O.S.D.A.V Public School, Kaithal
May Unit Test ,2025 - 26
SET - A
Class : XII
Subject : PHYSICS

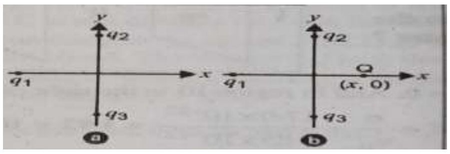
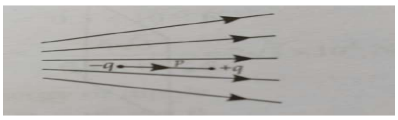
Time: 1 hr 30 min. **M.M.:35**

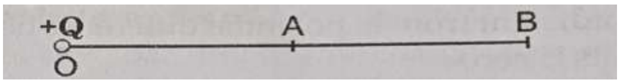
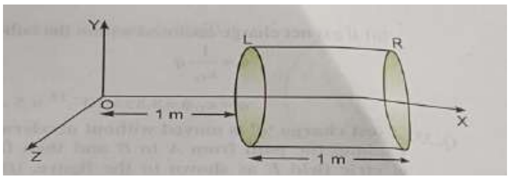
General Instructions:-

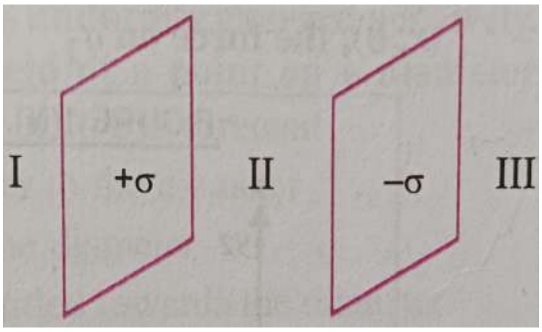
I. **There are 17 questions in all. All questions are compulsory.**

II. **This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.**

III. **Section A contains seven MCQ of one mark each, Section B contains five questions of two marks each, Section C contains three questions of three marks each, section D contains case study based questions of 4 marks and section E contains one long questions of five marks .**

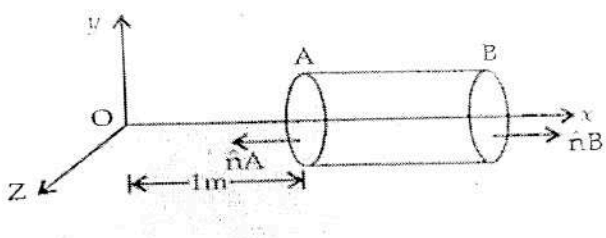
Q. No.	**Questions**	**Marks**
	SECTION – A	
1	The electric potential on the axis of an electric dipole at distance r from its centre is V. Then the potential at a point at the same distance on its equatorial line will be a) 2V b)V/2 c)-V d) zero	**1**
2	In the given figure, two positive charges q_2 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 q_1  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 q_2 and q_3.	**1**
3	A charge q is placed at one of the corner of a cube. The electric flux passing through any one of its face is a) $q/6\varepsilon_0$ b) $q/8\varepsilon_0$ c) $q/24\varepsilon_0$ d) none of these	**1**
4	A charge Q is placed at the centre of the line joining two charges q and q. The system of three charges will be in equilibrium if Q is a) +q/3 b) -q/3 c) +q/4 d) -q/4	**1**
5	Figure given shows electric field lines in which an electric dipole $\vec{p}$ is placed as shown.Which of the following statement is correct?  a) The dipole will not experience any force b) The dipole will experience a force towards right c) The dipole will experience a force towards left d) The dipole will experience a force upwards	**1**

