Q1 **Define the term resistance. State its S.I. unit.**

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

Q2 How does the resistance of a wire depend on its radius? Explain your answer.

Answer 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.

Q3 Name three factors on which resistance of a given wire depends and state how is it affected by the factors stated by you

Answer

(i) Resistance of a wire is directly proportional to the length of the wire means with the increase in length resistance also increases$R \propto I$

(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.

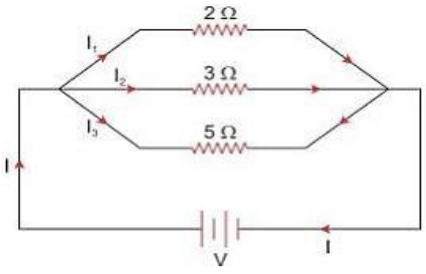
(iv) Resistance depends on the nature of conductor because different substances have different concentration of free electrons. Substances such as silver, copper etc. offer less resistance and are called good conductors; but substances such as rubber, glass etc. offer very high resistance and are called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

Q4 : Name the material used for (i) filament of an electric bulb, (ii) heating element of a room heater.

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.

Q5 : You have three resistors of values 2Ω, 3Ω and 5Ω. How will you join them so that the total resistance is less than 1Ω? Draw diagram and find the total resistance.

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,

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

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

Q. 6. What is heating effect of current? (CBSE 2016)

Ans. Heating effect of current : Consider a purely resistive circuit, i.e., a circuit which consists of only some resistors connected to a battery. The energy of the battery gets dissipated entirely in the form of heat produced in the resistors. The phenomenon of production of heat in a resistor by the flow of an electric current through it is called heating effect of current or Joule heating.

Q. 7. Define electric energy. Derive an expression for electric energy consumed in time *t* when a potential difference *V*
is applied across a conductor and a current I flows through it. (CBSE 2013)

Electrical energy is the energy derived from electric potential energy or kinetic energy of the charged particles. In general, it is referred to as the energy that has been converted from electric potential energy. We can define electrical energy as the energy generated by the movement of electrons from one point to another. The movement of charged particles along/through a medium (say wire) constitute current or electricity.

Formula,

Electric energy consumed

$W=Q\times V$

$I=TQ$

$=I\times T\times V$

$\therefore W=I\times T\times V$

Q. 8 Two wires of equal length, one of copper and the other of manganin (an alloy) have the same thickness. Which
one can be used for (i) electrical transmission lines (ii) electrical heating devices? Why ?

Ans. (i) Copper wires can be used for electrical transmission lines.

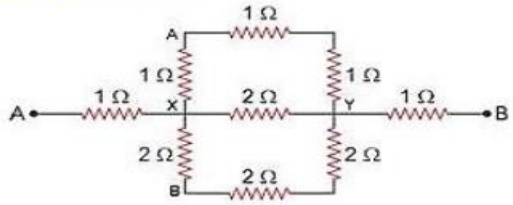
Reason : Copper has low resistivity. When electricity is transmitted through copper wires, power loss in the form of heat is minimum.

(ii) Manganin wires can be used for electrical heating devices.

Reason : Alloy manganin has high resistivity. When electricity is passed through a manganin element, a large amount of heat is produced.

Question 9: Calculate the effective resistance between the points A and B in the circuit shown in Fig 8.44.

Solution 13:



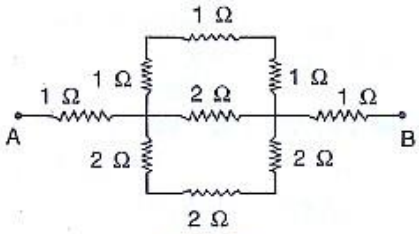


Fig. 8.44

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, $R^I = 1\Omega$

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, $R_{AB} = (1 + 1 + 1)\Omega = 3\Omega$

Question 10: Calculate the equivalent resistance between A and B in the adjacent diagram in Fig 8.46.

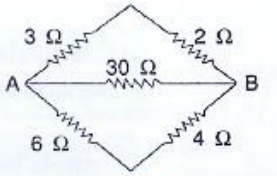


Fig. 8.46

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

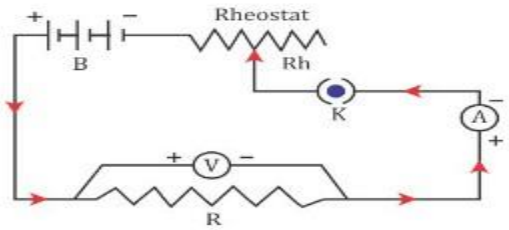
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{5} + \frac{1}{30} + \frac{1}{10} = \frac{10}{30}$$

R = 3 oh m

Question 11: State Ohm's law and draw a neat labelled circuit diagram containing a battery, a key, a voltmeter, an ammeter, a rheostat and an unknown resistance to verify it.

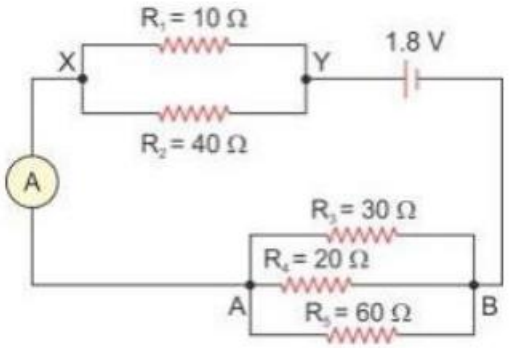
Solution 13: It states that electric current flowing through a metallic wire is directly proportional to the potential difference V across its ends provided its temperature remains the same. This is called Ohm's law.

