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INDIAN SCHOOL SOHAR
FIRST TERM EXAM- 2017
PHYSICS – THEORY

CLASS: XII **MARKS:70**
DATE: 24 /9/2017 **TIME: Hrs**

General Instructions:

1. All questions are compulsory.
2. There are 26 questions in all. Questions 1 to 5 carry one mark each, questions 6 to 10 carry two marks each, questions 11 to 22 carry three marks each. Question 23 is a value based question carrying four marks and questions 24 to 26 carry five marks each.
3. There is no overall choice. However, internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each.
4. You have to attempt only one of the given choices in such questions.
5. Use of calculator is not permitted.
6. You may use the following physical constants wherever necessary

$C = 3 \times 10^8$ m/s $h = 6.626 \times 10^{-34}$ Js $e = 1.6 \times 10^{-19}$ c

$\frac{1}{4\pi\varepsilon_O} = 9 \times 10^9$ Nm^2/c^2. $\mu_o = 4\pi \times 10^{-7}$ T m A^{-1} . $N_A = 6.023 \times 10^{23}$/mol

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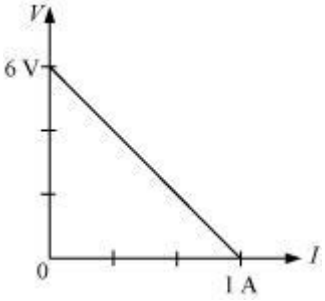
SECTION-A

1. Why is there no work done in moving a charge from one point to another on an equipotential surface.

2. The plot of the variation of potential difference across a combination of three identical cells in series versus current is as shown below. What is the emf of each cell?



3. A metallic rod of length 'L' is rotated with angular frequency ω with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L , about an axis passing through the centre and perpendicular to the plane of the ring. A constant uniform magnetic field B parallel to the axis is present everywhere. Mention the expression for the emf between the centre and the metal ring.

4. How does angle of dip vary as one moves from Equator towards the North pole ?

5. Write two factors by which voltage sensitivity of a galvanometer can be increased.

SECTION-B

6.Derive the expression for the electric field at any point along the equatorial line of an electric dipole?

7. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.

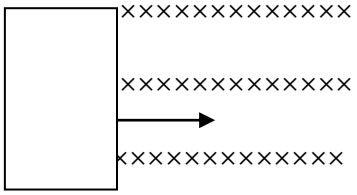
OR

7. A number of identical cells, *n*, each of emf *E*, internal resistance *r* connected in series are charged by a d.c. source of emf *E′*, using a resistor *R*.
(i) Draw the circuit arrangement.
(ii) Deduce the expressions for (a) the changing current and (b) the potential difference across the combination of the cells.

8. A proton , a deuteron and $\propto$ -particle,whose kinetic energies are same,enter perpendicularly a uniform magnetic field. Compare the radii of their circular paths.

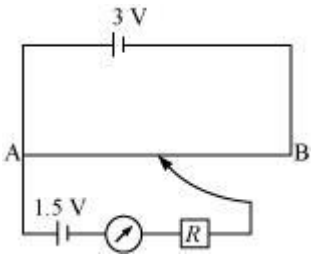
9. Draw a plot showing the variation of intensity of magnetization with the applied magnetic field intensity for Bismuth. Under what condition does diamagnetic material exhibit perfect conductivity and perfect diamagnetism.

10. A uniform magnetic field exists normal to the plane of the paper. A uniform wire is slowly moved with a uniform velocity across the field as shown in the figure. Draw the variation of
(i) magnetic flux linked with the loop and (ii) the induced e.m.f. in the loop with time.



SECTION-C

11. A potentiometer wire of length 1 m is connected to a driver cell of emf 3 V as shown in the figure. When a cell of 1.5 V emf is used in the secondary circuit, the balance point is found to be 60 cm. On replacing this cell and using a cell of unknown emf, the balance point shifts to 80 cm.



(i) Calculate unknown emf of the cell.(ii) Explain with reason, whether the circuit works, if the driver cell is replaced with a cell of emf 1 V.

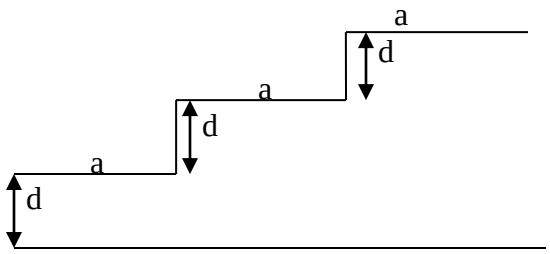
(iii) Does the high resistance *R*, used in the secondary circuit affect the balance point? Justify your answer.

12. An a.c source generating a voltage $V = V_m \sin \omega t$ is connected to a inductor of inductance L. Find the expression for the current *i*, flowing through it, plot a graph of *v* and *i* versus ωt to show that the current is $\frac{\pi}{2}$, behind the voltage.

OR

12. An a.c source generating a voltage $V = V_m \sin \omega t$ is connected to a resistor of resistance R. Find the expression for the current *i* flowing through it. Hence deduce the expression for I_{rms}

13. A capacitor is made of a flat plate of area A and a second plate having a stair like structure as shown.The width of each stair is a and height is d. Find the capacitance of the assembly.



14.Explain underlying principle and working of a cyclotron. Deduce an expression for the period of revolution and show that it does not depend on the speed of the charged particle.

15.Derive an expression for the electric potential at a point due to an electric dipole .Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge.

