PT-2/HALF YEARLY EXAMINATION, 2022-23

PHYSICS

Time – 3 Hours **Class - XII** **M.M. - 70**

Date – 16.09.2022 (Friday)

Name of the student _____ **Section** _____

General Instructions –

- There are 34 questions in all. All questions are compulsory.
- This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
- **Section A** contains sixteen questions of **one mark** each,
- **Section B** contains 1 case study question of **four mark**,
- **Section C** contains seven questions of **two marks** each,
- **Section D** contains seven questions of **three marks** each,
- **Section E** contains three questions of **Five marks** each,
- There is no overall choice. However, internal choice has been provided in one question of two marks, one question of three marks and in all questions of five marks. You have to attempt only one of the choices in such questions.

SECTION - A

Q.1 Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and of magnitude 17.0×10^{-22} C/m^2. What is the Electric field in the outer region of the first plate?

A) 1.92×10^{-10} N/C B) 0.96×10^{-10} N/C C) 0.48×10^{-10} N/C D) zero

Q.2 An arbitrary surface encloses a dipole (q and –q charge separated by a small distance). What is the electric flux through this surface?

A) $\frac{q}{\varepsilon_0}$ B) $\frac{q}{2\varepsilon_0}$ C) $\frac{q}{4\varepsilon_0}$ D) zero

Q.3 Which statement is not correct for an equipotential surface?

A) Electric field is always perpendicular to the equipotential surface.

B) Potential difference between any two points on it is zero.

C) Equipotential surfaces are always spherical in shape.

D) No work is required to move a charge on an equipotential surface.

Q.4 Assume that an electric field $\vec{E} = 30\ \hat{\imath}$ exists in space. Then the potential difference $V_A - V_O$, where V_O is the potential at the origin and V_A the potential at x = 2 m is:

A) + 60 V B) − 60 V C) + 120 V D) −120 V

Q.5 We know that charge in a capacitor is given as Q = CV. Which of the following relation/statement regarding C is correct?

A) $C \propto \frac{1}{V}$

B) $C \propto Q$

C) depends on geometrical factors like area of the plates and separation between them.

D) C does not depend on the medium between the plates of the capacitor.

Q.6 If an electron is moving in the positive X-direction, in a region where uniform magnetic field is applied along positive Y-direction, then what will be the direction of the magnetic force?

A) Along the positive Z-direction. B) Along the negative Z-direction.

C) Along the positive Y-direction. D) Along the negative Y-direction.

Q.7 There is one circular loop of a uniform wire whose radius is R. Electric current I enters at one point on its circumference and leaves at a diametrically opposite point. What will be the net magnetic field intensity at the centre of the loop?

A) $\frac{\mu_0}{4R} i$ B) $\frac{\mu_0}{2R} i$ C) $\frac{\mu_0}{R} i$ D) Zero

Q.8 There is a uniform magnetic field and a charged particle is given an initial velocity at an acute angle to the direction of the magnetic field. What kind of path will the particle follow?

A) Circle B) Straight line

C) Helical path with a non-uniform pitch. D) Helical path with a uniform pitch.

Q.9 The angle of dip at a place where the horizontal and vertical components of Earth's magnetic field are equal is:

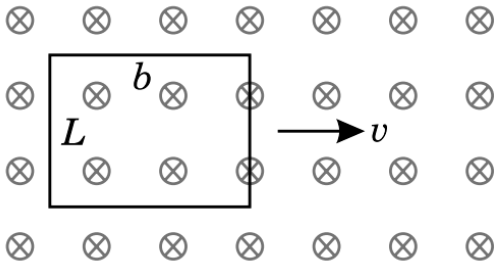
A) 45° B) 30° C) 0° D) 60°

Q.10 Electromagnets are made of soft iron because soft iron has

A) Low retentivity and low coercive force B) High retentivity and low coercive force

C) Low retentivity and high coercive force D) High retentivity and high coercive force

Q.11 Metallic rectangular loop of wire of size L × b is moved in its plane inside uniform magnetic field B as shown in figure.



R is the resistance of loop and v is its speed. Induced current in the loop is

A) BLv/R , clockwise B) 2BLv/R, anticlockwise C) 2Bbv/R ,clockwise D) zero

Q.12 In Lenz's law there is conservation of

A) charge B) momentum C) energy D) None of these

Q.13 The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of electric field strength is :

A) 3 V/m B) 6 V/m C) 9 V/m D) 12 V/m

Directions (for Q. No. 14 to 16) : These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) Assertion is correct, Reason is incorrect

(d) Both Assertion and Reason are correct.

Q.14 **Assertion:** Electric lines of field cross each other.

Reason: Electric field at a point superimposes to give one resultant electric field.

Q.15 **Assertion:** The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the number of turns of the circular coil.

Reason : Magnetic field strength is directly proportional to the number of turns of the circular coil.

Q.16 **Assertion:** The electromagnetic wave is transverse in nature.

Reason: Electromagnetic wave propagates parallel to the direction of electric and magnetic fields.

SECTION - B

Q.17 **Read the following passage and answer the following questions:**

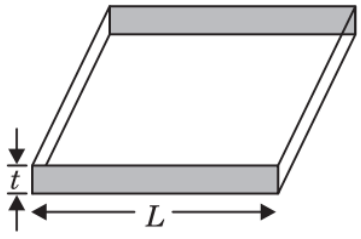
Resistance is the property of the conductor which opposes the free flow of electric current or electron. Resistance can also be simplified as the ratio of the voltage applied to the electric current flowing through it. The resistance of a conductor generally depends on a number of factors: length, nature of the material, and the area of cross-section. For a conductor material, the resistance of the material is inversely proportional to the area of cross-section and directly proportional to the length of the conductor. Resistivity is a property of a conductor which is defined as the resistance offered by a material per unit length for a unit cross-section. Relation between Resistivity and Resistance is: $R = \frac{\rho}{A} l$, where ρ is the resistivity, l is the length of the conductor and A is the cross-sectional area.

