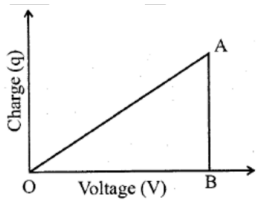
CHAPTER -2

ELECTRIC POTENTIAL AND CAPACITORS

1. (a) You are given two capacitors having capacitances C_1 and C_2 .

Derive an equation for the equivalent capacitance in (i) Series and (ii) Parallel combinations. (Score: 4)

(b) The variations of charge (q) on a capacitor with voltage (V) is shown in the figure given below:



The area of the ΔOAB represents

(i) Capacitance (ii) Capacitive reactance

(iii) Electric field between the plates

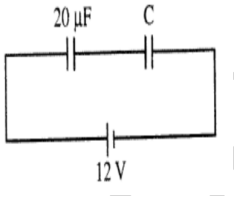
(iv) Energy stored in the capacitor.

(Score: 1) **[JUNE-2016]**

2. An equipotential surface is a surface with constant value of potential at all points on the surface.

(a) What is the amount of work done in moving a 2 μc charge between two points at 3 cm apart on an equipotential surface?

(b) Two capacitors are connected as shown in figure below



If the equivalent capacitance of the combination is 4 μF

(i)Calculate the value of C.

(ii) Calculate the charge on each capacitor.

(iii) What will be the potential drop across each capacitor?

(c) Two metallic spheres of same radii, one hollow and one solid, are charged to the same potential. Which will hold more charge?

(i) Solid sphere

(ii) Both will hold same charge

(iii) Hollow sphere

(iv) Cannot predict

(Score: 1+3+1) **[MARCH-2016]**

3. A capacitor is an electronic component having two conductors separated by an insulator.

a) An insulated capacitor with air between its plates has a potential difference of V_0 and a charge Q_0. When the space between the plates is filled with oil, the potential difference becomes V and charge become Q. Which of the following relation is correct?

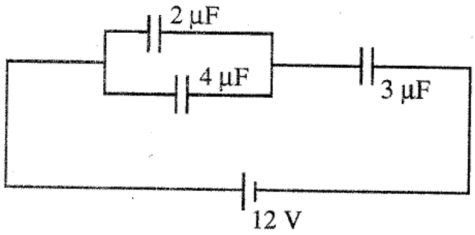
(i) $Q = Q_0$ $V > V_0$

(ii) $Q = Q_0$ $V < V_0$

(iii) $Q > Q_0$ $V = V_0$

(iv) $Q < Q_0$ $V = V_0$

b) Three capacitors are connected to a 12 V battery as shown in figure:



(i) What is the effective capacitance of the combination?

(ii) What is the potential difference across the 2 μ F capacitor?

(Score: 1+ ½ + 1 ½) **[JUNE-2015]**

4. (A) A device to store electric charge is called

(a) Transformer (b) Capacitor

(c) Resistor (d) Inductor

(B) What is meant by energy density of a capacitor?

(C) Derive an expression for the energy stored in a parallel plate capacitor.

(D) What is the area of plates of a 0.1μF parallel plate air capacitor, given that the separation between the plates is 0.1mm?

(Score: ½ +1+2+ 1 ½) **[MARCH 2015]**

5. A parallel plate capacitor connected to a cell gets fully charged. After disconnecting the cell, a thin sheet of mica is placed between the plates of the capacitor.

What happens to its
a) Charge b) Capacitance.
(Score: 1) **[JUNE 2014]**

6. A parallel plate capacitor consists of two metallic plate separated by a small distance with a dielectric in between.

a) A parallel plate air capacitor ahs charge densities $+\sigma$ and $-\sigma$ on the plates. Write the expression for electric field between the plates. What happens to the field if the separation between the plates is doubled? (Score: 1)

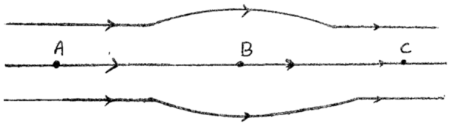
b) You are given two capacitors. They can be used individually, in series or in parallel in a circuit. Let the four possible values of capacitances be $3\mu F, 4\mu F$ $12\mu F$ and $16\mu F$. If so what are the values of individual capacitance given to you? (Score: 1)

c) Obtain the expression for effective capacitance, when three capacitors C_1, C_2 and C_3 are connected in series.
(Score: 2)

d) A parallel plate capacitor with air between the plates has a capacitance of $8\mu F$. What will be the capacitance if the distance between the plates is reduced by half and the space between is filled with a medium of dielectric constant 5?
(Score: 2) **[MAY 2013]**

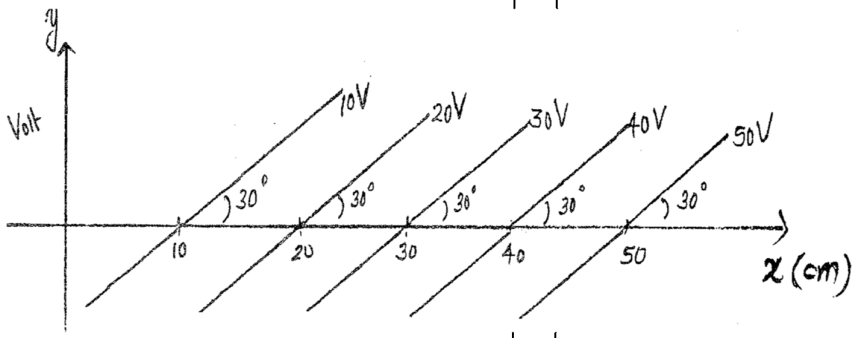
7. The region around a charge where its effect can be felt is called the electric field.

a) The electric field lines corresponding to an electric field is shown below.



