Holiday home assignment (2021-22)

Class – XII

Subject – Physics (042)

ENGLISH

Very short answer type questions:

1 One end of a copper wire is connected to a neutral pith ball and other end to a negatively charged plastic rod. What will be the charge acquired by a pitch ball?

2 Two metallic spheres having same shape and size, but one of Cu and other of Al, are both placed in an identical electric field. In which metallic sphere will more charge be induced?

3 What causes the charging of an object?

4 What is the cause of quantisation of electric charge?

5 If a body contains n_1 electrons and n_2 protons, then what will be the total amount of charge on the body?

6 Is the force acting between two point electric charges q_1 and q_2 kept at some distance apart in air, attractive or repulsive when (i) $q_1q_2 > 0$ (ii) $q_1q_2 < 0$?

7 The force on an electron kept in an electric field in a particular direction is **F**. What will be the magnitude and direction of the force experienced by a proton kept at the same point in the field? Mass of the proton is about 1836 times the mass of the electron.

8 How does the coulomb force between two point charges depend upon the dielectric constant of the intervening medium?

9 Two insulated charged copper spheres **A** and **B** of identical size have 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**?

10 Draw the electric field lines due to a point charge (i) **Q** > 0 and (ii) **Q** < 0.

11 Define the term electric flux. Write its SI unit.

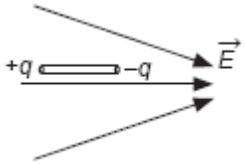
12 Define the term electric dipole moment. Is it a scalar or a vector quantity?

13 What does $q_1 + q_2 = 0$ signify?

14 What is the value of $\left|\frac{E_{ax}}{E_{eq}}\right|$ for a short electric dipole?

15 If **F** is the magnitude of force experienced by a unit charge placed at a distance of 1 cm from an infinitely large charged sheet, then what will be the force experienced by the same charge placed at a distance of 2 cm from the same sheet?

16 What is the direction of net force on electric dipole, placed in a non-uniform electric field?



17 When does an electric dipole placed in a non-uniform electric field experience a zero torque but non-zero force?

18 What is a Gaussian surface?

19 Draw the electric field lines if (i) a point charge + **q** is placed at the centre (ii) a point charge + **q** is placed at a distance **R**/2 from the centre.

20 Work done in taking an electron around a proton in a circular loop is zero. Should the proton necessarily be at the centre of the circular loop?

21 While defining the electrostatic potential energy, why do we bring a unit positive charge from infinity?

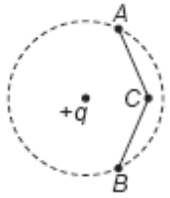
22 What is the work done in moving a test charge q through a distance of 1 cm along the equatorial axis of an electric dipole?

23 A metal sphere is surrounded by an uncharged concentric thin spherical shell with a charge **q** and the potential difference between them is **V**. What is the new potential difference between them, if the shell is now given an additional charge **q**?

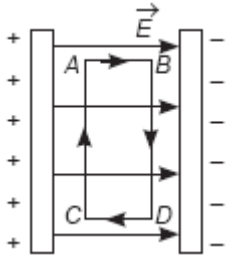
24 Why is electrostatic potential constant throughout the volume of the conductor and has the same value (as inside) on its surface?

25 A and B are two conducting spheres of the same radius, A being solid and B hollow. Both are charged to the same potential. What will be the relation between the charges on the two spheres?

26 If a point charge +q is taken first from A to C and then from C to B of a circle drawn with another point charge +q at centre, then along which path more work will be done?



27 A uniform electric field E exists between two charged plates as shown in figure. What would be the work done in moving a charge q along the closed rectangular path ABCDA?



28 What is the geometrical shape of equipotential surfaces due to a single isolated charge?

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

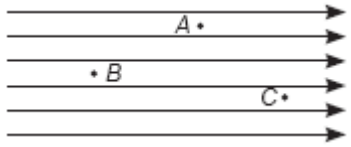
30 Can two equipotential surfaces intersect each other? Justify your answer.

