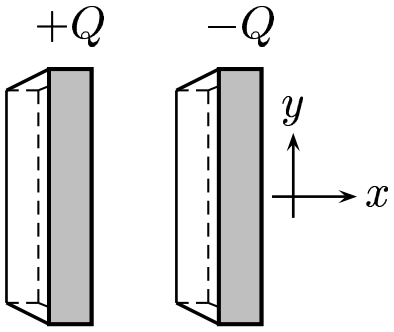
Consider an electrostatic situation. A parallel plate system has a plate charge $+Q$ on the left-hand plate and a plate charge $-Q$ on the right-hand plate. Each plate has an area A.



Determine the the force F the right-hand plate exerts on the left-hand plate.

A) $\vec{F}_{left} = \dfrac{Q^2}{\epsilon_0 A}$, to the right.

B) $\vec{F}_{left} = \dfrac{Q^2}{\epsilon_0 A}$, to the left.

C) $\vec{F}_{left} = \dfrac{Q^2}{2\,\epsilon_0 A}$, to the right.

D) $\vec{F}_{left} = \dfrac{Q^2}{2\,\epsilon_0 A}$, to the left.

The areal charge density is $\sigma = \dfrac{Q}{A}$, therefore

$$E_{gap} = \frac{\sigma}{\epsilon_0} = \frac{Q}{\epsilon_0 A}\,.$$

The electric field due to be right-hand plate alone contributes to one-half of the total field in the gap; *i.e.*,

$$E_{left} = \frac{\sigma}{2\,\epsilon_0} = \frac{Q}{2\,\epsilon_0 A} \quad \Rightarrow \quad \vec{F}_{left} = \frac{Q^2}{2\,\epsilon_0 A}\,, \quad \text{to the right}\,.$$

Answer **C**.

24.04-02˙Field˙Between˙Plates 2005-9-15