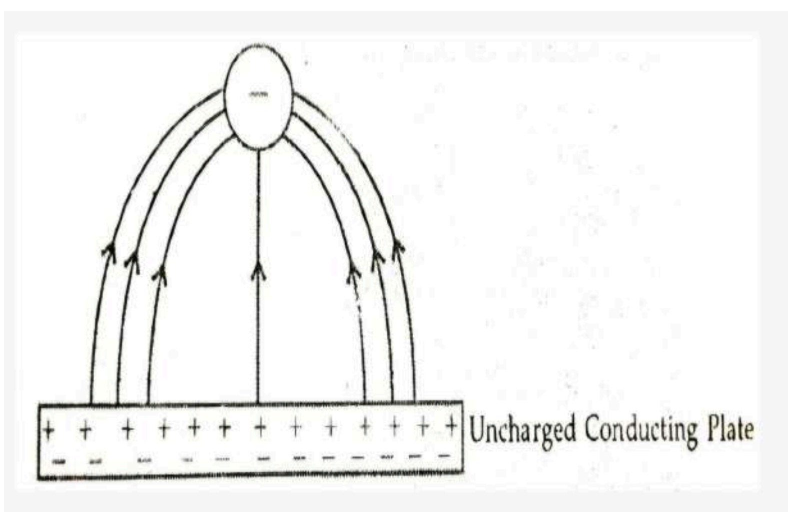
6	Assertion (A): A system of three positive charges, each having a charge q and placed equally distant from each other along a straight line can not be in equilibrium. Reason (R) : The charge in the middle experience zero net force, but the force on other charges is not zero. (a) Both A and R are true 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) : A parallel plate capacitor is connected across battery through a key. A dielectric slab of dielectric constant K is introduced between the plates. The energy which is stored becomes K times. Reason (R) : The surface density of charge on the plate remains constant or unchanged. (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	Why should electrostatic field be zero inside the conductor? Also explain why presence of dielectric increases capacitance of capacitor.	**2**
9	What will be the ratio of the surface charge density of the inner surface to that of the outer surface of a hollow conducting sphere if a point charge is placed at the centre of the hollow conducting sphere having internal radius 'r 'and outer radius '2r'?	**2**
10	Derive an expression for capacitance of a parallel plate capacitor when a dielectric slab partially fills the space between the plates.	**2**
11	a) Show that there is no work done in moving a charge from one point to another on an equipotential surface. b) A point charge + Q is placed at a point O as shown in figure  Is the potential difference V(A) - V(B) positive, negative or zero?	**2**
12	Two Charged conducting spheres of radii a and b are connected to each other by a wire. Find the ratio of electric fields at their surfaces.	**2**
	SECTION - C	
13	A hollow cylindrical box of length 1 m and area of cross section 25 cm^2 is placed in a 3 D coordinate system as shown in figure. The electric field in the region is given by $\vec{E} = 50x\, \hat{i}$, where E in NC^{-1} and x in metres. Find I. Net flux through the cylinder. II. Charge enclosed by the cylinder  	**3**

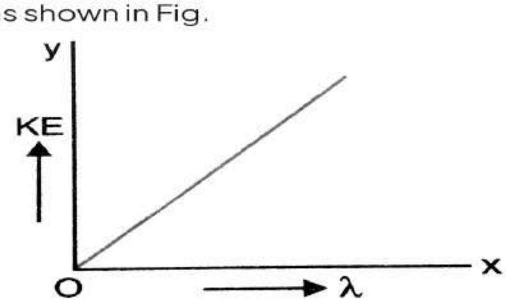
14	Two large thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and magnitude 17×10^{-22} C / m^2 What is vector E : a) in the outer region of the first plate b) in the outer region of the second plate, and c) between the plates ? 	3
15	a) Draw a pattern of electric field lines, when a point charge -Q is kept near an uncharged conducting plate. b) If potential (in volt) in a region is expressed as $V(x,y,z) = 6xy - y + 2yz$ Find the electric field (in N/C) at point (1,1,0)	1 2
	SECTION - D	
16	An electric dipole of length 0.1 m consists of two charges of + 500 uC (micro coulomb) and -500 uC (micro coulomb). It is placed in an electric field of strength 10^4 N/C along the direction of the electric field. i) The electric dipole moment of the dipole is a) 50×10^{-6} uCm b) 50×10^{-6} Cm c) 500×10^{-6} uCm d) 500×10^{-6} Cm ii) The torque acting on the electric dipole is a) 0.5 Nm ii) 5 Nm iii) 50 Nm iv) 500 Nm iii) The work done in rotating the electric dipole through an angle of 90° is a) 0.05 J b) 0.5 J c) 5 J d) 50 J iv) In case, the electric dipole was placed at an angle of 180° to an uniform electric field, the dipole will be a)not in equilibrium b) in stable equilibrium c) in unstable equilibrium d) none of these	4
	SECTION - E	
17	(a) Use Gauss' law to obtain an expression for the electric field due to an infinitely long thin straight wire with uniform linear charge density λ. (b) An infinitely long positively charged straight wire has a linear charge density λ. An electron is revolving in a circle with a constant speed v such that the wire passes through the centre and is perpendicular to the plane of the circle. Find the kinetic energy of the electron in terms of magnitudes of its charge and linear charge density λ on the wire. (c) Draw a graph of kinetic energy as a function of linear charge density λ.	2 2 1

