Solution

ELECTRICITY

Class 10 - Science

Section A

1.

(d) 80 Ω

Explanation:

We know that,

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

Given that,

l’ = 2l

A’ = $\frac{A}{2}$

And $\rho' = \rho$ (as the material of the wire is the same)

Therefore,

R’ = $\frac{\rho' l'}{A'}$

= $\frac{\rho 2l}{(\frac{A}{2})}$

= $\frac{4\rho l}{A}$

= 4R

Therefore, R’ = 4 $\times$ 20 = 80Ω

2.

(d) 2Ω

Explanation:

The resistance of each resistor = $\frac{1}{2}\Omega$

Maximum resistance can be found when the resistors are conned in series combination.

Thus for series combination

Re = R_1 + R_2 + R_3 + R_4

Re = $\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2}$ = $\frac{4}{2}$

Re = 2 Ω

3.

(c) 300 %

Explanation:

Let the original value of current is I ampere.

The new value of current $I' = I + 100\% I = 2I$

Now, the new power $P' = I'^2 R = 4I \cdot R = 4P$

So, the change in power $= P' - P = 3P$

Therefore, the change in power in terms of percentage is 300%.

4. **(a)** 600 kW h

Explanation:

V = 260 V, P = 2 kW = 2000 W,Time for which air conditioner is switched on(t) = 10 hours x 30 = 300 hours

Electrical energy consumed in 30 days

= p $\times$ t = 2000 $\times$ 300

= 600000 W h = 600 kW h

5. **(a)** 1250 J/s

Explanation:

Given,
R = 200 ohms
I = 2.5 amp
T = 1s
We know that,
$H = I^2RT$
H = 1250 J/s

6. **(a)** 59.4 kWh
Explanation:
Case 1:
Power, P_1 = 60W
Number, n_1 = 2
Time for use, T_1 = 4 hours everyday
Energy consumed, $E_1 = n_1 \times P_1 \times T_1$
$E_1 = 2 \times 60 \times 4$ = 480 watt-hour = 0.48kWh
Therefore, energy consumed for 30 days = 30×0.48 = 14.4 watt-hour
Case 2:
Power, P_2 = 100W
Number, n_2 = 3
Time for use T_2 = 5 hours everyday
Energy consumed, $E_2 = n_2 \times P_2 \times T_2$
$E_2 = 3 \times 100 \times 5$ = 1500 = 1.5kWh
Therefore, energy consumed for 30 days = 30×1.5 = 45kWh
Therefore, overall energy consumed = 14.4 + 45 = 59.4kWh

7.
(c) 92 J/s
Explanation:
Given,
V = 230V
I = 0.4 amp
Rate at which electrical energy is transferred = Power
P = VI
P = 92watt = 92 J/s

8.
(b) 3
Explanation:
3

9.
(c) 20 Ω
Explanation:
The resultant resistance obtained from the resistors that are placed in series combination is connected with 40 Ω in parallel such that the overall resistance obtained is equal to 20 Ω.

10.
(c) Nature of material
Explanation:
The resistivity of the conductor does not depend upon its length or thickness because it is the nature of the material. Resistivity is a material property. It changes with respect to the only temperature.

11.

(b) Kilowatt-hour

Explanation:

Kilowatt-hour is the commercial unit of energy.

12.

(c) heating effect of current

Explanation:

The heating effect of current is the working principle for an electric fuse.

13. **(a)** four times

Explanation:

The heat produced in an electric kettle becomes four times the actual value when the current is doubled.

14.

(b) two times

Explanation:

If V is constant, then H is inversely proportional to R because $H = V^2 t/R$. H will therefore double if R does.

15.

(c) Ohm

Explanation:

Ohm

16.

(d) ammeter is connected in series and the voltmeter in parallel.

Explanation:

ammeter is connected in series and the voltmeter in parallel.

17.

(c) 55 A

Explanation:

55 A

18.

(d) 40 V

Explanation:

Given,

Resistance, R = 20 Ohms

Current, I = 2 amp

We know that,

V = IR

Therefore, $V = 2 \times 20 = 40V$

19.

(c) $31.25 \times 10^{18}C$

Explanation:

Given,

Current, I = 5A

Time taken, t = 1s

We know that,

$I = \frac{Q}{t}$

Q = I × t = 5 × 1 = 5C

Number of electrons present in 1.6×10^{19}C = 1

Number of electrons present in 5C = $\frac{(5)}{(1.6 \times 10^{19})}$ = 31.25×10^{18}C

20.

