INDIAN SCHOOL AL WADI AL KABIR		
Class: XII	**Department: SCIENCE 2020 -2021** **SUBJECT : PHYSICS**	**Date of completion: 30.06.2020**
Worksheet No: 03 **With answers**	TOPIC : ELECTRIC CURRENT	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS & SEC:**	**ROLL NO.**

SECTION – A

1. A rise of temperature of 4 C is observed in a conductor by passing a current. If the current is tripled, the rise of temperature will be

(a) 8 C
(b) 12 C
(c) 16 C
(d) 36 C

Ans: - (d).

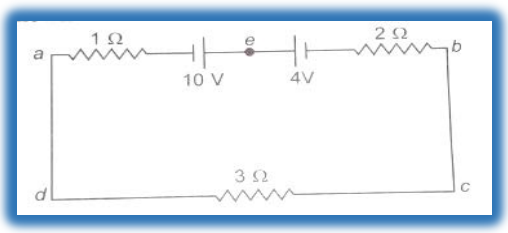
HINTS: - $Q = mc\Delta T = I^2Rt$, $\Delta T \propto I^2$.,

2. The magnitude and direction of the current in the circuit shown will be

(a) 7/3 A from a to b through e.
(b) 7/3 A from b to a through e.
(c) 1 A from a to b through e.
(d) 1 A from b to a through e.

Ans: - (c).

Hints: - cells are connected in parallel.



3. Ohm's law is true for

(a) For metallic conductors at low temperature.
(b) For metallic conductors at high temperature.
(c) for electrolytes when current passes through them.
(d) For diode when current flows.

Ans: - (a).

4. In an experiment of meter Bridge, a null point is obtained at the center of the bridge wire. When a resistance of 10 Ω is connected in one gap, the value of resistance in other gap is

(a) 10 Ω (b) 5 Ω (c) 15 Ω (d) 500

Ans: - (a).

5. The Terminal potential difference of a cell is greater than its e.m.f. when it is

(a) Being discharged. (b) In open circuit.
(c) Being charged. (d) Being either charged or discharged.

Ans: - (c).

6. A fuse wire is a wire of

(a) Both low resistance and low melting point.
(b) High resistance and low melting point.
(c) Low resistance and high melting point.
(d) Both high resistance and high melting point.

Ans: - (b).

7. In India electricity is supplied for domestic use at 220 V. It is supplied at 110 V in U.S.A. If the resistance of a 60 W bulb for use in India is R Ω, then resistance of a 60 W bulb for use in U.S.A will be

(a) R Ω. (b) 2R Ω. (c) R/4 Ω. (d) R/2 Ω.

Ans: - (c).

Hints: - $R = V^2/P$.

8 A wire of resistance 10 Ω is elongated by 10 %. The resistance of the elongated wire is

(a) 10.1 Ω. (b) 11.1 Ω. (c) 12.1 Ω. (d) 13.1 Ω.

Ans: - (c).

Hints: -$R = \rho\, l/A = \rho l^2/Al = \rho l^2/V$, $R \propto l^2$.

9. Which of the following physical quantities possesses the dimensions of $M^{-1}L^{-3}T^3A^2$?

(a) resistance. (b) resistivity. (c) conductivity. (d) emf.

Ans: - (c).

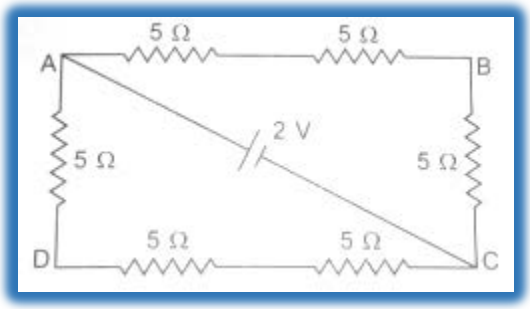
10. Given a current carrying wire of non-uniform cross section. Which of the following is constant throughout the length of the wire?

(a) current, electric field and drift speed (b) current and drift speed

(c) drift speed only (d) current only

Ans: - (d).

11. The potential difference between points A and B of given figure is……..



Ans: - (4/3 V)

Hints: - total resistance = 15/2 ohm.