Answer Key
Physics XII (Set - A
May Unit Test(2025-2026)

1	D	1
2	A	1
3	C	1
4	D	1
5	C	1
6	A	1
7	A	1
8	(a.)As charges resides on the surface of conductor, so electric field should be zero inside the conductor. (b.) The presence of di electric decreases the electric field which further decreases the potential, so according to formula C=q/V As the potential decreases, capacitance increases..	1 1
9	Surface charge density on inner surface $\sigma_1 = \frac{q}{4\pi r^2}$. and that on the outer surface $\sigma_2 = \frac{q}{4\pi(2r)^2} = \frac{q}{16\pi r^2} \Rightarrow \frac{\sigma_1}{\sigma_2} = \frac{4}{1}$	1 1
10	Derivation Only	2
11	a)$W/q_o = V_b - V_A$ As $V_b = V_A$ So , $W/q_o = 0$ Hence W = 0 b)V(A) - V(B) is positive as Direction Of electric field is in direction of decreasing potential by formula E = - dV/dR	 0.5 0.5 0.5 0.5

12	Let E_A be the electric field of sphere A and E_B be the electric field of sphere B. Therefore, their ratio, $\frac{E_A}{E_B} = \frac{Q_A}{4\pi \in_0 \times a_2} \times \frac{b^2 \times 4\pi \in_0}{Q_B}$ $\frac{E_A}{E_B} = \frac{Q_A}{Q_B} \times \frac{b^2}{a^2}$ ... (i) However, $\frac{Q_A}{Q_B} = \frac{C_A V}{C_B V}$ And, $\frac{C_A}{C_B} = \frac{a}{b}$ $\therefore \frac{Q_A}{Q_B} = \frac{a}{b}$ ...(2) Putting the value of (2) in (1), we obtain $\therefore \frac{E_A}{E_B} - \frac{a}{B}\frac{b^2}{a^2} = \frac{b}{a}$ Therefore, the ratio of electric fields at the surface is $\frac{b}{a}$.	0.5 0.5 0.5 0.5
13	 agnitude of electric field at cross - section A, $_A = 50 \times 1 = 50NC^{-1}$ agnitude of electric field at cross - section B, $_B = 50 \times 2 = 100NC^{-1}$ ıe corresponding electric fluxes are : $_A = \vec{E} \cdot \vec{\Delta} s = 50 \times 25 \times 10^{-4} \times \cos 180^\circ = -0.125Nm^2/C$ $_B = \vec{E} \cdot \vec{\Delta} s = 100 \times 25 \times 10^{-4} \times \cos 0^\circ = 0.25Nm^2/C$ o, the net flux through the cylinder, $= \phi_A + \phi_B = -0.125 + 0.25 = 0.125Nm^2/C$) Using Gauss's Law: $\vec{E} . \vec{ds} = \frac{q}{\varepsilon_0} \Rightarrow 0.125$ $\frac{q}{8.85 \times 10^{-12}}$ $= 8.85 \times 0.125 \times 10^{-12} = 1.1 \times 10^{12} C$.	0.5 0.5 0.5 0.5 0.5 0.5

