

Answer on Question #59301-Physics-Electromagnetism

After a parallel plate air filled capacitor has been charged to 70 V potential difference, the capacitor is disconnected from the voltage source. A sheet of plastic, dielectric constant $k = 3.50$, is slipped between its plates so as to fill the gap. What now is the potential difference between the plates if it is assumed that no charge left the capacitor's metal plates?

Solution

The capacitance of a parallel plate air filled capacitor:

$$C = \frac{\epsilon_0 A}{d}.$$

The charge is

$$Q = CU = \frac{\epsilon_0 A}{d} U.$$

New capacitance is

$$C' = \frac{k\epsilon_0 A}{d}.$$

The charge is conserved:

$$Q = Q' \rightarrow C'U' = CU = \frac{\epsilon_0 A}{d} U$$

$$\frac{k\epsilon_0 A}{d} U' = \frac{\epsilon_0 A}{d} U$$

$$U' = \frac{U}{k} = \frac{70 \text{ V}}{3.50} = 20 \text{ V}.$$

Answer: 20 V.