(c) 6000 J

Explanation:

6000J of energy is transferred in an electric bulb with a power of 100W in 1 minute.

21. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

Both A and R are true and R is the correct explanation of A.

22. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

When a conductor is placed in an electric field, it is said that electric current flows through the conductor due to the flow of electrons from positive to negative terminals. This is the reason for flowing electric current. If the circuit gets opened, then the path of flow of electrons gets interrupted and current stops flowing. Thus, this option is the correct answer.

23.

(d) A is false but R is true.

Explanation:

In tube light majority portion of radiation comes under the visible region while bulb radiation consists of visible, ultraviolet, infrared radiation giving less visible part.

24. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

Most of the part of consumed power of bulb is dissipated as heat but very less part gets converted into light. So, there is a need for thermal isolation in order to reduce heat losses. This is the reason why bulbs are filled with inactive nitrogen and argon. So, both assertion and reason is true and reason is the correct explanation of assertion.

25.

(c) A is true but R is false.

Explanation:

ρ is the characteristic of the material of resistors. It does not depend on the length and cross-sectional area of resistors. But R depends on the length and the cross-sectional area of the resistor. So, R_1 may be greater than R_2 even when.

26. $\mathrm{R} = \rho \frac{l}{\mathrm{A}}$

$\rho = 1.6 \times 10^{-8} \Omega \mathrm{m}$

$\mathrm{A} = 2 \times \left(10^{-3}\ \mathrm{m}\right)^2$

$l = 1000\ \mathrm{m}$

$\therefore \mathrm{R} = \left(1.6 \times 10^{-8} \Omega \mathrm{m}\right) \times \frac{1000\ \mathrm{m}}{2 \times \left(10^{-3}\ \mathrm{m}\right)^2}$

$= 8.0 \Omega$

27. A superconductor is a substance of zero resistance at very low temperatures.

Example: Mercury below 4.2 K, Lead below 7.25 K.

28. SI unit of resistivity is ohm-m (Ω·m) .

29. Resistance is equal to the slope of V-I graph. Here, slope of graph for temperature T_2 is higher, so resistance for temperature T_2 is higher, As resistance is directly proportional to the temperature.

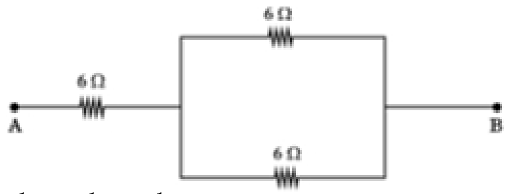
30. A galvanometer is an instrument that can detect the presence of a current in a circuit.

31. a. P = VI

b. $P = I^2R$

c. $P = \frac{V^2}{R}$

32. The obstruction offered to the flow of current by a conductor is called its resistance.
33. When two 6Ω resistances are connected in parallel and the third resistance of 6Ω is connected in series combinations to this, then equivalent resistance will be $9\Omega/$



$\frac{1}{R_P} = \frac{1}{6\Omega} + \frac{1}{6\Omega}$

$\therefore R_P = 3\Omega$

$\mathrm{Rs} = 6 + 3 = 9\Omega$

34. $R_s = R_1 + R_2 + R_3$

$= 1 + 2 + 3 = 6\Omega$

$I = \frac{V}{R}$

$= \frac{2\ V}{6\Omega} = \frac{1}{3}\ A$

V = IR

$= \frac{1}{3}\ A \times 3(\Omega) = 1\ V$

35. SI unit of electric current is Ampere. Current is said to be 1 ampere (1 A), if 1 coulomb charge flows per second across a cross-section of a conductor.

Section B

36. The current flows more easily through a thick wire as compared to thin wire of the same material, when connected to the same source. Resistance is inversely proportional to the area of cross section of the wire.It is due to this reason that resistance increases with decrease in thickness.
37. Properties of Charge:
    i. Electric charge can neither be created nor be destroyed but it can transfer from one body to another i.e., total electric charge in an isolated system is conserved.
    ii. Total charge on a body is equal to the algebraic sum of all the charges located on that body.
38. In solid the **atoms** are very tightly packed with little space which makes the electrons to travel smoothly in the solid crystal similar to a v**acuum.** The electrons' **motion in a conductor** is different from the **empty space charges.** The electrons move with average drift speed when the steady current flows through the conductor.
39. Rate at which energy is delivered by the current is called power. It is measured in watt or in kilowatt.

