Current Electricity Important Questions With Answers

NEET Physics 2023

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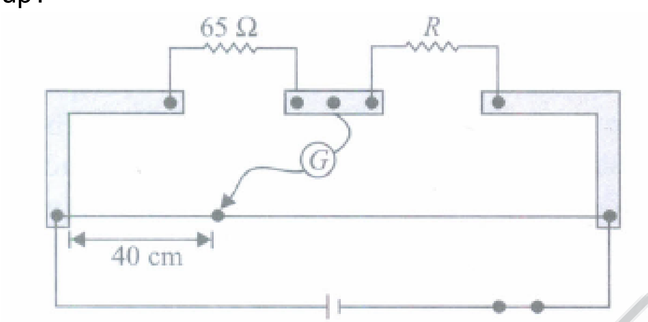
1. What is the value of unknown resistance R, if galvanometer shows null deflection in the given meter bridge set up?



a) 97.50Ω b) 105Ω c) 150Ω d) 110Ω

Solution : -

For null deflection in meter bridge

$\frac{R_1}{R_2} = \frac{1}{(100-1)}; \therefore \frac{65}{R_1} = \frac{40}{100-40} = \frac{40}{60}$

$R_1 = 65 \times \frac{60}{40} = 97.5\Omega$

2. A potentiometer circuit has been set up for finding the internal resistance of a given cell. The main battery, used across the potentiometer wire, has an emf of 2.0 V and a negligible internal resistance. The potentiometer wire itself is 4m long. When the resistance, R, connected across the given cell, has values of (i) infinity (ii) 9.5 Ω, the 'balancing lengths', on the potentiometer wire are found to be 3 m and 2.85 m, respectively. The value of internal resistance of the cell is :

a) 0.25 Ω b) 0.95 Ω **c) 0.5 Ω** d) 0.75 Ω

Solution : -

Internal resistance of cell $r = \left(\frac{l_1 - l_2}{l_2}\right)$ x R

Putting the values, $\frac{3-2.85}{2.85}$ x 9.5 = 0.5 Ω

3. The thermo e.m.f E in volts of a certain thermocouple is found to vary with temperature difference θ in ^oC between the two junctions according to the relation $E = 30\theta - \frac{\theta^2}{15}$. The neutral temperature for the thermocouple will be __________.

a) 30^{o}C b) 450^{o}C c) 400^{o}C **d) 225^{o}C**

Solution : -

$E = 30\theta - \frac{\theta}{15}$

For neutral temperature, $\frac{dE}{d\theta} = 0$

$0 = 30 - \frac{2}{15}\theta$

$\therefore$ q = 15 x 15 = 225^o C

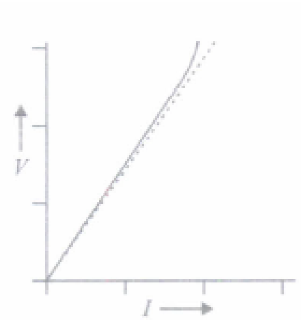
Thus, neutral temperature is 225^o C.

4. Two cities are 150 km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is 0.5 W. The power loss in the wires is _______.
a) 19.2 J b) 12.2 kw c) 19.2 w **d) 19.2 kw**

Solution : -
Total resistance R = (0.5 W km) x (150 km) = 75 W Total voltage drop = (8 V/km) x (150 km) = 1200 V
$$\text{Power loss } = \frac{(\Delta V)^2}{R} = \frac{(1200)^2}{75} W$$
= 19200 W = 19.2 kW

5. **Assertion:** For good conductors, the I- V graph is a perfect straight line inclined to current axis.
Reason: By Ohm's law, voltage across the ends of a conductor is directly proportional to the resistance point in a line. of the conductor.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but reason is not the correct explanation of assertion
c) If assertion is true but reason is false. **d) If both assertion and reason are false**

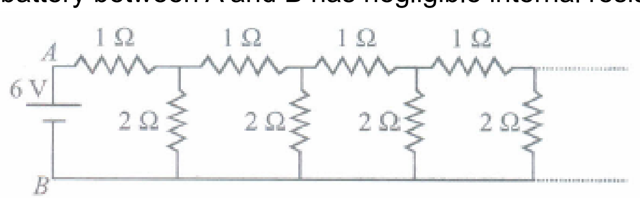
Solution : -
The given graph shows the V-I graph of a good conductor. Ohm's law states that, current flowing through a conductor is directly proportional to the voltage between the ends of a given conductor. i.e. V ∞ I.



6. A heating coil is labelled 100 W 220 V. The coil is cut in two equal halves and the two pieces are joined in parallel to the same source. The energy now liberated per second is ____________.
a) 25 J b) 50 J c) 200 J **d) 400 J**

Solution : -
When heating coil is cut into two equal parts and these parts are joined in parallel, then the resistance of the coil is reduced to $\frac{1}{4}$ of the previous value. As $\left(H \propto \frac{1}{R}\right)$ for constant voltage so, energy liberated per second becomes 4 times, i.e., 4 x 100 = 400 J.

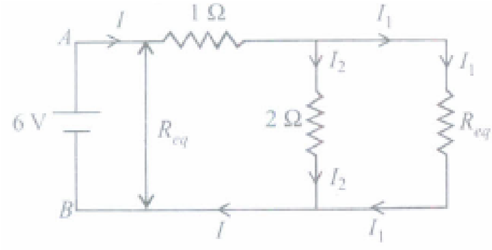
7. An infinite ladder network of resistances is constructed with 1Ω and 2Ω resistance as shown in figure. The 6 V battery between A and B has negligible internal resistance. The equivalent resistance between A and B is



a) 1Ω **b) 2Ω** c) 3Ω d) 4Ω

Solution : -

The equivalent circuit is



$$R_{eq} = 1 + \frac{2 \times R_{eq}}{(2 + R_{eq})} = \frac{2+3R}{2+R_{eq}}\ i.e.,\ R_{eq}^2 - R_{eq} - 2 = 0$$
$$\Rightarrow R_{eq} = \frac{1}{2}[1 \pm \sqrt{1+8}] = 2\Omega$$

8. Figure (a) and figure (b) both are showing the variation of resistivity (p) with temperature (T) for some materials. Identify the type of these materials.

