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INDIAN SCHOOL SOHAR
FIRST TERM EXAM- 2015
PHYSICS – THEORY

CLASS: XII **MARKS:70**
DATE: 15 /9/2015 **TIME:3hrs**

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= 3X 10^8 m/s ***h= 6.626 X10^{-34} Js*** ***e=1.6X 10^{-19} c***

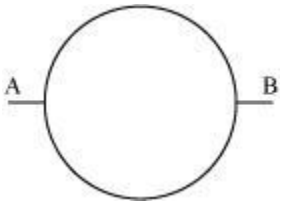
$\frac{1}{4\pi\varepsilon O}$ ***=9 X 10^9 Nm^2/c^2.*** ***μo=4π X 10^{-7} T m A^{-1} .*** ***N_A= 6.023 X10^{23}/mol***

Mass of proton=1.676 X 10^{-27} kg. ***Mass of neutron=1.675 X 10^{-27} kg.***

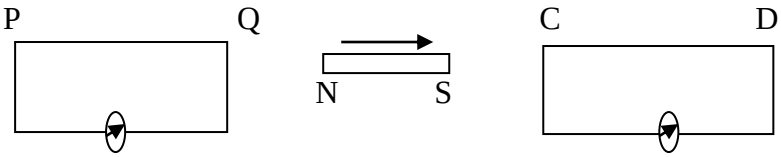
SECTION-A

1.Is the force acting between two point electric charges q1 and q2, kept at some distance apart in air, attractive or repulsive, when (i) q1q2 > 0 (ii) q1q2 <0 ? (1)

2.A wire of resistance 8R is bent in the form of a circle. What is the effective resistance between the ends of a diameter AB? (1)



3. A bar magnet is moved in the direction indicated in the figure between the coils PQ and CD . Predict the direction of current induced in each coil. (1)



4. Write two factors by which voltage sensitivity of a galvanometer can be increased. (1)

5. Two identical specimens of magnetic materials Nickel and Antimony are kept in a non-uniform magnetic field. Draw the modification in the field lines in each case. (1)

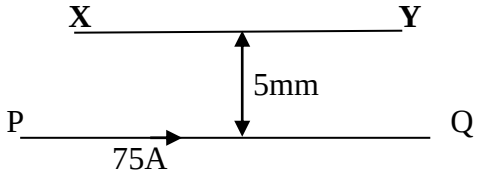
SECTION-B

6.(i) Write two characteristics of a material used for making permanent magnets.
(ii) Why is the core of an electromagnet made of ferromagnetic materials?

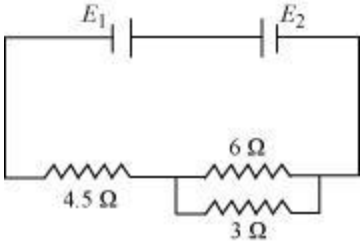
OR

6. Explain the pattern of magnetic field line when a (i) diamagnetic, (ii) paramagnetic substance is placed in an external magnetic field. (2)

7. A long straight conductor PQ, carrying a current of 75 A , is fixed horizontally. Another long conductor XY is parallel to PQ at a distance of 5mm,in air. Conductor XY is free to move and carries a current I. Calculate the magnitude and direction of' 'I' for which the magnetic repulsion just balances the weight of conductor XY (mass per unit length for conductor XY is 10^{-2} kg/m). (2)



8. Two cells E_1 and E_2 in the given circuit diagram have an *emf* of 5 V and 9 V and internal resistance of 0.3 Ω and 1.2 Ω respectively.



Calculate the value of current flowing through the resistance of 6Ω and 3 Ω. (2)

9.Find the resultant electric field due to an electric dipole of dipole moment,2aq,at a point distant 'x' on its equator. (2)

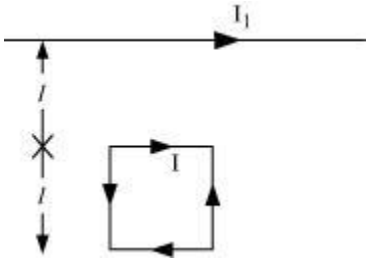
10.Define self-inductance of a coil.Obtain an expression for magnetic energy stored in an inductor of inductance L and a current I passing through it. (2)

SECTION-C

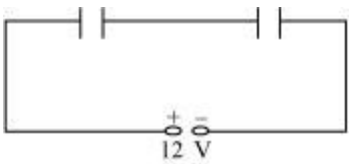
11.A circular coil of radius 10 cm,500 turns and resistance 200Ω is placed with its plane perpendicular to the horizontal component of the Earth's magnetic field. It is rotated about its vertical diameter through 180 ^{0} in 0.25 s. Estimate the magnitude of the emf and current induced in the coil. (Horizontal component of Earth's magnetic field at the place is 3.0×10^{-5}T). (3)

12.Draw a schematic diagram 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. (3)

13.Write the expression for the magnetic moment $(\vec{m})$ due to a planar square loop of side '*l*' carrying a steady current I in a vector form.In the given figure this loop is placed in a horizontal plane near a long straight conductor carrying a steady current I_1 at a distance *l* as shown. Give reason to explain that the loop will experience a net force but no torque. Write the expression for this force acting on the loop. (3)



