

Solution.

Capacitor 1:

A long time after the spheres are connected via a resistor, the potential difference between them is 0. Therefore, the electric field between the spheres is also 0, and there is no charge on the inner sphere (this follows from Gauss's Law). The charge Q has been completely transferred from the inner sphere to the outer sphere. The final state for both capacitors is shown in the Figure. Let us compare the net energy of the electric field at the capacitor's initial and final states. The electric fields for $r < a$ and $r > b$ at the initial and final states are the same. But in the space between the spheres ($a < r < b$), the electric field at the initial state is $E = \frac{Q}{4\pi\epsilon_0 r^2}$, while at the final state it is 0. The energy density between the spheres in the initial state is

$$u(r) = \frac{1}{2} \epsilon_0 E^2 = \frac{Q^2}{32\pi^2 \epsilon_0 r^4}.$$

Therefore, the difference in the energy of the electric field between the initial and final state of Capacitor 1 is:

$$U = \int_a^b u(r) 4\pi r^2 dr = \frac{Q^2}{8\pi\epsilon_0} \int_a^b \frac{dr}{r^2} = \frac{Q^2(b-a)}{8\pi\epsilon_0 ab}$$

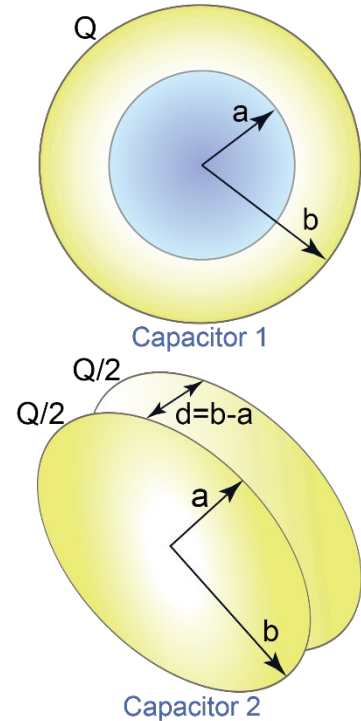
This energy difference is the net heat generated at the resistor in Capacitor 1.

Capacitor 2:

A long time after the plates are connected, the potential difference between them is 0, and the electric field between the plates is 0. It means the charge Q has been distributed equally between the plates, with charge $Q/2$ on each plate. The electric field outside the capacitor (neglecting edge effects) is the same in the initial and final states. The electric field in the space between the plates is $E = \frac{Q}{2A\epsilon_0}$ in the initial state and 0 in the final state. Therefore, the difference in the energy of the electric field between the initial and final state of this capacitor is:

$$U = \frac{1}{2} \epsilon_0 E^2 Ad = \frac{Q^2 d}{8\epsilon_0 A} = \frac{Q^2(b-a)}{8\pi\epsilon_0 ab}$$

since the area of the plates is $A = \pi ab$ and the plate separation is $d = b - a$.



This energy difference is the net heat generated at the resistor in Capacitor 2. We see that the net heat generated at the resistor **is the same for both capacitors.**

Now let's compare capacitances:

$$\text{Capacitance of capacitor 1 is: } C_1 = \frac{4\pi\epsilon_0 ab}{(b-a)}$$

$$\text{Capacitance of capacitor 2 is: } C_2 = \frac{\epsilon_0 A}{d} = \frac{\pi\epsilon_0 ab}{(b-a)}$$

We see that the capacitance of Capacitor 1 is 4 times that of Capacitor 2. Therefore, the time constant $\tau = RC$ for capacitor 1 is 4 times larger, and the charge in that capacitor will take longer to transfer.