# INDIAN SCHOOL SOHAR
## UNIT TEST- 2015
## PHYSICS – THEORY

**CLASS:XII** **MARKS:50**
**DATE: 12 /5/15** **TIME: 2hrs**

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**General Instructions**:

1. All questions are compulsory.
2. There are 18 questions in all .Questions 1 to 3 carry one mark each, questions 4 to 7 carry two marks each, questions 8 to 15 carry three marks each and questions 16 to 18 carry five marks each.
3. There is no overall choice. However, internal choice has been provided in one question of two marks, one question of three marks and one question of five marks each. You have to attempt only one of the given choices in such questions
4. Use of calculator is not permitted.
5. You may use the following physical constants wherever necessary

C= 3X $10^8$ m/s  h= 6.626 X$10^{-34}$ Js  e =1.6X $10^{-19}$ c

$\frac{1}{4\pi\varepsilon o}$ =9 X $10^9$ $Nm^2/c^2$  $N_A$= 6.023 X$10^{23}$/mol

Mass of proton=1.676 X $10^{-27}$ kg  Mass of neutron=1.675 X $10^{-27}$ kg

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1. A point charge Q is placed at a point O as shown in the figure. Is the potential difference $V_A - V_B$ positive, negative or zero, if Q is (i) positive (ii) negative ? (1)

•Q----------•A----------•-B

2. If the radius of the Gaussian surface enclosing a charge is halved, how does the electric flux through the Gaussian surface change ? (1)

3. Define resistivity of a conductor . Write its S.I. unit. (1)

4. Derive an expression for the potential energy of an electric dipole of dipole moment **P** in an electric field **E.** (2)

5. Plot a graph showing the variation of coulomb force (F) versus $(\frac{1}{r^2})$ where r is the distance between the two charges of each pair of charges :( 1μC,2 μC) and ( 2 μC,-3 μC). Interpret the graphs obtained. (2)

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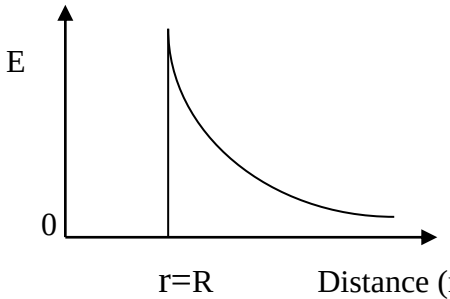
6.



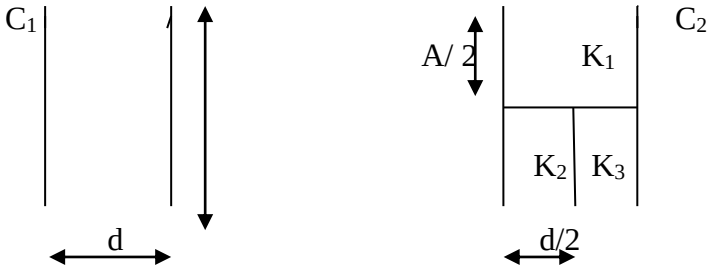
Graph shows the variation of electric field with distance of a uniformly charged conductor. Identify the charged conductor. Derive an expression for the electric field due to this charged conductor at a distance r >R. (2)

7. (i) Can two equi-potential surfaces intersect each other? Give reasons.

(ii) Two charges −q and +q are located at points A (0, 0, −a) and B (0, 0, +a) respectively. How much work is done in moving a test charge from point P (7, 0, 0) to Q (−3, 0, 0)?

**OR**

7. Two identical parallel plates (air) capacitors $C_1$ and $C_2$ have capacitances C each with cross sectional area A. The space between their plates is now filled with dielectrics as shown. If the two capacitors still have equal capacitance, obtain the relation between dielectric constants K, $K_1$ ,$K_2$and $K_3$



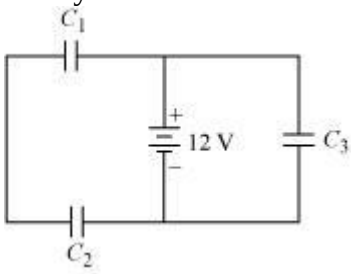

(2)

8 . (a) Depict the equipotential surfaces for a system of two identical positive point charges placed a distance 'd' apart.