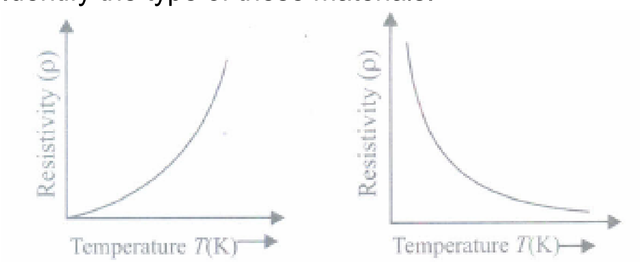
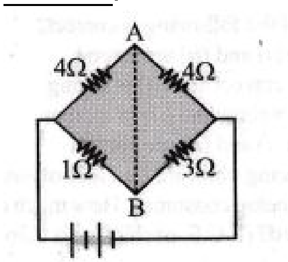


Fig. (a) Fig. (b)

a) Conductor and semiconductor b) Conductor and Insulator c) Insulator and semiconductor
d) Both are conductors

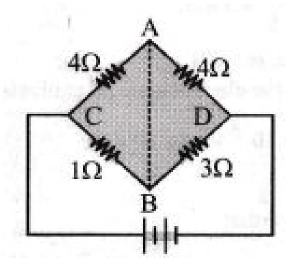
Solution : -
In conductors due to increase in temperature the resistivity increases and in semiconductors it decreases exponentially.

9. In the circuit shown, if a conducting wire is connected between points A and B, the current in this wire will _______.



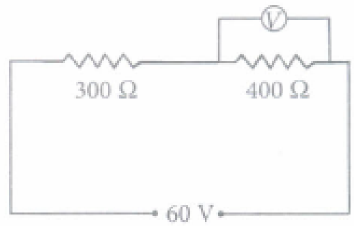
a) flow in the direction which will be decided by the value of V b) be zero **c) flow from B to A**
d) flow from A to B

Solution : -
Current will flow from B to A



Over the resistance CA Potential drop will be more due to higher resistance. So potential at A will be less as compared with at B. Hence, current will flow from B to A.

10. A heater is designed to operate with a power of 1000W in a 100 V line. It is connected in combination with a resistance of 10 Ω and a resistance R, to a 100 V mains as shown in the figure. What will be the value of R so that the heater operates with a power of 62.5 W?



a) 15Ω b) 10Ω **c) 5Ω** d) 25Ω

Solution : -

Let R' be the resistance of the heater of coil.

$$R' = \frac{V^2}{P} = \frac{(100)^2}{1000} = 10\Omega$$

If the heater has to operate with a power P' = 62.5 W, the voltage V' across its coil should be

V = $(P'R')^{1/2}$ = $(62.5 \text{ X } 10)^{1/2}$ = 25 V.

Thus, out of 100 V, a voltage drop of 25 V occurs across the heater and the rest 100 - 25 = 75 V occurs across the 10 Ω resistor. Therefore, current in the circuit is

$$I = \frac{75}{10} = 7.5A.$$

Now, current through the heater$= \frac{V'}{R'} = \frac{25}{10} = 2.5A$

Therefore, current through resistor R = 7.5 - 2.5 = 5.0 A.

Hence, $R = \frac{V'}{5.0A} = \frac{25V}{5.0A} = 5\Omega$

11. Point out the right statements about the validity of Kirchhoff's junction rule

a) it is based on conservation of charge.

b) outgoing currents add up and are equal to incoming currents at a junction.

c) bending or reorienting the wire does not change the validity of Kirchhoff's junction rule. **d) all of above**

12. Four wires of the same diameter are connected, in turn, between two points maintained at a constant potential difference. Their resistivities and lengths are; ρ and L (wire 1), 1.2 ρ and 1.2 L (wire 2), 0.9 ρ and 0.9 L (wire 3) and ρ and 1.5 L (wire 4). Rank the wires according to the rates at which energy is dissipated as heat, greatest first,

a) 4 > 3 > 1 > 2 b) 4 > 2 > 1 > 3 c) 1 > 2 > 3 > 4 **d) 3 > 1 > 2 > 4**

Solution : -

Resistance of a wire, R=$\frac{\rho_l}{A}$

Rate of energy dissipated as heat is $H = \frac{V^2}{R} = \frac{V^2 A}{\rho l}$

For a wire 1, $H_1 = \frac{V^2 A}{\rho L}$

For a wire 2,

$$H_2 = \frac{V^2 A}{(1.2\rho)(1.2L)} = \frac{0.694 V^2 A}{\rho L} = 0.694 H_1$$

For a wire 4, $H_4 = \frac{V^2 A}{(\rho)(1.5L)} = \frac{0.666 V^2 A}{\rho L} = 0.666 H_1$

$\therefore H_3 > H_1 > H_2 > H_4$

13. If 25Ω, 220 V and 100Ω, 220 V bulbs are connected in series across a 440 V line, then ______.

a) only 25Ω bulb will fuse b) only 100Ω bulb will fuse c) both bulbs will fuse d) none of these

Solution : -

For an electric appliance $R=\left(V_S^2/W\right)$

$\therefore$ For same specified voltage V_S

$\frac{R_{25}}{R_{100}}=\frac{100}{25}=4$

i.e., R_{25} = 4R with R_{100} = R

Now in series potential is divided in proportion to resistance

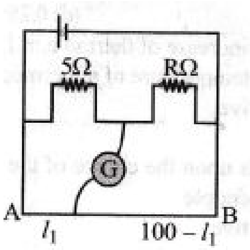
So, $V_1=\frac{R_1}{(R_1+R_2)}V$

i.e., $V_{25}=\frac{4}{5}\times 440=352\text{ V}$

and $V_2=\frac{R_2}{(R_1+R_2)}V$

i.e., $V_{100}=\frac{1}{5}\times 440=88\text{ V}$

14. The resistances in the two arms of the metre bridge are 5W; and RW, respectively. When the resistance R is shunted with an equal resistance, the new balance point is at $1.6l_1$. The resistance 'R' is ______.



