Home Assignment – 03

UNIT – II CURRENT ELECTRICITY

Chapter – 03 CURRENT ELECTRICITY

CBSE 2023 (Compartment)

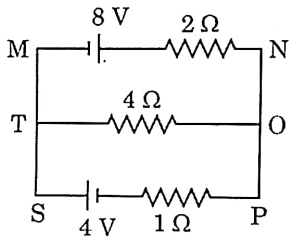
(SET -1)

1. When is more power delivered to a light bulb- just after it is turned on and the glow of the filament is increasing or after the glow becomes steady? Why? (2)

2. A battery is connected first across the series combination and then across the parallel combination, of three resistances R, 2R and 3R. In which of the three resistances will power dissipated be maximum in the two cases? Justify your answer. (2)

3. (i) Derive the relation between the current and the drift velocity of free electrons in a conductor. Briefly explain the variation of resistances of a conductor with rise in temperature.
   (ii) An ammeter, together with an unknown resistance in series is connected across to identical batteries, each of emf 1.5 V, connected (i) in series, and (ii) in parallel. If the current recorded in the two cases be $\frac{1}{2}$ A and $\frac{1}{3}$ A respectively, calculate the internal resistance of each battery. (5)

4. (i) State Kirchhoff's rules. Use them to obtain the condition of balance for a Wheatstone bridge.
   (ii) Use Kirchhoff's rule to determine the current flowing through the branches MN, TO and SP in the circuit shown in the figure.



(SET -2)

1. Assertion (A) : The temperature coefficient of resistance is positive for metals and negative for semiconductors.
   Reason (R) : The charge carrier in metals are negatively charged whereas in semiconductors they are positively charged.

CBSE 2023

(SET -1)

1. A current of 0.8 A flows in a conductor of 40 Ω for 1 minute. The heat produced in the conductor will be

   (a) 1445 J (b) 1536 J (c) 1569 J (d) 1640 J

2. A cell of emf E is connected across an external resistance R. When the current 'I' is drawn from the cell, the potential difference across the electrodes of the cell drops to V. The internal resistance 'r of the cell is

   (a) $\left(\frac{E-V}{E}\right)R$ (b) $\left(\frac{E-V}{R}\right)$ (c) $\frac{(E-V)}{I}R$ (d) $\left(\frac{E-V}{V}\right)R$

3. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time. (3)

(SET – 2)

1. A steady current of 8 mA flows through the wire. The number of electrons passing through a cross-section of the wire in 10 s is

   (a) 4.0×10^{16} (b) 5.0×10^{17} (c) 1.6×10^{16} (d) 1.0×10^{17}

2. A conductor of 10 Ω is connected across a 6 V ideal source. The power supplied by the source to the conductor is

   (a) 1.8 W (b) 2.4 W (c) 3.6 W (d) 7.2 W

3. Two cells of emf E1 and E2 and internal resistances r1 and r2 are connected in parallel, with their terminals of the same polarity connected together. Obtain an expression for the equivalent emf of the combination. (3)

(SET – 3)

1. The current in a device varies with time t as $I = 6t$, where I is in mA and t is in s. The amount of charge that passes through the device during t = 0 s to t = 3 s is

   (a) 10 mC (b) 18 mC (c) 27 mC (d) 54 mC

2. A potential difference V is applied across a conductor of length l and cross-sectional area A. Briefly explain how the current density j in the conductor will be affected if
   (a) the potential difference V is doubled
   (b) the conductor were gradually stretched to reduce its cross-sectional area to $\frac{A}{2}$ and then same potential difference V is applied across it. (3)

CBSE 2022

1. Kirchhoff's first rule $\Sigma I = 0$ and second rule $\Sigma IR = \Sigma E$ (where the symbols have their usual meanings) are respectively based on –

   (a) conservation of momentum and conservation of charge.
   (b) conservation of energy and conservation of charge.
   (c) conservation of charge and conservation of momentum.
   (d) conservation of charge and conservation of energy.

2. The electric power consumed by a 220 V – 100 W bulb when operated at 110 V is

   (a) 25 W (b) 30 W (c) 35 W (d) 40 W

3. Which of the following has negative temperature coefficient of resistivity?

   (a) metal (b) metal and semiconductor (c) semiconductor (d) metal and alloy

4. In a DC circuit the direction of current inside the battery and outside the battery respectively are –

(a) positive to negative terminal and negative to positive terminal.
(b) positive to negative terminal and positive to negative terminal.
(c) negative to positive terminal and positive to negative terminal.
(d) negative to positive terminal and negative to positive terminal.

