SELF ASSESSMENT TEST SOLUTIONS

1. $R \alpha l$, ... (1)

$R \alpha \frac{1}{A}$ ..... (2)

$R \alpha \frac{l}{A}$

$\Rightarrow R = \rho \frac{l}{A}$ where ρ is the electrical resistivity.

S.I. unit of resistivity, $\rho = \frac{RA}{l} = \frac{\text{ohm x m}^2}{\text{m}} = \text{ohm x m}$

(b) $\rho = \frac{RA}{l} = \frac{100 \times 3 \times 10^{-7}}{5} = 60 \times 10^{-7}$ ohm × m

2. (i) Resistance of a uniform metallic conductor is directly proportional to its length (l) and inversely proportional to the area of cross -section (A).

$$\text{i.e.,} R \propto l \quad \rightarrow(1)$$

$$\text{and } R \propto \frac{1}{A} \quad \rightarrow(2)$$

Combining equations (1) and (2),

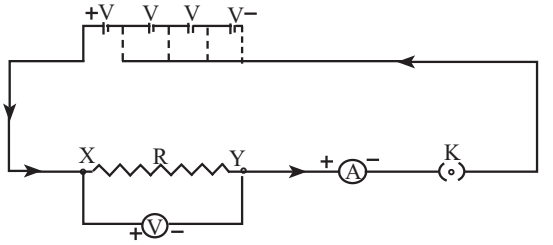
$$R \propto \frac{l}{A}$$

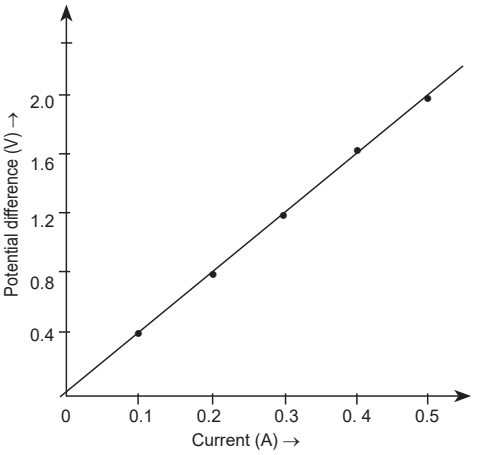
$$\text{i.e.,} R = \rho \frac{l}{A}, \text{ where } \delta \text{ is a constant of porportionality}$$

and is called electrical resistivity.

(b) $R = \rho \frac{l}{A} = 2.8 \times 10^{-8} \times \frac{4}{1.50 \times 10^{-6}} = 7.46 \times 10^{-2}\,\Omega$

3.



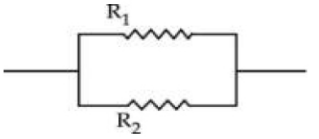


The value of I increases as V increases.

i.e., $V \propto I$ or $V = IR$

$R = \frac{V}{I} = \frac{1}{0.25} = 4\Omega$

4. (i)



(ii) Given, $R_1 = 4\Omega$, $R_2 = 8\Omega$,

Since the resistors are connected in parallel, V remains same.

$$\therefore I_1 = \frac{V}{R_1} = \frac{V}{4} \text{ and } I_2 = \frac{V}{R_2} = \frac{V}{8}$$

$$\therefore I_1 : I_2 = \frac{V/4}{V/8} = \frac{8}{4} = 2 : 1$$

5. (i) When coil A or B is used separately

$$I = \frac{V}{R_A} = \frac{V}{R_B} = \frac{220}{30} = 7.33\,A$$

(ii) When the two coils are arranged in series, the total resistance,

$$R_S = R_A + R_B = 30 + 30 = 60\Omega$$

$$\therefore I = \frac{V}{R_S} = \frac{220V}{60\Omega} = 3.67\,A$$

(iii) When the two coils are arranged in parallel the total resistance,

$$\frac{1}{R_P} = \frac{1}{R_A} + \frac{1}{R_B} = \frac{1}{30} + \frac{1}{30} = \frac{2}{30} = \frac{1}{15}$$

$$\Rightarrow R_P = 15\Omega$$

$$\therefore I = \frac{V}{R_P} = \frac{220}{15} = 14.67\,A$$

6. (a) In series arrangement, same current will flow through all the appliances which is not required and the equivalent resistance becomes higher hence the current drawn becomes less.

(b) Given, V = 2.5 V, I = 500mA = 0.5A

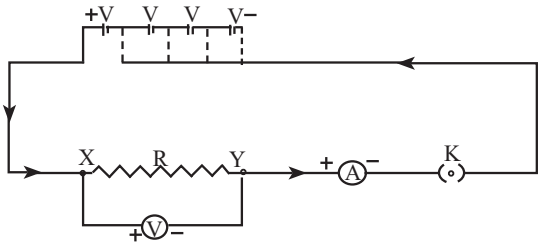
(i) Power = VI = 2.5 x 0.5 = 1.25 W

(ii) Resistance, $R = \frac{V}{I} = \frac{2.5}{0.5} = 5\Omega$

(iii) Energy consumed = P x t = 1.25 × 4 = 5wh

7. (a) Ohm's law : According to this law, the electric current flowing through a metallic conductor is directly proportional to the potential difference across its ends, provided its temperature remains the same.

(b)



(c) Since R_1 and R_2 are connected in parallel, their effective resistance,

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{1} = \frac{3}{2}$$

$$\Rightarrow R_p = \frac{2}{3}\ \Omega = 0.66\ \Omega$$

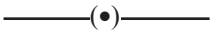
Now R_3 is in series with R_p.

$\therefore$ Effective resistance $= R_3 + R_p = 3\Omega + 0.66\Omega = 3.66\ \Omega$

8. Voltmeter is used to measure the P.D between two points. One volt is the potential difference between two points in a current carrying conductor when 1 joule of work is done to move a charge of 1 coulomb from one point to the other.

$$1 \text{ volt} = \frac{1 \text{ Joule}}{1 \text{ Coulomb}}$$

(i) Variable resistor: 

(ii) Plug key which is closed: 

(i) Circuit I (ii) Circuit II (iii) Circuit II (iv) Circuit I

9. • kW is the unit of power whereas kWh is the unit of energy.

• (i) $I = \frac{P}{V} = \frac{4.4kW}{220V} = \frac{4400}{220} = 20\,A$

(ii) $R = \frac{V^2}{P} = \frac{220 \times 220}{4400} = 11\ \Omega$

(iii) $E = P \times t = 4.4\ kW \times 5\ h = 22\ kWh$

(iv) Cost $= 22 \times 6.5 = Rs.143$

10. (i) When 1 ampere current flows through a conductor whose potential difference is 1 volt, then resistance is 1ohm.

(ii) $R_S = R_1 + R_2 = 24\ \Omega$

$$\frac{1}{R_P} = \frac{1}{12} + \frac{1}{12} = \frac{2}{12} = \frac{1}{6}$$

$$\Rightarrow R_P = 6\Omega$$

Power consumed in series combination, $P_S = \frac{V^2}{R_s} = \frac{6 \times 6}{24} = 1.5W$

Power consumed in parallel combination, $P_P = \frac{V^2}{R_P} = \frac{6 \times 6}{6} = 6W$

$$\text{Ratio} = \frac{P_S}{P_P} = \frac{1.5}{6} = \frac{1}{4} = 1 : 4$$

(iii) Voltmeter is connected in parallel across the two points in the circuit.