DELHI PUBLIC SCHOOL, DURGAPUR

QUESTION BANK & REVISION SHEET FOR BLOCK TEST-I (2018-19)

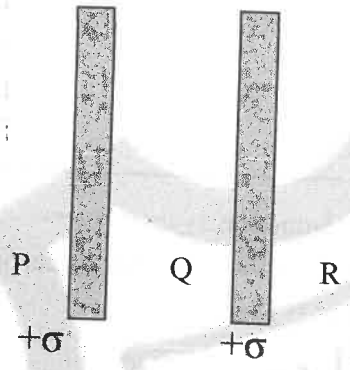
CLASS-XII

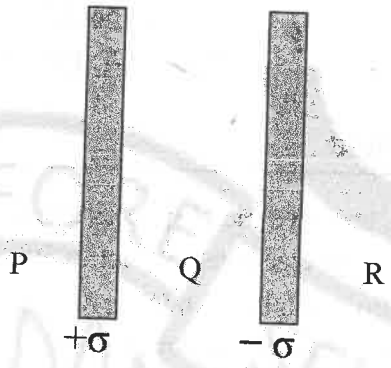
SUBJECT: PHYSICS

Electric charge and field

1. Show diagrammatically, how two metal spheres can be oppositely charged by induction.
2. Estimate the total number of electrons present in 100 gm of water. How much is the total charge carried by these electrons? Avogadro's number = 6.023×10^{23} and molecular mass of water = 18g.
3. Write down the different characteristics of charges.
4. Check that, the ratio $\frac{ke^2}{Gm_em_p}$ is dimensionless, where k is constant for Coulomb's law, e is the electronic charge, G is universal gravitational constant, m_e and m_p are the masses of electron and proton respectively. What does this ratio signify?
5. State and explain Coulomb's law. What is the force between two small charged spheres having charges 2×10^{-7} C and 3×10^{-7} C placed 30 cm apart in air?
6. Define relative permittivity of a medium in terms of Coulomb's force of interaction.
7. A particle of mass m and carrying charge $-q_1$ is moving around a charge $+q_2$ along a circular path of radius r. prove that, the period of revolution of the charge $-q_1$ about $+q_2$ is given by $T=\sqrt{\frac{16\pi^3\varepsilon_0 mr^3}{q_1q_2}}$.
8. Two point charges $+4e$ and $+e$ are fixed at a distance a apart. Where should a third point charge q be placed on the line joining the two charges so that it may be in equilibrium? In which case the equilibrium will be stable and in which case it will be unstable?
9. A charge Q has to be divided on two objects. What should be the value of these charges on the two objects so that the force between the objects can be maximum?
10. Obtain the dimensional formula for ε_0.
11. State the principle of superposition to obtain the expression of net force on a charge particle, when placed in a system of N number of discrete charges.
12. Write a short note on continuous charge distribution.
13. Two charges of equal magnitudes and at a distance r exert a force F on each other. If the charges are halved and distance between them is doubled, then find the new force acting on each charge.
14. Define Electric field. Find out the dimension of electric field.
15. State the properties if electric field lines. Why do two lines of force never intersect each other?
16. Without using Gauss law, Calculate the electric field at a point on the axis, passing through the center of a circular current carrying ring.
17. What is the total electric flux due to a q coulomb charge placed (a) at the center (b) at one of the vertices of a cube.
18. What do you mean by dipole moment? What is its unit?
19. Calculate the electric field at a point on the axis of a dipole.
20. Calculate the electric field at a point on the perpendicular bisector of a dipole?

