TEST SERIES 2019-20 **TEST NO. 3**

CH.1 AND 5 **CONDUCTED ON 29TH DECEMBER 2019**

Maximum Marks: 45 **Time Allowed: 2 hours**

- **Section A consists of 20 questions of 1 marks each.**
- **Section B consist of 5 questions of 2 marks each.**
- **Section C consists of 5 questions of 3 marks each.**

SECTION A

1. **Electric field at a point varies as r^0 for**
   (a) **An electric dipole**
   (b) **A point charge**
   (c) **A plane infinite sheet of charge**
   (d) **A line charge of infinite length**
2. **The magnitude of electric field E is such that, an electron placed in it would experience an electrical force equal to its weight is given by**
   (a) **mge**
   (b) **mg/e**
   (c) **e/mg**
   (d) **eg/m**
3. **a cylinder of radius R and length L is placed in a uniform electric field E parallel to the cylinder axis. The total flux for the surface of the cylinder is given by**
   (a) **$2\pi R^2 E$**
   (b) **πR^2**
   (c) $\frac{\pi R^2 - \pi R}{E}$
   (d) **Zero**
4. **Total electric flux coming out of a unit positive charge kept in air is**
   (a) ε_0
   (b) ε_0^{-1}
   (c) $1/4\pi\varepsilon_0$
   (d) $4\pi\varepsilon_0$
5. **A point charge +q is placed at a distance d from an isolated conducting plane. The field at a point P on the other side of the plane is**

(a) Directed perpendicular to the plane and away from the plane
(b) Directed perpendicular to the plane but towards the plane
(c) Directed radially away from the point charge
(d) Directed radially towards the point charge

6. Which of the following statement is correct?

If $\int \vec{E}.\overrightarrow{dS} = 0$, Over a surface, then

(a) The electric field inside the surface and on it is zero.
(b) The uniform electric field inside the surface is necessarily uniform
(c) The number of field lines entering the surface must be equal to the number of field lines leaving it.
(d) All charges must not necessarily be outside the surface.

7. An electric dipole is placed along x axis such that electric dipole moment is towards positive x axis. Electric field is along positive x axis and its magnitude is decreasing with increase in x. Which of the following statement is correct.

(a) The dipole will not experience any force.
(b) The dipole will experience a force towards right.
(c) The dipole will experience a force towards left.
(d) The dipole will experience a force upwards.

8. A positive charge Q is uniformly distributed along a circular ring of radius R. A small test charge q is placed at the centre of the ring.

Which of the following statement is not correct?

(a) If q>0 and is displaced away from the centre in the plane of the ring, it will be pushed back towards the centre.
(b) If q<0 and is displaced away from the centre in the plane of the ring, it will never return to the centre and will continue moving till it hits the ring.
(c) If q<0, it will perform SHM for small displacement along the axis.
(d) q at the centre of the ring is in unstable equilibrium within the plane of the ring for q>0.

9. The primary origin of magnetism lies in

(a) Pauli exclusion principle
(b) Polar nature of molecules
(c) Intrinsic spin of electron
(d) None of these

10. A magnetic needle suspended parallel to a magnetic field requires 3 J of work to turn it through 60^{o}. the torque needed to maintain the needle in this position will be

(a) $3\sqrt{3}$ J
(b) $2\sqrt{3}$ J
(c) $\sqrt{3}$ J

(d) 3 J

11. Domain formation is the necessary feature of

(a) Diamagnetism

(b) Paramagnetism

(c) Ferromagnetism

(d) All of these

12. A magnet can be completely demagnetized by

(a) Breaking the magnet into small pieces

(b) Heating it slightly

(c) Dropping it into ice cold water

(d) A reverse field of appropriate strength.

