Assignment 2

Department of Electrical & Computer Engineering

North South University

Submitted By

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Course: Electrical Circuits (EEE141)

Section: 05

Faculty Advisor

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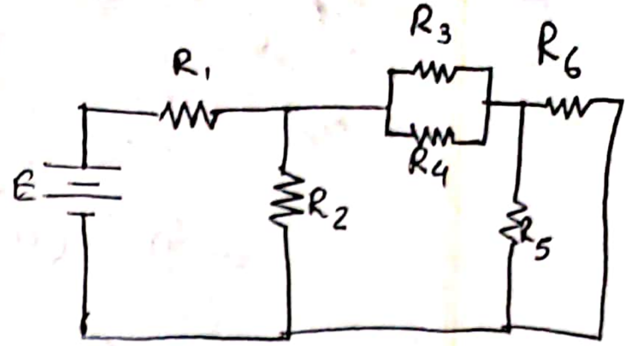
Problem: 6·2

2 (a) Here R_3 & R_4 are in parallel. Then, R_6 & R_5 are in parallel.



(b) Here, E, R_1 & R_2 are in series.

3 (a) $R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{9.1 \times 18}{9.1 + 18} = 6.044\,\Omega$

(b) $\frac{1}{R_T} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3}$.

$= \frac{6 + 3 + 2}{6} = \frac{11}{6}$

$\therefore R_T = \frac{6}{11} = 0.54\,k\Omega$

(c) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{100} + \frac{1}{1 \times 10^3} + \frac{1}{10 \times 10^3}$

$\therefore \frac{1}{R_T} = \frac{111}{10000}\,\Omega$.

$\therefore R_T = \frac{10000}{111} = 90.09\,\Omega$.

(d) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

$= \frac{1}{18k\Omega} + \frac{1}{18k\Omega} + \frac{1}{18k\Omega} + \frac{1}{6\times10^3 k\Omega}$

$= \frac{1001}{6000} k\Omega$.

$\therefore R_T = \frac{6000}{1001} = 5.994 k\Omega$.

(e) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6}$

$= \frac{1}{22} + \frac{1}{10} + \frac{1}{22} + \frac{1}{10} + \frac{1}{22} + \frac{1}{22}$

$= \frac{1}{22}(4) + \left(\frac{1}{10} \times 2\right)$.

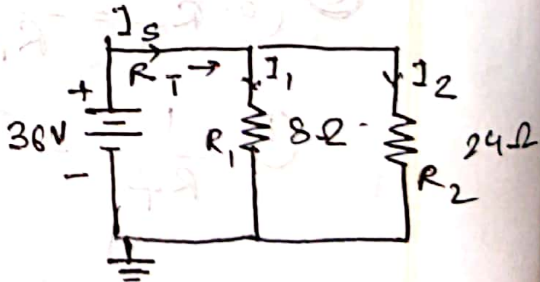
$= \frac{4}{22} + \frac{2}{10} = 0.3818\,\Omega$.

Section 6.3.

(10) (a) For Parallel R_1 & R_2.

$R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{8\times24}{8+24}\,\Omega$.

$= 6\,\Omega$.



(b) As it is a parallel circuit, so voltage across each branch would be same as source voltage 36V.

(c) Here, $I_1 = \frac{V}{R_1} = \frac{36}{8} = 4.5\,A$.

$I_2 = \frac{V}{R_2} = \frac{36}{24} = 1.5\,A$

$\therefore I_s = I_1 + I_2 = (4.5 + 1.5)\,A = 6\,A$.

(d) Here,

$$I_s = \frac{V}{R_T} = \frac{36}{6} A = 6A = I_1 + I_2$$

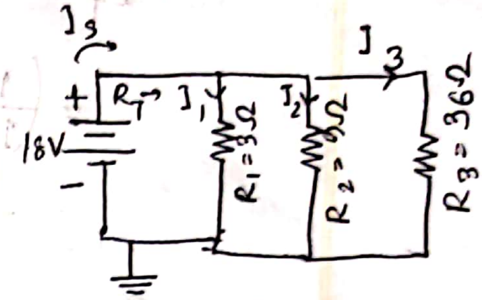
(11) (a)

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$= \left(\frac{1}{3} + \frac{1}{9} + \frac{1}{36}\right) \Omega$$

$$= \frac{17}{36}$$

$$\therefore R_T = \frac{36}{17} = 2.12 \Omega.$$



(b) As, it is a parallel circuit, so voltage in each branch would same as source voltage 18V.

