AIRPORT SENIOR SECONDARY SCHOOL

MODEL EXAM – 1 (2022-23)

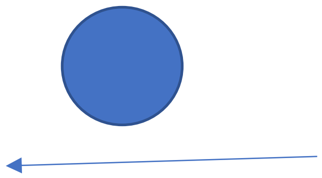
PHYSICS

CLASS: XII **MARKS: 70**

TIME: 3 HOUR

SECTION A **(1x7 = 7)**

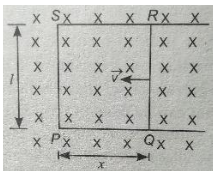
1. What is the advantage of using a radial magnetic field in a moving coil galvanometer?
2. Why are equipotential surfaces perpendicular to field lines?
3. Two charges of magnitude -2Q and +Q are located at points (a,0), and (4a,0) respectively. What is the electric flux through a sphere of radius 3a with its centre at the origin?
4. Draw the electric field lines of a point charge Q when Q < 0.
5. A charged particle of charge q moves in a magnetic field B with a velocity v. What is the force F acting on the particle when v makes an angle θ with B? Among F, V and B, which pair of vectors is always perpendicular to each other?
6. Show diagrammatically the behaviour of magnetic field lines in the presence of a diamagnetic substance.
7. The electric current flowing in a wire in the direction from B to A is decreasing. Find out the direction of the induced current in the metallic loop kept above the wire as shown.



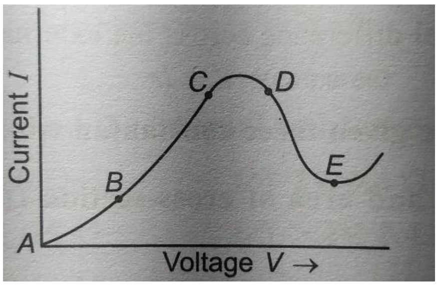
A B

SECTION B **(2x9=18)**

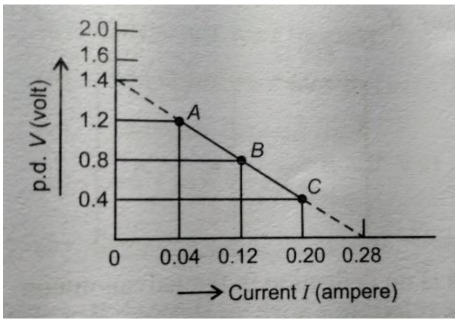
8. How does the mutual inductance of a pair of coils change, when
   i. Distance between the coils is increased
   ii. Number of turns in the coils is increased.
9. A conducting rod of length l is moved in a magnetic field of magnitude /b/ with velocity v such that the arrangement is mutually perpendicular. Prove that the magnitude of induced emf in the rod is Blv.



10. Describe the path of a charged particle moving in a uniform magnetic field with initial velocity
    i. parallel to the field.
    ii. Perpendicular to the field.
11. A long straight wire of circular cross section (radius, a) carries a steady current I. The current is uniformly distributed across the cross section. Apply Ampere's circuital law to calculate the magnetic field at a point r in the region for
    i. $r < a$ ii. $r > a$
12. Graph shows the variation of current versus voltage for a material Ga As. Identify the region
    i. of negative resistance ii. where Ohm's law is obeyed.



13. Define mobility of electron in a conductor. How does the electron mobility change when
    i. Temperature is decreased and
    ii. Applied potential difference is doubled at constant temperature?
14. A straight-line plot showing the variation of potential difference as a function of current I drawn from a cell is shown in figure. Using this plot, determine the
    i. Emf and ii. internal resistance of this cell.
    ii.

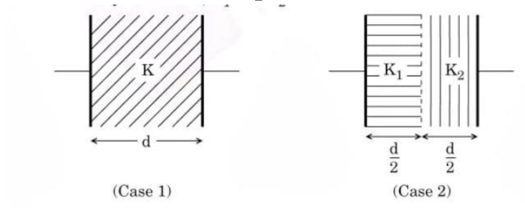


15. In a medium the force of attraction between two-point electric charges, distance d apart is F. What distance apart should these be kept in the same medium so that the force between them becomes
    i. 3F. ii. F/3 ?

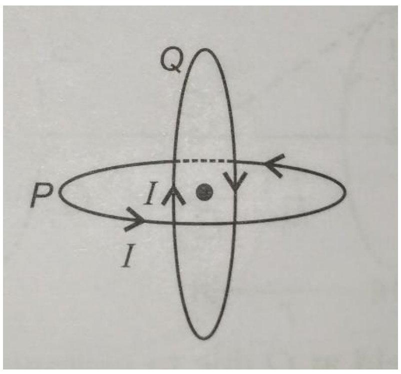
16. Given a uniform electric field E= 2x 10^3 i N/ C, find the flux of this field through a square of side 20 cm whose plane is parallel to the Y-Z plane. What would be the flux through the same square if the plane makes an angle of 30 ° with the X axis?