31 Why does the electric field inside a dielectric decrease when it is placed in an external electric field?

32 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?

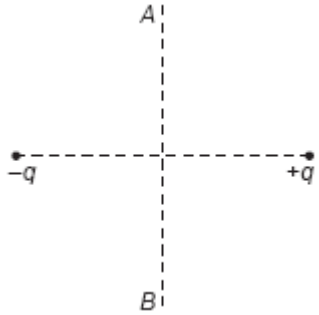
33 Figure given below shows three points **A**, **B** and **C** in a uniform electrostatic field. At which

of the points will the electric potential be maximum?



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

35 A charge q is moved from a point A above dipole of dipole moment P to a point B below the dipole in equatorial plane without acceleration. Find the work done in the process.



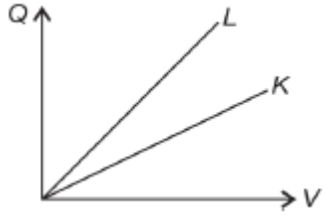
36 If the plates of a charged capacitor be suddenly connected to each other by a wire, what will happen?

37 A metal plate is introduced between the plates of a charged parallel plate capacitor. What is

its effect on the capacitance of the capacitor?

Short answer type questions:

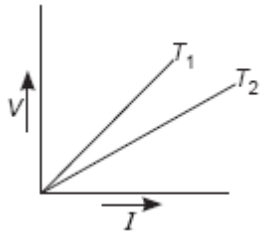
38 The following graph shows the variation of charge Q, with voltage V, for two capacitors K and L. In which capacitor is more electrostatic energy stored?



39 Plot a graph showing the variation of resistance of a conducting wire as a function of its radius, keeping the length of the wire and its temperature as constant.

40 V–I graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in the

figure. Which of the two temperatures is higher and why?

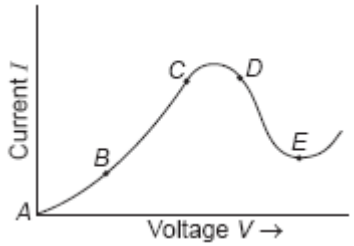


41 State the condition for maximum current to be drawn from a cell.

42 State the condition under which the terminal potential difference across a battery and its emf are equal.

43 Graph showing the variation of current versus voltage for a material GaAs is shown in the figure. Identify the region of
(i) negative resistance,

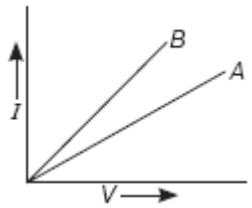
(ii) where Ohm's law is obeyed.



44 A steady current flow in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along the conductor: current, current density, drift speed and electric field?

45 The electron drift arises due to the force experienced by electrons in the electric field inside the conductor. But force should cause acceleration. Why then do the electrons acquire a steady average drift speed?

46 Out of V – I graph for parallel and series combination of two metallic resistors, which one represents parallel combination of resistors? Justify your answer.



47 Sketch a graph showing variation of resistivity of carbon with temperature.

48 In a medium the force of attraction between two-point electric charges, distance **d** apart is **F**. What distance apart should these be kept in the same medium so that the force between them becomes (i) 3**F** (ii) $\frac{F}{3}$?

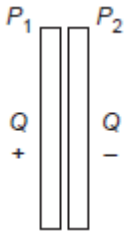
49 A charge **q** is placed at the centre of the line joining two equal charges **Q**. Show that the system of three charges will be in equilibrium if **q** = – **Q**/4.

50 Two fixed point charges + 4 **e** and + **e** units are separated by a distance '**a**'. Where should the third point charge be placed for it to be in equilibrium?

51 An oil drop of mass m and charge – **q** is to be held stationary in the gravitational field of the earth. What is the magnitude and direction of the electrostatic field required for this purpose?

