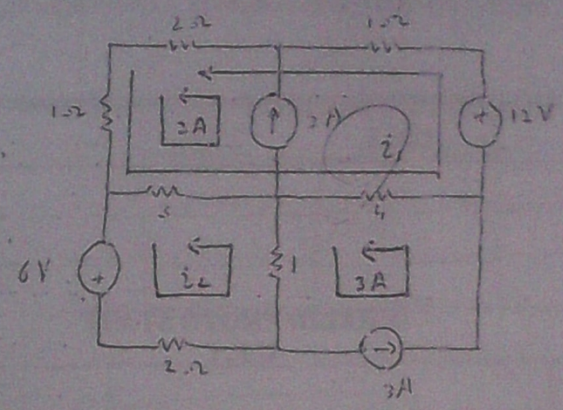
loop III:

$$(i_2 - i_1) + 3i_2 + 10 = 0$$

Hint:-

Applying loop analysis to the circuit m
that find each current of each loop and show
in the figure.

3.37



For i_1:

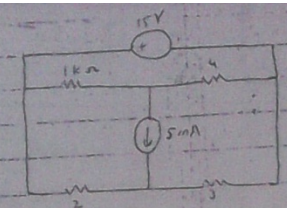
$$12 = i_1 + 2(i_1+2) + (i_1+2) + 3((i_1+2) - i_2) + 4(i_1-3)$$

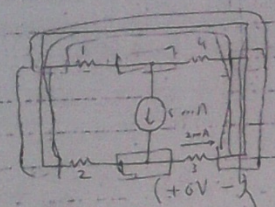
For i_2:

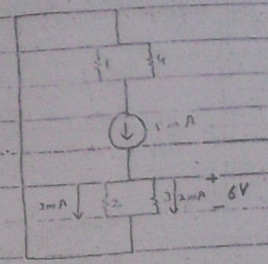
$$6 = 3(i_2-(i_1+2)) + 2i_2 + (i_2-3)$$

KHALID PHOTO STATE

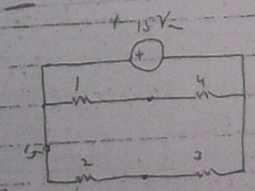
3.38







by ohm's law



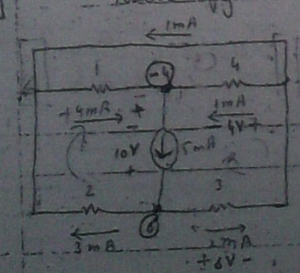
KHALID PHOTO STATE
U.E.T

By superposition :-

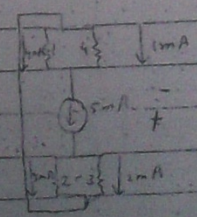
Total voltage across 2kΩ = 6 + 9 = 15V

3.39

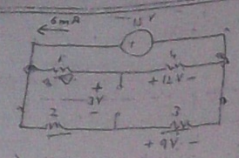
Above fig.



(by KCL & current divider)



KHALID PHOTO STATE
U.E.T



$R_{eq} = 2.5\,k\Omega$ $\quad i = \frac{15}{2.5k} = 6mA$

By superposition principle:-

$i_{15V} = 6mA\ (\leftarrow) + 1mA\ (\leftarrow)$

$i_{15V} = 7mA$

$P_{15V} = 7m \times 15 = 105\ mW$

$v_{5mA} = 10V\ (-/+) - 3V\ (+/-)$

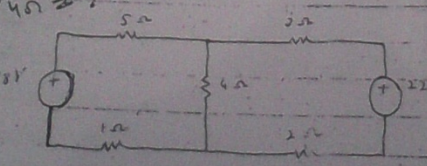
$v_{5mA} = 7V\ (-/+)$

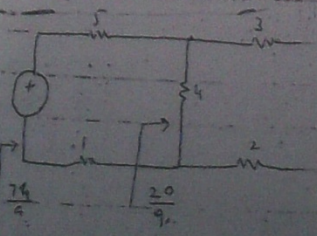
$P_{5mA} = 7 \times 5m = 35\ mW$

KHALID PHOTO STATE
U.E.T

3.40

$V_{4\Omega} = ?$



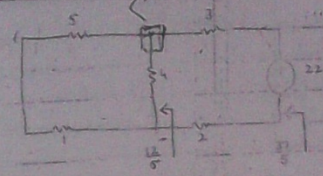


$$V_{4\Omega} = \frac{20/9}{20/9 + 6} \times 18$$

$$V_{4\Omega} = V_{\frac{20}{9}\Omega} = \frac{20/9}{74/9} \times 18 = \frac{180}{37}\ V\ \left(\frac{+}{-}\right)$$

KHALID PHOTO STATE
U.E.T

KHALID PHOTO
U.E.T.



$\frac{12}{5} + 5 = \frac{12+25}{5} = \frac{37}{5}$

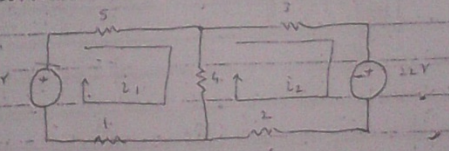
$V_{4\Omega} = V_{\frac{12}{5}\Omega} = \frac{12/5}{37/5} \times 22 = \frac{264}{37}\ V \left(\frac{+}{-}\right)$

By superposition

$V_{4\Omega} = \frac{180}{37}\left(\frac{+}{-}\right) + \frac{264}{37}\left(\frac{+}{-}\right)$

$\boxed{V_{4\Omega} = 12\ V \left(\frac{+}{-}\right)}$

By loop Method :-



loop I: $18 - 5i_1 - 4(i_1 - i_2) - i_1 = 0$

$18 - 10i_1 + 4i_2 = 0$ ①

loop II: $-22 - 2i_2 - 4(-i_2 - i_1) - 3i_2 = 0$

$-22 - 9i_2 + 4i_1 = 0$ ②

from ① & ②

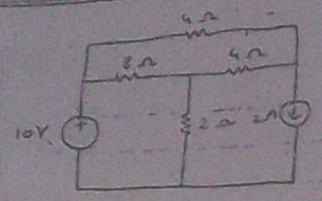
$\boxed{i_1 = 1A\ \circlearrowleft \quad i_2 = -2A \quad i_2 = 2A\ \circlearrowleft}$ (reflecting sign)

$i_{4\Omega} = i_1 + i_2 = 1 + 2 = 3\ A$

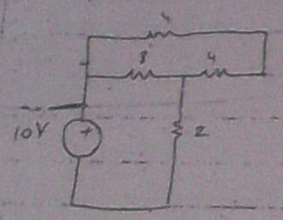
$\boxed{V_{4\Omega} = 4 \times 3 = 12\ V \left(\frac{+}{-}\right)}$

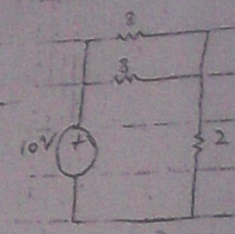
$Z = ?$

3.41

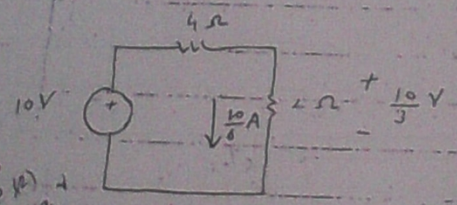


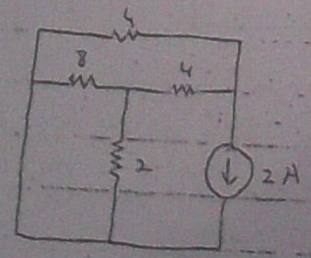
$P_{2\Omega} = ?$

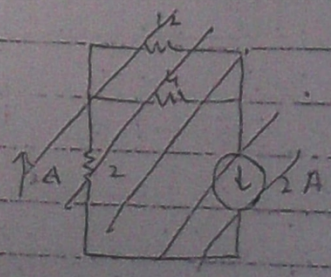


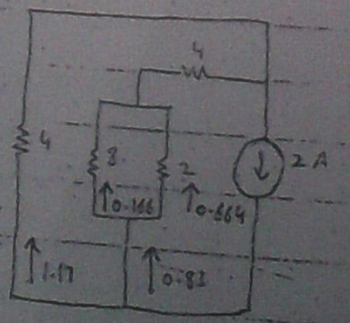


$$R_{eq} = (8^{-1} + 8^{-1})^{-1} + 2 = 4 + 2 = 6$$

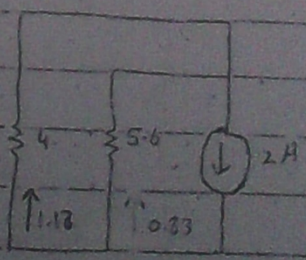








$\Rightarrow$



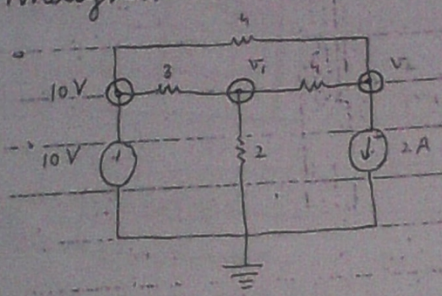
KHALID PHOTO STATE

$i_{2\Omega} = \frac{10}{6} A \downarrow - 0.667 A \uparrow$

$$\boxed{i_{2\Omega} = 1 A \ (\downarrow)}$$

$\Rightarrow P_{2\Omega} = i^2 R = (1)^2 (2) = 2 W$

By Nodal Analysis:-



For v_1: $\frac{v_1 - 0}{2} + \frac{v_1 - 10}{3} + \frac{v_1 - v_2}{4} = 0$

$7 v_1 - 2 v_2 - 10 = 0$ ——— (1)

