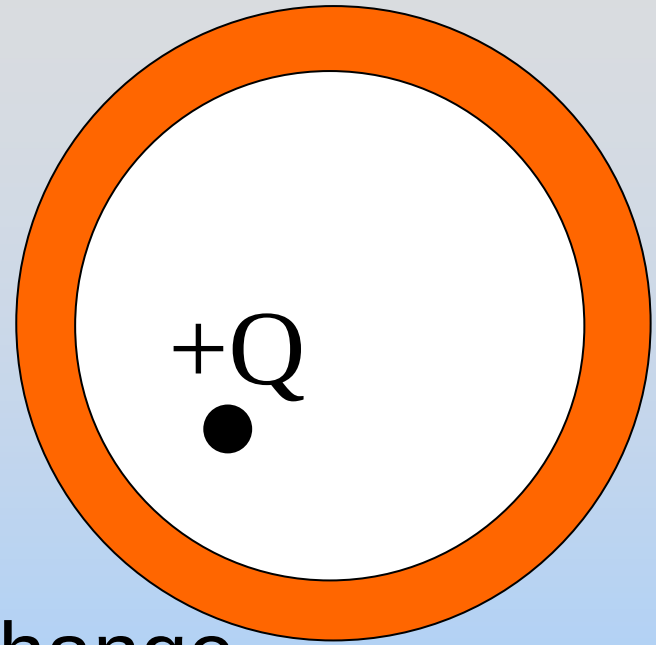
Concept Question: Point Charge in Conductor

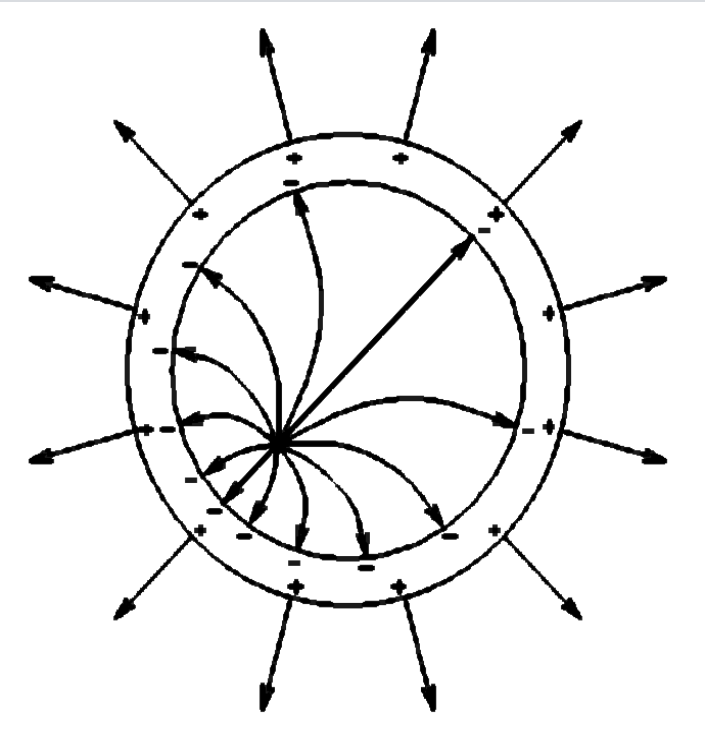
A point charge +Q is placed inside a neutral, hollow, spherical conductor. As the charge is moved around *inside*, the electric field ***outside***



1. is zero and does not change
2. is non-zero but does not change
3. is zero when centered but changes
4. is non-zero and changes
5. I don't know