52 Figure shows two large metal plates, P_1 and P_2, 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.



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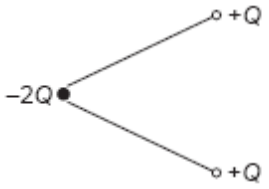


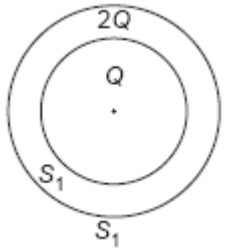
Sketch the electric field lines for the following system of charges.

54 Define electric field intensity. Write its SI unit. Write the magnitude and direction of electric field intensity due to an electric dipole of length 2**a** at the mid-point of the line joining the two charges.

55 Two small balls with equal positive charges **q** coulomb are suspended by two insulating strings of equal length **l** metre from a hook fixed to a stand. The whole set up is taken in a satellite into space where there is no gravity. Find the angle between the strings and tension (**T**) in each string.

56 A point charge **Q** is at the centre of a conducting shell and another charge **q** is outside the shell. Now, answer the following:
(a) Does the charge Q experience a force?
(b) Does the charge **q** experience a force? Explain.

57 S_1 and S_2 are two hollow concentric spheres enclosing charge **Q** and 2**Q** respectively as shown in figure.
(i) What is the ratio of the electric flux through S_1 and S_2?
(ii) How will the electric flux through the sphere S_1 change, if a medium of dielectric constant 5 is introduced in the space inside S_1 in place of air?



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

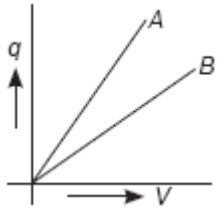
59 Two spherical conductors **A** and **B** of radii r_A and r_B ($r_A > r_B$) are given equal amounts of charge. In which direction will the charge flow when these spheres are brought in contact? Give reason for your answer.

60 Why are equipotential surfaces perpendicular to field lines?

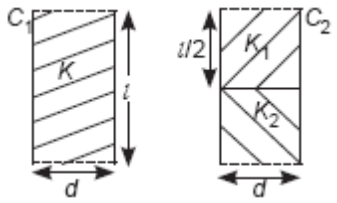
61 Derive the expression for the capacitance of a parallel plate capacitor having plate area **A** and plate separation **d**.

62 Draw equipotential surfaces and corresponding electric field lines for the: (**i**) single point charge **q** < 0 and (**ii**) uniform electric field.

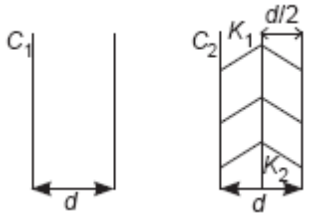
63 The given graph shows that variation of charge **q** versus potential difference **V** for two capacitors C_1 and C_2. The two capacitors have same plate separation but the plate area of C_2 is double than that of C_1. Which of the lines in the graph correspond to C_1 and C_2 and why?



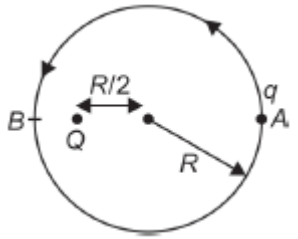
64 Two identical parallel plates (air) capacitors C_1 and C_2 have capacitances **C** each. The space between their plates is now filled with dielectrics as shown. If the two capacitors still have equal capacitance, obtain the relation between dielectric constants **K**, K_1 and K_2.



65 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 capacitance of the capacitor C_2 if area of the plates is A and distance between the plates is d.



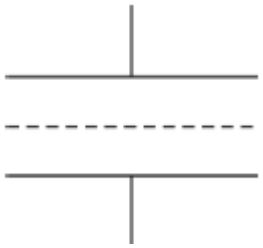
66 There is a point charge Q at a distance $\frac{R}{2}$ from the centre of a circle of radius R. Another point charge q is to be moved from A to B, where A and B are two points on the circle diametrically opposite to each other. How



much work is done by the electrostatic force exerted by **Q** on **q**?