For v_2: $2 + \frac{v_2 - 10}{4} + \frac{v_2 - v_1}{4} = 0$

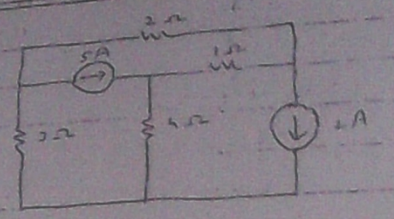
$2 v_2 - v_1 - 2 = 0$ ——— (2)

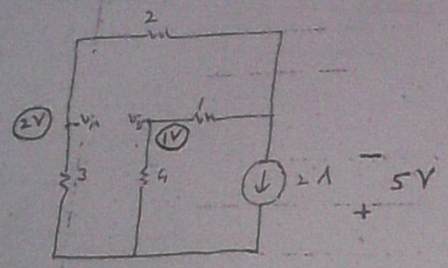
from (1) & (2)

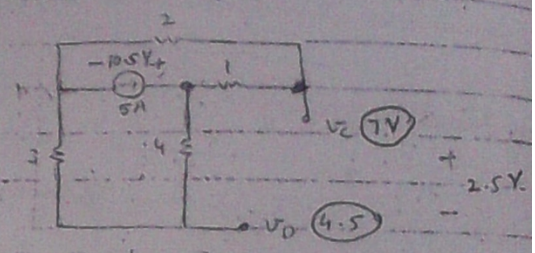
$$\boxed{\begin{array}{c} v_1 = 2 V \\ \& \\ v_2 = 2 V \end{array}}$$

$\Rightarrow P_{2\Omega} = \frac{v^2}{R} = \frac{4}{2} = 2 W$

3.42







$R_{eq} = 2.5\,\Omega$

$v_{AB} = v_A - v_B = 1V$

$R_{eq} = 2.1\,\Omega$

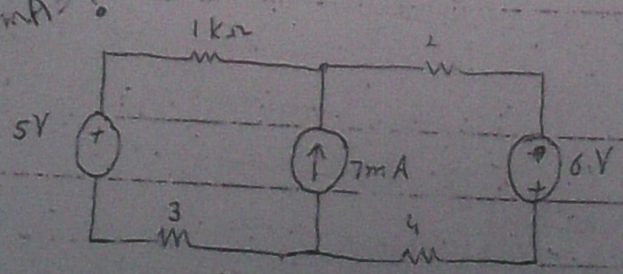
$v_{CD} = v_C - v_D = 2.5$

$i_{2A} = 2A \downarrow$

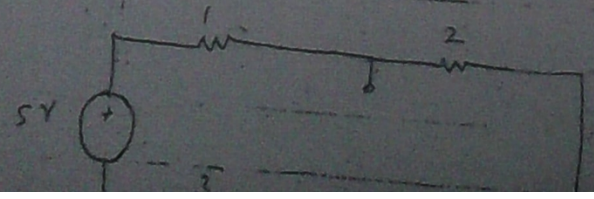
$v_{2A} = 5V\left(\frac{-}{+}\right) = 2.5V\left(\frac{+}{-}\right) = 2.5V\left(\frac{-}{+}\right)$

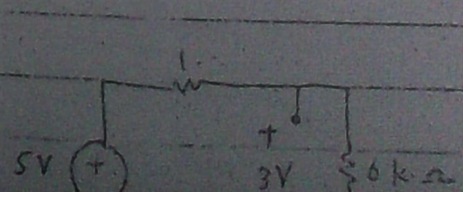
$\Longrightarrow P_{2A} = 2 \times 2.5 = 5\,W$ (releasing)

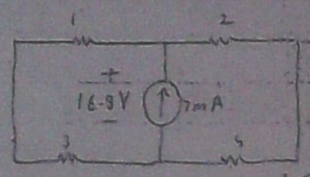
3.43 $7mA = ?$



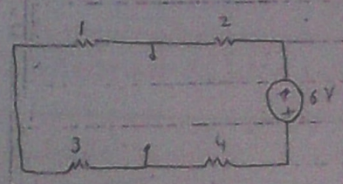
$v_{7mA} = ?$

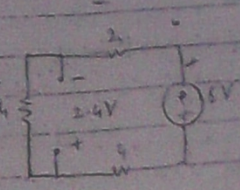






$R_{eq} = 2.4\,k\Omega$



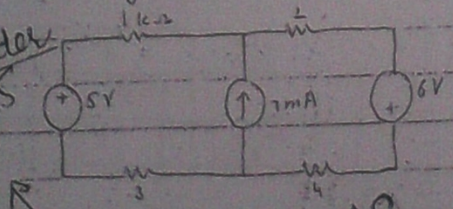


By superposition:-

$V_{7mA} = 16.8\,V\,(+\,-) + 3\,V\,(+\,-) - 2.4\,V\,(-\,+)$

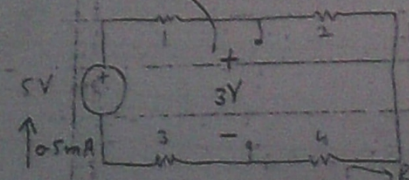
$$\boxed{V_{7mA} = 17.4\,V}$$

3.44 Power by each source (b) Power of each V-source?



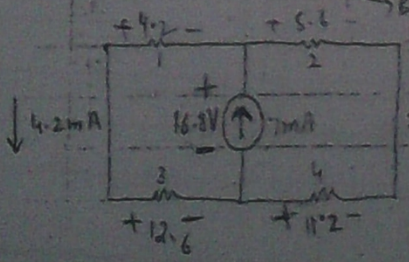
By V-divider

$V_{7mA} = \frac{6}{4+6} \times 5$



$i = \frac{V}{R} = \frac{5}{10} = 0.5\,mA$

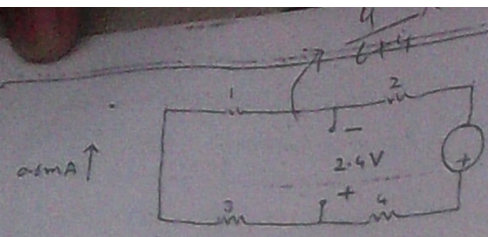
By V-divider



$6 \parallel 4 = \frac{24}{10}$

$R_{eq} = 2.4\,k\Omega$

$V = iR = 16.8\,V$



By superposition:

★ $i_{5V} = 0.5\,mA(\uparrow) - 4.2\,mA(\downarrow) + 0.6\,mA(\uparrow)$

$= -3.1\,mA\,(\downarrow)$

$\Rightarrow \boxed{P_{5V} = i_{5V}\, v_{5V} = 3.1m \times 5 = 15.5\,mW \text{ (absorbing)}}$

★ $i_{7mA} = 7\,mA\,\uparrow$

$v_{7mA} = 16.8\,V\,(\pm) + 5V\,(\pm) - 2.4\,V\,(\mp)$

$= 17.4\,V\,(\pm)$

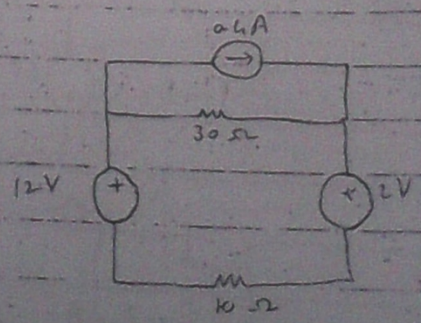
$\Rightarrow P_{7mA} = i_{7mA}\, v_{7mA} = 7m \times 17.4 = 121.8\,mW$ (releasing)

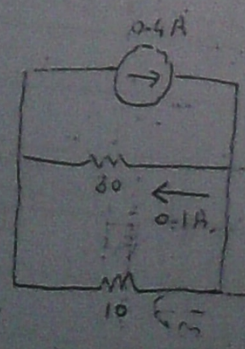
★ $i_{6V} = 0.6\,mA\,(\downarrow) - 0.5\,mA\,(\downarrow) + 2.8\,mA\,(\downarrow)$

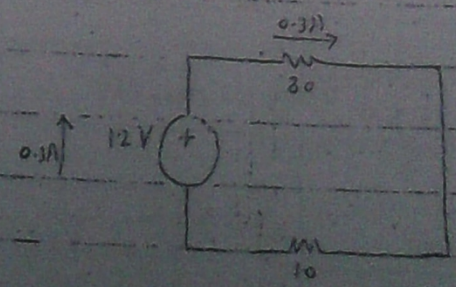
$= 3.9\,mA$

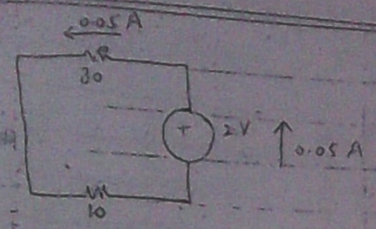
$\Rightarrow P_{6V} = i_{6V}\, v_{6V} = 3.9m \times 6 = 23.4\,mW$ (releasing)