a) 10 Ω **b) 15 Ω** c) 20 Ω d) 25 Ω

Solution : -

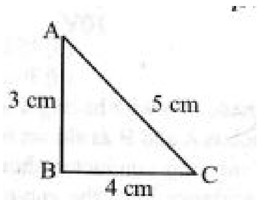
This is a balanced Wheatstone bridge condition,

$\frac{5}{R}=\frac{\ell_1}{100-\ell_1}$ and $\frac{5}{R/2}$

$=\frac{1.6\ell_1}{100-1.6\ell_1}$

$\Rightarrow R=15\Omega$

15. A 12 cm wire is given a shape of a right-angled triangle ABC having sides 3 cm, 4 cm and 5 cm as shown in the figure. The resistance between two ends (AB, BC, CA) of the respective sides are measured one by one by a multimeter. The resistances will be in the ratio of ________.



a) 3:4:5 b) 9:16:25 **c) 27:32:35** d) 21:24:25

Solution : -

Resistance is directly proportional to length

$\frac{1}{R_{AB}}=\frac{1}{3}+\frac{1}{4+5}=\frac{(4+5)+3}{(3)(4+5)}$

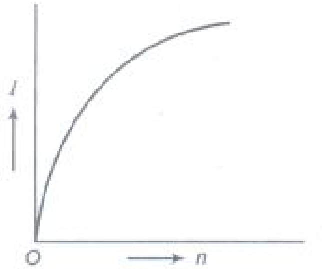
$R_{AB}=\frac{3\times(4+5)}{3+(4+5)}=\frac{3\times 9}{3+9}=\frac{27}{12}$

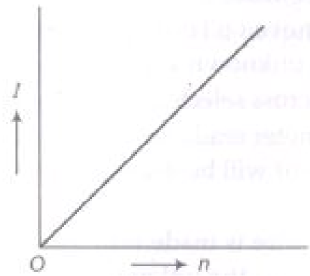
Similarly

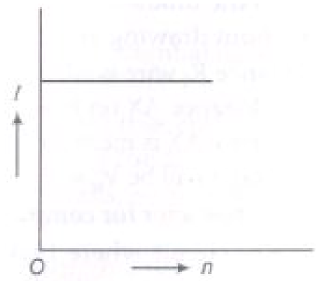
$R_{BC}=\frac{4\times(3+5)}{4+(3+5)}=\frac{4\times 8}{4+8}=\frac{32}{12}$

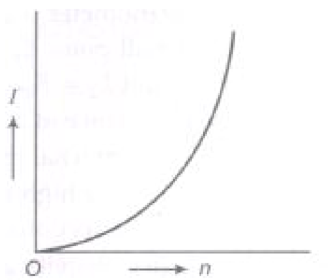
$R_{AC}=\frac{5\times(3+4)}{5+(3+4)}=\frac{5\times 7}{5+7}=\frac{35}{12}$

16. A battery consists of a variable number 'n' of identical cells (having internal resistance 'r' each) which are connected in series. The terminals of the battery are short-circuited and the current I is measured. Which of the graphs shows the correct relationship between I and n?

a) 

b) 

c) 

d) 

Solution : -

Given, battery with variable number 'n' of identical cells having internal resistance of 'r' each connected in series.
If the battery terminals are short-circuited, the current I is measured.
The relationship between I and n are plotted as I = nE/nr = E/r, so option (c) is correct.

17. A wire with 15 Ω resistance is stretched by one tenth of its original length and volume of wire is kept constant. Then its resistance will be

a) 15.18 Ω b) 81.15 Ω c) 51.18 Ω **d) 18.15 Ω**

Solution : -

If the wire is stretched by $(1/10)^{th}$ of its original length then the new length of wire become

$l_2 = l + \frac{l}{10} = \frac{11l}{10}$ .....(i)

As the volume of wire remains constant then

$\pi r_1^2 l = \pi r_2^2 l_2 = \pi r_2^2\left(\frac{11l}{10}\right)$(using (i))

$\Rightarrow \quad r_2^2 = \frac{10}{11} r_1^2$ ....(ii)

Now the resistance of stretched wire.

$$R_2 = \frac{\rho\left(\frac{11}{10} l\right)}{\pi r_2^2} = \frac{\left(\frac{11}{10}\right)\rho l}{\pi \times \frac{10}{11} r_1^2} = \left(\frac{11}{10}\right)^2 \times \frac{\rho l}{\pi r_1^2}$$

$$\left(\because R_1 = \frac{\rho l}{\pi r_1^2} = 15\Omega\right)$$

$$\therefore R_2 = \left(\frac{11}{10}\right)^2 \times 15 = 18.15\Omega$$

18. The total resistance in the parallel combination of three resistances 9 Ω, 7Ω and 5 Ω is

a) 1.22 Ω b) 2.29 Ω c) 4.22 Ω **d) 2.02 Ω**

Solution : -

In the parallel combination of three resistances, the equivalent resistance is

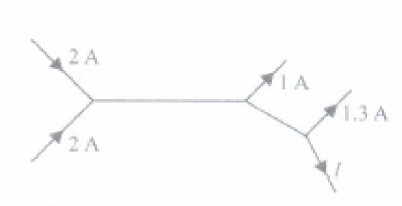
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

or $\frac{1}{R_{eq}} = \frac{1}{9} + \frac{1}{7} + \frac{1}{5} = \frac{143}{315}; R_{eq} = \frac{315}{143} = 2.02\Omega$

19. In the following question, a statement of assertion is followed by a statement of reason. Mark the correct choice as :
Assertion: Insulators do not allow flow of current through them.
Reason: Insulators have no free charge carriers
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but reason is not the correct explanation of assertion
c) If assertion is true but reason is false. d) If both assertion and reason are false

Solution : -
Current arises due to continuous flow of charged particles. There is no free charge carriers in insulator hence no flow of charges are possible. Therefore current do not flow through insulators.

