

Roll Number

Code Number 42



INDIAN SCHOOL MUSCAT HALF YEARLY EXAMINATION

PHYSICS

CLASS: XII

Sub. Code: 042

Time Allotted: 3 Hrs

18.09.2017

Max. Marks: 70

General Instructions:

1. All questions are compulsory. There are 26 questions in all.
2. This question paper has five sections: Section A, Section B, Section C, Section D, and Section E.
3. Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.
4. There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the questions of five marks weightage. You have to attempt only one of choices in such questions.
5. You may use the following values of physical constants wherever necessary.

$$c = 3 \times 10^8 \text{ m/s}, \quad h = 6.63 \times 10^{-34} \text{ Js}, \quad e = 1.6 \times 10^{-19} \text{ C}, \quad \mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$

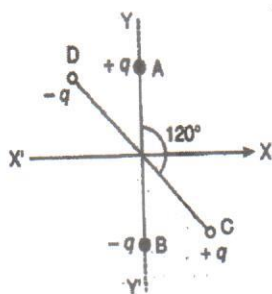
$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}, \quad \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}, \quad m_e = 9.1 \times 10^{-31} \text{ kg}$$

SECTION - A

1. Write SI unit of (a) electric field intensity and (b) electric dipole moment. ½ + ½
2. Define dielectric constant of a medium. What is the value of dielectric constant of a metal? 1
3. Plot a graph showing the variation of resistance of a conducting wire as a function of its radius, keeping the length of the wire and its temperature as constant. 1
4. A charged particle enters along the axis of a current carrying a long solenoid. How is its velocity affected? Will the particle be accelerated or decelerated? 1
5. What is the angle of dip at a place where the horizontal and vertical components of the Earth's magnetic field are equal? 1

SECTION-B

6. Derive an expression for the electric field strength at a distant point situated on the axis of an electric dipole. 2
7. Two small identical electrical dipoles AB and CD, each of dipole moment 'P' are kept at an angle of 120° as shown in the figure. What is the resultant dipole moment of this combination?



8. A conductor of length 'l' is connected to a dc source of potential 'V'. If the length of the conductor is tripled by gradually stretching it, keeping 'V' constant, how will (a) drift speed of electrons and (b) resistance of the conductor be affected? Justify your answer. 1 + 1
9. Derive an expression for the force per unit length between two long straight parallel current carrying conductors. 2
10. If the rate of change of current 2 ampere/second induces an emf of 40mV in the solenoid, What is the self inductance of this solenoid? 2

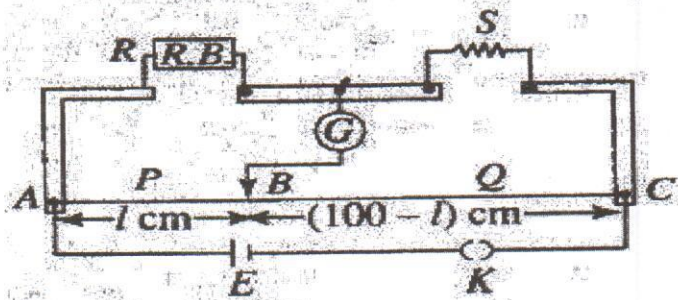
(OR)

A small piece of metal wire is dragged across the gap between the pole piece of a magnet in 0.5s. The magnetic flux between the pole pieces is known to be 8×10^{-4} Wb. Estimate the induced emf in the wire.

SECTION - C

11. An electric dipole is held in a uniform electric field. 2 + 1
- (a) Show that the net force acting on it is zero.
- (b) The dipole is aligned parallel to the field. Find the work done in rotating it through the angle of 180° .

- 12 Using Gauss's theorem derive the expression for the electric field intensity at a point outside a uniformly charged thin spherical shell of radius R . Draw a graph showing the variation of electric field with r , for $r > R$. 3
13. A $4 \mu\text{F}$ capacitor is charged by a 200V supply. It is then disconnected from the supply and is connected to another uncharged $2\mu\text{F}$ capacitor. How much electrostatic energy of the capacitor is lost in the form of heat and electromagnetic radiation? 3
- 14 Draw the circuit diagram of a potentiometer which can be used to determine the internal resistance (r) of a given cell (E). Describe a method to find the internal resistance of a primary cell. 1 + 2
- 15 Two Wires X, Y have the same resistivity but their cross-sectional areas are in the ratio 2:3 and lengths in the ratio 1:2. They are first connected in series and then in parallel to a dc source. Find out the ratio of the drift speeds of the electrons in the two wires for the two cases. 3
- 16 A resistance $R = 4 \Omega$ is connected to one of the gaps in a meter bridge, which uses a wire of length 1m . An unknown resistance $S > 4 \Omega$ is connected in the other gap as shown in the figure. The balance point is noticed at $l\text{cm}$ from the positive end of the battery. On interchanging R and S , it is found that the balance point further shifts by 20cm (away from the end A). Neglecting the end correction calculate the value of unknown resistance 'S' used. 3



