Answer on Question 56734, Physics, Electric Circuits

Question:

Two identical capacitors store different amounts of energy: capacitor A stores $3.8 \cdot 10^{-3} J$, and capacitor B stores $4.3 \cdot 10^{-4} J$. The voltage across the plates of capacitor B is $13V$. Find the voltage across the plates of capacitor A?

Solution:

Let's write the potential energy stored in two capacitors A and B:

$$U_A = \frac{1}{2} C_A (\Delta V_A)^2,$$

$$U_B = \frac{1}{2} C_B (\Delta V_B)^2,$$

here, C_A, C_B is the capacitance of capacitors A and B respectively; ΔV_A, ΔV_B is the voltage across the plates of capacitors A and B.

Let's find C_A and C_B from the previous equations:

$$C_A = \frac{2U_A}{(\Delta V_A)^2},$$

$$C_B = \frac{2U_B}{(\Delta V_B)^2}.$$

Since the capacitors are identical, $C_A = C_B = C$ and we can equate both expressions:

$$\frac{2U_A}{(\Delta V_A)^2} = \frac{2U_B}{(\Delta V_B)^2},$$

$$(\Delta V_A)^2 = \frac{2U_A \cdot (\Delta V_B)^2}{2U_B} = \frac{U_A \cdot (\Delta V_B)^2}{U_B},$$

$$\Delta V_A = \sqrt{\frac{U_A \cdot (\Delta V_B)^2}{U_B}} = \sqrt{\frac{3.8 \cdot 10^{-3} J \cdot (13V)^2}{4.3 \cdot 10^{-4} J}} = 38.6V.$$

Answer:

The voltage across the plates of capacitor A is $\Delta V_A = 38.6V$.