*Book Name: Selina Concise*

**EXERCISE (8 A)**

## Solution 1:
Current is defined as the rate of flow of charge.
$I = Q/t$
Its S.I. unit is Ampere.

## Solution 2:
Electric potential at a point is defined as the amount of work done in bringing a unit positive charge from infinity to that point. Its unit is the volt.

## Solution 3:
The potential difference between two points is equal to the work done in moving a unit positive charge from one point to the other.
It's S.I. unit is Volt.

## Solution 4:
One volt is the potential difference between two points in an electric circuit when 1 joule of work is done to move charge of 1 coulomb from one point to other.

## Solution 5:
If a body is free to fall, on releasing it from a height, it falls downwards towards the earth's surface. For, this one end has to be at higher level and other at lower level, so that gravity could effect on this difference and body could freely fall. Same way to make flow of the charge through a conductor, the gravity of course has no role of play; there should be difference of electric potential. This difference gives the flow of charge in a conductor.

## Solution 6:
It is the property of a conductor to resist the flow of charges through it. It's S.I. unit is Ohm.

## Solution 7:

In a metal, the charges responsible for the flow of current are the free electrons. The direction of flow of current is conventionally taken opposite to the direction of motion of electrons.

## Solution 8:

Resistance of a wire is inversely proportional to the area of cross-section of the wire.

$R \propto \frac{1}{A}$

$R \propto \frac{1}{\pi r^2}$

This means if a wire of same length, but of double radius is taken, its resistance is found to be one-fourth.

## Solution 9:

Resistance of a wire is directly proportional to the length of the wire.

R ∝ I

The resistance of a conductor depends on the number of collisions which the electrons suffer with the fixed positive ions while moving from one end to the other end of the conductor. Obviously the number of collisions will be more in a longer conductor as compared to a shorter conductor. Therefore, a longer conductor offers more resistance.

## Solution 10:

With the increase in temperature of conductor, both the random motion of electrons and the amplitude of vibration of fixed positive ions increase. As a result, the number of collisions increases. Hence, the resistance of a conductor increases with the increase in its temperature. The resistance of filament of a bulb is more when it is glowing (i.e., when it is at a high temperature) as compared to when it is not glowing (i.e., when it is cold).

## Solution 11:

Iron wire will have more resistance than copper wire of the same length and same radius because resistivity of iron is more than that of copper.

## Solution 12:

(i) Resistance of a wire is directly proportional to the length of the wire means with the increase in length resistance also increases.

R ∝ I

(ii) Resistance of a wire is inversely proportional to the area of cross-section of the wire. If area of cross-section of the wire is more, then resistance will be less and vice versa.

$R \propto \frac{1}{A}$

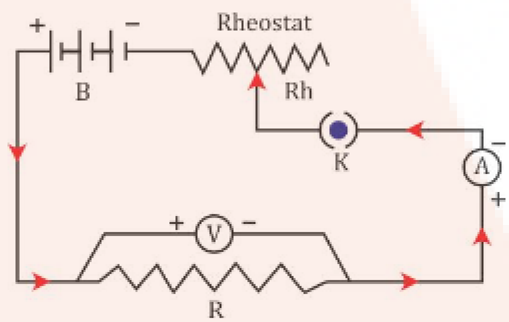
(iii) Resistance increases with the increase in temperature since with increase in temperature the number of collisions increases.

(iv) Resistance depends on the nature of conductor because different substances have different concentration of free electrons. Substances such as silver, copper etc. offer less resistance and are called good conductors; but substances such as rubber, glass etc. offer very high resistance and are called insulators.

## Solution 13:

It states that electric current flowing through a metallic wire is directly proportional to the potential difference V across its ends provided its temperature remains the same. This is called Ohm's law.

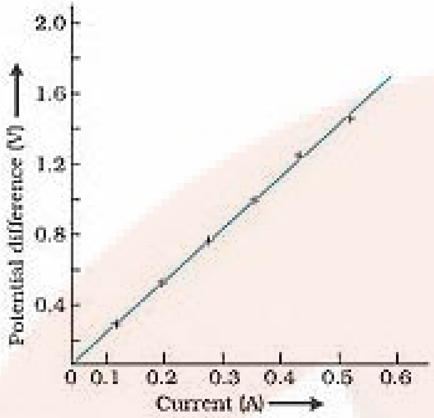
V = IR




## Solution 14:

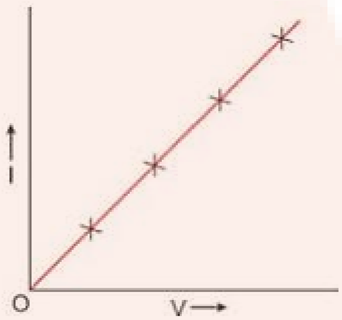
Ohm's law is obeyed only when the physical conditions and the temperature of the conductor remain constant.