(c) Source current, $I_s = \frac{E}{R_T} = \frac{18}{2.12} A$.

$$= 8.49 A.$$

$$I_1 = \frac{V}{R_1} = \frac{18}{3} = 6A.$$

$$I_2 = \frac{V}{R_2} = \frac{18}{9} = 2A.$$

$$I_3 = \frac{V}{R_3} = \frac{18}{36} = 0.5A.$$

(d) Here, $I_1 + I_2 + I_3 = (6 + 2 + 0.5) A$

$$= 8.5 A.$$

$$I_s = 8.49 A \approx 8.5 A.$$

So, $I_1 + I_2 + I_3 = I_s$ [Verified]

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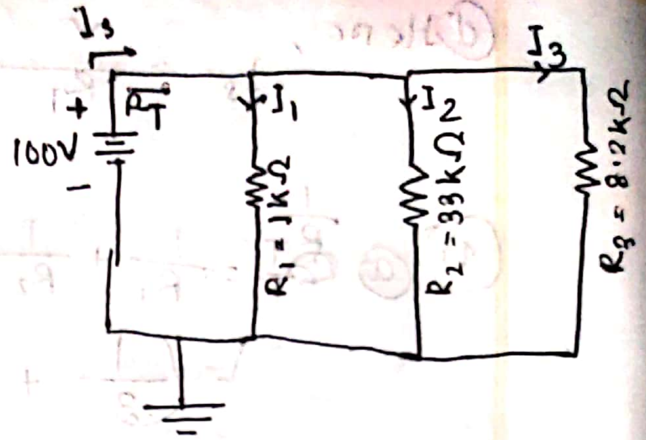
Section : 6.4

(10) (a) Here,



$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$= \left(\frac{1}{1} + \frac{1}{33} + \frac{1}{8.2}\right) k\Omega.$$

$$= \frac{1559}{1353} k\Omega.$$

$$\therefore R_T = 0.868 k\Omega$$

Here, $E = V_1 = V_2 = V_3 = 100V$

So, $I_1 = \frac{E}{R_1} = \frac{100V}{1k\Omega} = 100mA.$

$I_2 = \frac{E}{R_2} = \frac{100V}{33k\Omega} = 3.03 mA.$

$I_3 = \frac{E}{R_3} = \frac{100V}{8.2k\Omega} = 12.195 mA.$

(b) As per law, Power, $P = VI$.

So, Power across, R_1 = $P_{R_1} = V_{R_1} \cdot I_{R_1} = (100V)(100mA)$.
$= 10$ Watt.

$P_{R_2} = V_{R_2} \cdot I_{R_2} = (100V)(3.03mA) = 303 mW = 0.30W$

$P_{R_3} = V_{R_3} \cdot I_{R_3} = (100V)(12.195mA) = 1219.5 mW$
$= 1.22 W.$

ⓒ $P_{source} = (E)(I_s)$

Here, $I_s = \frac{E}{R_T} = \frac{100V}{0.868k\Omega}$ = ~~0.1158A~~ ~~115~~ 115.21 mA

So, $P_{source} = (100V)(115.21 mA)$

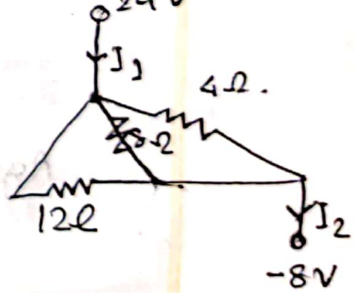
$= 11520.74 \, mW = 11.52 W$.

ⓓ $P_{R_1} + P_{R_2} + P_{R_3} = (10 + 0.3 + 1.22) W$

$= 11.52 W = P_{source}$ [Compared].

ⓔ Here, Resistor P_{R_1} received most power. As, it has the lowest resistance in this path current was maximum. Thus, it received most power.

(23) ⓐ Here, 8 Ω & 12 Ω are Parallel.