14	Charge density of plate A, $\sigma = 17.0 \times 10^{-22} C/m^2$ Charge density of plate B, $\sigma = -17.0 \times 10^{-22} C/m^2$ In the regions, I and III, electric field E is zero. This is because charge is not enclosed by the respective plates. Electric field E in region II is given by the relation, $E = \frac{\sigma}{\epsilon_0}$ Where, ϵ_0 = Permittivity of free space = $8.854 \times 10^{-12} N^{-1} C^2 m^{-2}$ $\therefore E = \frac{17.0 \times 10^{-22}}{8.854 \times 10^{-12}}$ $= 1.92 \times 10^{-10} N/C$ Therefore, electric field between the plates is $1.92 \times 10^{-10} N/C$. Charge density outer region of both the plates is zero.	0.5 0.5 2
15	a) 	0.5 0.5

	b) Given, $V = 6xy - y + 2yz$ $\vec{E} = \left[\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right]$ $\vec{E} = -\left\{\frac{\partial}{\partial x}[6xy - y + 2yz]\hat{i} + \frac{\partial}{\partial y}[6xy - y + 2yz]\hat{j} + \frac{\partial}{dz}[6xy - y + 2yz)\hat{k}\right\}$ $= -\left\{(6y)\hat{i} + (6x - 1 + 2z)\hat{j} + (2y)\hat{k}\right\}$ $\vec{E}_{1,1,0} = -\left\{(6x1)\hat{i} + (6 \times 1 - 1 + 2 \times 0)\hat{j} + (2 \times 1)\hat{k}\right]$ $= -\left(6\hat{i} + 5\hat{j} + 2\hat{k}\right)$	0.5 0.5 0.5 0.5
16	1. B 2. None of these 3. B 4. C	1 1 1 1
17	A. Derivation only The electostatic force exerted by the infinitely long line charge provides the necessary centripetal force to the revolving electron. $\therefore eE = \frac{mv^2}{r}, but E = \frac{\lambda}{2\pi \in_0 r}$ $\frac{e\lambda}{2\pi \in_0 r} = \frac{mv^2}{r}$ or $v^2 = \frac{e\lambda}{2\pi \in_0 m}$ $KE = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{e\lambda}{2\pi \in_0 m}\right) = \frac{e\lambda}{4\pi \in_0}$ As KE $\propto \lambda$, therefore, graph of KE as a function of charge density will be a straight line as shown in Fig. B. 	2 2 1

O.S.D.A.V. Public School. Kaithal

May Unit Test ,2025-26

SET - B

Class : XII

Subject : PHYSICS

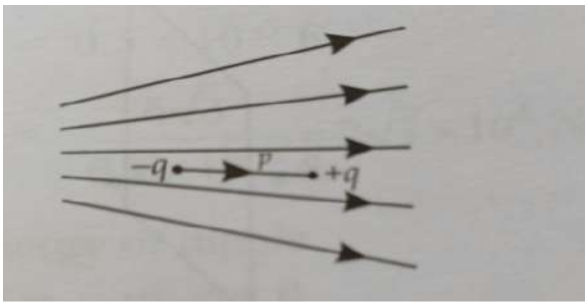
Time: 1 hr 30 min. **M.M.:35**

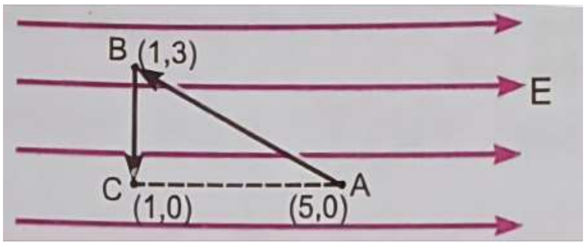
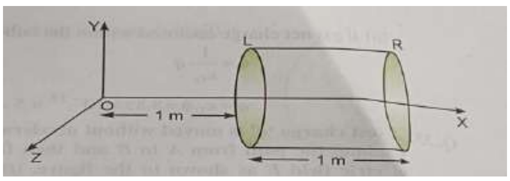
General Instructions:-

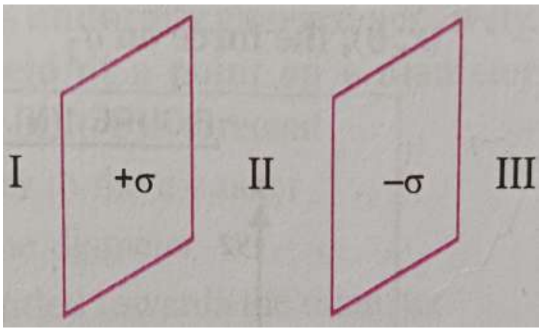
I. **There are 17 questions in all. All questions are compulsory.**

