VENKATESHWAR INTERNATIONAL SCHOOL
Sector – 10, Dwarka, New Delhi – 110075
HALF YEARLY EXAMINATION (2024-2025)
CLASS – XII
PHYSICS

Time Allowed: 3 Hours **Maximum Marks – 70**

General Instructions:

1. **There are 35 questions in all. All questions are compulsory.**
2. **This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All sections are compulsory.**
3. **Section A contains eighteen questions of one mark each.**
   Section B contains seven questions of two marks each.
   Section C contains five questions of three marks each.
   Section D contains three long questions of five marks each.
   Section E contains two case study- based questions of four marks each.
4. **There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in each such questions.**
5. **Use of calculator is not allowed.**

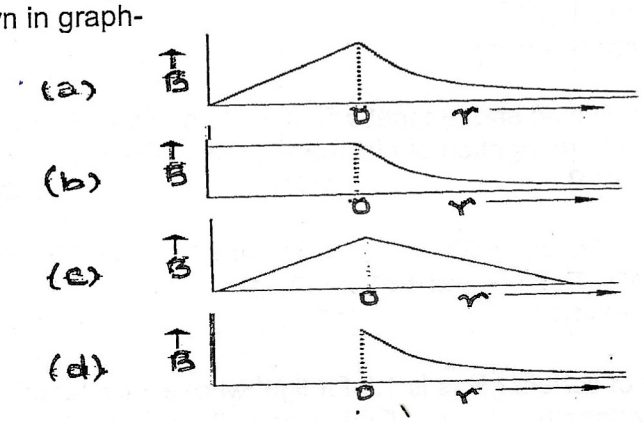
SECTION A

1. SI unit of magnetic flux is (1)
   a) tesla b) gauss c) oersted d) weber

2. In a transformer, core is made of soft iron to reduce (1)
   a) hysteresis loss b) eddy current loss
   c) force opposing electric current d) copper loss

3. Which of the following is not true? (1)
   a) For a point charge, the electrostatic potential varies as 1/r
   b) For a dipole, the potential depends on the position vector and dipole moment vector.
   c) The electric dipole potential varies as 1/r at large distance.
   d) For a point charge, the electrostatic field varies as $1/r^2$

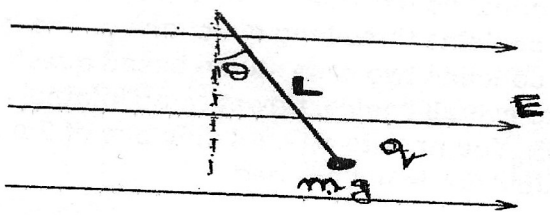
4. Magnetic field B due to a straight conductor of uniform cross-section, radius 'a' and carrying a steady current varies with the distance 'r' from the centre of conductor as shown in graph- (1)



5. A convex mirror has a focal length f. A real object placed at a distance f in front of it from the pole, produces an image at (1)
a) infinity b) f c) f/2 d) 2f

6. Which of the following has negative temperature coefficient of resistivity? (1)
a) metal b) metal and semiconductor c) semiconductor d) metal and alloy

7. A small object with charge q and weight mg is attached to one end of a string of length 'L' attached to a stationary support. The system is placed in a uniform horizontal electric field 'E', as shown in the accompanying figure. In the presence of the field, the string makes a constant angle θ with the vertical. The sign and magnitude of q- (1)



a)positive with magnitude mg/E b)positive with magnitude mg tanθ /E
c)negative with magnitude mg/(E tanθ) d)positive with magnitude (E tanθ)/mg

8. A solenoid is connected to an AC source so that a current flow through it. If an iron core is inserted into the solenoid, the current will (1)
a)increase b)decrease c)remain same d)first increase then decrease

9. The unit of self-inductance is: (1)
a) weber ampere b) weber^{-1} ampere c) ohm second d) farad

10. A magnet of magnetic moment 50i Am^2 is placed along the x-axis in a magnetic field B=(0.5i+3.0j)T. The torque acting on the magnet is. (1)
a) 175k N-m b)150k N-m c) 75k N-m d) 25 k N-m

11. Displacement current exists only when (1)
a) electric field is changing
b) magnetic field is changing
c) electric field is not changing
d) magnetic field is not changing

12. If **E** and **B** represent electric and magnetic field vectors of the electromagnetic waves, the direction of propagation of electromagnetic wave is along (1)
a) **E** b) **B** c) **BxE** d) **ExB**

13. The magnetic flux linked with a coil at any instant 'E' is given by $\Phi=10t^2-50t+250$ Wb. The induced emf at t=3s is (1)
a) -190V b) -10V c)10V d)190V

14. The refractive index of certain glass is 1.5 for light whose wavelength in vacuum is 6000 Å. The wavelength of this light when it passes through glass is (1)
a)4000Å b)6000Å c)9000 Å d)150000 Å

For question numbers 15 to 18, two statements are given-one is labelled Assertion(A) and the other is labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below

a) **Both A and R are true and R is the correct explanation of A**
b) **Both A and R are true but R is not the correct explanation of A**
c) **A is true but R is false**
d) **A is false and R is also false**

15. **Assertion**: The conductivity of an electrolyte is very low as compared to a metal at room temperature. (1)
Reason: The number density of free ions in an electrolyte is much smaller as compared to the number density of free electrons in metals. Further ions drift much more slowly, being heavier.