So, $\frac{1}{R_{(8+12)}} = \frac{1}{8} + \frac{1}{12}$

$\therefore \frac{1}{R_{(8+12)}} = \frac{5}{24}$

$\therefore R_{(8+12)} = 4.8$.

Again, 4 Ω is parallel with this 4.8 Ω.

So, $\frac{1}{R_{(4\|4.8)}} = \frac{1}{4} + \frac{1}{4.8} = \frac{11}{24}$

$\therefore R_{(4\|4.8)} = 2.182 \Omega$.

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Here, Total Voltage, $V = 24 - (-8) = 24 + 8 = 32V$.

$\therefore I_1 = \frac{V}{R_T} = \frac{32}{2.182} = 14.67\ A$.

(b) Power of 4Ω resistor $= \frac{V^2}{R} = \frac{(32)^2}{4} = 256\Omega$.

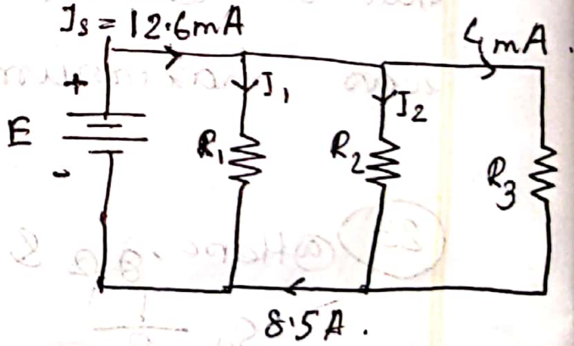
(c) ~~Here~~ As there is only one path for output current.
So, output current = input current.
So, $I_2 = I_1 = 14.67A$.

Section: 6.5

(24) Here, $I_1 = I_S - 8.5\ mA$

$= 12.6 - 8.5\ mA$

$= 4.1\ mA$.



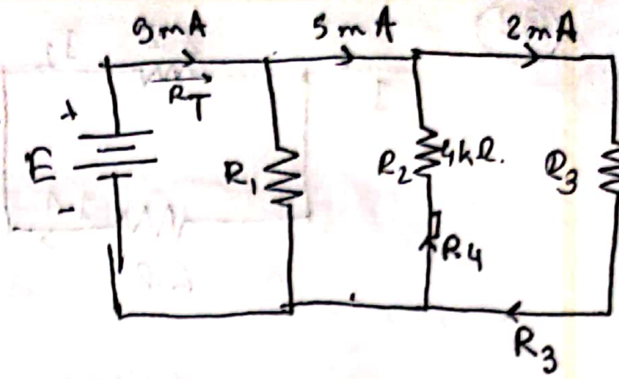
Again, $I_S = I_1 + I_2 + 4\ mA$

$12.6 = 4.1 + I_2 + 4$

$\therefore I_2 = (12.6 - 4.1 - 4)\ mA = 4.5\ mA$.

(27) Here,

$I_{R_4} = 5mA - 2mA = 3mA.$



$E = V_{R_2} = (3mA)(4k\Omega)$

$= 12V.$

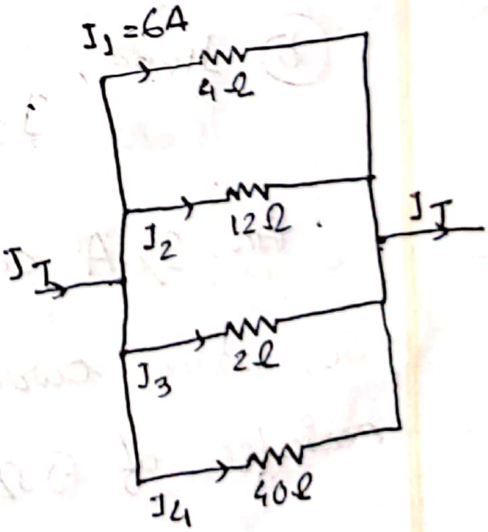
$R_1 = \frac{V_{R_1}}{I_{R_1}} = \frac{12V}{(9-5)mA} = \frac{12V}{4mA} = 3k\Omega.$

$R_3 = \frac{V_{R_3}}{I_{R_3}} = \frac{12V}{2mA} = 6k\Omega$

$R_T = \frac{E}{I_T} = \frac{12V}{9mA} = 1.33k\Omega.$

Section: 6.6.

