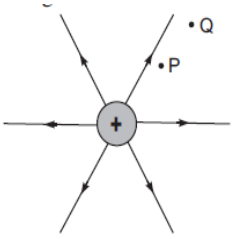
2014 F

1. *Why must electrostatic field at the surface of a charged conductor be normal to the surface at every point? Give reason.*
2. *Figure shows the field lines on a positive charge. Is the work done by the field in moving a small positive charge from **Q** to **P** positive or negative? Give reason*



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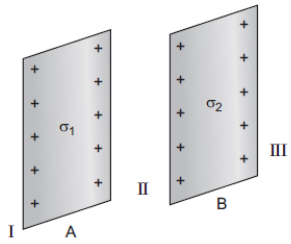
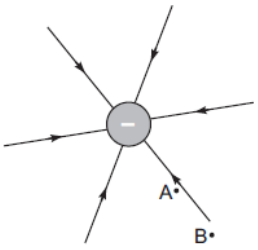
3. *(a) A point charge **(+Q)** is kept in the vicinity of uncharged conducting plate. Sketch electric field lines between the charge and the plate*
*(b) Two infinitely large plane thin parallel sheets having surface charge densities **s1** and **s2** **(s1 > s2)** are shown in the figure. Write the magnitudes and directions of the net fields in the regions marked II and III.*



4. *In a parallel plate capacitor with air between the plates, each plate has an area of **6 X 10^{-3} m^2** and the separation between the plates is **3 mm.**(i) Calculate the capacitance of the capacitor.(ii) If this capacitor is connected to **100 V** supply, what would be the charge on each plate?(iii) How would charge on the plates be affected, if a **3 mm** thick mica sheet of **K = 6** is inserted between the plates while the voltage supply remains connected?*
5. *Figure shows the field lines due to a negative point charge. Give the sign of the potential energy difference of a small negative charge between the points A and B*



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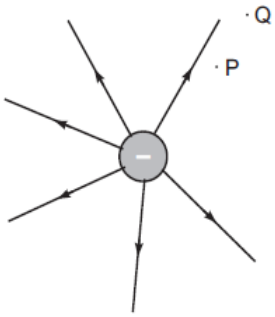
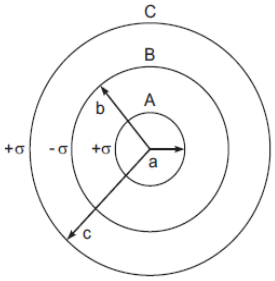
6. *In a parallel plate capacitor with air between the plates, each plate has an area of **5 × 10^{-3} m^2** and the separation between the plates is 2.5 mm.*
***(i)** Calculate the capacitance of the capacitor.**(ii)** If this capacitor is connected to 100 V supply, what would be the charge on each plate?**(iii)** How would charge on the plates be affected, if a 2.5 mm thick mica sheet of K =8 is inserted between the plates while the voltage supply remains connected?*
7. *Figure shows the field lines due to a positive point charge. Give the sign of potential energy difference of a small negative charge between the points **Q** and **P***



8. *Three concentric metallic shells **A, B** and **C** of radii a, b and c **(a < b < c)** have surface charge densities +σ, −σ and + σ respectively as shown in the figure.*

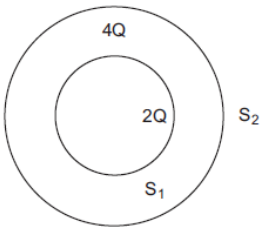


*If shells **A** and **C** are at the same potential, then obtain the relation between the radii a, b and c.*

2014 AI

9. *Two equal balls having equal positive charge **'q'** coulombs are suspended by two insulating strings of equal length. What would be the effect on the force when a plastic sheet is inserted between the two?*
10. *A parallel plate capacitor of capacitance C is charged to a potential V. It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor.*
11. *a) Deduce the expression for the torque acting on a dipole of dipole moment **p** in the presence of a uniform electric field **E***
*(b) Consider two hollow concentric spheres, **S1** and **S2** , enclosing charges **2Q** and **4Q** respectively as shown in the figure. **(i)** Find out the ratio of the electric flux through them. **(ii)** How will the electric*

flux through the sphere **S1** change if a medium of dielectric constant 'ε_r' is introduced in the space inside S_1 in place of air? Deduce the necessary **expression** .



