Hollow Conductors

O2
I2
O1
I1
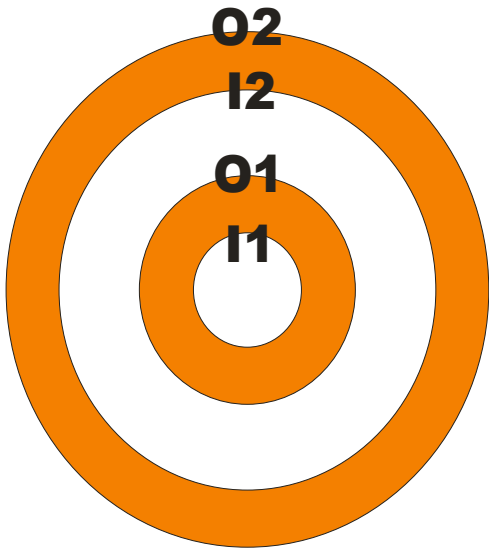
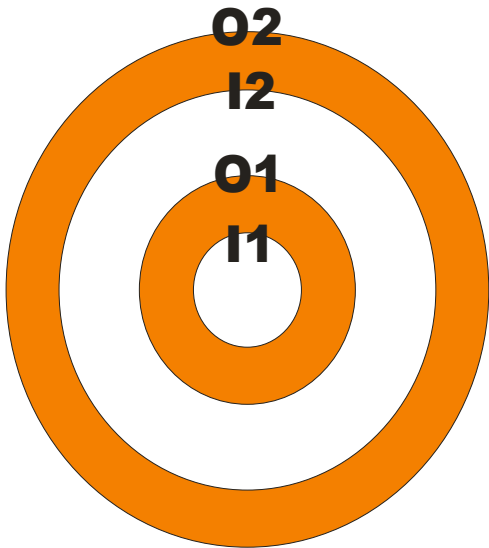A point charge +Q is placed at the center of the conductors. The induced charges are:

1. $Q(I1) = Q(I2) = -Q$;
   $Q(O1) = Q(O2) = +Q$

2. $Q(I1) = Q(I2) = +Q$;
   $Q(O1) = Q(O2) = -Q$

3. $Q(I1) = -Q$; $Q(O1) = +Q$
   $Q(I2) = Q(O2) = 0$

4. $Q(I1) = -Q$; $Q(O2) = +Q$
   $Q(O1) = Q(I2) = 0$

Hollow Conductors

(1) The inner faces are negative, the outer faces are positive.

Looking in from each conductor, the total charge must be zero (this gives the inner surfaces as –Q). But the conductors must remain neutral (which makes the outer surfaces have induced charge +Q).
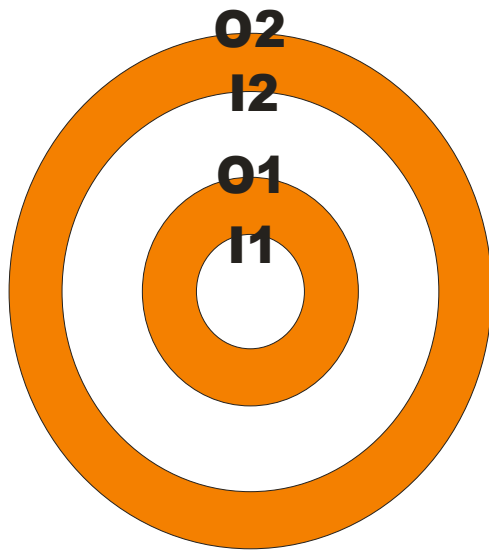
Hollow Conductors

O2

I2

O1

I1

A point charge $+Q$ is placed at the center of the conductors. The potential at O1 is:

1. Higher than at I1

2. Lower than at I1

3. The same as at I1

Hollow Conductors

(3) O1 and I1 are at the same potential

O2
I2
O1
I1

A conductor is an equipotential surface. O1 and I1 are on the same conductor, hence at the same potential

Hollow Conductors

O2

I2

O1

I1

A point charge +Q is placed at the center of the conductors. The potential at O2 is:

