विद्या सर्वार्थि साधिका

ANANDALAYA

PERIODIC TEST - 2

Class : XII

Subject: Physics M.M : 70

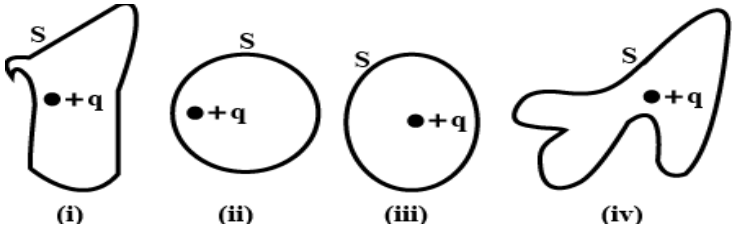
Date : 19-09-2022 Time : 3 hours

General Instructions:

1. This question paper consists of five sections- A,B,C,D and E.
2. There are 33 questions in the question paper. All questions are compulsory.
3. Section A: Question number 1 to 10 are objective type questions/ very short answer type questions carrying 1 mark each and question number 11 to 14 are assertion reasoning of 1 mark each.
4. Section B: Question number 15 to 17 are case-based/passage-based integrated questions of 12 marks in total.
5. Section C: Question number 18 to 27 are short answer questions carrying 2 marks each.
6. Section D: Question number 28 to 30 are long answer type (I) questions and carry 3 marks each.
7. Section C: Question number 31 to 33 are long answer type (II) questions and carry 5 marks.
8. There is no overall choice. However, an internal choice has been provided in four questions of one mark, three questions of two mark each, one question of three marks and all the three questions of five marks. You have to attempt only one of the choices in such questions.However, separate instructions are given with each section and questions, whenever necessary.
9. Use of calculators and log table is not permitted.

SECTION A

1. The electric flux through the surface __. (1)



(A) in figure (i) is least among all.

(B) in figure (iv) is largest among all.

(C) is same for all the figures.

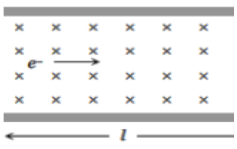
(D) is same in figures (ii) and (iii) but smaller than figure (i)

2. The SI unit of pole strength of a bar magnet is ____. (1)

(A) Am^2 (B) Am (C) A/m^2 (D) A/m

OR

An electron moves straight inside a charged parallel plate capacitor of uniform surface charge density σ. The space between the plates is filled with constant magnetic field of induction B. The time of straight line motion of the electron in the capacitor is:



(A)$\varepsilon_0 lB/\sigma$ (B) $e\sigma/\varepsilon_0 lB$ (C) $\sigma e/\varepsilon_0 B$ (D) $\varepsilon_0 B/\sigma e$

3. The magnetic flux linked with a coil changes by 2×10^{-2}Wb when the current changes by 0.01A. The self-inductance of the coil is_____. (1)

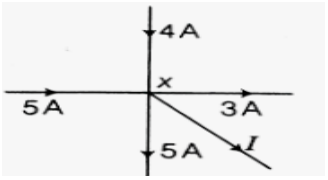
(A) 0.02 H (B) 0.2 H (C) 2 H (D) 20 H

4. Two capacitors of capacitance C and C/2 are connected in parallel with V volt battery. The work (1)

done in charging fully both the capacitors is __.

(A) $\frac{1}{4}CV^2$ (B) $\frac{1}{2}CV^2$ (C) CV^2 (D) $\frac{3}{4}CV^2$

5. Five conductors are meeting at a point x as shown in the figure. What is the value of current in fifth conductor? (1)



(A) 3A away from x (B) 1A away from x (C) 3A towards x (D) 1A towards x

6. By increasing the temperature, the specific resistance of a conductor and a semiconductor___. (1)

(A) increases for both (C) increases for a conductor and decreases for a semiconductor

(B) decreases for both (D) decreases for a conductor and increases for a semiconductor.

OR

Alloys are used for making standard resistors because they have ___.