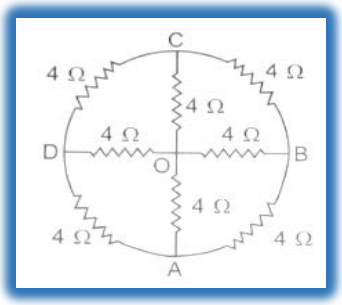
Current through each branch = 2/15 A.

V_{AB} = I X resistance of AB. = 2/15 x 10 = 4/3 volt.

12. Eight resistances each of 4 Ω are connected in the circuit as shown in figure. The equivalent resistance between A and B is …….

Ans: - (2.8),

Hints: - apply law of symmetry about O.



13. An electric bulb is rated 220 V and 100 W. Power consumed by it when operated on 110 V is ……..

Ans: - (25 W).

14. the mean time interval of two consecutive collisions of free electrons with positive ion in a conductor is called ……..

Ans: - relaxation time.

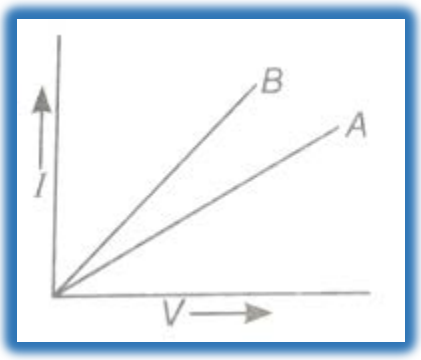
15. 10 kWH = ……. J.

Ans: - 3.6×10^7 J.

16. Two materials Si and Cu are cooled from 300 K to 60 K. What will be the effect on their resistivity?

Ans: -The specific **resistivity** of copper (metal) **will** decrease but that of **silicon** (semi-conductor) **will** increase.

17. Out of *V* - *I* graph for parallel and series combination of two metallic resistors, which one represents parallel combination of resistors? Justify your answer.



Ans: - A is series and B is in parallel, R = slope of V-I graph.

18. It is easier to start a car engine on a warm day than on a chilly day. Why?

Ans: - On a **warm day** the temperature is higher as compared to **than on a chilly day**. The internal resistance of a **car** battery decreases with increase in temperature and hence, it becomes **easier to start a car engine.**

19a. What is the composition of materials used in the fuse wire?

Ans: - (63%tin and 37%lead)

19b. A wire of resistivity ρ is stretched to double its length. What will be its new resistivity?

Ans: - (unchanged).

20. Define SI unit of current.

Ans: - the flow of electric charge across a surface at the rate of one coulomb per second.

Or

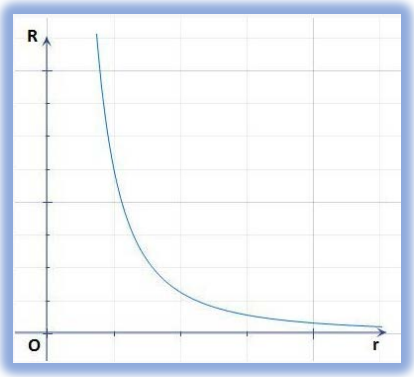
A carbon resistor has a value of 62 kΩ with a tolerance of 5%. Give the colour code of the resistor.

Ans: - Red = 2, Blue = 6, Orange = 3, Gold = 5%

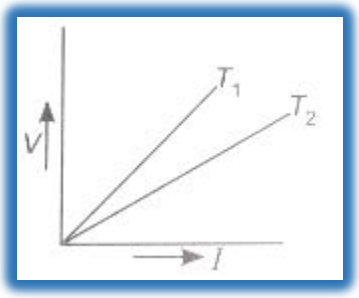
SECTION - B

21.(a) Plot a graph showing the variation of resistance of a conducting wire as a function of its radius, keeping the length of the wire and its temperature as constant.

Ans: - $R = \rho l/A$, $R \propto 1/r^2$



(b) V – I graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in the figure. Which of the two temperatures is higher and why?



Ans: -R = V/I and varies directly to temperature.
At T_1 resistance is greater. ($T_1 > T_2$)

22. (a) The EMF of a cell is always greater than its terminal voltage. Why? Give reason.

Ans: -he emf of a cell is **greater than its terminal voltage** because there is some potential drop across the **cell** due to **its** small internal resistance.

