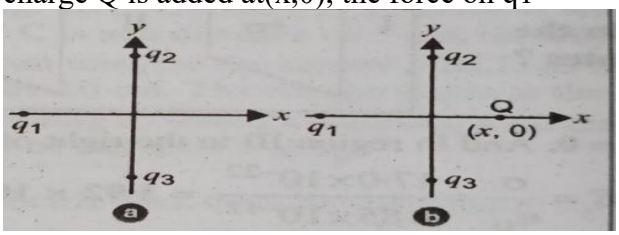
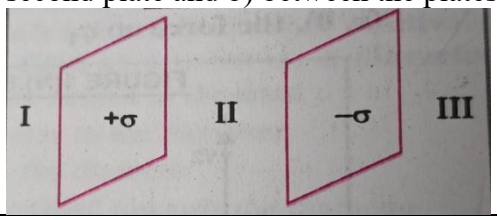
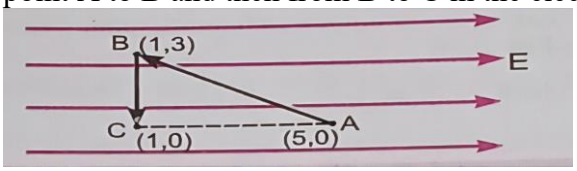
OSDAV Public School,Kaithal
First Unit Test (May,2024) **Set -B**
Class : XII
Subject : PHYSICS

Time: 1 hr **M.M.:30**

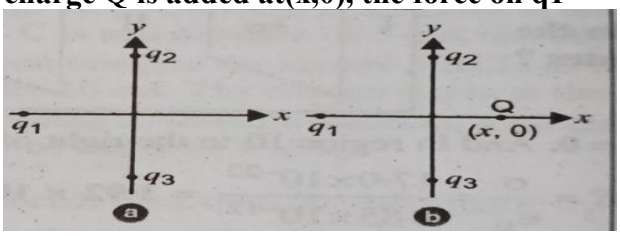
Q.No.	Questions	Marks
	SECTION – A	
1	Two point charges –q and +q are placed at distance L. The magnitude of electric potential at distance R (R>>L) varies as a) $1/R^2$ b) $1/R^3$ c) $1/R^4$ d) None of these	**1**
2	In the given figure, two positive charges q_2 and q_3 fixed along the y axis, exert 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 q1  a) shall increase along the positive x axis b) shall decrease along the positive x axis c) shall point along the negative x axis d) shall increase but the direction changes because of intersection of Q with q2 and q3	**1**
3	A square sheet of side 'a' is lying parallel to XY plane at z = a. The electric field in the region is $\vec{E} = cz\,\hat{k}$. The electric flux through the sheet is a) $ca^3/2$ b) ca^3 c)a^4c d) $a^4c/2$	**1**
4	The electric potential on the axis of an electric dipole at distance r from its centre is V. Then the potential at a point at the same distance on its equatorial line will be a) 2V b)V/2 c)-V d) zero	**1**
5	An electric dipole of dipole moment 4×10^{-5}Cm kept in a uniform electric field of 10^{-3}N/C experiences a Torque of 2×10^{-8}Nm. The angle which the dipole makes with the electric field is a) 30° b) 45° c) 60° d) 90°	**1**
6	Assertion: The surface charge densities of two spherical conductors of different radii are equal. Then the electric field intensities near their surface are also equal. Reason: Surface charge density is equal to charge per unit volume. (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	**1**
7	Assertion: A negative charge in an electric field moves along the direction of electric field. Reason: On a negative charge a force acts in the direction of electric field. (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	**1**
	SECTION –B	
8	An arbitrary surface encloses a dipole. What is the electric flux through this surface. Will the answer change on increasing or decreasing the charge on dipole.	**2**