$\boxed{3.45}$ $P_{30\Omega} = ?$







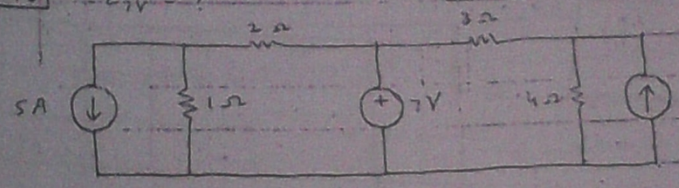


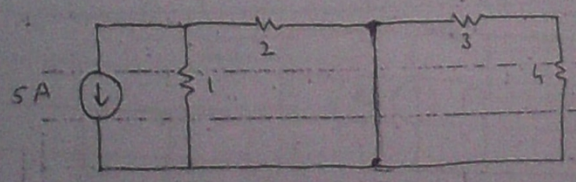
★ $i_{30\Omega} = -0.1A(\leftarrow) + 0.3A(\rightarrow) - 0.05A(\leftarrow)$

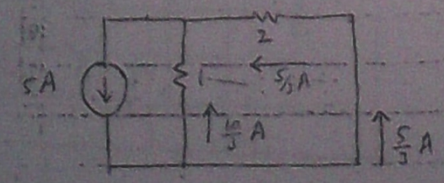
$i_{30\Omega} = 0.15A(\rightarrow)$

$\Longrightarrow P_{30\Omega} = i^2 R = (0.15)^2 (30) = 675\,mW$

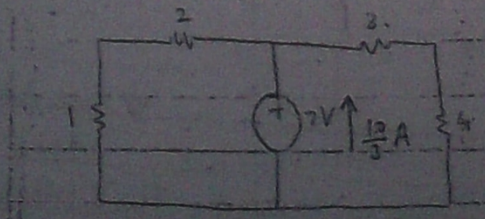
$\boxed{3.46}$ $i_{7V} = ?$



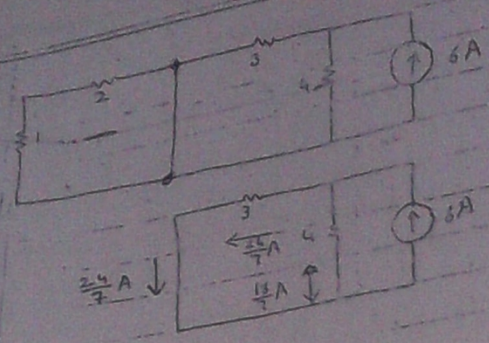




∵ as no current will flow from $(3+4)\,\Omega$



$R_{eq} = 2.1\,\Omega$

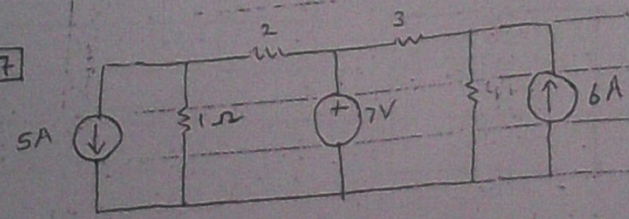


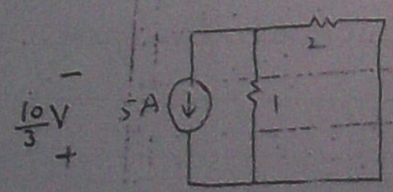
∴ as no current will flow from (1+2) Ω

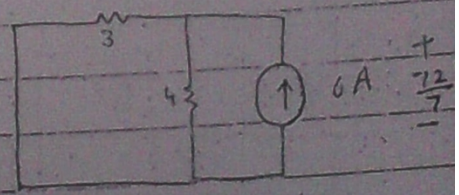
$$i_{7V} = \frac{10}{3}\,A\,(\uparrow) + \frac{5}{3}\,A\,(\uparrow) = \frac{24}{7}\,A\,(\downarrow)$$

$$\boxed{i_{7V} = \frac{11}{7}\,A\,(\uparrow)}$$

3.47

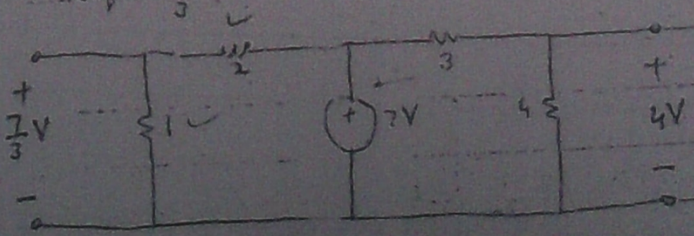






$R_{eq} = \frac{2}{3}\,\Omega$

$R_{eq} = \frac{12}{7}\,\Omega$



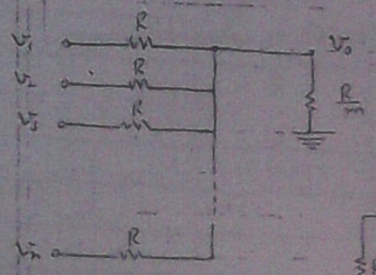
Both de power

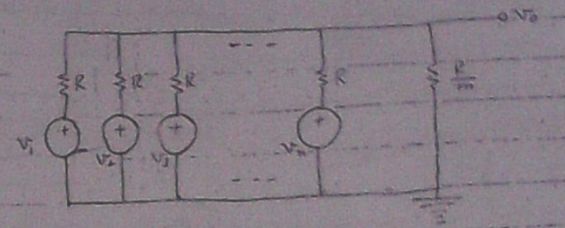
* By superposition:-

$V_{5A} = \frac{10}{3}\,V\left(\frac{-}{+}\right) - \frac{7}{3}\,V\left(\frac{+}{-}\right) = 1\,V\left(\frac{-}{+}\right) \rightarrow P_{5A} = (1)(5$

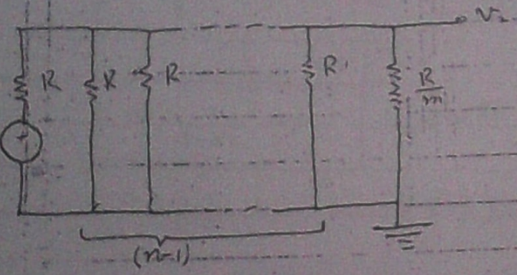
$V_{6A} = \frac{72}{7}\,V\left(\frac{+}{-}\right) + 4\,V\left(\frac{+}{-}\right) = \frac{100}{7}\,V\left(\frac{+}{-}\right) \rightarrow P_{6A} = \frac{600}{7}$

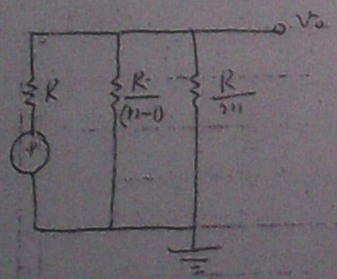
3.48 (a). Show:- $v_o = \frac{1}{m+n}(v_1 + v_2 + \cdots + v_n)$

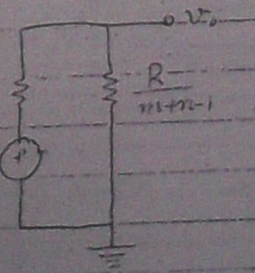




For v_1



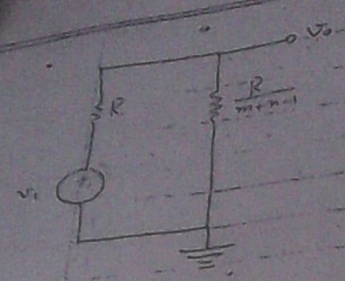




$$\frac{R}{n-1} \parallel \frac{R}{m} = \frac{(R/m)(R/n-1)}{R/m + R/n-1}$$

$$= \frac{R^2/m(n-1)}{R(m+n-1)/m(n-1)}$$

$$= \frac{R}{m+n-1}$$



$$v_0 = \frac{R/(m+n-1)}{R + \frac{R}{(m+n-1)}} \times v_1$$

For v_1 — $\boxed{v_0 = \frac{1}{m+n} v_1}$

For v_2 — $\boxed{v_0 = \frac{1}{m+n} v_2}$

For v_3 — $\boxed{v_0 = \frac{1}{m+n} v_3}$

$\vdots$

For v_n — $\boxed{v_0 = \frac{1}{m+n} v_n}$

By superposition principle :-

$$v_0 = \frac{1}{m+n}(v_1 + v_2 + v_3 + \cdots + v_n) \quad \text{--- (1)}$$

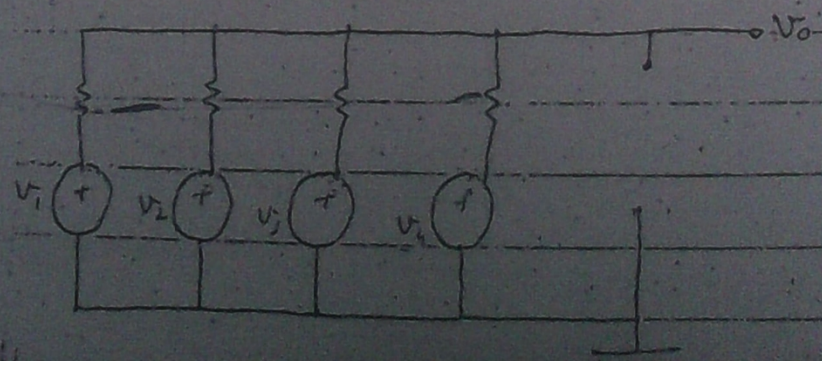
(b) Given $v_0 = \frac{1}{4}(v_1 + v_2 + v_3 + v_4)$ $\rightarrow n = 4$

