Electricity Worksheet-7

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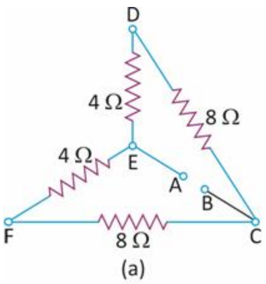
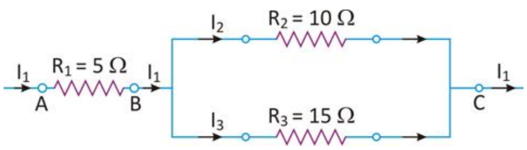
6. Calculate the equivalent resistance of the network across the points A and B shown in the figure.



7. Three resistors are connected as shown in the figure. Through the resistor of 5 Ω, a current of 1 A is flowing.

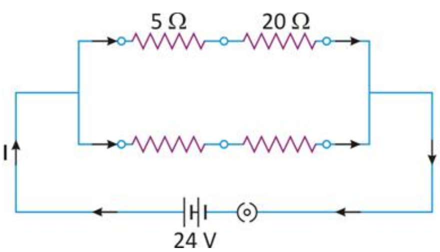


(a) Find the potential difference across AB and across AC?

(b) Find the current through the other two resistors?

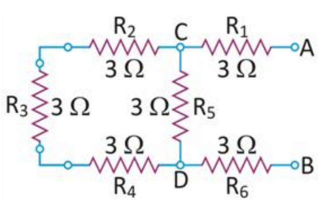
(c) Find the total resistance?

8. A 24 volt battery is connected to the arrangement of resistances shown in fig. calculate (i) the total effective resistance of the circuit, (ii) the total current flowing in the circuit.



9. Three resistors of 6 Ω, 3 Ω and 2 Ω are connected together so that the total resistance is greater than 6 Ω but less than 8 Ω. Draw a diagram to show this arrangement and calculate its total resistance.

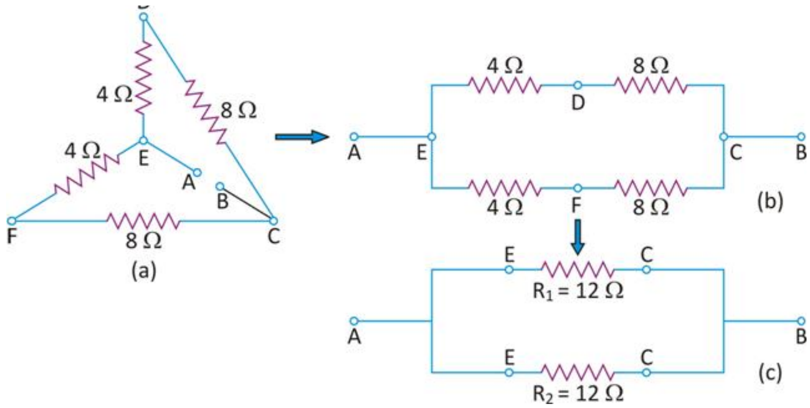
10. For the combination of resistors shown in the figure, find the equivalent resistance between (i) C and D and (ii) A and B.



Answer:

6.

D



The given network, shown in the figure a, can be represented as shown in figure b.

The resultant of 4 Ω and 8 Ω resistances, which are in series in the arm EDC, is given by

$R_1 = 4\ \Omega + 8\ \Omega = 12\ \Omega$

Similarly, the resultant of 4 Ω and 8 Ω in the arm EFC is given by

$R_2 = 4\ \Omega + 8\ \Omega = 12\ \Omega$

The equivalent circuit of R_1 and R_2 which are in parallel is shown in figure c.

If R is the equivalent resistance between the point A and B, then

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{12} + \frac{1}{12} = \frac{2}{12} = \frac{1}{6}$$

Or $R = 6\ \Omega$

7. (a) As current (I_2) through R_1 is 1 A,

Potential difference across AB = $V_1 = I_1 R_1 = 1 \times 5 = 5V$

Since R_2 and R_3 are in parallel, resultant resistance between B and C is given by

$$R_P = \frac{\text{Product of } R_2 \text{ and } R_3}{\text{sum of } R_2 \text{ and } R_3} = \frac{10 \times 15}{10 + 15} = \frac{150}{25} = 6\Omega$$

Potential difference across BC, i.e.,

$V_2 = I_1 R_P = 1 \times 6 = 6V$ ($\because$ current through BC is I_1, i.e., 1 A)

Potential difference across AC

= Potential difference across AB + Potential difference across BC = 5 V + 6 V = 11 V