(A) low temperature coefficient of resistivity and high specific resistance

(B) high temperature coefficient of resistivity and low specific resistance

(C) low temperature coefficient of resistivity and low specific resistance

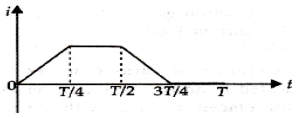
(D) high temperature coefficient of resistivity and high specific resistance

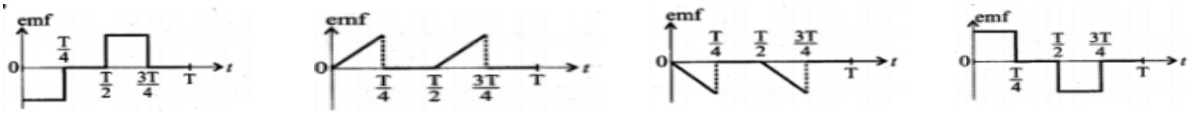
7. Which of the following figures correctly depicts the Lenz's law? (1)

(A) (B) (C) (D)

OR

The current I in a coil varies with time as shown in the figure. The variation of induced emf with time would be:





(A) (B) (C) (D)

8 Two wires of the same length are shaped into a square of side 'a' and a circle with radius 'r'. Both wires carry same current. Find the ratio of their magnetic moments. (1)

9. Calculate the amount of work done in rotating a dipole of dipole moment p, from its position of stable equilibrium to 90^0, in an external uniform electric field E. (1)

OR

'Electric potential of earth is zero'. Justify the statement.

10. A long straight wire in the horizontal plane carries a current of 50A in north to south direction. What is the direction of magnetic field B at a point 2m east of the wire? (1)

In the following questions (Q.No. 11 to 14), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(A) Both assertion and reason are true, and reason is the correct explanation of the assertion.

(B) Both assertion and reason are true, but reason is not the correct explanation of the assertion.
(C) Assertion is true, but reason is false.
(D) Assertion is false, but reason is true.

11. Assertion: In electrostatic equilibrium, electric field is zero everywhere inside the conductor. (1)
Reason: When a conductor is kept in an external field, the applied electric field and induced electric field inside the conductor cancel out each other in static situation.

12. Assertion: The torsion head in the galvanometer is mainly used to control the location of the coil and also for regulating the setting to zero. (1)
Reason: Current sensitivity of galvanometer is increased by decreasing torsional constant k of a spring.

13. Assertion (A): In an AC circuit containing only inductor, the current leads voltage by 90^0. (1)
Reason (R): Inductive reactance decreases as the frequency of AC source decreases.

14. Assertion: The opposition offered by an capacitor to the flow of AC through it is called reactance. (1)
Reason: The dimension of capacitive reactance is same as that of capacitance of the capacitor.

SECTION B

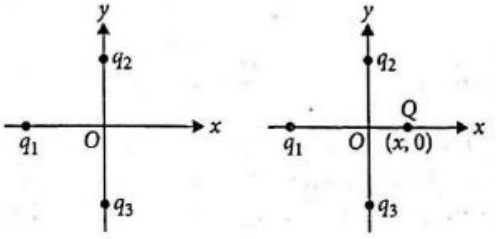
15. Read the passage given below and answer the questions:
Coulomb, a French physicist, performed several experiments to measure the extent of force between two point charged bodies. Coulomb measured the force between two point charges and found that it varied inversely as the square of the distance between the charges and was directly proportional to the product of the magnitude of the two charges and acted along the line joining the two charges. The electrostatic force constant in Coulomb's law depends upon the permittivity of the medium separating the charges. Coulomb's law is an electrical analogue of Newton's law of Universal Gravitation in mechanics.

(i) The value of electric permittivity of free space is ___. (1)
(A) 9×10^9 Nm^2/C^2 (C) 8.85×10^{-12} Nm^2/C^2
(B) 9×10^9 NC^2/m^2 (D) 8.85×10^{-12} C^2/Nm^2

(ii) Identify the wrong statement in the following: (1)
Coulomb's law correctly describes the electric force that binds _____.
(A) the electrons of an atom to its nucleus (C) atoms and molecules to form solids.
(B) atoms together to form molecules. (D) protons and neutrons in the nucleus of an atom.

