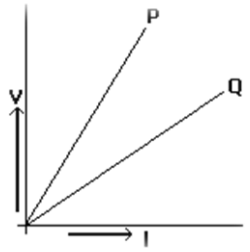
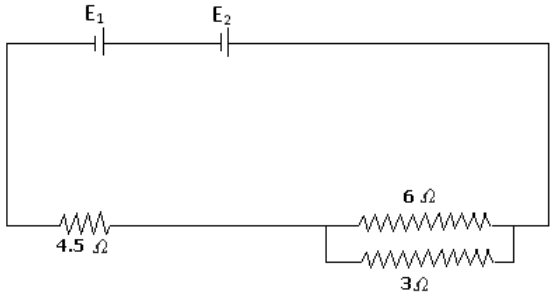
## Current Electricity

1. Sketch a graph showing variation of resistivity of carbon with temperature.
2. The variation of potential difference V with length l in case of two potentiometers P and Q is as shown. Which one of these two will you prefer for comparing emfs of two primary cells?

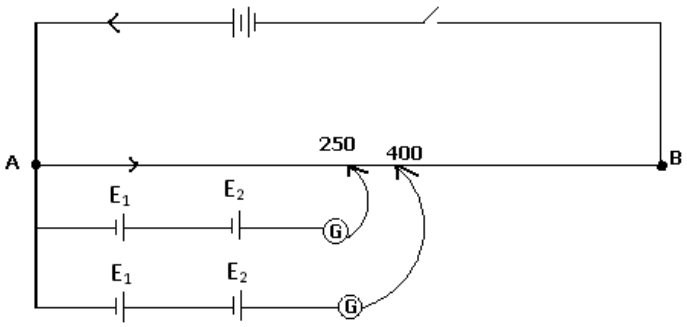



3. Define electrical conductivity of a conductor and give its S.I. unit.
4. What happens to the power dissipation if the value of electric current passing through a conductor of constant resistance is doubled?
5. A wire of length $'\rho'$ is stretched to twice its length. What will be its new resistivity?
6. What will be the change in the resistance of a Eureka wire, when its radius is halved and length is reduced to one –fourth of its original length?
7. How does the drift velocity of electrons in a metallic conductor change, if the length of the conductor is doubled by stretching it, keeping the applied potential difference constant?
8. The metallic conductor is at a temperature $\theta_1$. The temperature of the metallic conductor is increased to $\theta_2$. How will the product of its resistivity and conductivity change?
9. Two electric lamps A and B are marked 220 V – 100 W and 220V – 60 W. Out of the two which lamp has higher resistance?
10. The sequence of bands marked on a carbon resistor is: Red, Red, Red, Silver. Write the value of resistance with tolerance.
11. State the condition in which terminal voltage across a secondary cell is equal to its e.m.f.
12. If the temperature of a good conductor increases, how does the relaxation time of electron in the conductor change?
13. Write the mathematical relation between mobility and drift velocity of charge carriers in a conductor. Name the mobile charge carriers responsible for conduction of electric current in (i) an electrolyte , (ii) an ionized gas.
14. Two cells $E_1$ and $E_2$ in the given circuit diagram have an emf of 5 V and 9 V and internal resistance of $0.3\Omega$ and $1.2\Omega$ respectively.



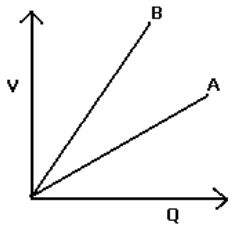

Calculate the value of current flowing through the resistance of $3\Omega$.

15. Two primary cells of e.m.f $E_1$ and $E_2$ ($E_1 > E_2$ ) are connected to the potentiometer wire AB as shown in the figure.

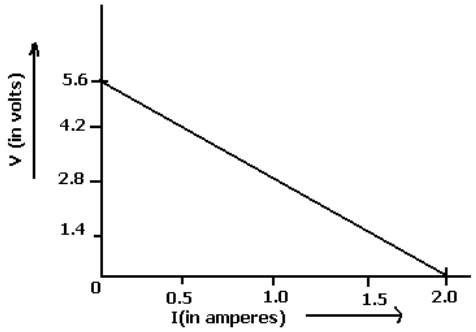



If the balancing lengths for the two combinations of the cells are 250 cm and 400 cm, find the ratio of $E_1$ and $E_2$ .

16. Draw a circuit diagram using a metre bridge and write the necessary mathematical relation used to determine the value of an unknown resistance? Why cannot such an arrangement be used for measuring very low resistances?
17. Explain how electron mobility changes for a good conductor when:
    a. The temperature of the conductor is decreased at constant potential difference
    b. Applied potential difference is doubled at constant temperature.
18. The graph shows the variation of voltage, 'V' across the plates of two capacitors A and B versus increase of charge, 'Q' stored on them. Which of the two capacitors has higher capacitance? Give reason for your answer.