12. *Why do the electrostatic field lines not form closed loops?*

13. *Why do the electric field lines never cross each other?*

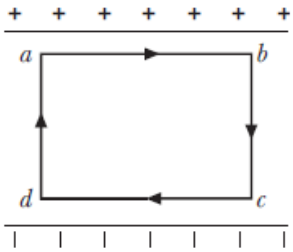
2014 D

14. *"For any charge configuration, equipotential surface through a point is normal to the electric field."Justify.*

15. *Two spherical bobs, one metallic and the other of glass, of the same size are allowed to fall freely from the same height above the ground. Which of the two would reach earlier and why?*

16. *Given a uniform electric field $E = 5 \times 10^3$ i N/C, find the flux of this field through a square of 10 cm on a side whose plane is parallel to the y-z plane. What would be the flux through the same square if the plane makes a 30° angle with the x-axis?*

17. *(a) Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.*
(b) The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop abcda .



OR

(a) Derive the expression for the capacitance of a parallel plate capacitor having plate area A and plate separation d.
(b) Two charged spherical conductors of radii R_1 and R_2 when connected by a conducting wire acquire charges q_1 and q_2 respectively. Find the ratio of their surface charge densities in terms of their radii.

18. *An electric dipole of length 2 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of 8 3 Nm. Calculate the potential energy of the dipole, if it has a charge of ±4 nC.*

19. *Given a uniform electric field $E = 2 \times 10^3$ i N/C, find the flux of this field through a square of side 20 cm, whose plane is parallel to the y-z plane. What would be the flux through the same square, if the plane makes an angle of 30° with the x-axis?*

20. *An electric dipole of length 1 cm, which placed with its axis making an angle of 60° with uniform electric field, experiences a torque of 6 3 Nm. Calculate the potential energy of the dipole if it has charge ± 2 nC.*

2013 F

21. *Define electric dipole moment. Is it scalar or vector?*

22. *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 $Q_1 : Q_2$.*

23. *A parallel plate capacitor, each of plate area A and separation 'd' between the two plates, is charged with charges + Q and – Q on the two plates. Deduce the expression for the energy stored in the capacitor.*

24. *(a) An infinitely long positively charged straight wire has a linear charge density λ cm^{-1}. An electron is revolving around the wire as its centre with a constant velocity in a circular plane perpendicular to the wire. Deduce the expression for its kinetic energy.*
(b) Plot a graph of the kinetic energy as a function of charge density λ.

25. *Two concentric metallic spherical shells of radii R and 3R 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 $Q_1 : Q_2$.*

2013 AI

26. *Two charges of magnitudes – 2Q and + Q are located at points (a, 0) and (4a, 0) respectively. What is the electric flux due to these charges through a sphere of radius '3a' with its centre at the origin?*

27. *A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor*

28. *A capacitor, made of two parallel plates each of plate area A and separation d, is being charged by an external ac source. Show that the displacement current inside the capacitor is the same as the current charging the capacitor.*

29. *(a) Define electric dipole moment. Is it a scalar or a vector? Derive the expression for the electric field of a dipole at a point on the equatorial plane of the dipole.*
(b) Draw the equipotential surfaces due to an electric dipole. Locate the points where the potential due to the dipole is zero.

OR

Using Gauss' law deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point (i) outside and (ii) inside the shell.
Plot a graph showing variation of electric field as a function of r > R and r < R. (r being the distance from the centre of the shell)

30. *Two charges of magnitudes – 3Q and + 2Q are located at points (a, 0) and (4a, 0) respectively.*

What is the electric flux due to these charges through a sphere of radius '5a' with its centre at the origin?

31. *Two charges of magnitudes + 4Q and – Q are located at points (a, 0) and (– 3a, 0) respectively. What is the electric flux due to these charges through a sphere of radius '2a' with its centre at the origin?*

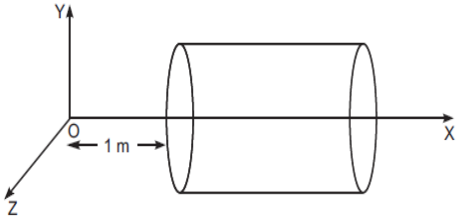
32. *A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness 2d/3, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.*

2013 D

33. *A capacitor has been charged by a dc source. What are the magnitudes of conduction and displacement currents, when it is fully charged?*

34. *A capacitor of unknown capacitance is connected across a battery of V volts. The charge stored in it is 360 μC. When potential across the capacitor is reduced by 120 V, the charge stored in it becomes 120 μC. Calculate:*
(i) The potential V and the unknown capacitance C.
(ii) What will be the charge stored in the capacitor, if the voltage applied had increased by 120 V?

35. *A hollow cylindrical box of length 1 m and area of cross-section 25 cm2 is placed in a three dimensional coordinate system as shown in the figure. The electric field in the region is given by E =50 x**i** , where E is in NC–1 and x is in metres. Find*
(i) Net flux through the cylinder.
(ii) Charge enclosed by the cylinder.