13. A magnetic needle is kept in a non uniform magnetic field. It experiences

(a) A torque but not a force

(b) Neither a force nor a torque

(c) A force and a torque

(d) A force but not a torque

14. The material suitable for making electromagnets should have

(a) High retentivity and high coercivity

(b) Low retentivity and low coercivity

(c) High retentivity and low coercivity

(d) Low retentivity and high coercivity

15. Gauss's law in magnetism indicates that magnetic…… do not exist.

16. SI unit of magnetic dipole moment is…….

17. Two point charges +q and –q are placed d distance apart. Draw the line on which the resultant field is parallel to the line joining the two charges.

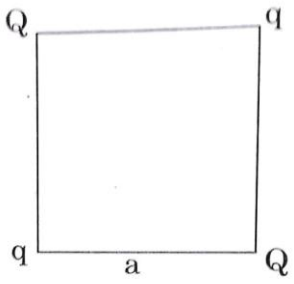
18. What is the cause of quantisation of charge?

19. Ratio of the intensity of magnetization to magnetizing field intensity is known as……

20. Why should the material used for making permanent magnets have high coercivity?

SECTION B

21. Two large parallel plane sheets uniform charge densities $+2\sigma$ and $-\sigma$. Determine the electric field
    (i) Between the sheets
    (ii) Outside the sheets.
22. Four point charges Q, q, Q and q are placed at the corners of a square of side a as shown in the figure.



Find the resultant electric force on a charge Q.

23.

(i) Define the term electric flux. Write its SI unit.

(ii) What is the flux due to electric field 3 x 10^3 i N/C through a square of side 10 cm, when held normal to electric field?

24.

(i) Define the term magnetic susceptibility and write its relation in terms of relative magnetic permeability.

(ii) Two magnetic materials A and B have relative magnetic permeabilities of 0.96 and 500. Identify the magnetic materials A and B.

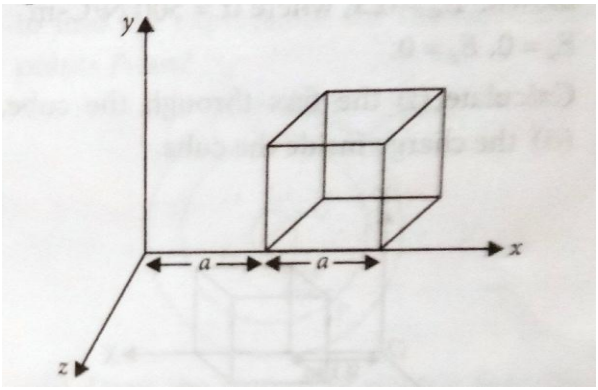
25. A short bar magnet of magnetic moment 6 J/T is aligned at 60^O with a uniform external magnetic field of 0.44 T. Calculate the work done in turning the magnet to align its magnetic moment (i) normal to the magnetic field, (ii) opposite to the magnetic field.

SECTION C

26. An electron of mass m_e revolves around a nucleus of charge $+Z_e$. Show that it behaves like a tiny magnetic dipole. Hence prove that the magnetic moment associated with it is expressed as $\vec{\mu} = -\frac{e}{2me}\vec{L}$, where $\vec{L}$ is the orbital angular momentum of the electron. Give the significance of negative sign.
27. Depict the behaviour of magnetic field lines with (i) diamagnetic material and (ii) paramagnetic material placed in an external magnetic field. Mention briefly the properties of these materials which explain this distinguishing behaviour.
28. State Gauss's law in electrostatics. A cube with each side 'a' is kept in an electric field given by$\vec{E} = 10x\hat{\imath}$. Find out

(i) Electric flux through the cube.

(ii) The net charge inside the cube. (Take a = 100 cm)



29. Two identical metallic spherical shells A and B having charges +4Q and -10Q are kept at 3m apart. A third identical uncharged sphere C is first placed in contact with sphere A and then with sphere B, then spheres A and B are brought in contact and then separated to the same distance. Find
    (i) the final charge on the spheres A and B.
    (ii) initial and final force between A and B.(TAKE Q = 1μC)

30.
    (a) Derive an expression for the torque experienced by an electric dipole kept in a uniform electric field?
    (b) In which orientation, a dipole placed in a uniform electric field is in
        (i) Stable equilibrium
        (ii) Unstable equilibrium?

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