AISSCE Home Assignment – 02

UNIT – I ELECTROSTATICS

Chapter – 02 Electrostatic potential and capacitances

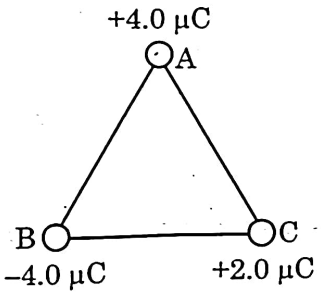
CBSE 2023

1. Two charged conducting spheres of radii a and b are connected to each other by a wire. Find the ratio of the electric fields at their surfaces.

OR

2. A parallel plate capacitor (A) of capacitance C is charged by a battery to voltage V. The battery is disconnected and an uncharged capacitor (B) of capacitance 2C is connected across A. Find the ratio of
   (i) Final charges on A and B.
   (ii) total electrostatic energy stored in A and B finally and that stored in a initially. (3)

3. (i) Consider two identical point charges located at points (0,0) and (a,0). Is there a point on the line joining them at which the electric potential is zero? Justify your answer.
   (ii) State the significance of negative value of electrostatic potential energy of a system of charges.
   Three charges are placed at the corners of an equilateral triangle ABC of side 2 m as shown in figure. Calculate the electric potential energy of the system of three charges. (5)



CBSE 2022

1. The electric potential V at any point (x,y,z) is given by $V = 3x^2$ Where x is in metres and V in volts. The electric field at the point (1m, 0, 2m) is –
   (a) 6 V/m along – x axis (b) 6 V/m along + x axis
   (c) 1.5 V/m along – x axis (d) 1.5 V/m along + x axis

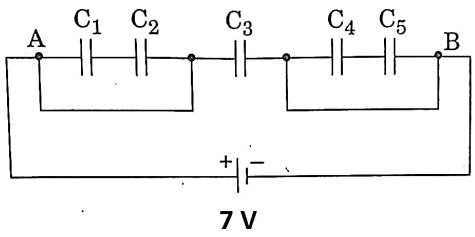
2. A variable capacitor is connected to a 200 V battery. If its capacitance is changed from 2 μF to X μF, the decrease in energy of the capacitor is 2×10^{-2} J. The value of X is –
   (a) 1 μF (b) 2 μF (c) 3 μF (d) 4 μF

3. A + 3.0 nC charge Q is initially at rest at a distance of $r_1 = 10$ cm from a + 5.0 nC charge q fixed at the origin. The charge Q is moved away from q to a new position $r_2 = 15$ cm. In this process work done by the field is
   (a) 1.29×10^{-5} J (b) 3.6×10^{5} J (c) -4.5×10^{-7} J (d) 4.5×10^{-7} J

4. Two charges 14 μC and – 4 μC are placed at (-12 cm, 0, 0) and (12 cm, 0, 0) in an external electric field $E = \frac{B}{r^2}$, where B = 1.2 x 10^6 N/ $(cm)^2$ and r is in metres. The electrostatic potential energy of the configuration is

(a) 97.9 J (b) 102.1 J (c) 2.1 J (d) - 97.9 J

CBSE 2020



(SET – 1)

1. In the figure given below, find the

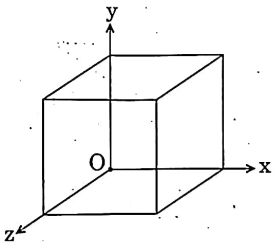
(a) Equivalent capacitance of the network between points A and B.
Given : $C_1 = C_5 = 8$ μF, $C_2 = C_3 = C_4 = 4$ μF.

(b) maximum charge supplied by the battery, and (c) total energy stored in the network. (3)

2. (a) Two point charges q_1 and q_2 are kept r distance apart in uniform external electric field $\vec{E}$. Find the work done in assembling this system of charges.

(b) A cube of side 20 cm is kept in a region as shown in the figure. An electric field $\vec{E}$ exists in the region such that the potential at a point is given by V = 10 x + 5, where V is in volt and x is in m. Find the

(i) Electric field $\vec{E}$, and (ii) total electric flux through the cube.



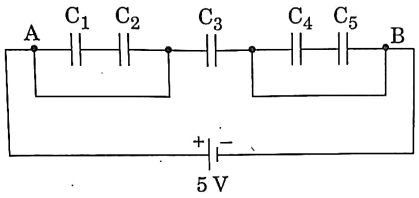
(SET – 2)

1. In the figure given below, find the

(a) Equivalent capacitance of the network between points A and B.
Given : $C_1 = C_5 = 4$ μF, $C_2 = C_3 = C_4 = 2$ μF.