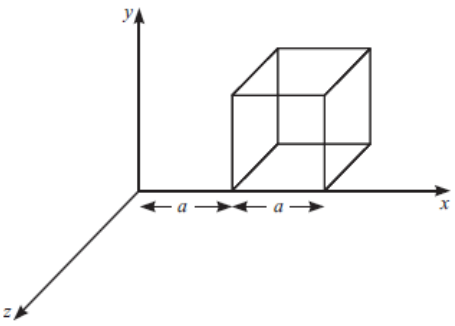


2012 F

36. Why is the potential inside a hollow spherical charged conductor constant and has the same value as on its surface?

37. Define dipole moment of an electric dipole. Is it a scalar or a vector?

38. State Gauss's law in electrostatic. A cube with each side '***a***' is kept in an electric field given by ***E***=C x ***i*** (as is shown in the figure) where ***C*** is a positive dimensional constant. Find out
(i) the electric flux through the cube, and
(ii) the net charge inside the cube



39. *A capacitor of 200pF is charged by a 300**V** battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of 100 **pF**. Calculate the difference between the final energy stored in the combined system and the initial energy stored in the single capacitor.*

40. *Why is there no work done in moving a charge from one point to another on an equipotential surface?*

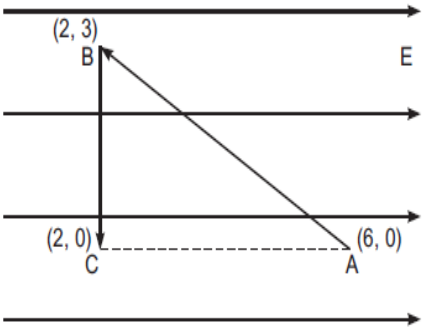
41. *A capacitor of 150 pF is charged by a 220 V battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of 50 pF. Calculate the difference between the final energy stored in the combined system and the initial energy stored in the single capacitor.*

42. *Why do the equipotential due to a uniform electric field not intersect each other?*

43. *A capacitor of 400**pF** is charged by a 100**V** battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of 100 **pF**. Calculate the difference between the final energy stored in the combined system and the initial energy stored in the single capacitor.*

2012 AI

44. *A test charge **'q'** is moved without acceleration from **A** to **C** along the path from **A** to **B** and then from **B** to **C** in electric field **E** as shown in the figure.*
***(i)** Calculate the potential difference between **A** and **C**.*
***(ii)** At which point (of the two) is the electric potential more and why?*



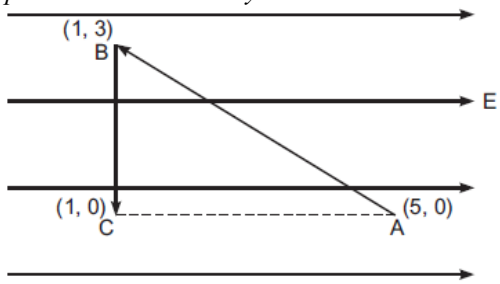
45. *An electric dipole is held in a uniform electric field.*
***(i)** Show that the net force acting on it is zero.*
***(ii)** The dipole is aligned parallel to the field. Find the work done in rotating it through the angle of 180°*

46. *A capacitor of capacitance of 'C' is being charged by connecting it across a dc source along with an ammeter. Will the ammeter show a momentary deflection during the process of charging? If so, how would you explain this momentary deflection and the resulting continuity of current in the circuit? Write the expression for the current inside the capacitor.*

47. *Deduce the expression for the electrostatic energy stored in a capacitor of capacitance* ***'C'*** *and having charge* ***'Q'****. How will the* ***(i)*** *energy stored and* ***(ii)*** *the electric field inside the capacitor be affected when it is completely filled with a dielectric material of dielectric constant* ***'K'****?*

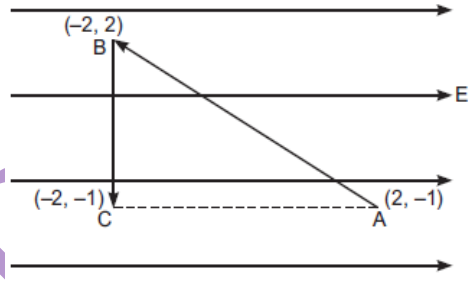
48. *A charge q is placed at the centre of a cube of side* ***l****. What is the electric flux passing through two opposite faces of the cube?*

49. *A test charge* ***'q'*** *is moved without acceleration from* ***A*** *to* ***C*** *along the path from* ***A*** *to* ***B*** *and then from* ***B*** *to* ***C*** *in electric field* ***E*** *as shown in the figure.*
(i) *Calculate the potential difference between* ***A*** *and* ***C.***
(ii) *At which point (of the two) is the electric potential more and why?*



