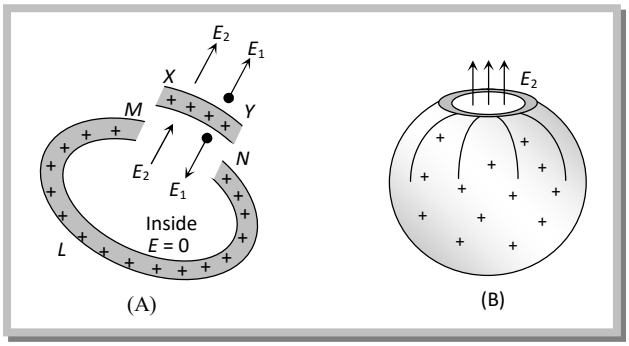
Force on a Charged Conductor.

To find force on a charged conductor (due to repulsion of like charges) imagine a small part XY to be cut and just separated from the rest of the conductor MLN. The field in the cavity due to the rest of the conductor is E_2, while field due to small part is E_1. Then

Inside the conductor $E = E_1 - E_2 = 0$ or $E_1 = E_2$

Outside the conductor $E = E_1 + E_2 = \dfrac{\sigma}{\varepsilon_0}$

Thus $E_1 = E_2 = \dfrac{\sigma}{2\varepsilon_0}$



To find force, imagine charged part XY (having charge $\sigma\, dA$ placed in the cavity MN having field E_2). Thus force $dF = (\sigma\, dA)E_2$ or $dF = \dfrac{\sigma^2}{2\varepsilon_0} dA$. The force per unit area or electric pressure is

$$\frac{dF}{dA} = \frac{\sigma^2}{2\varepsilon_0}$$

The force is always outwards as $(\pm\sigma)^2$ is positive i.e., whether charged positively or negatively, this force will try to expand the charged body.

A soap bubble or rubber balloon expands on given charge to it (charge of any kind + or –).