14.Two parallel plate capacitors, X and Y, have the same area of plates and same separation between them. X has air between the plates while Y contains a dielectric medium of $\in_r = 4$. (i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4 μF.(ii) Calculate the potential difference between the plates of X and Y.(iii) What is the ratio of electrostatic energy stored in X and Y? (3)



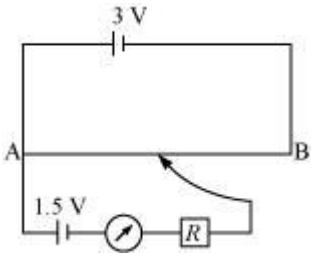
15.Two metallic wires of the same material have the same length but cross-sectional area is in the ratio 1:2. They are connected (i) in series and (ii) in parallel. Compare the drift velocities of electrons in the two wires in both the cases (i) and (ii) (3)

16.Two point charges $q_1 = 10 \times 10^{-8}$ C and $q_2 = -2 \times 10^{-8}$ C are separated by a distance of 60 cm in air.
(i) Find at what distance from the 1st charge, q_1, would the electric potential be zero.
(ii) Also calculate the electrostatic potential energy of the system.

OR

16.Two point charges $4Q$, Q are separated by 1 m in air. At what point on the line joining the charges is the electric field intensity zero? Also calculate the electrostatic potential energy of the system of charges, taking the value of charge, $Q = 2 \times 10^{-7}$ C. (3)

17.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. (3)

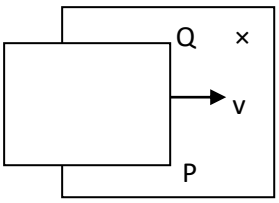
18. Derive the expression for the energy stored in a parallel plate capacitor of capacitance C with air as medium between its plates having charges Q and − Q. Show that this energy can be expressed in terms of electric field as $\frac{1}{2}\varepsilon_0 E^2 A\, d$ where A is the area of each plate and d is the separation between the plates. (3)

19.State the Ampere circuital law. Use it to derive an expression for magnetic field inside a air cored toroid. (3)

20. A small compass needle of magnetic moment 'M' and moment of inertia 'I' is free to oscillate in a magnetic field 'B'. It is slightly disturbed from its equilibrium position and then released. Show that it executes simple harmonic motion. Hence, write the expression for its time period. (3)

21. What are eddy currents? How are these produced? In what sense are they considered undesirable in a transformer and how are these reduced in such a device. (3)

22.A conducting rod,of length 'l' , connected to a resistor R is moved at a uniform speed 'v' normal to a uniform magnetic field B.as shown.
(i) Deduce the expression for the emf induced in the conductor.
(ii) Find the force required to move the rod in the magnetic field.
(iii) Mark the direction of induced current in the conductor. (3)



SECTION-D

23. Sushil is in the habit of charging his mobile and then leaving the charger connected through the mains with the switch on. When his sister Asha pointed it out to him, he replied there was no harm as the mobile had been disconnected. Asha then explained to him and convinced him, how the energy was still being wasted as the charger was still consuming energy.
(a) What values did Asha display in convincing her brother?
(b) What measures in your view should be adopted to minimize the wastage of energy in your households?
(c) Imagine an electric appliance of 2W, left connected to the mains for 20 hrs. Estimate the amount of electrical energy wasted . (4)

SECTION-E

24.An a.c source generating a voltage $V = V_m \sin \omega t$ is connected to a capacitor of capacitance *C*. 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 $\frac{\pi}{2}$, ahead of the voltage. Obtain an expression for instantaneous power and hence prove that an ideal capacitor, in an a.c. circuit does not dissipate power.

OR

24.Describe briefly, with the help of a labelled diagram, the basic elements of an A.C. generator. State its underlying principle. Show diagrammatically how an alternating emf is generated by a loop of wire rotating in a magnetic field. Derive the expression for the instantaneous value of the emf induced in the rotating loop. (5)

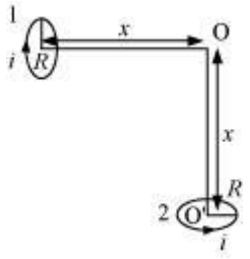
25. Obtain an expression for the self –inductance of a long solenoid of N turns,having a core relative permeability μ_r.

How is the mutual inductance of a pair of coils affected when:
(i) Separation between the coils is increased?
(ii) The number of turns of each coil is increased?
(iii) A thin iron sheet is placed between the two coils, other factors remaining the same?
Explain your answer in each case.

OR

25.With the help of a neat and labelled diagram, explain the underlying principle and working of a moving coil galvanometer. What is the function of
(i) Uniform radial field
(ii) Soft iron core
in such a device? (5)

26.(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

26.(a)Derive a mathematical expression for the force per unit length experienced by each of the two long current carrying conductors placed parallel to each other in air. Hence define one ampere of current.
(b) 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. (5)