50. *A charge 'q' is placed at the centre of a cube. What is the electric flux passing through the cube?*

51. *A test charge* ***'q'*** *is moved without acceleration from* ***A*** *to* ***C*** *along the path from* ***A*** *to* ***B*** *and them from* ***B*** *to* ***C*** *in electric field* ***E*** *as shown in the figure.* ***(i)*** *Calculate the potential difference between* ***A*** *and* ***C.*** ***(ii)*** *At which point (of the two) is the electric potential more and why?*



2012 D

52. *Draw a plot showing the variation of* ***(i)*** *electric field (E) and* ***(ii)*** *electric potential* ***(V)*** *with distance* ***r*** *due to a point charge* ***Q.***

53. ***(a)*** *Define electric flux. Write its S.I. units.*
(b) *Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.*
(c) *How is the field directed if* ***(i)*** *the sheet is positively charged,* ***(ii)*** *negatively charged?*

54. *Why must electrostatic field be normal to the surface at every point of a charged conductor?*

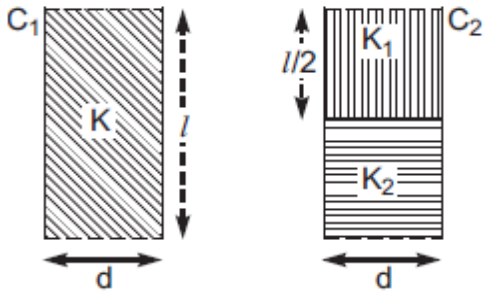
55. *Why is electrostatic potential constant throughout the volume of the conductor and has the same value (as inside) on its surface?*

2011 F

56. *Two insulated charged copper spheres* ***A*** *and* ***B*** *if identical size has charges* q_A *and* q_b *respectively. A third sphere* ***C*** *of the same size but uncharged is brought in contact with the first and then in contact with the second and finally removed from both. What are the new charges on* ***A*** *and* ***B****?*

57. *Calculate the amount of work done in rotating a dipole, of dipole moment* 3×10^{-8} ***cm****, from its position of stable equilibrium to the position of unstable equilibrium, in a uniform electric field of intensity* 10^4 ***N/C.***

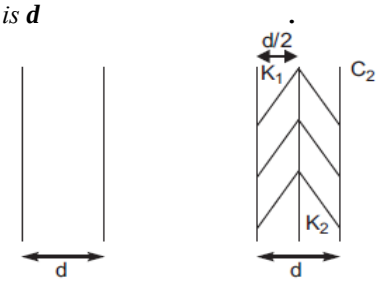
58. *Two identical parallel plate (air) capacitors* C_1 *and* C_2 *have capacitances C each. The between their plates is now filled with dielectrics as shown. If the two capacitors still have equal capacitance, obtain the relation between dielectric constants K,* K_1 *and* K_2 *.*



59. *Two insulated charged copper spheres* ***A*** *and* ***B*** *of identical size have charges* q_A *and* q_B *respectively. When they are brought in contact with each other and finally separated, what are the new charges on them?*

60. *Calculate the amount of work done in rotating a dipole, of dipole moment* 5×10^{-8} ***cm,*** *from its position of stable equilibrium to the position of unstable equilibrium, in electric field of intensity* 10^4 ***N/C.***

61. *You are given an air filled parallel plate capacitor* C_1*. The space between its plates is now filled with slabs of dielectric constants* K_1 *and* K_2 *as shown in* C_2 *.Find the capacitances of the capacitor* C_2 *if area of the plates is* ***A*** *distance between the plate is* ***d***

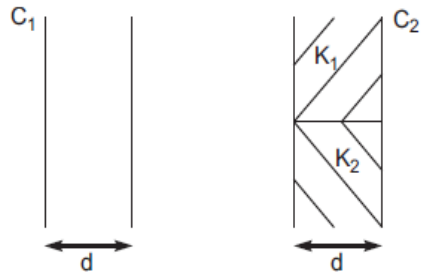


62. *Two insulated charged copper spheres* ***A*** *and* ***B*** *of identical size have charges* q_A *and* $-3q_A$ *respectively. When they are brought in contact with*

each other and then separated, what are the new charges on them?

63. *Calculate the amount of work done in rotating a dipole, of dipole moment* 2×10^{-8} *cm, from its position of stable equilibrium to the position of unstable equilibrium, in uniform electric field of intensity* 5×10^{4} *N/C.*

64. *You are given an air filled parallel plate capacitor* C_1. *The space between its plates is now filled with slabs of dielectric constants* K_1 *and* K_2 *as shown in* C_2 . *Find the capacitances of the capacitor* C_2 *if area of the plates is* A *and distance between the plates is* d.