(b) maximum charge supplied by the battery, and

(c) total energy stored in the network. (3)



(SET – 3)

1. The potential difference between two points in vacuum is V_0. If vacuum is replaced by a medium of dielectric constant K, the new value of potential difference will be ____.(1)

2. A capacitor of 4 μF is charged by a battery of 12 V. The battery is disconnected and a dielectric slab of dielectric constant 8 is inserted between the plates of the capacitor to fill the space completely. Find the change in the

(a) charge stored in the capacitor, (b) potential difference between the plates of the capacitor, and

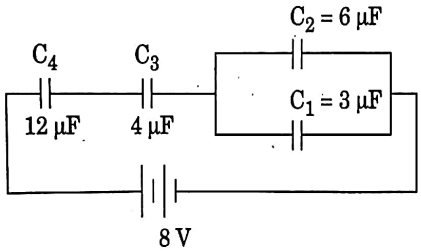
(c) energy stored in the capacitor. (3)

CBSE 2019

1. Draw the equipotential surfaces for an electric dipole. (1)

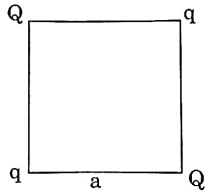
2. A 200 μF parallel plate capacitor having plate separation of 5 mm is charged by a 100 V dc source. It remains connected to the source. Using an insulated handle, the distance between the plates is doubled and a dielectric slab of thickness 5 mm and dielectric constant 10 is introduced between the plates. Explain with reason, how the (i) capacitance, (ii) electric field between the plates, (iii) energy density of the capacitor will change? (3)

3. In a network, four capacitors C_1, C_2, C_3 and C_4 are connected as shown in the figure.
   (a) Calculate the net capacitance in the circuit.
   (b) if the charge on capacitor C_1 is 6μC, (i) calculate the charge on capacitor C_3 and C_4, and (ii) net energy stored in the capacitors C_3 and C_4 connected in series. (3)

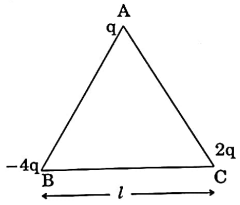


CBSE 2018

1. Four charges Q, q, Q and q are placed at the corners of a square of side 'a' as shown in figure. Find the (a) resultant electric force on a charge Q, and (b) potential energy of this system. (3)

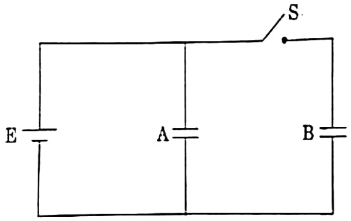


2. Three charges q, -4q and 2q are placed at the vertices of an equilateral triangle ABC of side 'l' as shown in figure.
   (a) Obtain the expression for the magnitude of the resultant electric force acting on charge q.
   (b) Find out the amount of work done to separate the charge at infinite distance. (3)



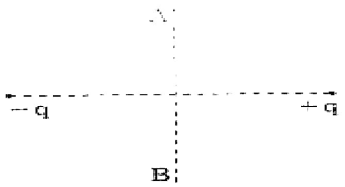
CBSE 2017

1. Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S closed. The switch is now opened and the free space between plates of the capacitor is filled with a dielectric of dielectric constant K. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric. (3)



CBSE 2016

1. A charge 'q' is moved from point A above the dipole of dipole moment 'p' to a point B below the dipole in equatorial plane without acceleration. Find the work done in the process. (1)



2. Define equipotential surface. Draw equipotential surfaces :
   (i) In case of a single point charge and
   (ii) In a constant electric field in Z- direction. Why the equipotential surfaces about a single point charge are not equidistant?
   (iii) Can electric field exist to an equipotential surface? Give reason. (3)

3. Find the ratio of potential differences that must be applied across the parallel and series combinations 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. (5)

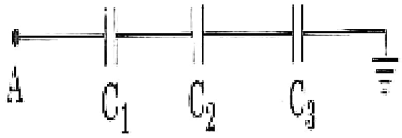
4. (i) If two similar large plates, each of area 'A' having charge densities + σ and – σ are separated by a distance 'd' in air. Find the expression for field at points between the two plates and on outer side of the plates.
   (a) Specify the direction of field in each case.

(b) The potential difference between the plates.
(c) The capacitance of the capacitor so formed.

(ii) Two metallic spheres of radii R and 2R are charged so that both of these have same surface charge density 'σ'. If they are connected to each other with a conducting wire, in which direction will the charge flow and why? (5)

CBSE 2015

1. Calculate potential difference and the energy stored in the circuit shown in the fig. Given that potential at A is 90 V, $C_1 = 20\ \mu F$, $C_2 = 30\ \mu F$ and $C_3 = 15\ \mu F$ (3)



2. (a) Derive the expression for the energy stored in a parallel plate capacitor. Hence obtain the expression for the energy density of the electric field.
(b) A fully charged parallel plate capacitor is connected across an uncharged identical capacitor. Show that the energy stored in the combination is less than that stored initially in the single capacitor.(5)

CBSE 2014

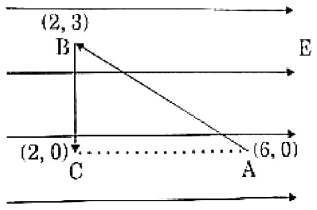
1. A parallel palate capacitor of capacitance C is charged to a potential V. It is then connected to another capacitor having same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor. (2)

CBSE 2013

1. 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. (2)

CBSE 2012

1. 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? (3)



2. (a) Deduce the expression for the electrostatic energy stored in a capacitor of capacitance 'C' and having charge 'Q'.
(b) 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? (3)