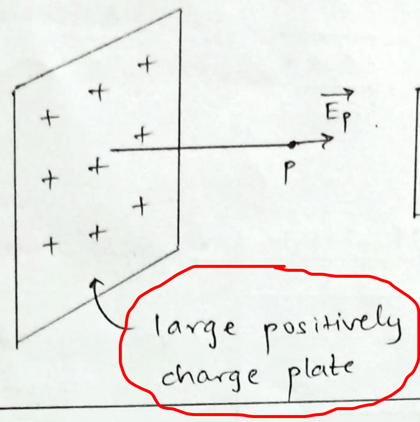
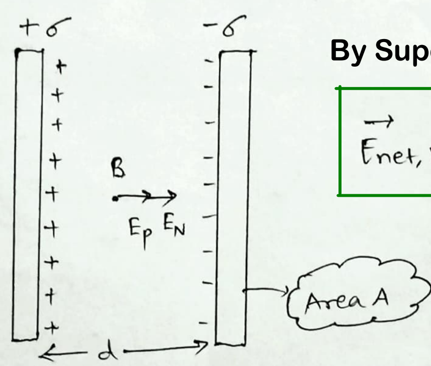
Capacitance Expression for Parallel Plate Capacitor

- We all know, (From Electrostatics)



$$\boxed{E_P = \frac{\sigma}{2\varepsilon_0}}$$

- Now, we find the electric field at any general point B considered between the 2 plates



By Superposition Principle,

$$\boxed{\vec{E}_{net,B} = \vec{E}_P + \vec{E}_N}$$

$$|\vec{E_P}| = \frac{\sigma}{2\varepsilon_0} \qquad |\vec{E_N}| = \frac{\sigma}{2\varepsilon_0}$$

$$\therefore \quad |\vec{E}_{net,B}| = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

- We know,

$$\Delta V = E \times d$$

$$\Delta V = \frac{\sigma}{\varepsilon_0} \times d = \frac{Qd}{A\varepsilon_0}$$

• We know $C = \frac{Q}{\Delta V}$

$$C = \frac{Q}{\left(\frac{Qd}{A\varepsilon_0}\right)} = \frac{A\varepsilon_0}{d}$$

∴ For parallel plate capacitor,

$$\boxed{C = \frac{A\varepsilon_0}{d}} \quad \text{(for air as dielectric)}$$

* Note : 'B' was any general point considerd in the region between the 2 plates.

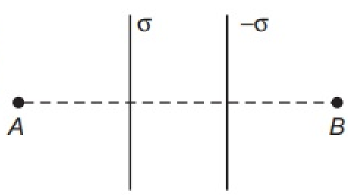
$$|\vec{E}_{B,net}| = \frac{\sigma}{\varepsilon_0}$$

Independent of x

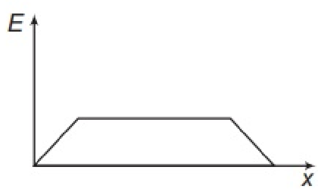
⇓

∴ uniform field between 2 plates

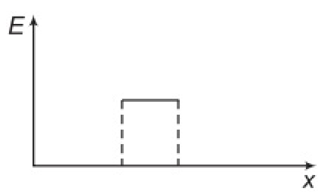
Two large parallel sheets charged uniformly with surface charge density σ and – σ are located as shown in the figure. Which one of the following graphs shows the variation of electric field along a line perpendicular to the sheets as one moves from *A* to *B*?



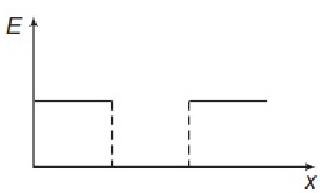
(a)



(b)



(c)



(d)