AIRPORT SENIOR SECONDARY SCHOOL
TERMINAL EXAMINATION– 1 (2023-24)
PHYSICS

CLASS :XII **MARKS : 70**
TIME : 3 Hrs

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General Instructions :

(i) **This question paper comprises 5 sections-A, B, C, D & E.**

(ii) **There are 33 questions in the question paper. All questions are compulsory.**

(iii) **Section A: Questions 1 to 12 are objective type questions carrying 1 mark each and questions 13 to16 are assertion reasoning type questions of 1 mark each.**

(iv) **Section B: Questions 17 to 21 are short answer type questions carrying 2 mark each.**

(v) **Section C: Questions 22 to 28 are long answer type questions carrying 3 mark each.**

(vi) **Section D: Questions 29 to 30 are two case-based/passage-based integrated questions of 4 marks each.**

(vii) **Section E: Questions 31 to 33 are also long answer type questions carrying 5 marks each.**

(viii) **There is no overall choice in the question paper. However, an internal choice has been provided 3 questions of 2 marks, 1 question of 3 marks and all 3 questions of 5 marks. You have to attempt only one of the choices in such questions.**

(ix) **However, separate instructions are given with each section and question, wherever necessary.**

(x) **Use of calculators and log table is not permitted.**

(xi) **You may use the following values of physical constants wherever necessary.**

$c = 3 \times 10^8$ m/s

e = 1.6 x 10-19 C

$\mu_0 = 4\pi \times 10^{-7}$ T m A¹

$\varepsilon_0 = 8.854 \times 10\text{-}12$ C²N¹m²

$1/4\pi\varepsilon 0 = 9 \times 10$ Nm² C^{-2}

Mass of electron (m) = 9.1×10^{31} kg

Mass of neutron = 1.675×10^{-27} kg

Mass of proton = 1.673×10^{-27} kg

1. A positive charge enters a magnetic field and travels parallel and opposite to the field. The charge experiences

   a. an upward force b. a downward force

   c. force perpendicular to the field d. zero force.

2. A proton and alpha particle of the same velocity enter a uniform magnetic field which is acting perpendicular to their direction of motion. The ratio of the radii of the circular paths described by the alpha particle and proton is

   a. 1:4 b. 4:1 c. 2:1 d. 1:2

3. The temperature dependence of resistivity of materials A and B are represented in figures 1 & 2

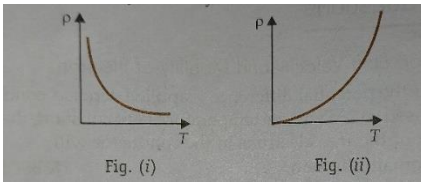


Fig. (i) Fig. (ii)

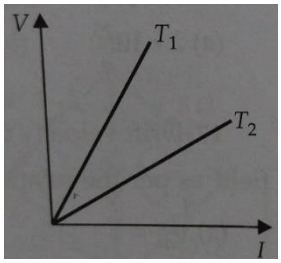
   respectively. Identify material A and material B.

   a. Material A is copper and B is germanium
   b. Material A is germanium and material B is copper.
   c. Material A is nichrome and material B is germanium.
   d. Material A is copper and material B is nichrome

4. When a current of 0.2 A is drawn from a battery, the potential difference between its terminals is 20 Volt and when a current of 2 A is drawn the potential difference drops to 16 Volt. The emf of the battery is

   a. 15.1 V b. 20.4 V c. 18.9 V d. 23.3 V

5. The voltage V Versus current I graphs for a conductor at 2 different temperatures are shown in figure. The correct relationship between T_1 and T2 is



   a. $T_1 < T_2$ b. $T_1 = T_2$ c. $T_1 > T_2$ d. $T_1 = 2\,T_2$

6. Two parallel wires carrying currents in the same direction,

   a. attract each other b. repel each other
   c. May attract or repel d. neither attract nor repel.

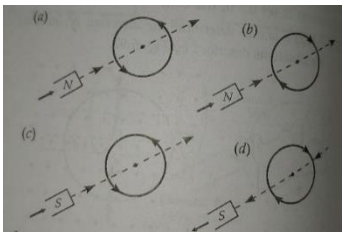
7. A charge q is moving in the magnetic field B. The value of work done by B is

   a. -1 J b. +1 J c. zero J d. None of the above.

