UDAYA PUBLIC SCHOOL AYODHYA FIRST- TERM EXAMINATION 2025-26 CLASS XII PHYSICS(042)

Time : 3 Hours

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.

(2) This guestion paper has five sections: Section A, B, C, D and E.

(3) All the sections are compulsory.

(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains three long answer questions of five marks each.

(5) There is no overall choice.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

i. $c = 3 \times 10^8 \text{ m/s}$

ii. $m_e = 9.1 \times 10^{-31} \text{ kg}$

iii. e = 1.6 x 10-¹⁹ C

iv. $\mu_0 = 4\pi \times 10^{-7} \text{ Tm}A - 1$

v. h = 6.63 x10⁻³⁴ Js

vi. $\varepsilon_0 = 8.854 \times 10^{-12} C 2N - 1m - 2$

vii. Avogadro's number = 6.023 X 10²³ per gram mole

SECTION - A

Q1.A charge Q is placed at the centre of the cube. The electric flux through one of its face is (a)Q/ ε_0 (b) Q/ $6\epsilon_0$ (c) Q/ $8\epsilon_0$ (d) Q/ $3\varepsilon_0$ Q2.Gauss's law is valid for (a) Any closed surface (b) only regular closed surface (c) Any open surface (d)Only regular open surface Q3.A parallel plate air capacitor has a capacitance C. When it is half filled with a dielectric of dielectric constant 5, the percentage increase in the capacitance will be (a) 400% (b)66.6% (c) 33.3% (d)200% Q4. The angle between the electric field lines of force and the equipotential surface is (a) 0⁰ (c) 90⁰ (d) 180⁰ (b) 45⁰ Q5. Two point charges placed in a medium of dielectric constant 5 are at a distance r between them experience a electrostatic force F. The electrostatic force between them in vacuum at the same distance r will be (a) 5 F (b) F (c) F/2 (d) F/5

Q6. Which quantity is a vector quantity among the following?

(a) Electric Flux (b) Electric Charge (c) Electric Field (d) Electric Potential

Q7.Two parallel large thin metal sheets have equal surface densities 26.4 x 10⁻¹² C/m² of opposite signs. The electric field between these sheets is

(b) 1.5 x 10⁻¹⁶ N/C (c) 3 x 10⁻¹⁰ N/C (d) 3 N/C (a) 1.5 N/C

Q8. Which of the following is not the property of equipotential surface?

(a) They do not cross each other.

(b) The rate of change of potential with distance on them is zero.

- (c) For a uniform electric field, they are concentric spheres.
- (d) They can be imaginary spheres.

Q9.An electric dipole of moment p is placed parallel to the uniform electric field. The amount of work done in rotating the dipole by 90° is

(a) 2pE (c) pE/2 (d) Zero (b) pE

Q10. How many 1µF capacitors must be connected in parallel to store a charge of 1C with a potential of 110 V across the capacitors

(a) 990	(b) 900	(c) 9090	(d) 909
Q11.What is the angle between electric field and equipotential surface?			
(a) 90º always	(b) 0 ⁰ always	(c) 0 ⁰ to 90 ⁰	(d) 0 ⁰ to 180 ⁰
Q12.Electric field and electric potential inside a charged spherical shell are			
(a)E=0, V=0	(b) E=0, V≠ 0	(c) E ≠ 0, V=0	(d) E ≠ 0, V ≠ 0

MM: 70

question numbers **13,14,15** and **16** two statements are given one labelled **Assertion (A)** and the other 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.

Q13. Assertion (A): Net Electric field inside a conductor is zero.

- **Reason** (R):Total positive charge equals to total negative charge in a charged conductor.
- Q14. Assertion (A): Lines of force are perpendicular to conductor surface.
- **Reason** (R): Generally electric field is perpendicular to equipotential surface.
- **Q15**. **Assertion** (A): Electric potential of earth is taken zero.
- **Reason** (R): No electric field exists on earth surface.
- Q16. Assertion (A): Work done in moving a charge around a closed path, in an electric field, is always zero.
 Reason (R): Electrostatic force is a conservative force.

SECTION-B

Q17.Write coulomb's Law in vector form.

Q18.A slab of material of dielectric constant K has the same area as the plate of parallel plate capacitor, but has a thickness 3d/4. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric. **Q19**. An electric dipole is free to move in a uniform electric field. Explain its motion when it is placed (i) parallel to the field , and (ii) perpendicular to the field.