## Solution 15:




Slope of V-I graph represents the Resistance.

## Solution 16:

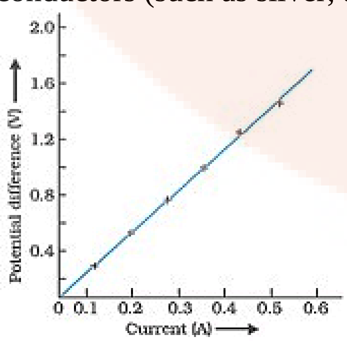



The slope of I-V graph (= $\frac{\Delta I}{\Delta v}$ ) is equal to the reciprocal of the resistance of the conductor, i.e.

Slope = $\frac{\Delta I}{\Delta v} = \frac{1}{\text{Resistance of conductor}}$ = Conductance

## Solution 17:

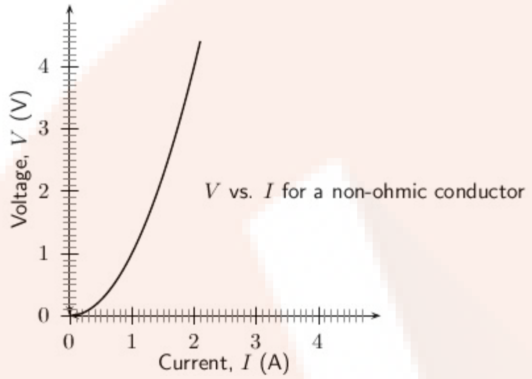
Ohmic Resistor: An ohmic resistor is a resistor that obeys Ohm's law. For example: all metallic conductors (such as silver, aluminium, copper, iron etc.)



From above graph resistance is determined in the form of slope.

## Solution 18:

The conductors which do not obey Ohm's Law are called non-ohmic resistors. Example: diode valve.




## Solution 19:

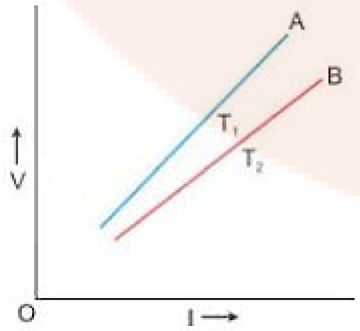
(1) Ohmic resistor obeys ohm's law i.e., V/I is constant for all values of V or I; whereas Non-ohmic resistor does not obey ohm's law i.e., V/I is not same for all values of V or I.
(2) In Ohmic resistor, V-I graph is linear in nature whereas in non-ohmic resistor, V-I graph is non-linear in nature.

## Solution 20:

Ohmic: (d), Non-Ohmic: (a), (b) and (c)

Only for (d) the I-V graph is a straight line or linear while for (a), (b) and (c), the graph is a curve.

## Solution 21:



In the above graph, $T_1 > T_2$. The straight line A is steeper than the line B, which leads us to conclude that the resistance of conductor is more at high temperature $T_1$ than at low temperature $T_2$. Thus, we can say that resistance of a conductor increases with the increase in temperature.

## Solution 22:

The resistivity of a material is the resistance of a wire of that material of unit length and unit area of cross-section.

Its S.I. unit is ohm metre.

## Solution 23:

Expression :

$$R = p\frac{I}{A}$$

p − resistivity

R – resistance

l – length of conductor

A – area of cross-csection

## Solution 24:

Metal < Semiconductor < Insulator

## Solution 25:

Manganin

## Solution 26:

'Copper or Aluminium' is used as a material for making connection wires because the resistivity of these materials is very small, and thus, wires made of these materials possess negligible resistance.

The connection wires are made thick so that their resistance can be considered as negligible.

$$R = \rho \frac{l}{a}$$

Therefore, greater the area of cross-section, lesser shall be the resistance.

**Solution 27:**

Manganin is used for making the standard resistor because its resistivity is quite large and the effect of change in temperature on their resistance is negligible.

**Solution 28:**

Generally fuse wire is made of an alloy of lead and tin because its resistivity is high and melting point is low.

**Solution 29:**

(i) A wire made of tungsten is used for filament of electric bulb because it has a high melting point and high resistivity.

(ii) A nichrome wire is used as a heating element for a room heater because the resistivity of nichrome is high and increase in its value with increase in temperature is high.

**Solution 30:**

A superconductor is a substance of zero resistance at a very low temperature. Example: Mercury at 4.2 K.

