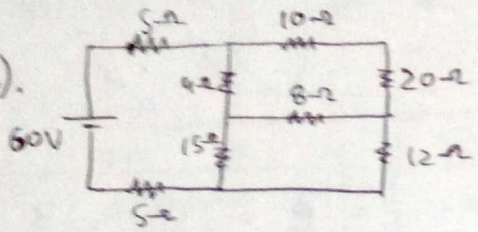
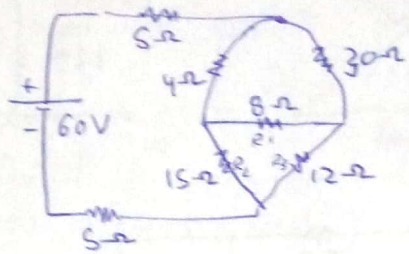
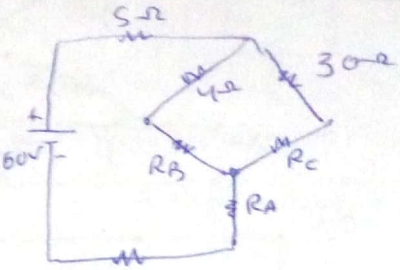
ELECTRICAL SCIENCE ASSIGNMENT - 02

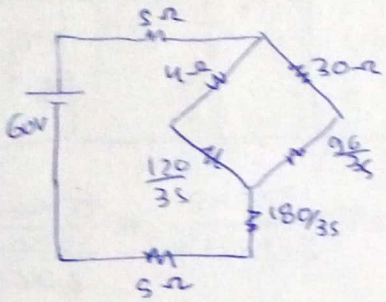
1).

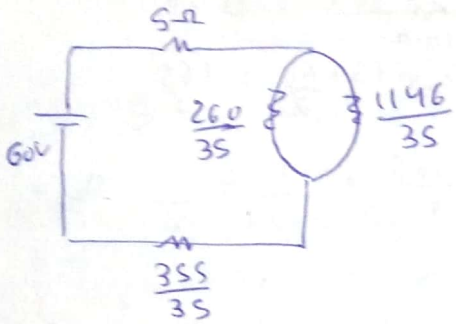


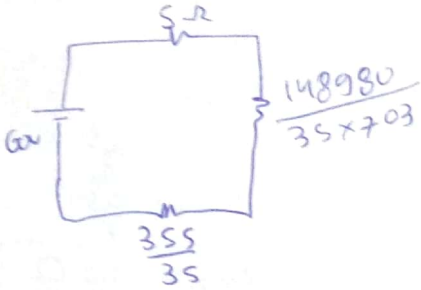




$R_A = \frac{15\times12}{15+12+8} = \frac{180}{35}$ $\quad R_B = \frac{15\times8}{15+12+8} = \frac{120}{35}$ $\quad R_C = \frac{12\times8}{15+12+8} = \frac{96}{35}$

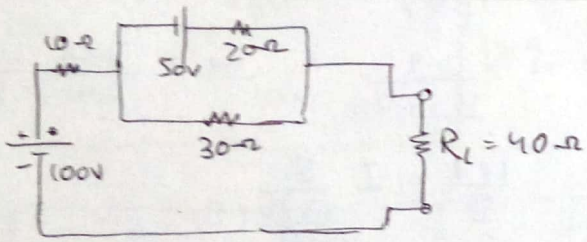


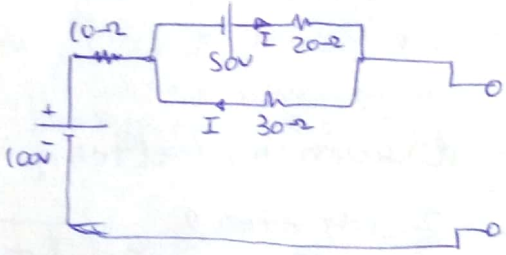




$R_{eq} = \frac{14902}{703}\ \Omega$ $\quad I = \frac{60\times703}{14902} = 2.8309$

2).