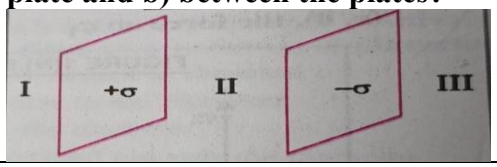
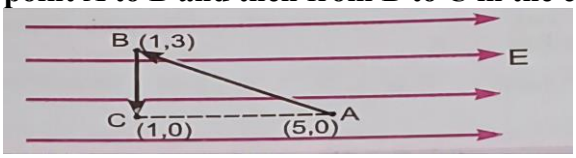
9	Two large thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and magnitude 17 x 10^{-22}C/m^2.What will be the value of electric field a) in outer region of first plate and second plate and b) between the plates? 	**2**
10	Two identical point charges, q each, are kept 2m apart in the air. A third point charge Q of unknown magnitude and sign is placed on line joining the charges such that the system remains in equilibrium. Find the position and nature of Q.	**2**
11	A test charge q is moved without acceleration from A to C along the path from the point A to B and then from B to C in the electric field as shown in figure.  i) Calculate the potential difference between A and C. ii) At which point (of the two) is the electric potential more and why.	**2**
	SECTION - C	
12	Find expression for electric potential at any point due to electric dipole.	**3**
13	Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle 30° with each other. When suspended in a liquid of density 800 kg/m^3,the angle remains the same. What is the dielectric constant of the liquid? The density of material of the sphere is 1600 kg/m^3.	**3**
	SECTION - D	
14	Coulomb's law states that the electrostatic force of attraction or repulsion acting between two stationary points charges is given by $F = \frac{q1q2}{4\pi\varepsilon.r^2}$ Where F denotes the force between two charges q1 and q2 separated by distance r in free space. i) In coulomb's law, $F = kq1q2/r^2$, then on which of the following factors does the proportionality constant k depends? a) Electrostatic force acting between two charges b) Nature of medium between two charges c) Magnitude of two charges d) Distance between two charges ii) Dimensional formula for the permittivity constant is a) $[M^{-1}L^3T^2A^2]$ b) $[ML^{-3}T^2A^2]$ c) $[M^{-1}L^{-3}T^4A^2]$ d) none of these iii) The force of repulsion between two charges of 1C each, kept 1m apart in vacuum is a) $1/(9x10^9)$N b) $9x10^9$ N c) $9x10^{-9}$ N d) none of these iv) Two identical charges repel each other with a force equal to 10mg wt. When they are 0.6 m apart in the air.($g = 10m/s^2$). The value of each charge is a) 2mC b) 2uC c) 2×10^{-7} C d) none of these	**4**
	SECTION - E	
15	Using Gauss law, deduce the expression for the electric field due to uniformly charged hollow sphere of radius R at a point a) outside the shell b) at the surface of the shell and c) inside the shell. Also draw a graph showing the variation of electric field intensity with distance r from centre of the sphere.	**5**

First Unit Test (May,2024
Class : XII
Subject : PHYSICS

SET- A

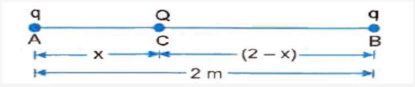
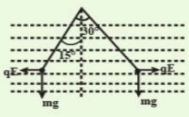
Time: 1 hr **M.M.:30**

Q.N.	Questions	Marks
	SECTION – A	
1	**Two point charges –q and +q are placed at distance L. The magnitude of electric field intensity at distance R (R>>L) varies as** **a) $1/R^2$ b) $1/R^3$ c) $1/R^4$ d) None of these**	1
2	**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 q1**  **a) shall increase along the positive x axis** **b) shall decrease along the positive x axis** **c) shall point along the negative x axis** **d) shall increase but the direction changes because of intersection of Q with q2 and q3**	1
3	**A square sheet of side 'a' is lying parallel to XY plane at z = a. The electric field in the region is $\vec{E} = cz^2\,\hat{k}$. The electric flux through the sheet is** **a) $ca^3/2$ b) zero c)a^4c d) $a^4c/2$**	1
4	**The electric potential on the axis of an electric dipole at distance r from its centre is V. Then the potential at a point at the same distance on its equatorial line will be:- a) 2V b)V/2 c)-V d) zero**	1
5	**An electric dipole of dipole moment 4 x 10^{-5}Cm kept in a uniform electric field of 10^{-3}N/C experiences a Torque of 2 x 10^{-8}Nm. The angle which the dipole makes with the electric field is :- a) 30° b) 45° c) 60° d) 90°**	1
6	**Assertion: The surface charge densities of two spherical conductors of different radii are equal. Then the electric field intensities near their surface are also equal.** **Reason: Surface charge density is equal to charge per unit volume.** **(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**	1
7	**Assertion: A negative charge in an electric field moves along the direction of electric field.** **Reason: On a negative charge a force acts in the direction of electric field.** **(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**	1
	SECTION –B	
8	**An arbitrary surface encloses a dipole. What is the electric flux through this surface. Will the answer change on increasing or decreasing the charge on dipole.**	2
9	**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 magnitude 17 x 10^{-}**	2