(b) You are given three constantan wires P, Q and R of length and area of cross-section (L, A), (2L, A/2), (L/2, 2A) respectively. Which has higher resistance?

Ans: - Q.

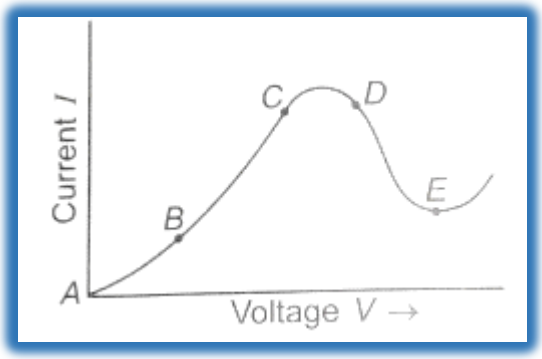
23. (a) Graph showing the variation of current vs voltage for a material GaAs is shown in the figure. Identify the region of

(i) negative resistance.

(ii) where Ohm's law is obeyed.

(b) Give an example of a material each for which temperature coefficient of resistivity is (i) positive and

(ii) negative.



Ans: - (a)

(i) DE (slope is negative and hence resistance).

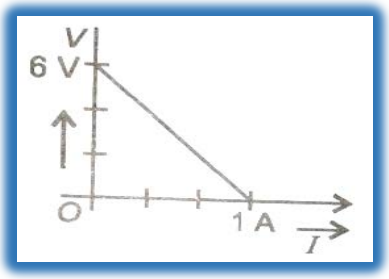
(ii) BC (straight line)

(b) (i) Cu (metals, alloys).

(ii) Si (semiconductor).

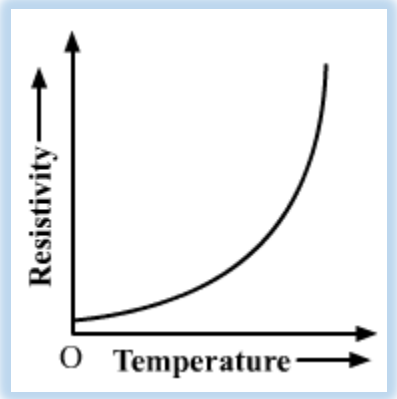
24. (a) Show variation of resistivity of copper as a function of temperature in a graph.

(b) the plot of the variation of potential difference across a combination of three identical cells in series, versus a current is as shown here. What is the EMF of each cell?



Ans: - (a)

(b) 2V.



25. (a) You are required to select a carbon resistor of resistance 47 kΩ ± 10% from a large collection. What should be the sequence of colour bands used to code it?

Ans: - yellow, violet, orange and silver.

(b) Write two characteristics of manganin, which make it suitable for making standard resistances.

Ans: - **Manganin** has a constant electrical **resistance** over a wide range of temperature that is a small value of temperature coefficients. This **makes** it has same **resistance** even if **resistance** is heated up.

Or

Define mobility of electron in a conductor. How does electron mobility change when (i) temperature of conductor is decreased?

(ii) and applied potential difference is doubled at constant temperature?

Ans: - drift velocity per unit electric field applied is termed as mobility.

(i) When **temperature** of the **conductor decreases**, the relaxation time τ of the **electrons** in the **conductor** increases, so **mobility** μ increase.

(ii) (**ii**) **Mobility** μ is independent of **applied potential difference**.

26.State the two Kirchhoff's rule used in electric networks. How are these rules justified?

- Ans: - K1L- The algebraic sum of total current into any junction of an electric circuit is zero.
- K2L-The algebraic sum of the potential differences in any loop, including

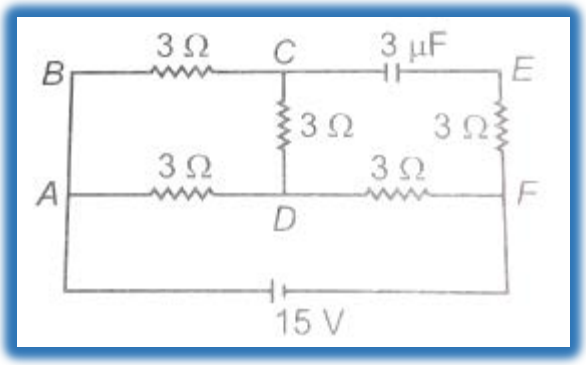
$$\sum I = 0 \qquad \text{(junction rule, valid at any junction)}$$

those associated with emfs and those of resistive elements, must equal zero.

$$\sum V = 0 \qquad \text{(loop rule, valid for any closed loop)}$$

Or

In the circuit shown in the figure, find the total resistance of the circuit and the current in the arm CD.