$50 = I(30+20)$ $\quad I = 1A$

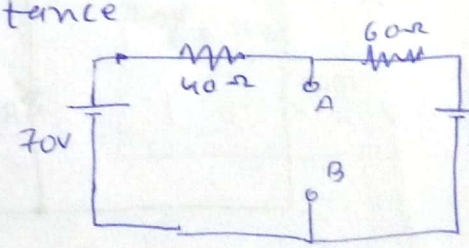
$V_{oc} = 100 + 50 - 20(1) = 130$ $\quad V_{oc} = 130V$

$R_{th} = 10 + \frac{20\times30}{50} = 22\Omega$ $\quad R_{th} = 22\Omega$

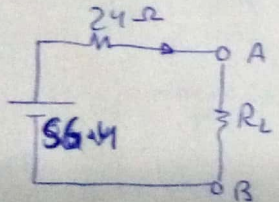
3). Let us take 90Ω & 180Ω, both as load resistance

~~Voltage~~ $I = \frac{70-36}{40+60} = 0.34$

Voltage across AB $= 70 - (40\times0.34) = 56.4V$

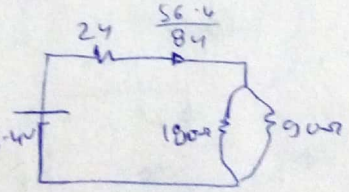


Thevenin's equivalent circuit



$R_L = 60\Omega = \frac{90\times180}{270}$

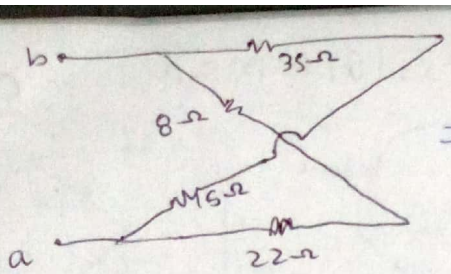
$I = \frac{56.4}{84}$

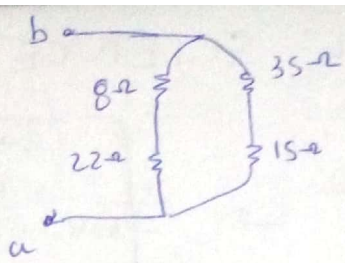


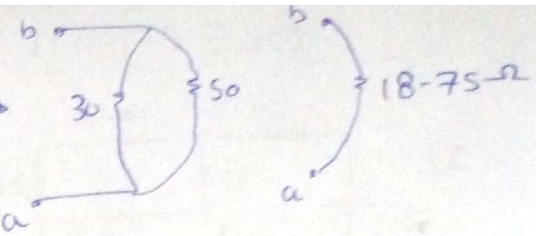
Current through 90Ω resistor is $= \frac{56.4}{84}\times\frac{180}{270}$

$I_{90\Omega} = 0.448$

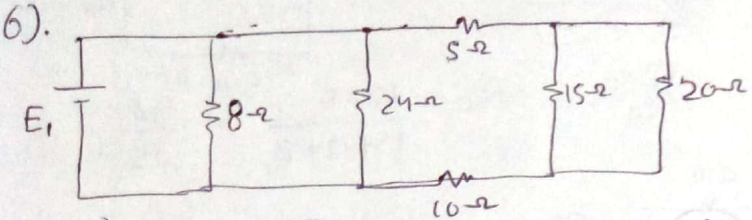
5).



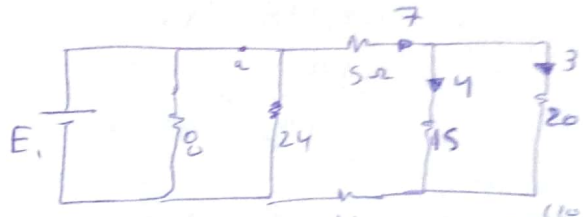




6).



$P = I^2R \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{180}{20}} = 3$



$R_1 = \frac{25 \times 20}{357} = \frac{60}{7} \qquad R_2 = 15 + \frac{60}{7} = \frac{165}{7}$

$R_3 = \frac{24 \times \frac{165}{7}}{24 + \frac{165}{7}} = \frac{24 \times 165}{333} = \frac{1320}{111}$

$R_{eq} = \frac{\frac{1320}{111} \times 8}{\frac{1320}{111} + 8} = \frac{1320 \times 8}{999 + 1320} = \frac{8 \times 1320}{2208} = \frac{110}{23}$