(b) Deduce the expression for the potential energy of a system of two point charges $q_1$ and $q_2$ brought from infinity to the points $\vec{r_1}$ and $\vec{r_2}$ respectively in the presence of external electric field $\vec{E}$. (3)

9. Define drift velocity. Derive its relationship with relaxation time in terms of the electric field **E** applied to a conductor. A potential difference V is applied to a conductor of length L. How is the drift velocity affected when V is doubled and L is halved? (3)

10. Three identical capacitors $C_1$, $C_2$ and $C_3$ of capacitance 6 μF each are connected to a 12 V battery as shown.




Find

(i) charge on each capacitor

(ii) equivalent capacitance of the network

(iii) energy stored in the network of capacitors

**OR**

10.The two plates of a parallel plate capacitor are 4mm apart. A slab of dielectric constant 3 and thickness 3mm is introduced between the plates with its faces parallel to them. The distance between the plates is so adjusted that the capacitance of the capacitor becomes 2/3 of its original value. What is the new distance between the plates. (3)

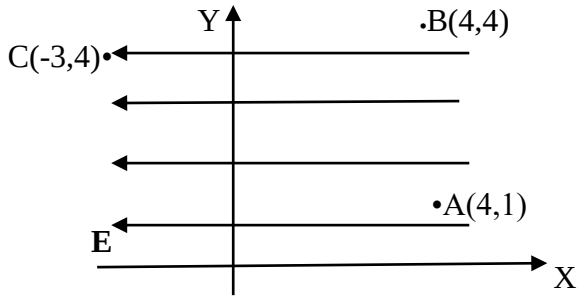
11. State Gauss's law in electrostatics. Use this law to derive an expression for the electric field due to an infinitely long straight wire of linear density $\lambda$ C/m. (3)

12. Define the term electric dipole moment. Is it a scalar or a vector ? Deduce an expression for the potential at a point on the equatorial plane of an electric dipole of length 2a. (3)

13. Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons .Hence discuss the behaviour of a semiconductor with the increase in temperature. (3)

14.Four point charges 2μC,-5 μC,2 μC,-5 μC are located at the four corners of a square ABCD respectively of side 10cm. What is the force on a charge of 1 μC placed at the centre of the square. (3)

15. A uniform electric field **E** of 300 N/C is directed along negative X-axis. A,B and C are three points are three points in the field, having x and y coordinates as shown. Find the potential differences $\Delta V_{BA}$, $\Delta V_{CB}$ and $\Delta V_{CA}$.




(3)

16. Derive an expression for the energy stored in a parallel plate capacitor.
On charging a parallel plate capacitor to a potential *V*, the spacing between the plates is halved, and a dielectric medium of $\epsilon_r = 10$ is introduced between the plates, without disconnecting the d.c source. Explain, using suitable expressions, how the (i) capacitance, (ii) electric field and (iii) energy density of the capacitor charge.

**OR**

16. (a) Using Gauss' law, derive an expression for the electric field intensity at any point on a thin sheet with charge density $\sigma$ C/m$^2$. Draw the field lines when the charge density of the sphere is (i) positive, (ii) negative.
(b) A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100 μC/m$^2$. Calculate the
(i) Charge on the sphere
(ii) Total electric flux passing through the sphere. (5)

17.(a) Show that if we connect the smaller and the outer sphere by a wire,the charge q on the former will always flow to the later, independent of how large the charge Q is.
(b) A Van de Graaff type generator is capable of building up potential difference of $15 \times 10^6$ V. The dielectric strength of the gas surrounding the electrode is $5 \times 10^7$ V/m. What is the minimum radius of the spherical shell required? (5)

18. (a)A dielectric slab of thickness 't' is kept in between the plates, each of area 'A', of a parallel plate capacitor separated by a distance ,d. Derive an expression for the capacitance of this capacitor for $t \ll d$.
(b) Two charges $5\times 10^{-8}$μC and $-3\times 10^{-8}$ μC are located 16cm apart, at what point on the line joining the two charges is the electric potential zero. (5)