CURRENT ELECTRICITY

HOTS QUESTIONS (solved)

Q1> A steady current flows in a metallic conductor of non-uniform cross section. Explain which of these quantities constant along the conductor: current, current density, electric field and drift speed?

Ans> only current through the conductor of non-uniform area of cross-section is constant as the remaining quantities vary inversely with the area of cross section of the conductor.

Q2> A low voltage supply from from which one needs high currents must have low internal resistance. Why?

Ans> As the maximum current is equal to the ratio of the e m f to the internal resistance, so for maximum current, internal resistance should be least.

Q3> A high tension (HT) supply of say 6 KV must have a very large resistance. Why?

Ans> A high tension supply must have a large internal resistance otherwise, if accidently the circuit is shorted, the current drawn will exceed safety limit and cause damage to circuit.

Q4> A current is passed through a steel wire heated to red. Then half of the wire is immersed in cold water. Which half of the wire will heat up more and why?

Ans> The half part of wire immersed in cold water is at lower temperature, so it's less than that of unimmersed part. The net resistance of wire decrease and so the current will increase. The resistance of exposed part is same before therefore the heat

produced in exposed part is increased; hence the exposed part of the wire is heated up still more.

Q5> How does the resistivity of a conductor and a semiconductor vary with temperature? Give reason for each case.

Ans> The resistivity of a conductor increases with increase of temperature and by the relation that resistivity $\rho=m/ne^2\zeta$ which shows that ρ is proportional to 1/ ζ .The resistivity of a semiconductor decreases with increase of temperature because ρ is proportional to 1/n.

Q.6> What is the function of high resistance R connected in series with the galvanometer? Does this high resistance R affect the balance point?

Ans> High Resistance R is connected in series with the galvanometer to avoid large current through the galvanometer. Large current through the galvanometer damages it. High resistance R does not affect the balance point in any manner.

Q7> An electric circuit is completed by connecting the ends of a very long wire, nearly 100 Km, battery. On passing the switch the electric current is established at once, explain it.

Ans> When switch is turned on the electric field is transmitted in the wire with speed of light and is established in the whole wire. Hence at each point wire the free electrons start drifting and constitute current.

The time taken, $t=100km/ (3*10^8)$

$=3.34*10^{-4}$ sec

This time is negligible; hence current in the wire begins to flow at once.

Q8>The earth's surface has a negative surface charge density of 10^{-9} C m^{-2}.The potential difference of 400kV between the top of the atmosphere and the surface results (due to the low conductivity of the lower atmosphere) in a current of only 1800A over the entire globe. If there were no mechanism of sustaining atmospheric electric field, how much time would be required to neutralize the earth's surface?

Ans> Here $r=6.37*10^6$m; $\sigma = 10^{-9}$ Cm^{-2}; I=1800 A

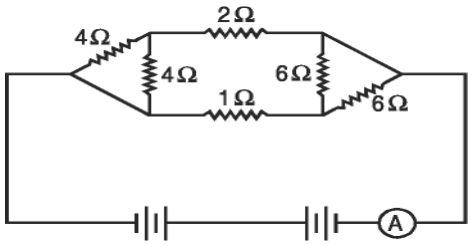
Area of the globe, $A= 4\pi r^2=4*3.14*(6.37*10^6)^2=509.64*10^{12}$ m^2

As charge, $Q= \sigma*A = 10^{-9}*509.64*10^{12}= 509.64*10^3 C$

$t= Q/T = (509.64*10^3)/1800 = 283.1$ s

UNSOLVED QUESTIONS

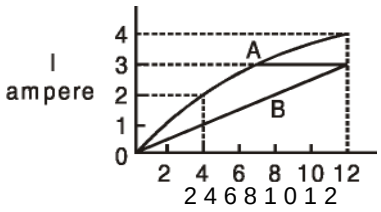
1. **Q1>Calculate the equivalent resistance and current shown by the ammeter in the circuit diagram given.**



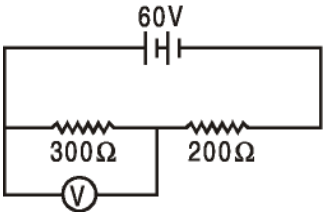
Q2. The graph shows how the current I vary with applied potential difference V across a 12 V filament lamp (A) and across one meter long nichrome wire (B). Using the graph, find the ratio of the values of the resistance of filament lamp to the nichrome wire

(i) when potential difference across them is 12 V.

(ii) when potential difference across them is 4V. Give reason for the change in ratio of resistances in (i) and (ii).



Q3> In the circuit shown, the reading of voltmeter is 20V. Calculate resistance of voltmeter. What will be the reading of voltmeter if this is put across 200 resistance?



Q4 Given two resistors X and Y whose resistances are to be determined using an ammeter of resistance 0.5 and a voltmeter of resistance 20 k . It is known that X is in the range of a few ohms, while Y is in the range of several thousand ohm. In each case, which of the two connection shown should be chosen for resistance measurement