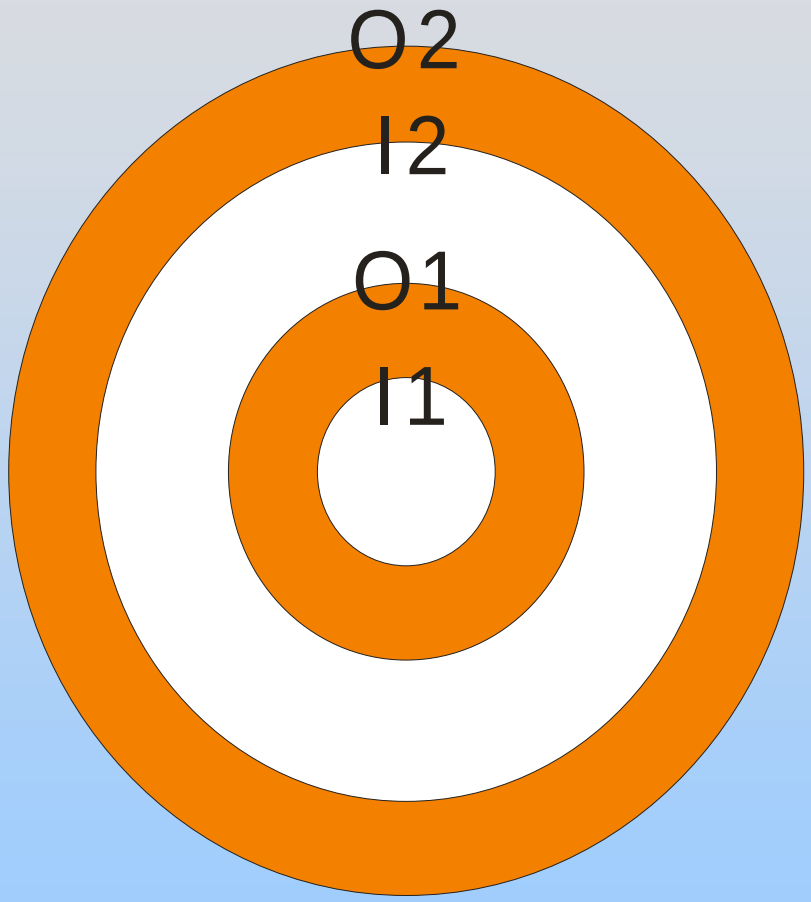
Concept Question Answer: Q in Conductor

Answer: 2. is non-zero but does not change



E = 0 in conductor → -Q on inner surface
Charge conserved → +Q on outer surface
E = 0 in conductor → No "communication"
between –Q & +Q → + Q uniformly distributed

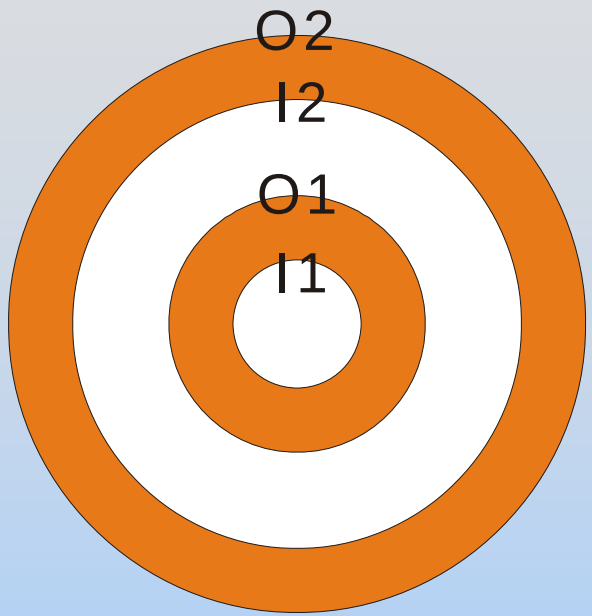
Concept Question Setup



What happens if we put Q in the center of these nested (concentric) spherical conductors?

Concept Question: Hollow Conductors

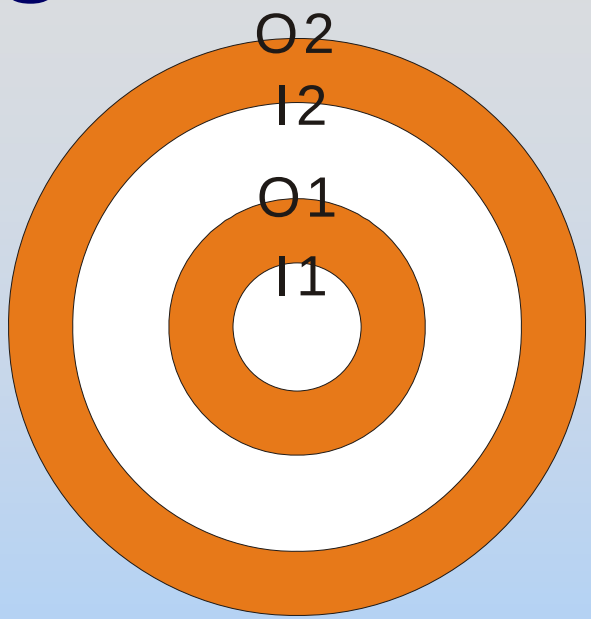
A point charge +Q is placed at the center of the conductors. The induced charges are:



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

Concept Question Answer: Hollow Conductors

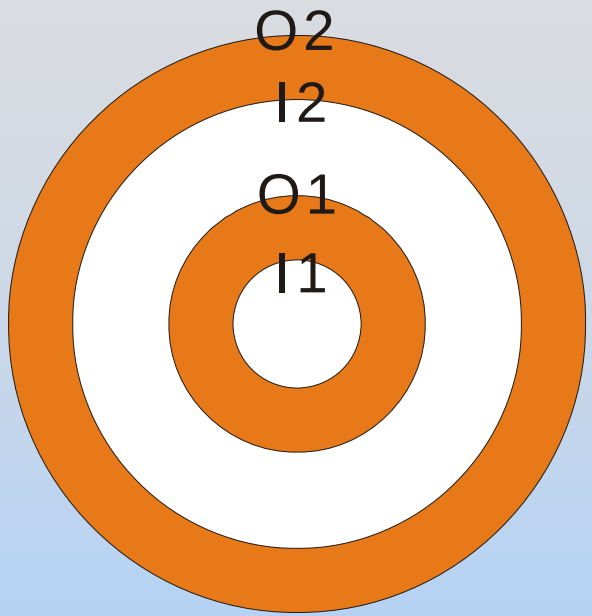
Answer: 1. The inner faces are negative, the outer faces are positive.



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).

Concept Question: Hollow Conductors

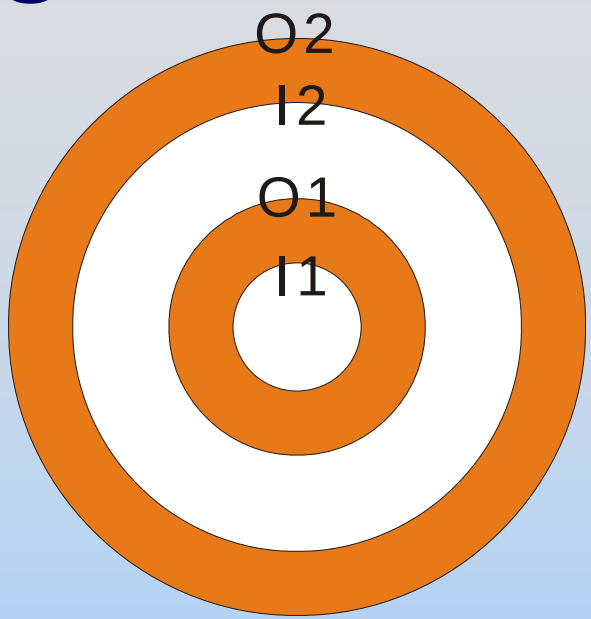
A point charge +Q is placed at the center of the conductors. The potential at O1 is:



1. Higher than at I1
2. Lower than at I1
3. The same as at I1

Concept Question Answer: Hollow Conductors

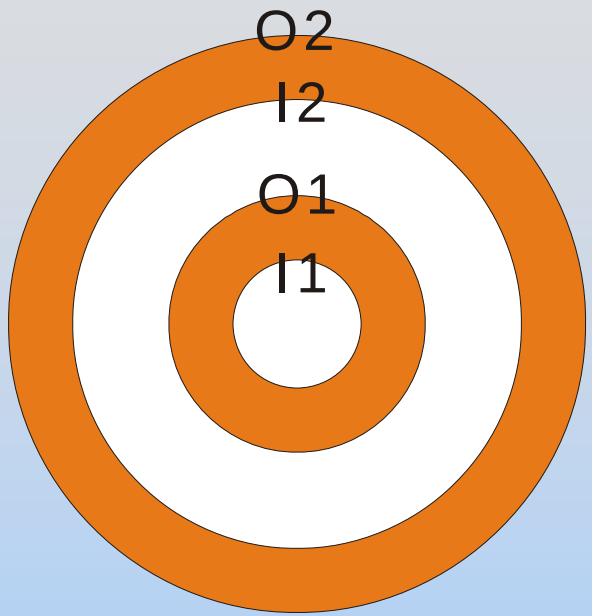
Answer: 3. O1 and I1 are at the same potential