II. **This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.**

III. **Section A contains seven MCQ of one mark each, Section B contains five questions of two marks each, Section C contains three questions of three marks each, section D contains case study based questions of 4 marks and section E contains one long questions of five marks .**

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	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**
3	A charge q is placed at one of the corner of a cube. The electric flux passing through the cube is a) $q/6\varepsilon_0$ b) $q/8\varepsilon_0$ c) $q/24\varepsilon_0$ d) none of these	**1**
4	A charge Q is placed at the centre of the line joining two charges q and q. The system of three charges will be in equilibrium if Q is a) +q/3 b) -q/3 c) +q/4 d) -q/4	**1**
5	Figure given shows electric field lines in which an electric dipole $\vec{p}$ is placed as shown.Which of the following statement is correct?  a) The dipole will not experience any force b) The dipole will experience a force towards right c) The dipole will experience a force towards left d) The dipole will experience a force upwards	**1**

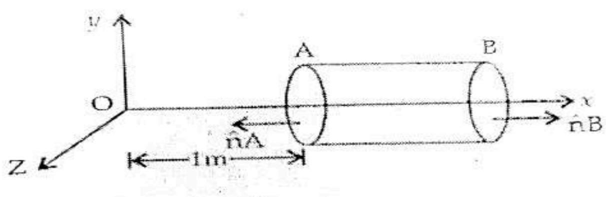
6	Assertion (A): A system of three positive charges, each having a charge q and placed equally distant from each other along a straight line can not be in equilibrium. Reason (R) : The charge in the middle experience zero net force, but the force on other charges is not zero. (a) Both A and R are true 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) : A parallel plate capacitor is connected across battery through a key. A dielectric slab of dielectric constant K is introduced between the plates. The energy which is stored becomes K times. Reason (R) : The surface density of charge on the plate remains constant or unchanged. (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	Why should electrostatic field be zero inside the conductor? Also explain why presence of dielectric increases capacitance of capacitor.	**2**
9	What will be the ratio of the surface charge density of the inner surface to that of the outer surface of a hollow conducting sphere if a point charge is placed at the centre of the hollow conducting sphere having internal radius 'r 'and outer radius '2r'?	**2**
10	Derive an expression for capacitance of a parallel plate capacitor when a dielectric slab partially fills the space between the plates.	**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**
12	Two Charged conducting spheres of radii a and b are connected to each other by a wire. Find the ratio of electric fields at their surfaces.	**2**
	SECTION - C	
13	A hollow cylindrical box of length 1 m and area of cross section 25 cm^2 is placed in a 3 D coordinate system as shown in figure. The electric field in the region is given by $\vec{E} = 50x\ \hat{i}$, where E in NC^{-1} and x in metres. Find I. Net flux through the cylinder. II. Charge enclosed by the cylinder  	**3**

