HS 2nd Year

Physics (Theory)

TEST-2

Time: 3 hrs. Total Marks: 70

1. Answer the following: 1×8=8

   a) Mention one difference between Coulomb's law and Biot-Savart's law.

   b) Express the Biot-Savart's law in vector form.

   c) You know, if a charge q, moving with velocity $\vec{V}$ enters a uniform magnetic field $\vec{B}$, it experiences a force $\vec{F} = q(\vec{V} \times \vec{B})$. Name the path describe by q when the angle between $\vec{V}$ and $\vec{B}$ is $\theta < 90^0$.

   d) The discovery and understanding of electromagnetic induction are based on a long series of experiments carried out by _____ and _____. (Fill in the blank)

   e) In a prism except, the position of minimum deviation there are _____ values of angle of incidence producing same angle of deviation. (Fill in the blank)

   f) Name the equipment which can transmit optical signal through it and are used as 'light pipe'.

   g) Name the series of hydrogen spectrum lying in ultraviolet region.

   h) Why electric lines of force can not intersect each other.

2. Define 1 coulomb charge. Two point charges at a distance r in air exert a force F on each other. At what distance will these charges experience the same force F in a medium of dielectric constant K. 1+1=2

3. There is an electric dipole on the x-y plane, its dipole moment is 4×10^{-9} Cm. On the same plane there is also a uniform electric field of magnitude 5×10^{4} NC^{-1}. If the axis of the dipole makes an angle 30^0 with the electric field, Calculate the magnitude of the torque acting on the dipole and also mention the direction of torque. 2

4. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min. in a plane normal to the horizontal component of Corks magnetic field H_E at a place. If H_E = 0.4 G at the place. What is the induced emf between the axle and the rim of the wheel. (1 G = 10^{-4}T) 2

5. Use the mirror equation to deduce that, a convex mirror always produces a virtual image independent of the location of the object. 2

6. You have learnt that plane and convex mirrors produce virtual images of objects. Can they produce real images under some circumstances? Explain. 2

7. It is found experimentally that 13.6 eV energy is required to separate a hydrogen atom into a proton and an electron. Compute the orbital radius of the electron in a hydrogen atom. 2

8. There exists a non uniform magnetic field in free space. A charged particle of mass m and velocity V enters the field and comes out after a certain time. Comment with reason about the kinetic energy of the particle after coming out of the field. 2

9. Define self inductance of a coil. Write it's SI unit. 1+1=2

10. State the Ampere's Circuital Law. Define 1 Tesla. 1+1=2

11. State Gauss's theorem of electrostatics. What is the electric-flux associate with an electric dipole. 1+1=2

12. Derive an expression for electric field intensity on equatorial line of an electric dipole. 3

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13. Apply Gauss's Law to derive the expression for electric field intensity due to an infinitely long straight uniformly charge wire. What is the direction of the field intensity if it is positively charged? 3

14. Two parallel co-axial coils of equal radius R and numbers of turn N carrying equal currents I in same direction are separated by a distance R. Show that magnetic field intensity B on the axis around the mid point between the coils is uniform over a very small distance as compared to R and is given by 3

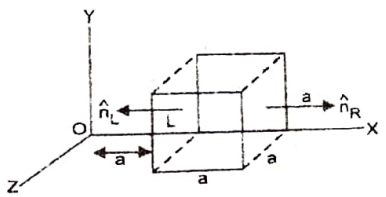
$$B = \left(\frac{4}{5}\right)^{\frac{3}{2}} \frac{\mu_0 IN}{R}$$

15. Suppose while sitting in a parked car, you notice a jogger approaching towards you in the side view mirror of R = 2 m. If the jogger is running at a speed of 5 m/s, how fast the image of the jogger appear to move when the jogger is (a) 39 m, (b) 29 m, (c) 19 m.

16. Derive the expression for motional emf. 3

17. A circular coil of radius 10 cm, 500 turns and resistance 2Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180^0 in 0.25 s. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is 3.0×10^{-5} T. 3

18. The electric field components in fig are $E_X = \alpha x^{\frac{1}{2}}$, $E_y = E_Z = 0$, where α is a constant and x is the distance of the faces from the origin calculate (a) the flux through the cube and (b) the charge within the cube.



19. A square loop of side 3 cm is placed 25 cm away from a concave mirror of focal length 10 cm. The axis of the mirror passes through the intersecting point of the diagonals of the loop and perpendicular to the plane of the loop. What is the area enclosed by the image of the loop. 3

20. In the light of Rutherford's atom model discuss the stability of an atom. Show that the total energy of an electron is $E = -\frac{e^2}{8\pi\epsilon_0 r}$ 1+2=3

21. Write the mathematical expression of the postulate that an electron strictly follow in order to revolve round the nucleus. Name the scientist who proposed it in 1913. Calculate the energy in joule that is equivalent to 1 MeV. The total energy of an electron in the 1st orbit is - 13.6 eV. Does it mean that - 1+1+2+1=5

(a) The electron is bound with the nucleus.

(b) Energy will be required to remove the electron to infinity?

22. Derive an expression for force between two parallel current carrying conductor and hence define 1 Ampere current. 4+1=5

23. State the Faraday's laws of electromagnetic induction. Establish that Lenz's law is the manifestation of law of conservation of energy. 2+3=5

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