26.08.19 EVERWIN MATRIC.HR.SEC.SCHOOL

Std: X PHYSICS STUDY MATERIAL AUGUST

UNIT:4 ELECTRICITY

		FORMULAE	UNIT
1	Electric Current	I=Q/t=$\frac{Charge}{time}$	ampere (A)
2	Ohm's law	V=IR=Current × Resistance I=V/R R=$^{V}/_{I}$	Volt Ampere Ohm (Ω)
3	Potential difference	V=W/Q =$\frac{workdone}{charge}$	Volt (V)
4	Resistivity	ρ = RA/L	Ohm-metre (Ωm)
5	Conductance	G=1/R	Ohm^{-1} (mho)
6	Conductivity	$\sigma = \frac{1}{\rho}$	Ohm^{-1} meter-1 ($mhom^{-1}$)
7	Equivalent resistance in a series combination	Rs=$R_1 R_2$+R_3 (or) Rs=nR	
8	Equivalent resistance in a parallel combination	$\frac{1}{R_P}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$	
9	Electric Power	P=$\frac{work}{time} = \frac{VIt}{t}$ (or) P=VI	watt (W)
10	Joule's law of Heating	H=VIt H=I^2Rt (∴V=IR)	Joule (J)

VI. Very short answer questions: Pg.No.56

2. What happens to the resistance, as the conductor is made thicker?

Ans: i) The resistance decreases as the conductor is made thicker.

Reason: Resistance is inversely proportional to area of cross section A. R∝ $\frac{1}{A}$

3. Why is tungsten metal used in bulbs, but not in fuse wires?

Ans: Tungsten has high melting point, it can bear high heat for glowing. But it is not used in fuse wires, because a metal (wire) which has low melting point should be used in a fuse wire.

IX. Numerical Problems: (Pg.No.57)

1. An electric iron consumes energy at the rate of 420 W when heating is at the maximum rate and 180 W when heating is at the minimum rate. The applied voltage is 220V. What is the current in each case?

Ans: i) When heating is maximum:

P_1 = 420 W

Applied Voltage (V) = 220V

P=VI

Current I = P/V

I = $\frac{420}{220}$ = 1.909A

I=1.909A

ii) When heating is minimum:

P_2=180W

Applied voltage V=220V

P=VI

I=P/V

I=$^{180}/_{220}$ = 0.818A

I=0.818A

2. A 100 watt electric bulb is used for 5 hours daily and four 60 watt bulbs are used for 5 hours daily. Calculate the energy consumed (in KWh) in the month of January.

Ans: Energy used by 100W bulb is E=P × t

=100×5

=500Wh

Energy used by four 60W bulbs E=4×60×5

=1200Wh

Total energy per day = 500 + 1200

= 1700 Wh

= 1.7 KWh

Number of days in January = 31days

Energy consumed in January = 31 × 1.7

= 52.7 KWh

3. A torch bulb is rated at 3V and 600mA, calculate it's

a) Power b) resistance

c) energy consumed if it is used for 4 hour.

Ans: a) P=VI

P= 3×0.6=1.8W

b) V=IR

R= $^{V}/_{I}$ = $\frac{3}{0.6}$ = 5Ω

c) Energy consumed for 4 hours

= Power of the bulb × time

= 1.8W × 4h
= 7.2 Wh

4. A piece of wire having a resistance R is cut into five equal parts.
 a) How will the resistance of each part of the wire change compared with the original resistance?
 b) If the five parts of the wire are placed in parallel, how will the resistance of the combination change?
 c) What will be the ratio of the effective resistance in series connection to that of the parallel connection?

Solution: a) Resistance of a piece of wire is proportional to its length.

$R \propto L$

Each piece has a resistance = R

Wire is cut into five equal parts

Resistance of each part = $R/5$

b) All the five parts are connected in parallel, the effective resistance is

$$\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$$
$$\frac{1}{R_p}=\frac{5}{R}+\frac{5}{R}+\frac{5}{R}+\frac{5}{R}+\frac{5}{R}$$
$$\frac{1}{R_P}=\frac{25}{R}$$
$$\therefore Rp=\frac{R}{25}$$

c) The ratio of the effective resistance in series to parallel connection.

$$\frac{1}{R_P}=\frac{25}{R_S}$$
$$\frac{R_S}{R_P}=\frac{25}{1}$$

Ratio of R_s & R_p = 25:1

R_s:R_p=25:1

X. Hot Questions:

1. Two resistors when connected in parallel give the resultant resistance of 2 Ohm; but when connected in series the effective resistance becomes 9 Ohm. Calculate the value of each resistance.

Solution: Effective resistance in parallel $R_p=2\Omega$

Effective resistance in series $R_s=9\Omega$

$$R_s=R_1+R_2$$
$$\frac{1}{Rp}=\frac{1}{R_1}+\frac{1}{R_2}$$
$$R_s=R_1+R_2=9$$
$$R_2=9-R_1$$
$$\frac{1}{R_1}+\frac{1}{R_2}=\frac{1}{R_p}=\frac{1}{2}$$
$$\frac{1}{R_1}+\frac{1}{9-R_1}=\frac{1}{2}$$
$$\frac{9-R_1+R_1}{R_1(9-R_1)}=\frac{9}{9R_1-R_1^2}$$
$$\frac{9}{9R_1-R_1^2}=1/2$$
$$9R_1-R_1^2=18$$
$$-R_1^2+9R_1=18=0$$
$$-R_1^2-9R_1+18=0$$
$$(R_1-3)\,(R_1-6)=0$$
$$\therefore R_1=3,6$$

When $R_1=3\Omega$, $R_2=9-3=6\Omega$

When $R_1=6\Omega$, $R_2=9-6=3\Omega$

2. How many electrons are passing per second in a circuit in which there is a current of 5A?

Solution: $I = Q/t$

Where charge of electron which is equal to 1.6×10^{-19c}

'Q' no. of charges (Q=ne)

$I=\frac{ne}{t}$ (t=IS)

$n=\frac{It}{e}=\frac{5\times1}{1.6\times10^{-19}}$

Number of electrons

$n=3.125\times10^{19}$ electrons

3. A piece of wire of resistance 10 ohm is drawn out so that its length is increased to three times its original length. Calculate the new resistance.

Solution: R=10 Ohm; Length is increased thrice = 3L

$$R=\frac{\rho L}{A}$$
$$10=\frac{\rho L}{A}$$

When the length is increased by three times (3L) the area of cross section is reduced by three times. $(A/3)$

New length = 3L

New Area = $A/3$

$\therefore$ New Resistance $R=\frac{\rho\times3L}{\frac{A}{3}}=9\left(\frac{\rho L}{A}\right)$

R =9×R

= 9 × 10

R = 90 Ω