5. A car battery is charged by 12 V supply and energy stored in it is 7.20×10^5 J. The charge passed through the battery is

(a) 6.0×10^4 C (b) 5.8×10^3 J (c) 8.64×10^6 J (d) 1.6×10^5 J

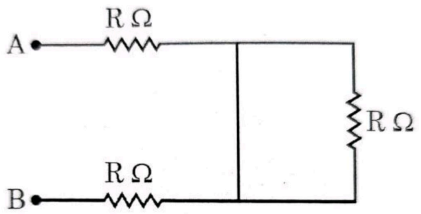
6. If n, e, τ and m have their usual meanings, then the resistance of a wire of length *l* and cross-sectional area A is given by –

(a) $\frac{ne^2A}{2ml\tau}$ (b) $\frac{ml}{ne^2A\tau}$ (c) $\frac{m\tau A}{ne^2l}$ (d) $\frac{ne^2\tau A}{2ml}$

7. Two sources of equal emf are connected in series. This combination is, in turn connected to an external resistance R. The internal resistance of two sources are r_1 and r_2 ($r_2 > r_1$).
The potential difference across the source of internal resistance r_2 is zero, then R equals to –

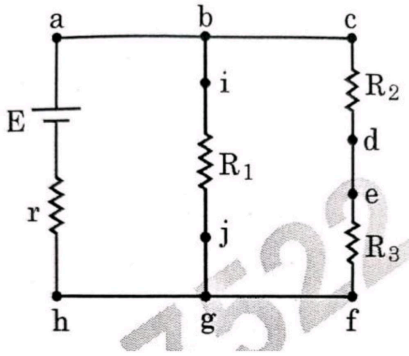
(a) $\frac{r_1 + r_2}{r_2 - r_1}$ (b) $r_2 - r_1$ (c) $\frac{r_1 r_2}{r_2 - r_1}$ (d) $\frac{r_1 + r_2}{r_2\ r_1}$

8. The equivalent resistance between A and B of the network shown in figure is



(a) 3R Ω (b) $\frac{3}{2}$R Ω (c) 2R Ω (d) $\frac{2}{3}$R Ω

9. Case Study : An experiment was set up with the circuit diagram shown in figure. Given that
$R_1 = 10\ \Omega$, $R_2 = R_3 = 5\ \Omega$, r = 0 Ω and E = 5 V



(i) The points with the same potentials are -

(a) b, c, d (b) f, h, j (c) d, e, f (d) a, b, j

(ii) The current through the branch *bg* is –

(a) 1 A (b) $\frac{1}{3}$ A (c) $\frac{1}{2}$ A (d) $\frac{2}{3}$ A

(iii) The power dissipated in R_1 is –

(a) 2 W (b) 2.5 W (c) 3 W (d) 4.5 W

(iv) The potential difference across R_3 is –

(a) 1.5 V (b) 2 V (c) 2.5 V (d) 3 V

CBSE 2020

(SET – 1)

1. A cell of internal resistance r connected across an external resistance R can supply maximum current when

(A) $R = r$ (B) $R > r$ (C) $R = \frac{r}{2}$ (D) $R = 0$

2. In a current carrying conductor, the ratio of the electric field and the current density at a point is called

(A) Resistivity (B) Conductivity (C) Resistance (D) Mobility

3. Define the term mobility of the charge carriers in a current carrying conductor. Obtain the relation for mobility in term of relaxation time. (2)

4. Define the term drift velocity of electrons in a current carrying conductor. Obtain the relationship between the current density and the drift velocity of electrons. (2)

5. (a) Derive the condition of balance for Wheatstone bridge.
(b) Draw the circuit diagram of a meter bridge to explain how it is based on Wheatstone bridge. (3)

(SET – 2)

1. Resistivity of a given conductor depends upon

(A) temperature (B) length of conductor (C) area of cross section (D) shape of the conductor

2. The ratio of the current density and the electric field is called

(A) Resistivity (B) Conductivity (C) Resistance (D) Mobility

(SET – 3)

1. For a fixed potential difference applied across a conductor, the drift speed of free electrons does not depend upon

(A) Free electron density in the conductor (B) mass of the electron.
(C) length of the conductor. (D) temperature of the conductor.

2. Ohm's law is obeyed by

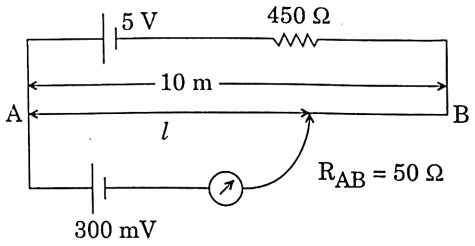
(A) Extrinsic semiconductors. (B) Intrinsic semiconductors.
(C) metal at low temperature. (D) metal at high temperature.

