CSET102

Tutorial Sheet - 1 (Solutions)

1) Fig. 1 $R_{AB} = 4k + (12k \| 24k) = 12k\Omega$

$I = V/R = \frac{24V}{12k\Omega} = 2mA$ $P = V \cdot I = 48mW$

Fig. 2 $R_{AB} = 910\Omega + [(6k\Omega + 6k\Omega) \| (0.8k\Omega + 0.4k\Omega)]$

$= 2k\Omega$

$I = V/R = 24/2k\Omega = 12mA$ $P = V \cdot I = \underline{288mW}$

Fig. 3: $R_{AB} = 1k\Omega + 1k\Omega + (3k \| 3k \| 3k) + 1k\Omega = 4k\Omega$

$I = V/R = 24/4k\Omega = 6mA$ $P = VI = \underline{144mW}$

Fig. 4: $R_{AB} = 2k\Omega + [16k\Omega \| (2k + 2k + 2k + 2k)] = 7.3k\Omega$

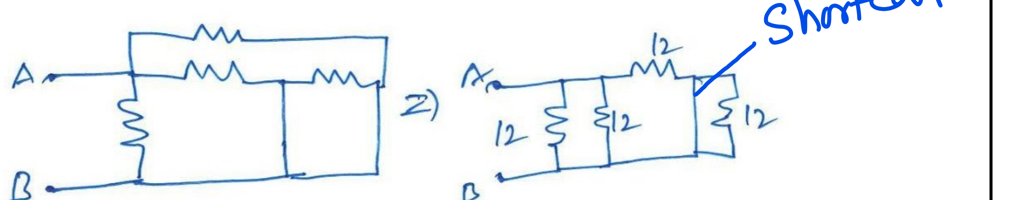
$I = V/R = 3.3mA$ $P = 79.2mW$

Fig. 5: $R_{AB} = 6\Omega + [12\Omega \| [8\Omega + (6\Omega \| 12\Omega)]]$

$= 12\Omega$

$I = V/R = 24/12 = 2A$ $\underline{P = 48W}$

Fig. 6

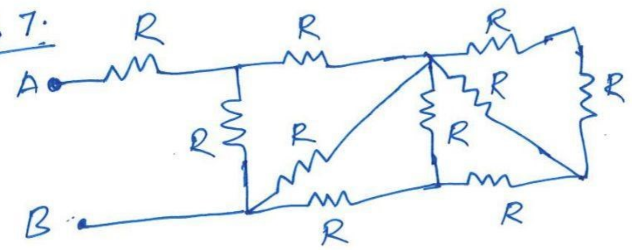


$R_{AB} = (12 \| 12 \| 12) = 4\Omega$

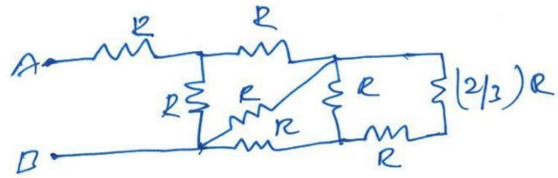
$V = 24/4 = 6A$ $P = V \cdot I = \underline{144W}$

2

2) Fig. 7:

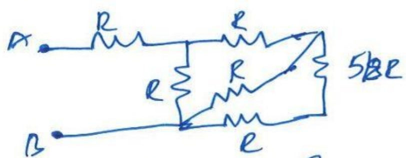


$(2R \| R) = 2/3\,R$

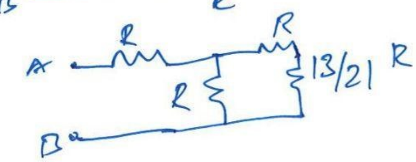


$\frac{2}{3}R + R = (5/3)\,R$

$R \,\|\, \frac{5R}{3} = \frac{5}{8}R$

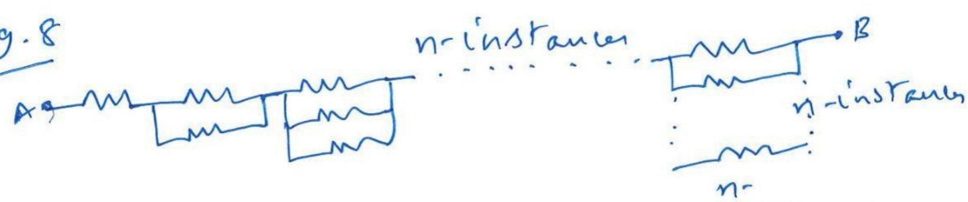


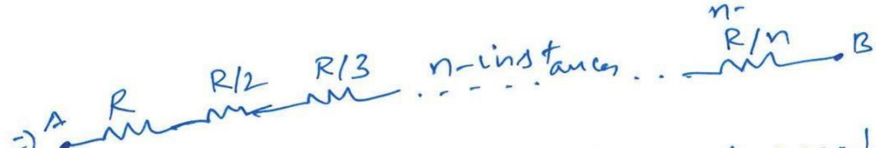
$\frac{5}{8}R + R = \frac{13}{8}R \qquad \frac{13}{8}R \,\|\, R = 13/21\,R$



$\Rightarrow R_{AB} = \frac{89}{55}R$

Fig. 8





$R_{AB} = R + \frac{R}{2} + \frac{R}{3} \cdots \frac{R}{n} = R\left(1 + \frac{1}{2} + \frac{1}{3} + \cdots \frac{1}{n}\right)$

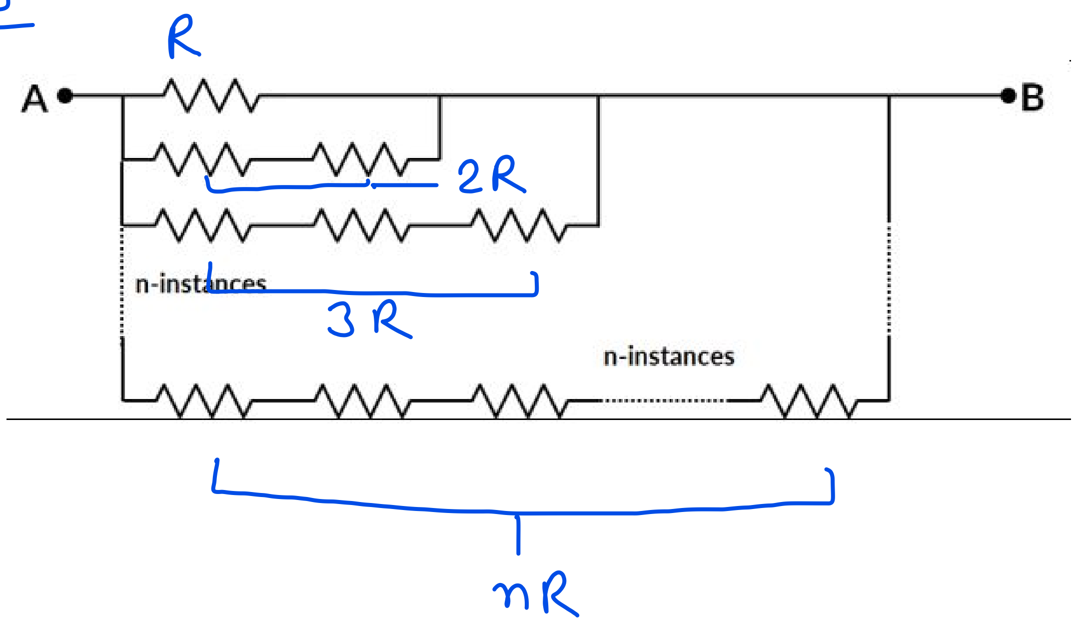
$R_{AB} = R \sum_n \frac{1}{n} \qquad n \to \infty \qquad \sum_n \frac{1}{n} \to \infty$

$R_{AB} = \infty$

As n tends to infinity, the series 1 + 1/2 + 1/3 + 1/4 + ------ + 1/n diverges to infinity. Although there is no perfect formula to calculate the sum of this series, it can be approximated by calculating the integral of 1/n as n tends to infinity (within the limits 1 and infinity). The resultant of the integral of 1/n will be ln(n) which tends to infinity as n tends to infinity.

Thus, infinity multiplied by R will result in the equivalent resistance R_{AB} to be infinity.

