FIRST TERM EXAMINATION (07 SEPT 2015)

Paper - PHYSICS

Class – XII

(SET – B)

Time: 3hrs. **MM: 70**

Instructions:

1. ***All questions are compulsory.***
2. ***Q.no.1 to 5 carry 1 mark each.***
3. ***Q.no. 6 to 10 carry 2 marks each.***
4. ***Q. no. 11 to 22 carry 3 marks each.***
5. ***Q. no. 23 carry 4 marks.***
6. ***Q no. 24 to 26 carry 5 marks each.***
7. ***Use of calculator is not allowed.***

Q1. Draw equipotential surfaces corresponding to a field that uniformly increases in magnitude but remains in a constant (say z) direction.

Q2. How the conductivity of ionic conductor vary with temperature?

Q3. What is the rms value of alternating current shown in figure?

Q4. Which one of the following will have the minimum frequency of revolution, when projected with same velocity v perpendicular to the magnetic field B (i) α - particle and (ii) β - particle.

Q5. Write a relation for polarization $\vec{p}$ of a dielectric material in the presence of external electric field $\vec{E}$. (1×5=5)

Q6. Using Gauss theorem, drive an expression for Electric field at a point due to an infinitely long, thin, uniformly charged straight wire of linear charge density λCm^{-1}.

Q7. Using Ampere's circuital law, derive an expression for magnetic field inside a long solenoid.

Q8. State the two Kirchhoff's rules used in electric networks. How are these rules justified?

Q9 A bar magnet is allowed to fall freely under gravity through a solenoid. Plot variation of induced e.m.f. in the coil

w.r.t. time and explain significance of this graph. (2×5=10)

OR

Establish the relation between Dielectric constant and electric susceptibility.

Q10. The flux of electrostatic field through the closed spherical surface S' is found to be four times that through closed spherical surface S. Find the magnitude of the charge Q.

Given $q_1 = 1\mu C,\ q_2 = -2\mu C,\ q_3 = 9.84\mu C$

OR

Calculate capacitance between X and Y.

Q11. a) How is ferromagnetism affected on increasing temperature?

b) Define curie point?

c) The permeability of a magnetic material is 0.9983. Name the type of magnetic material it represents.

Q12. Plot a graph showing variation of current density versus electric field for two conductors of different materials. What information from this plot regarding the properties of conducting material can be obtained. Which can be used to select for making:

(i) Standard resistance and
(ii) Connecting wires in electric circuits?

Electron drift speed is estimated to be of the order of mms^{-1}. Yet large current of the order of few amperes can be set up in the wire. Explain briefly.

OR

a) The following graph shows the variation of terminal potential difference V, across the combination of three cells in series to a resistor, versus current:
   i) Calculate the emf of each cell
   ii) For what current i, will the power dissipated in the circuit be maximum?

b) The heating element is marked 210V, 630W. What is the value of the current drawn by the element when connected to a 210V dc source?

Q13. Figure shows a rectangular conducting loop PQRS in which arms RS of length l is movable. The loop is kept in a

uniform magnetic field B directed perpendicularly downward to the plane of loop. If arm, RS is moved with speed 'v' what will be.

a) emf induced across RS
b) external force required to move RS
c) power dissipated as heat

Q14. Explain briefly the process of charging a parallel plate capacitor when it is connected across a d.c. battery.

A capacitor of capacitance C is charged to V volts by a battery. After some time the battery is disconnected and the distance b/w plates is doubled. Now a slab of dielectric constant $1<K<2$ is introduced to fill the space between the plates. How will the following be affected:

a) The electric field between the plates of capacitor.
b) The energy stored in the capacitor.

Justify your answer by writing the necessary expressions.

Q15. State and explain Biot-savart law. Use it to drive an expression for the magnetic field product at a point near a long current carrying wire.

Q16. Two cells of emf's 3V and 4V and internal resistance 1Ω and 2Ω respectively are connected in parallel so as to send current in same direction through an external resistance 5Ω. Calculate the current in each branch of network.

Q17. Explain the term inductive reactance. Show graphically the variation of inductive reactance with frequency of the applied alternating voltage.