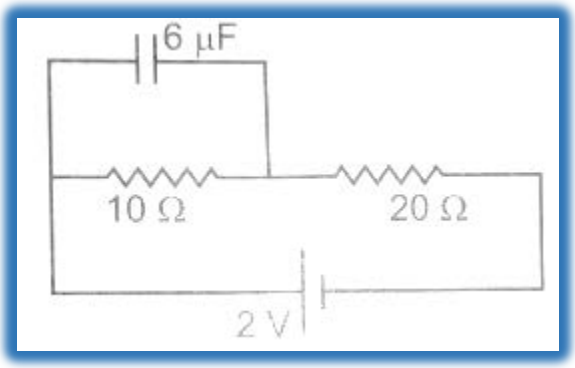
Hints: -current through the capacitor (CE) is zero hence branch CEF is not worth in the circuit.
So, equivalent resistance is 5Ω.
Total current is 3A.
Current is CD = ½ A.

27. Define relaxation time of the free electrons drifting in a conductor. How is it related to the drift velocity of free electrons?

Ans: -The average **time** elapsed between two successive collisions is known as the **relaxation time of free electrons drifting in a conductor**.

Or

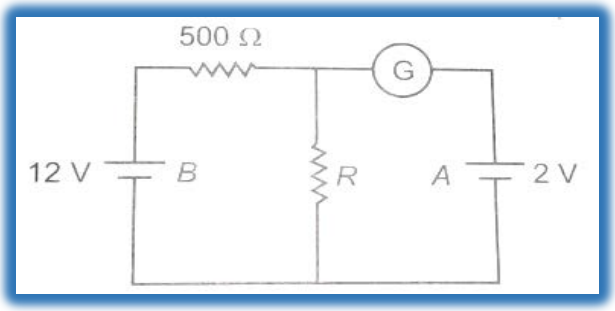
Find the charge on the capacitor as shown in the circuit.



Hints: - equivalent resistance = 30Ω.
Current = 1/15 A.
Potential difference between ends of capacitor = 1/15 x 10 = 2/3 volt.
Charge on capacitor, q = CV = 2/3 x 6μ c = 4μc.

SECTION – C

28. In the circuit shown in the figure, the galvanometer G gives zero deflection. If the batteries A and B have negligible internal resistance, find the value of the resistor R.



Hints: - if galvanometer gives zero deflection, it means source of current by 12 V across R and voltage across R is 2V.

Current in the circuit $I = \frac{\varepsilon}{R_1 + R_2} = \frac{12.0V}{500 + R}$

and $V = IR = 2.0V$

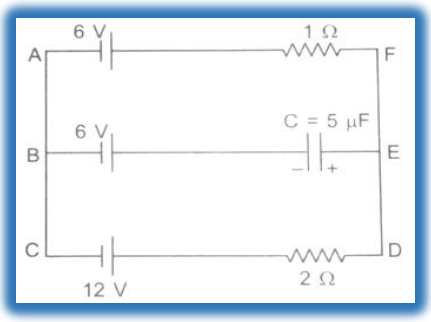
$$\left(\frac{12.0V}{500 + R}\right)R = 2.0$$

$$12R = 1000 + 2R$$

$$10R = 1000$$

$$\Rightarrow R = 100\ \Omega$$

29. In the given circuit with a steady current, calculate the potential difference across the capacitor and the charge stored in it.

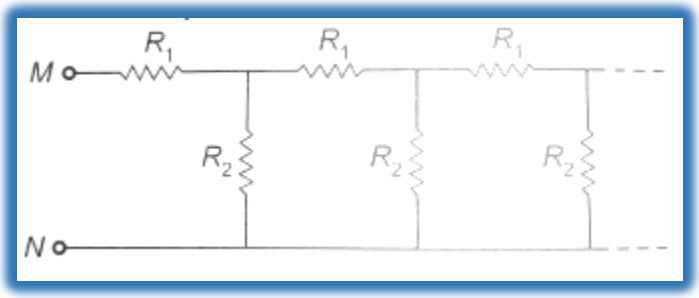


Hints: - first remove branch BE and find the current in the circuit as, 6V/ 3Ω = 2A.
Now take a closed loop as ABEFA or BEDCA and apply loop law to find voltage of capacitor and then charge.