1. Higher than at I1

2. Lower than at I1

3. The same as at I1

Hollow Conductors
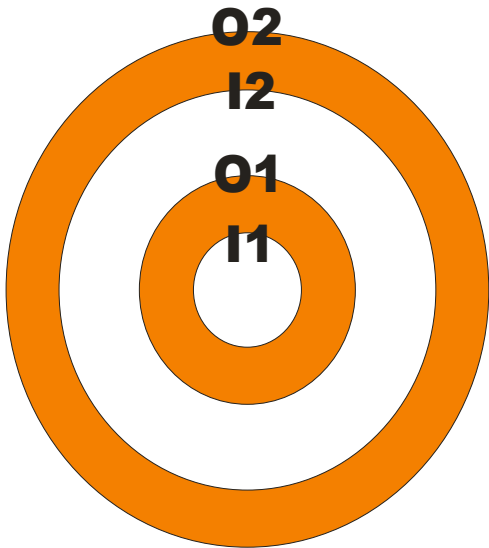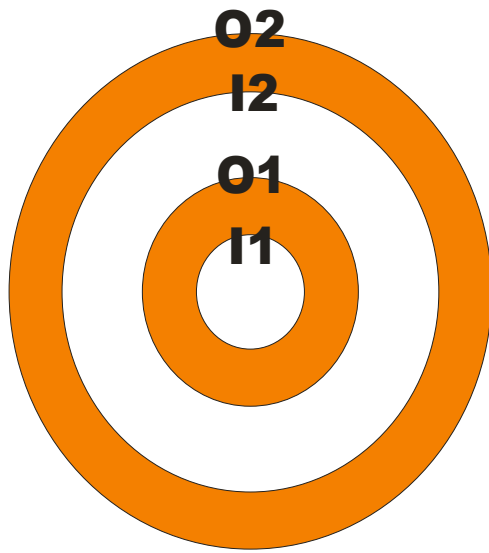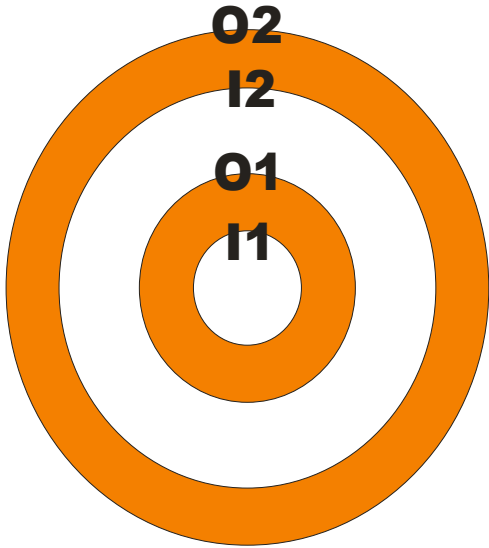
(2) O2 is lower than I1

As you move away from the positive point charge at the center, the potential decreases.

Hollow Conductors

O2
I2
O1
I1

A point charge +Q is placed at the center of the conductors. If a wire is used to connect the two conductors, then positive charge will flow

1. From the inner to the outer conductor

2. From the outer to the inner conductor

3. Not at all

Hollow Conductors

(1) Positive charge flows outward

Positive charges always flow "downhill" – from high to low potential. Since the inner conductor is at a higher potential the charges will flow from the inner to the outer conductor.