8. If both the number of turns and core length of an inductor are doubled, keeping other factors constant, then its self inductance will be,

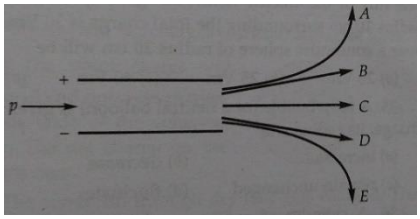
   a. unaffected. b. doubled c. halved d. quadrupled.

9. Which of the following figures correctly define Lenz's law? The arrow shows the movement of the labelled pole of a bar magnet into a closed circular loop and the arrows on the circle show the direction of the induced current.



a. a b. b c. c d. d

10. A proton moving at constant velocity enters a region between two charged plates as shown below.



Which of the paths correctly indicates the trajectory of proton after leaving the region between the charged plates?

a. A b. B. c. C. d. D

11. In a purely resistive AC circuit the current,

a. is in phase with the emf b. Leads the emf by $\pi/2$

c. Lags behind the emf by $\pi/2$ d. Leads the emf by π

12. A current carrying coil kept in a uniform magnetic field is said to be in equilibrium, when

a. it is parallel to the field b. it is perpendicular to the field.

c. it is at 45° with the field d. None of the above.

Question numbers 13 to 16 are assertion and reason type question . Choose the correct option in each of these questions.

a. Assertion And reason are correct and reason is the correct explanation of assertion.
b. Assertion And reason are correct and reason is not the correct explanation of assertion.
c. Assertion is correct but reason is wrong.
d. Assertion is wrong and reason is correct.

13. Assertion: It is advantageous to transmit electric power at high voltage.
Reason: High voltage implies high current.
14. Assertion: An electron has a high potential energy when it is at a location associated with a more negative value of potential, and a low potential energy when at a location associated with a more positive potential.

Reason: electrons move from a region of higher potential to a region of lower potential.

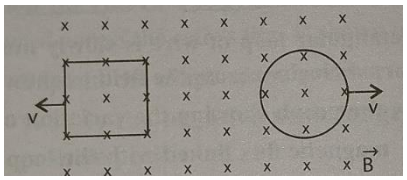
15. Assertion. Though large number of free electrons are present in a metal there is no current in the absence of external electric field.
    Reason: In the absence of external electric field electrons move randomly in all directions.
16. Assertion: Increasing the current sensitivity of a galvanometer by increasing the number of turns may not necessarily increase its voltage sensitivity.
    Reason: The resistance of the coil of the galvanometer increases on increasing the number of turns.

Section B

17. Write the expression for the force acting on a particle of mass m and charge q moving with velocity v in a magnetic field B. Under what conditions will it move in i. a circular ii. helical path?

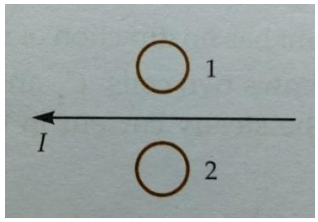
    Or

    Write the expression for magnetic Lorentz force. Out of the 3 vectors, F, v and B which pair of vectors are always perpendicular?
18. A rectangular loop and the circular loop are moving out of a uniform magnetic field with constant velocity v as shown in figure. Explain in which loop do you expect the induced emf to be constant during the passage out of the field region. The magnetic field is normal to the loops.

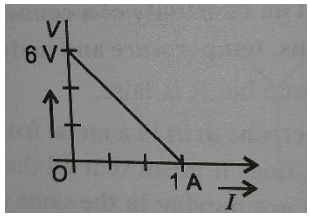


Or

What is the direction of induced currents in the loops 1 and 2 when the current in the wire is increasing steadily?

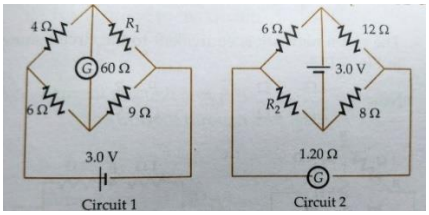


19. The plot of the variation of potential difference V across a combination of three identical cells in series versus current I is as shown here. What is the emf of each cell?