	^{22}C/m^2.What will be the value of electric field a) in outer region of first plate and second plate and b) between the plates? 	
10	**Two identical point charges, q each, are kept 2m apart in the air. A third point charge Q of unknown magnitude and sign is placed on line joining the charges such that the system remains in equilibrium. Find the position and nature of Q.**	**2**
11	**A test charge q is moved without acceleration from A to C along the path from the point A to B and then from B to C in the electric field as shown in figure.**  **i) Calculate the potential difference between A and C.** **ii) At which point (of the two) is the electric potential more and why.**	**2**
	SECTION - C	
12	**a) An electric dipole is held in uniform electric field. Using suitable diagram show that it does not undergo any translation motion. Derive the expression for the torque acting on it.** **b) What would happen if the field is non uniform?**	**3**
13	**Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle 30° with each other. When suspended in a liquid of density 800 kg/m^3,the angle remains the same. What is the dielectric constant of the liquid? The density of material of the sphere is 1600 kg/m^3.**	**3**
	SECTION - D	
14	**Coulomb's law states that the electrostatic force of attraction or repulsion acting between two stationary points charges is given by** $F = \frac{q1q2}{4\pi\varepsilon.r^2}$ **Where F denotes the force between two charges q1 and q2 separated by distance r in free space.** **i) In coulomb's law, F = kq1q2/r^2, then on which of the following factors does the proportionality constant k depends?** **a) Electrostatic force acting between two charges** **b) Nature of medium between two charges** **c) Magnitude of two charges** **d) Distance between two charges** **ii) Dimensional formula for the permittivity constant is** **a) [M^{-1}L^{3}T^{2}A^2] b) [ML^{-3}T^{2}A^2] c) [M^{-1}L^{-3}T^{4}A^2] d) none of these** **iii) The force of repulsion between two charges of 1C each, kept 1m apart in vacuum is** **a) 1/(9x10^9)N b) 9x10^9 N c) 9x10 $^{-9}$ N d) none of these** **iv) Two identical charges repel each other with a force equal to 10mg wt. When they are 0.6 m apart in the air.(g = 10m/s^2). The value of each charge is** **a) 2mC b) 2uC c) 2 x 10 $^{-7}$ C d) none of these**	**4**
	SECTION - E	
15	**Using Gauss law, deduce the expression for the electric field due to uniformly charged hollow sphere of radius R at a point a) outside the shell b) at the surface of the shell and c) inside the shell. Also draw a graph showing the variation of electric field intensity with distance r from centre of the sphere.**	**5**

OSDAV Public School Kaithal
Marking Scheme
Physics - XII
Set - A

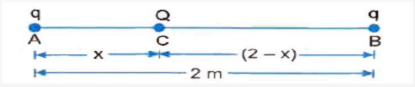
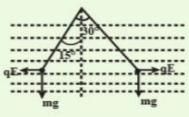
1	B	1
2	A	1
3	C	1
4	D	1
5	A	1
6	C	1
7	D	1
8	Electric flux through this surface is zero as positive and negative charge cancel out each other. No the answer will not change on increasing or decreasing the charge on dipole.	1 1
9	a) In the outer region of first and second plate , the electric field will be zero. The figure shows the two plates, plate A and plate B are placed parallel to each other. Region I and region III are the outer region of the plate and region II is the inner region of the plate. Let σ A and σ B be the charge density of the plate A and plate B respectively and the charge density on plate A is positive. Here, σ A =17× 10 −22 C/ m 2 σ B =−17× 10 −22 C/ m 2 In the outer region of plate A that is region I, there is no charge enclosed by plate A. Thus, the intensity of electric field is zero in the outer region of plate A. b) In the outer region of plate B that is region III, there is no charge enclosed by plate B. Thus, the intensity of electric field is zero in the outer region of plate B. c) The electric field in the region II is given as, E= σ ε 0 Where, the surface charge density is σ. The ε 0 be the permittivity of free space, ε 0 =8.854× 10 −12 C 2 / Nm 2 By substituting the given values in the above equation, we get E= 17× 10 −22 8.854× 10 −12 =1.92× 10 −10 N/C Thus, the magnitude of electric field between the plates is 1.92× 10 −10 N/C . b)	0.5 0.5 1

10	For equilibrium of system the net force on any charges must be zero. Considering net force on charge Q, we have $\overrightarrow{F_{CA}} + \overrightarrow{F_{CB}} = \vec{0}$ or $\left\|\overrightarrow{F_{CA}}\right\| = \left\|\overrightarrow{F_{CB}}\right\|$ $\therefore \quad \frac{1}{4\pi \in_0}\frac{qQ}{x^2} = \frac{1}{4\pi \in_0}\cdot\frac{qQ}{(2-x)^2}$ $\Rightarrow \quad x = 2 - x \text{ or } x = 1m$ Again considering net force on charge q situated at point A, we have $\overrightarrow{F_{AC}} + \overrightarrow{F_{AB}} = \vec{0}$ $\Rightarrow \quad \frac{1}{4\pi \in_0}\cdot\frac{qQ}{(1)^2} + \frac{1}{4\pi \in_0}\cdot\frac{q^2}{(2)^2} = 0$ $\Rightarrow \quad Q + \frac{q}{4} = 0 \text{ or } Q = -\frac{q}{4}$ 	0.5 0.5 0.5 0.5
11	i) Potential difference = E d = E (5 -1) = 4E ii) Electric potential is more at point C because electric field moves in the direction of decreasing potential.	1 1
12	a) Derivation b) It will also exhibit translational motion.	2 1
13	From fig, $\tan\theta = qE/mg$ $\tan 15^0 = \frac{kq^2}{d^2 mg}$ $\tan 15^0 = \frac{kq^2}{1.6V\,gd^2}$.....[v is the volume].....(1) When system is suspended in liquid, $\tan 15^0 = \frac{kq^2}{K(mg - \rho V g)d^2}$ $\tan 15^0 = \frac{kq^2}{K(1.6 - 0.8)V\,gd^2}$.....(2) from (1) and (2) we get, $\frac{kq^2}{K(1.6 - 0.8)V\,gd^2} = \frac{kq^2}{1.6V\,gd^2}$ $\therefore$ K = 2 =Dielectric constant of liquid. 	1 0.5 0.5 0.5 0.5

