Electricity Class 12

Problems Based on the Given Formulae

1. **Calculate Current**:

   - A charge of 10 C flows through a conductor in 2 seconds. Calculate the current.
   - Formula: $I = \frac{Q}{t}$

2. **Ohm's Law**:

   - A resistor has a resistance of 5 Ω and a current of 2 A flows through it. Find the voltage across the resistor.
   - Formula: $V = IR$

3. **Drift Velocity**:

   - Calculate the drift velocity if the number density of free electrons in a copper wire is 8.5×10^{28} electrons/m^3, the cross-sectional area is 1×10^{-6} m^2, and the current is 3 A.
   - Formula: $I = neAv_d$

4. **Resistance and Resistivity**:

   - A wire of length 2 m and cross-sectional area 1×10^{-6} m^2 has a resistivity of $1.7 \times 10^{-8}\ \Omega \cdot m$. Calculate its resistance.
   - Formula: $R = \frac{\rho l}{A}$

5. **Relation for Resistivity**:

   - Given the number density n, the charge of an electron e, relaxation time τ, and mass of electron m, derive the resistivity of a material.
   - Formula: $\rho = \frac{m}{ne^2\tau}$

6. **Conductance**:

   - Find the conductance of a resistor with resistance 10 Ω.
   - Formula: $C = \frac{1}{R}$

7. **Current Density**:

   - If the current through a conductor is 5 A and the cross-sectional area is 2×10^{-6} m^2, calculate the current density.
   - Formula: $J = \frac{I}{A}$

8. **Mobility of Electron**:

- Given the drift velocity v_d is 5×10^{-4} m/s and the electric field E is 10 V/m, calculate the mobility of the electron.
- Formula: $\mu = \frac{v_d}{E}$

9. **Temperature Coefficient of Resistivity**:

   - A material has a resistivity of $\rho_0 = 1.5 \times 10^{-8} \, \Omega \cdot m$ at $T_0 = 20°C$. If the temperature coefficient of resistivity is $\alpha = 0.0039 \, °\text{C}^{-1}$, calculate the resistivity at $100°C$.
   - Formula: $\rho = \rho_0[1 + \alpha(T - T_0)]$

10. **Finding Alpha**:

    - Given resistivities ρ_1 and ρ_2 at temperatures T_1 and T_2 respectively, find the temperature coefficient of resistivity α.
    - Formula: $\alpha = \frac{\rho_2 - \rho_1}{\rho_1(T_2 - T_1)}$

11. **Series Combination**:

    - Calculate the equivalent resistance of three resistors $R_1 = 2\Omega$, $R_2 = 3\Omega$, and $R_3 = 4\Omega$ connected in series.
    - Formula: $R_s = R_1 + R_2 + R_3$

12. **Parallel Combination**:

    - Calculate the equivalent resistance of three resistors $R_1 = 2\Omega$, $R_2 = 3\Omega$, and $R_3 = 4\Omega$ connected in parallel.
    - Formula: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

13. **Electrical Power**:

    - A device operates at a voltage of 12 V and draws a current of 2 A. Calculate the power consumed by the device.
    - Formula: $P = VI$

14. **Internal Resistance**:

    - A cell with EMF E of 12 V has an internal resistance r of 1 Ω. When a resistor of 5 Ω is connected, calculate the terminal voltage.
    - Formula: $V = E - Ir$

15. **Internal Resistance Using Potentiometer**:

    - A potentiometer measures the potential drop across a known resistance R. Given l_1 and l_2 are the balancing lengths, calculate the internal resistance r.
    - Formula: $r = \left(\frac{l_1}{l_2} - 1\right)R$

16. **Current with Identical Cells in Series**:

- Calculate the current drawn when $n = 4$ identical cells, each with EMF $E = 1.5V$ and internal resistance $r = 0.5\Omega$, are connected in series with an external resistance $R = 10\Omega$.
- Formula: $I = \frac{nE}{R+nr}$

17. **Current with Cells in Parallel**:

- Calculate the current drawn when $m = 4$ cells are connected in parallel, each with EMF $E = 1.5V$ and internal resistance $r = 0.5\Omega$, and the external resistance $R = 2\Omega$.
- Formula: $I = \frac{mE}{(mR+r)}$

18. **Current with Rows of Identical Cells**:

- Calculate the current drawn when $m = 2$ rows of $n = 3$ identical cells, each with EMF $E = 1.5V$ and internal resistance $r = 0.5\Omega$, are connected with an external resistance $R = 10\Omega$.
- Formula: $I = \frac{mnE}{mR+nr}$

19. **Kirchhoff's Junction Rule**:

- Apply Kirchhoff's current law to a junction with three incoming currents $I_1 = 2A$, $I_2 = 3A$, and one outgoing current $I_3 = 4A$. Calculate the unknown current.
- Formula: $\sum I = 0$

20. **Balanced Condition of Wheatstone Bridge**:

- In a Wheatstone bridge, $P = 4\Omega$, $Q = 6\Omega$, and $R = 3\Omega$. Find the value of S for the bridge to be balanced.
- Formula: $\frac{P}{Q} = \frac{R}{S}$

21. **Unknown Resistance Using Wheatstone Bridge**:

- In a Wheatstone bridge, the known resistance R is 5 Ω, and the balancing length l is 40 cm. Calculate the unknown resistance S.
- Formula: $S = \left(\frac{100-l}{l}\right)R$

22. **Potential Drop Using Potentiometer**:

- A potentiometer wire has a length of 1 m and a constant $K = 0.01V/cm$. Calculate the potential drop for a balancing length L of 50 cm.
- Formula: $V = KL$

23. **Comparison of EMFs Using Potentiometer**:

- Two cells have EMFs E_1 and E_2. Given the balancing lengths $l_1 = 30cm$ and $l_2 = 45cm$, compare their EMFs.
- Formula: $\frac{E_1}{E_2} = \frac{l_1}{l_2}$

These problems cover a range of concepts and formulae from the topic of current electricity, providing a comprehensive set of exercises for practice.