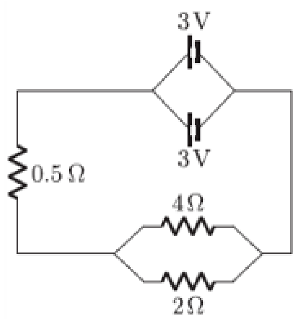
P = VI

Power in watt = V in volt $\times$ I in ampere.

If V = 1 volt; I = 1 ampere; then P = 1 watt

$\therefore$ Power consumed by a device is 1 Ω, if 1A of current flows across a potential difference of 1 V.

40. The figure (a) obeys Ohm's law because the V-I graph is a straight line and its slope (or resistance) is constant.
41. i. Negligible current will pass through the circuit because the voltmeter has a very high resistance.
    ii. Ammeter will get damaged due to flow of large amount of current through it, because it has low resistance.
42. Alloys are used in electrical heating devices rather than pure metals because they have higher resistivity as compared to pure metals.Hence, more heat is produced.Moreover, alloy does not burn (or oxidize readily at higher temperature).
43. The circuit diagram is as follows:



To calculate the current

Resistor 4Ω and 2Ω are connected in parallel. So, their equivalent resistance is given by

$R_p = \frac{4\times2}{4+2} = \frac{8}{6} = \frac{4}{3}\Omega = 1.33\Omega$

Total resistance of circuit,

R = R_p + 0.5 Ω = (1.33 + 0.5) Ω = 1.83 Ω

Current in the circuit,

$I = \frac{3V}{1.83\Omega} = 1.64\text{A}$

Potential difference across 0.5Ω resistor is

$V' = 1.64 \times 0.5$ = 0.82 V

The potential difference across 4Ω resistor is

V" = V - V' = 3 - 0.82 = 2.18 V

Thus, current flowing through 4Ω resistor is

$I_1 = \frac{2.18\text{V}}{4\Omega} = 0.55\text{A}$

44. a. Factors affecting resistance of a conductor:
    i. Resistance is directly proportional to the length of the conductor
    ii. Resistance is inversely proportional to the area of cross-section of the conductor

    b. Metals are a good conductor of electricity because they have low resistivity and also have free electrons.
    Glass is a bad conductor of electricity because it has high resistivity and have no free electrons.

    c. Alloys are commonly used in electrical heating devices because they have high resistivity and high melting point. They do not get oxidized(or burn) readily at high temperatures.

45. The figure (b) and (d) do not obey Ohm's law because the V-I graphs are not straight lines.

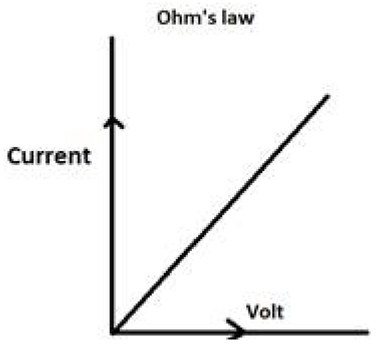
Section C

46. The brightness of the glow of bulb P will increase and brightness of the glow of bulb Q will decrease. This is because on closing S, bulbs Q and R will be in parallel and the combination will be in series with bulb P. Hence the total resistance of the circuit will decrease and the current flowing in the circuit will increase. Therefore, the glow of bulb P will increase.
    Also, since bulbs Q and R will be in parallel in this case, the current gets divided and lesser current flows through Q and hence the glow of bulb Q will decrease.

47. a. Here, 2Ω, 3Ω and 6Ω resistance are connected in series.
    $R_{eq} = R_1 + R_2 + R_3$
    = 2 + 3 + 6
    = 11

    b. $\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$
    $\frac{1}{R_{eq}} = \frac{3+2+1}{6}$
    $\frac{1}{R_{eg}} = \frac{6}{6}$
    $R_{eq} = 1\Omega$

48. The graph obtained by plotting the values of V and I is a linear graph. We will observe that as the voltage V increases the value of current I also increases linearly.
    This happens because we know that according to Ohm’s Law:
    $V \propto I$
    $\therefore V = IR$



49. Given, power, P = 1500W, voltage, V = 230 V

i. $\therefore$ Electric down drawn,

$I = \frac{P}{V} = \frac{1500}{250} = 6\text{A}$

ii. $\therefore$ Energy consumed, E = power $\times$ Time

$= 1500 \times 50$

$= 75000 Wh$

$= 75 kWh$ [$\therefore$1 kW = 1000 W]

$= 75\ unit$[$\therefore$ 1 unit = 1 kWh]

iii. $\therefore$ Cost of energy consumed $= 75 \quad \times \quad 6$

$= Rs\ 450.$

50. Given,

Power P = 4 kW,

Voltage, V = 220 V

a. We know that, P = VI.