(iii) Two charges q_1 and q_2 are placed in vacuum at a distance d and the force acting between them is F. If a medium of dielectric constant 4 is introduced around them, the force now will be __. (1)
(A) 2F (B) F/2 (C) F/4 (D) 4F

(iv) In the given figure, two positive charges, q_2 and q_3 fixed along the *y* axis, exert a net electric force in the +*x* direction on a charge q_1 fixed along the *x* axis. If a positive charge Q is added at (*x*, 0), the force on q_1 shall increase along positive x-axis. The nature of the charge q_1 *is* ___. (1)



(A) positive (B) negative (C) neutral (D) neither (+) nor (-)

OR

If charges q, q and –q are placed at vertices of an equilateral triangle of side l. If F_1, F_2 and F_3 are the forces on the charges respectively, then:

(A) $|F_1 + F_2 + F_3| = \sqrt{3}kq^2/l^2$ (C) $|F_1 + F_2 + F_3| = 3\sqrt{2}kq^2/l^2$

(B) $|F_1 + F_2 + F_3| = 0$ (D) $|F_1 + F_2 + F_3| = \sqrt{2}kq^2/l^2$

16. Read the passage given below and answer the questions:

The resistance offered by the electrolyte of a cell to the flow of current between its electrodes is called internal resistance (r) of the cell. An ideal battery has zero internal resistance and the potential difference across the battery equals to its emf ε. But a real cell is made of electrodes and electrolyte, there is resistance to the flow of charges within the cell. A freshly prepared cell has low internal resistance. The internal resistance of a cell increases with ageing and so reduces the current it can drive. Internal resistance of the cell depends on nature and concentration of electrolyte, separation and common area of the electrodes dipped in the solution, and temperature of electrolyte. The knowledge of internal resistance becomes important when we consider how a source of emf can deliver maximum power to an appliance connected to it.

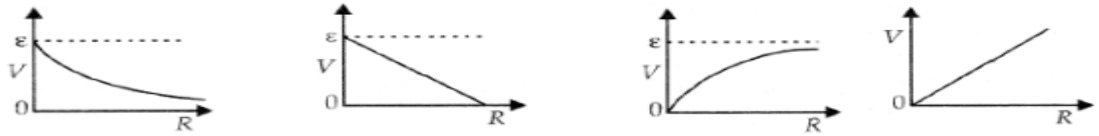
(i) A cell of emf 10V and internal resistance 3Ωis connected to a resistor. The current in the circuit is 0.5A. The terminal voltage of the battery when the circuit is closed is___. (1)

(A) 10 V (B) Zero (C) 1.5 V (D) 8.5 V

(ii) Under what condition, can we draw maximum current from a cell of emf ε? (R and r are external and internal resistance respectively). (1)

(A) R = r (B) R > r (C) R < r (D) R = 0

(iii) A cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by (1)



(A) (B) (C) (D)

OR

A student measures the terminal potential difference (V) of a cell of emf Ɛ and internal resistance (r) as a function of the current (I) flowing through it. The slope and intercept of the graph between V and I, then respectively equal

(A) $-r\ and\ -\varepsilon$ (B) $r\ and\ \varepsilon$ (C) $-r\ and\ \varepsilon$ (D) $r\ and\ -\varepsilon$

(iv) Two cells of same emf Ɛ but of different internal resistance r_1 and r_2 are connected in series with an external resistance R. The potential drop across the first cell is found to be zero. The external resistance R is __. (1)

(A) $R = r_1 + r_2$ (B) $R = r_1 - r_2$ (C) $R = r_1/r_2$ (D) $R = r_1 = r_2$

17. Read the passage given below and answer the questions:

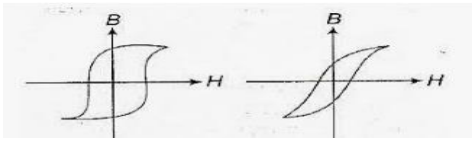
Magnetic behaviour of Materials: The origin of magnetism is explained by taking into consideration of the circular motion of electrons. The electrons present inside the atoms move in circular orbits around the nucleus; this is similar to a circular coil carrying current. The electron's orbital motion gives rise to the orbital magnetic moment. The electrons tend to spin around in their own axis, thus creating a spin magnetic moment. The magnetic moment of an atom is the result of the vector sum of the orbital and spin magnetic moment. The magnitude and direction of these resultant magnetic moment is responsible for the behaviour of the

material. Based upon the magnetic properties, the magnetic substances are classified into three groups, namely diamagnetic, ferromagnetic, and paramagnetic. Magnetic induction (B) of a sample depends on its net magnetic moment per unit volume. It is directly proportional to the magnetising current (H). The ratio of B and H is magnetic susceptibility(χ). For ferromagnetic materials have large value of χ and are characterised by non-linear relation between B and H.

