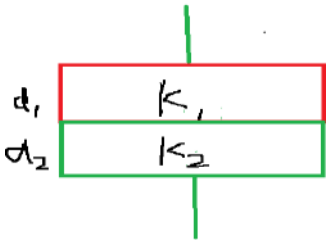
CHAPTER-2

Electrostatic Potential and Capacitance

ASSIGNMENT-3

1 MARK QUESTIONS

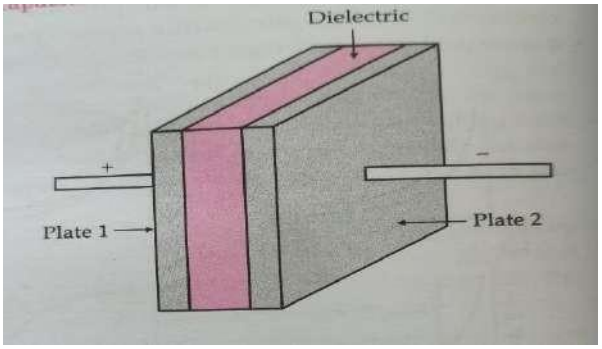
Q1. A parallel plate capacitor is made of two dielectric blocks in series. One of the blocks has thickness d_1 and dielectric constant K_1 and the other has thickness d_2 and dielectric constant K_2 as shown in figure. This arrangement can be thought as a dielectric slab of thickness d (= d_1 + d_2) and effective dielectric constant K. Then K is



(a) $\frac{k_1 d_1 + k_2 d_2}{d_1 + d_2}$ **(b)** $\frac{k_1 + k_2 d_2}{k_1 + k_2}$

(c) $\frac{k_2 k_1 + (d_1 + d_2)}{(k_1 a, + k_2 d_2)}$ **(d)** $\frac{2k_1 k_2}{k_1^+ k_2}$

Q2. **CASE BASED STUDY QUESTION**



An arrangement of two conductors separated by an insulating medium can be used to store electric charge and electric energy. Such a system is called a capacitor. The more charge a capacitor can store, the greater is its capacitance. Usually, a capacitor consists of two conductors having equal and opposite charge +Q and -Q. Hence, there is a potential difference V between them. By the capacitance of a capacitor, we mean the ratio of the charge Q to the potential difference V. By the charge on a capacitor we mean only the charge Q on the positive plate. Total charge of the capacitor is zero. The capacitance of a capacitor is a constant and depends on geometric factors, such as the shapes, sizes and relative positions of the two conductors, and the nature of the medium between them. The unit of capacitance is farad (F), but the more convenient units are μF and pF. A commonly used capacitor consists of two long strips or metal foils, separated by two long strips of dielectrics, rolled up into a small cylinder. Common dielectric materials are plastics (such as polyestors and polycarbonates) and aluminium oxide. Capacitors are widely used in radio, television, computer, and other electric circuits.

1.A parallel plate capacitor C has a charge Q . The actual charge on its plates are

(a) Q,Q (b) Q/2, Q/2 (c) Q ,-Q (d) Q/2, -Q/2

2.A parallel plate capacitor is charged. If the plates are pulled apart .

(a) the capacitance increases (b) the potential difference increases

(c) the total charge increases (d) the charge & potential difference remains the same

3.Three capacitors of 2 , 3 & 6 μF are connected in series to a 10 V source. The charge on the 3 μF capacitor is

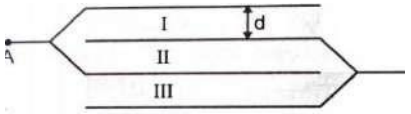
(a) 5μC (b) 10μC (c) 12μC (d) 15μC

4.If n capacitors each of capacitance C are connected in series, then the equivalent capacitance of the combination is

(a) NC (b) n^2C (c) C/n (d) C/n^2

1 MARKS QUESTIONS

Q3. A capacitor has some dielectric between its plates and the capacitor is connected to a DC source. The battery is now disconnected and then the dielectric is removed. State whether the capacitance, electric field, charge stored and the voltage will increase, decrease or remain constant.



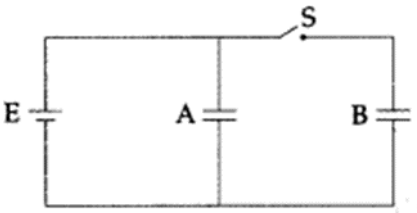
Q4.What is the capacitance of arrangement of 4 plates of area A at distance d in air in fig.

Q5. A parallel plate capacitor has square plates of side 5 cm and separated by a distance of 1 mm. (a) Calculate the capacitance of this capacitor. (b) If a 10 V battery is connected to the capacitor, what is the charge stored in any one of the plates? (The value of $\varepsilon_o = 8.85 \times 10^{-12}$ Nm^2 C^{-2})

2 MARKS QUESTIONS

Q6. 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 ?

Q7.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 the plates of the capacitors 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.

5 MARKS QUESTIONS

Q8. A capacitor of unknown capacitance is connected across a battery of V volt. A charge of 120 μC is stored in it. When the potential across the capacitor is reduced by 40 V, the charge stored in the capacitor becomes 40 μC. Calculate V and the unknown capacitance. What would have been the charge in the capacitor if the voltage were increased by 40 V?

Q9. A capacitor of unknown capacitance is connected across a battery of V volt. A charge of 240 pC is stored in it. When the potential across the capacitor is reduced by 80 V, the charge stored in the capacitor becomes 80 pC. Calculate V and the unknown capacitance. What would have been the charge in the capacitor if the voltage were increased by 80 V?

Q10. Find equivalent capacitance between A and B in the combination given below. Each capacitor is of 2 μF capacitance.