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

Concept Question: Hollow Conductors

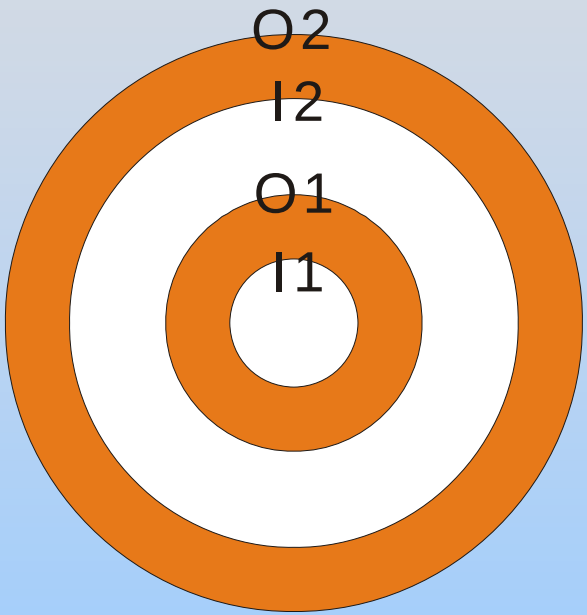
A point charge +Q is placed at the center of the conductors. The potential at O2 is:

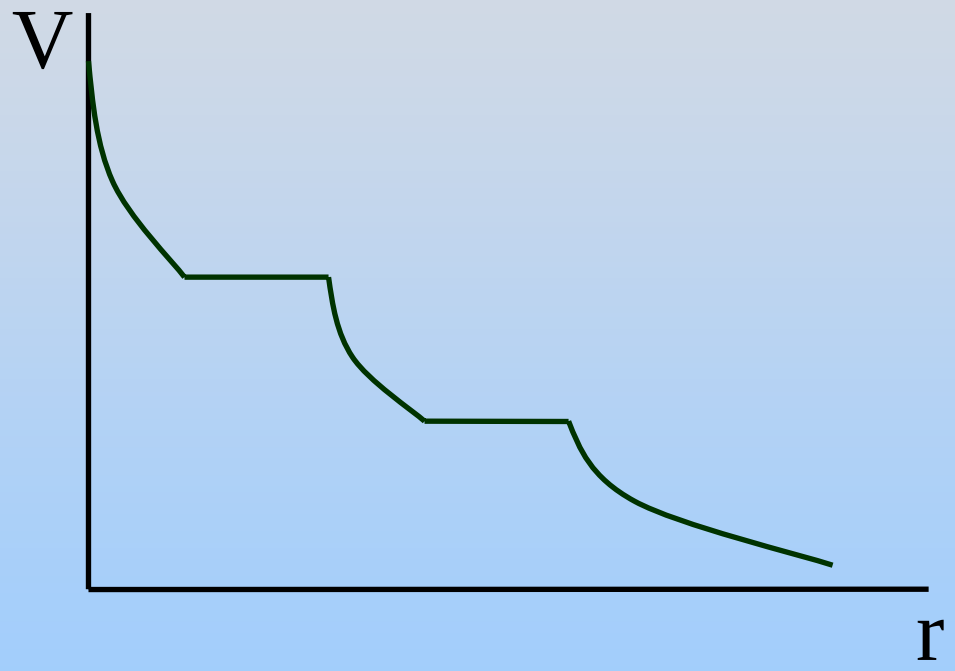


1. Higher than at I1
2. Lower than at I1
3. The same as at I1

Concept Question Answer: Hollow Conductors

Answer: 2. O2 is lower than I1

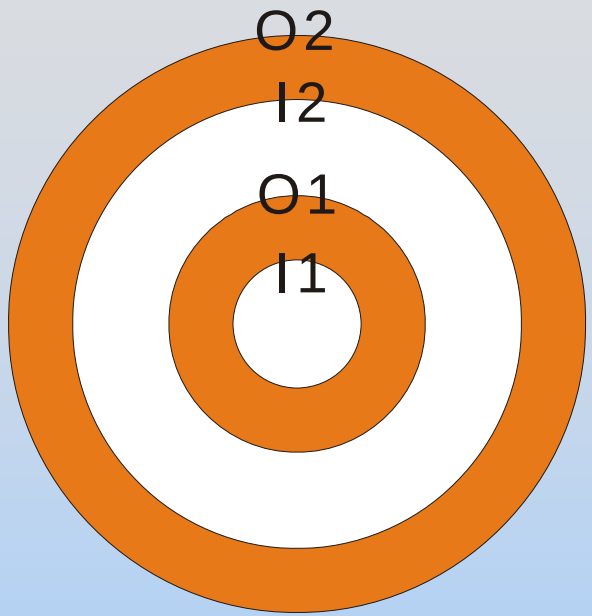




As you move away from the positive point charge at the center, the potential decreases.