$R_{eq} = \frac{110}{23}$

we know that 20Ω have 3 Amp

Current in 5Ω be (x), then $3 = x \times \frac{153}{357}$ $(x = 7)$

current at point a (x') $\quad 7 = x' \times \frac{24}{\frac{165}{7} + 24} \qquad x' = \frac{333}{24} \frac{114}{8}$

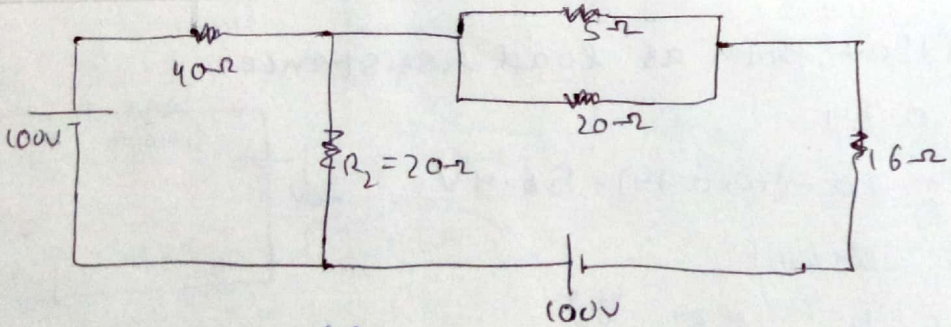
Current drawn by battery I $\quad \frac{114}{8} = I \frac{8}{\frac{1320}{111} + 8}$

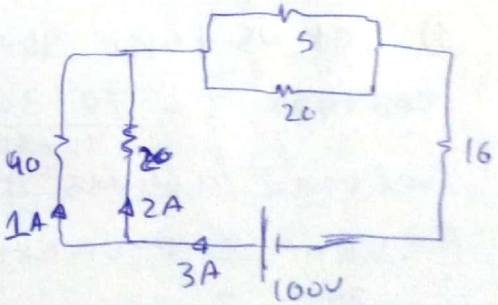
$I = \frac{2208}{8 \times 999} 27669 \Rightarrow I = \frac{69}{2}$

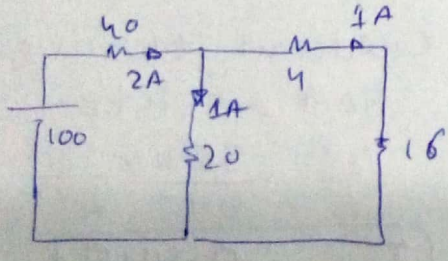
$E = \frac{69}{2} \times \frac{110}{23} = 165$

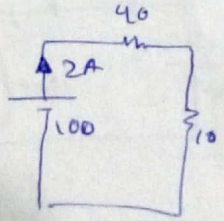
$E = 165\ V$

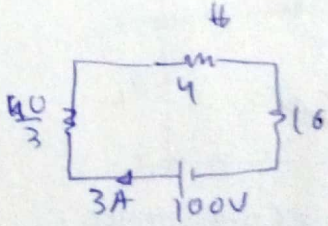
7).









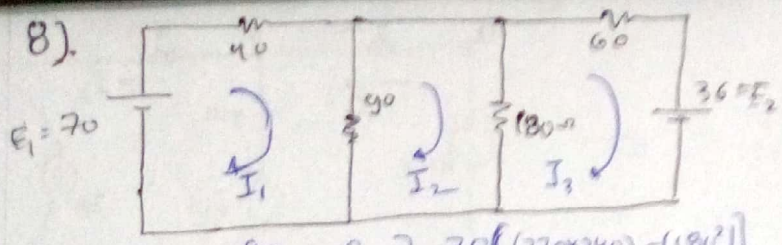


$R = \frac{10}{3}$

Current through $R_2 = 2 - 1 = 1$

$I_{R_2} = 1\ A$

8).



$$\begin{bmatrix} 130 & -90 & 0 \\ -90 & 270 & -180 \\ 0 & -180 & 240 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 70 \\ 0 \\ -36 \end{bmatrix}$$

$$\Delta_0 = 130[(270\times240)-(180)^2] + 90[(-90\times240)] + 0$$

$$\Delta_0 = 2268000$$

$$\Delta_1 = \begin{bmatrix} 70 & -90 & 0 \\ 0 & 270 & -180 \\ -36 & -180 & 240 \end{bmatrix} = 70[(270\times240)-(180^2)] + 90(-180\times36) = 1684800 = \Delta_1$$

