Assignment-1
Answer Key

1. Zero, because the two plates have equal & opposite charges.

2. A surface with a constant value of potential at all points on the surface. Example: Surface of a charged conductor.

3. For the point charge, the equipotential surfaces are concentric spherical shells with their centre at the point charge.

4. If it were not so, the presence of a component of the field along the surface would destroy its equipotential nature

5. The ratio of the capacitance of the capacitor completely filled with dielectric material to the capacitance of the same capacitor with vacuum between the platesis called dielectric constant.

6. Water molecules have permanent dipole moment.

7. Electrostatic potential energy

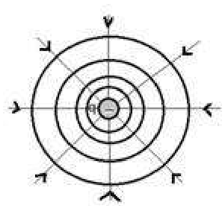
MCQ

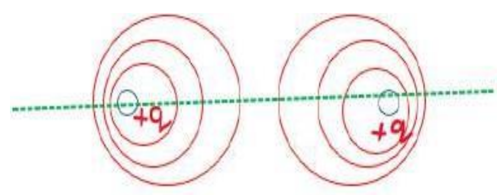
8. (c) 9. (b) V = Ed , V increases as distance increases

10. (a) 11. (a) 12. (d)

2 MARKS ANSWERS

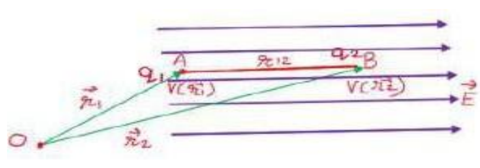
13.





14. Work done in moving the charge q_1 at the point A,

$W_1 = q_1V\ (\mathbf{r_1})$ Work done in moving the charge q_1 at the point B,



$$W_2 = q_2V\ (\mathbf{r_2}) + \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r_{12}}$$

Total work done in assembling this configuration,

$$W = W_1 + W_2$$

$$W = q_1V\ (\mathbf{r_1}) + q_2V\ (\mathbf{r_2}) + \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r_{12}}$$

3 MARKS ANSWERS

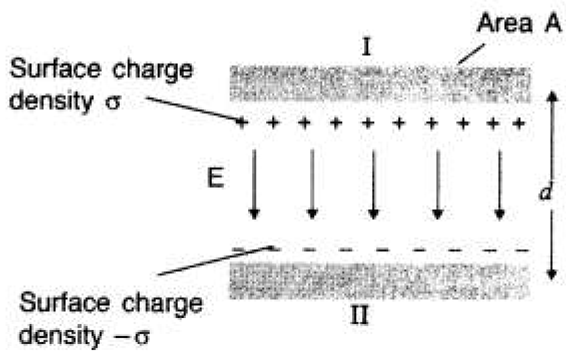
15. Derivation from ncert book

16. Derivation from ncert book

5 MARKS ANSWERS

17.When a charge of one coulomb produces a potential difference of one volt between the plates of capacitor, the capacitance is one farad.

Capacity of a parallel plate capacitor. A parallel plate capacitor consists of two large plane parallel conducting plates separated by a small distance. We first take the intervening medium between the plates to be vaccum. Let A be the area of each plate and d the separation between them. The two plates have charges Q and – Q. Since d is much smaller than the linear dimension of the plates ($d^2 << A$), we can use the result on electric field by an infinite plane sheet of uniform surface charge density. Plate 1 has surface charge density σ = Q/A and Plate 2 has a surface charge density -σ, the electric field in different region is:



Outer region I (region above the plate 1),

$$E = \frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0} = 0$$

Outer region II (region below the plate 2),

$$E = \frac{\sigma}{2\varepsilon_0} - \frac{\sigma}{2\varepsilon_0} = 0$$

In the inner region between the plates 1 and 2, the electric fields due to the two charged plates add up, giving

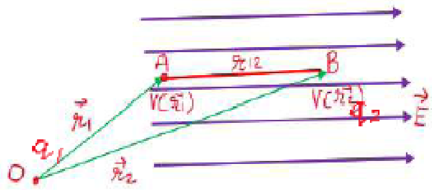
$$E = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0} = \frac{Q}{\varepsilon_0 A} \text{ or } V = Ed = \frac{1}{\varepsilon_0}\frac{Qd}{A}$$

The capacitance C of the parallel plate capacitor is then

$$C = \frac{Q}{V} = \frac{\varepsilon_0 A}{d}$$

18. a) The potential energy of a system of two charges is the amount of work done in assembling the charges at their locations by bringing them in, from infinity.

(b) Work done in moving the charge q_1 at the point A,



$W_1 = q_1V\,(\mathbf{r}_1)$

Work done in moving the charge q_1 at the point B,

$W_2 = q_2V\,(\mathbf{r}_2) + \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r_{12}}$

Electric energy of the system,

U = Total work done in assembling this configuration,

$U = W_1 + W_2$

$U = q_1V\,(\mathbf{r}_1) + q_2V\,(\mathbf{r}_2) + \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r_{12}}$