Or

The galvanometer , in each of the two circuits, does not show any deflection. Find the ratio of resistance R_1 and R_2 used in these circuits.



20. State the principle of a transformer. How is the large scale transmission of electrical energy over a long distance done with the use of transformers?

21. Two charges of magnitudes - 2q and +q are located at points (a,0) and (4a,0) respectively. What is the electric flux due to these charges through a sphere of radius 3a with its centre at the origin?

Section C .

22. A parallel plate capacitor is charged to a potential V by a battery. Without disconnecting the battery, the distance between the plates is tripled and a dielectric medium of dielectric constant 10 is introduced between the plates of the capacitor.
Explain with reasons, how will the following be affected (i) capacitance of the capacitor (ii) charge on the capacitor.

23.Derive an expression for the mutual inductance of a pair of coaxial solenoids.

Or

State the working principle of an ac generator. A circular coil of radius 10 cm and 20 turns is rotated about its vertical diameter with an angular speed 50 rad/s in a uniform horizontal magnetic field of 3.0×10^{-2} T. Calculate the maximum and average emf induced in the coil.

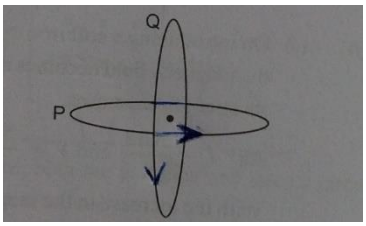
24. With the help of a figure show the behavior of a diamagnet in an external magnetic field. Compare the magnetic permeability of a diamagnet and ferromagnet.

25. i. Draw two equipotential surfaces representing a uniform electric field lying along the Y direction.
ii. What is the work required to move a charge from one point to other on an equipotential surface?

26. A closely wound solenoid 80 cm long has 5 layers of winding having 400 turns each. The diameter of the solenoid is 1.8 cm. If the current carried is 8.0 A estimate the magnitude of B inside the solenoid near its centre.

27. In a series LCR circuit connected to an AC source of variable frequency and voltage $v = v_m \sin \omega t$. Draw a plot showing the variation of current i with angular frequency ω for two different values of resistance R_1 and R_2, where ($R_1 > R_2$). Write the condition under which the phenomenon of resonance occurs.

28. Two identical loops P and Q each of radius 5 cm lying in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils if they carry currents equal to 3A and 4A



respectively.

Section D

Case based questions.

29.Flux is the property of any vector field. Electric flux is a property of electric field. It is equal to the product of the given area and the normal component of the electric field through it. Gauss's theorem gives a relationship between the total flux passing through any closed surface S and the charge Q enclosed within the surface. It states that the total flux through a closed surface is $1/\varepsilon_0$ times the net charge enclosed by the surface. Gauss's theorem is quite useful in calculating the electric field in problems where it is possible to choose closed surface such that the electric field E has a normal component which is either zero or has a single fixed value at every point on the surface. Symmetry considerations in many problems make the application of Gauss's theorem much easier than close surface we choose to solve a given problem is called Gaussian surface Gauss's theorem is based on inverse square dependence on distance content in Colomb's law . Any violation of Gauss's theorem will reflect a deviation from the inverse square law.

1. What is the SI unit of electric flux?

a. Nm^2/C b. $N\ m^2$ c. NC/m^2 d. N^2C^2/m^2

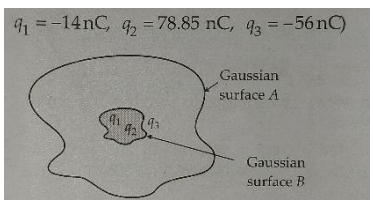
2. If E.ds = 0, inside a surface means,

a. There is no net charge present in the surface b. the total flux through the surface is zero
c. uniform electric field inside the surface d. discontinuous field lines inside the surface

3. A charge q is first kept in a sphere of radius 5 cm and then it is kept in a cube of side 5 cm. The outgoing flux is

a. more in case of sphere b. more in case of cube.
c. same in both the cases. d. Cannot be determined.