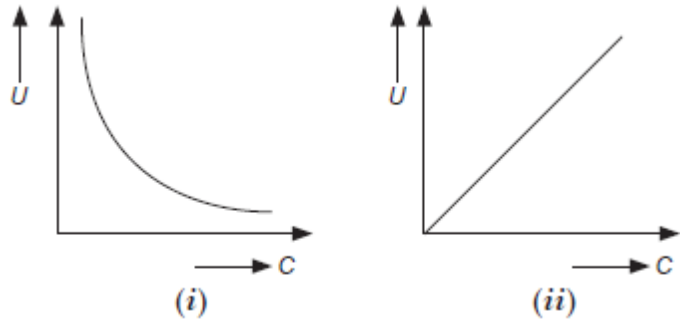
67 Can we create an electric field in which all the lines of force are parallel but their density increases continuously in a direction perpendicular to the lines of force?

68 Figure shows a sheet of aluminium foil of negligible thickness placed between the plates of a capacitor. How will its capacitance be affected if (i) the foil is electrically insulated and (ii) the foil is connected to the upper plate with a conducting wire?

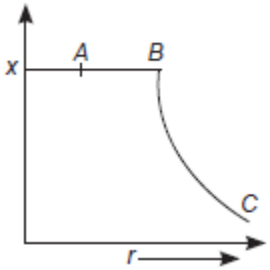


69 Let two conducting spheres of radii r_1 and r_2 be joined by a thin wire and a total charge **q** be given to them. Prove that the charges on the spheres will be in the ratio of their radii.

70 The energy of a capacitor varying with its capacitance is shown by two graphs (i) and (ii). Find in which of the graphs: (a) charge is constant, and (b) potential difference is constant.

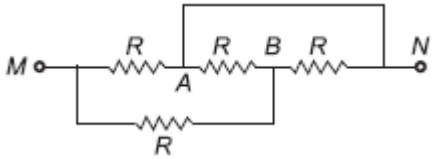


71 A graph is drawn between some physical quantity **x** and **r** as shown below, where **r** is the distance from the centre of a charged conducting sphere.
Now answer the following:
(a) Name the physical quantity **x**.



(b) At what point electric field is (i) maximum, and (ii) minimum?

72 Calculate the resistance across the points **M** and **N** in the given figure.

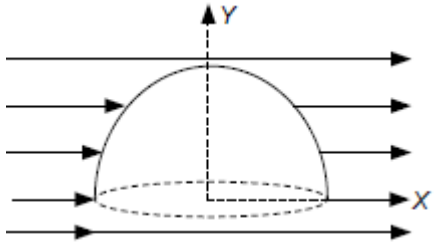


73 A uniform wire of resistance **R** ohm is bent into a circular loop as shown in the figure. Compute effective resistance between diametrically opposite points **A** and **B**.

74 Name two factors on which the resistivity of a given material depends. A carbon resistor has a value of 62 kΩ with a tolerance of 5%. Give the colour code for the resistor.

75 A hemispherical surface lies as shown in an uniform electric field region. Find the net electric flux through the curved surface if electric field is

(a) along **x**-axis, and

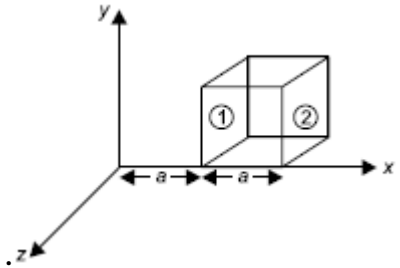


(b) along **y**-axis.

