ST. LAWRENCE HIGH SCHOOL

A JESUIT CHRISTIAN MINORITY INSTITUTION

STUDY MATERIAL - 4 (PART - II)

Subject : PHYSICS

Topic : Current Electricity

CLASS : XII Date : 18.6.20

D : Numericals

1. Exmple : A wire of length 6 m and area of cross-section 1 mm^2 carries a current of 2 A. If unit cubic meter of the material of a wire contains 10^{29} free electrons, find the average time taken by an electron to cross the length of the wire.

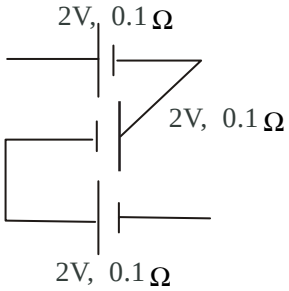
   Solution : $v = \frac{1}{neA} = \frac{2}{10^{29} \times 1.6 \times 10^{-19} \times 1 \times 10^{-6}} = 1.25 \times 10^{-4}\, ms^{-1}$

   $t = \frac{1}{v} = \frac{6}{1.25 \times 10^{-4}} = 4.8 \times 10^{4}\, s = 13.33\, hr$

2. The resistivity of a metallic wire is 1 x $10^{-8}\,\Omega$ m. If the length of the metallic wire is doubled and its area of cross-section is made half, what will be the new value of the resistivity of the wire?

   Solution : Since resistivity does not depend upon the physical dimensions i.e, length and area of cross-section of the material, so new resistivity will be unchanged i.e it remains 1 x $10^{-8}\,\Omega$ m.

3. Find the total e.m.f. and total internal resistance of the group of cells shown below :

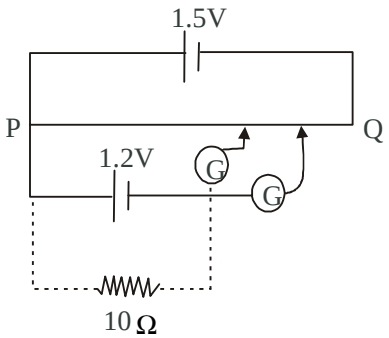


   Solution : The cells are connected in series. Here, n = 3, E = 2V, r = 0.1 Ω

   E_{eq} = nE = 3 x 2 = 6V

   r_{eq} = nr = 3 x 0.1= 0.3 Ω

4. A potentiometer with 1.5 V cell is used for finding the internal resistance of a 1.2 V cell. The balance point comes at 65 cm. If a resistor of 10 Ω is used as shown in the figure, the balance point changes to 55 cm. Calculate the internal resistance of the cell.



Solution : Here, R = $10\,\Omega$, l_1 =65 cm and l_2 = 55cm

Internal resistance of the cell is given by,

$$r = \left(\frac{l_1 - l_2}{l_2}\right)R = \left(\frac{65-55}{55}\right)\times 10 = 1.82\Omega$$

5. What is the expression for determining unknown resistance by a meter bridge? [2012]

Soln. In case of a meter bridge, the unknown resistance

$$S = R.\frac{Q}{P} = R.\frac{100-l}{l}$$

6. When a resistance of $7\,\Omega$ is connected across the terminals of a cell, the current through the circuit is 1.1A. When the resistance is increased to $13\,\Omega$, the current is 0.67A. Determine the emf of the cell and its internal resistance. [2012]

Soln : Let the emf and internal resistance of the cell are E and r respectively.

In first case, current through the circuit,

$$l_1 = \frac{E}{R+r} \quad \text{or, } 1.1 = \frac{E}{7+r} \qquad \ldots(1)$$

In second case, current through the circuit

$$l_2 = \frac{E}{R+r} \quad \text{or, } 0.67 = \frac{E}{13+r} \qquad \ldots(2)$$

Solving (1) and (2) we get,

E = 10.28 V and r = $2.35\,\Omega$

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