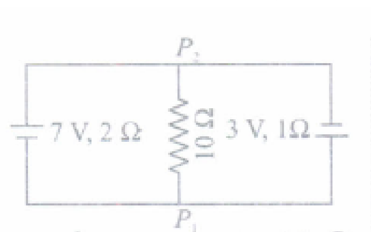
20. Figure shows currents in a part of an electric circuit, then current I is



a) 1.7A b) 3.7A c) 1.3A d) 1A

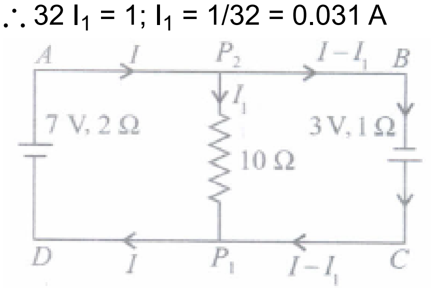
Solution : -
Applying Kirchhoff's first law, 1= 2 + 2 - 1 - 1.3 = 1.7 A

21. A 7 V battery with Internal resistance 2 Ω and a 3 V battery with internal resistance 1 Ω are connected to a 10 Ω resistor as shown in figure, 10 Ω resistor is

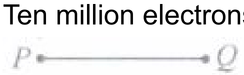


a) 0.27A b) 0.31A **c) 0.031A** d) 0.53A

Solution : -
Using Kirchhoff's law in loop A P_2 P_1 DA
$\therefore 10I_l + 2I - 7 = 0$
$10I_1+2I=7$ ... (i)
Using Kirchhoff's law in loop P_2 P_1 CBP_2
$-3 + 1(I - I_1) - 10\ I_1= 0$
$I-11I_1 =3; I=3+11I_1$ ...(ii)
From (i) and (ii),
$10\ I_1 + 2\ (3 + 11I_1) = 7; 10\ I_1 + 6 + 22\ I_1 = 7$
$\therefore 32\ I_1 = 1; I_1 = 1/32 = 0.031$ A



22. Ten million electrons pass from point P to point Q in one microsecond. The current and its direction is



a) 1.6×10^{-14} A, from point P to point Q b) 3.2×10^{-14} A, from point P to point Q
c) 1.6×10^{-6} A, from point Q to point P d) 3.2×10^{-12} A, from point Q to point P

Solution : -

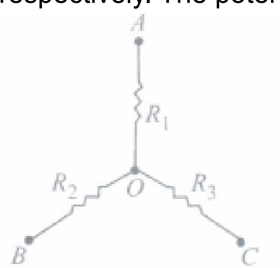
Here, number of electron, n = 10000000 = 10^7
Total charge on ten million electrons is
Q = ne [where e = 1.6×10^{-19}C]
= $10^7 \times 1.6 \times 10^{-19}$ C = 1.6×10^{-12} C
Time taken by ten million electrons to pass from point P to point Q is t = 1 μs = 10^{-6} s
The current
$I = \frac{Q}{t} = \frac{1.6\times10^{12}}{10^{-6}} = 1.6 \times 10^{-6} A$
Since the direction of the current is always opposite to the direction of flow of electrons. Therefore due to flow of electrons from point P to point Q the current will flow from point Q to point P.

23. A wire of resistance 4 Ω is used to wind a coil of radius 7 cm. The wire has a diameter of 1.4 mm and the specific resistance of its material is 2×10^{-7} Ω m. The number of turns in the coil is
a) 50 b) 40 c) 60 **d) 70**

Solution : -

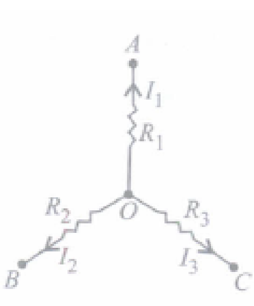
Let n be the number of turns in the coil.
Then total length of wire used,
l = $2\pi r \times n = 2\pi \times 7 \times 10^{-2} \times n$
Total resistance, R=$\rho\frac{l}{A}$
or $4 = \frac{2\times10^{-7}\times2\pi\times7\times10^{-2}\times n}{\pi(0.7\times10^{-3})^2} \therefore n = 70$

24. A circuit has a section ABC as shown in figure. If the potentials at points A, B and C are V_1 V_2 and V_3 respectively. The potential at point O is:



a) V_1+V_2+V_3 **b)** $\left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right]\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]^{-1}$ c) Zero
d) $\left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right](R_1 + R_2 + R_3)$

Solution : -



Applying junction rule to O
$-I_1 - I_2 - I_3 = 0$
i.e., $I_1 + I_2 + I_3 = 0$ ... (i)
Let, V_0 be the potential at point O. By

Ohm's law for resistances R_1, R_2 and R_3 respectively, we get
$(V_0 - V_1) = I_1R_1$; $(V_0 - V_2) = I_2R_2$ and $(V_0 - V_3) = I_3R_3$
or $I_1 = \frac{(V_0 - V_1)}{R_1}; I_2 = \frac{(V_0 - V_2)}{R_2}; I_3 = \frac{(V_0 - V_3)}{R_3}$
So substituting these values of II' lz and 13 in eqn. (i), we get
$V_0\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right] - \left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right] = 0$
$V_0 = \left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right]\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]^{-1}$

25. If n cells each of emf ϵ and internal resistance r are connected in parallel, then the total emf and internal resistances will be
a) $\epsilon, \frac{r}{n}$ b) $\epsilon,\ nr$ c) $n\epsilon, \frac{r}{n}$ d) $n\varepsilon, nr$

Solution : -
In the parallel combination,
$\frac{\varepsilon_{eq}}{r_{eq}} = \frac{\varepsilon_1}{r_1} + \frac{\varepsilon_2}{r_2} + \ldots + \frac{\varepsilon_n}{r_n}$
$\frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} + \ldots\ldots + \frac{1}{r_n}$
($\because \varepsilon_1 = \varepsilon_2 = \varepsilon_3 = \ldots\ldots = \varepsilon_n = \varepsilon$ and $r_1 = r_2 = r_3 = \ldots\ldots r_n = r$)
$\therefore \frac{\varepsilon_{eq}}{r_{eq}} = \frac{\varepsilon}{r} + \frac{\varepsilon}{r} + \ldots + \frac{\varepsilon}{r} = n\frac{\varepsilon}{r}$ .....(i)
$\frac{1}{r_{eq}} = \frac{1}{r} + \frac{1}{r} + \ldots + \frac{1}{r} = \frac{n}{r}$
$r_{eq} = r/n$ ......(ii)
From (i) and (ii),
$\varepsilon_{eq} = n\frac{\varepsilon}{r} \times r_{eq} = n \times \frac{\varepsilon}{r} \times \frac{r}{n} = \varepsilon$