76 State Gauss's law in electrostatics. A cube with each side a is kept in an electric field given by $\vec{E} = Cx\hat{i}$, (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

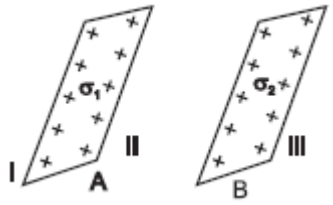


77 Using Gauss's theorem, deduce an expression for the electric field intensity at any point due to a thin, infinitely long wire of charge/length λ C/m.

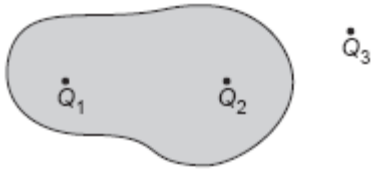
78 Using Gauss's theorem, show mathematically that for any point outside the shell, the field due to a uniformly charged thin spherical shell is the same as if the entire charge of the shell is concentrated at the centre. Why do you expect the electric field inside the shell to be zero according to this theorem?

79 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 theshell for $0 \leq r \leq \infty$.

80 (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 σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and directions of net fields in the regions marked II and III.



81 Three charges Q_1, Q_2 and Q_3 are placed inside and outside a closed Gaussian surface as



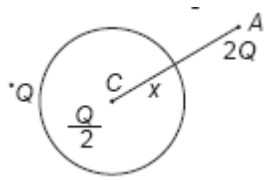
shown in the figure.
Answer the following:
(a) Which charges contribute to the electric field at any point on the Gaussian surface?
(b) Which charges contribute to the net flux through this surface?
(c) If $Q_1 = -Q_2$, will electric field on the surface be zero?

82 Two identical point charges Q are kept at a distance r from each other. A third point charge is placed on the line joining the above two charges such that all the three charges are in equilibrium. What is the magnitude, sign and position of the third charge?

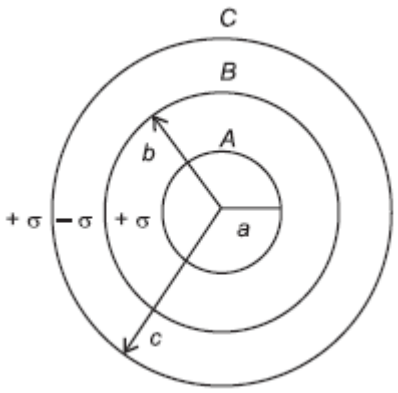
83 An uncharged comb after combing hair, when brought near the paper bits attracts them.
Answer the following:
(a) Does the mass of comb/paper bit get changed?

(b) Is paper bit still uncharged?
(c) What is the difference between the charging of a comb and the charging of the paper bits?

84 A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge $\frac{Q}{2}$ is placed at its centre
C and an other charge +2Q is placed outside the shell at a distance x from the centre as shown in figure. Find (i) the force on the charge at the centre of shell and at the point A, (ii) the electric flux through the shell.



85 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, c.



86 Deduce an expression for the electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric potential of a dipole at a point as compared to that due to a single charge.

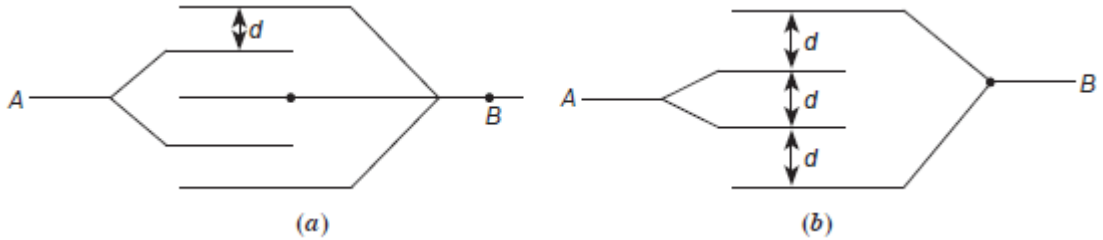
87 Four charges **+q**, **−q**, **+q** and **−q** are to be arranged respectively at the four corners of a square **ABCD** of side a. (a) Find the work required to put together this arrangement. (b) A charge q_0 is bought to the centre of the square, the four charges being held fixed. How much extra work is needed to do this?

