ST. XAVIER'S SENIOR SECONDARY SCHOOL, DELHI – 110 054

Std. 12 Time : 3 hrs.

15-9-2014 Half Yearly Examination in **PHYSICS (Set - I)** M. Marks : 70

INSTRUCTIONS*:*

i) Q. Nos. 1 to 5 carry 1 mark each.
ii) Q. Nos. 6 to 10 carry 2 marks each.
iii) Q. Nos. 11 to 22 carry 3 marks each.
iv) Q. No. 23 carries 4 marks.
v) Q. Nos. 24 to 26 carry 5 marks each.
vi) Use pencil for the diagrams and graphs.
vii) Answers should be to the point.
viii) Use log tables if necessary.

1. A carbon resistor is marked in colour bands in the sequence blue, green, orange and gold. Quote the value of the resistance. (1)

2. Justify the statement 'Electric field lines are always perpendicular to an equipotential surface'. (1)

3. Give reason why charge moving in a magnetic field experience force. (1)

4. Why does a paramagnetic sample display greater magnetization when cooled? (1)

5. What are eddy currents? How can it be minimized? (1)

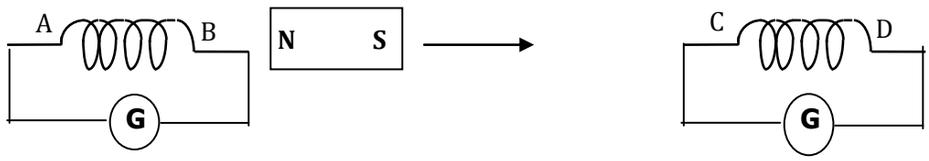
6. A current flowing through a copper wire is passed through another copper wire of the same length but of double the radius of the first one. How would the drift velocity of the free electrons change? Justify your answer. (2)

7. A magnet having a magnetic moment of 1.0×10^{6} J/T is free to rotate in horizontal plane where a magnetic field 4×10^{-5}T exists. Find the work done in rotating the magnet slowly form a direction parallel to the field to a direction 60^{0} from the field.

(OR)

Obtain a relation for magnetic dipole moment due to revolution of an electron around the nucleus in an orbit of radius 'r' with a speed 'v'. (2)

8. A magnet is moved in the direction indicated by an arrow between the coils AB & CD as shown in the figure. Find the direction of current in each coil stating clearly the law used. (2)



9. An electric dipole of length 'a' and charge ±q is placed in an electric field of intensity E with its dipole moment inclined at an angle of θ with electric field. Write the expression of its potential energy. Give the expression of potential energy and work done when it comes to the stable equilibrium position. (2)

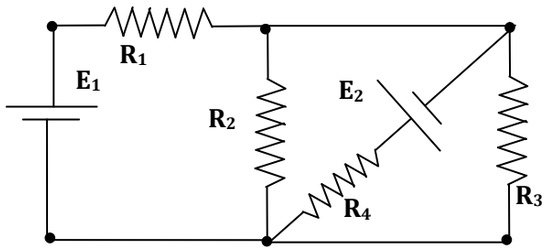
10. A wire of length L is used to form successively (i) square loop (ii) circular loop and placed in a magnetic field B. Write the expression of torque experienced by them for a given inclination. Which of the two will experience greater torque? Justify your answer. (2)

11. Define resistivity of a material and write its SI unit. The resistance of a tungsten filament at 150^{0} is 133Ω. What will be its resistance at 500^{0} C? The temperature coefficient of resistances of tungsten is 0.0045per degree Celsius. (3)

12. If δ_1, and δ_2 are the virtual angle of dips in two vertical planes at right angles to each other and δ is the true angle of dip. Prove that $\cot^2\delta_1 + \cot^2\delta_2 = \cot^2\delta$. (3)

13. State the principle of potentiometer. Draw a circuit diagram used to compare the emf of two primary cells. Derive the formula used. How can the sensitivity of a potentiometer be increased? (3)

14. In the following circuit E_1=10V, E_2=5V, R1 = 4Ω, $R_2 = R_3$ =15 Ω and R_4 =30Ω Calculate the current through each resistor. (3)



15. Define magnetic susceptibility of a material. Name two elements, one having positive susceptibility and other having negative susceptibility. What does negative susceptibility signify? How intensity of magnetization changes with temperature in case of a diamagnetic substance and paramagnetic substance? (3)

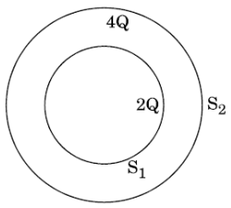
16. Explain the phenomenon of mutual induction. Define co efficient of mutual induction. What are its units? Calculate co efficient of mutual induction between two long solenoid.