21. What is the relationship between the electric fields at axial and equatorial points for a short dipole?
22. Calculate the electric field at the points P, Q and R for the following cases:



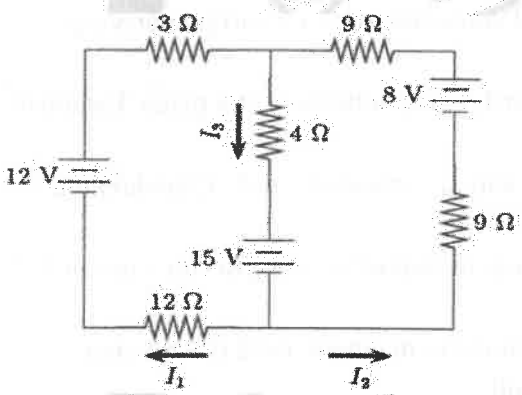


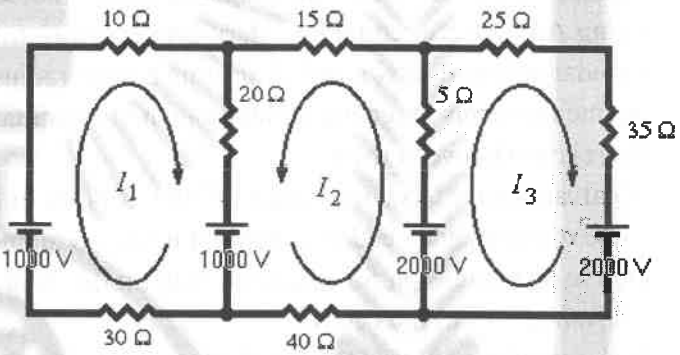
23. What is the net flux due to a dipole?
24. Calculate the torque acting on a dipole when it is placed in a uniform electric field. When is the torque maximum?
25. Derive an expression for the total work done in rotating a dipole in a uniform electric field from an angle θ_1 to θ_2. What is the condition for doing the minimum work?
26. Two positive charges of magnitude q are kept at a distance 2 m apart from each other. Where a third charge should be placed so that this charge will be in equilibrium? Is this equilibrium stable or unstable?
27. Calculate the total electric field at a point due to a continuous charge distribution in a solid cylinder and hence draw the field distribution graph.
28. Derive Gauss law from Coulomb's law.
29. Derive the dimension of electric flux.
30. What is the electric flux due to a charge q around a cube of side a cm.

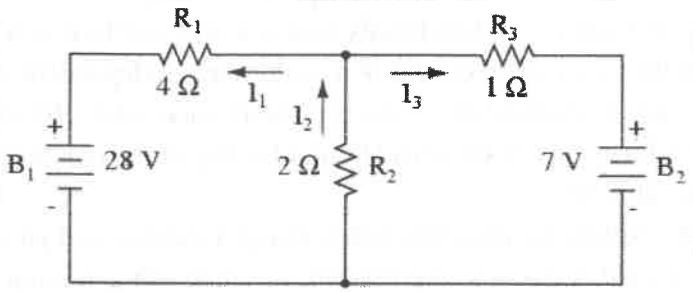
Current Electricity

1. Differentiate between electromotive force and potential difference.
2. Derive the vectorial form of Ohm's law.
3. Differentiate between conductors, semiconductors and insulators.
4. Derive the relation between drift velocity and relaxation time.
5. Deduce Ohm's law from the relation between electric current and drift velocity. Also write the expressions for resistivity in terms of number density of free electrons and relaxation time.
6. Derive the relation between electric current and mobility for (i) a conductor and (ii) a semiconductor. Hence, find out an expression for the conductivity of a semiconductor.
7. Draw the variation of resistivity with temperature for a conductor and a semiconductor and compare them. Define temperature coefficient of resistance.
8. Mention some of the non-ohmic conductors and present their V-I characteristic graph.
9. Find out the expression for the equivalent resistance of a combination of resistors, connected in (a) series and (b) parallel.
10. Establish the relation among internal resistance, emf and terminal potential difference of a cell. Hence, draw the characteristic curve for a cell.