88 Calculate the electrostatic potential energy of a system of three point charges q_1, q_2 and q_3 located respectively at $\vec{r}_1$, $\vec{r}_2$ and $\vec{r}_3$ with respect to a common origin **O**.

89 A conducting slab of thickness **t** is introduced without touching between the plates of a parallel plate capacitor, separated by a distance **d** (**t** < **d**). Derive an expression for the capacitance of the capacitor.

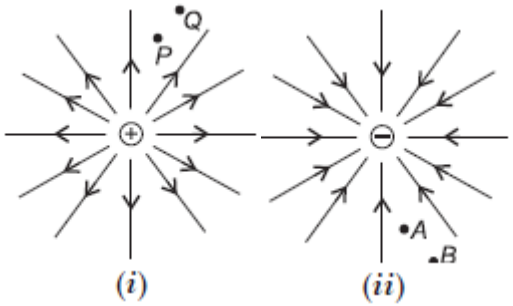
90 Find the ratio of the potential differences that must be applied across the parallel and the series combination of two capacitors C_1 and C_2 with their capacitances in the ratio 1 : 2 so that the energy stored in the two cases, becomes the same.

91 Five identical horizontal square metal plates each of area **A** are placed at a distance d apart in air and connected to the terminals **A** and **B** as shown in the figures (a) and (b). Find the effective capacitance between the two terminals **A** and **B**.



92 Figures (i) and (ii) show the field lines of the positive and negative point charges

respectively. (a) Give the signs of the potential difference $V_P - V_Q$, $V_B - V_A$. (b) Give the sign of the potential energy difference of a small negative charge between the points Q and P, A and B. (c) Give the sign of the work done by the field in moving a small positive charge from Q to P. (d) Give the sign of the work done by the external agency in moving a small negative charge from B to A. (e) Does the kinetic energy of a small negative charge increase or decrease in going from B to A?

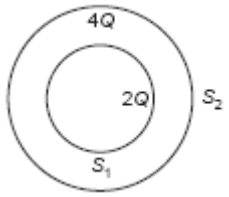


93 A charge Q is distributed over two concentric hollow spheres of radii r and R (R > r) respectively, such that their surface densities of charges are equal. Find the potential at the common centre.

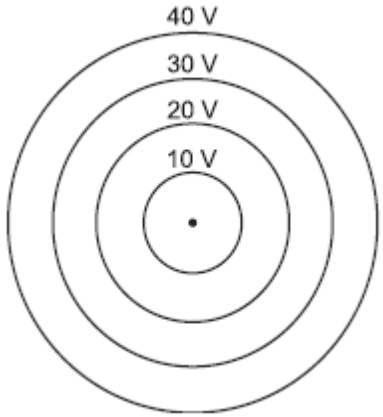
Long answer type questions:

94 (a) (a) Deduce the expression for the torque acting on a dipole of dipole moment $\vec{p}$ in the presence of a uniform electric field $\vec{E}$.

(b) Consider two hollow concentric spheres, S_1 and S_2, 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 S_1 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.



95 (a) Two isolated metal spheres A and B have radii R and 2R respectively, and same charge q. Find which of the two spheres have greater: (i) capacitance and (ii) energy density just outside the surface of the spheres. (b) (i) Show that the equipotential surfaces are closed together in the regions of strong field and far apart in the regions of weak field. Draw

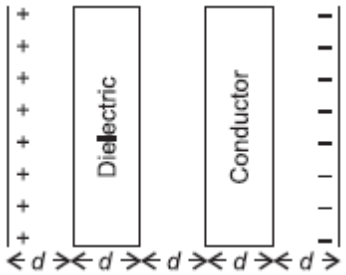


equipotential surfaces for an electric dipole. (ii) Concentric

equipotential surfaces due to a charged body placed at the centre are shown. Identify the polarity of the charge and draw the electric field lines due to it.