$\downarrow$

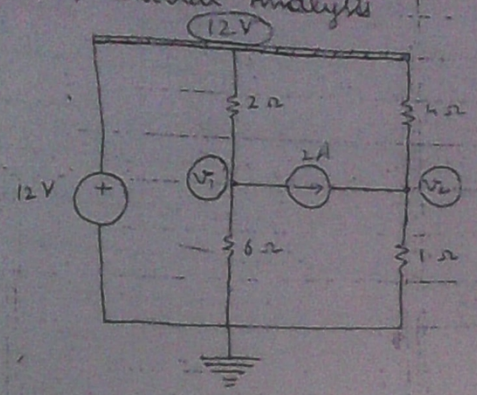
$m+n$

So, $\boxed{m = 0}$, $\boxed{n = 4}$

So, circuit will



49 (a) Nodal Analysis



KHALID PHOTO STATE
U.E.T

For v_1 : $\frac{v_1 - 12}{2} + \frac{v_1 - 0}{6} + 2 = 0$

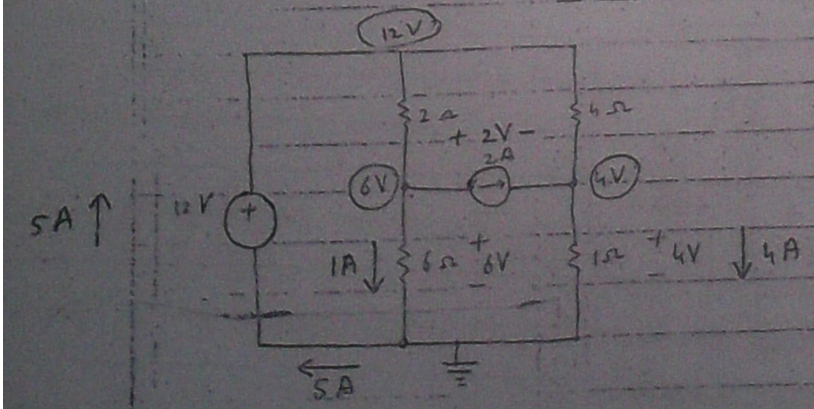
$$\boxed{v_1 = 6\,V}$$

For v_2 :

$$\frac{v_2 - 12}{4} + \frac{v_2 - 0}{1} = 2$$

$$\boxed{v_2 = 4\,V}$$

KHALID PHOTO STATE
U.E.T

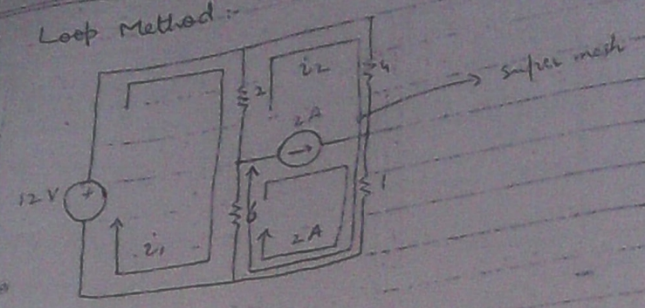


∵ Current by Ω is low

$P_{2A} = 2V(+-) \times 2A(\rightarrow) = 4W$ (absorbing)

$P_{12V} = 12V(\pm) \times 5A(\uparrow) = 60W$ (releasing)

(b) Loop Method :-



Loop I :-

$$12 = 2(i_1 - i_2) + 6(i_1 - (i_2 + 2)) \quad \text{--- (1)}$$

$$i_1 - i_2 = 3$$

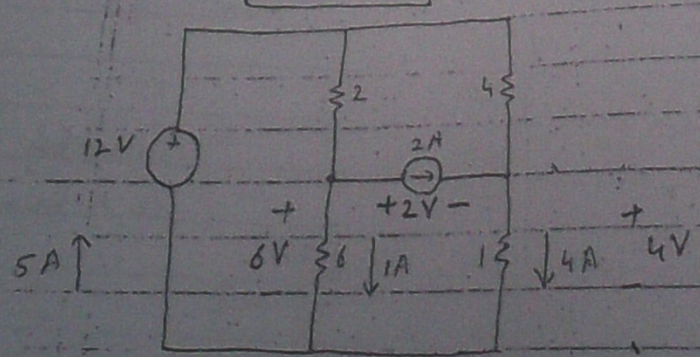
Loop II :-

$$2(i_2 - i_1) + 4i_2 + 1(i_2 + 2) + 6(i_2 + 2 - i_1) = 0$$

$$13 i_2 - 8 i_1 + 14 = 0 \quad \text{--- (2)}$$

from (1) & (2)

$$\boxed{\begin{aligned} i_1 &= 5A \\ i_2 &= 2A \end{aligned}}$$

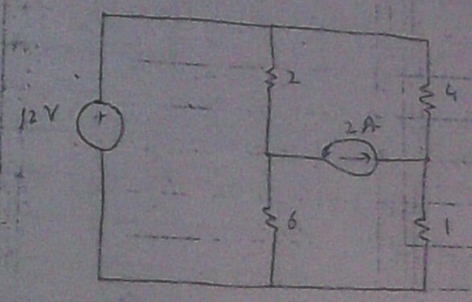


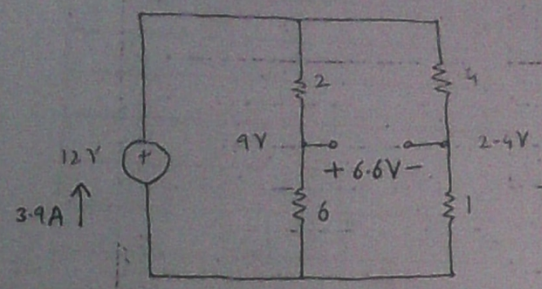
∵ voltage by Ω's law

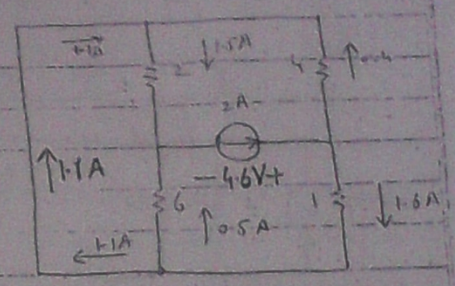
$P_{2A} = 2A\ (\rightarrow) \times 2V\ (+\ -) = 4W$ (absorbing)

$P_{12V} = 5A\ (\uparrow) \times 12V\ (\pm) = 60W$ (releasing)

(e) By Superposition :-







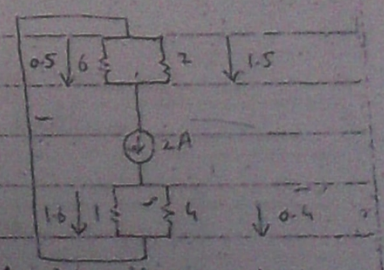
$R_{eq} = \frac{40}{13}\,\Omega$

$i = \frac{39}{10} = 3.9V$

$R_{eq} = \frac{23}{10}\,\Omega$

$v = \frac{23}{5} = 4.6\,V$

∴ The above circuit is like



∴ 1st find the branch currents. then find the actual current in the actual circuit by KCL

~~$V_{2A} = 4.6V(-+) - 6.6V(+-) = -2V(+-)$~~

~~$P_{2A} = 2A(\rightarrow) \times 4.6V(-+)$~~

★ $V_{2A} = 4.6V(-+) - 6.6V(+-) = -2V(+-)$

$P_{2A} = 2A(\rightarrow) \times -2(+-) = -4W$

$\Longrightarrow P_{2A} = 4W$ (absorbing)

★ $i_{12V} = 3.9A(\uparrow) + 1.1A(\uparrow) = 5A(\uparrow)$

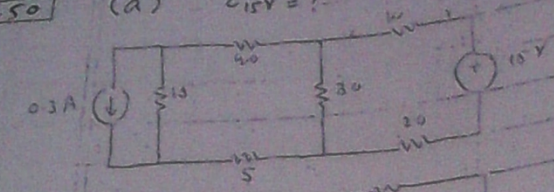
$P_{12V} = 12V(+-) \times 5A(\uparrow) = 60W$

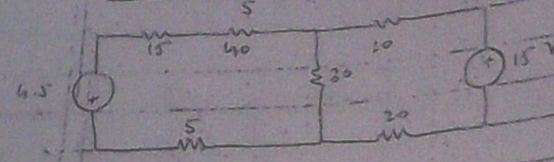
$\Longrightarrow P_{12V} = 60W$ (releasing)

