9 - Current Electricity

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9 Current Electricity

9.1 Electric Conduction in Metals

- (1999) State Kirchhoffs laws of circuit analysis
- (2000) State Kirchhoffs laws of electric circuits.
- (2000) What do you understand by the term drift velocity as applied to any current carriers in a wire?
- (2000) Determine the drift velocity of electrons in a silver wire of a crosssectional area 4.5×10^{-6} m^2 when a current of 15 A flows through it. Given: The density of silver $= 1.05 \times 10^4$ kg/m^3 . The atomic weight of silver $= 108$.
- (2000) An unknown wire of 1 mm diameter is found to carry and passes a total charge of 90 C in 1 hour and 15 min. If the wire has 5.8×10^{28} free electrons per m^3 , find
  - the current in the wire.
  - the drift velocity of the electrons in m s^{-1}
- (2000) The current of 12 A is made to pass through an aluminium wire of radius 1.5 mm which is joined in series with a copper wire of radius 0.8 mm. Determine.
  - the current density in an aluminium wire.
  - the drift velocity of the electron tn the copper wire, given that the number of free electrons per unit volume in a copper wire is 10^{29} .
- (2007) Define the internal resistance (r) of a cell and the terminal potential difference.
- (2007) The e.m.f. of a cell is a special terminal potential difference. Comment.
- (2007) State Kirchhoff's laws of electrical network.
- (2007) Discuss two (2) harmful effects of electrolysis.
- (2009) Explain the mechanism of electric conduction in:
  - Gases
  - Electrolytes

- (2010) Define the temperature coefficient of resistance
- (2013) What is meant by power rating" as regards to a resistor?
  - Mention two distinct velocities of an electron in a wire.
- (2013) Explain why it is better to use a small current for a long time to plate a metal with a given thickness of silver than using a larger current for a short time?
- (2013) Give four difference between the passage of electricity through metals and ionized solution.
- (2014) Define the following terms:
  - Current density
  - Conductivity
- (2014) Under what condition is Ω s law true?
- (2014) Why does the voltage across the terminals of a cell or battery fall when it is delivering a current?
- (2014) Define temperature coefficient of resistance.
  - A heating coil of Nichrome wire with cross sectional area of 0.1 mm^2 operates on a 12 V supply, and has a power of 36 W when immersed in water at 373 K. Calculate the length of the wire.
- (2015) What is meant by the following terms:
  - Internal resistance of a cell.
  - Drift velocity.
- (2015) What is a potentiometer.
  - Mention two advantages and two disadvantages of potentiometer.
- (2015) Distinguish between ohmic and non-ohmic conductor. Give one example in each
- (2016) What ts the physical significance of Kirchhoffs first law.
- (2016) Why is Kirchhoffs second law sometimes referred to as the voltage law?
- (2016) List down five points to be considered when applying Kirchhoffs second law in formulating analytical problems or equations.
- (2017) What is the advantage of using a greater length of potentiometer wire?
- (2017) Why is Wheatstone bridge not suitable for measuring very high resistance?
- (2017) List two factors on which the resistivity of a material depends.
- (2017) A wire of resistivity, ρ , is stretched to double its length. What will be its new resistivity? Give reason for your answer.
- (2017) Why a high voltage supply should have high internal resistance?

- (2017) Justify the statement that it is not possible to verify Ohm's law by using a filament lamp.
- (2017) A potential difference of 4 V is connected to 4 uniform resistance wire of length 3.0 m and cross-sectional area 9×10^{-9} , when a current of 0.2 A is flowing in the wire. Find the:
  - Resistivity of the wire.
  - Conductivity of the wire.
- (2018) Outline three important points which are usually referred as sign convection in solving Kirchhoffs second law problems.
- (2018) How is ohmic conductor differ from non-ohmic conductor? Give one example in each case.
- (2018) State a condition that could be employed to make an insulator conduct some electricity.
- (2018) What is meant by the term Ballistic galvanometer?
- (2018) State two conditions to be fulfilled for a galvanometer to be used as a ballistic galvanometer.
- (2019) A researcher has 2 g of gold and wishes to form it into a wire having a resistance of 80Ω at $0°C$. How long should the wire be?