96 Derive the expression for the energy stored in a parallel plate capacitor of capacitance **C** with air as medium between its plates having charges **Q** and $\frac{1}{2}\varepsilon_0 E^2 Ad$ where **A** is the area of each plate and **d** is the separation between the plates.
How will the energy stored in a fully charged capacitor change when the separation between the plates is doubled and a dielectric medium of dielectric constant 4 is introduced between the plates?

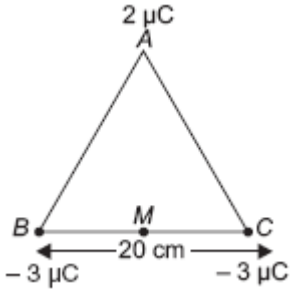
97 (a) Compare the individual dipole moment and the specimen dipole moment for H_2O molecule and O_2 molecule when placed in
(i) absence of external electric field
(ii) presence of external electric field.
Justify your answer.
(b) Given two parallel conducting plates of area A and charge densities +σ and −σ. A dielectric slab of constant K and a conducting slab of thickness d each are inserted in between them as shown.
(i) Find the potential difference between the plates.
(ii) Plot E versus **x** graph, taking **x** = 0 at positive plate and **x** = 5**d** at negative plate.



98 (a) A parallel plate capacitor is charged by a battery to a potential. The battery is disconnected and a dielectric slab is inserted to completely fill the space between the plates. How will (i) its capacitance, (ii) electric field between the plates, and (iii) energy stored in the capacitor be affected?
Justify your answer giving necessary mathematical expressions for each case.
(b) Sketch the pattern of electric field lines due to (i) a conducting sphere having negative charge in it, (ii) an electric dipole.

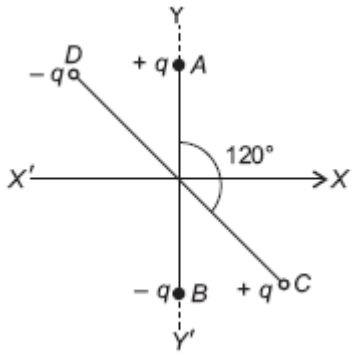
99 If **n** similar small drops of mercury, each of capacity **C**, surface charge density σ, energy **E** and potential **V**, combine to form a big drop, then calculate the capacity, surface charge density, energy and potential of the big drop.

100 Three point charges of +2 μC, −3 μC and −3 μC are kept at the vertices **A**, **B** and **C** respectively of an equilateral triangle of side 20 cm as shown in the figure. What should be the sign and magnitude of the charge to be placed at the mid-point (**M**) of side **BC** so that the charge at **A** remains in equilibrium?

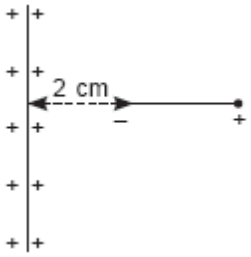


101 Given a uniform electric field $\vec{E} = 5 \times 10^3 \hat{i}$ N/C, find the flux of this field through a square of 10 cm on a side whose plane is parallel to the **y-z** plane. What would be the flux through the same square if the plane makes a 30° angle with the **x**-axis?

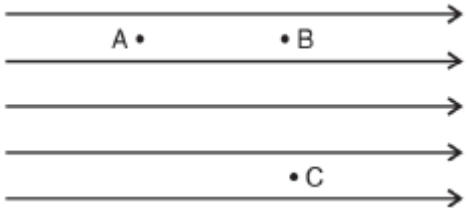
102 Two small identical electrical dipoles **AB** and **CD**, each of dipole moment **p** are kept at an angle of 120° as shown in the figure. What is the resultant dipole moment of this combination? If this system is subjected to electric field $(\vec{E})$ directed along **+X** direction, what will be the magnitude and direction of the torque acting on this?