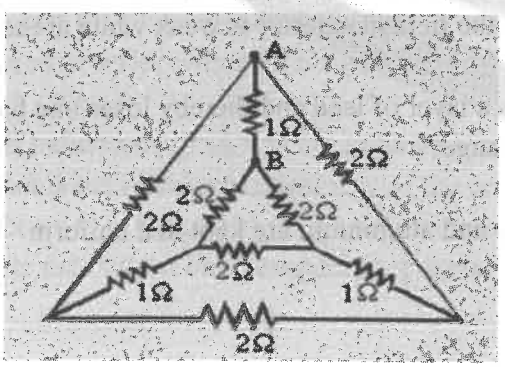
11. Find an expression for the total current flowing through a mixed combination of identical cells, arranged in *m* rows, containing n cells in each row. Each cell has the emf ε and internal resistance *r*.
12. Derive the condition for obtaining maximum current through an external resistance connect across a mixed grouping of cells.
13. Obtain an expression for the heat developed in a resistor by the passage of electric current through it. Hence state Joule's law of heating.
14. Find out the condition under which power output of a cell will be maximum. Hence find out the maximum power output.
15. Mention few applications of heating effect of current.
16. State Kirchhoff's current and voltage laws for electrical circuits. Show that, these laws are in accordance with the principles of conservation of charge and energy respectively.
17. When a Wheatstone bridge is said to be in balanced condition? Applying Kirchhoff's laws, derive this balanced condition.
18. With the help of a circuit diagram, explain the working principle of a meter bridge in finding an unknown resistance.
19. Using KCL and KVL, solve for the currents:

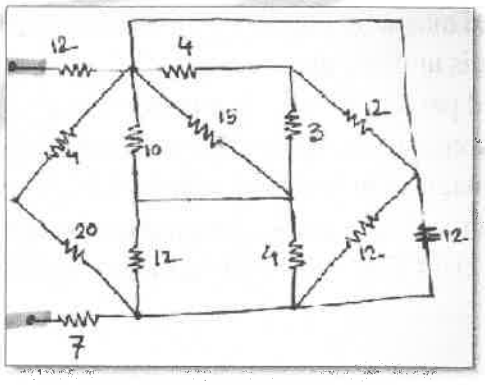






20. Calculate the equivalent resistance for the following circuits:





Magnetic effect of current and Magnetism

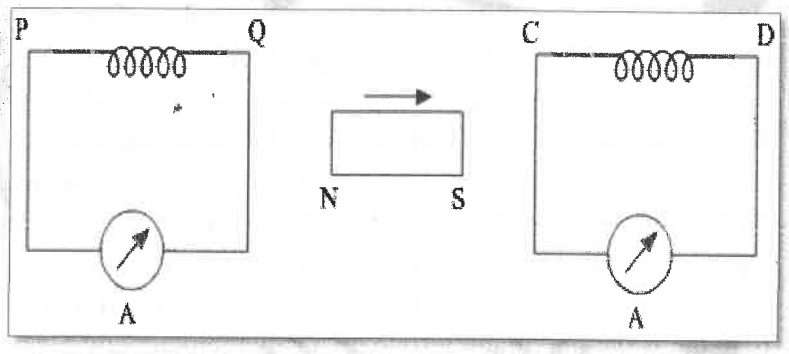
1. State and explain Biot-Savart's law.
2. State the rules for finding the direction of magnetic field due to a straight current carrying conductor.
3. A beam of electrons projected along +X axis, experiences a force due to a magnetic field along +Y axis. What is the direction of magnetic field?
4. Calculate the magnetic field at a on the axis passing through the centre of a current carrying circular coil.
5. Why should the spring/suspension wire in a moving coil galvanometer have low torsional constant?
6. For a Para magnetic material, plot the variation of intensity of magnetisation with temperature.
7. A particle with charge q moving with a velocity v moving in the plane of paper enters a uniform magnetic field B acting perpendicular to paper and pointing inwards. Why does the kinetic energy of the charge particle not change while moving in the field?
8. How will the magnetic field strength at the centre of the circular coil carrying current change, if the current through the coil is doubled and radius is halved?
9. Can moving coil galvanometer be used to detect an a.c. in a Circuit? Give reason.
10. Deduce an expression for the magnetic dipole moment of an electron orbiting around the central nucleus.
11. Using Ampere's circuital law, derive an expression for magnetic field along the axis of a current carrying toroidal solenoid of N number of turns having radius r.
12. Define the terms magnetic inclination and horizontal component of earth's magnetic field at a place. Establish the relation between them.
13. A galvanometer has a resistance of 30Ω. It gives full scale deflection with a current of 2 mA. Calculate the value of resistance needed to convert it into an ammeter of range 0-0.3A.
14. Derive an expression for magnetic field on the axial line of circular loop of radius 'a' and carrying current I at a distance x from the centre.
15. A rectangular coil of N turns and area of cross section A is placed in uniform magnetic field B with area vector making angle with B. Derive an expression for torque on the coil.
16. Draw a schematic sketch of a cyclotron. Explain briefly how it works and how it is used to accelerate the charged particle i) Show that the time period of ions in a cyclotron is independent of both the speed and radius of circular path. ii) What is resonance condition? How is it used to accelerate the charged particle?
17. Two straight long parallel conductors carry currents I1 and I2 in the same direction. Deduce an expression for the force per unit length between them.
18. a) With the help of a diagram, explain the principle and working a moving coil galvanometer. b) What is the importance of radial magnetic field and how is it produced. c) While using moving coil galvanometer as a voltmeter a high resistance in series is required whereas in an ammeter a shunt is used. Why?
19. Derive an expression for the magnetic field along the axis of air cored solenoid, using Ampere's circuital law. Sketch the magnetic field lines for a finite solenoid. Explain why the field at exterior is weak while at the interior it is uniform and strong.
20. A charged particle moving in a uniform magnetic field penetrates a layer of lead and thereby loses one half of its kinetic energy. How does the radius of curvature of its path change?
21. Why diamagnetism is almost independent of temperature?
22. Three identical specimens of magnetic materials nickel, antimony and aluminium are kept in a uniform magnetic field. Draw the modification of field lines in each case.