SECTION C **(3x10 = 30)**

17. Two cells of emf E_1 and E_2 have their internal resistances r_1 and r_2 respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the cells are supporting each other.
18. The space between the plates of a parallel plate capacitor is completely filled in two ways. In the first case, it is filled with a slab of dielectric constant k . in the second case it is filled with two slabs of equal thickness and dielectric constants k_1 and k_2 respectively as shown in the figure. The capacitance of the capacitor is same in the two cases. Obtain the relationship between k, k_1 and k_2.



19. Explain the term drift velocity of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of drift velocity.
20. Derive an expression for the self-inductance of a solenoid. How does the self-inductance change when an iron core is inserted in the solenoid?
21. A current carrying coil is free to turn in a uniform magnetic field B. under what conditions, will the torque acting on it be i. minimum   ii. maximum?
22. Two identical circular wires P and Q each of radius R carrying current I are kept in perpendicular planes such that they have a common centre as shown in figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils.

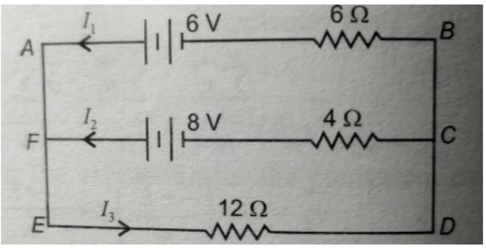


23. What is the magnitude of magnetic force per unit length on a wire carrying a current of 8A and makes an angle of 30° with the direction of a uniform magnetic field of 0.15 T ?

24. An electric dipole of dipole moment p is placed in a uniform electric field E. Obtain the expression for the torque experienced by the dipole. Identify two pairs of perpendicular vectors in the expression.

25. (i) In the network shown here, find the currents I_1, I_2 and I_3.

(ii)Terminal p.d of each battery.



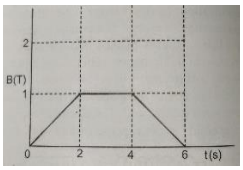
26. A proton and an alpha particle having the same kinetic energy are, in turn passed through a region of uniform magnetic field, acting normal to the plane of the paper and travel in circular paths. Deduce the ratio of the radii of the circular paths described by them.

SECTION D **(5x3=15)**

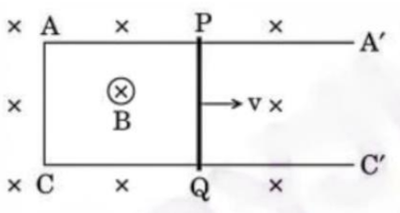
27. State Faraday's law of electromagnetic induction.

Show that Lenz's law is in agreement with law of conservation of energy.

The magnetic field through a circular loop of radius 12.5 cm and resistance 8.5 Ω changes with time as shown in figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time.



Or



A conducting rod PQ of length 20 cm and resistance 0.1 Ω rest on two smooth parallel rails of negligible resistance AA' and CC'. It can slide on thee rails and the arrangement is positioned between the poles of a permanent magnet producing uniform magnetic field B= 0.4 T. The rails, the rod and the magnetic field are in three mutually perpendicular directions as shown in figure. If the ends A and C of the rails are short circuited, find the

i. External force required to move the rod with uniform velocity v= 10 cm/s and
ii. power required to do so.

28. Find the expression for potential energy of a system of two-point charges q_1 and q_2 located at r_1 and r respectively in an electric field E.
Three-point charges +1 μC and +2 μC are initially infinite distance apart. Calculate the work done in assembling these charges at the vertices of equilateral triangle of side 10cm.

Or

State Gauss's theorem in Electrostatics. Using it obtain the electric field due to an infinitely long straight wire of linear charge density.

29. i. Derive an expression for the force between two current carrying straight wires carrying currents I_1 and I_2 in the same direction.
ii. A wire AB is carrying a steady current of 12 A and is lying on the table. Another wire CD carrying 5A is held directly above AB at a height of 1 mm. Find the mass per unit length of the wire CD so that it remains suspended at its position when left free. Give the direction of the current flowing in CD with respect to that in AB.

Or

Draw a labelled diagram of a moving coil galvanometer. Describe briefly its principle and working. Why is it necessary to introduce a soft iron core inside the coil of a galvanometer? Explain giving reasons, the basic difference in converting a galvanometer into a voltmeter and an ammeter.