**Solution 31:**

Superconductor

## MULTIPLE CHOICE TYPE:

**Solution 1:**

Nichrome is an ohmic resistance.

Hint: Substances that obey Ohm's law are called Ohmic resistors.

### Solution 2:
For carbon, resistance decreases with increase in temperature.
Hint: For semiconductors such as carbon and silicon, the resistance and resistivity decreases with the increase in temperature.

## NUMERICALS:

### Solution 1:
Number of electrons flowing through the conductor,
N = 6.25 × $10^{16}$ electrons
Time taken, t = 2 s
Given, e = 1.6 × $10^{-19}$c
Let I be the current flowing through the conductor.
Then, I = $\frac{ne}{t}$

$$\therefore \ I = \frac{(6.25\times10^{16})(1.6\times10^{-19})}{2} = 5\times10^{-J}\text{ A}$$

Or, I = 5 mA
Thus, 5 Ma current flows from B to A.

### Solution 2:
Current , I = 1.6 mA = 1.6 × $10^{-3}$ A
Charge, Q = −1.6 x $10^{-19}$ coulomb
t = 1 sec
I = Q/t
Q = I x t
Q = 1.6 ×$10^{-3}$ × 1
No. of electrons = 1.6 × $10^{-3}$/1.6 × $10^{-19}$
= $10^{16}$

### Solution 3:
Current (I) = 0.2 A
Resistance (R) = 20 ohm
Potential Difference (V) = ?
According to Ohm's Law :
V = IR
V = 0.2 × 20 = 4 V

## Solution 4:

Current (I) = 1.2 A

Potential Difference/Voltage (V) = 6.0 V

Resistance (R) = ?

According to Ohm's Law :

V=IR

Then R = V/I

R = 6 / 1.2

R = 5 Ohm

## Solution 5:

Potential Difference/Voltage (V) = 12 V

Current (I) = 2 A

Resistance (R) = ?

According to Ohm's Law :

V=IR

Then R = V/I

R = 12 / 2

R = 6 Ohm

Resistance will be less when the bulb is not glowing.

## Solution 6:

Potential Difference/Voltage (V) = 3 V

Resistance (R) = 5 ohm

Current (I) = ?

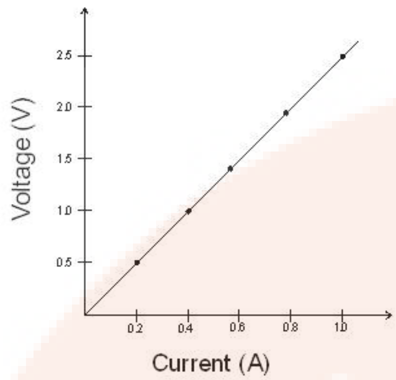
According to Ohm's Law :

V=IR

Then I = V/R

I = 3/5 = 0.6 A

## Solution 7:




(a) 1.25 V
(b) 0.3 A
(c) The graph is linear so resistance can be found from any value of the given table. For instance:
When V = 2.5 Volt
Current is I = 1.0 amp
According to ohm's law :
R = V/I
R = 2.5/1.0 = 2.5 ohm

## Solution 8:

(i) For wire of radius

$$R_1 = \rho \frac{1}{A_1}$$

$$R_1 = \rho \frac{1}{\pi r_1^2}$$

(ii) For wire of radius $r_2$ :

$$R_2 = \rho \frac{1}{A_2}$$

$$R_2 = \rho \frac{1}{\pi r_2^2}$$

$$R_2 : R_2 \text{ will be } \rho \frac{1}{\pi r_1^2} : \rho \frac{1}{\pi r_2^2}$$

$$= r_2^2 : r_1^2$$

(ii) Since the material of the two wires is same, so their resistivities will also be same i.e., $\rho_1 : \rho_2 = 1:1$

**Solution 9:**

Let 'I' be the length and 'a' be the area of cross – section of the resistor with resistance, R = 1Ω
when the wire is stretched to double its length,
the new length I' = 2I and the new area of cross section,
a' = a/2

$$\therefore \text{Resistance } (R^{'}) = \rho\frac{I^{'}}{a^{'}} = \rho\frac{2I}{a/2}$$

$$\therefore R^{'} = 4p\frac{I}{a} = 4R$$

$$\therefore R^{'} = 4\times1 = 4\Omega$$

## Solution 10:

Resistance (R) = 3 ohm
Length l = 10 cm
New Length (l') = 30 cm = 3 × l

$$R = \rho\frac{l}{A}$$

New Resistance :
With stretching length will increase and area of cross-section will decrease in the same order

$$R^{'} = \rho\frac{3}{A/3}$$

Therefore,

$$R^{'} = 9\rho\frac{1}{A} = 9R$$

$$R^{'} = 9\times3 = 27\Omega$$

## Solution 11:

Resistance (R) = 9 ohm
Length l = 30 cm
New Length (l) = 30 cm = 3/l = 10 cm

$$R = \rho\frac{1}{A}$$

New Resistance :
With change in length, there will be change in area of cross-section also in the same order.