16. **Assertion**: Kinetic energy of a free charged particle remains constant in a magnetic field. (1)
Reason: Magnetic force always acts perpendicular to the velocity of the charged particle and thus work done by the magnetic force on a free charged particle remains zero.

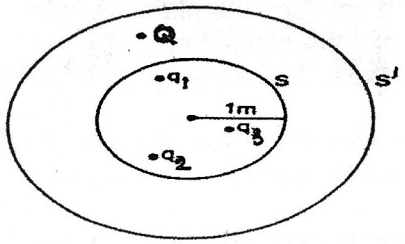
17. **Assertion**: Self induction is called inertia of electricity. (1)
Reason: Self inductance is the phenomena, according to which an opposing induced emf is produced in a coil as a result of change in current or magnetic flux linked in the coil.

18. **Assertion**: Work done in moving a charge between two points in an electric field is independent of the path followed by the charge between these points.
Reason: Electrostatic forces are non-conservative forces.

SECTION B

19. A capacitor blocks DC but allows AC to pass through it. Explain why. (2)

20. The flux of the electrostatic field through the closed spherical surface S' is found to be four times that through the closed spherical surface S. Find the magnitude of the charge Q. Given $q_1=1\mu C$, $q_2=-2\mu C$, $q_3=9.84\mu C$ (2)



21. Using the mathematical expression for the conductivity of a material, explain how it varies with temperature for (i) semiconductor, (ii)good conductor. (2)

22. Show that the magnetic energy required to build up the current I in a coil of self inductance L, is given by 1/2 (LI^2) (2)

OR

Show that the current leads the voltage in phase by $\pi/2$ in an ac circuit containing an ideal capacitor.

23. Name the constituent radiation of the electromagnetic spectrum which (2)
(i) is used in satellite communication.
(ii) is used for studying crystal structure.
(iii) is similar to the radiations emitted during the decay of radioactive nuclei.
(iv) is absorbed from sunlight by ozone layer.

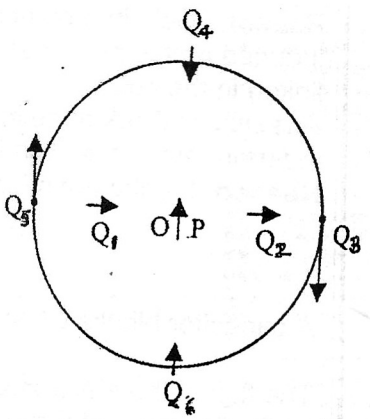
24. Out of the two magnetic materials, A has relative permeability slightly greater than unity while B has less than unity. Identify the nature of the materials A and B. Will their susceptibility be positive or negative? (2)

25. Given a uniform electric field $\mathbf{E} = 5X10^{3}\hat{i}\ N\ C^{-1}$. Find the flux of this field through a square of 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 30^0 angle with the x - axis? (2)

SECTION C

26. A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of the magnetic field B at the centre of the coil? Also draw magnetic field lines due to current carrying cicular coil. (3)

27. Figure below shows a small magnetized needle 'P' placed at a point 'O'. The arrow shows the direction of its magnetic moment. The other arrows show different positions (and orientation of the magnetic moment) of another identical magnetized needle Q. (3)



(a) In which configuration is the system in (i) stable, and (ii) unstable equilibrium?
(b) Which configuration corresponds to the lowest potential energy among all the configurations shown?
(c) In which configuration the system is not in equilibrium?

28. In a parallel plate capacitor with air between the plates, each plate has an area of $6x10^{-3}m^2$ and the separation between the plates is 3mm. (3)
(i)Calculate the capacitance of the capacitor.
(ii)If this capacitor is connected to 100 V supply, what would be the charge on each plate?
(ii)How would the charge on the plates be affected, if a 3mm thick mica sheet of K=6 is inserted between the plates while the voltage supply remains connected?

29. a)A cell of emf 'ε' and internal resistance 'r' is connected across a variable load resistor 'R'. Draw the plots of the terminal voltage 'V' versus (i) R and (ii) current. (3)
b)It is found that when R=4 Ω, the current is 1 A and when R is increased to 9 Ω, the current reduces to 0.5 A. Fid the values of the emf ε and internal resistance r.

30. Deduce the relation $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ for two thin lenses kept in contact coaxially. (3)

OR

Draw a ray diagram showing the image formation of a distant object by a refracting telescope. Derive an expression for its magnifying power.

SECTION D

31. Draw a ray diagram for formation of image of an object (placed beyond center of curvature) by a concave mirror. Hence, derive the mirror equation. State the assumptions made and sign convention used. (5)

OR

Draw a ray diagram for formation of image of a point object by a thin convex lens having radii of curvature R_1 and R_2. Hence, derive lens maker's formula for a double convex lens. State the assumptions made and sign convention used.