2011 AI

65. *Define electric dipole moment. Write its S.I. unit.*

66. *A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. What is the potential at the centre of the sphere?*

67. *A thin straight infinitely long conducting wire having charge density* λ *is enclosed by a cylindrical surface of radius* r *and length* l, *its axis coinciding with the length of the wire. Find the expression for the electric flux through the surface of the cylinder.*

68. *Plot a graph showing the variation of coulomb force* (F) *versus* $1/r^2$, *where* r *is the distance between the two charges of each pair of charges:* $(1\ \mu C, 2\ \mu C)$ *and* $(2\ \mu C - 3\ \mu C)$. *Interpret the graphs obtained.*

69. *A parallel plate capacitor is being charged by a time varying current. Explain briefly how Ampere's circuital law is generalized to incorporate the effect due to the displacement current.*

70. *Net capacitance of three identical capacitors in series is* $1\ \mu F$. *What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if they are both connected to the same source.*

71. *A hollow metal sphere of radius 10 cm is charged such that the potential on its surface is 5V.What is the potential at the centre of the sphere?*

72. *Net capacitance of three identical capacitors in series is* $2\ \mu F$. *What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if they are both connected to the same source.*

73. *A hollow metal sphere of radius 6 cm is charged such that the potential on its surface is 12 V. What is the potential at the centre of the sphere?*

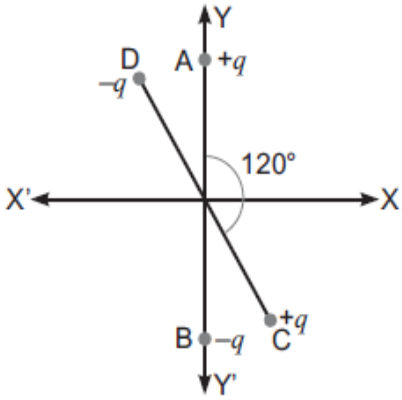
2011 D

74. *A point charge* Q *is placed at 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?*

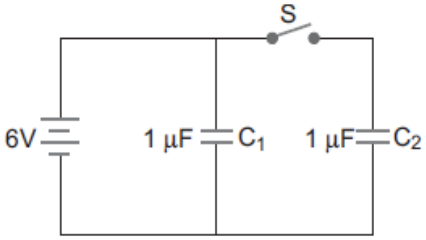
75. *Two uniformly large parallel thin plates having charge densities* $+\sigma$ *and* $-\sigma$ *are kept in the* X-Z *plane at a distance* d *apart. Sketch an equipotential surface due to electric field between the plates. If a particle of mass* m *and charge* $-q$ *remains stationary between the plates, what is the magnitude and direction of this field?*

OR

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? If this system is subjected to electric field* (E) *directed along* $+X$ *direction, what will be the magnitude and direction of the torque acting on this?*



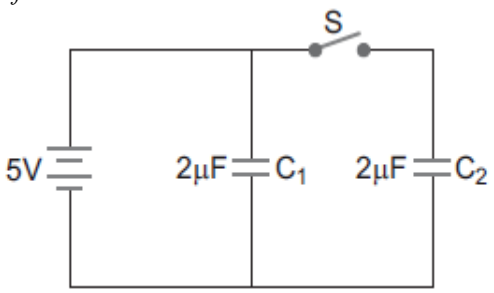
76. *Figure shows two identical capacitors,* C_1 *and* C_2, *each of* $1\ \mu F$ *capacitance connected to a battery of* $6\ V$. *Initially switch* S *is closed. After sometimes* S *is left open and dielectric slabs of dielectric constant* $K = 3$ *are inserted to fill completely the space between the plates of the two capacitors. How will the* **(i)** *charge and* **(ii)** *potential difference between the plates of the capacitors be affected after the slabs are inserted?*



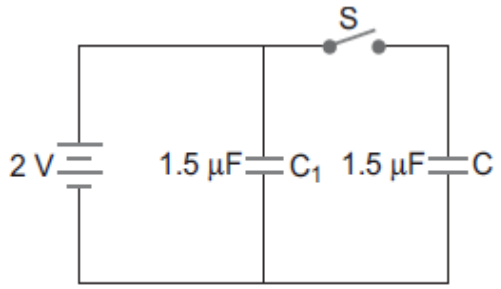
77. *Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r, for* $r > R$ *and* $r < R$.

