Answer on Question #90479, Physics / Electric Circuits

A capacitor is charged to store energy U. The charging battery is now disconnected. An identical capacitor is now connected to first one in parallel. What is the energy in each of the capacitors?

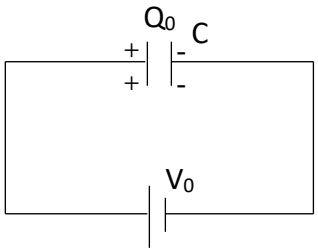
Solution:

Let a capacitor of capacitance C is connected to a charging battery of voltage V_0. Then the charge on the capacitor is given by

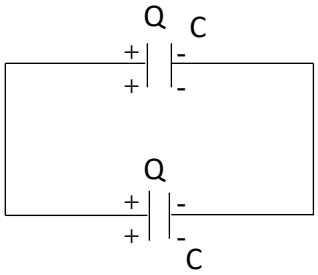
$$Q_0 = CV_0$$

and the energy stored in the capacitor is

$$U = \frac{1}{2}CV_0^2$$



When the battery is disconnected and an identical capacitor is connected to the first one in parallel, the charge from the first capacitor will flow to the second capacitor until the voltage across them become same. Let Q be the charge on each capacitor (since capacitors are identical, both will have same charge) and V be the voltage across the capacitors when equilibrium is reached.



Then

$$Q_0 = Q + Q$$

$$Q_0 = 2Q$$

$$CV_0 = 2CV$$

$$V = \frac{V_0}{2}$$

Now energy stored in each capacitor is given by

$$U' = \frac{1}{2}CV^2$$

$$U' = \frac{1}{2}C\left(\frac{V_0}{2}\right)^2$$

$$U' = \frac{1}{4}.\frac{1}{2}CV_0^2$$

$$\boxed{U' = \frac{U}{4}}$$

Therefore, the energy stored in each capacitor after disconnecting the battery is $\frac{U}{4}$.