

49. (a) According to Chapter 26, the capacitance is $C = \kappa \varepsilon_0 A/d$. In our case $\kappa = 4.5$, $A = (0.50 \mu\text{m})^2$, and $d = 0.20 \mu\text{m}$, so

$$C = \frac{\kappa \varepsilon_0 A}{d} = \frac{(4.5)(8.85 \times 10^{-12} \text{ F/m})(0.50 \mu\text{m})^2}{0.20 \mu\text{m}} = 5.0 \times 10^{-17} \text{ F} .$$

- (b) Let the number of elementary charges in question be N . Then, the total amount of charges that appear in the gate is $q = Ne$. Thus, $q = Ne = CV$, which gives

$$N = \frac{CV}{e} = \frac{(5.0 \times 10^{-17} \text{ F})(1.0 \text{ V})}{1.6 \times 10^{-19} \text{ C}} = 3.1 \times 10^2 .$$