PHYSICS PRESENTATION

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Concepts used for the question- Superposition of electric fields

The problem- To find the force of interaction between two non conducting hemispherical shells with the charge distribution as given in the figure 1.1

Solution- consider the case where both charge

distributions are same and are **σ1.**

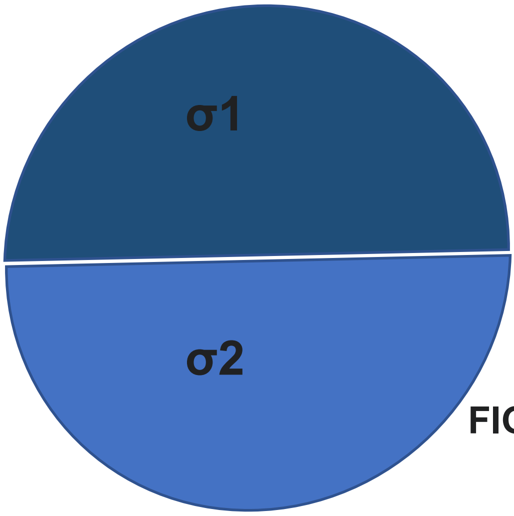

FIG - 1.1

Now, we can write an integral as such

$\int E(z)\sigma 1 da$ = Interaction force …….(1)

Here the E(z) is the field along z axis (as those parallel to xy plane would cancel out)

Case when charge distributions are the same-

- For this, first we will go about finding the electric field at the surface(we will remove a small da from a part and write the electric field at that place), this turn out to be $\sigma 1/2\varepsilon_0$ (standard result)
- Now the integration part- $\int \frac{\sigma 1}{2\varepsilon 0}\sigma 1 \ \cos \boldsymbol{\theta}\, da$ where **θ** is the angle made by the vector from the centre of the sphere to da with respect to the z axis. This integral is basically saying that the force of interaction is contributed by the z component of forces(as the horizontal components cancel out). One more thing this integral is saying is, **locally** the z component of the force(magnitude) is cos(θ) times the net force. We can transfer this cos(θ) over to da, which is just the projection of da over the xy plane. Doing so, the integral reduces to - $(\sigma 1/2\varepsilon 0)\, \sigma 1\, \pi\, R^2$.

Finding the final "expression"

$\int E(z)\sigma 1 da$ = $(\sigma 1/2\varepsilon 0)\, \sigma 1\, \pi\, R^2$.

- ⇨ $\int E(z) da$ = $(\sigma 1/2\varepsilon 0)\pi\, R^2$, hence we have successfully found an expression for $\int E(z) da$ given a hemisphere of charge distribution σ1 of hemisphere.
- ⇨ *Therefore the force of interaction is* $\int E(z)\sigma 2 da$ = $(\sigma 1/2\varepsilon 0)\, \sigma 2\, \pi\, R^2$. (ANSWER)