$$R' = \rho \frac{I/3}{3A}$$

$$R' = \frac{1}{9} \rho \frac{I}{A}$$

$$R' = \frac{1}{9} R$$

$$R' = 1 \text{ohm}$$

## Solution 12:

Resistance (R) = 1 ohm

Resistivity (ρ) = 1.7 x $10^{-8}$ ohm metre

Radius (r) = 1 mm = $10^{-3}$ m

Length (l) = ?

$$R = \rho \frac{1}{A}$$

$$I = \frac{RA}{\rho}$$

$$= \frac{R\pi r^2}{\rho}$$

$$= \frac{1 \times \pi \times 10^{-6}}{1.7 \times 10^{-8}}$$

$$= 184.7 \text{m}$$

**EXERCISE. (8 B)**

## Solution 1:

e.m.f.: When no current is drawn from a cell, the potential difference between the terminals of the cell is called its electro-motive force (or e.m.f.).

Terminal voltage: When current is drawn from a cell, the potential difference between the electrodes of the cell is called its terminal voltage.

Internal Resistance: The resistance offered by the electrolyte inside the cell to the flow of electric current through it is called the internal resistance of the cell.

## Solution 2:

| e.m.f. of cell | Terminal voltage of cell |
|---|---|
| 1.It is measured by the amount of work done in moving a unit positive charge in the complete circuit inside and outside the cell. | 1. It is measured by the amount of work done in moving a unit positive charge in the circuit outside the cell. |
| 2.It is the characteristic of the cell i.e., it does not depend on the amount of current drawn from the cell | 2. It depends on the amount of current drawn from the cell. More the current is drawn from the cell, less is the terminal voltage. |
| 3.It is equal to the terminal voltage when cell is not in use, while greater than the terminal voltage when cell is in use. | 3. It is equal to the emf of cell when cell is not in use, while less than the emf when cell is in use. |

## Solution 3:

Internal resistance of a cell depends upon the following factors:

(i) The surface area of the electrodes: Larger the surface area of the electrodes, less is the internal resistance.

(ii) The distance between the electrodes: More the distance between the electrodes, greater is the internal resistance.

## Solution 4:

(a) Total resistance = R + r

(b) Current drawn from the circuit:

As we know that,

$\varepsilon = V+v$

$= IR + Ir$

$= I(R+r)$

I = e / (R + r)

(c) p.d. across the cell : $\frac{\varepsilon}{(R+r)} \times R$

(d) voltage drop inside the cell: $\frac{\in}{R+r} \times r$

## Solution 5:

(a) Terminal voltage is less than the emf : Terminal Voltage < e.m.f.
(b) e.m.f. is equal to the terminal voltage when no current is drawn.

## Solution 6:

When the electric cell is in a closed circuit the current flows through the circuit. There is a fall of potential across the internal resistance of the cell. So, the p.d. across the terminals in a closed circuit is less than the p.d. across the terminals in an open circuit by an amount equal to the potential drop across the internal resistance of the cell.

## Solution 7:

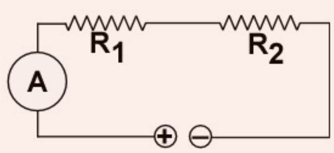
(a) Total Resistance in series:

$R = R_1 + R_2 + R_3$

(b) Total Resistance in parallel:

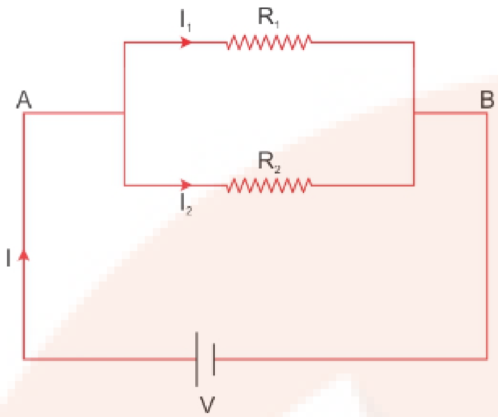
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

## Solution 8:




If current I is drawn from the battery, the current through eac resistor will also be I.
On applying Ohm's law to the two resistors separately, we further
have
$V_1 = I R_1$
$V_2 = I R_2$
$V = V_1 + V_2$
$IR = I R_1 + I R_2$
$R = R_1 + R_2$
Total Resistance in series R
$R = R_1 + R_2 + R_3$