Concept Question: Hollow Conductors

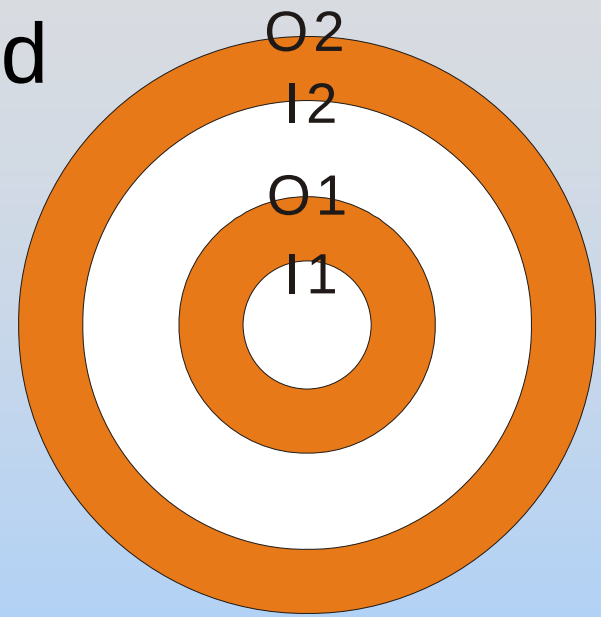
A point charge +Q is placed at the center of the conductors. If a wire is used to connect the two conductors, then current (positive charge) will flow



1. from the inner to the outer conductor
2. from the outer to the inner conductor
3. not at all

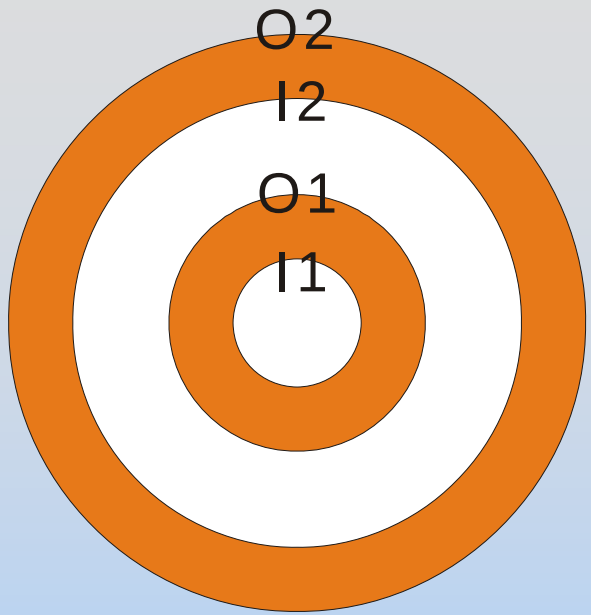
Concept Question Answer: Hollow Conductors

Answer: 1. Current 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.