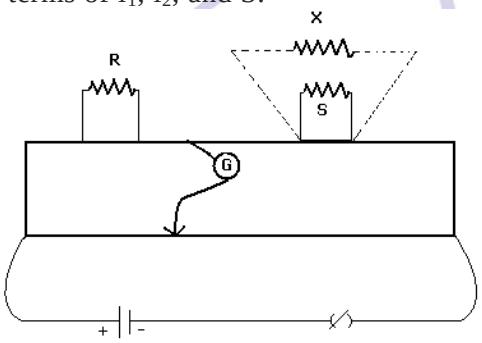

19. Establish the relation between drift velocity '$v_d$' of the electrons in a conductor of cross- section 'A', carrying current 'i' and concentration of free electrons per unit volume of the conductor being 'n'.
20. A 10m long wire of uniform cross-section and 20$\Omega$ resistance is used in a potentiometer. The wire is connected in series with a battery of 5 V along with an emf E is balanced at 6.0 m length of the wire, calculate: (i) the potential gradient of the potentiometer wire (ii) the value of unknown emf E.
21. Define the term current density of a metallic conductor. Deduce the relation connecting current density (J) and the conductivity ($\sigma$) of the conductor, when an electric field E, is applied to it.
22. 4 cells of identical emf E, internal resistance r are connected in series to a variable resistor. The following graph shows the variation of terminal voltage of the combination with the current output:



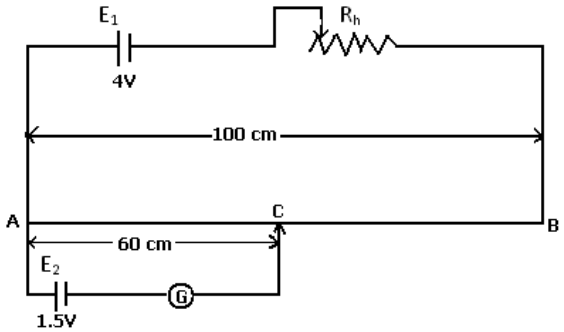

(i) What is the emf of the cell?

(ii) For what current from the cells, does maximum power dissipation occur in the circuit?
(iii) Calculate the internal resistance of each cell.

23. Define the term 'resistivity 'and write its S.I. units. Derive an expression for the resistivity of a metal in terms of number density and mass of free electrons present in it.
24. State the principle of potentiometer. Draw a circuit diagram used to compare the e.m.f. of two primary cells. Write the formula used. How can the sensitivity of a potentiometer be increased.
25. Three cells of emf 2.0 V, 1.8 V and 1.5 V are connected in series. Their internal resistances are $0.05\Omega$, $0.7\Omega$ and $1\Omega$respectively. If this battery connected to an external resistor of 4 $\Omega$, calculate:
    a. The total current flowing in the circuit.
    b. The potential difference across the terminals of the cell of emf 1.5 V while in use.
26. In a potentiometer, a standard cell of emf 5 V and of negligible resistance maintains a steady current through the potentiometer wire of length 5m. Two primary cells of emfs $E_1$ and $E_2$ are joined in series with (i) same polarity (ii) opposite polarity. The combination is connected through a galvanometer and a jockey to the potentiometer. The balancing lengths in the two cases are found to be 350 cm and 50 cm respectively.
    a. Draw the necessary circuit diagram.
    b. Find the value of the emfs of the two cells.
27. When two known resistances, R and S, are connected in the left and right gaps of a meter bridge, the balance point is found at a distance $l_1$, from the 'zero end' of the meter bridge wire. An unknown resistance X is now connected in parallel to the resistance S and the balance point is now found at a distance $l_2$ from the zero end of the meter bridge wire. Obtain a formula for X in terms of $l_1$, $l_2$, and S.