9.2 Electric Conduction in Gases

- (1998) What is thermionic emission?
- (2013) Explain the following observation:
  - Light in the bulb comes on once the switch is kept on despite the drift velocity of electrons being very low.
  - The potentiometer is said to be a better device for measuring the potential difference (p.d) than a moving coil voltmeter.
- (2013) A milliameter connected in series with a hydrogen discharge tube indicates a current of 1.0×10^{-3} A. If the number of electrons passing the cross section of the tube at a particular point is 4.0×10^{15} per second, find the number of protons that pass the same cross section per second.
- (2015) Sketch the diagram showing the variation of current with potential difference across the following:
  - Filament electric bulb.
  - Gas-filled diode.
- (2018) Distinguish between ionization energy and excitation energy.

9.3 Alternating Current (ac)

- (1999) What is a resonant frequency of an oscillator?
- (1999) An inductance of 4 mH is connected in series with a resistance of 20Ω together with a battery:
  - Determine how the current will vary with time in this circuit.
  - Sketch the current of above against time
  - Calculate the inductive time constant
- (2000) What is meant by the terms electrical resistivity and ohmic conductor.
- (2000) A 4 m long resistance wire has a cross-sectional area of 0.8 mm? and has a resistance of 2.80Ω . Determine:
  - The resistivity of the wire.
  - The length of a similar wire which when joined in parallel will give a total resistance of 2.0Ω .
- (2000) Two cells of emf 1.5 V and 2.0 V and internal resistances of 1Ω and 2.0Ω respectively are connected in parallel and across them an external resistance of 5.0 Q. Calculate the currents in each of the three branches of the network.
- (2000) What is a rectifier?
- (2007) An a.c. generator consists of a coil of 50 turns and an area of 2.5 m^2 , rotates at an angular speed of 60 rad/s in a uniform magnetic field of 0.30 T between two fixed pole pieces. The resistance of the circuit including that of the coil is 500Ω .
  - What is the maximum current that can be drawn from the generator?
  - What is the magnetic flux through the coil if the current is maximum?
- (2013) A 20 kΩ resistor is to be connected across a potential difference of 300 V Calculate the required power rating.
- (2013) Derive an expression for impedance of a series $R - C$ circuit.
- (2013) Write down two advantages of digital circuits over the analogue circuits.
- (2014) What is meant by the following terms:
  - Alternating current (a.c.)
  - Effective value of A.C.
- (2014) A 60 V, 10 W lamp is to be run on 100 V, 60 Hz A.C mains.
  - Calculate the inductance of a choke coil required.
  - If a resistor is used in above instead of choke, what will be value of its resistance.
- (2014) An LCR circuit with $R = 70\Omega$ in series with a parallel combination of $L = 1.5$ H and
  - $C = 30$ μF is driven by a 230 V supply with angular frequency of 300 rad/s.

  - (1) Find the power in put to the circuit.
  - At the frequency $\omega_o = 1/(\sqrt{LC})$, how does the circuit respond?

- (2015) Explain the statement that, a sinusoidal current, of peak value 5 A passed through an a.c. ammeter reads $5/\sqrt{2}$ A.
- (2015) Show that the average power transferred to an a.c. circuit is, in general, given by EIR/Z , where R is the resistance in the circuit defined to be the real part of complex impedance and Z is its impedance.
- (2015) A coil which has an inductance of 0.2 H and negligible resistance is in series in a resistor, whose resistance is 60Ω . The pair is connected across a 50 V supply alternating at $100/\pi$ Hz. Calculate the toal impedance of the circuit and its power factor.
- (2016) An a.c. circuit consists of a pure resistance of 10Ω is connected across an a.c. supply of 230 V , 50 Hz. Calculate the;
  - Current flowing in the circuit.
  - Power dissipated
- (2016) An X-ray tube, operated at a d.c. potential difference of 60 kV , produces heat at the target at the rate of 840 W . Assuming 0.65% of the energy of the incident electrons is converted into X-radiation, calculate:
  - The number of electrons per second striking the target.
  - The velocity of the incident electrons.
  - The energy of incident electrons
- (2018) Calculate the current flowing in the circuit when three similar cells each of emf 1.5 V and internal resistance 0.3Ω are connected in parallel across a 2Ω resistor.
- (2018) Why choke coil is preferred over resistance to control alternating current?
- (2018) Explain what could be done to light a 30 V bulb from a 220 volt A.C. supply?
- (2019) A current of 3.0 mA flows in a Television resistor R when a potential difference of 6.0 V is connected across its terminals. Determine the value of conductance.