## Solution 9:




On applying Ohm's law to the two resistors separately, we further Have

$I_1 = V / R_1$

$I_2 = V / R_2$

$I = I_1 + I_2$

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2}$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

## Solution 10:

(a) series
(b) parallel
(c) parallel
(d) series

## Solution 11:

For the same change in I, change in V is less for the straight line A than for the straight line B (i.e., the straight line A is less steeper than B), so the straight line A represents small resistance, while the straight line B represents more resistance. In parallel combination, the resistance decreases while in series combination, the resistance increases. So A represents the parallel combination.

## MULTIPLE CHOICE TYPE:

### Solution 1:
In series combination of resistances, current is same in each resistance.
Hint: In a series combination, the current has a single path for its flow. Hence, the same current passes through each resistor.

### Solution 2:
In parallel combination of resistances, P.D. is same across each resistance.
Hint: In parallel combination, the ends of each resistor are connected to the ends of the same source of potential. Thus, the potential difference across each resistance is same and is equal to the potential difference across the terminals of the source (or battery).

### Solution 3:
(a) and (d)

Solution:

In fig (a), the resistors are connected in parallel

Between X and Y.

Let $R'$ be their equivalent resistance.

Then , $\frac{1}{R'} = \frac{1}{2} + \frac{1}{2} = \frac{2}{2}\Omega$

Or, $R^I = 1\ \Omega$ .................. (i)

In fig (d) a series combination of two $1\Omega$ resistors

Is in parallel with another series combination of two

$1\Omega$ resistors

Series resistance of two 1 Ohm resistors,

$R = (1 + 1)\Omega = 2\ \Omega$

Thus, we can say that across X and Y, two $2\Omega$ resistors

are connected in parallel

Let $R'$ be the net resistance across X and Y.

Then, $\frac{1}{R'} = \frac{1}{2} + \frac{1}{2} = \frac{2}{2}\Omega$

Or, $R' = 1\Omega$ ......................(ii)

From (i) and (ii), it is clear that (a) and (d) have

The same equivalent resistance between X and Y.

**NUMERICALS:**

## Solution 1:

(i) Ammeter reading = 0 because of no current

Voltage V = ϵ − Ir

V = 2 − 0 × 1 = 2 volt

(ii) Ammeter reading :

$I = \varepsilon/(R+r)$

I=2 / (4+1) = 2 / 5 = 0.4 amp

Voltage reading :

Voltage V = ϵ - Ir

V=2 - 0.4 x 1 = 2 - 0.4 = 1.6 V

## Solution 2:

ε = 3 volt

I = 1.5 A

V = 2.7 V

V = ε − Ir

r = (e-V) / I

= (3 – 2.7) / 1.5 = 0.2 ohm

## Solution 3:

(a) ε = 1.8 V

Total Resistance = 2 + 4.5 + 0.7 = 7.2 W

I = ?

I = ε / R (total resistance)

I = 1.8 / 7.2 = 0.25 A

(b) Current (calculated in (a) part) I = 0.25 A

Now, total resistance excluding internal resistance = 4.5 + 0.7 = 5.2 ohm

V = IR = 0.25 x 5.2 = 1.3 V

## Solution 4:

(a) ε = 15 V

R = 6 + 3 = 9 ohm

r = 3 ohm
I = ?
I = ε / (R + r)
I = 15 / (9 + 3) = 15/12 = 1.25 A
(b) Current (calculated in (a) part) I = 1.25 A
External Resistance R = 6 + 3 = 9 ohm
V = IR = 1.25 × 9 = 11.25 V

## Solution 5:
In first case
I = 1 A, R = 1.9 ohm
ε = I(R + r) = 1(1.9+r)
ε = 1.9 + r------------(1)
In second case
I = 0.5 A, R = 3.9 ohm
ε = I(R + r) = 0.5 (3.9 + r)
ε = 1.95 + 0.5r ----------------(2)
From eq. (1) and (2),
1.9 + r = 1.95 + 0.5r
r = 0.05/0.5 = 0.1 ohm
Substituting value of r
ε = 1.9 + r = 1.9 + 0.1 = 2 V

## Solution 6:
Let $R'$ be their equivalent resistance of the 4Ω and 6Ω resistors connected in parallel.

Then, $\frac{1}{R'} = \frac{1}{4} + \frac{1}{6} = \frac{3+2}{12} = \frac{5}{12}\Omega$