(i) When a bar is placed near a strong magnetic field and it is feebly attracted, then the material of bar is ___. (1)

(A) diamagnetic (B) paramagnetic (C) ferromagnetic (D)anti ferromagnetic

(ii) Hysteresis loops for two ferromagnetic materials (1) and (2) are shown in the figure: These materials are used to make magnets for electric generator and transformers. Then it is proper to use ____. (1)



(1) (2)

(A) material (1) for transformers and material (2) for electric generator.

(B) material (1) for electric generator and material (2) for transformers

(C) Both materials (1) and (2) for electric generator.

(D) Both materials (1) and (2) for transformers.

(iii) The value of magnetic susceptibility for diamagnetic material is __. (1)

(A) Zero (B) infinity (C) between 0 and 1 (D) between -1 and 0

(iv) For a paramagnetic material, the dependence of magnetic susceptibility on absolute temperature is given as ___. (1)

(A) $\chi \propto T$ (B) $\chi \propto 1/T$ (C) $\chi \propto 1/T^2$ | (D) $\chi \propto \sqrt{T}$

SECTION C

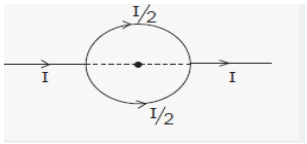
18. Derive the expression for drift velocity of free electron in terms of relaxation time and electric field applied across a conductor. (2)

OR

(a) What is the nature of path of free electrons in a conductor in thepresence of electric field?

(b) Do all the electrons have the same average velocity? How does this velocity vary with temperature?

19. The current I enters and leave the circular loop of uniform wire of radius R through diametrically opposite points. Find the net magnetic field of the centre of circular loop. (2)



20. A proton and an alpha particle enter at right angles into a uniform magnetic field B. Calculate the ratio of radii of the path of alpha particle to that of proton when they enter the field with the same momentum. (2)

21. A slab of material of dielectric constant k has the same area as that of the plates of a parallel plate capacitor but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor. (2)

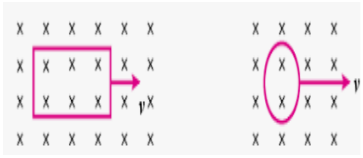
OR

Net capacitance of three identical capacitors in series is 1μF. What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if both are connected to the same source separately.

22. Define mutual inductance. Give two factors on which the coefficient of mutual inductance depends. (2)

23. Give reason for the following:
(a) An electrostatic field line is a continuous curve. That is, a field line cannot have sudden break.
(b) Two field lines never cross each other.

24. A rectangular loop and a circular loop are moving out of a uniform magnetic field region to a field-free region with a constant velocity v. In which loop, the induced emf to be constant during the passage out of the field region? The field is normal to the loops. Justify your answer. (2)

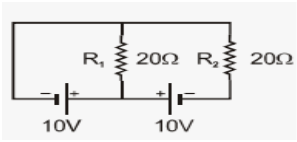


OR

A rectangular wire loop of sides 8 cm and 2 cm with a small cut is moving out of a region of uniform magnetic field of magnitude 0.3 T directed normal to the loop. What is the emf developed across the cut if the velocity of the loop is 1 cm s^{-1} in a direction normal to (i) the shorter side of the loop and (ii) the longer side of the loop?