- 17 Define the term 'drift velocity' of charge carriers in a conductor. Obtain the expression for the current density in terms of relaxation time. 3

- 18 State Ampere's circuital law. Using Ampere's circuital law, obtain the expression for the magnetic field due to a long solenoid at a point inside the solenoid on its axis 3
- (OR)**
- Derive an expression for torque acting on a rectangular current carrying loop kept in a uniform magnetic field B . Indicate the direction of torque acting the loop.
- 19 (i) A narrow beam of protons and neutrons, each having the same momentum, enters a region of uniform magnetic field directed perpendicular to their direction of momentum. What would be the ratio of the circular paths described by them? 2 + 1
- (ii) An electron beam passes through a region of crossed electric and magnetic fields of strength E and B respectively. For what value of electron speed the beam will remain undeflected?
- 20 Deduce an expression for magnetic dipole moment of an electron revolving around a nucleus in a circular orbit. Indicate the direction of magnetic dipole moment? Use the expression to derive the relation between the magnetic moment of an electron moving in a circle and its related angular momentum? 3
- 21 (a) Define mutual inductance and write its S.I. Units. 1 + 2
- (b) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other
- 22 (a) What is induced emf? 1 + 2
- (b) A conducting rod of length ' l ', with one end pivoted, is rotated with a uniform angular speed ' ω ' in a vertical plane, normal to a uniform magnetic field ' B '. Deduce an expression for the emf induced in this rod.

SECTION - D

- 23 Asha's uncle was advised by his doctor to have an MRI (Magnetic resonance imaging) scan of his brain. Her uncle felt that it was too expensive and wanted to postpone it. 2 + 2
- When Asha learnt about this, she took the help of her family and when she approached the doctor, he also offered a substantial discount. She thus convinced her uncle to undergo the test to enable the doctor to know the condition of his brain. The resulting information greatly helped his doctor to treat him properly.

Based on the above paragraph, answer the following questions:

- (a) What according to you are the values displayed by Asha, her family and the doctor?
- (b) Assuming the MRI test was performed using a magnetic field of 0.1T, find the maximum and minimum values of the force that the magnetic field could exert on a proton that was moving with a speed of 10^4 m/s.

SECTION - E

- 24 (a) State Gauss theorem in electrostatics. 1 + 4
- (b) Apply this theorem to obtain the expression for the electric field at a point due to an infinitely long thin, uniformly charged straight wire of linear charge density λ Cm⁻¹.

(OR)

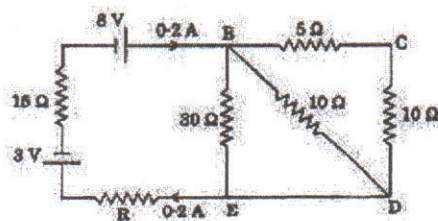
- (a) Derive an expression for the capacitance of a parallel plate capacitor when a dielectric slab of dielectric constant K thickness $t = d/2$ but of same area as that of the plates inserted between the capacitor plates ($d =$ separation between the plates).
- (b) Two concentric metallic spherical shells of radii R and 2R are given charges Q_1 and Q_2 respectively. The surface charge densities on the outer surfaces of the shells are equal.

Determine the ratio $Q_1 : Q_2$

- 25 (a) Draw circuit diagram showing balancing of wheatstone bridge. Use kirchhoff's rules to obtain the balance condition in terms of the resistances of four arms of wheatstone bridge. 3 + 2
- (b) A battery of emf 10V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5A, what is the resistance of the resistor? What is the terminal voltage of the battery when the circuit is closed?

(OR)

- (a) Draw a circuit diagram of a meter bridge and write a mathematical relation used to determine the value of unknown resistance.
- (b) Calculate the value of resistance R in the circuit shown in the fig. So that the current in the circuit is 0.2A. What would be the Potential difference between the points B and E?



26 (a) Explain with the help of a labelled diagram construction, principle and working of a cyclotron.

3 + 2

(b) Derive an expression for time period of revolution and cyclotron frequency.

(OR)

(a) State Biot-Savart law giving the mathematical expression for it.

(b) Use this law to derive the expression for the magnetic field due to circular coil carrying current at a point along its axis.

End of the Question Paper