Fig. 9



$$\frac{1}{R_{AB}} = \frac{1}{R} + \frac{1}{2R} + \frac{1}{3R} + \cdots + \frac{1}{nR}$$

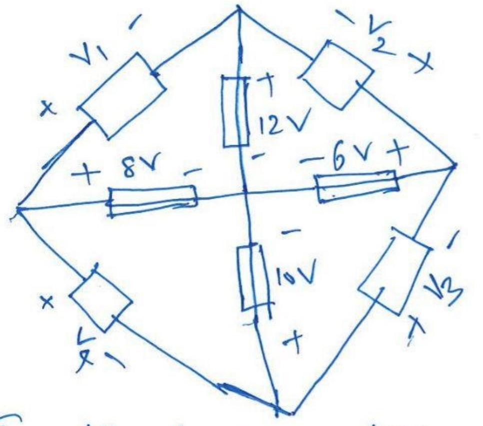
$$\frac{1}{R_{AB}} = \frac{1}{R}\left(1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n}\right)$$

$$\frac{1}{R_{AB}} = \frac{1}{R}\sum_{n}\frac{1}{n} \Rightarrow R_{AB} = \frac{R}{\sum_{n} 1/n}$$

$$\text{for } n \to \infty \; ; \; \sum_{n} 1/n = \infty$$

$$\Rightarrow R_{AB} \simeq 0$$

3



In the loop containing v_1, apply KVL

$$8 - v_1 - 12 = 0 \Rightarrow \underline{v_1 = -4\,V}$$

KVL in loop containing v_2

$$v_2 - 6 + 12 = 0 \Rightarrow \underline{v_2 = -6\,V}$$

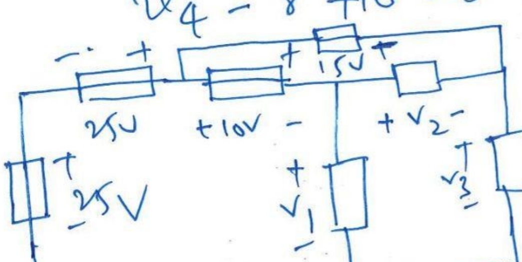
KVL in loop containing v_3

$$v_3 - 10 + 6 = 0 \Rightarrow v_3 = 4\,V$$

KVL in loop containing v_4

$$v_4 - 8 + 10 = 0 \Rightarrow v_4 = -2\,V$$

4



Applying KVL in the loop containing v_2, (2)

$v_2 + 10 - 15 = 0 \Rightarrow v_2 = 5V$

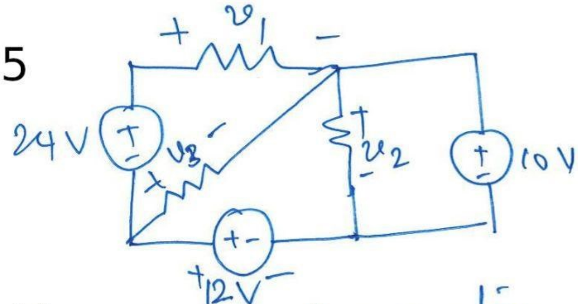
KVL in the loop containing v_1,

$25 + 25 - 10 - v_1 = 0 \Rightarrow v_1 = 40V$

KVL in the loop containing v_1, v_2, and v_3

$v_1 - v_2 - v_3 = 0 \Rightarrow v_3 = v_1 - v_2 = 35V$

5



KVL in the loop containing v_2,

$v_2 - 10 = 0 \Rightarrow v_2 = 10V$

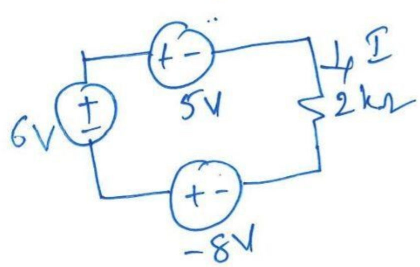
KVL in the loop with v_2 and v_3

$12 - v_3 - v_2 = 0 \Rightarrow v_3 = -v_2 + 12 = 2V$

KVL in the loop with v_1 and v_3

$24 - v_1 + v_3 = 0 \Rightarrow v_1 = 26V$

6



Apply KVL

$6 - 5 - 2k \cdot I + (-8) = 0$

$\Rightarrow I = -3.5mA$