78. *Figure shows two identical capacitors* C_1 *and* C_2 *each of* $1\ \mu F$ *capacitance, connected to a battery of* $5\ V$. *Initially switch* S *is closed. After sometimes* S *is left open and dielectric slabs of dielectric constant* $K = 5$ *are inserted to fill completely the space between the plates of the two capacitors. How will the* **(i)** *charge and* **(ii)** *potential difference between the plates of the capacitors be affected*

after the slabs are inserted?



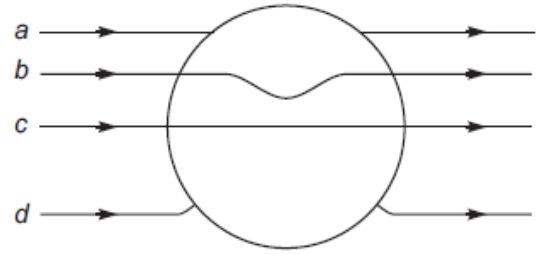
79. *Figure shows two identical capacitors* C_1 *and* C_2 *each of* **1.5μF** *capacitance, connected to a battery of* **2 V**. *Initially switch '***S***' is closed. After sometimes '***S***' is left open and dielectric slabs of dielectric constant* **K = 2** *are inserted to fill completely the space between the plates of the two capacitors. How will the* **(i)** *charge and* **(ii)** *potential difference between the plates of the capacitors be affected after the slabs are inserted?*



2010 F

80. *A charge Q*μ*C is placed at the centre of a cube. What is the electric flux coming out from any one surface?*

81. *A metallic sphere is placed in a uniform electric field as shown in the figure. Which path is followed by electric field lines and why?*



82. *(a) Plot a graph comparing the variation of potential 'V' and electric field 'E' due to a point charge 'Q' as a function of distance 'R' from the point charge.*
(b) Find the ratio of the potential differences that must be applied across the parallel and the series combination of two identical capacitors so that the energy stored, in the two cases, becomes the same.

83. *(a)How is the electric field due to a charged parallel plate capacitor affected when a dielectric slab is inserted between the plates fully occupying the intervening region?*
(b) A slab of material of dielectric constant K has the same area as the plates of a parallel plate capacitor but has thickness ½ d, where d is the separation between the plates. Find the expression for the capacitance when the slab is inserted between the plates.

84. ***(a)****Plot a graph comparing the variation of potential 'V' and electric field 'E' due to a point charge 'Q' as a function of distance 'R' from the point charge.*
(b) *Find the ratio of the potential differences that must be applied across the parallel and the series combination of two capacitors* C_1 *and* C_2 *with their capacitances in the ratio 1: 2 so that the energy stored, in the two cases, becomes the same*

85. ***(a)****Plot a graph comparing the variation of potential 'V' and electric field 'E' due to a point charge 'Q' as a function of distance 'R' from the point charge.*
(b) *Find the ratio of the potential differences that must be applied across the parallel and the series combination of two capacitors* C_1 *and* C_2 *with their capacitances in the ratio 1: 3 so that the energy stored, in the two cases, becomes the same.*

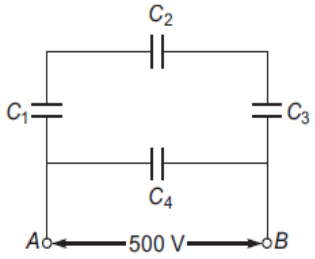
2010 AI

86. *Name the physical quantity whose S.I. unit is JC*$^{-1}$. *Is it a scalar or a vector quantity?*

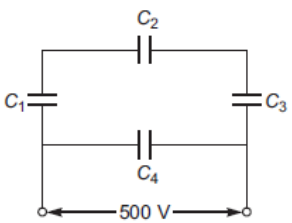
87. *A spherical conducting shell of inner radius* r_1 *and outer radius* r_2 *has a charge '***Q***'. A charge '***q***' is placed at the centre of the shell.*
(a) *What is the surface charge density on the* **(i)** *inner surface,* **(ii)** *outer surface of the shell?*
(b) *Write the expression for the electric field at a point* $x > r_2$ *from the centre of the shell.*

88. *Show that the electric field at the surface of a charged conductor is given by* $E = \sigma/\varepsilon_0 \, n$, *where* σ *is the surface charge density and* $ n *is a unit vector normal to the surface in the outward direction.*

89. *A network of four capacitors each of 12 μF capacitance is connected to a 500 V supply as shown in the figure. Determine*
(a) Equivalent capacitance of the network and
(b) Charge on each capacitor.



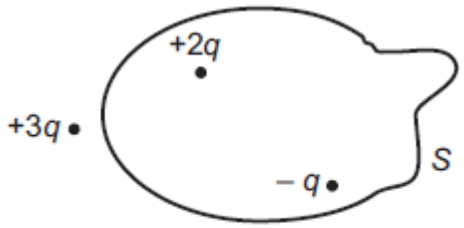
90. *A network of four capacitors each of 15 μF capacitance is connected to a 500 V supply as shown in the figure. Determine*
(a) Equivalent capacitance of the network and
(b) Charge on each capacitor.