$\text{Or, } R' = \frac{12}{5} = 2.4\Omega$

## Solution 7:
$R_1$ = 2 ohm
$R_2$ = 2 ohm
$R_3$ = 2 ohm
$R_4$ = 2 ohm

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+\frac{1}{R_4}$$

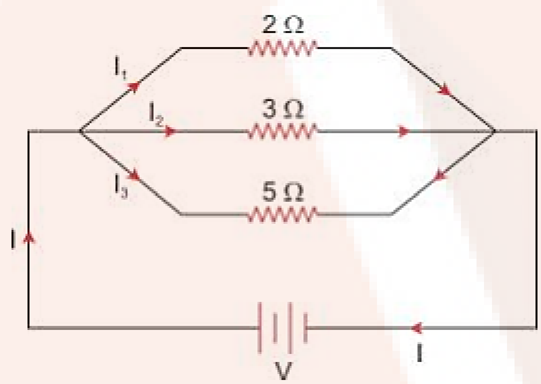
$$=\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}=2$$

R = 0.5 oh m

## Solution 8:

The three resistors should be connected in parallel

To get a total resistance less than 1Ω




Let $R^{'}$ be the total resistance.

Then,

$$\frac{1}{R^{'}}=\frac{1}{2}+\frac{1}{3}+\frac{1}{5}=\frac{15+10+16}{30}=\frac{31}{30}\Omega$$

$$\text{Or}, R^{'}=\frac{30}{31}=0.97\Omega$$

## Solution 9:

A parallel combination of two resistors, in series with one resistor.

$R_1$ = 2 ohm

$R_2$ = 2 ohm

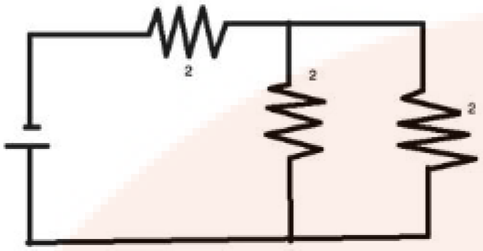
$R_3$ = 2 ohm

$$\frac{1}{R^{'}}=\frac{1}{R_1}+\frac{1}{R_2}$$

$$\frac{1}{R^{'}}=\frac{1}{2}+\frac{1}{2}=1$$

$R^{'} = 1ohm$

$R = R^{'} + R_3 = 1 + 2 = 3ohm$




## Solution 10:

$r_1 = r_2 = r_3 = r_4 = 2.0\,ohm$

$r' = r_1 + r_2 = 2 + 2 = 4$ ohm

$$\frac{1}{r^{"}} = \frac{1}{r_3} + \frac{1}{r_4} = \frac{1}{2} + \frac{1}{2} = 1$$

$r^{"} = 1ohm$

$r = r^{'} + r^{"} = 4 + 1 = 5ohm$

## Solution 11:

Resistance of each set:

$r_1 = 2 + 2 + 2 = 6$ ohm

$r_2 = 2 + 2 + 2 = 6$ ohm

$r_3 = 2 + 2 + 2 = 6$ ohm

$r_4 = 2 + 2 + 2 = 6$ ohm

Now these resistances are arranged in parallel :

$$\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \frac{1}{r_4}$$

$$\frac{1}{r} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6}$$

$$r = \frac{6}{4} = 1.5ohm$$

## Solution 12:

$r_1$ = 4 ohm
$r_2$ = 8 ohm
$r_3$ = x ohm
$r_4$ = 5 ohm
r = 4 ohm

$$r' = r_1 + r_2 = 4 + 8 = 12\text{ohm}$$

$$r'' = r_3 + r_4 = (x+5)\text{ohm}$$

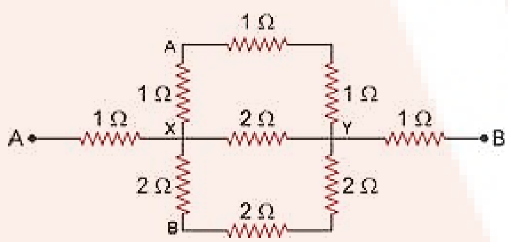
$$\frac{1}{r} = \frac{1}{r'} + \frac{1}{r''}$$

$$\frac{1}{4} = \frac{1}{12} + \frac{1}{5+x}$$

$$\frac{1}{6} = \frac{1}{5+x}$$

$$x = 1\text{ohm}$$

## Solution 13:




In the figure above,
Resistance between XAY = (1 + 1 + 1) = 3Ω
Resistance between XY = 2Ω
Resistance between XBY = 6Ω
Let $R'$ be the net resistance between points X and Y

Then, $\frac{1}{R'} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6}\Omega$