25. When a circuit element X is connected across an AC source, a current of $\sqrt{2}$A flows through it and this current is in phase with the applied voltage. When another element Y is connected across the same AC source, the same current flows in the circuit but it leads the voltage by $\pi/2$ radians. Find the impedance in the circuit when the series combination of X and Y is connected across the same a.c. voltage. (2)

26. In a given circuit, the cells have zero internal resistance. Find the currents (in Amperes) passing through resistance R_1 and R_2? (2)



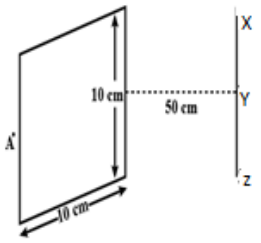
27. A long straight conductor P carrying current of 2A is placed parallel to a short conductor Q of length 0.05 m carrying a current of 3A. Two conductors are 0.10 m apart. Calculate the force on the short conductor Q. (2)

SECTION D

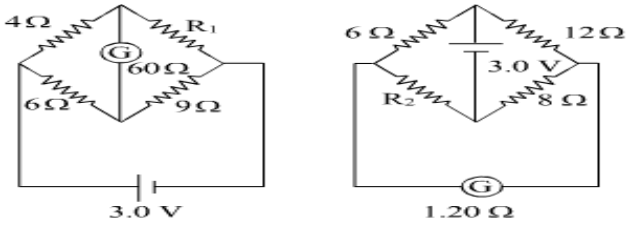
28. Derive an expression for the potential due to dipole at a point r distance from the midpoint. (3)

OR

Given a uniformly charged plane/ sheet of surface charge density $\sigma = 2 \times 10^{17}$ C/m^2 .
(a) Find the electric field intensity at a point A, 5mm away from the sheet on the left side.
(b) Given a straight line with three points X, Y & Z placed 50 cm away from the charged sheet on the right side. At which of these points, the field due tothe sheet remain the same as that of point A and why?



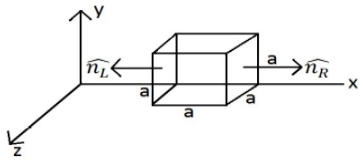
29. Figure shows two circuits each having a galvanometer and a battery of 3V. When the galvanometers in each arrangement do not show any deflection, btain the ratio $\frac{R_1}{R_2}$. (3)



30. (a) State the underlying principle of a transformer. (3)
(b) Obtain the expression for the ratio of secondary to primary voltage in terms of the number of secondary and primary windings and primary and secondary currents.
(c) Write one main assumption involved in deriving the above relation.

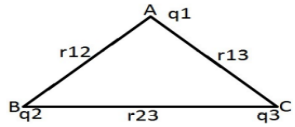
SECTION E

31. (a) Using Gauss's law, derive expression for intensity of electric field at any point near the infinitely long straight uniformly charged wire. (5)
(b)The electric field components in the given figure are
$E_x = \alpha x$, $E_y = 0$, $E_z = 0$; in which $\alpha = 400$ N/C m. Calculate
(i) the electric flux through the cube, and
(ii) the charge within the cube assume that a = 0.1m.



OR

(a) Define electrostatic potential at a point. Write its SI unit.
(b) Three charges q1 , q2 and q3 are kept respectively at points A, B and C as shown in figure. Write the expression for electrostatic potential energy of the system.



(c) Depict the equipotential surfaces due to (i) an electric dipole (ii) two identical negative charges separated by a small distance.

32. (a) State Ampere's circuital law. Use this law to obtain the expression for the magnetic field inside a solenoid of length 'l', cross-sectional area 'A' having 'N' closely wound turns and carrying a steady current 'I'. (5)
(b) A straight horizontal conducting rod of length 0.45 m and mass 60 g is suspended by two vertical wires at its ends. A current of 5.0 A is set up in the rod through the wires. Find the magnitude and direction of the magnetic field which should be set up in order that the tension in the wire is zero.

OR

(a) Describe the working principle of a moving coil galvanometer.
(b) Why is it necessary to use (i) a radial magnetic field and (ii) a cylindrical soft iron core in a galvanometer?
(b) A galvanometer coil has a resistance of 12 Ω and the metre shows full scale deflection for a current of 3 mA. How will you convert the metre into a voltmeter of range 0 to 18 V?

33. State the principle of an AC generator and explain its working with the help of a labelled diagram. Obtain the expression of the emf induced in a coil having N turn each of cross-sectional area A, rotating with the constant angular speed $\boldsymbol{\omega}$ in a magnetic field directed perpendicular to the axis of rotation. (5)

OR

A 80μF capacitor, a 5.0 H inductor and a 40 Ω resistors are connected in series with a variable frequency 230 V source.
(a) Determine the source frequency which drives the circuit in resonance.
(b) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.
(c) Plot variation of impedance of series LCR circuit with the frequency of the applied AC source.