Capacitor Circuit

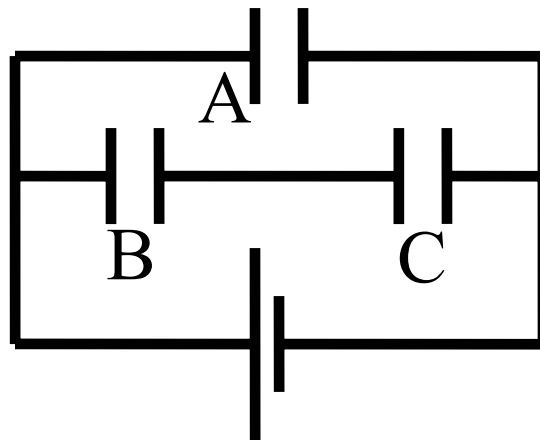Three identical capacitors are connected to a battery as pictured.
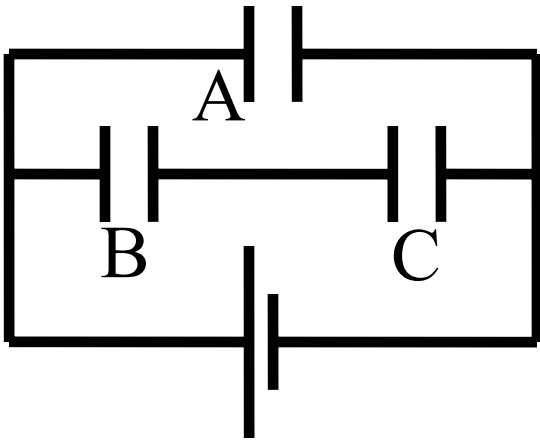
The battery is then disconnected.
How do the charge on A, B & C compare before and after the battery is removed?

	BEFORE;	AFTER
1.	$Q_A = Q_B = Q_C$;	No Change
2.	$Q_A = Q_B = Q_C$;	$Q_A > Q_B = Q_C$
3.	$Q_A = Q_B = Q_C$;	$Q_A < Q_B = Q_C$
4.	$Q_A > Q_B = Q_C$;	No Change
5.	$Q_A > Q_B = Q_C$;	$Q_A = Q_B = Q_C$
6.	$Q_A < Q_B = Q_C$;	No Change
7.	$Q_A < Q_B = Q_C$;	$Q_A = Q_B = Q_C$

Capacitor Circuit

4. $Q_A > Q_B = Q_C$; No Change

The potential drop across A is the same as the sum of the potential drops across B & C. By symmetry $V_B = V_C$, so

$$V_A > V_B = V_C$$

Since $Q = CV$, $Q_A > Q_B = Q_C$. When the battery is disconnected there is no reason for the potential to change or charge to flow so it doesn't.

Dielectric in a Capacitor

A parallel plate capacitor is charged to a total charge Q and the battery removed. A slab of material with dielectric constant κ is inserted between the plates. The **charge** stored in the capacitor
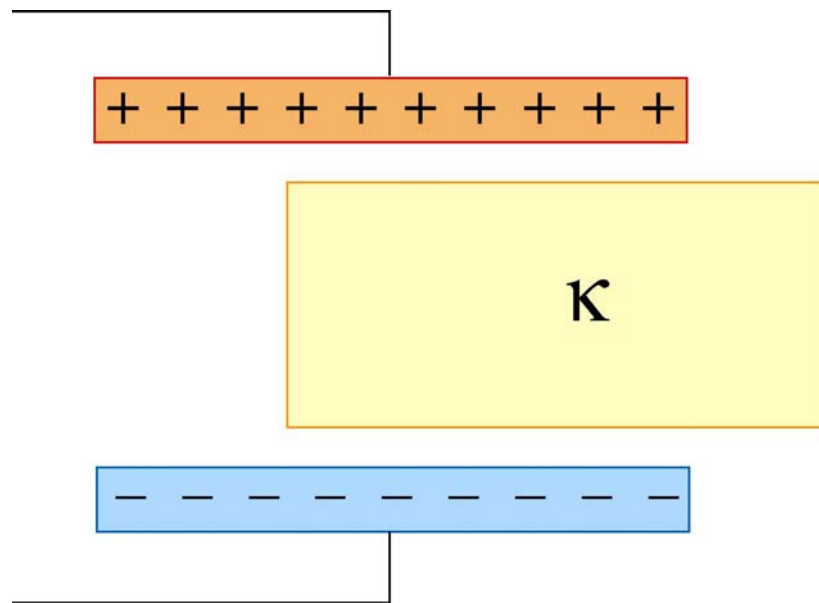
1. Increases
2. Decreases
3. Stays the Same
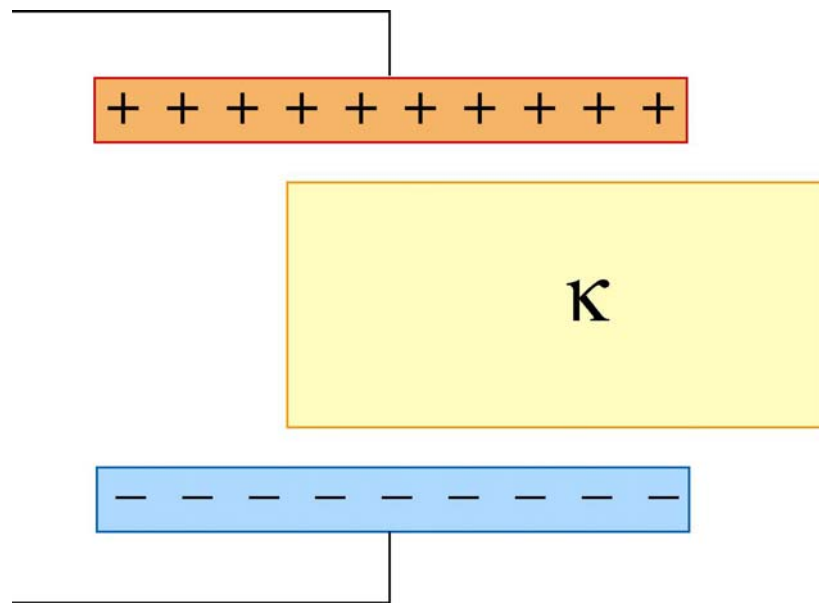
Dielectric in a Capacitor