14	i) b ii) c iii) b iv) d	1 1 1 1
15	Derivation only	5

OSDAV Public School Kaithal
Marking Scheme
Physics - XII
Set - B

1	A	1
2	A	1
3	B	1
4	D	1
5	A	1
6	C	1
7	D	1
8	Electric flux through this surface is zero as positive and negative charge cancel out each other. No the answer will not change on increasing or decreasing the charge on dipole.	1 1
9	a) In the outer region of first and second plate , the electric field will be zero. b) The figure shows the two plates, plate A and plate B are placed parallel to each other. Region I and region III are the outer region of the plate and region II is the inner region of the plate. Let σ A and σ B be the charge density of the plate A and plate B respectively and the charge density on plate A is positive. Here, σ A =17× 10 −22 C/ m 2 σ B =−17× 10 −22 C/ m 2 In the outer region of plate A that is region I, there is no charge enclosed by plate A. Thus, the intensity of electric field is zero in the outer region of plate A. b) In the outer region of plate B that is region III, there is no charge enclosed by plate B. Thus, the intensity of electric field is zero in the outer region of plate B. c) The electric field in the region II is given as, E= σ ε 0 Where, the surface charge density is σ. The ε 0 be the permittivity of free space, ε 0 =8.854× 10 −12 C 2 / Nm 2 By substituting the given values in the above equation, we get E= 17× 10 −22 8.854× 10 −12 =1.92× 10 −10 N/C Thus, the magnitude of electric field between the plates is 1.92× 10 −10 N/C .	0.5 0.5 1

10	For equilibrium of system the net force on any charges must be zero. Considering net force on charge Q, we have $\overrightarrow{F_{CA}} + \overrightarrow{F_{CB}} = \vec{0}$ or $\left\|\overrightarrow{F_{CA}}\right\| = \left\|\overrightarrow{F_{CB}}\right\|$ $\therefore \quad \frac{1}{4\pi \in_0}\frac{qQ}{x^2} = \frac{1}{4\pi \in_0}\cdot\frac{qQ}{(2-x)^2}$ $\Rightarrow \quad x = 2 - x \text{ or } x = 1m$ Again considering net force on charge q situated at point A, we have $\overrightarrow{F_{AC}} + \overrightarrow{F_{AB}} = \vec{0}$ $\Rightarrow \quad \frac{1}{4\pi \in_0}\cdot\frac{qQ}{(1)^2} + \frac{1}{4\pi \in_0}\cdot\frac{q^2}{(2)^2} = 0$ $\Rightarrow \quad Q + \frac{q}{4} = 0 \text{ or } Q = -\frac{q}{4}$ 	0.5 0.5 0.5 0.5
11	i) Potential difference = E d = E (5 -1) = 4E ii) Electric potential is more at point C because electric field moves in the direction of decreasing potential.	1 1
12	a) Derivation b) It will also exhibit translational motion.	2 1
13	From fig, $\tan\theta = qE/mg$ $\tan 15^0 = \frac{kq^2}{d^2 mg}$ $\tan 15^0 = \frac{kq^2}{1.6V\,gd^2}$.....[v is the volume].....(1) When system is suspended in liquid, $\tan 15^0 = \frac{kq^2}{K(mg - \rho V g)d^2}$ $\tan 15^0 = \frac{kq^2}{K(1.6 - 0.8)V\,gd^2}$.....(2) from (1) and (2) we get, $\frac{kq^2}{K(1.6 - 0.8)V\,gd^2} = \frac{kq^2}{1.6V\,gd^2}$ $\therefore$ K = 2 =Dielectric constant of liquid. 	1 0.5 0.5 0.5 0.5

14	i) b ii) c iii) b iv) d	1 1 1 1
15	Derivation only	5