# CURRENT ELECTRICITY

Class 12 - Physics

Time Allowed: 1 hour and 28 minutes   **Maximum Marks: 45**

1. Is Ohm's law obeyed by semiconductors? **[1]**

2. Define an emf of one volt. **[1]**

3. An electric current of 2.0 μA exists in a discharge tube. How much charge flows across a cross-section of the tube in 5 minutes? **[1]**

4. Define the term electrical conductivity of a metallic wire. Write its SI unit. **[1]**

5. V-I graphs for parallel and series combination of two metallic resistors are as shown in Fig. Which graph represents parallel combination? Justify your answer. **[1]**
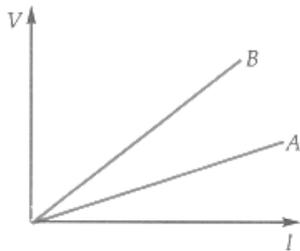

6. Two heating coils, one of fine wire and the other of thick wire, made of same material and of the same length are connected in turn to a source of emf. Which of the coils will produce more heat? **[1]**

7. A 500 W electric heater is designed to work with a 200 V line. If the voltage of the line drops to 160 V, then what will be the percentage loss of the heat developed? **[1]**

8. In the figure, P = 3Ω, Q = 2Ω, R = 6Ω, S = 4Ω and X = 5Ω. Calculate the current I. **[1]**
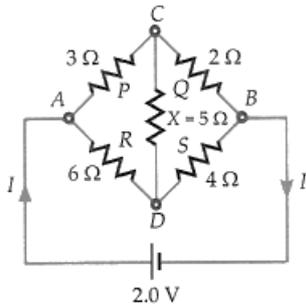

9. A heating element is marked 210 V, 630 W. What is the value of the current drawn by the element when connected to a 210 V DC source? **[1]**

10. How is current kept continuous inside a conductor? **[1]**

11. Two electric bulbs rated as 100 W, 220 V and 25 W, 220 V are connected in series across 220 V line. Calculate: **[3]**

    i. current through

    ii. the potential difference across and

    iii. actual powers consumed in the filament of each bulb

12. In the circuit shown in Figure, find the potential difference across the capacitor. **[3]**
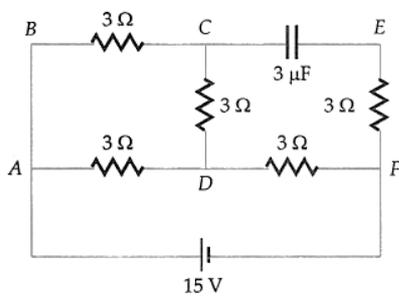
13. i. A car has a fresh storage battery of emf 12 V and internal resistance 5.0×10^{-2} Ω. If the starter motor draws a current of 90 A what is the terminal voltage of the battery when the starter is on? **[3]**

ii. After long use, the internal resistance of the storage battery increases to 500 Ω. What maximum current can be drawn from the battery? Assume the emf of the battery to remain unchanged.

iii. If the discharged battery is charged by an external emf source, is the terminal voltage of the battery during charging greater or less than its emf 12 V?

14. A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit? **[3]**

15. 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 below: **[3]**
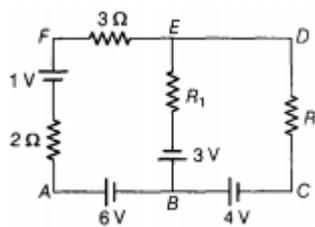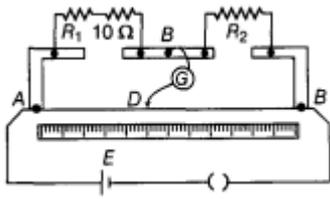

16. i. Find the emf E_1 and E_2 in the circuit of the following diagram and the potential difference between the points A and B. **[5]**
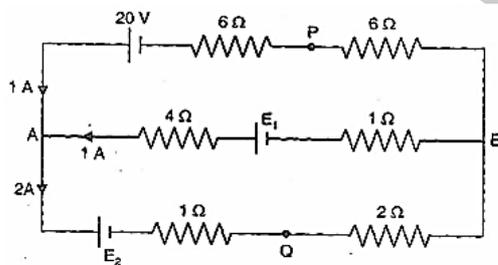
ii. If in the circuit, the polarity of the battery E_1, be reversed, what will be the potential difference between A and B?

17. i. Derive the relation between current density J and potential difference V across a current carrying conductor of length l, area of cross-section A and the number density n of free electrons. **[5]**

ii. 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 that the number density of conduction electrons is 9×10^{28} m^{-3}]

18. i. Define the term conductivity of a metallic wire. Write its SI unit. **[5]**

ii. Using the concept of free electrons in a conductor, derive the expression for the conductivity of wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field E.

19. a. State Kirchhoff's rules for an electric network. Using Kirchhoff's rules, obtain the balance condition in terms **[5]**

of the resistances of four arms of Wheatstone bridge.

b. In the meter bridge experimental set up, shown in the figure, the null point D is obtained at a distance of 40 cm from end A of the meter bridge wire. If a resistance of 10Ω is connected in series with R_1, null point is obtained at AD = 60 cm. Calculate the values of R_1 and R_2.