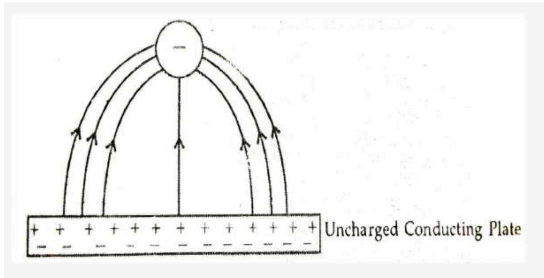
14	Two large thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and magnitude 12×10^{-23} C / m^2 What is vector E : a) in the outer region of the first plate b) in the outer region of the second plate, and c) between the plates ?  	**3**
15	a) Draw a pattern of electric field lines, when a point charge -Q is kept near an uncharged conducting plate. b) If potential (in volt) in a region is expressed as V(x,y,z) = 6xy - y + 2yz Find the electric field (in N/C) at point (1,1,0)	**1** **2**
	SECTION - D	
16	An electric dipole of length 0.1 m consists of two charges of + 500 uC (micro coulomb) and - 500 uC (micro coulomb). It is placed in an electric field of strength 10^4 N/C along the direction of the electric field. i) The electric dipole moment of the dipole is a) 50×10^{-6} uCm b) 50×10^{-6} Cm c) 500×10^{-6} uCm d) 500×10^{-6} Cm ii) The torque acting on the electric dipole is a) 0.5 Nm ii) 5 Nm iii) 50 Nm iv) 500 Nm iii) The work done in rotating the electric dipole through an angle of 90° is a) 0.05 J b) 0.5 J c) 5 J d) 50 J iv) In case, the electric dipole was placed at an angle of 180° to an uniform electric field, the dipole will be a)not in equilibrium b) in stable equilibrium c) in unstable equilibrium d) none of these	**4**
	SECTION - E	
17	(a) Use Gauss' law to show that due to a uniformly charged spherical shell of radius R, the electric field at any point situated outside the shell at a distance r from its centre is equal to the electric field at the same point, when the entire charge on the shell were concentrated at its centre. Also plot the graph showing the variation of electric field with r, for $r \leq R$ and $r \geq R$. (b) Two point charges of + 1 μC and + 4 μC are kept 30 cm apart. How far from the + 1 μC charge on the line joining the two charges, will the net electric field be zero?	**3** **2**

Answer Key
Physics XII (Set - B
May Unit Test(2025-2026)

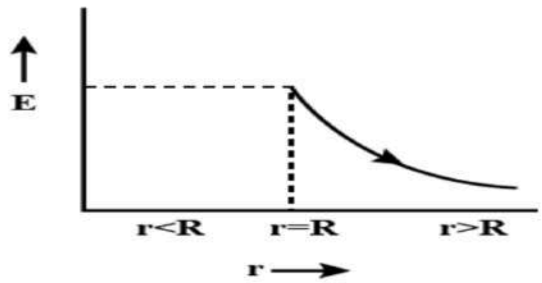
1	A	1
2	B	1
3	B	1
4	D	1
5	C	1
6	A	1
7	A	1
8	(a.)As charges resides on the surface of conductor, so electric field should be zero inside the conductor. (b.) The presence of di electric decreases the electric field which further decreases the potential, so according to formula C=q/V As the potential decreases, capacitance increases..	1 1
9	Surface charge density on inner surface $\sigma_1 = \frac{q}{4\pi r^2}$. and that on the outer surface $\sigma_2 = \frac{q}{4\pi(2r)^2} = \frac{q}{16\pi r^2} \Rightarrow \frac{\sigma_1}{\sigma_2} = \frac{4}{1}$	1 1
10	Derivation Only	2

11	The distance d between points A and C is the difference in their x-coordinates. $d = x_A - x_C = 5 - 1 = 4$ The potential difference V_{AC} is given by: $V_{AC} = -Ed$ $V_{AC} = -E(4)$ $V_{AC} = -4E$ Since the electric field is directed along the positive x-axis, the potential decreases in that direction. Point C is at a lower potential than point A. Point B and C are at the same potential because they have the same x-coordinate. Therefore, the potential at point B is equal to the potential at point C and is higher than the potential at point A. Vb= Vc>Va	0.5 0.5 0.5 0.5
12	Let E_A be the electric field of sphere A and E_B be the electric field of sphere B. Therefore, their ratio, $\frac{E_A}{E_B} = \frac{Q_A}{4\pi \in_0 \times a_2} \times \frac{b^2 \times 4\pi \in_0}{Q_B}$ $\frac{E_A}{E_B} = \frac{Q_A}{Q_B} \times \frac{b^2}{a^2} \ldots$ (i) However, $\frac{Q_A}{Q_B} = \frac{C_A V}{C_B V}$ And, $\frac{C_A}{C_B} = \frac{a}{b}$ $\therefore \frac{Q_A}{Q_B} = \frac{a}{b} \ldots(2)$ Putting the value of (2) in (1), we obtain $\therefore \frac{E_A}{E_B} - \frac{a}{B}\frac{b^2}{a^2} = \frac{b}{a}$ Therefore, the ratio of electric fields at the surface is $\frac{b}{a}$.	0.5 0.5 0.5 0.5