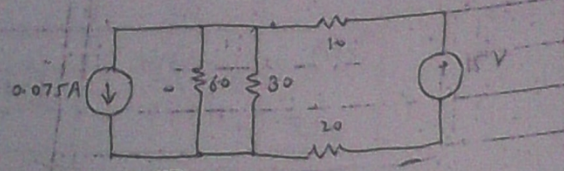
(e) is correct

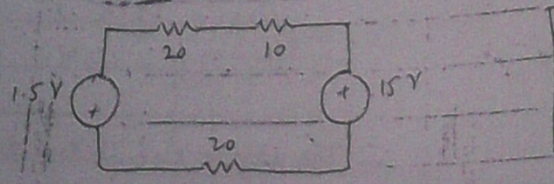
3.5 Source Transformation

3.50 (a) $i_{15V} = ?$

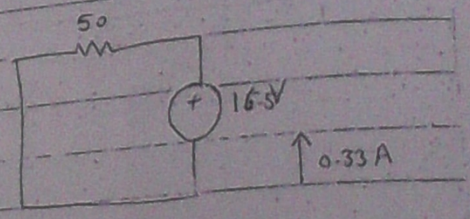








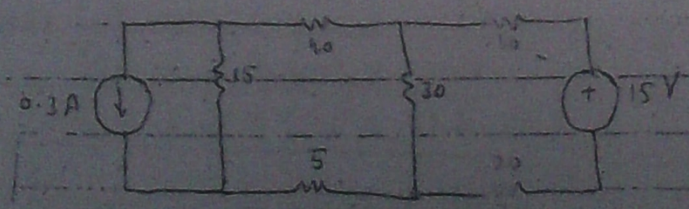
(α)

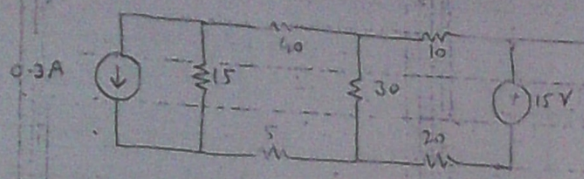


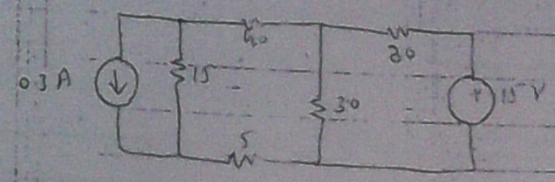
* you can apply superposition here OR the method at right side (α)

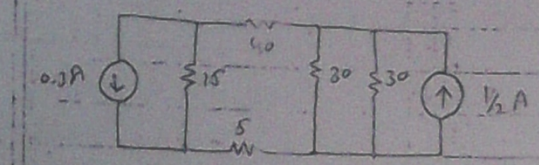
$$\boxed{i_{15V} = 0.33\,A\ (\uparrow)}$$

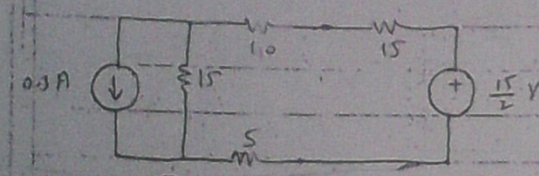
(b) $v_{0.3A} = ?$

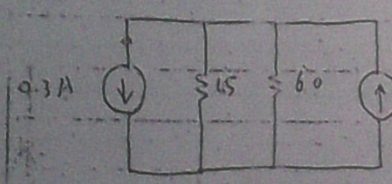


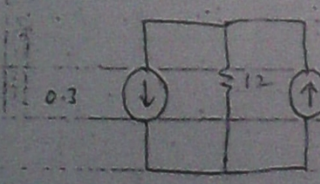




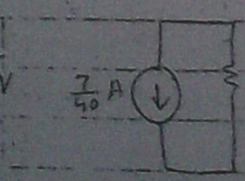






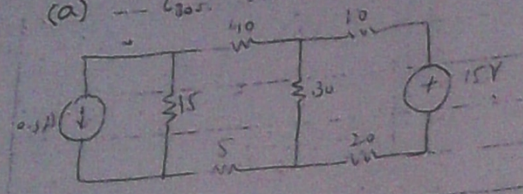


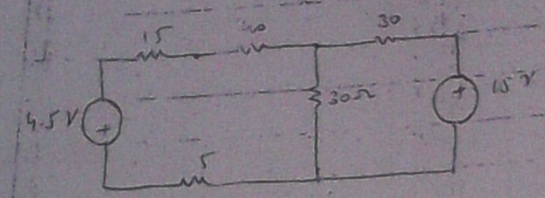
$\frac{1}{8} + 0.3$

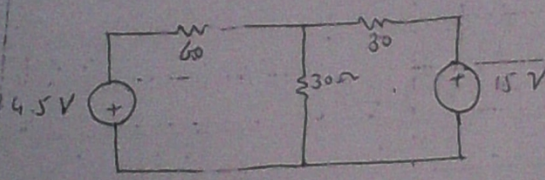


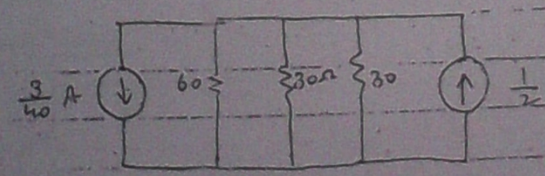
$$\boxed{V_{0.3A} = 2.1\,V \left(\frac{-}{+}\right)}$$

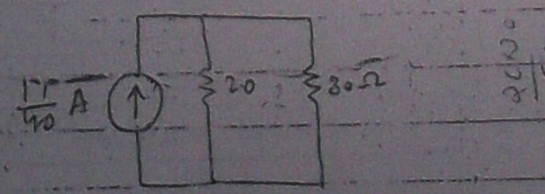
3.51 (a) — $i_{30\Omega}$







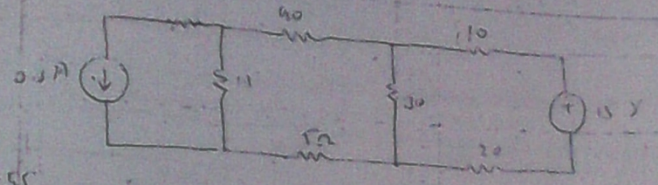




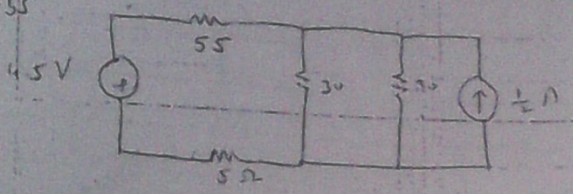
$$i_{30\Omega} = \frac{20}{50} \times \frac{17}{40} = \frac{17}{100} = 0.17\ A \downarrow$$

$$\boxed{i_{30\Omega} = 0.17\ A\ (\downarrow)}$$

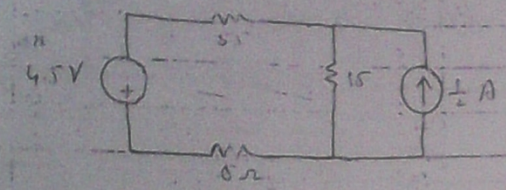
(b) $V_{5\Omega} = ?$



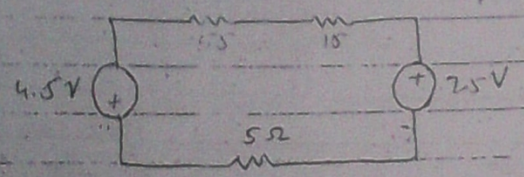
$(40+15) = 55$

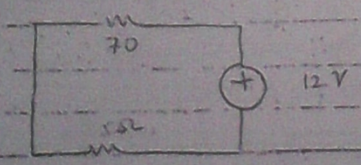


KHALID PHOTO STAT



KHALID PHOTO STAT
U.E.T





KHALID PHOTO STAT
U.E.T

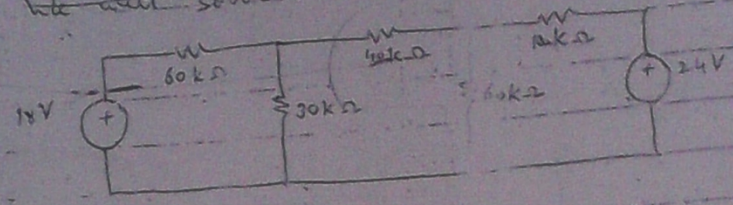
$V_{5\Omega} = \frac{5}{75} \times 12 = 0.8\,V\ (+\ -)$

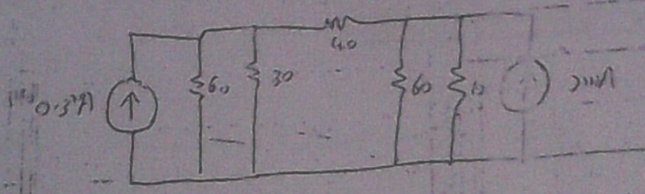
$$\boxed{V_{5\Omega} = 0.8\,V\ (+\ -)}$$