Q20. Define dielectric constant in terms of forces between two charges.

Q21. Name the physical quantity whose S.I. unit is JC⁻¹. Is it a scalar or a vector quantity? Define that quantity? **SECTION -C**

Q22. Derive the expression for electric field due to an infinite line of charge using Gauss's law.

Q23. Derive an expression for the electric potential at any general point at a distance r from the centre of dipole.

Q24. Derive the formula for energy stored in a capacitor.

- **Q25**. A capacitor is charged and then disconnected from the battery. A dielectric is inserted between the plates. Explain what happens to potential, capacitance and energy.
- **Q26.** Explain the concept of electric potential energy for a system of two-point charges.
- **Q27.**A regular hexagon of side 10 cm has a charge of 5 micro coulomb at each of it vertices .calculate the potential at the vertices of hexagon.
- **Q28**. Derive the expression for the electric field intensity due to an electric dipole in equatorial position.

SECTION- D

Case Study Based Questions

Q29. Read the following paragraph and answer any four questions that follow.

Smallest charge that can exist in nature is the charge of an electron. During friction it is only the transfer of electron which makes the body charged. Hence net charge on any body is an integral multiple of charge of an electron $(1.6 \times 10^{-19} \text{ C})$ i.e., q=±ne

where r= 1, 2, 3, 4

Hence no body can have a charge represented as 1.8e, 2.7e, 2e/5, etc.

Recently, it has been discovered that elementary particles such as protons or neutrons are elemental units called quarks.

(i) Which of the following properties is not satisfied by an electric charge?

(a) Total charge conservation. (b) Quantization of charge.

(c) Two types of charge. (d) Circular line of force.

(ii) Which one of the following charges is possible?

(a) 5.8×10^{-18} C (b) 3.2×10^{-18} C (c) 4.5×10^{-19} C (d) 8.6×10^{-19} C

(iii) If a charge on a body is 1 nC, then how many electrons are present on the body?

(a) 6.25×10^{27} (b) 1.6×10^{19} (c) 6.25×10^{28} (d) 6.25×10^{9}

(iv) If a body gives out 10⁹ electrons every second, how much time is required to get a total charge of 1 from it? (a) 190.19 years (b) 150.12 years (c) 198.19 years(d) 188.21 years

(v) A polythene piece rubbed with wool is found to have a negative charge of 3.2×10^{-7} C. Calculate the number of electrons transferred.

(a) 2×10^{12} (b) 3×10^{12} (c) 2×10^{14} (d) 3×10^{14}

Q30. Read the following paragraph and answer any four guestions that follow.

Electric field strength is proportional to the density of lines of force i.e., electric field strength at a point is proportional to the number of lines of force cutting a unit area element placed normal to the field at that point. As illustrated in given figure, the electric field at P is stronger than at Q.



(i) Electric lines of force about a positive point charge are

- (a) Radially outwards (b) Circular clockwise (c) Radially inwards (d) Parallel straight lines
- (ii) Which of the following is false for electric lines of force?
- (a) They always start from positive charge and terminate on negative charges.
- (b) They are always perpendicular to the surface of a charged conductor.
- (c) They always form closed loops.
- (d) They are parallel and equally spaced in a region of uniform electric field.
- (iii) Which one of the following patterns of electric line of force is not possible in field due to stationary charges?



(iv) Electric field lines are curved

(a) in the field of a single positive or negative charge (c) in the field of two like charges.

(b) in the field of two equal and opposite charges. (d) both (b) and (c)

(v) The figure below shows the electric field lines due to two positive charges. The magnitudes E_A, E_B and E_C of the electric fields at point A, B and C respectively are related as:



(a) $E_A > E_B > E_C$

(b) $E_B > E_A > E_C$

(d) $E_A > E_B = E_C$

SECTION-E

31. Derive the expression for the electric field due to a uniformly charged spherical shell. Discuss the field inside and outside the shell also draw graph.

(c) $E_A = E_B > E_C$

32. Explain the working of a parallel plate capacitor with dielectric slab. derive its capacitance. What is the effect of inserting a dielectric slab fully between the plates?

OR

Two tiny spheres carrying charges 15μ C and 25μ C are located 30 cm apart.

Find the potential and electric field:

(a) At the midpoint of the line joining the two charges, and

(b) At a point 10 cm from this midpoint in a plane normal to the line and passing through the midpoint.

33. Use Gauss's law to derive the electric field due to a uniformly charged infinite plane sheet. Also discuss its dependence on distance.