26. A current of 2A flows through a 2Ω resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a 9Ω resistor. The internal resistance of the battery is _______.
a) 0.5 Ω **b) 1/3 Ω** c) 1/4 Ω d) 1 Ω

Solution : -
Suppose, the internal resistance of the battery is r,
Then the current flowing through the circuit = $i = \frac{E}{R+r}$
Case 1: $2 = \frac{E}{2+r}$ ....(i)
Case 2 : $0.5 = \frac{E}{9+r}$ ....(ii)
From equations (i) and (II)
4+2r=4.5+0.5r
$\Rightarrow 1.5r = 0.5 \Rightarrow r = \frac{1}{3}\Omega.$

27. A battery of 6 volts is connected to the terminals of a three metre long wire of uniform thickness and resistance of the order of 100 Ω. The difference of potential between two points separated by 50 cm on the wire will be :
a) 1 V b) 1.5 V c) 2 V d) 3 V

Solution : -
In a potentiometer, similar amount of current is passing in the entire wire length so, V α R α l
Now, $V_1/V_2 = l_1/l_2$
$6/V_2 = 300/50$
Solving for potential difference V_2 we get 1 V

28. Three equal resistors connected in series across a source of emf together dissipate 10 W of power. What will be the power dissipated in Watt if the same resistors are connected in parallel across the same source of emf?
a) $\frac{10}{3}$ b) 10 c) 30 **d) 90**

Solution : -

Power, $P = \frac{\Delta U}{\Delta t} = V\frac{\Delta q}{\Delta t} = V_i$

or $P = Vi = \frac{V^2}{R}(\text{Q}V = iR)$

when resistance are in series, then

R_1 = R + R + R = 3R

$\therefore$ power dissipated

$P_1 = \frac{V^2}{R_1} = \frac{V^2}{3R}$ ....(i)

When resistors are in parallel, then

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

$\Rightarrow \quad R_2 = \frac{R}{3}$

$\therefore \quad P_2 = \frac{V^2}{R_2} = \frac{V^2}{R/3} = \frac{3V^2}{R}$ ....(ii)

By taking ratio of Eqs. (i) and (ii)

$\frac{P_2}{P_1} = \frac{3V^2}{R} \times \frac{3R}{V^2}$ = 9

$p_2 = 9p_1$

= 9 x 10 = 90 W

29. A battery of 10 V and internal resistance 0.5 Ω is connected across a variable resistance R. The value of R for which the power delivered is maximum is equal to _______.

a) 0.25 Ω **b) 0.5 Ω** c) 1.0 Ω d) 2.0 Ω

Solution : -

Power of maximum when r = R, R = r = 0.5 Ω.

30. In the following question, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

Assertion: Drift velocity of electrons is independent of time.

Reason : Electrons are accelerated in the presence of electric field

a) If both assertion and reason are true and reason is the correct explanation of assertion.

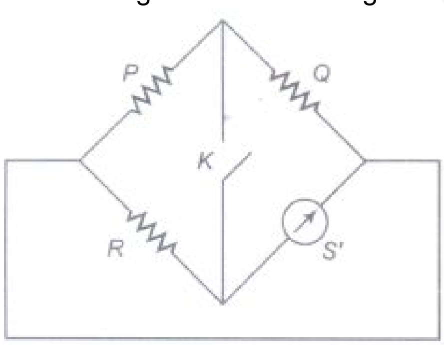
b) If both assertion and reason are true but reason is not the correct explanation of assertion

c) If assertion is true but reason is false. d) If both assertion and reason are false

Solution : -

Drift velocity is the average velocity of electrons in presence of electric field, which is independent of time.

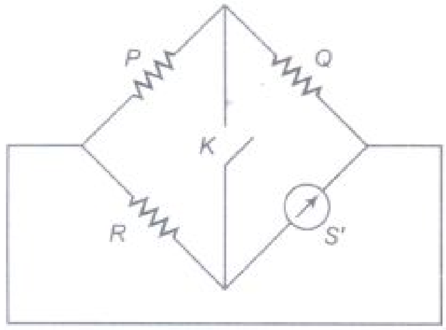
31. In the following Wheatstone bridge P/Q=R/S. If key K is closed, then the galvanometer will show deflection :



a) In left side b) In right side c) No deflection **d) In either side**

Solution : -

From the balanced Wheatstone bridge:



P/Q =R/S

On pressing the key, it is observed that there will be no effect of current in the resistances, hence deflection in galvanometer will be remain in whatever direction it was observed.

32. In a potentiometer a cell of emf 1.5 V gives a balanced point at 32 cm length of the wire. If the cell is replaced by another cell then the balance point shifts to 65.0 cm then the emf of second cell is

a) 3.05 V b) 2.05 V c) 4.05 V d) 6.05 V

Solution : -

Here, in the balance condition of potentiometer

$\frac{\varepsilon_1}{\varepsilon_2} = \frac{I_1}{I_2}$ or $\varepsilon_1 = 1.5$ V, I_1 = 32 cm, I_2 = 65 cm

$\therefore \quad \varepsilon_2 = \varepsilon_1 \times \frac{I_2}{I_1} = 1.5 \times \frac{65}{32} = 3.05v$

33. In a meter bridge, the balancing length from the left end (standard resistance of one ohm is in the right gap) is found to be 20 cm. The value of the unknown resistance is:

a) 0.8 Ω b) 0.5 Ω c) 0.4 Ω **d) 0.25 Ω**

Solution : -

In a meter bridge, if balancing length from left end is 20 cm, then value of unknown resistance X will be X = R