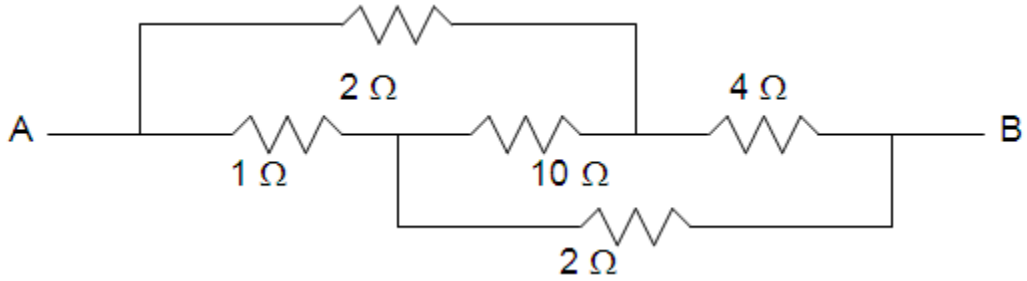
16. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge Q.A charge q is placed at the centre of the shell.
(a) What is the surface energy density on the (i) inner surface (ii) outer surface of the shell?
(b) Write expression for the electric field at a point $x > r_2$ from the centre of the shell.

17. How can you convert a galvanometer into an ammeter. A galvanometer with a coil of resistance 120 ohm shows full scale deflection for a current of 2.5 mA. How will you convert the galvanometer into an ammeter of range 0 to 7.5 A.

18.Three identical specimens of magnetic materials Antimony, Cobalt, Aluminium are kept in a non-uniform magnetic field. Draw the modification in the field lines in each case. Justify your answer.

19. Where on the earth's surface is the value of the vertical component of the earth's magnetic field zero? A bar magnet of magnetic moment 1.5 J/T lies aligned with the direction of a uniform magnetic field of 0.22 T. Calculate the amount of work done to turn the magnet so as to align its magnetic moment (i) normal to the field direction,(ii) opposite to the field direction.

20. Calculate the resistance between A and B of the given network. State and explain the underlying principle.



21. Obtain an expression for the magnetic energy stored in a solenoid due to a current I flowing in it. How is this expressed in terms of magnetic field B, area of cross section A and length *l* of the solenoid.

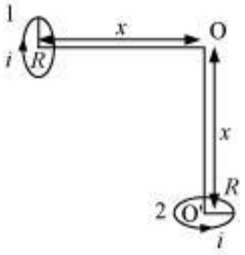
22. Derive an expression for the self -inductance of a long air-cored solenoid of length *l* and number of turns N. Current in a circuit falls steadily from 5A to 0A in 100ms. If an average e.m.f. of 200V is induced, calculate the self-inductance of the circuit.

SECTION -D

23. Vijay carries out a physics project on electric energy consumption and the electric bill for fifty houses in the vicinity of his residence. The survey also includes the list of electrical appliances regularly used in different houses and general awareness and precautions observed by families to save electric energy and excessive expenditure incurred on the payment of the bills. The findings of his studies were shared with the residents as well as his classmates. He highlighted the importance of saving electrical energy and explained how the consumption can be minimized.
(i) Two different electric irons A and B are rated 750W-220V and 1000W -220V respectively. Which of the two has lower resistance of its element? Which of two you will you prefer for saving electrical energy?
(ii) Which values are reflected in the choice and carrying out the project by Vijay?
(iii) How can such values be inculcated in the lifestyles of individuals and particularly the students?

SECTION-E

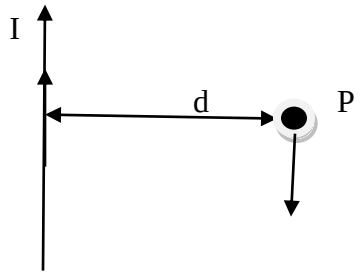
24.(a) Using Biot-Savart's law, derive an expression for the magnetic field at the centre of a circular coil of radius *R*, number of turns *N*, carrying current *i*.
(b) Two small identical circular coils marked 1, 2 carry equal currents and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at O.



OR

24. (a) Derive an expression for the force between two long parallel current carrying conductors.
(b) Use this expression to define S.I. unit of current.

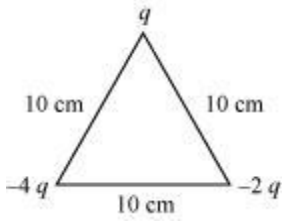
(c) A long straight wire AB carries a current I . A proton P travels with a speed *v*, parallel to the wire, at a distance *d* from it in a direction opposite to the current as shown in figure. What is the force experienced by the proton and what is the direction?



25.(a) Using Gauss' law, derive an expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius *R* and charge density σ C/m^2. Draw the field lines when the charge density of the sphere is (i) positive, (ii) negative.
(b) A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100 μC/m^2. Calculate the
(i) Charge on the sphere
(ii) Total electric flux passing through the sphere

OR

25.(a) Derive an expression for the torque experienced by an electric dipole kept in a uniform electric field.
(b) Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown.
Here $q = 1.6 \times 10^{-10}$C



26. Obtain the expression for the mutual inductance of a pair of coaxial circular coils of radii r and R (R> r) placed with their centres coinciding.
What are eddy currents? Write and explain any two applications of eddy currents.

OR

26. Explain briefly, with the help of a labelled diagram, the basic principle of the working of an a.c generator.
In an a.c generator, coil of *N* turns and area *A* is rotated at *V* revolutions per second in a uniform magnetic field *B*.
Derive the expression for the *emf* produced. A 100-turn coil of area 0.1 m^2 rotates at half a revolution per second. It is placed in a magnetic field 0.01 T perpendicular to the axis of rotation of the coil. Calculate the maximum voltage generated in the coil.