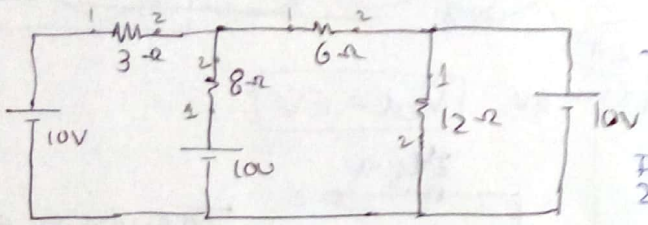
$$\Delta_2 = \begin{bmatrix} 130 & 70 & 0 \\ -90 & 0 & -180 \\ 0 & -36 & 240 \end{bmatrix} = 130(-36\times180) + 70(240\times90) = 669600 = \Delta_2$$

$$I_1 = \frac{\Delta_1}{\Delta_0} = \frac{1684800}{2268000} = 0.7428 \qquad I_2 = \frac{\Delta_2}{\Delta_0} = \frac{669600}{2268000} = 0.2952$$

Current through 90Ω is $I_1 - I_2 = 0.7428 - 0.2952 = 0.4476$

$$I_{90\Omega} = 0.448 \text{ Amp}$$

4).



Take clockwise current as +ve

If current flow from 1 to 2, then direction is +ve.

If current flows from 2 to 1, then direction is -ve.

$$I_3 = -\frac{6}{9} + \frac{11}{9} - \frac{8}{9}$$

$$I_6 = \frac{3}{9} + \frac{8}{9} - \frac{11}{9}$$

$$I_8 = 1 + \frac{2}{3} - \frac{1}{3}$$

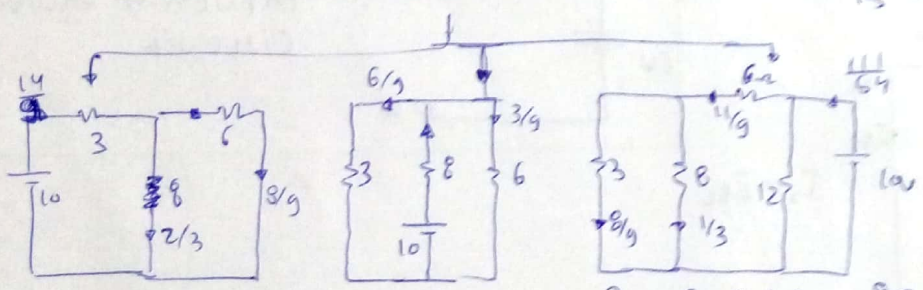
$$I_{12} = 0 + 0 + \frac{15}{18}$$

$I_3 = 0$

$I_6 = 0$

$I_8 = 0$

$I_{12} = 0.835A$



$$Req = \frac{8\times6}{14} + 3$$

$$Req = \frac{45}{7}$$

$$I_{\text{through battery}} = \frac{14}{9} A$$

$$Req = \frac{3\times6}{9} + 8$$

$$Req = 10\Omega$$

$$I = 1A$$

$$R_1 = \frac{8\times3}{11} + 6 = \frac{90}{11}$$

$$Req = \frac{\frac{90}{11}\times12}{\frac{90}{11}+12} = \frac{1080}{222}$$

$$Req = \frac{540}{111}$$

$$I = \frac{111}{54} A$$

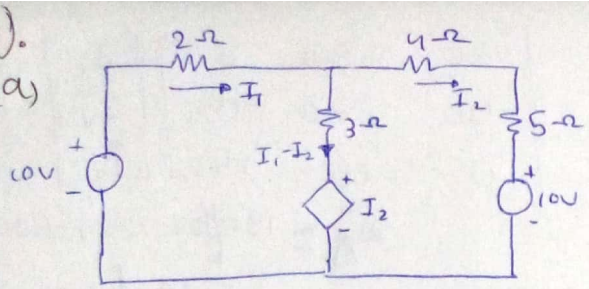
$$I_{12\Omega} = \frac{111}{54} \times \frac{\frac{90}{11}}{12+\frac{90}{11}}$$

$$= \frac{111}{54} \times \frac{90}{222} = \frac{15}{18}$$

$$I_{12} = \frac{15}{18} = 0.835A$$

9).