30. (a) State the working principle of a Potentiometer. Draw a circuit diagram to compare EMF of two primary cells. Derive the formula used.
(b) How can the sensitivity of a potentiometer be increased?
Hints: - (a) refer to previous class lecture or video uploaded.
(b) **Sensitivity** of **potentiometer can** be **increased** by: **Increasing** the length of the **potentiometer** wire. By reducing the current in the circuit by using a rheostat.

Or

The figure shows an infinite circuit which is formed by the repetition of same chain consisting R_1 and R_2. If $R_1 = 4\ \Omega$ and $R_2 = 3\ \Omega$, then calculate the resistance between the points M and N.



Hints: - this type of question is already solved during classes, plz refer to the same.

31. First a set of '*n*' equal resistors of 'R' each are connected in series to a battery of emf 'E' and internal resistance 'R'. A current *I* is observed to flow. Then the *n*

resistors are connected in parallel to the same battery. It is observed that the current is increased 10 times. What is n?

Ans: - 10.

Hints: - for series combination, R_S = nR, with cell total resistor = nR + R = (n + 1) R, current, I = $\frac{E}{(n+1)R}$ .....(i)

Now for parallel combination,

Rp = R/ n. with cell total resistance = $\frac{R}{n} + R = \frac{(n+1)\,R}{n}$.

Current I' = E/$\frac{(n+1)\,R}{n}$ = $\frac{nE}{(n+1)\,R}$ .....(ii)

From (i) & (ii), I' = nI.

Hence, n = 10.

32. Heating element is marked 210 V, 630 W. What is the value of the current drawn by the element when connected to a 210 V dc source.

Hints: - p = VI, I = p/V = 3A.

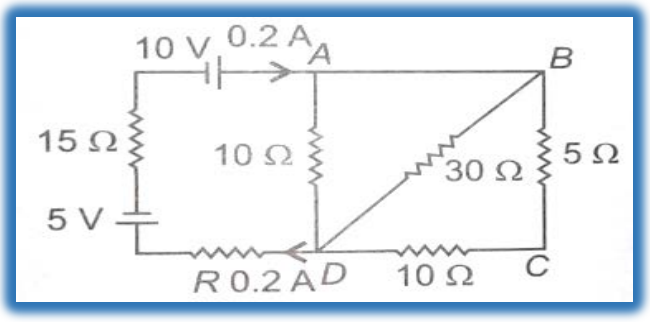
Or

An emf of a cell is 1.5 V and its internal resistance is 1 Ω. For what current drawn from the cell will its terminal potential difference be half of its emf?

Hints: - V = E -Ir, but, V = E/2,

then E/2 = E -Ir or E/2 = Ir or, I = E/2r = 1.5/2x1 = 0.75A.

33. Calculate the value of the resistance R in the circuit shown in the figure so that the current in the circuit is 0.2 A. What would be the potential difference between points A and D?



Hints: -equivalent resistance between B and D is 10Ω. It means 0.2 A of current is divided in to two equal parts of O.1 A.

Now applying loop law for closed path containing batteries and resistor R.

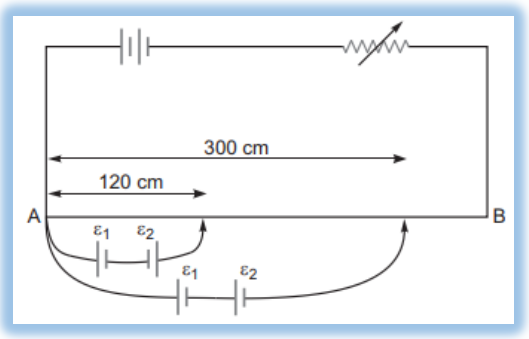
-5 – (15 x 0.2) + 10 – (10 x 0.2) – 0.2 R = 0,

R = 5 Ω.

34. (a) State the principle of potentiometer. Define potential gradient. Obtain an expression for potential gradient in terms of resistivity of the Potentiometer wire.