$\frac{l}{100-l}$ = X/1 = 20/80

X = 1/4Ω=0.25 Ω

34. The masses of the three wires of copper are in the ratio of 1: 3: 5 and their lengths are in the ratio of 5: 3: 1. The ratio of their electrical resistance is________.

a) 1: 3: 5 b) 5: 3: 1 c) 1: 25: 125 **d) 125: 15: 1**

Solution : -

Let A_1 A_2, A_3 be the area of cross-section of three
wires of copper of masses m_1, m_2, m_3 and length l_1, l_2, l_3
respectively. Given m_1 = m, m_2 = 3m, m_3 = 5m, l_1 = 5l, l_2 = 3l,l_3 = l
Mass = volume x density
So, m = A_1 x 51 x r ....(i)
3m = A_2 x 31 x r ....(ii)
5m = A_3 x 1 x p ....(iii)
From Eqs. (i) and (ii), we get
A_2 = $5A_1$
FromEqs. (i) and (iii),
A_3 = 25A1

$\therefore R_1 = \rho \frac{l_1}{A_1} = \rho \frac{5l}{A_1}$

$R_2 = \rho \frac{l_2}{A_2} = \rho \times \frac{3l}{5A_1} = \frac{3}{25} R_1$

$$R_3 = \rho\frac{l_3}{A_3} = \frac{\rho\times l}{25A_1} = \frac{R_1}{125}$$

$$\therefore \quad R_1 : R_2 : R_3 = R_1 : \frac{3}{25}R_1 : \frac{R_1}{125}$$

= 125: 15: 1

35. In the following question, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

Assertion: Potentiometer is used only to compare potential differences.

Reason: The potentiometer draws current from the voltage source being measured.

a) If assertion is true but reason is false **b) If both assertion and reason are false**

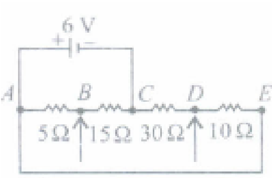
c) If both assertion and reason are true and reason is the correct explanation of assertion.

d) If both assertion and reason are true but reason is not the correct explanation of assertion

Solution : -

Potentiometer is a device used to compare potential differences. Since the method involves a condition of no current flow, the device can be used to measure potential difference, internal resistance of a cell and compare emf's of two sources. Potentiometer draws no current from the voltage source being measured.

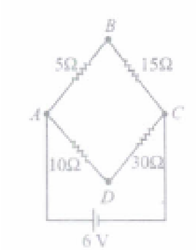
36. Four resistors are connectedas shown in the figure. A 6 V battery of neghgible resistance is connected across terminals A and C. The potential difference across terminals Band D will be



a) Zero b) 1.5V c) 2V d) 3V

Solution : -

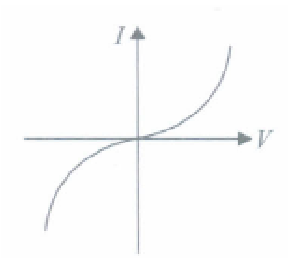
The given figure is a circuit of balanced Wheatstone bridge as shown in the figure.



Points Band D would be at the same potential,

i e., V_B - V_D = 0 volt

37. The I- V characteristics shown in figure represents

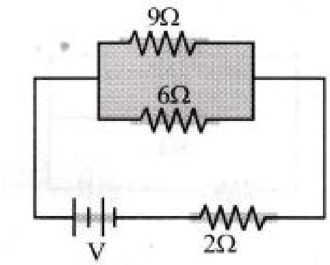


a) ohmic conductors **b) non-ohmic conductors** c) insulators d) superconductors

Solution : -

The figure is showing I- V characteristics of non-ohmic or non-linear conductors.

38. If power dissipated in the 9 W resistor in the circuit shown is 36 watt, the potential difference across the 2 W resistor is _________.



a) 4 volt b) 8 volt **c) 10 volt** d) 2 volt

Solution : -

$\because P = \frac{V^2}{R}$

$\Rightarrow 36 = \frac{V^2}{R} \Rightarrow V^2 = 9 \times 9 \times 4$

$\Rightarrow$ V = 18 V

Current passing through the 9Ω resistor is

$i_1 = \frac{V}{R} = \frac{18}{9} = 2\ \mathrm{A}$

The 9Ω and 6Ω resistors are in parallel combination

$\therefore i_1 = \frac{6}{9+6} \times i$

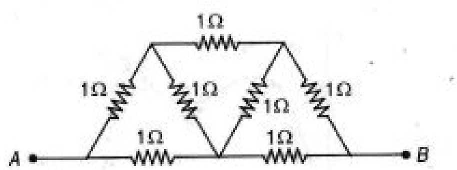
where i is the current supplied by the battery.

$\therefore i = \frac{2 \times 15}{6} = 5\ \mathrm{A}$

Therefore, potential difference across 2f) resistor is

V = iR = 5 x 2 = 10V.

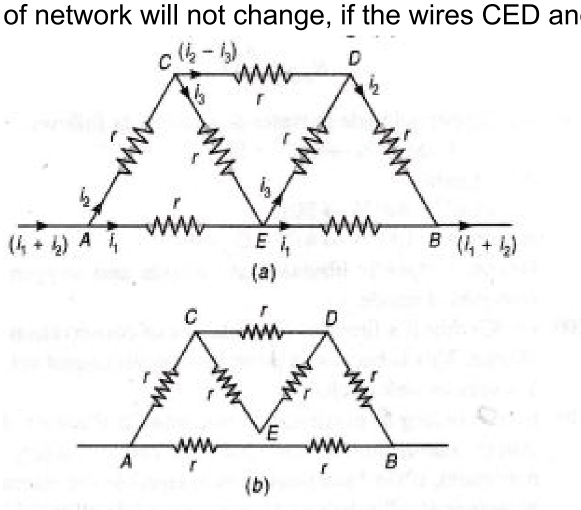
39. In the network shown in figure each resistance is 1Ω. The effective resistance between A and B is _______.



a) $\frac{4}{3}\Omega$ b) $\frac{3}{2}\Omega$ c) 7Ω **d) $\frac{8}{7}\Omega$**

Solution : -

The distribution of currents in the circuit is shown in Fig. (a). Due to symmetry current in arm AE is equal to current in the arm EB. Since, current in the arm CE is equal to the current in the arm ED, therefore the resistance of network will not change, if the wires CED and AEB are disconnected at E, as shown in Fig. (b).