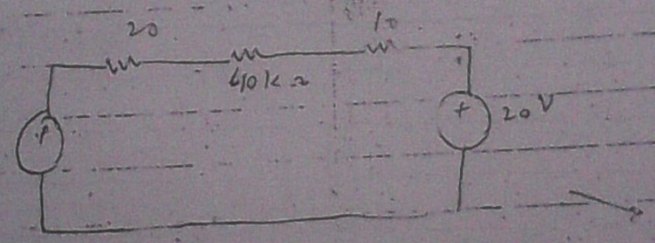
KHALID PHOTO STAT

3.52 (a) $v_{40k\Omega}$

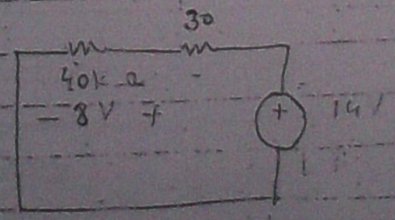
~~We will solve it with 4 Ω~~







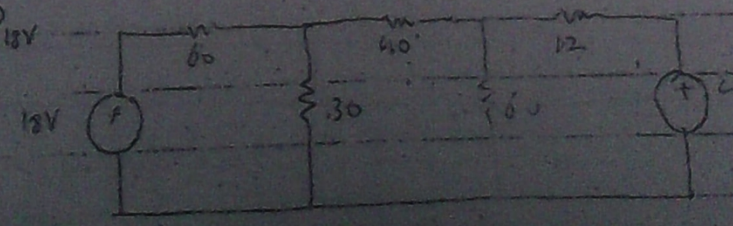
you can apply superposition here also

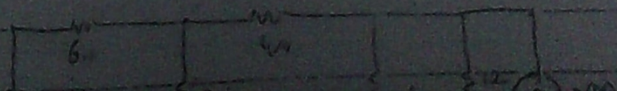


$\frac{40}{10} \times 14$

$$\boxed{v_{40k\Omega} = 8V \ (-+)}$$

(b) P_{18V}





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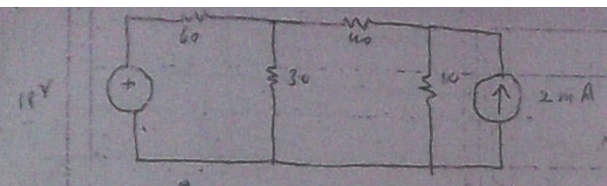
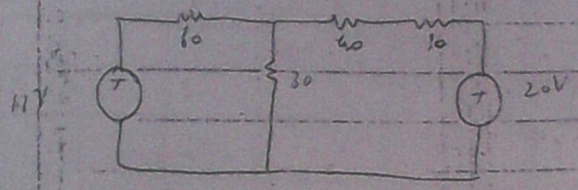
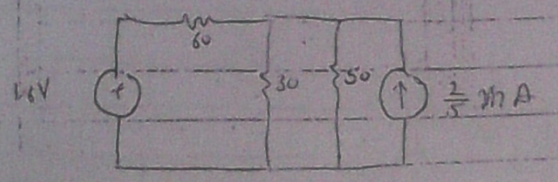
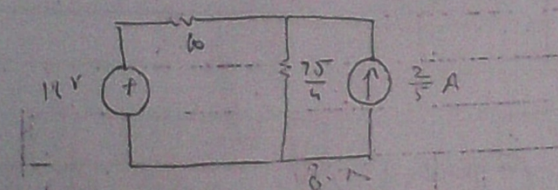
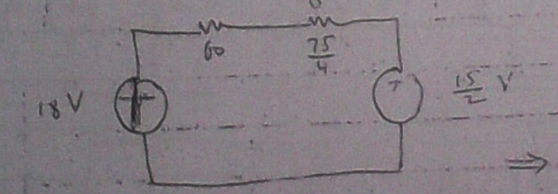
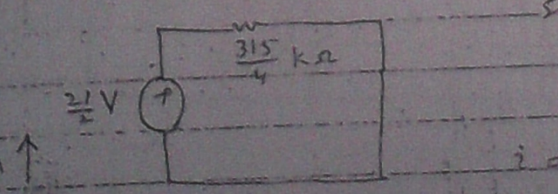












⇒ You can also apply superposition here

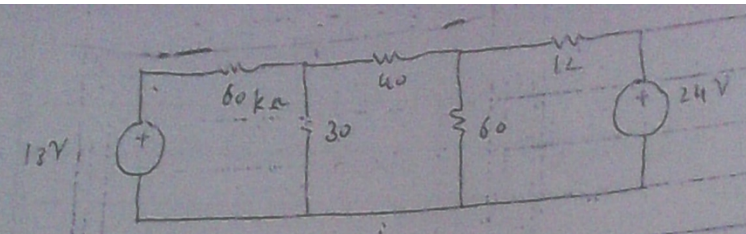
OR

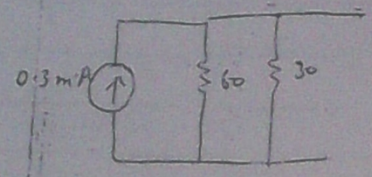
$i = \frac{V}{R} = \frac{2}{15}$

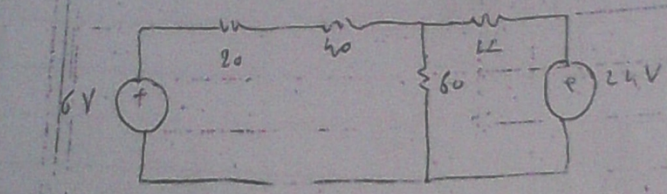
Now,

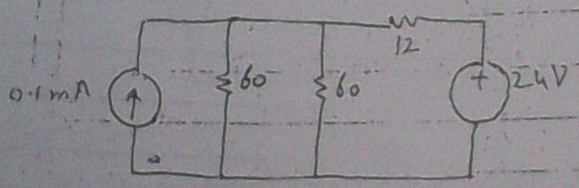
$P_{18V} = i \times 18 = \frac{2}{15} \times 18 = \frac{12}{5}$ mW

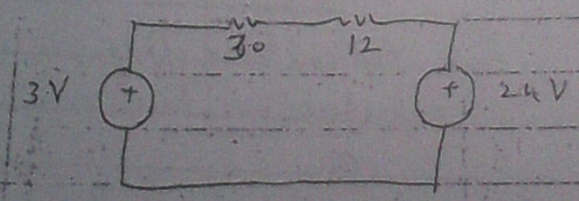
$\boxed{P_{18V} = \frac{12}{5} \text{ mW}}$ (releasing)

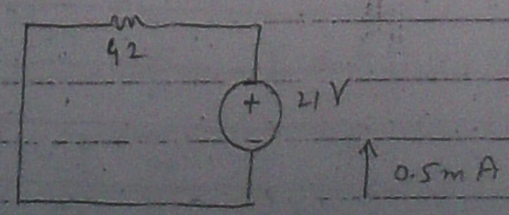






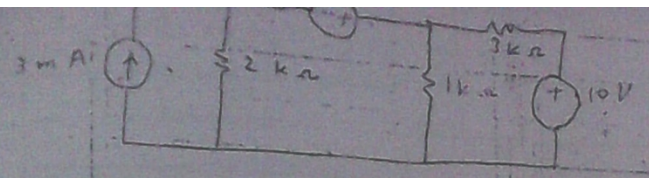


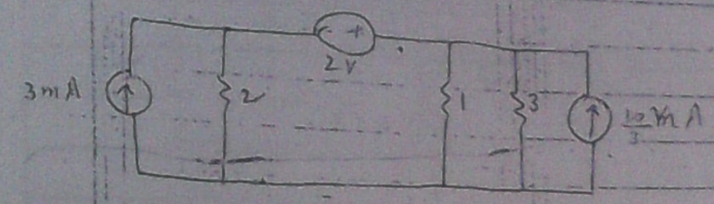


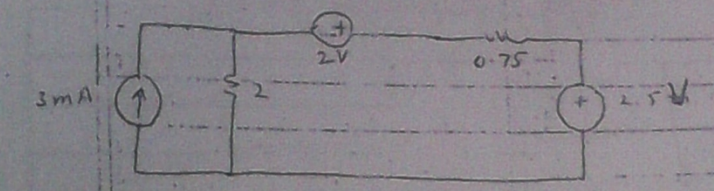


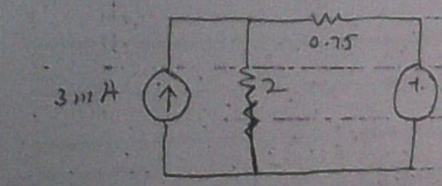
$P_{24V} = 24 \times 0.5\,m = 12\ mW$

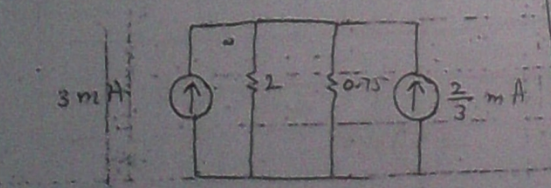
$$\boxed{P_{24V} = 12\ mW \text{ (releasing)}}$$