2010 D

91. *In which orientation, a dipole placed in a uniform electric fields is in (i) stable, (ii) unstable equilibrium?*

92. *Figure shows three point charges, +2q, –q and +3q. Two charges +2q and –q are enclosed within a surface 'S'. What is the electric flux due to this configuration through the surface 'S'?*



93. *A parallel plate capacitor is charged by a battery. After sometime the battery is disconnected and a dielectric slab with its thickness equal to the plate separation is inserted between the plates. How will (i) the capacitance of the capacitor, (ii) potential difference between the plates and (iii) the energy stored in the capacitor be affected? Justify your answer in each case.*

94. *(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 point's* r_1 *and* r_2 *respectively in the presence of external electric field* **E.**

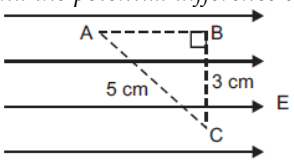
95. *A parallel plate capacitor, each with plate area A and separation d, is charged to a potential difference V. The battery used to charge it remains connected. A dielectric slab of thickness d and dielectric constant k is now placed between the plates. What change, if any, will take place in:*
(i) charge on plates?
(ii) electric field intensity between the plates?
(iii) capacitance of the capacitor?
Justify your answer in each case

96. *A parallel plate capacitor is charged to a potential difference V by a d.c. source. The capacitor is then disconnected from the source. If the distance between the plates is doubled, state with reason how the following will change:*
(i) electric field between the plates.
(ii) capacitance, and
(iii) energy stored in the capacitor.

2009 F

97. *Why is it necessary that the field lines from a point charge placed in the vicinity of a conductor must be normal to the surface of the conductor at every point?*

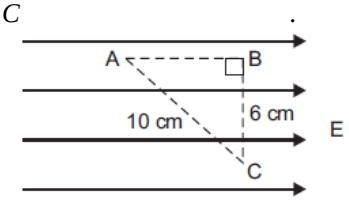
98. *Three points A, B and C lie in a uniform electric field* **(E) of 5 x 10** ^{3} **NC**$^{-1}$ *as shown in the figure. Find the potential difference between A and C.*



99. *The sum of two point charges is 7 m C. They repel each other with a force of 1 N when kept 30cm apart in free space. Calculate the value of each charge.* **(2)**

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

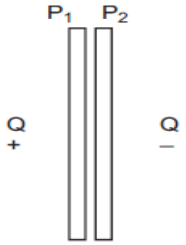
101. *Three points A, B and C lie in a uniform electric field (E) of 5 x 10* ^{3} *NC*$^{-1}$ *as shown in the figure. Find the potential difference between A and C*



102. *The sum of two point charges is* **9 μC.** *They repel each other is force of* **2 N** *when kept* **30 cm** *apart in free space. Calculate the value of each charge.* **(2)**

103. *A metal plate is introduced between the plates of a charged parallel plate capacitor. What is its effect on the capacitance of the capacitor?* **(1)**

104. *Figure shows two large metal plates P1 and P2, tightly held against each other and placed between two equal and unlike point charges perpendicular to the line joining them. (i) What will happen to the plates when they are released? (ii) Draw the pattern of the electric field lines for the system.***(2)**



105. *A 800 pF capacitor is charged by a 100 V battery. After some time the battery is disconnected. The capacitor is then connected to another 800 pF capacitor. What is the electrostatic energy stored?* **(2)**

106. *The sum of two point charges is 7 m C. They repel each other with a force of 1 N when kept 30 cm apart in free space. Calculate the value of each charge.* **(2)**

2009 AI

107. *What is the electrostatic potential due to an electric dipole at an equatorial point?(* **1)**

108. *Define electric flux. Write its S.I. units. A charge q is enclosed by a spherical surface of radius R. If the radius if reduced to half, how would the electric flux through the surface change* **(2)**

109. *A positive point charge (+q) is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines originating from the point on to the surface of the plate. Derive the* expression for

the electric field at the surface of a charged conductor. **(3)**

OR

110. *A parallel plate capacitor is charged by a battery. After some time the battery is disconnected and a dielectric slab of dielectric constant K is inserted between the plates. How would (i) the capacitance, (ii) the electric field between the plates and (iii) the energy stored in the capacitor, be affected? Justify your answer.* **(3)**

111. *What is the work done in moving a test charge q through a distance of 1 cm along the equatorial axis of an electric dipole?* **(1)**