(b) current through R_2, i.e., $I_2 = \frac{V_2}{R_2} = \frac{6}{10} = 0 \cdot 6\ A$

($\because$ Potential difference across R_2 is the same as across BC)

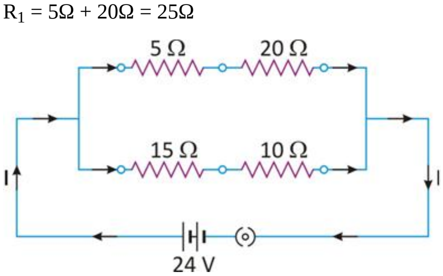
Current through R_3, i.e., $I_3 = I_1 - I_2 = 1A - 0.6 = 0.4\ A$

(c) Total resistance between A and C, i.e., $R = R_1 + R_P = 5\Omega + 6\Omega = 11\Omega$

The resultant of R_2 and R_3 which are in parallel is R_P; and R_1 and R_P are in series

8. R_1 is the equivalent resistance of 5Ω and 20Ω which are in series,

$R_1 = 5\Omega + 20\Omega = 25\Omega$



R_2 is the equivalent resistance of 15Ω and 10Ω which are in series,

$R_2 = 15\ \Omega + 10\ \Omega = 25\ \Omega$

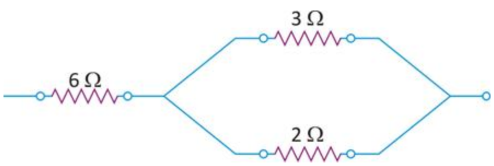
Now R_1 and R_2 are in parallel so final resistance is given by

$$R_P = \frac{R_1R_2}{R_1+R_2} = \frac{25\times25}{25+25} = \frac{625}{50} = 12\cdot5\,\Omega$$

Total potential difference across the arrangement of all the resistances is 24 V

Total current in the circuit, $I = \frac{V}{R_P} = \frac{24}{12\cdot5} = 1\cdot92\text{ A}$

9. Here the total resistance has to be greater than 6Ω, therefore, 6Ω resistance should be in series with some other resistance. Now the total resistance is less than 8Ω, the other two resistances should be in parallel and their combination be connected in series with 6Ω resistance. Now R_P is the resultant of two resistances of 3Ω and 2Ω in parallel, then



$$R_P = \frac{\text{Product of two resistances}}{\text{sum of the two resistances}},$$

i.e., $R_P = \frac{3\times2}{3+2} = \frac{6}{5} = 1\cdot2\,\Omega$

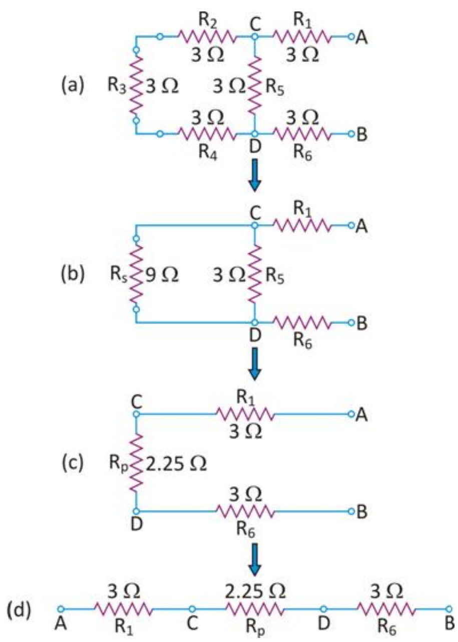
Since R_P and 6Ω are in series, total resistance of the combination, i.e.,

$R = 6 + R_P = 6 + 1.2 = 7.2\Omega$

10. (i) The resistors R_2, R_3 and R_4 are in series. Their equivalent resistance R_s is given by

$R_s = 3\Omega + 3\Omega + 3\Omega = 9\Omega$

Further, R_s (= 9Ω) and R_5 (= 3Ω) are in parallel so their equivalent resistance is given by



$$R_P = \frac{\text{product of two resistances}}{\text{sum of two resistances}}$$

$$= \frac{9\times3}{9+3} = \frac{27}{12} = 2\cdot25\,\Omega$$

Thus, the equivalent resistance between C and D is 2.25 Ω.

(ii) Now R_1 (= 3Ω), R_P (= 2.25 Ω)

and R_6 (= 3 Ω)

Are in series

Thus, equivalent resistance between A and B,

$= R_1 + R_P + R_6$

$= 3 + R_P + R_6$

= 3 + 2.25 + 3

= 8.25 Ω