CBSE 2019

(SET – 1)

1. Show, on a plot, variation of resistivity of (i) a conductor, and (ii) a typical semiconductor as a function of temperature. Using the expression for the resistivity in terms of number density and relaxation time between the collisions, explain how resistivity in the case of a conductor increases while it decreases in a semiconductor, with the rise of temperature.

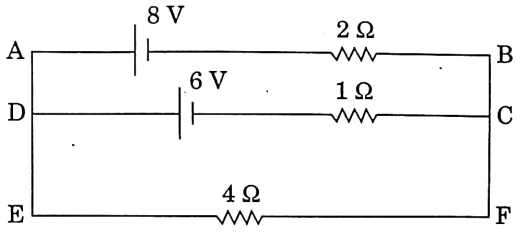
2. (a) Describe briefly, with the help of a circuit diagram, the method of measuring the internal resistance of the cell.
Give reason why a potentiometer is preferred over a voltmeter for the measurement of emf of a cell.



(b) In the potentiometer circuit given below, calculate the balancing length *l*. Give reason, weather the circuit will work, if the driver cell of emf 5 V is replaced with a cell of 2 V, keeping all other factors constant.

3. (a) State working principle of a metre bridge used to measure an unknown resistance.
(b) Give reason, (i) why the connections between the resistors in a metre bridge are made of thick copper strips?
(ii) why is it generally preferred to obtain the balance length near the mid-point of the bridge wire?

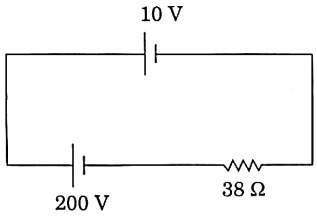
(c) Calculate the potential difference across the 4 Ω resistor in the given electrical circuit, using Kirchhoff's rules.



CBSE 2018

1. Two electric bulbs P and Q have their resistances in the ratio of 1:2. They are connected in series across a battery. Find the ratio of the power dissipation in there bulbs. (2)

2. A 10 V cell of negligible internal resistance is connected in parallel across a battery of emf 200 V and internal resistance 38 Ω as shown in figure.
Find the value of the current in the circuit. (2)

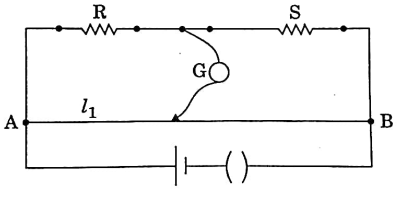


3. In a potentiometer arrangement for determining the emf of a cell, the balance point of cell in open circuit is 350 cm.When a resistance of 9 Ω is used in the external circuit of cell the balance point shifts to 300 cm. Determine internal resistance of the cell. (2)

4. (a) Define the term 'conductivity' of a metallic wire. Write its SI unit. (3)
(b) Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field.

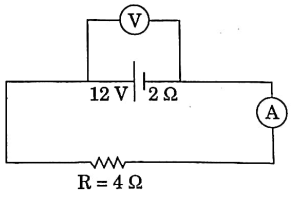
CBSE 2017

1. (a) Write the principle of working of a metre bridge.
(b) In a metre bridge, the balance point is found at a distance l_1 with resistances R and S as shown in figure. An unknown resistance X is now connected parallel to the resistance and balance point is found at distance l_2. Obtain formula for X in terms of l_1, l_2 and R. (3)



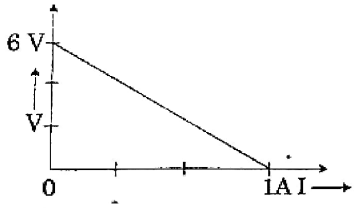
2. (a) The potential difference applied across a given resistor is altered so that the heat produced per second increases by a factor of 9. By what factor does the applied potential difference change?

(b) In the figure shown, an ammeter A and a resistor of 4 Ω are connected to the terminals of the source. The emf of the source is 12 V having an internal resistance of 2 Ω. Calculate the voltmeter and ammeter readings. (3)

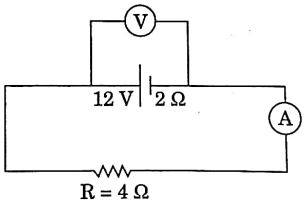


CBSE 2016

1. The plot of variation of potential difference across the combination of three identical cells in series versus the current is shown below. What is the emf and internal resistance of each cell? (2)



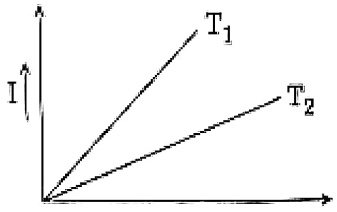
2. A battery of 12 V and internal resistance 2 Ω is connected to a 4 Ω resistance as shown in the figure. Show that a voltmeter when placed across the cell and across the resistor, in turn, gives the same reading. To record the voltage and the current in the circuit, why is voltmeter placed in parallel and ammeter in series in the circuit. (2)



