When a potential difference of 150 V is applied to the plates of a parallel-plate capacitor, the plates carry a surface charge density of 30.0 nC/cm2 . What is the spacing between the plates?

Solution.

The capacitance of the parallel-plate capacitor is equal to the following:

$$C = \frac{\varepsilon_0 A}{d},$$

where C is the capacitance, A is the area of overlap of the two plates, ε_0 is the electric constant ($\varepsilon_0 \approx 8.85 \cdot 10^{-12}$ F/m), d is the spacing between the plates.
On the other hand, the capacitance is given by:

$$C = \frac{q}{U},$$

where q is the charge of one plate, U is the potential difference between the plates. The charge may be expressed in terms of the surface charge density σ:

$$q = \sigma A.$$

Considering all the formulas above we have:

$$\frac{\varepsilon_0 A}{d} = \frac{\sigma A}{U}; d = \frac{\varepsilon_0 U}{\sigma} = \frac{8.85 \cdot 10^{-12} \frac{\text{F}}{\text{m}} \cdot 150\text{V}}{30 \cdot 10^{-5} \frac{\text{C}}{\text{m}^2}} = 4.43 \text{ μm}.$$

Answer: 4.43 μm.