Or, $R^{I}$ = 1Ω
Thus, we can say that between points A and B,
Three 1 Ω resistors are connected in series.
Let $R_{AB}$ be the net resistance between points A and B.
Then, $R_{AB}$ = ( 1 + 1 + 1)Ω = 3Ω

## Solution 14:

Wire cut into three pieces means new resistance = 27/3 = 9

Now three resistance connected in parallel :

$$\frac{1}{r}=\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}=\frac{1}{9}+\frac{1}{9}+\frac{1}{9}$$

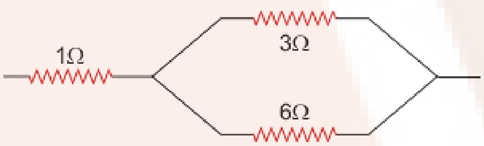
r = 9/3 = 3 oh m

## Solution 15:

$$\frac{1}{r}=\frac{1}{6}+\frac{1}{3}+\frac{1}{2}$$

R = 2 oh m

R = 2 + 1 = 3 oh m




## Solution 16:

$R_1$=1+2 = 3 ohm

$R_2$=1.5 ohm

$R_1$ and $R_2$ are connected in parallel

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}=\frac{1}{3}+\frac{1}{1.5}=1$$

R = 1 oh m

## Solution 17:

$R_1$ = 3 + 2 = 5 ohm

$R_2$ = 30 W

$R_3$ = 6 + 4 = 10 ohm

$R_1$ , $R_2$ and $R_3$ are connected in parallel

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}=\frac{1}{5}+\frac{1}{30}+\frac{1}{10}=\frac{10}{30}$$

R = 3 oh m

## Solution 18:

(a) $R_1 = 2 + 2 + 2 = 6$ohm

$R_2 = 2$ohm

$R_1$ and $R_2$ are connected in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{2} = \frac{4}{6}$$

R = 6/ 4 = 1.5 oh m

(b) $R_1$=2+2 = 4 ohm

$R_2$=2+2=4 W

$R_1$ and $R_2$ are connected in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{4} + \frac{1}{4} = \frac{1}{2}$$

R = 2 oh m

## Solution 19:

(a) $R_1$=3+3=6 W

$R_2$=3 W

$R_1$ and $R_2$ are connected in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{3} = \frac{1}{2}$$

(b) As calculated above R=2 ohm

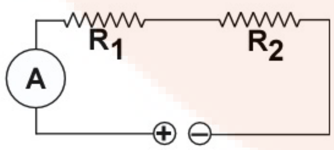
$R_3$ = 3 ohm

$R_4$ = 3 ohm

R' = R + $R_3$ + $R_4$ = 2 + 3 + 3 = 8 ohm

## Solution 20:

(a)




$R_1$=2 ohm

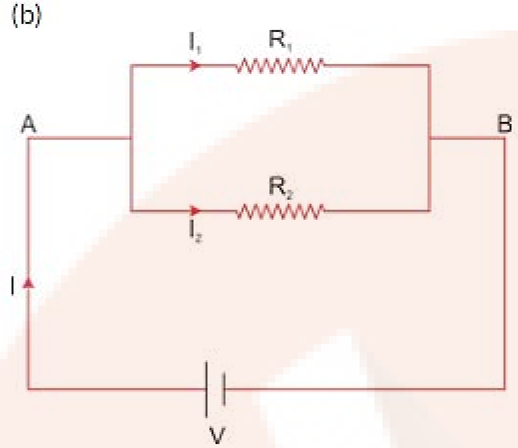
$R_2$=3 ohm

R = $R_1$ + $R_2$ = 2 + 3 = 5 ohm

V=6 V

$$I = \frac{V}{R} = \frac{6}{5} = 1.2\,\text{oh m}$$

(b)




$R_1$ and $R_2$ are connected in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{3} = \frac{5}{6}$$

R = 1.2 oh m

V = 6 V

$$I = \frac{V}{R} = \frac{6}{1.2} = 5A$$

## Solution 21:

(a) $R_1$ = 6 ohm

$R_2$ = 4 ohm

$R = R_1 + R_2$ = 6 + 4 = 10 ohm

V = 20 V

I = V/R = 20/10 = 2 A

(b) R = 6 W

I = 2 A

V = ?