23. How will the magnetic field intensity at the centre of a circular our carrying current change, if the current though the will is doubled and radius of the coil is halved?
24. Can neutrons be accelerated in a cyclotron? Why?
25. A bar magnet of magnetic moment M is aligned parallel to the direction of a uniform magnetic field B. What is the work done to turn the magnet, so as the align its magnetic moment (i) Opposite to the field direction (ii) Normal to the field direction?
26. An electron in the ground state of hydrogen atom is revolving in anti – clockwise direction in a circular orbit. The atom is placed normal to the electron orbit makes an angle of 30o in the magnetic induction. Find the torque experienced by the orbiting electron?
27. A short bar magnet of magnetic moment 0.9 J/T is placed with its axis at 60^0 to a uniform magnetic field. It experience a torque of 0.063 Nm. (i) calculate the strength of the magnetic field and (ii) what orientation of the bar magnet corresponds to the equilibrium position in the magnetic field?
28. A beam of electrons is moving with a velocity of 3 ×106 m/s and carries a current of 1 μ A. (a) How many electrons per second pass a given point? (b) How many electrons are in 1m of the beam? (c) What is the total force on all the electrons in 1m of the beam if it passes through the field of 0.1NA-1 m-1?
29. What is the main function of soft iron core used in a moving coil galvanometer?
30. A galvanometer gives full deflection for Ig. Can it be converted into an ammeter of range I < Ig?
31. (a) Obtain an expression for the torque acting on a current carrying circular loop.
32. (b) What is the maximum torque on a galvanometer coil 5 cm ×12 cm of 600 turns when carrying a current of 10 A in a field where flux density is 0.10T.
33. Explain the construction and working principle of a cyclotron.

Electromagnetic induction

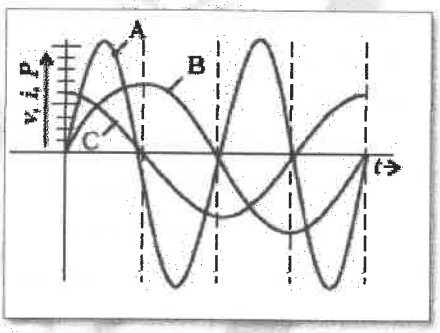
1. The current in the direction from B-A is decreasing, what is the direction of induced current in the metallic loop kept above the wire?
2. How does the self inductance of an air core coil changes when – (i) no. of lines in the coil is decreased (ii) an iron rod is introduced in the coil.
3. Why does the metallic piece become very hot when it is surrounded by a coil carrying high frequency ac?
4. Draw impedance triangle of LCR series circuit.
5. The magnetic flux linked with the coil at any instant t is given by $\phi = \left(5t^3 + 10t^2 - 7\right)$Wb. What is the emf induced in the coil at t = 5 sec?
6. A sinusoidal emf ***E=200 sin 314t*** is applied to a resistor of 10 Ω resistance, calculate (i) rms value of voltage (ii) rms value of current (iii) Power dissipated as heat in watt.
7. Why eddy currents are reduced in a laminated core?
8. Discuss the phenomenon of resonance in LCR series circuit. A capacitor of 15 Ω and 101.5mH inductor are placed in series with a 50 Hz AC source. Calculate the capacity of capacitor if the current is observed in phase with voltage.
9. Self inductance of an air core inductor increases from 0.01mH to 10 mH on introducing an iron core into it. What is the relative permeability of the core used?
10. When a.c. is fed to a moving coil galvanometer it shows no deflection. Why?
11. State the laws of electromagnetic induction.