(29) Here,



$I_2 = \frac{4\Omega}{12\Omega} \times I_1 = \frac{1}{3} I_1 = \frac{1}{3} \times 6 = 2A.$

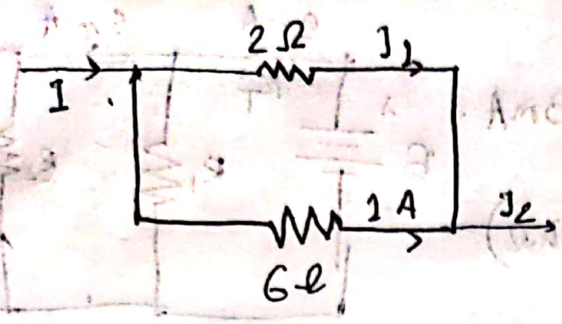
$I_3 = \frac{4}{2} I_1 = 2I_1 = 12A.$

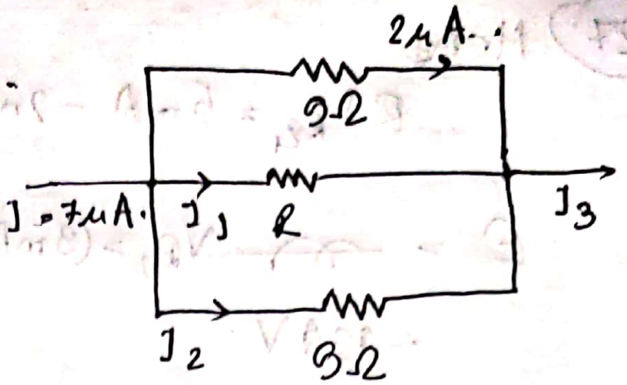
$I_4 = \frac{4}{40} I_1 = \frac{1}{10} I_1 = 0.6A$

$I_T = I_1 + I_2 + I_3 + I_4$

$= (6 + 2 + 12 + 0.6) = 20.6A.$

(32)





(a) Applying CDR!

$$I_{6\Omega} = \frac{2\Omega \cdot I}{2\Omega + 6\Omega} = 1A.$$

$$I = \frac{(1A)(8\Omega)}{2\Omega} = 4A = I_2.$$

Again, $I_1 = I - 1A = 3A$.

(b) Here, $I_3 = I = 7\mu A$.

As, $2\mu A$ current passes through 9Ω resistor of top so, same current would be found at bottom resistor of 9Ω.

So, $I_2 = 2\mu A$.

$$I_1 = I - 2(2\mu A) = 7\mu A - 4\mu A = 3\mu A.$$

$$V_R = (2\mu A)(9\Omega) = 18\mu V,$$

$$R = \frac{V_R}{I_R} = \frac{18\mu V}{3\mu A} = 6\Omega.$$

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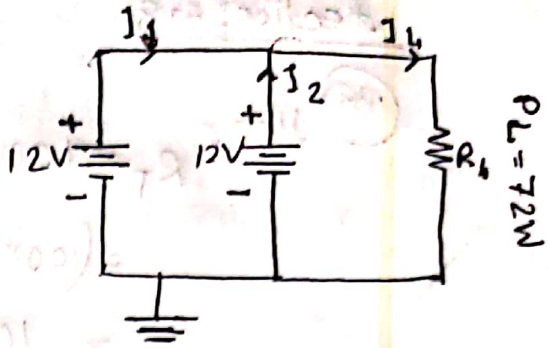
Section 6.7.

(35) (a) $P_L = V_L I_L$



$\Rightarrow 72W = 12V \cdot I_L$.

$\therefore I_L = 6A$.

Here,

$I_1 = I_2 = \frac{I_L}{2} = \frac{6A}{2} = 3A$.

(b) $P_{source} = E \cdot I = (12V)(3A) = 36W$.