Hints: -refer to notes or video lesson uploaded.

(b) Figure shows a long potentiometer wire AB having a constant potential gradient. the null points for the two primary cells of emfs E_1 and E_2 connected in the manner shown null points are obtained at a distance of L_1 = 120 cm, and L_2 = 300 cm from the end A. Determine (i) E_1/E_2 and (ii) position of null point for the cell E_1 only.



Hints: -

(i) Let k = potential gradient in V/cm

$$\varepsilon_1 + \varepsilon_2 = 300k \qquad ...(i)$$
$$\varepsilon_1 - \varepsilon_2 = 120k \qquad ...(ii)$$

We can solve, $\frac{\varepsilon_1}{\varepsilon_2} = \frac{7}{3}$

(*ii*) From equation (*i*)

$$\varepsilon_1 + \varepsilon_2 = 300k$$
$$\therefore \quad \varepsilon_1 + \frac{3}{7}\varepsilon_1 = 300k \quad \Rightarrow \quad \varepsilon_1 = 210k$$

Therefore, balancing length for cell ε_1 is 210cm.

SECTION – D

35. The length of a potentiometer wire is 600 cm and it carries a current of 40 mA for a cell of emf 2 V and internal resistance 10 Ω, the null point is found to be at 500 cm. If a voltmeter is connected across the cell, the balancing length is decreased by 10 cm. Find (a) the resistance of whole wire (b) reading of voltmeter, and (c) resistance of voltmeter.

(a) $E = Kl \rightarrow K = \frac{E}{l} = \frac{2}{500}\frac{V}{cm}$.

$$V = KL = \frac{2}{500} \cdot 600 = 2.4\ V,$$

where V is the potential difference across potentiometer wire.

The resistance of potentiometer wire is

$$R = \frac{V}{I} = \frac{2.4\ V}{40 \cdot 10^{-3} A} = 60\ \Omega.$$

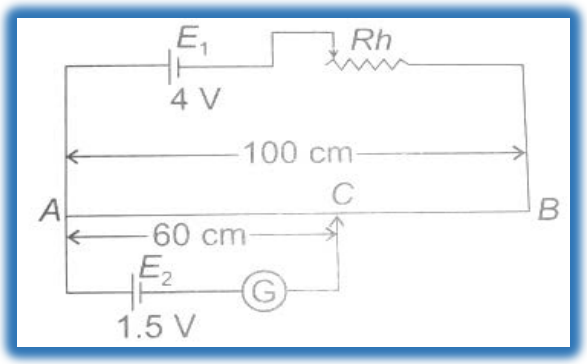
(b) On connecting voltmeter new balancing length is $l' = 490\ cm$.
Reading of voltmeter is

$$U = \frac{l'}{L}V = \frac{490}{600} \cdot 2.4 = 1.96\ V.$$

(c) The resistance of voltmeter is

$$R_{\text{voltmeter}} = \frac{U}{I} = \frac{1.96\ V}{40 \cdot 10^{-3} A} = 49\ \Omega.$$

Or



What is meant by the sensitivity of a Potentiometer?

A battery E_1 of 4 V and the variable resistance Rh are connected in series with the wire AB of the Potentiometer. The length of the wire is the Potentiometer is 1 m. When a cell of emf 1.5 V is connected between points A and C, no current flows through E2. Length of AC = 60 cm.

(i) Find the potential difference between the ends A and B of the Potentiometer.

(ii) Would the method work, if the battery E1 is replaced by a cell of emf 1 V?

: (i) Let V be the pot. Diff. between the ends A and B of the potentiometer wire. Then

$$\frac{V}{100} = \frac{\varepsilon_2}{60}$$

or $V = \varepsilon_2 \times \frac{100}{60} = 1.5 \times \frac{100}{60} = 2.5V$

(ii) If battery ε_1 is replaced by a cell of emf 1 V, then method would not work. As $\varepsilon_1 < \varepsilon_2$, the balance point cannot be obtained on the potentiometer wire.

36. (i)Derive an expression for drift velocity of electrons in a conductor. Hence deduce Ohm's law.

(ii) Cross sectional area is increasing linearly from its one end to the other is connected across a battery of V volts. Which of the following quantities remain constant in the wire?