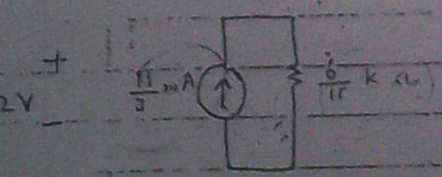


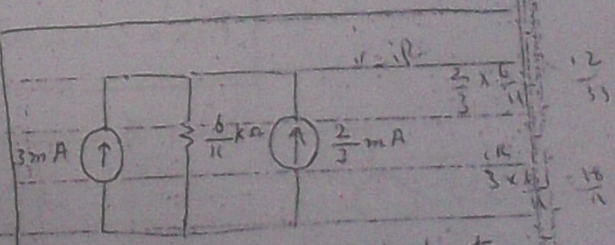












OR apply superposition

$v = iR$

$\frac{2}{3} \times \frac{6}{11}$

$\frac{12}{33}$

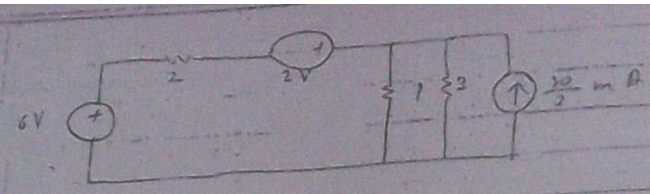
$\frac{12}{3 \times 11}$

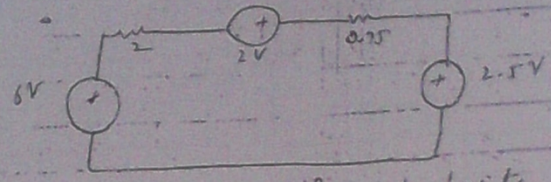
$\frac{4}{11}$

$v = iR = 2V$

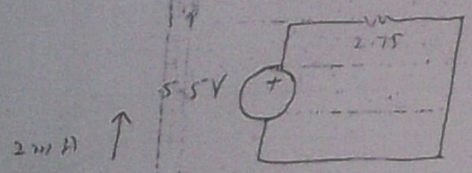
$P_{3mA} = 2 \times \frac{2}{3} = 6\ mW$

$P_{3mA} = 6\ mW$ (selecting)



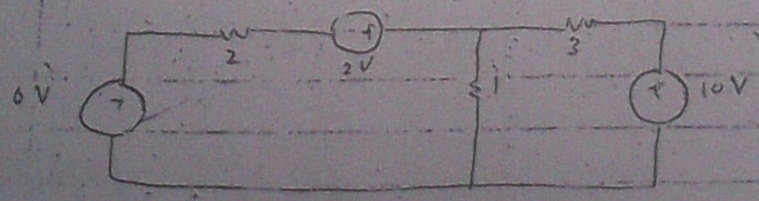


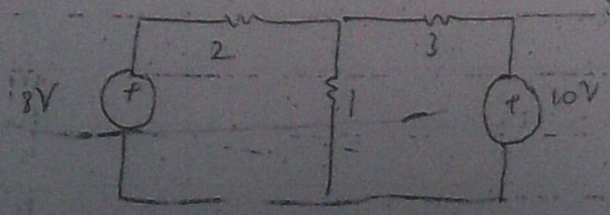
Apply superposition on

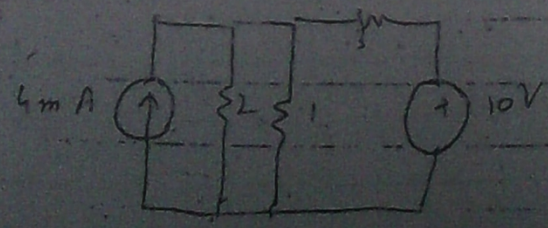


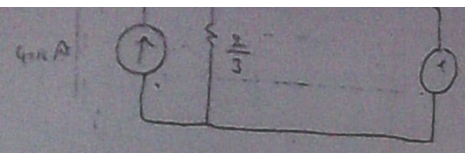
$P_{2V} = 2mA(\rightarrow) \times 2V(-+) = 4mW$

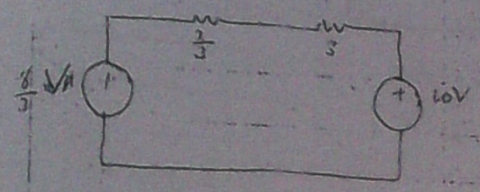
$$\boxed{P_{2V} = 4mW \text{ (absorbing)}}$$



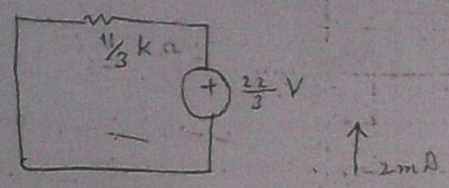






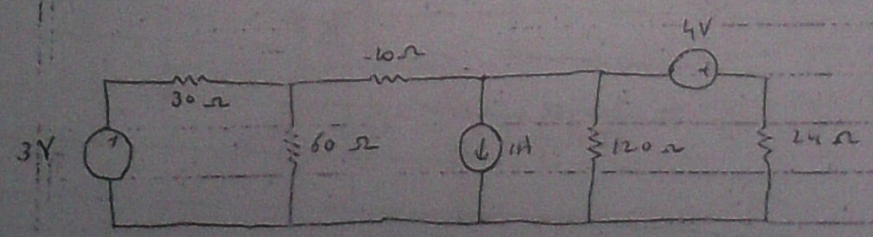


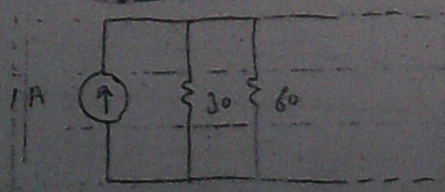
Apply superposition or

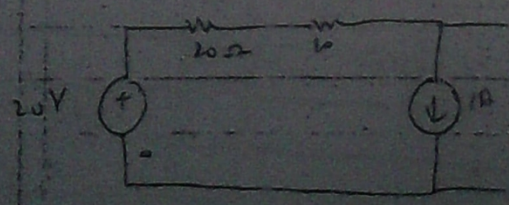


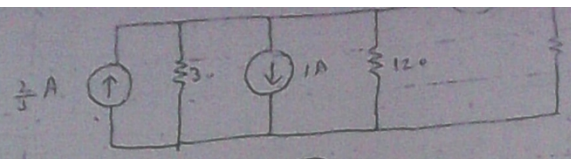
$$\boxed{P_{10V} = 2m \times 10 = 20\ mW \quad \text{(releasing)}}$$

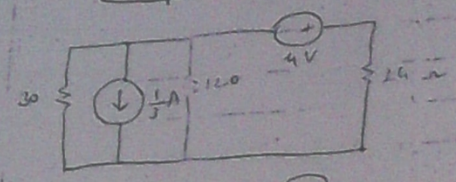
3.54 $i_{24\Omega} = ?$

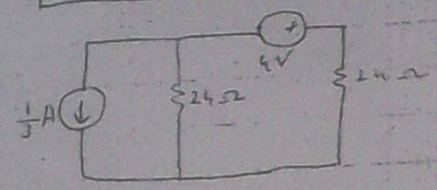


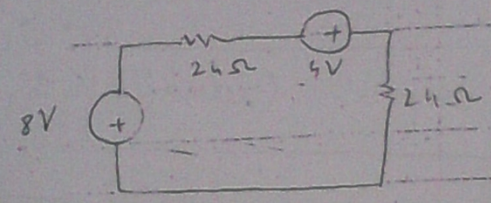


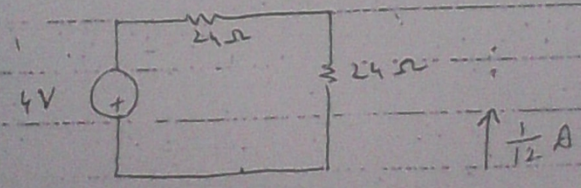








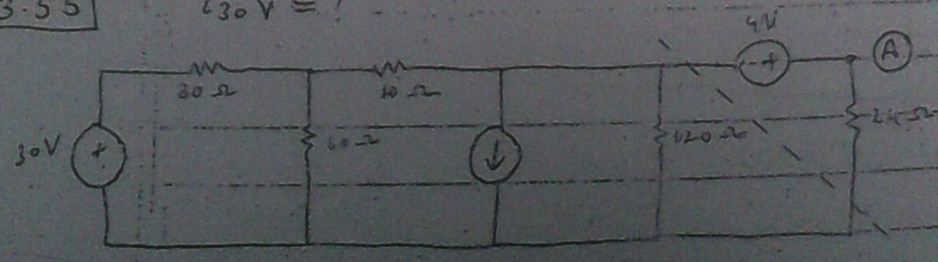


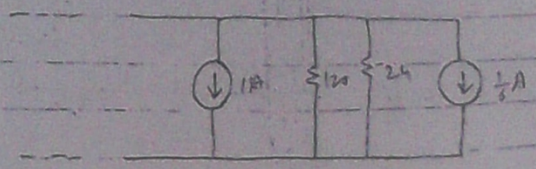


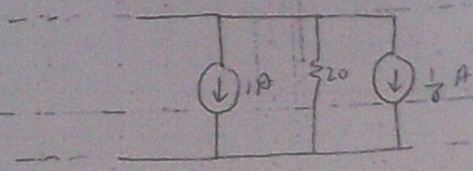
$$i = \frac{V}{R} = \frac{4}{48} = \frac{1}{12} \text{ A}$$

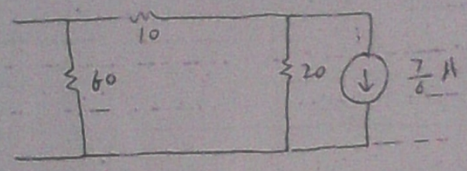
$$\boxed{i_{24\Omega} = \frac{1}{12} \text{ A} \quad (\uparrow)}$$