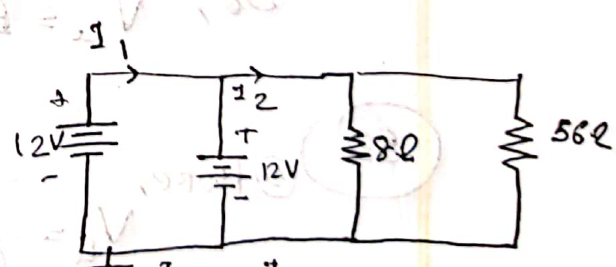
(c) $P_{S_1} + P_{S_2} = 36W + 36W = 72W$ [As, both source value are same]

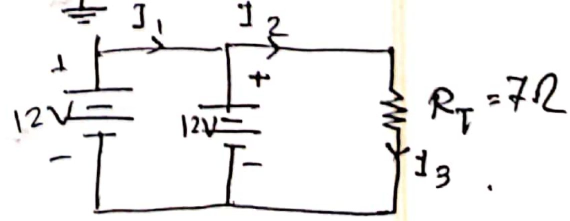
(d) I_{drain} would be 6A; because if there was only source current available to supply the same power to the load still load resistance is same. So ~~power~~ current I_L would be same.

(36) Here,

$R_T = (8 \parallel 56)\,\Omega = \frac{8 \times 56}{8+56}\,\Omega$

$= 7\Omega$.





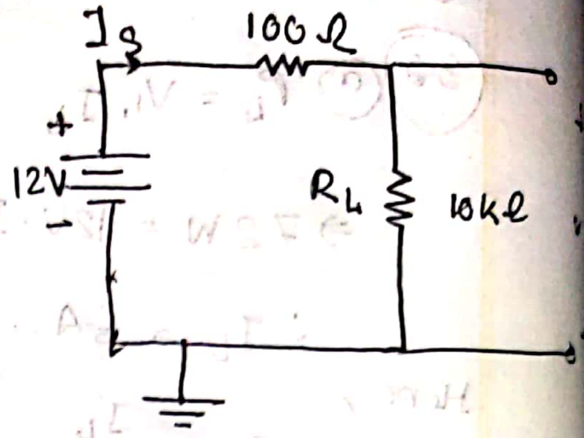
Here, $I_2 = I_3$ [series circuit; current same]

$\therefore I_2 = I_3 = \frac{E}{R_T} = \frac{12V}{7\Omega} = 1.71A$

$I_1 = \frac{1}{2} I_2 = \frac{1}{2}(1.71A) = 0.86A$

Section: 6.8.

(38) Here,



$$R_T = 100\,\Omega + 10k\Omega$$
$$= (100\times10^{-3} + 10)k\Omega.$$
$$= 10.1\,k\Omega.$$

$$I_S = \frac{E}{R_T} = \frac{12V}{10.1k\Omega} = 1.19\,mA.$$

$$V_L = I_S R_L = (1.19mA)(10k\Omega) = 11.9V.$$

(b) If R_L is shorted,

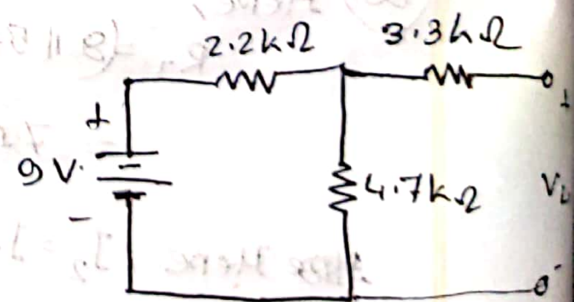
I_S would be, $\frac{E}{R_1} = \frac{12V}{100\,\Omega} = 120\,mA$.

(c) If R_L is replace by open circuit,

V_L would same as source voltage.

So, $V_L = E = 12V$.

(39) (a) Here,



$$V_L = \frac{4.7k\Omega}{(4.7+2.2)k\Omega}\times 9V.$$
$$= \frac{42.3V}{6.9k\Omega} = 6.13V.$$

(b) If 2.2kΩ resistor shorted, then V_L would be ~~same~~ same as source voltage. So, $V_L = E = 9V$.

(c) If $4.7\,k\Omega$ resistor is replaced by open circuit then the voltage V_L would be same as Source Voltage. Because, other both are in same node.

So, $V_L = E = 9\,V$.