(I) Resistivity of a conductor depends upon

A) its material B) its cross-sectional area

C) its length D) All of the above

(II) Consider a thin square sheet of side L and thickness t, made of a material of resistivity ρ.



The resistance between two opposite faces, shown by the shaded areas in the figure is:

A) directly proportional to L B) directly proportional to t

C) independent of L D) independent of t

(III) With increase in temperature, the resistivity of a conductor

A) increases B) decreases

C) may increase or decrease D) does not change

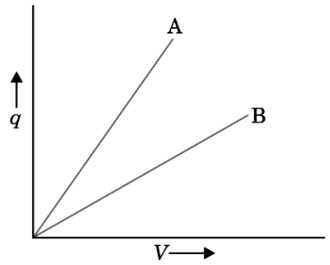
(IV) Which of the following quantities does not change when a resistor is heated by passing current through it?

A) Resistance B) Resistivity C) Drift velocity D) Number of free electrons

SECTION - C

Q.18 Consider a uniform electric field $\vec{E} = 3 \times 10^3 \, \hat{\imath}$ N/C ,What is the flux of the field through a square of side 10 cm, if its plane makes a 60° angle with X-axis?

Q.19 Two capacitors C_1 and C_2 have the same separation between the plates but the plate area of C_2 is twice that of C_1. The given graph shows the variation of q with V.



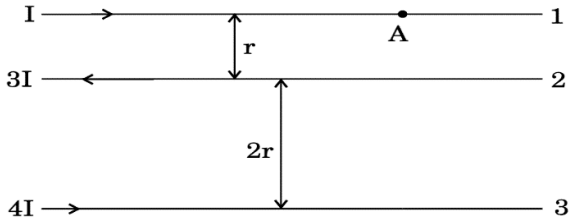
Which of the two lines in the graph represents C_1 and why?

OR

Eight identical drops merge to form a bigger drop. If the potential of each drop is 220 V, find the potential of the bigger drop.

Q.20 Write any two factors on which internal resistance of a cell depends.

Q.21 The figure shows three infinitely long straight parallel current carrying conductors.



Find the magnitude and direction of the net magnetic field at point A lying on conductor 1.

Q.22. What is motional electromotive force? Write an expression for it.

Q.23. Define susceptibility. Is the value of susceptibility for a diamagnetic substance positive or negative?

Q.24. Write the order of frequency range of each of the following electromagnetic radiations

(i) Microwaves (ii) Ultraviolet rays (iii) Gamma- rays.

SECTION - D

Q.25. Derive an expression for the electrostatic potential energy of a system of point charges.

Q.26. State Gauss theorem and apply it to find the electric field at a point due to a plane sheet of charge.

Q.27. Derive an expression for the torque acting on an electric dipole, which is held in a uniform electric field, when the axis of the dipole makes an angle θ with the electric

Q.28. Deduce Ohm's law from elementary ideas and hence write an expression for resistance and resistivity.

Q.29. State Biot-Savart law and apply it to find the magnetic field due to a circular loop carrying current at a point on the axis.

OR

What is radial magnetic field? What is its importance in a moving coil galvanometer? How is a radial magnetic field achieved in moving coil galvanometers?

Q.30. Deduce an expression for the mutual inductance of two long co-axial solenoids but having different radii and different number of turns.

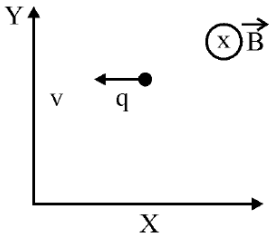
Q.31. Find the expression for the magnetic moment when an electron revolves at a speed 'v', around an orbit of radius 'r' in hydrogen atom hence define Bohr's magneton.

SECTION - E

Q.32. Two straight long parallel conductors carry currents I_1 and I_2 in the opposite direction. Deduce the expression for the force per unit length between them. Hence define 1 ampere current.

OR

A point charge q moving with speed v enters a uniform magnetic field B that is acting into the plane of the paper as shown.



(a) Write the equation of force on a charge particle in a magnetic field.

(b) What is the path followed by the charge q and in which plane does it move?

(c) How does the path followed by the charge get affected if its velocity has a component parallel to B?

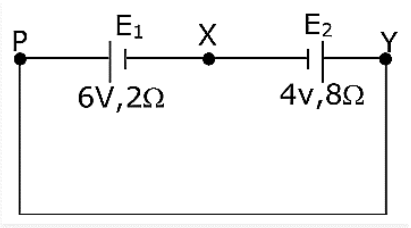
(d) If an electric field E is also applied such that the particle continues moving along the original straight-line path, find the magnitude and direction of the electric field E?

Q.33. What is a Wheatstone bridge? Deduce the condition for which Wheatstone bridge is balanced? Write one application of Wheatstone bridge.

OR

State Kirchhoff's current law and voltage law.

A cell E_1 of EMF 6 volt and internal resistance 2 ohm is connected with another cell E_2 of EMF 4 volt and internal resistance 8 ohm as shown in the figure. Find the potential difference across points X and Y.



Q.34. Derive an expression for the capacitance of a parallel plate capacitor with (a) a dielectric slab (b) a metallic plate in between the plates of the capacitor.

OR

Define electric potential at a point. Derive an expression for the electric potential at a point due to a point charge. Does the potential increase or decrease in the direction of electric field.