Now, resistance of path AEB = r + r = 2r

Resistance of path ACDB = $= r + \frac{(2r)\times r}{(2r)+r} + r\ \frac{8r}{3}$

The paths AEB and ACDB are in parallel, therefore the effective resistance between A and B will be

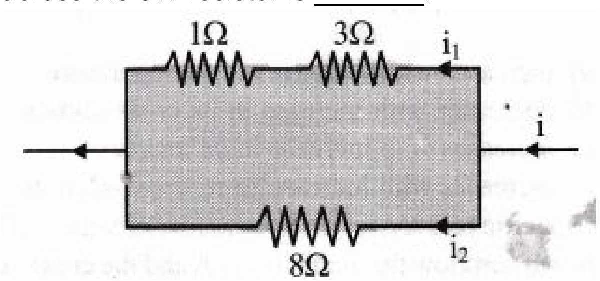
$\frac{1}{R} = \frac{1}{2r} + \frac{3}{8r} = \frac{4+3}{8r} = \frac{7}{8r}$

or $R = \frac{8r}{7}$

But r = 1Ω

Therefore, $R = \frac{8\times 1}{7} = \frac{8}{7}\Omega$

40. Power dissipated across the 8W resistor in the circuit shown here is 2 watt. The power dissipated in watt units across the 3W resistor is _______.



a) 1.0 b) 0.5 **c) 3.0** d) 2.0

Solution : -

Power = V, I = I^2R

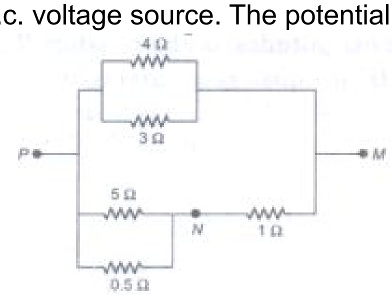
$i_2 = \sqrt{\frac{\text{Power}}{\text{R}}} = \sqrt{\frac{2}{8}} = \sqrt{\frac{1}{4}} = \frac{1}{2}\ \text{A}$

Potential over $8\Omega = Ri_2 = 8 \times \frac{1}{2} = 4\ \text{V}$

This is the potential over parallel branch. So $i_1 = \frac{4}{4} = 1\ \text{A}$

power of 3Ω = i_2^1 R = 1 x 1 x 3 = 3 Ω

41. In the circuit shown, the current through the 4 Ω resistor is 1 amp when the points P and M are connected to a d.c. voltage source. The potential difference between the points M and N is :



a) 3.2 volt b) 1.5 volt c) 1.0 volt d) 0.5 volt

Solution : -

In the circuit shown, potential difference between the points P and M is 1 x 4 = 4 volts

Equivalent resistance of 0.5 | | 5 in 1.25 Ω

So, the current through it will be I = $\frac{4V}{1.25\Omega}$ = 3.2 A

Potential difference between the points M and N is

V_{MN} = 1 x 3.2 = 3.2 volts

42. The temperature co-efficient of resistance of a wire is 0.00125/^{0}C. At 300 K it's resistance is 1 Ω. The resistance of the wire will be 2Ω at :

a) 1154 K b) 1127 K **c) 1100 K** d) 1400 K

Solution : -

Since, ∝ = $\frac{R_2 - R_1}{R_1(T_2 - T_1)}$

125 x 10^{-5} = $\frac{2-1}{1(T_2 - 300)}$ or T_2 = $\frac{100000}{125}$+300 = 1100 K

43. Match the Column I with Column II.

Column I		Column II	
(A)	Ohm's law is applicable to	(p)	metals
(B)	Ohm's law is not applicable to	(q)	greater resistivity
(C)	alloys have	(r)	diodes, electrolytes, semiconductors

a) A-r, B-q, C-p **b) A-p, B-r, C-q** c) A-r, B-p, C-q d) A-q, B-r, C-p

Solution : -

(A) $\rightarrow$ (p) if the temperature is not very high.

(B) $\rightarrow$ (r)

(C) $\rightarrow$ (q)

44. Three resistances P, Q, R each of 2 W and an unknown resistance S form the four arms of a Wheatstone bridge circuit. When a resistance of 5 W is connected in parallel to S the bridge gets balanced. What is the value of S?

a) 3 Ω b) 6 Ω c) 1 Ω d) 2 Ω

Solution : -

When Wheatstone bridge is balanced,

$\frac{P}{Q} = \frac{R}{S} \Rightarrow \frac{2}{2} = \frac{2}{S}$

Therefore, S should be 2Ω.

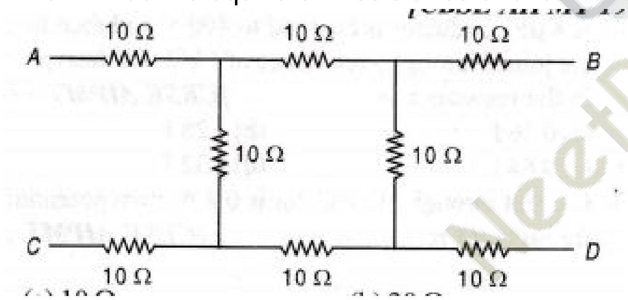
A resistance of 6Ω is connected in parallel. A parallel combination.