An ac voltage $V=V_0 \sin \varpi t$ is applied across a pure inductor of inductance L. find an expression for the current i, flowing in the circuit and show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of $\pi/2$. Also draw (i) phasor a diagram (ii) graph of V and i versus ϖ for the circuit.

Q18. Derive an expression for electric potential at any pt point due to an electric dipole?

Q19. For the given circuit would the balancing length increase, decrease or remain same if

(i) R_1 is decreased (ii) R_2 is decreased without any other change in the rest of the circuit.

Justify your answer.

Why broad copper strips are used in meter bridge.

Q20. Derive an expression for force per unit length experienced by two parallel straight current carrying conductors carrying currents in same direction. Write nature of force & hence define an ampere.

Q21. You are given 3 circuit elements X, Y and Z. When X is connected across a.c. source of given voltage, the current and the voltage are is same phase. When Y is connected in series with X across source voltage is ahead of current by $\pi/4$. But the current is ahead of voltage in phase by $\pi/4$ when Z is connected in series with X across source. Identify these elements X, Y and Z.

When all the 3 elements are connected in series across same source. Find impedance of circuit? Draw a plot of Current versus frequency of applied source.

Q22. Electric filed in the given figure is directed along +X direction and given by $E_x = 5Ax + 2B$ E is in Nc^{-1} and x in metre. A & B are constants. $A = 10Nc^{-1}m^{-1}$ and $B = 5\,Nc^{-1}$ calculate :

i) Electric flu x through cube.
ii) Net charge enclosed within the cube

Q23. Mrs. Thakur left her car headlights on while parking. The car would not start when she returned. Seeing her struggle Mohit went to her help. Not knowing much about cars, he ran and brought a Mechanic Raju from a nearby garage. Raju realized that the battery had got discharged as the headlight had been left on for a long time. He brought another battery to get the engine started. Once the engine was running, he disconnected this second battery. This is known as "Jump Starting" Mrs. Thakur thanked both Mohit and Raju for helping her.

i) What value did Mohit have?
ii) A storage battery of emf 8V and internal resistor 0.5Ω is being charged by a 120VDC supply using a series resistor 15.5Ω. What is the terminal voltage of the battery during charging? What is the purpose to having a series resistor in the charging circuit? (4×1=4)

Q24.a) Explain with the help of label diagram the principle, construction and working of a transformer.

b) Why core of transformer is laminated?

c) Write any 4 energy losses in transformer.

OR

Define the term capacitive reactance. Show graphically the variation of capacitive reactance with frequency of applied alternating voltage.

An a-c voltage V=Vo Sin ωt is applied across a pure capacitor of capacitance C. Find an expression for current through it. Show mathematically the current flowing through it leads the applied voltage by angle $\pi/2$.

Q25. a) Draw the magnetic field lines due to a circular loop of area $\vec{A}$ carrying a current I. Show that it acts as a bar magnet of magnetic moment $\vec{M} = I\vec{A}$.

b) Derive the expression for magnetic field, due to a solenoid of length 2l, radius 'a' having 'n' number of turns per unit length and carrying a steady current 'I' at a point on the axial line, distance r from the centre of solenoid. How does this expression compare with axial magnetic field due to a bar magnet of magnetic moment M.

OR

a) In a meter bridge, the null point is found to be at a distance of 40cm from A. If a resistance of 12Ω is connected in parallel with S, the null point occurs at 50cm from A. Find value of R and S.

b) A cell of emf 'E' and internal resistance 'r' is connected across and external resistance R. Plot a graph showing variation of P.D. across R, vs R.

Q26a) Deduce the expression for the potential energy of a system of two charges q_1 and q_2 located at $\vec{r_1}$ & $\vec{r_2}$ respectively in an external electric field.

b) Three point charges +Q, +2Q and -3Q are placed at the vertices of an equilateral triangle ABC of side l. If these charges are displaced to the midpoints A_1, B_1 & C_1 respectively find the amount of work done in shifting the charges to the new locations.

OR

Define electric flux. Write its S.I. Unit. State and explain Gauss's Law. Find out the out ward flux due to a point charge +q placed at the centre of a cube of side 'a'. Why is it found to be independent of size & shape of surface enclosing it explain.