Therefore current I = $\frac{P}{V}$ = $\frac{4kW}{220V}$ = $\frac{4000W}{220V}$ = 18.18 A

b. Energy consumed in 2h = Pt = 4 kW $\times$ 2h = 8 kWh.

c. If cost of 1 kWh = ₹ 4.50, then cost of 8 kWh of energy = ₹ 4.50 $\times$ 8 = ₹ 36

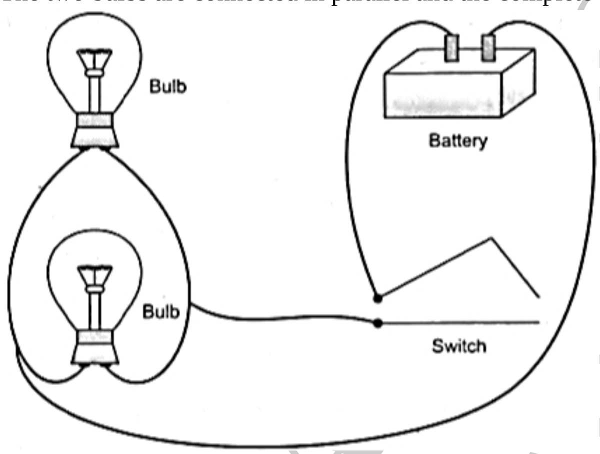
51. Given, P = 1.5 kW = 1.5 $\times$ 10^3 W, V = 220 V

therefore, the current drawn by a heater, I = $\frac{P}{V}$

$= \frac{1.5 \times 10^3 \text{W}}{220\text{V}}$ = 6.8 A

Now, the current rating of the fuse (5A) is less than the current flowing (6.81 amps) in the circuit. This would mean that the fuse will blow (or melt) and the circuit will shut down, not allowing further current to flow.

52. The two bulbs are connected in parallel and the complete circuit diagram is drawn below:



The reason for connecting the two bulbs in parallel is that (i) both the bulbs glow at the same voltage, and (ii) if one bulb stops glowing, the other bulb remains unaffected.

53. i. I. $R_{AB} = R_1 + R_2 + R_3$

II. $\frac{1}{R_{A_B}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

ii. According to ohm's law (V = IR). Slope of V-I graph gives resistance. So greater the slope of graph, greater will be its resistance. Since we know that equivalent resistance in series is greater than the equivalent resistance in Parallel. So the first (I) graph is correct representation of V-I graph in series and Parallel combination.

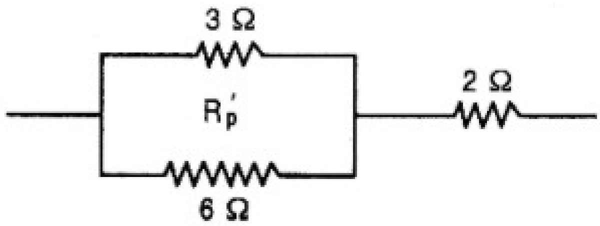
54. $\frac{1}{R_p} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6} = 1$

Or R_P = 1Ω when three are in parallel

when 3Ω and 6Ω are in parallel

$\frac{1}{R'_p} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6} = \frac{1}{2}$

R'_P = 2Ω is in series with Total 2Ω



∴ Total resistance when 3Ω and 6Ωare in parallel are in series with 2 Ω is = R'_p + 2 = 2 + 2 = 4 Ω = 4 Ω

55. a. (i) Join the three resistors R_1, R_2 and R_3 of different values in series connected to a battery of V volt.