4. The electric flux for Gaussian surface A that encloses the charged particles in free space is ,



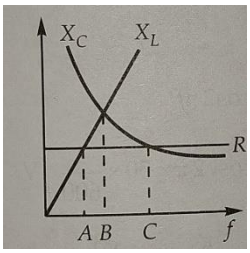
(q_1= -14 n C, q_2 = 78.85nC, q_3 = -56 nC)

a. $10^3\ N\ m^2\ C^{-1}$ b. $6.32 \times 10^3\ N\ m^2C^{-1}$
c. $10^3\ N^{-1}m^{-2}\ C$ d. $6.32 \times 10^3\ CN^{-1}\ m^{-2}$

30. Impedance is a quantity that measures the opposition of of a circuit to the flow of current through it and so determines the magnitude of current. In a dc circuit, this is the resistance R alone. In an ac circuit the reactance has also to be taken into account according to the relation

$Z^2= R^2+(X_L-X_c)^{2,}$ where Z is the impedance. Impedance triangle is a right angle triangle ,in which base represents resistance and perpendicular represents reactance X and hypotenuse represents the impedance Z. From this triangle the phase angle between voltage and current is given by $\tan \Phi= X_L-X_c /R$. Resonance occurs in a series LCR circuit when $X_L= X_C$. For resonance to occur the presence of both L and C elements is essential. Only then voltage across L and C cancel each other and current amplitude will be Vm/R, the total source voltage will appear across R. So we cannot have resonance in LR and CR circuits.

1. The figure given below shows the variation of X_L and Xc with frequency f for a series LCR circuit. The circuit will be inductive for the frequency point



a. A b. B c. C d. all of the above

2. In a series LCR AC circuit the impedance cannot be increased by a

a. Increasing frequency of source. b. Decreasing frequency of source
c. Increasing the resistance d. Increasing the voltage of the source

3. In an LCR circuit the potential difference between the terminals of the inductance is 60 V between the terminals of the capacitor is 30 V and that across the resistor is 40 V, then supply voltage will be equal to

a. 50 V b. 70 V c. 130 V d. 10 V

4. In LCR series circuit the capacitance is changed from C to 4C. For the same resonant frequency the inductance should be changed from L to

a. 2 L b. L/2 c. L/4 d.4 L

Section E

31. An electric dipole is a system consisting of two equal and opposite point charges separated by a small and finite distance. If dipole moment of the system is P and it is placed in a uniform electric field E,

(i) Write the expression of torque experienced by a dipole.

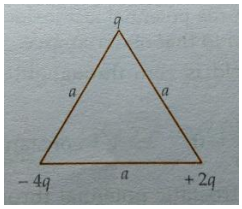
(ii) Identify to pairs of perpendicular vectors in the expression.

(iii) Show diagrammatically the orientation of the dipole in the field for which the torque is

a. Maximum. b. Half the maximum value c. Zero

Or

a. Explain why, for any charge configuration, the equipotential surface through a point is normal to the electric field at the point.
b. Obtain an expression for the work done to dissociate the system of 3 charges placed at the vertices of an equilateral triangle of side a as shown in figure.



32.a. Name the device used to change the alternating voltage to a higher or lower value. State one cause for power dissipation in this device. Why cannot such a device be used to step up DC voltage?

b. Draw the phasor diagram of a purely inductive circuit. Also write the expressions for voltage and current in the circuit.

Or

a. Draw the phasor diagram of a series LCR circuit and obtain the relationship between current in the circuit and voltage.

b. Express the variation of impedence with angular frequency w for the same circuit.

c. Distinguish between resistance, reactance and impedance.

33. Describe the working principle of a moving coil galvanometer. Why is it necessary to use a radial magnetic field and a cylindrical soft and core in a galvanometer?

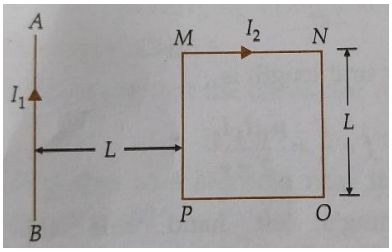
Can a galvanometer be to be used for measuring the current. Why?

Or

a. How can we convert a moving coil galvanometer to a voltmeter?

b. Why ammeter is always connected in series with a circuit?

c. A square shaped current carrying loop MNOP is placed near a straight long current carrying wire AB as shown in figure. The wire and the loop lie in the same plane. If the loop experiences a net force F towards the wire, find the magnitude of the force on the side NO of the loop.



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