13	Charge density of plate A, $\sigma = 17.0 \times 10^{-22} C/m^2$ Charge density of plate B, $\sigma = -17.0 \times 10^{-22} C/m^2$ In the regions, I and III, electric field E is zero. This is because charge is not enclosed by the respective plates. Electric field E in region II is given by the relation, $E = \frac{\sigma}{\epsilon_0}$ Where, ϵ_0 = Permittivity of free space = $8.854 \times 10^{-12} N^{-1} C^2 m^{-2}$ $\therefore E = \frac{17.0 \times 10^{-22}}{8.854 \times 10^{-12}}$ $= 1.92 \times 10^{-10} N/C$ Therefore, electric field between the plates is $1.92 \times 10^{-10} N/C$.	0.5 0.5 0.5 0.5 0.5 0.5
14	 agnitude of electric field at cross - section A, $_A = 50 \times 1 = 50 NC^{-1}$ agnitude of electric field at cross - section B, $_B = 50 \times 2 = 100 NC^{-1}$ ne corresponding electric fluxes are : $_A = \vec{E} \cdot \vec{\Delta} s = 50 \times 25 \times 10^{-4} \times \cos 180^\circ = -0.125 Nm^2/C$ $_B = \vec{E} \cdot \vec{\Delta} s = 100 \times 25 \times 10^{-4} \times \cos 0^\circ = 0.25 Nm^2/C$ o, the net flux through the cylinder, $= \phi_A + \phi_B = -0.125 + 0.25 = 0.125 Nm^2/C$) Using Gauss's Law: $\vec{E} . \vec{ds} = \frac{q}{\varepsilon_0} \Rightarrow 0.125$ $: \frac{q}{8.85 \times 10^{-12}}$ $= 8.85 \times 0.125 \times 10^{-12} = 1.1 \times 10^{12} C$.	0.5 0.5 0.5 0.5 0.5 0.5

<table>
<tr><td>15</td><td>a) 

Given, $V = 6xy - y + 2yz$
$\vec{E} = \left[\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right]$
$\vec{E} = -\left\{\frac{\partial}{\partial x}[6xy - y + 2yz]\hat{i} + \frac{\partial}{\partial y}[6xy - y + 2yz]\hat{j}\right.$
$\left. + \frac{\partial}{dz}[6xy - y + 2yz)\hat{k}\right\}$
$= -\left\{(6y)\hat{i} + (6x - 1 + 2z)\hat{j} + (2y)\hat{k}\right\}$
$\vec{E}_{1,1,0} = -\left\{(6x1)\hat{i} + (6 \times 1 - 1 + 2 \times 0)\hat{j} + (2 \times 1)\hat{k}\right]$
b) $= -\left(6\hat{i} + 5\hat{j} + 2\hat{k}\right)$</td><td>0.5
0.5
0.5
0.5
0.5
0.5</td></tr>
<tr><td>16</td><td>1. B
2. None of these
3. B
4. C</td><td>1
1
1
1</td></tr>
<tr><td>17</td><td>A. Derivation only</td><td>2
1
0.5</td></tr>
</table>



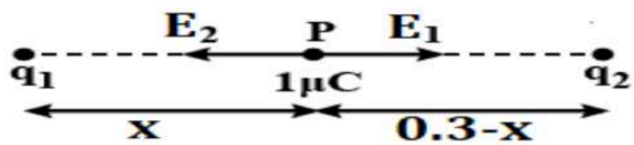
0.5

0.5

0.5

For $r < R, E = 0$ because $q = 0$ inside the shell.

(b)



$\mathrm{E}_1 = \mathrm{E}_2$

$\frac{1}{4\pi\epsilon_o}\frac{1\times10^{-6}}{x^2} = \frac{1}{4\pi\epsilon_o}\frac{4\times10^{-6}}{(0.3-x)^2}$

$(0.3 - x)^2 = 4x^2$

$0.3 - x = 2x$

B. $x = 0.1\ \mathrm{m} = 10\ \mathrm{cm}$ (to the right of q_1)