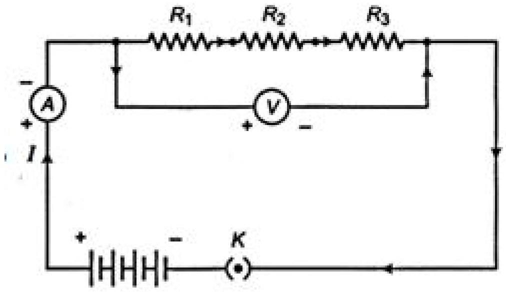
(ii) Connect them with battery, an ammeter (A) and plug key (K).

(iii) Plug the key and note the ammeter reading

(iv) Change the position of the ammeter to anywhere in between the resistors and note the ammeter reading each time.

(v) The ammeter reading will remain the same every time.

Therefore when resistors are connected in series same current flows through all resistors.



b. Given: $R_1 = 5\Omega$, $R_2 = 10\Omega$, $R_3 = 15\Omega$ and V = 30V

Total resistance of the circuit, $R = R_1 + R_2 + R_3$

R = 5 + 10 + 15

R = 30 Ω

Potential difference across the circuit, by ohm's law,

V = IR

or $I = \frac{\text{V}}{\text{R}} = \frac{30}{30} = 1\text{A}$

Potential difference across 15 ohm Resistor = 1 × 15 = 15 volt

Section D

56. i. ∵ In arm A three resistance are connected in series

So,

$R_s = R_1 + R_2 + R_3$

$R_s = 5\Omega + 15\Omega + 20\Omega$

$R_s = 40\Omega$

ii. For arm B

As resistance are connected in series

$R_B = R_1 + R_2 + R_3$

R_B = 5 + 10 + 15 = 30 Ω

For arm C

As resistance are in series

$R_C = R_1 + R_2 + R_3$

R_C = 10 + 20 + 30

R_C = 60 Ω

Now, equivalent resistance of arm B and arm C

$\frac{1}{R} = \frac{1}{R_B} + \frac{1}{R_C}$

$\frac{1}{R} = \frac{1}{30} + \frac{1}{60} = \frac{2+1}{60} = \frac{3}{60}$

R = 20 Ω

iii. Total resistance of circuit

$R_{equi} = R_S + R$

$R_{equi} = 40 + 20 = 60\Omega$

$\because V = IR$

$I = \frac{V}{R}$

$I = \frac{6}{60} = \frac{1}{10}$

I = 0.1 A

OR

If arm B is removed

Total resistance = 40 + 60 = 100Ω

$I = \frac{V}{R}$

$I = \frac{6}{100}$

I = 0.06 A

57. i. Live wire is of Red colour.

ii. The fuse is connected in between live wire.

iii. KWh is the commercial unit of power supply.

OR

A fuse wire is a safety device connected in series with the live wire of circuit. It has high resistivity and a low melting point.

58. i. $V = \frac{W}{q} = \frac{W}{It}$

ii. I = 1 A, t = 1 s

q = It = 1 $\times$ 1 = 1C

$n = \frac{q}{e} = \frac{1}{1.6\times10^{-19}} = 6.25 \times 10^{18}$

iii. The potential difference is the work done in moving a unit of positive electric charge from one point to another.

W = 100 J, q = 20 C

$V = \frac{W}{q} = \frac{100}{20} = 5$ V

OR

q = 2 C, t = 100 ms = 0.1 s

$I = \frac{q}{t} = \frac{2}{0.1}$ = 20 A

59. i. The law implies that heat produced in a resistor is

a. directly proportional to the square of current for a given resistance,
b. directly proportional to resistance for a given current, and
c. directly proportional to the time for which the current flows through the resistor.

ii. Firstly, we calculate the current flowing through it, using the relation $I = \frac{V}{R}$. Then we apply the formula $H = I^2Rt$ to calculate the heating effect.

iii. Heat produced, H = VIt

OR

The resistivity of nichrome is more than that of copper so its resistance is also high. Therefore, a large amount of heat is produced in the nichrome wire for the same current as compared to that of copper wire.

60. a. $R_s = 4\Omega + 6\Omega + 16\Omega = 26\Omega$

b. $\frac{1}{R_P} = \frac{1}{8\Omega} + \frac{1}{8\Omega} = \frac{1}{4}\Omega$

$R_P = 4\Omega$

c. Total resistance = $26\Omega + 4\Omega = 30\Omega$

Potential difference = V = 6V

Current $I = \frac{V}{R}$

$\frac{6}{30} = \frac{1}{5}$ A or 0.2 A.