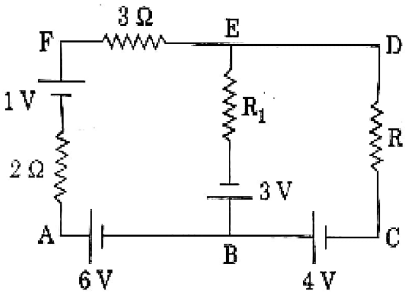
3. Derive an expression for the drift velocity of free electrons. How does drift velocity of free electrons in a metallic conductor vary with increase in temperature? Explain.

CBSE 2015

1. I-V graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in the figure. Which of the two temperature is lower and why? (1)



2. Use Kirchhoff's rules to determine the potential difference between the points A and D when no current flows in the arm BE of the electric network shown in the figure. (2)



3. Find the relation between drift velocity and relaxation time of charge carriers in a conductor. A conductor of length 'L' is connected to d.c. source of emf 'E'. If the length of conductor is tripled by stretching it, keeping 'E' constant explain how its drift velocity would be affected. (3)

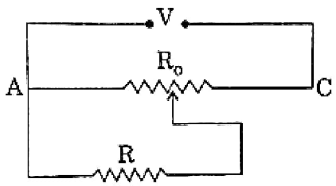
CBSE 2014

1. A cell of emf 'E' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing the variation of terminal voltage 'V' of the cell versus the current 'I'. Using the plot, show how the emf and its internal resistance can be determined. (2)

2. Estimate the average drift speed of conduction electrons in a copper wire of cross sectional area 1.0×10^{-7} m^2 carrying a current of 1.5 A. Assume the density of conduction electrons be 9×10^{25} m^{-3}. (2)

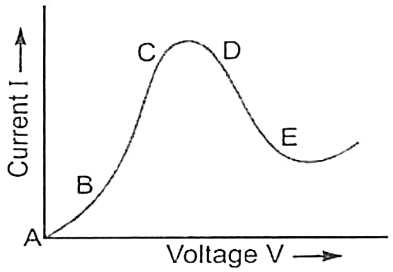
3. Answer the following :
   (a) Why are the connections between the resistors in a meter bridge made of thick copper strips.
   (b) Why is it generally preferred to obtain the balance point in the middle of meter bridge wire?
   (c) Which material is used for the meter bridge wire and why? (3)

4. A resistance of 'R' Ω draws current from a potentiometer as shown in the figure. The potentiometer has a total resistance R_0 Ω. A voltage V is supplied to the potentiometer. Derive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer. (3)



CBSE 2013

1. The graph shown in figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any, over which the semiconductor has a negative resistance. (1)

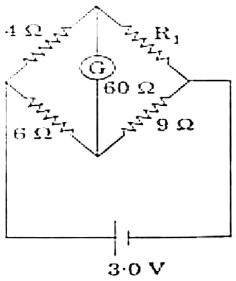


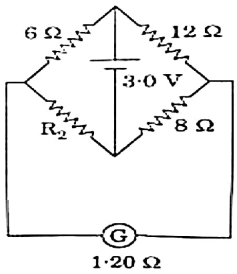
2. Two identical cells, each of emf E, having negligible internal resistance, are connected in parallel with each other across an external resistance R. What is the current through this resistance? (1)

3. Explain the term 'drift velocity' of the electrons in a conductor. Obtain the expression for the current in a conductor in term of drift velocity. (2)

4. Describe briefly, with help of circuit diagram, how a potentiometer is used to determine internal resistance of cell. (2)

5. Figure shows two circuits each having a galvanometer and a battery of 3V. When the galvanometers in each arrangement do not show any deflection, obtain the ratio R_1/R_2. (2)

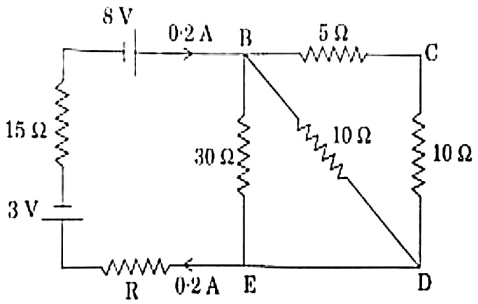




CBSE 2012

1. Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker? (1)

2. Calculate value of the resistance R in the circuit shown in figure so that the current in circuit is 0.2 A. What would be potential difference between points B and E? (3)



3. Define relaxation time of the free electrons drifting in a conductor. How is it related to the drift velocity of free electrons? Use this relation to deduce the expression for the electrical resistivity of the material. (3)