32. a) What is a transformer? Write the principle and explain its construction with the help of labeled diagram. (5)

b) The primary coil of an ideal step-up transformer has 100 turns and the transformation ratio is also 100. The input voltage and power are 220V and 1100 W respectively. Calculate:

(i) number of turns in the secondary
(ii) the current in the primary
(iii) voltage across the secondary
(iv) the current in the secondary
(v) power in the secondary.

OR

a) State the principle on which AC generator works. Draw a labeled diagram and explain its working.

b) An a.c. generator consists of a coil of 50 turns and area 2.5m^2 rotating at an angular speed of 60 rad/s. in a uniform magnetic field B =0.03 T between two fixed pole pieces. The resistance of the circuit including that of the coil is 500 Ω.

(i) What is the maximum current drawn from the generator?
(ii) What is the flux through the coil when the current is zero?

33. Two long straight parallel current carrying conductors are kept at a distance d from each other in air. The direction of current in both the conductors is the same. Find the magnitude and direction of the force between them. Hence define one ampere. (5)

OR

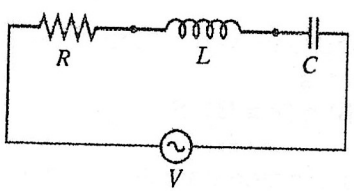
With the help of a diagram, explain the principle and working of a moving coil galvanometer. What is the importance of a radial magnetic field and how is it produced?

SECTION E
Case Study Based Questions

Question number **34** and **35** are case study-based questions. Read the following paragraphs and answer the questions that follow.

34. **Alternating Current Series Circuit** – As Alternating Current is one whose magnitude changes continuously with time between zero and a maximum value and whose direction reverses periodically. If an alternating voltage $V = V_m \sin \omega t$ is applied across a series of a resistor *R*, inductor *L* and capacitor *C*, then current flowing through the circuit is given as : (4)

$$I = I_m \sin(\omega t + \phi) = (V_m/Z) \sin(\omega t + \phi)$$



Where $Z = \sqrt{(R^2 + (X_L - X_C)^2)}$ is the impedance offered by *L-C-R* circuit, ø is the phase difference between the alternating voltage and current.
If net reactance to the circuit $(X_L - X_C)$ is zero, then current amplitude is maximum having a value $(I_m)_{max} = V_m/R$ and current is in phase with voltage.

i) An alternating voltage is expressed as ***V = 311 sin 314t.*** The frequency of alternating voltage is –
(a)311 Hz (b) 314 Hz (c)100 Hz (d)50 Hz

ii) A ***LCR*** series circuit consists of a resistance of 30 Ω, inductive reactance 80 Ω and capacitive reactance of 40 Ω, then total impedance of the circuit is-
(a)150 Ω (b) 70 Ω (c) 50 Ω (d) 10Ω

iii) The value of effective voltage of a given alternating voltage is
(a)311 V (b) 220 V (c) 0 V (d) 314 V

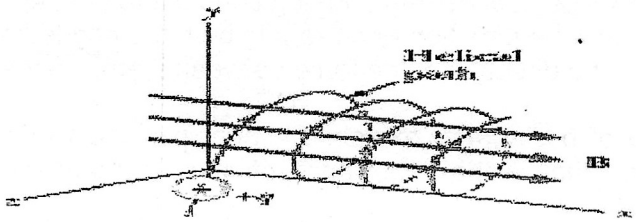
OR

The effective value of current flowing in the circuit is-

(a)4.4 A (b) 6.2 A (c) 2.2 A (d) 6.3 A

iv) If inductive and capacitive reactance be adjusted, then what will be the value of maximum current amplitude in the circuit?
(a)7.1 A (b) 10.4 A (c) 6.2 A (d) 5.4 A

35 HELICAL MOTION OF A CHARGED PARTICLE IN A MAGNETIC FIELD (4)



If velocity has a component along B, this component remains unchanged as the motion along the magnetic field will not be affected by the magnetic field. The motion in a plane perpendicular to magnetic field is a circular one, thereby producing a helical motion.

i) The radius of the charge particle, (when v is perpendicular to B) placed in a uniform magnetic field is given by
(a) R = mv/qB (b) R = qB/mv (c) R = Bqm/v (d)R = vq/Mb

ii) An electron, proton, He^+ and Li^{++} are projected with the same velocity perpendicular to a uniform magnetic field. Which one will experience maximum magnetic force?
(a) Electron (b) Proton (c) He^+ (d) Li^{++}

iii) The work done by the magnetic field on the charge particle moving perpendicular to a uniform magnetic field is
(a) Zero (b) q (**v x B**). S (c) Maximum (d) qBS/v

iv) The distance moved by a charged particle along the magnetic field in one rotation, when v has a component parallel to B is
(a) $\frac{2\pi v cos\theta}{qBm}$ (b) $\frac{2\pi mv cos\theta}{qB}$ (c) $\frac{qBm}{2\pi v cos\theta}$ (d) $\frac{qB}{2\pi m}$

OR

The vectors which are not necessarily perpendicular to each other in the relation for magnetic force acting on a charged particle are:
(a) F and v (b) F and B (c) v and B (d) All of these

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