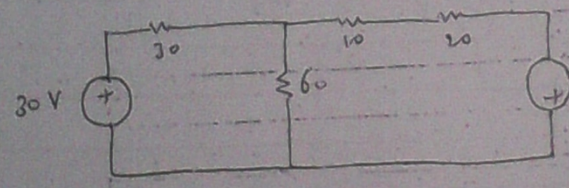
3.55 $i_{30V} = ?$

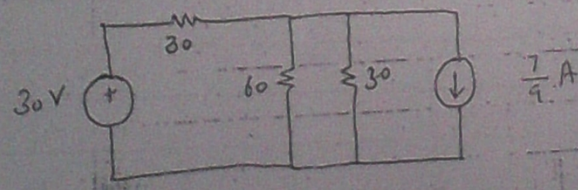


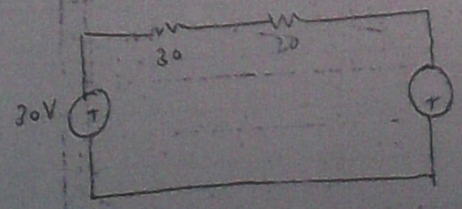


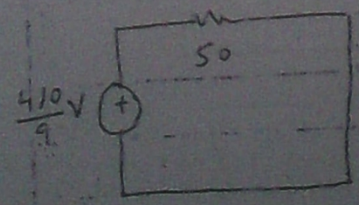












$\frac{140}{9} - 30$

$\frac{140}{9} - 270$

$\frac{140}{9} - 30$

$\frac{140}{9} + 30$

$\frac{140}{9} + 270$

$\frac{140}{9} > 30$

$V = iR$

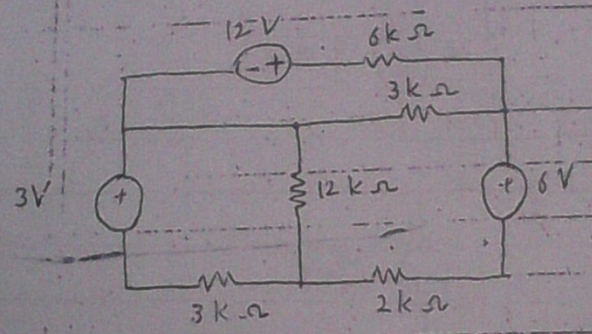
$\frac{420}{9} = i\,(50)$

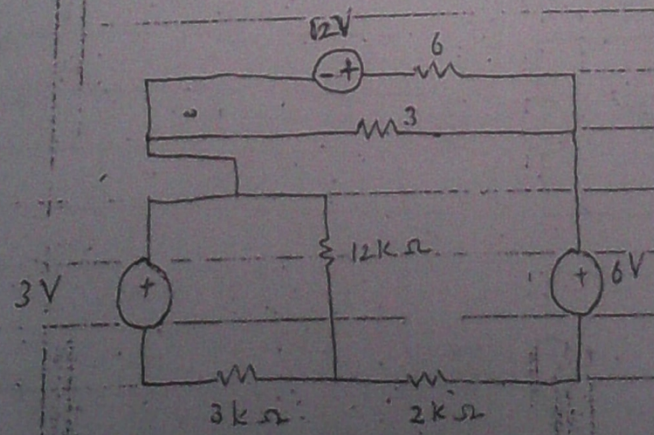
$\frac{41}{45}$ A ↑

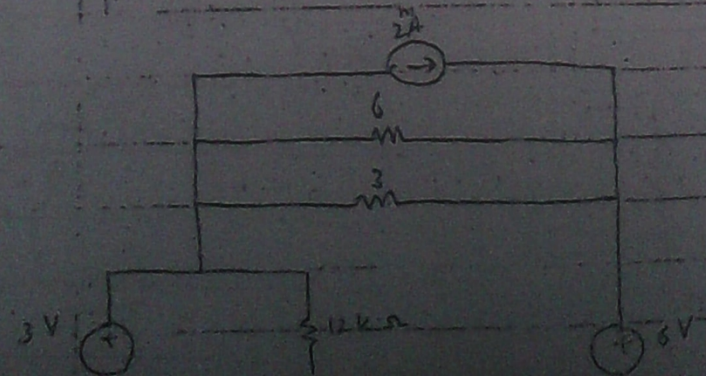
$$i = \frac{V}{R} = \frac{410/9}{50} = 41/45 \text{ A}$$

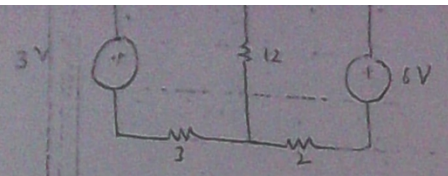
$$\boxed{i_{30V} = \frac{41}{45} \text{ A } (\uparrow)}$$

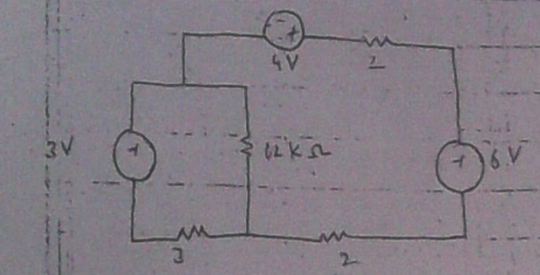
3.56 $P_{12k\Omega} = ?$

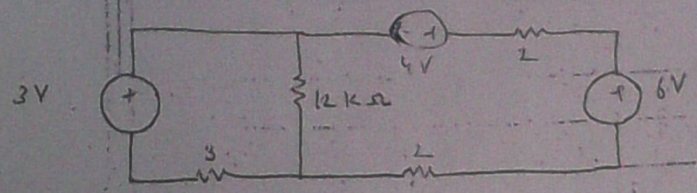




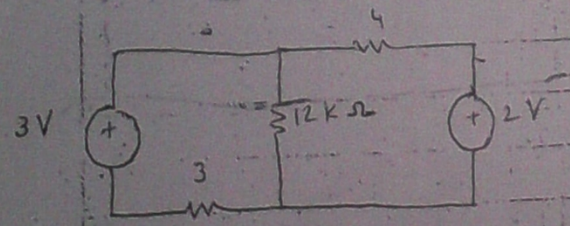


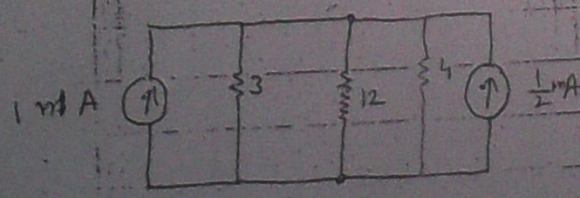




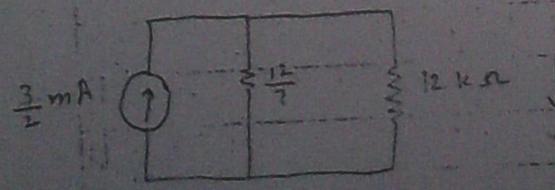


$\because 6 > 4$





$\because 1 > \frac{1}{2}$



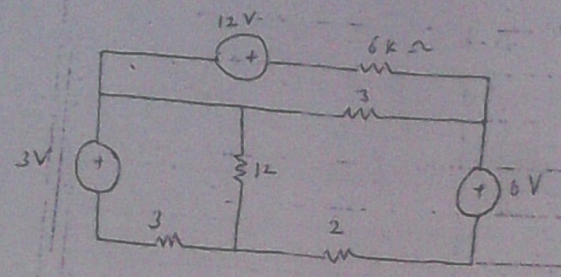
By current divider

$P_{12K\Omega} = i_{12K\Omega}^2 \, R = \left(\frac{3}{14}m\right)^2 (12K) = 0.42\,mW$

Answer has been varified and it is correct

3.57

$P_{12V} = ?$



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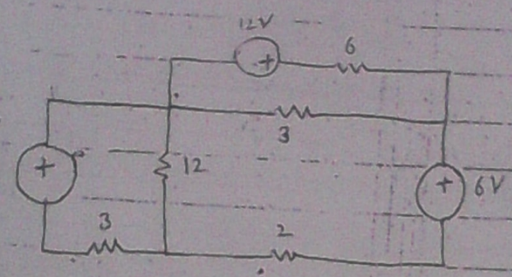

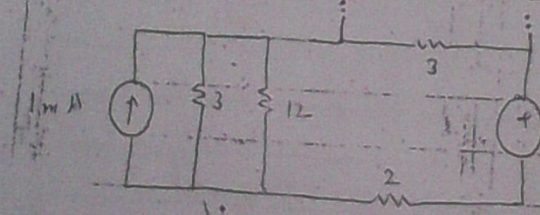

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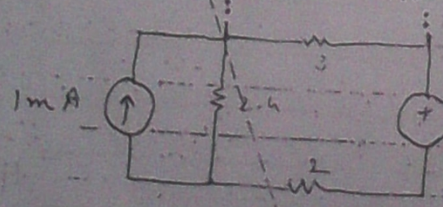

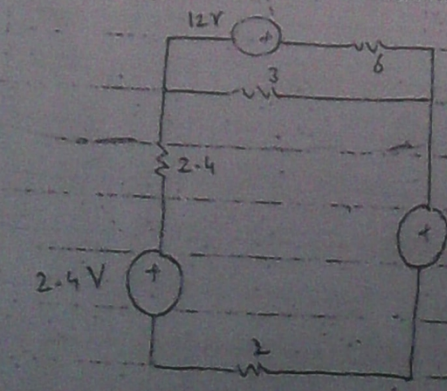

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