OR

16Ω

Justification: According to Ohm’s law when same current flows, the potential difference across a higher resistance is always higher.

Potential difference across $16\Omega = \mathrm{V} = \mathrm{IR} = 0.2 \times 16 = 3.2$ V
Potential difference across $8\Omega = \mathrm{V} = \mathrm{IR}_{(\text{total})} = 0.2 \times 4 = 0.8$ V

61. i. If a net charge Q, flows across any cross-section of a conductor in time 't', then the current 'I', through the cross-section is given by I = $\frac{Q}{T}$
ii. The SI unit of electric charge is the coulomb (C), which is equivalent to the charge contained in nearly 6×10^{18} electrons.
iii. The electric current is expressed by a unit called ampere (A). One ampere is constituted by the flow of one coulomb of charge per second.
OR
$I = \frac{Q}{t} = \frac{12}{4} = 3A$

62. i. $E \propto t$
When the time of operating the heater is doubled, the energy dissipated is doubled.
ii. Given: P = 60 W, t = 1 min
E = 60 $\times$ 1 $\times$ 60 = 3600 J
iii. Given: P = 400 Ω, t = 8 hour
E = 400 $\times$ 8 = 3200 Wh = 3.2 kWh
Cost = 3.2 $\times$ 5 = ₹ 16
OR
Given: I = 5A, R = 2Ω, t = 30 min
E = I^2Rt = 5 $\times$ 5 $\times$ 2 $\times$ 30 $\times$ 60
E = 90000 J = 90 kJ

63. i. In series combination, Rs = R_1 + R_2 + R_3 = R + R + R = 3R.
ii. The equivalent resistance is where the total resistance is connected either in parallel or in series.
Resistance of each wire = $\frac{20}{4}$ = 5 Ω
Equivalent resistance in series
R_s = 5 + 5 + 5 + 5 = 20Ω
iii. All are in series, R_s = 5R = 5 $\times$ 2 = 10Ω
OR
R_s = 1 + 2 + 3 = 6 Ω
$I = \frac{18}{6} = 3$ A

64. i. The equivalent resistance in the parallel combination is lesser than the least value of the individual resistance.
The equivalent resistance of parallel combinations
$\frac{1}{Rp} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$
$\Rightarrow$ Rp = $\frac{8}{7}\Omega$
Thus equivalent resistance is less than 2Ω.
ii. Resistance of each piece $= \frac{12}{3} = 4\Omega$
$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4} \Rightarrow R_p = \frac{4}{3}\Omega$
iii. All the three resistors are in paralle.
$\therefore \frac{1}{R_p} = \frac{1}{6} + \frac{1}{3} + \frac{1}{1} = \frac{1+2+6}{6} = \frac{9}{6} \quad R_P = \frac{6}{9} = \frac{2}{3}\Omega$
OR
All are in parallel.
$\frac{1}{R_p} = \frac{1}{12} \times 4 = \frac{1}{3} \Rightarrow R_p = 3\Omega$
$I = \frac{3}{3} = 1$ A
So, current in each resistor $I' = \frac{3}{12} = \frac{1}{4}$ A

65. i. Since the resistance in arm B are connected in series.
So, R_B = 5Ω + 10Ω + 15Ω
R_B = 30Ω
ii. Total resistance in arm C
R_C = 10Ω + 20Ω + 30Ω
R_C = 60Ω

Now as arm B and arm C are in parallel

Equivalent resistance $\frac{1}{R} = \frac{1}{R_B} + \frac{1}{R_C}$

$\frac{1}{R} = \frac{2+1}{60} = \frac{3}{60}$

R = 20Ω

iii. Total resistance in arm A

$R_A = 5\Omega + 15\Omega + 20\Omega$

$R_A = 40\Omega$

Now, Equivalent resistance of circuit

$R_{eq} = R_{eq} + R$

$R_{eq} = 40 + 20 = 60\Omega$

By ohm's law

V = IR

$I = \frac{V}{R} = \frac{6}{60}$ = 0.1 A

OR

If arm B is removed

Equivalent resistance in circuit

$R_{eq} = R_A + R_C$

$R_{eq} = 40 + 60 = 100\Omega$

From ohm's law

V = IR

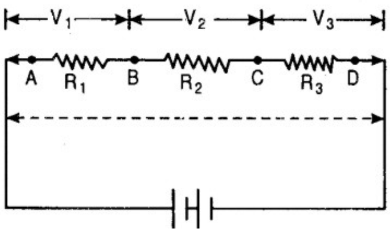
$I = \frac{V}{R} = \frac{6}{100}$ = 0.06 A

Section E

66. Combination of resistors: Resistors of all values of resistances are not available. Hence resistors are connected in a number of ways to increase or decrease the combined resistance. There are two distinct ways in which resistors can be connected. They are resistors in series and resistors in parallel.