The figure suggests that
i) $E_A > E_B > E_C$
ii) $E_A = E_B = E_C$
iii) $E_A < E_B < E_C$
iv) $E_A = E_B > E_C$
v) $E_A = E_B > E_C$ (Score: 1)

b) Some equipotential surfaces are shown in the figure. What can you say about the magnitude and direction of the electric field?



(Score: 2) **[MARCH 2013]**

8. Capacitor is an arrangement to increase the charge carrying capacity of a conductor.

a) Each plate of a parallel plate capacitor has a charge q on it. The capacitor is now connected to a battery. Pick out the correct statement/statements:

(Score: 1)

i) The facing surface of the plates have equal and opposite charges.

ii) The battery supplies equal and opposite charges to the two plates.

iii) The two plates of the capacitor have equal and opposite charges.

b) The plates of a parallel plate capacitor each of area A is charged with charges +Q and –Q. Deduce the force acting between the plates of the capacitor. (Score: 1)

c) Van De Graaff generator is a high voltage generator used to accelerate charged particles.
Draw a labelled schematic diagram of a Van De Graaff generator and state the principle behind its working.

(Score: 2) **[MARCH 2013]**

9. Besides its use in storing charge, a capacitor is a key element of most a.c circuits.

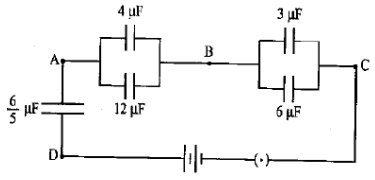
a) What are the factors on which the capacitance of a parallel plate air capacitor depends? (Score: 1)

b) Define the term 'dielectric constant' of a medium. (Score: 1)

c) Two capacitors C_1 and C_2 are connected in series. Derive an expression for the capacitance of the combination. (Score:2 ½)

d) Find the equivalent capacitance of capacitors given in the network.

(Score:2 ½)



[MARCH 2012]

10. A capacitor is a system of two conductors separated by an insulator.

a. Write down the relation for the capacity of a parallel plate capacitor.
b. The plates of a parallel plate capacitor have area of 90 cm^2 each and are separated by 2.5 mm. What would be its capacity?

$\epsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$

(Score: 1+2) **[SAY 2011]**

11. A capacitor is a device used for storing charges as well as energy. It is based on a property called capacitance.

a) Write the SI unit of capacitance and define it.
b) You are given two capacitors of 2μF and 3 μF. What are the maximum and minimum values of capacitance that can be obtained by combining them?
c) Obtain an expression for the electrostatic energy stored in a capacitor

(Score: 1+2+3) **[MARCH-2011]**

12. For a parallel plate capacitor with each plate of area 'A' separated by distance 'd' in air, its capacitance is given by $C = \frac{\varepsilon_0 A}{d}$

a) Represent the charge 'q' given to a capacitor of capacitance 'C' with potential difference 'V' in a graph. What will be the shape of the curve?
b) If you connect the plates of a parallel plate capacitor by a copper wire, what happens to the capacitor? Justify your answer.
c) Using the above expression, show that energy density of a parallel plate capacitor is $\frac{1}{2}\varepsilon_0 E^2$ where 'E' is electric field between parallel plates.

(Score: 1½ + 1 ½ +3) **[JUNE-2010]**

13. One coulomb charge is initially at rest and is accelerated through a potential difference of I volt. During this process the kinetic energy acquired by the charge is

(a) I J (b) 1.6×10^{-19}J

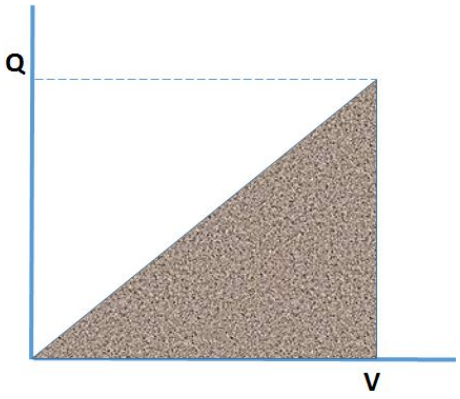
(c) 1.6×10^{19}J (d) 10J

(Score: ½ x4=2) **[MARCH-2010]**

14. Capacitors are considered to be the building blocks of all integrated circuits. A Parallel plate capacitor is a simple form of a capacitor.

a) Write down the expression for the capacity of a parallel plate air capacitor in terms of plate area and their separation.
b) Raju found that capacity of a parallel plate air capacitor is 10 μF. Find the capacity of it when he immersed the unit completely in a medium of dielectric constant 2.5.
c) Obtain an expression for the energy stored in a capacitor.
d) Raju charged this capacitor and he plotted a graph between changing potential and charge stored in the capacitor. The graph is shown in the figure.

What does the area of the shaded portion of the graph represent?



(Score: 1 +2+3+ 1) **[MARCH-2010]**