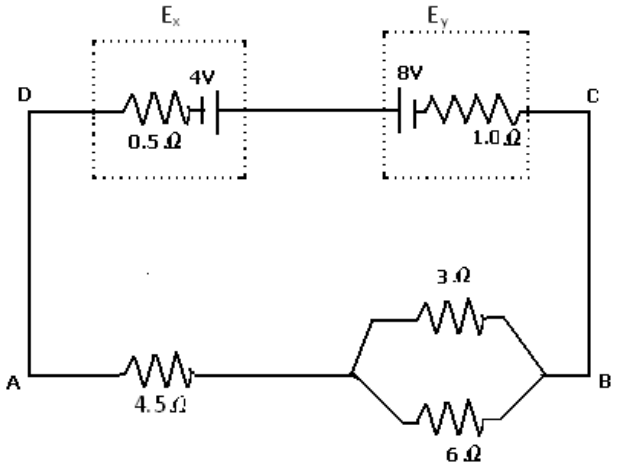



28. What is meant by 'drift velocity of free electrons'? Derive Ohm's law on the basis of the theory of free electrons?
29. What is meant by the sensitivity of a potentiometer? A battery $E_1$ of 4 V and a variable resistance $R_h$ are connected in series with the wire AB of the potentiometer. The length of the wire of potentiometer is 1 metre. When a cell $E_2$ of e.m.f 1.5 V is connected between points A and C, no current flows through $E_2$. Length of AC = 60 metre.

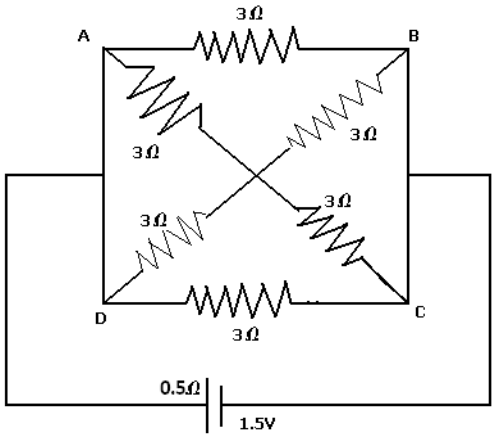



    a. Find the potential difference between the ends A and B of the potentiometer?
    b. Would the method work, if the battery $E_1$ is replaced by a cell of e.m.f of 1V?
30. Define the term 'potential gradient'. With the help of a circuit diagram, explain how a potentiometer can be used to compare the emfs of two primary cells.

31. A battery of e.m.f. 'E', and internal resistance 'r' gives a current of 0.5Awith an external resistor of 12 ohm and a current of 0.25 A with an external resistor of 25 ohm. Calculate (i) internal resistance of the cell and (ii) e.m.f. of the cell.
32. Three identical cells each of e.m.f. 4V and internal resistance 'r' are connected in series to a $6\Omega$ resistor. If the current flowing in the circuit is 1.5 A, calculate (i) the internal resistance of each cell and (ii) the terminal voltage across the cells.
33. Define the term resistivity of a conductor. Give its S.I unit. Show the resistance R of a conductor is given by $\frac{ml}{ne^2\tau A}$ where symbols have their usual meanings.
34. In the given circuit, calculate the value of current in 4.5 $\boldsymbol{\Omega}$ resistor and indicate its direction. Also calculate potential difference across each cell.

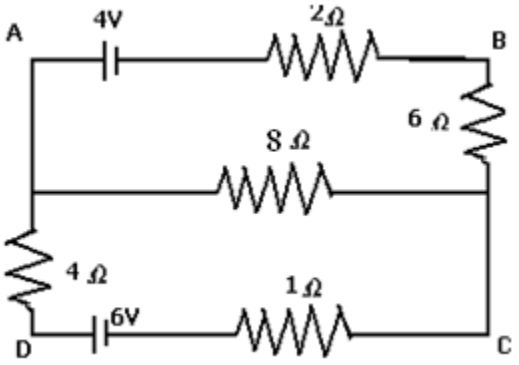



35. Define 'relaxation time' of electrons in a conductor. Explain how it varies with increase in temperature of a conductor. State the relation between resistivity and relaxation time.
36. Find the current drawn from a cell of e.m.f 1.5 V and internal resistance $\mathbf{0.5\Omega}$ connected to the electrical network given below.




37. A conductor of length 'l' is connected to a d.c. source of potential 'V'. if the length of the conductor is tripled by stretching it, keeping 'V' constant, explain how do the following factors vary in the conductor:
    (i) Drift speed of electrons
    (ii) Resistance
    (iii) Resistivity

38. State Kirchhoff's laws of an electrical network. Using Kirchhoff's laws, calculate the potential difference across the 8 ohm resistor.




39. State the working of a potentiometer. Explain, with the help of a circuit diagram, how the emf of two primary cells are compared by using a potentiometer.

In a potentiometer arrangement, a cell of emf 1.20 volt gives a balance point at 30 cm length of the wire. This cell is now replaced by another cell if unknown emf. If the ratio of the emfs of the two cells is 1.5, calculate the difference in the balancing length of the potentiometer wire in the two cases.

40. Deduce the condition for balance in a Wheatstone bridge. Using the principle of Wheatstone bridge, describe the method to determine the specific resistance of a wire in the laboratory. Draw the circuit diagram and write the formula used.