Resistors connected in series

Resistors are said to be in series if they are joined end to end so that the same current flows through each one of them in succession. Since there is a single path for the moving charge, the same current must flow through each resistor. Let the conductor AB, BC and CD having resistances equal to R_1, R_2 and R_3 respectively, be joined in series and let the current passing through them be I.



Let V_1, V_2 and V_3 be the potential difference between the ends of the first, second and third conductor respectively.

By Ohm's law,

$V_1 = IR_1$; $V_2 = IR_2$ and $V_3 = IR_3$

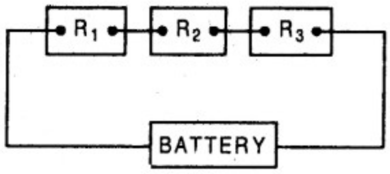
If V is the total potential difference between the ends A and D and R_s is the effective resistance of the combination of all the resistors, then

$V = IR_s$ But $V = V_1 + V_2 + V_3$

OR $IR_s = IR_1 + IR_2 + IR_3$

OR $R_s = R_1 + R_2 + R_3$

The above result holds good for any number of resistors joined in series.



Thus when some resistors are joined in series, the total resistance is the sum of individual resistances.

67. The arrangement of resistance is shown in fig. (a) and its equivalent circuit is shown in fig (b).

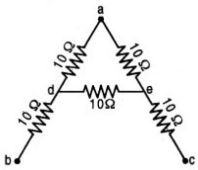


Fig. (a)

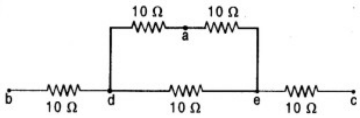


Fig. (b)

Since the wire has a resistance of $1\Omega cm^{-1}$, the resistance of cross-piece de is 10 Ω. Since apex angle is 60^0 and the cross-piece is 10 cm. long, the ends d and e of the cross-piece must be the mid-point of the legs ab and ac so that ade becomes an equilateral triangles.

As it is clear from the fig. da and ae are in series. Therefore, resistance of the combination of da and ae = 10 + 10 = 20Ω. This 20 Ω resistance is parallel to de.

∴ Effective resistance r of the portion daed is given by

$\frac{1}{r} = \frac{1}{10} + \frac{1}{20} = \frac{2+1}{20} = \frac{3}{20} or\ r = \frac{20}{3}$

Now bd and ec are in series with the resistance of portion daed.

∴ Resistance between b and c = 10 + $\frac{20}{3}$ + 10 = $\frac{80}{3}$ = 26.67Ω

68.

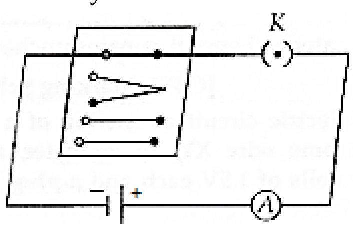
Series Combination	**Parallel Combination**
The current has a single path for its flow, hence, same current flows through each resistor.	The main current from the source divides itself in different arms. The current in each resistors is inversely proportional to its resistance.
The potential difference across the entire circuit is equal to the sum of the potential difference across the individual resistor.	The potential difference across each resistor is same and it is equal to the potential difference across the terminals of the battery (or source).
The equivalent resistance in series combination is greater than the highest resistance in the series combination.	The equivalent resistance in parallel combination is less than the least resistance in the parallel combination.
If one component breaks down, the whole circuit will burn out.	Other components will function even if one component breaks down, each has its own independent circuit

69. The resistivity of substance is numerically equal to the resistance of the rod of that substance which is 1 meter long and 1 m^2 in cross-section. The S.I. unit of resistivity is ohm metre (Ωm).

If I is the length of the conductor, A it is an area of the crosssection and R its total resistance then,

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

Where ρ is a constant of proportionality and is called the electrical resistivity of the material of the conductor. The SI unit of resistivity is Ohm meter.