112. Use Gauss's law to derive the *expression for the electric field between two uniformly charged large parallel sheets with surface charge densities* σ *and* $-\sigma$ *respectively.* **(3)**

OR

113. *(a)A charge +Q is placed on a large spherical conducting shell of radius R. Another small conducting sphere of radius r carrying charge 'q' is introduced inside the large shell and is placed at its centre. Find the potential difference between two points, one lying on the sphere and the other on the shell.*
(b) How would the charge between the two flow if they are connected by a conducting wire? Name the device which works on this fact. **(3)**

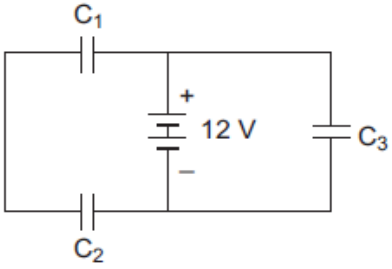
2009 D

114. *Define the term 'potential energy' of charge 'q' at a distance 'r' in an external electric field.* **(1)**

115. *(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)? **(2)**

116. *A thin conducting spherical shell of radius R has charge Q spread uniformly over its surface.Using Gauss's law, derive an expression for an electric field at a point outside the shell.Draw a graph of electric field E(r) with distance r from the centre of the shell or* $0 \le r \le \infty$

117. *Three identical capacitors* C_1 *,* C_2 *and* C_3 *of capacitance 6 mF 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*

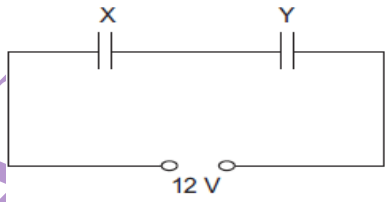


118. *The equivalent capacitance of the combination between A and B in the given figure is 4 mF. (i) Calculate capacitance of the capacitor C.*
(ii) Calculate charge on each capacitor if a 12 V battery is connected across terminals A and B.
(iii) What will be the potential drop across each capacitor?

119. *State Gauss's law in electrostatic. Using this law derive an expression for the electric field due to a uniformly charged infinite plane sheet.* **(3)**

120. *State Guass's law in electrostatics. Use this law to derive an expression for the electric field due to an infinitely long straight wire of linear charge density* λ Cm^{-1}. **(3)**

121. *Two parallel plate condition X and Y, have the same area of plates and same separation between them. X has air between the plates while Y contains a dielectric medium of* $\varepsilon_r = 4$.
(i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4 mF.
(ii) Calculate the potential difference between the plates of X and Y.
(iii) What is the ratio of electrostatic energy stored in X and Y?

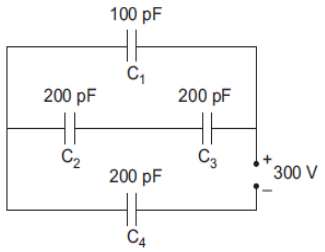


2008 AI

122. *Draw an equipotential surface for a system, consisting of two charges Q,* $-Q$ *separated by a distance 'r' in air.*

123. *Obtain the expression for the potential energy of an electric dipole of dipole moment* **p** *placed in an electric field* **E**.

124. *(a) Derive an expression for the energy stored in a parallel plate capacitor C, charged to a potential difference V.*
(b) Obtain the equivalent capacitance of the network given below. For a supply of 300 V, determine the charge and voltage across C_4 .



125. *Derive an expression for the torque acting on an electric dipole, which is held in a uniform electric field, when the axis of the dipole makes an angle* θ *with the electric field.*

126. *Draw an equipotential surface for a uniform electric field.*

127. *Using Gauss's law derive an expression for the electric field intensity at any point near a uniformly charged thin wire of charge/length* λ *C/m.*

2008 D

128. *A 500* μ*C charge is at the centre of a square of side 10 cm. Find the work done in*

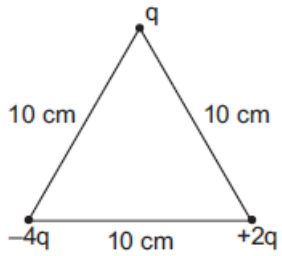
moving a charge of 10 μC between two diagonally opposite points on the square.

129. *Derive the expression for the electric potential at any point along the axial line of an electric dipole ?*

130. ***(a)*** *Using Gauss law, derive an expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius R and charge density σ 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.

131. *(a)Derive an expression for the torque experienced by an electric dipole kept in a uniformly electric field.*
(b) Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown. Here q =1·6 ×10^{-10} C.



132. *Derive an expression for the potential energy of an electric dipole of dipole moment* ***p*** *in an electric field* ***E****.*