(OR)

Explain how emf is induced across a metallic rod of length 'l' is moving with a velocity 'v' in a magnetic field "B'. Hence obtain relation for induced emf. Assume that length of the conductor, velocity and magnetic field are mutually perpendicular to each other. (3)

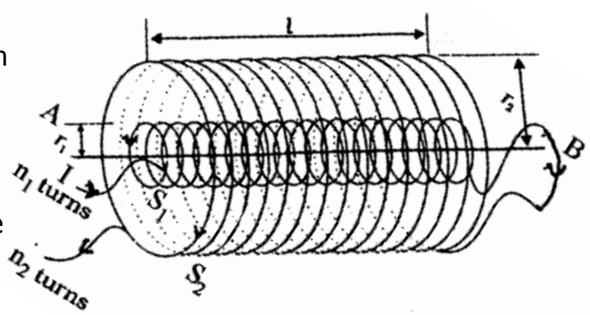
17. A pendulum is made with charged metal bob of mass 50 gm. It is placed in an electric field of $\vec{E} = (5 \times 10^3)\hat{i}$ N/C. If it makes an angle of 37° with vertical in equilibrium position calculate the charge in the bob and tension in the string. (3)

18. Consider two hollow concentric spheres, S_1 and S_2, enclosing charges 2Q and 4Q respectively as shown in the figure. (i) Find out the ratio of the electric flux through them. (ii) How will the electric flux through the sphere S_1 change if a medium of dielectric constant 'κ' is introduced in the space inside S_1 in place of air?
Deduce the necessary expression. Write the new ratio. (3)



19. Given a uniform electric field $\vec{E} = (5 \times 10^3)\hat{i}$ N/C, find the flux of this field through a square of 10 cm on a side whose plane is parallel to the y-z plane. What would be the flux through the same square if the plane makes a 30° angle with the x-axis? (3)

20. Two long coaxial insulated solenoids, S_1 and S_2 of equal lengths are wound one over the other as shown in the figure. A steady current I flow through the inner solenoid S_1 to the other end B, which is connected to the outer solenoid S_2 through which the same current I flows in the opposite direction so as to come out at end A. If n_1 and n_2 are the number of tums per unit length, find the magnitude and direction of the net magnetic field at a point
(i) Inside on the axis, and
(ii) Outside the combined system.

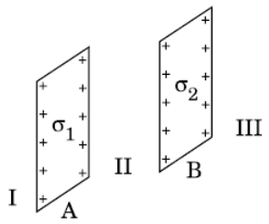


21. A particle having mass of 2×10^{-4} gm and charge of 5×10^{-5} C enters normally with a speed of 25×10^4 m/s into a magnetic field of 5 T. Calculate the radius of its trajectory. What will be the radius if the charge enters at an angle of 30° to the field? (3)

22. State Ampere's circuital law. Use the law to derive expression for the magnetic field at a point on the axis of a solenoid. How does the magnetic field of toroid different from that of solenoid? (3)

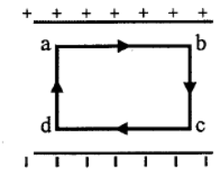
23. Harsh was performing an experiment to carry out a project for that he required a voltmeter of range 7.5 V. It was not available in the laboratory and in the market. So, he decided to convert galvanometer into a voltmeter of required range. He took galvanometer of resistance 12 Ω having maximum safe current limit of 0.25 mA.
    a) What values do you think are there in Harsh?
    b) How could he do that? Explain by showing necessary calculations. (4)

24. a) Using Gauss's theorem derive an expression for the electric field at a point outside a thin uniformly charged conducting spherical shell of radius R. Using the relation justify the behavior of conductor and determine field at point very close to the sphere.
    b) Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and directions of the net fields in the regions marked II and III. (3+2)



(OR)

    a) Obtain the expression for the energy stored per unit volume in a charged parallel capacitor. Where is this energy stored?
    b) The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop a b c d a. Justify the work done in each step. (3+2)



25. a) Deduce an expression for the frequency of revolution of a charged particle in a magnetic field and show that it is independent of velocity of the particle.
    b) Draw a schematic sketch of a cyclotron. Explain the role of the electric field and the magnetic field in cyclotron. (2+3)

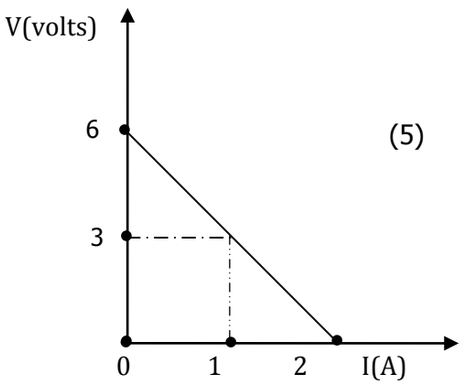
(OR)

    a) Draw a labelled diagram of a pivoted moving coil galvanometer. Write its principle and explain the role of radial magnetic field in the galvanometer.
    b) Answer the following: (i) Why is it necessary to introduce a cylindrical soft iron core inside the coil of a galvanometer? (ii) Increasing the current sensitivity of a galvanometer not necessarily increase its voltage sensitivity. Explain, giving reason. (3+2)

26. a) Deduce the condition for balance in a Wheat Stone's bridge. What is a meter bridge?
    b) Explain how it is used to determine the resistivity of a material. (5)

(OR)

What do you mean by internal resistance? How it is different from the resistance offered by a wire? Write the relation between emf and terminal voltage Three identical cells of same emf and internal resistance 'r' connected in series to a variable resisto The following graph shows the variation of terminal voltage of the combination with the current. Calculate the emf of each cell and internal resistance. (5)



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