V = IR = 6 × 2 = 12 V

## Solution 22:

For resistor A:

R = 1 ohm

V = 2 V

I = V/R = 2/1 = 2A

For resistor B:

R = 2 ohm
V = 2 V
I = V/R = 2/2 = 1A

## Solution 23:

(a)
V = 4 V
I = 0.4 A
Total Resistance R'=?
R' = V/I = 0.4/4 = 10 ohm

(b)
$R_1$= 20 ohm

R' = 10 ohm

$$\frac{1}{R'} = \frac{1}{R} + \frac{1}{R_1}$$

$$\frac{1}{10} = \frac{1}{R} + \frac{1}{20}$$

$$\frac{1}{R} = \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$$

$$R = 20\Omega$$

(c)
R = 20 ohm
V = 4 V
I = V/R = 4/20 = 0.2 A

## Solution 24:

(a)
Resistance of 1m of wire = 3 ohm
Resistance of 1.5 m of wire = 3 × 1.5 = 4.5 W

$$\frac{1}{R} = \frac{1}{4.5} + \frac{1}{4.5} + \frac{1}{4.5} = \frac{3}{4.5}$$

R = 1.5 oh m
(b)
I=2 A
V=IR = 2 × 4.5 = 9 V

(c)
R = 3 ohm for 1 m
For 5 m: R = 3 × 5 = 15 ohm
But Area A is double i.e. 2A and Resistance is inversely proportional to area so Resistance will be half.
R = 15/2 = 7.5 ohm

## Solution 25:

In parallel R = ½ + ½ = 1 ohm
I = 1.2 A
ε = I(R + r) = 1.2(1 + r) = 1.2 + 1.2 r
In series R = 2+2 = 4 ohm
I = 0.4 A
ε = I(R + r) = 0.4(4 + r) = 1.6 + 0.4 r
It means :
1.2 + 1.2 r = 1.6 + 0.4 r
0.8 r = 0.4
r = 0.4 / 0.8 = ½ = 0.5 ohm
(i) Internal resistance r = 0.5 ohm
(ii) ε = I(R+r) = 1.2(1+0.5) = 1.8 V

## Solution 26:

(a)In parallel 1/R = 1/3 + 1/6 = 1/2
So R = 2 ohm
r = 3 W
ε = 15 V
ε = I(R + r)
15 = I(2 + 3)
I = 15/5 = 3 A
(b) V = ?
R = 2 ohm
V = IR = 3 × 2 = 6 V
(c)V = 6 V
R = 3 ohm
I = V/R = 6/3 = 2 A
(d) R = 6 ohm

V = 6 V

I = V/R = 6/6 = 1 A

## Solution 27:

(a)R = 4 Ω

I = 0.25 A

V = IR = 0.25 × 4 = 1 V

(b)Internal Resistance r=3 ohm

I = 0.25 A

V = IR = 0.25 × 3 = 0.75 V

(c) Effective resistance of parallel combination of two 2 ohm resistances = 1 ohm

V = I/R = 0.25/1 = 0.25 V

(d) I = 0.25 A

ε = 2V, r = 3 ohm

ε = I(R' + r)

2 = 0.25(R' + 3)

R' = 5 W

$$\frac{2R}{2+R}+4=5$$

R = 2 oh m

## Solution 28:

(a) $R_1$=6 W

R'= $R_2$ + $R_3$ = 2 + 4 = 6 W

$R_1$ and R' in parallel :

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

R = 3 oh m

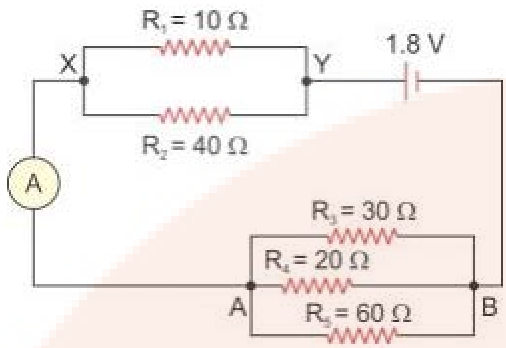
(b) R = 3 ohm

V = 6 V

I = ?

I = V/R = 6/3 = 2 A

## Solution 29:




(a) In the figure above,

Let resistance between X and Y be $R_{xy}$

Then, $\frac{1}{R_{xy}} = \frac{1}{10} + \frac{1}{40} = \frac{4+1}{40} = \frac{5}{40}\Omega$

Or, $R_{xy} = 8\Omega$

Let $R_{AB}$ be the net resistance between points A and B.

Then, $\frac{1}{R_{AB}} = \frac{1}{30} + \frac{1}{20} + \frac{1}{60} = \frac{2+3+1}{60} = \frac{6}{60}\Omega$

Or, $R_{AB} = 10\Omega$

∴ Total resistance of the circuit = 8Ω + 10Ω = 18Ω

(b) Current, $I = \frac{\text{Voltage}}{\text{Total resistance}} = \frac{1.8}{18}A$

Or, I = 0.1 A

Thus, 0.1 A shall be the reading of the am meter