Concept Question: Hollow Conductors

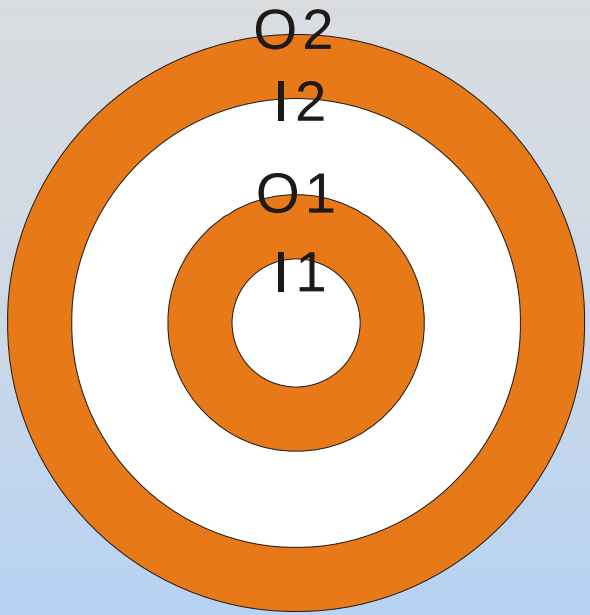


You connect the “charge sensor’s” red lead to the inner conductor and black lead to the outer conductor. What does it actually measure?

1. Charge on I1
2. Charge on O1
3. Charge on I2
4. Charge on O2
5. Charge on O1 – Charge on I2
6. Average charge on inner – ave. on outer
7. Potential difference between outer & inner
8. I don’t know

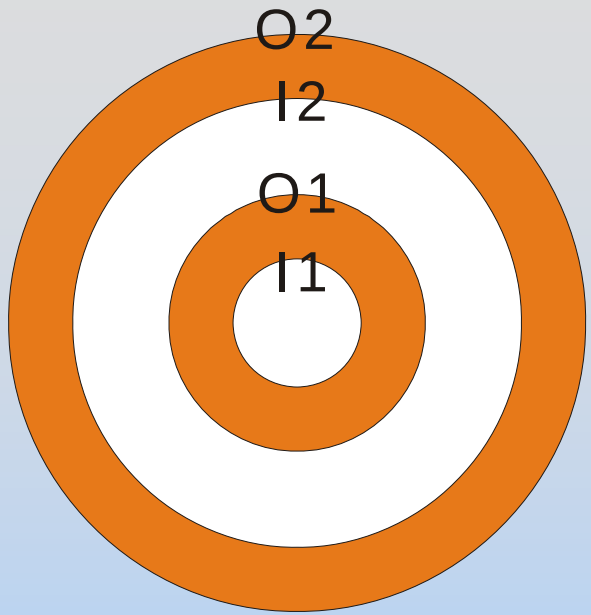
Concept Question Answer: Hollow Conductors

Answer: 7. "Charge Sensor" measures potential difference between outer & inner conductor



So what is the "charge axis?" From the capacitance and potential difference it can calculate $Q = C\Delta V$ which is charge on O1 and negative charge on I2

Concept Q.: Hollow Conductors

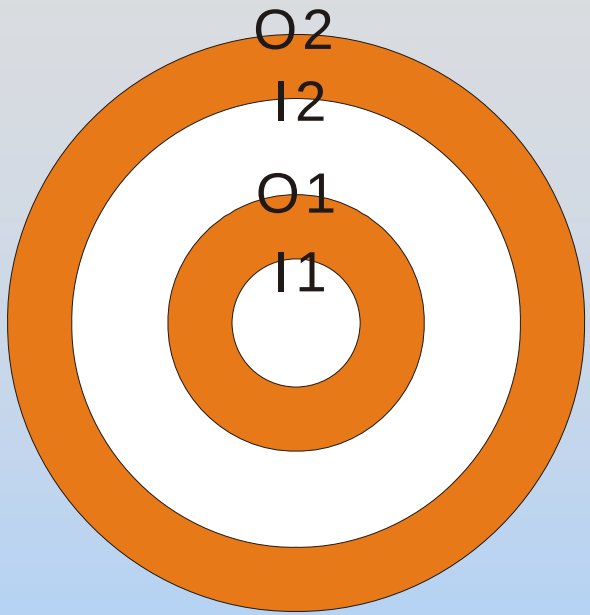


You connected the “charge sensor’s” red lead to the inner conductor and black lead to the outer conductor. What does it actually measure?

1. Charge on I1
2. Charge on O1
3. Charge on I2
4. Charge on O2
5. Charge on O1 – Charge on I2
6. Average charge on inner – ave. on outer
7. Potential difference between inner & outer
8. I don’t know

Concept Question Answer: Hollow Conductors

Answer: 7. “Charge Sensor” measures potential difference between inner & outer conductor



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8.02SC Physics II: Electricity and Magnetism

Fall 2010