

9 - Current Electricity

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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 $4.5 \times 10^{-6} \text{ m}^2$ when a current of 15 A flows through it. Given: The density of silver = $1.05 \times 10^4 \text{ kg/m}^3$. 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 a 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 to as sign convention in solving Kirchhoff's second law problems.
- (2018) How do ohmic conductors differ from non-ohmic conductors? 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 milliammeter 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^2 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 5.0Ω . 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 $20 \text{ k}\Omega$ 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 $L = 1.5 \text{ H}$ and $C = 30 \mu\text{F}$ 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 total 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.