(a)drift speed (b)current density

(c)electric current (d) electric field

Justify your answer.

Hints: - (i) refer to drift velocity, (ii) The **electric current** will **remain constant. Because current** is the only **quantity** that does not depend on the **area** of **cross-sections** of the **wire**.

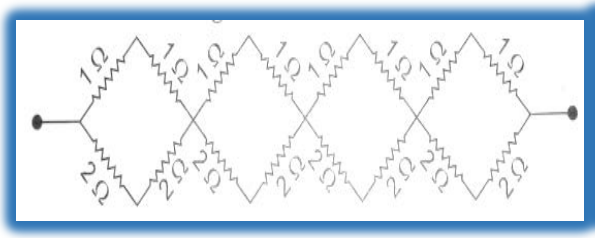
Or

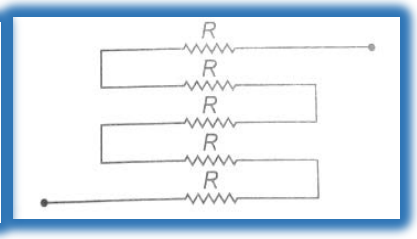
(a) Given *n* resistors each of resistance R, how will you combine them to get

(i) maximum (ii) minimum effective resistance? What is the ratio of maximum to minimum resistance?

(b) Given the resistances of 1 Ω, 2 Ω, 3 Ω, how will you combine them to get an equivalent resistance of: (i) 11/3 Ω (ii)11/5Ω (iii) 6 Ω and 6/11 Ω.

(c) Determine the equivalent resistance of network shown in the figures.





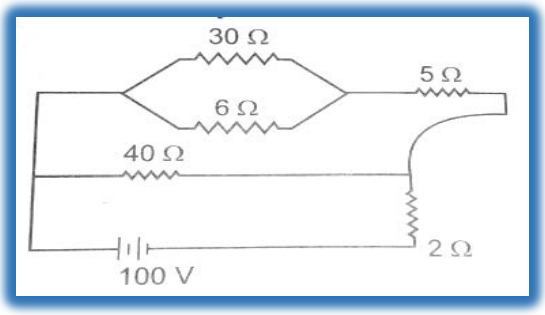
Hints: -(a), (i) series (ii) parallel.

(b) Try by connecting two parallel and one in series or connecting one parallel and two in series.

(c) 16/3Ω. and 5R.

37. (a) Define the term drift velocity of charge carriers in a conductor. Obtain the expression for the current density in terms of relaxation time.

(b) A 100 V battery is connected to the electric network as shown. if the power consumed in the 2 Ω resistor is 200 W. Determine the power dissipated in the 5 Ω resistor.



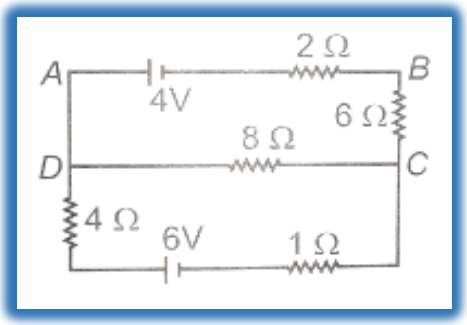
Hints: - (a) Refer to class notes.

(b) Equivalent resistance of the circuit is 10 Ω. hence current is 10 A. Current across, 5 Ω is 8 A, $p = I^2R = 64 \times 5 = 320$ W.

Or

(a) State Kirchhoff's law of an electrical network.

(b) Using Kirchhoff's laws, Calculate the potential difference across the 8 Ω resistor.



Hints: - Let I_1 is the current through the cell of 4 V

I_2 is the current through 6 V.

So current through 8 ohms is I_1+I_2.

Taking the loop of first loop,

$-4 + 2I_1 + 8(I_1+I_2) + 6I_1 = 0$

$4I_1 + 2I_2 = 1$ ..... (i)

Taking the loop of second loop,

$-6 + 4I_2 + 8(I_1+I_2) + 1I_2 = 0$

$13I_2 + 8I_1 = 6$ ..... (ii)

Solving both, we get, $I_1 = 1/36$A and $I_2 = 4/9$A,

Total current across 8Ω resistor = $I_1+I_2 = 17/36$A.

$V = IR = 17/36 \times 8 = 34/9$ volt.

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