

CC 3

Electricity and Magnetism

I. One mark questions.

1. A charge of $15 \mu\text{C}$ is placed at one corner of a cube. The electric flux will be
 - (A) zero through each face.
 - (B) same through each face
 - (C) zero through three faces meeting at the location
 - (D) None of the above
2. The electric field intensity \mathbf{E} inside a uniformly charged sphere varies with distance r of the observation point as
 - (A) $E \propto r$
 - (B) $E \propto 1/r$
 - (C) $E \propto r^2$
 - (D) $E \propto 1/r^2$
3. The electric field between two oppositely plates having charge density σ is given by
 - (A) σ/ϵ_0
 - (B) $\sigma/2\epsilon_0$
 - (C) zero
 - (D) $2\sigma/\epsilon_0$
4. The unit of electric flux density is
 - (A) Cm^{-2}
 - (B) Cm^2
 - (C) C^2m
 - (D) Cm^{-3}
5. The solid angle subtended at a point at the centre of a closed sphere is
 - (A) zero
 - (B) 2π
 - (C) 4π
 - (D) π
6. The electric field intensity due to a non-conducting charged sheet
 - (A) depends upon the distance of observation point
 - (B) does not depend upon the distance of observation point
 - (C) depends upon charge on sheet
 - (D) None of these.

7. Electric lines of force start from _____ charge and end at _____ Charge.
8. Two equipotential surfaces never _____ each other.
9. The intensity of electrostatic field inside a charged hollow sphere is _____ at all the points.
10. The electrostatic potential inside a charged hollow sphere is _____ at all points.
11. The least charge a body can possess is _____ .
12. The unit positive charge when free to move in an electric field moves in the direction of _____ .
13. The total charge on a body is always _____ .
14. Work done in giving one complete rotation to a dipole in a uniform electric field is _____ .
15. Dipole moment of an electric dipole is given by the product of _____ and _____ of the dipole.
16. The electrostatic force always obeys _____ law.
17. Coulomb's law holds for all distances greater than _____ .
18. Electric field intensity is equal to the _____ between two points.
19. If the divergence of magnetic field is said to be zero, then the magnetic field is said to be (a) solenoidal (b) lamellar (c) divergent (d) gradient
20. When a ballistic galvanometer executes oscillations of successively decreasing amplitude then logarithm of the ratio of successive galvanometer deflection is known as (a) over damped deflection (c) dead beat deflection (b) logarithmic decrement (d) none of the above
21. The ratio of permittivity of dielectric to the permittivity of free space is called the _____.
22. The electric susceptibility is _____ .
23. The ferromagnetic material should have (a) high permeability and high retentivity (b) low permeability and low retentivity (c) low permeability and high retentivity (d) high permeability and low retentivity
24. The domain formation is the necessary feature of (a) ferromagnetism (b) paramagnetism (c) diamagnetism (d) all of these
25. The unit of magnetic dipole moment is _____ .
26. Permeability of a diamagnetic substance is _____ and _____ .
27. The susceptibility of a diamagnetic substance is _____ .
28. The magnetic flux linked with a coil of n turns and area of cross-section A held with its plane parallel to the magnetic field \mathbf{B} is (a) $nAB/2$ (b) nAB (c) $nAB/4$ (d) zero

29. A copper disc of radius 0.1 m is rotated about its centre with 20 revolutions per second in a uniform magnetic field of 0.1 Tesla with its plane perpendicular to the field. The e.m.f. induced across the radius of the disc is (a) $\pi/20$ V (b) $\pi/10$ V (c) 20π mV (d) 10π mV

30. In a series resonant circuit, the _____ is minimum at resonance.

31. In a series resonant circuit, the resonance frequency is independent of _____ .

II. 1.5 mark questions.

1. Which equation shows that isolated magnetic pole do not exist ? Name the equation.
2. What is the value of $\text{div } \mathbf{B}$ and $\text{curl } \mathbf{B}$ for points inside the current loop ?
3. Express Biot-Savart's law in vector notation ?
4. What are the advantages of studying the hysteresis loop ?
5. Does the magnetisation of a ferromagnetic substance depend on temperature? Justify your answer.
6. What should be the retentivity of a substance used to make permanent magnets?
7. Name and define the S.I. unit of self inductance.
8. Does the Lenz's law violate the law of conservation of energy ?
9. How does the self inductance of the coil change when the number of turns in the coil is decreased ?
10. Does Faraday's induced e.m.f. depend on resistance of the material of the coil ?
11. How will you find the Norton equivalent current and Norton equivalent resistance?
12. Explain what maximum power theorem is ?
13. Is reciprocity theorem applied to the circuit having resistors, capacitors and diodes ?
14. Verify that CR has dimensions of time.
15. What is the difference between a steady current and transient current ?

III. 2.5 mark questions.

1. Which one of the following will experience a maximum magnetic force, when projected with the same velocity (v) perpendicular to the magnetic field (B) : (i) α -particle and (ii) β -particle.
2. Write dimensional formula of capacitance.
3. What is capacity of earth ?
4. Why is ferromagnetism not found in liquids and gases ?
5. Give the difference between self induction and mutual induction ?
6. Show that charge induced during electromagnetic induction is independent of the rate of change of the magnetic flux.
7. Why a.c. is more dangerous than d.c. for same voltage ?
8. In an a.c. circuit, there is no power consumption in an ideal inductor. Why ?
9. A capacitor C , resistance 15 ohm and an inductance of 101.5 mH are placed in series with 50 Hz A.C. source. Calculate the capacity of the capacitor if the current is observed in phase with voltage.
10. How do the inductive reactance and capacitive reactance change with frequency of a.c. ?
11. What is the impedance of LCR series a.c.circuit.
12. What is a lumped network ? Give example.
13. What is a distributed network ? Give example.

IV. 5 mark questions.

1. Define electric field and electric line of force. Give the properties of electric lines of force.
2. State and prove Gauss's theorem in electrostatics.
3. Define electric flux density and establish a relation between electric flux and flux density.
4. Define electrostatic potential. Show that the potential difference between two points can be expressed as the line integral of the electric field between two points.
5. State Gauss's law in differential form. Hence derive Poisson's equation and Laplace's equation in electrostatics.
6. What is electric image ? Using method of images, derive the expressions for electric field intensity and potential on the surface of an earth connected conducting sphere due to a point charge placed near the sphere.
7. Define the following and explain their physical significance. (i) Magnetic induction (ii) Intensity of magnetisation (iii) Magnetic intensity
8. Define ferromagnetic substances? Explain ferromagnetisation on the basis of domain theory.
9. Write the expression for force \mathbf{F} , acting on a charged particle of charge q , moving with a velocity \mathbf{v} in the presence of both electric field \mathbf{E} and the magnetic field \mathbf{B} . Obtain the condition and which the particle moves undeflected through the fields.
10. State Biot-Savart's law, use it to find the strength of magnetic field at the centre of a circular coil of radius R , number of turns N carrying a current I . What is its direction ?
11. What do you understand by electrical capacitance of a conductor ? What are the unit of capacitance ? Calculate the capacitance of a spherical conductor.
12. What is electromagnetic induction ? State and explain Faraday's laws of electromagnetic induction. Give differential form of electromagnetic induction laws.
13. Define self induction. Derive an expression for the self induction i.e. Neumann formula.
14. Obtain an expression for the self inductance of a long solenoid. Also derive an expression for the energy stored in a inductance coil.
15. Define mean value and root mean square value of alternating current. Derive an expression for root mean square value of alternating current.
16. Derive the relations for average value and r.m.s. value of a.c.