12. Show that, Lenz's law is in accordance with the principle of conservation of energy.
13. What is motional emf? Find an expression for this.
14. What are the methods of generating induced emf?
15. With a relevant diagram explain the theory of AC generator.
16. Explain briefly the theory of electromagnetic damping.
17. Calculate the maximum emf induced in a coil of 100 turns and 0.001 m^2 area rotating at the rate of 50 rps about an axis perpendicular to a uniform magnetic field of 0.05T. If the resistance of the coil is 30Ω, what is the maximum power generated by it?
18. Compare self induction and mutual induction. Calculate the mutual inductance of two long solenoids.
19. What do you mean by coefficient of coupling? What is its range?
20. A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the direction of induced current in each coil.



Alternating current

1. A device X is connected to an A.C. source. The variation of voltage, current and power in one complete cycle is shown in figure.
   (a) Which curve shows power consumption over a full cycle?
   (b) What is the average power consumption over a complete cycle?
   (c) Identify the device X.



2. A coil of 0.01H inductance and 1 ohm resistance is connected to 200 volt, 50 Hz ac supply. Find the impedance of the circuit and time lag between maximum alternating voltage and current.
3. Find out the average value of an AC over a complete cycle.
4. Establish the relationship between the average value and the peak value of an alternating current.
5. What is rms value of an alternating current? Derive a relation between rms value and peak value of an alternating current over a complete cycle.
6. Show that for a pure resistive circuit, the current and emf are in the same phase. Hence draw the relevant phasor diagram.
7. Show that for a pure inductive circuit, the current lags emf by a phase difference of $\pi/2$. Hence draw the relevant phasor diagram.
8. Show that for a pure resistive circuit, the current leads emf by a phase difference of $\pi/2$. Hence draw the relevant phasor diagram.
9. What do you mean by reactance of an inductor and a capacitor?

10. Why is a DC blocked by a capacitor? What is the standard frequency maintained in India for AC communication?
11. Show graphically the variation of inductive and capacitive reactance with frequency.
12. An inductance of negligible resistance, whose reactance is 22Ω at 200Hz, is connected to a 220V, 50Hz power line. What is the value of inductance and reactance?
13. An alternating emf is applied to a series combination of resistor and a capacitor. Investigate the phase relationship between current and emf. Find the impedance of the circuit.
14. An alternating emf is applied to a series combination of resistor and an inductor. Investigate the phase relationship between current and emf. Find the impedance of the circuit.
15. An alternating emf is applied to a series LCR circuit. Investigate the phase relationship between current and emf. Find the impedance of the circuit.
16. What do you mean by the resonance condition of a series LCR circuit? Calculate the resonant frequency.
17. Write down some important characteristics of a series resonant circuit.
18. What do you mean by sharpness of resonance in a series resonant circuit?
19. Find out an expression of Q factor of a series LCR circuit.
20. A resistor of 12Ω, capacitor of reactance 14 Ω and a pure inductor of inductance 0.1H are joined in series and placed across a 200V, 50Hz AC supply. Calculate
    (a) the current in the circuit.
    (b) the phase angle between the current and the voltage. (Take $\pi=3$ for the sake of calculation)

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SYLLABUS

1. Electric charge and field
2. Electric potential
3. Current Electricity
4. Magnetic effect of electric current
5. Magnetism
6. Electromagnetic induction
7. Alternating current