(a)



$10 - 2I_1 - 3(I_1 - I_2) - I_2 = 0$

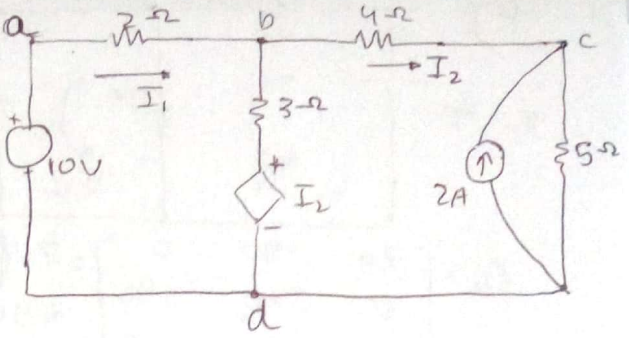
$10 = 5I_1 - 2I_2$ —— (i)

$I_2 + 3(I_1 - I_2) - 9I_2 - 10 = 0$

$10 = 3I_1 - 11I_2$ —— (ii)

$-2I_1 + 9I_2 = 0 \quad I_2 = \frac{-2}{9} I_1$ —— (iii)

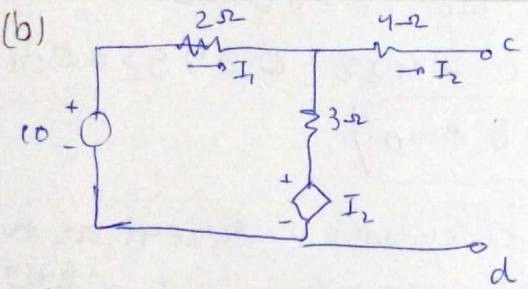
⇐



Putting value of I_2 in eq (i), we get $10 = 5I_1 + \frac{4}{9} I_1 = \frac{49}{9} I_1$

$$I_1 = \frac{90}{49} A$$

(b)



In this case $I_2 = 0$, then

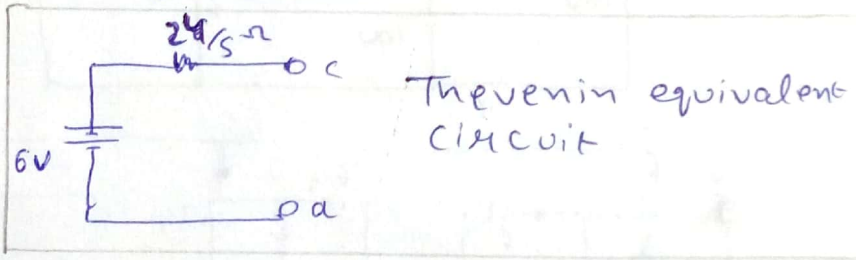
~~thevenin equivalent circuits is resistance~~

~~$R_{eq} = \frac{3 \times 2}{3+2} + 4 = \frac{6}{5} + 4 = \frac{26}{5} = R_{th}$~~

$I_1 = 2A$

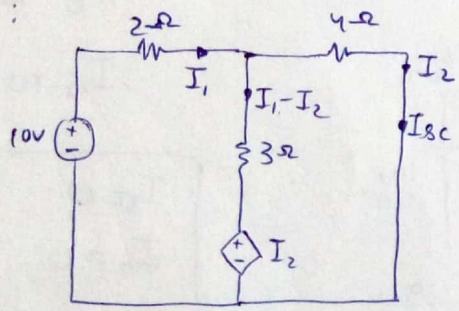
Voltage across cd ⇒ $10 - 2(2) = 6V$ $\quad V_{cd} = 6V$

~~thevenin~~ eq circuit



Thevenin equivalent circuit

Rth:



$I_2 = I_{sc}$

$10 - 2I_1 - 3(I_1 - I_2) - I_2 = 0$ —— (i)

$I_2 + 3(I_1 - I_2) - 4I_2 = 0$ —— (ii)

$10 = 5I_1 - 2I_2$

$0 = -3I_1 + 6I_2$

On solving $\boxed{I_2 = \frac{5}{4}}$

$$R_{th} = \frac{6}{5/4} = \frac{24}{5} \Omega$$