

# Charged Plates

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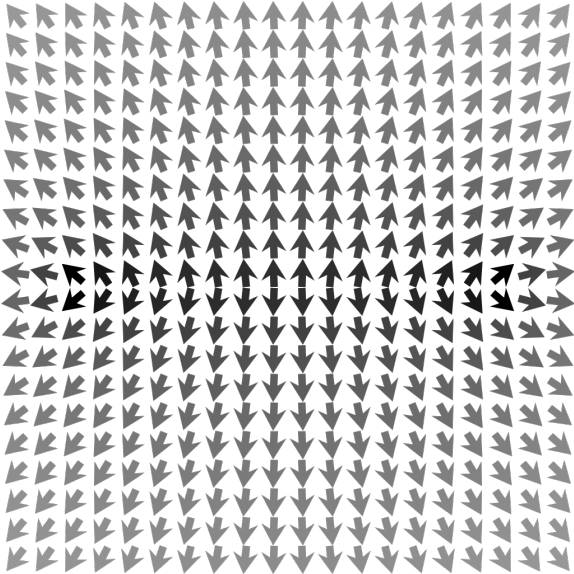
# Surface charge density

If charge is spread over a surface, it is useful to talk about the amount of charge per unit area. That is the purpose of *surface charge density*.

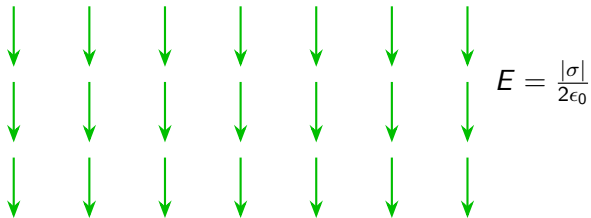
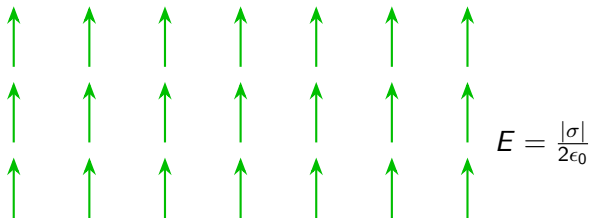
- ▶ Symbol for surface charge density is  $\sigma$  (lower case greek letter sigma).
- ▶ Units are  $\text{C}/\text{m}^2$ .
- ▶ If 20 C of charge is uniformly spread over a square plate 2 m by 2 m, the surface charge density is

$$\sigma = (20 \text{ C})/(4 \text{ m}^2) = 5 \text{ C}/\text{m}^2.$$

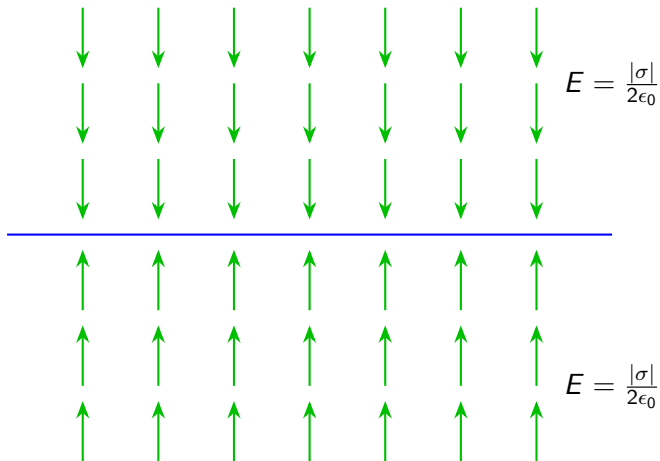
# Electric field produced by a positively charged plate



# Electric field produced by an ideal positively charged plate



# Electric field produced by an ideal negatively charged plate



## Electric field produced by a charged plate

The electric field produced by a large charged plate with surface charge density  $\sigma$  is

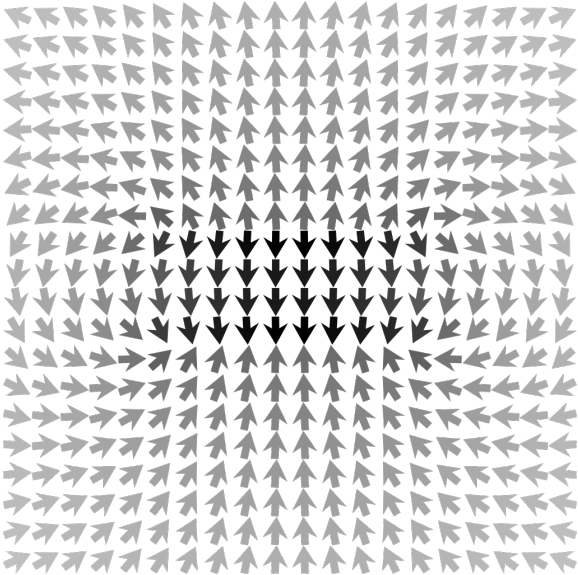
$$E = \frac{|\sigma|}{2\epsilon_0} = 2\pi k |\sigma|$$

- ▶ The electric field points away from the plate if the plate is positively charged.
- ▶ The electric field points toward the plate if the plate is negatively charged.
- ▶ If the plate is large and we are talking about places near the plate, away from its edges, then the electric field is uniform on each side of the plate, meaning its magnitude and direction do not change from place to place.

# Superposition Principle

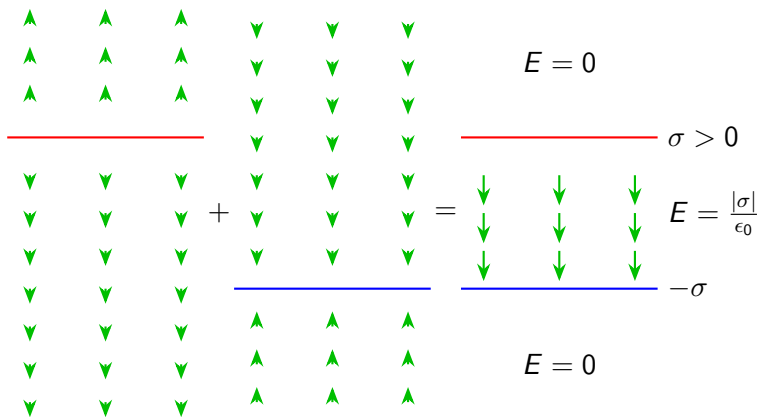
- ▶ The electric field produced by multiple objects is the vector sum of the electric fields produced by each object alone.
- ▶ Uses for superposition:
  - ▶ Electric field produced by two plates
  - ▶ Electric field produced by a particle and a plate
  - ▶ Electric field produced by two particles

# Electric field produced by a parallel-plate capacitor





# Superposition of positive and negative plates



# Electric field produced by an ideal parallel-plate capacitor