(3) The charge is unchanged

Since the capacitor is disconnected from a battery there is no way for the amount of charge on it to change.

Dielectric in a Capacitor

A parallel plate capacitor is charged to a total charge Q and the battery removed. A slab of material with dielectric constant κ is inserted between the plates. The **energy** stored in the capacitor

1. Increases
2. Decreases
3. Stays the Same

Dielectric in a Capacitor
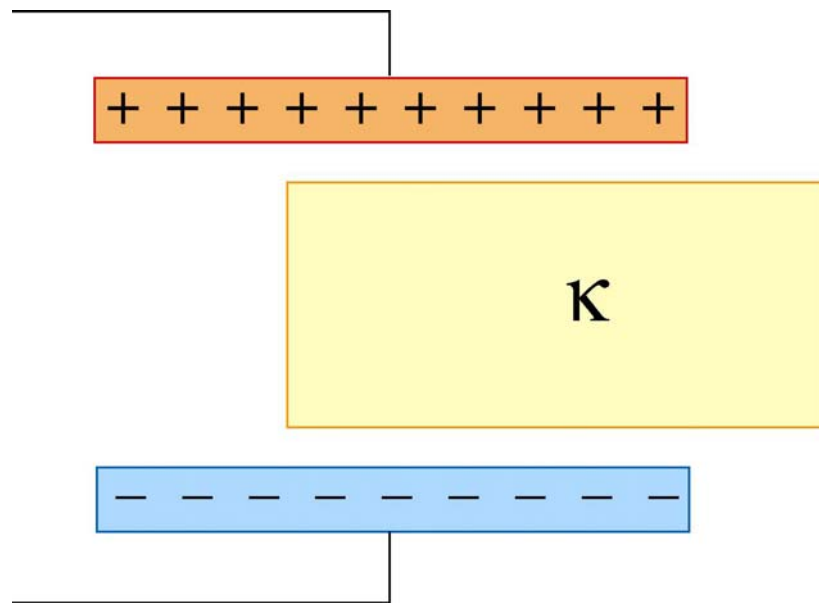
(2) The energy stored decreases

The dielectric reduces the electric field and hence reduces the amount of energy stored in the field.

Dielectric in a Capacitor

A parallel plate capacitor is charged to a total charge Q and the battery removed. A slab of material with dielectric constant κ is inserted between the plates. The **force on the dielectric**

1. pulls in the dielectric
2. pushes out the dielectric
3. is zero

Dielectric in a Capacitor

(1) The dielectric is pulled into the capacitor

We just saw that the energy is reduced by the introduction of a dielectric. Since systems want to reduce their energy, the dielectric will be sucked into the capacitor.

Alternatively, since opposing charges are induced on the dielectric surfaces close to the plates, the attraction between these will lead to the attractive force.