Now, plug the key. Note the current in the ammeter. Now replace the wire by a thicker nichrome wire, of the same length. The thicker wire has a larger cross-sectional area. Again note down the current through the circuit. Instead of taking a nichrome wire, connect a copper wire in the circuit. Again note down the current.

70. a. Power is defined as rate of doing work/ rate at which energy is consumed/ rate at which electric energy is dissipated in an electric circuit. In simpler terms, it measures how quickly energy is converted from one form to another or how quickly work is done.

S.I unit of Power is watt

i. P = VI

= 5 volt $\times$ 500 mA

= 5 volt $\times$ $\frac{500}{1000}$A

= 2.5 watt

ii. P = $\frac{V^2}{R}$

or R = $\frac{5 \text{ volt} \times 5 \text{ volt}}{2.5 \text{ watt}}$

R = $\frac{250}{25}$ = 10Ω

iii. Energy Consumed = Power $\times$ Time

= 2.5 W $\times$ 2.5 h

= 6.25 Wh

71. Let a charge Q be moved from one point to the other, in the electric field and W be the work done, the potential difference V between two points is given by :

V = $\frac{W}{Q}$ if Q = + 1C, then V = W

$\therefore$ the potential difference between two points in the electric field is defined as the amount of work done in moving a unit positive charge from one point to the other against electrostatic force due to electric field.

SI units of P.D. is volt. Potential difference between two points is said to be 1 volt if 1 J of the work is done in moving a charge of 1 C from one point to the other.

Hence 1 Volt = $\frac{1\ Joule}{1\ Coulomb}$

1 V = 1 J/C = 1 JC^{-1}

72. Resistance of a conductor depends upon the nature of conductor, its temperature and its dimensions. (length, area etc.)

It has been experimentally verified that when temperature, pressure etc. are kept constant, the resistance R of a wire is directly proportional to its length *l* and inversely proportional to its area A i.e.

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

where r is a constant called specific resistance or resistivity.

It depends on the nature of the material and its temperature. It does not depend upon its dimensions.

$\rho = \frac{RA}{l}$, A =1 , l = 1 , $\rho = \frac{R\times 1}{1}$

$\therefore$ Specific resistance or resistivity is the resistance of a wire of unit length and of unit area cross-section. In other words, the resistivity is the resistance of a unit cube of the wire.

SI unit $\rho = \frac{RA}{l} = \frac{ohm\ m^2}{m}$

$\therefore$ Unit of ρ is ohm m

73. a. The Commercial unit of energy is kilowatt hour(kWh).

The SI unit of energy is Joule(J).

1 kWh = 1000 J/s $\times$ 3600 s

1 kWh = 3.6 $\times$ 10^6 J

b. P = 10W, V = 220V, I = 5A

We know that power is given as:

P = VI

= 220 $\times$ 5

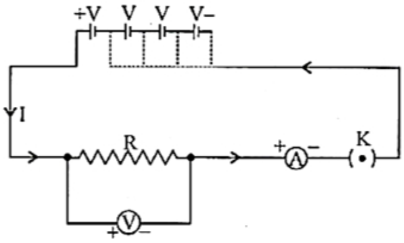
P = 1100W

Power of one bulb = 10W

Total no. of bulbs that can be connected = $\frac{1100}{10}$ = 110

74. i. V = IR, where V is potential difference, I is current and R is constant for a given resistor as its resistance. Hence, current I is directly proportional to V.

Labelled circuit diagram to verify this relationship is as follows;



ii. An ammeter has a low resistance, which makes it easy for all the current to flow through the circuit without energy loss from heat losses. This means that it does not alter the flow of electric current.

iii. We know that V = IR or $\frac{1}{R} = \frac{1}{V}$ = slope of graph given.

The resistance increases as the slope decreases. Graph B clearly has a greater slope than graph A. As a result, B has less resistance than A. As far as we are aware, combined series resistance is consistently greater than combined parallel resistance. As a result, A and B are series and parallel combinations, respectively.

75. a. Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference across the two points and inversely proportional to the resistance between two points.

b. The slope of the displacement time graph gives us the physical quantity called velocity.

The SI unit of velocity is metre per second (m/s).

c. 1 KWh is defined as the 1000 J energy is used in 1 hour.

Mathematically, 1 KWh = 3.6 $\times$ 10^6 J/s.