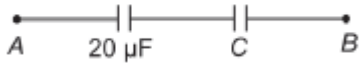
103 An electric dipole consists of charges $\pm 2.0 \times 10^{-8}$C separated by a distance of 2.0×10^{-3} m. It is placed near a long line charge of linear charge density 4.0×10^{-4} C/m as shown in the figure, such that the negative charge is at a distance of 2.0 cm from the line charge. Find the force acting on the dipole.



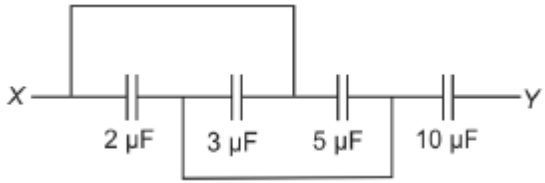
104 In a uniform electrostatic field of strength 5×10^5 N/C, what will be the potential difference between the points **A** and **C** as shown? It is given that **AC** = 5 cm and **BC** = 3 cm.



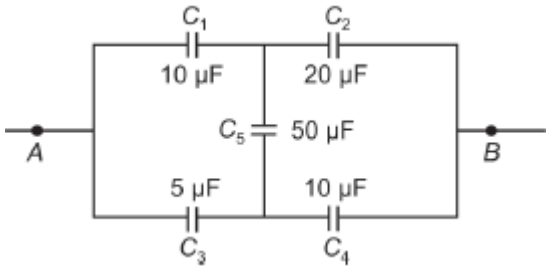
105 The equivalent capacitance of the combination between **A** and **B** in the given figure is 4 μF.
(i) Calculate capacitance of the capacitor **C**.
(ii) Calculate charge on each capacitor if a 12 V battery is connected across terminals **A** and **B**.
(iii) What will be the potential drop across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



106 Four capacitors are connected as shown in the figure. Calculate the equivalent capacitance between the points **X** and **Y**.

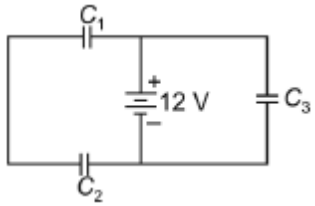


107 Calculate the equivalent capacitance between the points A and B of the circuit given below. If a battery of emf 10 V is connected between the points A and B, calculate the total charge



in the circuit.

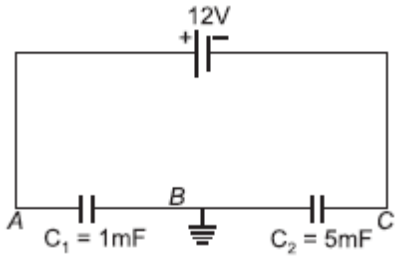
108 Three identical capacitors C_1, C_2 and C_3 of capacitance 6 μF each are connected to a 12 V battery as shown.
Find (i) charge on each capacitor. (ii) equivalent capacitance of the network and (iii) energy



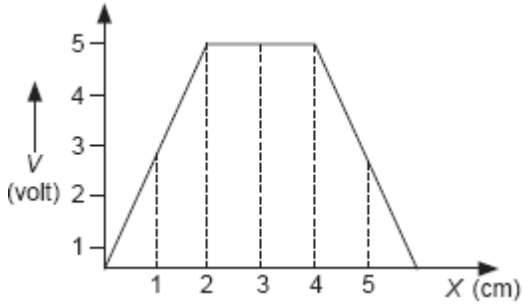
stored in the network of capacitors.

109

Find the potential at **A** and **C** in the following circuit.



110 The variation of electric potential with distance from a fixed point is shown in the figure.



What is the electric field at (i) **x** = 3 and (ii) **x** = 5?