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

$\frac{1}{2} = \frac{1}{6} + \frac{1}{S}$

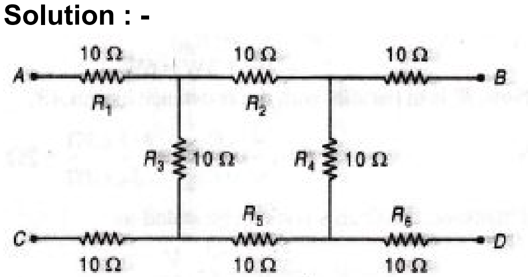
$\Rightarrow S = 3\Omega$

45. What will be the equivalent resistance of circuit shown in figure between two points A and D?



a) 10 Ω b) 20 Ω **c) 30 Ω** d) 40 Ω

Solution : -



Effective resistance of R_2 and R_4 in series, R' = 10 + 10 = 20Ω

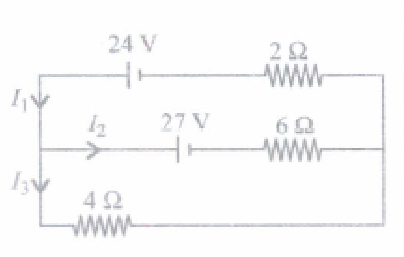
Effective resistance of R3 and R5 in series, R" = 10 + 10 = 20Ω

Net total resistance of R' and R" in parallel is $R_p = \frac{20 \times 20}{20+20} = 10\Omega$

$\therefore$ Total resistance between A and D

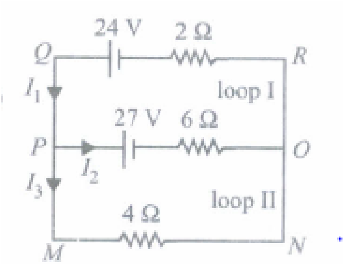
= 10 + 10 + 10 = 30 Ω

46. In the circuit shown, the value of currents I_1, I_2 and I_3 are



a) $3A, \frac{-3}{2}A, \frac{9}{2}A$ b) $\frac{9}{2}A, 3A, \frac{-3}{2}A$ c) 5A,4A,-3A d) $7A, \frac{5}{4}A, \frac{9}{2}A$

Solution : -

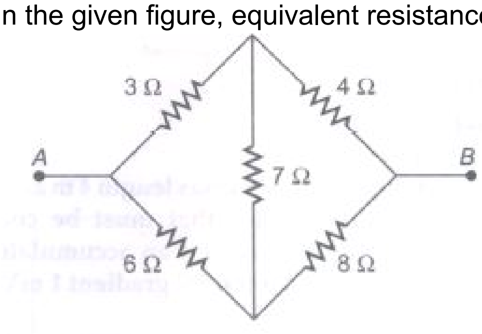


Applying Kirchhoff's voltage law,
In loop I, -27 - $6I_2$ - $2I_1$ + 24 = 0
$6I_2 + 2I_1 = -3$ ... (i)
In loop II, -27 - $6I_2$ + $4I_3$ = 0
$6I_2 - 4I_3 = -27$ ... (ii)
At junction P, $I_1 - I_2 - I_3 = 0$ ... (iii)
Solving equations (i), (ii) and (iii) we get
I_1 = 3 A, I_2 = -3/2 A, I_3 = 9/2 A.

47. A 4 μF conductor is charged to 400 V and then its plates are joined through a resistance of 1 kΩ. The heat produced in the resistance is ________.
a) 0.16 J b) 1.28 J c) 0.64 J **d) 0.32 J**

Solution : -
The energy stored in the capacitor
$= \frac{1}{2}CV^2$
This energy will be converted into heat in the resistor.
$H = \frac{1}{2}CV^2$
where, C= capacitance of capacitor
V = voltage across the plate of capacitor
$H = \frac{1}{2} \times 4 \times 10^{-6} \times (400)^2 = 0.32$ J

48. In the given figure, equivalent resistance between A and B will be :

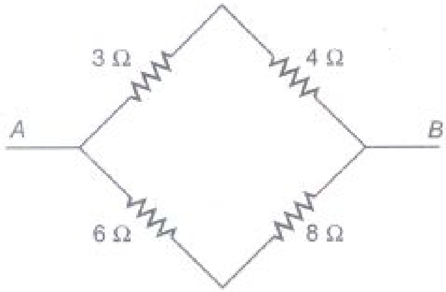


a) $\frac{14}{3}\Omega$ b) $\frac{3}{14}\Omega$ c) $\frac{9}{14}\Omega$ d) $\frac{14}{9}\Omega$

Solution : -

In the Wheatstone bridge, the circuit is balanced as $\frac{P}{Q} = \frac{R}{S} or \frac{3}{4} = \frac{6}{8}$

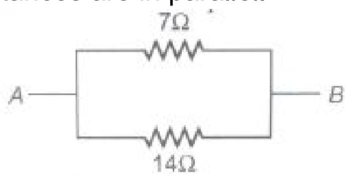
If we re-draw the above circuit, we see that :



Resistances 3 Ω and 4 Ω are in series, so the equivalent resistance is 3 Ω + 4 Ω = 7 Ω = R_1

Also, resistances 6 Ω and 8 Ω are in series, so the equivalent resistance is 6 Ω + 8 Ω = 14 Ω = R_2

Now after having equivalent resistances, if we further reduce the above circuit, we see that the equivalent resistances are in parallel.



So, Equivalent resistance is:

$1/R_{th} = 1/R_l + 1/R_2$

$1/R_{th}$ = 1/7 Ω + 1/14 Ω = 3/14 Ω or R_{th} = 14/3 Ω

49. Three resistors 2Ω , 4Ω and 5Ω are combined in parallel. This combination is connected to a battery of emf 20 V and negligible internal resistance. The total current drawn from the battery is

a) 10 A b) 15 A **c) 19 A** d) 23 A

Solution : -

Potential of 20 V will be same across each resistance current

$$I_1 = \frac{V}{R_1} = \frac{20}{2} = 10A$$
$$I_2 = \frac{V}{R_2} = \frac{20}{4} = 5A$$
$$I_3 = \frac{V}{R_3} = \frac{20}{5} = 4A$$

∴ Total current drawn from circuit $I = I_1 + I_2 + I_3$ = 10 + 5 + 4 = 19 A

50. In a Wheatstone's bridge all the four arms have equal resistance R. If the resistance of the galvano meter arm is also R, the equivalent resistance of the combination as seen by the battery is _______.

a) 2R b) $\frac{R}{4}$ c) $\frac{R}{2}$ **d) R**

Solution : -

As, Wheatstone's bridge is balanced, the resistance of galvanometer will remain ineffective.