V = IR



Question 12: The diagram below in Fig. 8.53 shows the arrangement of five different resistances connected to a battery of e.m.f. 1.8V Calculate: (a) the total resistance of the circuit, and (b) the reading of ammeter A.

Solution 29:



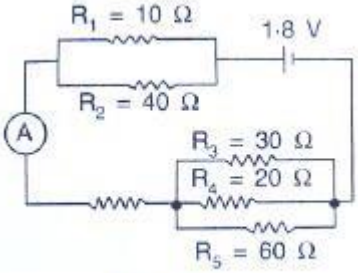


Fig. 8.53

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

Q. 7. An electric lamp of resistance 20Ω and a conductor of resistance 4Ω are connected to a 6 V battery as shown in

the circuit. Calculate :

(a) the total resistance of the circuit, (b) the current through the circuit,

(c) the potential difference across the (i) electric lamp and (ii) conductor, and

(d) power of the lamp. $(CBSE2019)$

Solution

Step 1: Given data

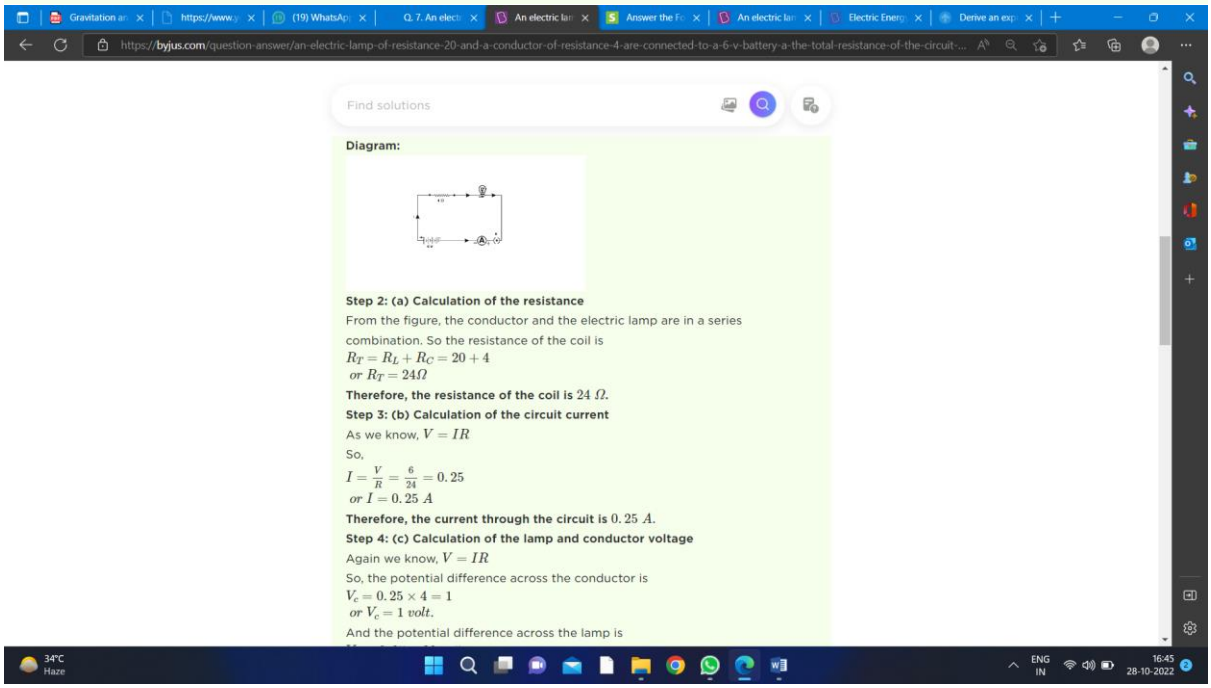
1. The resistance of the electric lamp is, $R_L = 20\Omega$.
2. The resistance of the conductor is, $R_c = 4\Omega$.
3. Supplied voltage, $V = 6\ volt$.

Ohm's law:

1. Ohm's law states that the current flowing through a conductor is directly proportional to the potential difference across the conductor.
2. The mathematical form of Ohm's law is defined by the form, $V = IR$, where, V is the potential difference, I is the current flowing through the circuit and R is the resistance of the conductor.

Power:

1. Power is the amount of energy consumed by a circuit in a unit time.
2. Power is defined by the form, $P = VI$, where, V is the voltage across a circuit and I is the current flow through the circuit.



Q. 14. Calculate the following from the electric circuit given in Fig. 12.33.

(a) Effective resistance of the combination of two 8Ω resistors. (b) Current flowing through 4Ω resistor.

(c) Potential difference across 4Ω resistors. (d) Power dissipated in 4Ω resistor.

(e) Difference in ammeter readings, if any. (CBSE 2011)

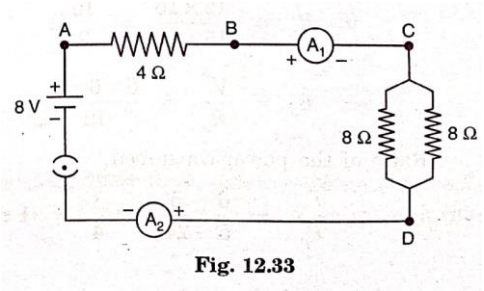


Fig. 12.33