WebAssign
CH17-HW04-FALL2010 (Homework)

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PHYS 272-FALL 2012, Fall 2012
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Current Score : 30 / 30 **Due :** Friday, September 28 2012 11:59 PM EDT

1. 4/4 points | Previous Answers MI3 17.7.P.094.alt01

A highly charged piece of metal (with uniform potential throughout) tends to spark at places where the radius of curvature is small, or at places where there are sharp points. The breakdown electric field strength for air is about 3×10^6 V/m.

(a) It is possible to calculate the maximum possible potential (relative to infinity) in air of a metal sphere of 13 cm radius. First, what is the maximum charge you can put on this sphere?

5.633e-6 ✓ C

For that amount of charge, what is the potential of the sphere relative to infinity?

389976.92 ✓ volts

(b) Next, calculate the maximum possible potential relative to infinity in air of a metal sphere of only 0.8 mm radius. What is the maximum charge you can put on this sphere?

2.133e-10 ✓ C

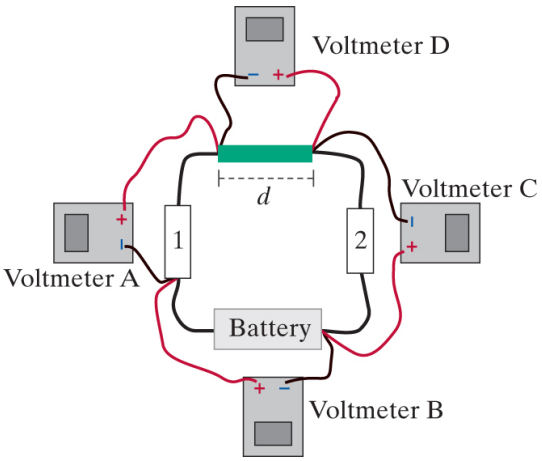
For that amount of charge, what is the potential of the sphere relative to infinity?

2399.625 ✓ volts

These results are related to the fact that if a piece of metal has a small radius of curvature, it will spark at relatively low potential relative to infinity.

- *Read the eBook*
- Section 17.7

2. 7/7 points | Previous Answers MI3 17.6.P.082



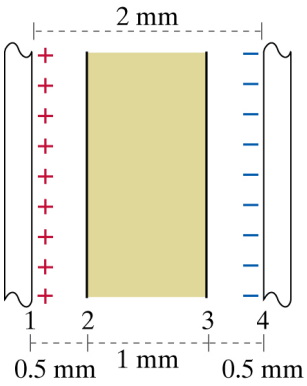
Four voltmeters are connected to a circuit as shown in the diagram. As is usual with voltmeters, the reading on the voltmeter is positive if the negative lead (black wire, usually labeled COM) is connected to a location at lower potential, and the positive lead (red) is connected to a location at higher potential.

The circuit contains two devices whose identity is unknown, and a rod of length d = 8 cm made of a conducting material. At a particular moment, the readings observed on the voltmeters are:
Voltmeter A: -1.9 volts
Voltmeter B: -4 volts
Voltmeter C: -5.5 volts

At this moment, what is the reading on Voltmeter D, both magnitude and sign?
V = 11.4 volts
What is the magnitude of the electric field inside the bar?
$|\vec{E}|$ = 142.5 V/m
What is the direction of the electric field inside the bar?
to the left

- *Read the eBook*
- Section 17.6

3. 8/8 points | Previous Answers MI3 17.8.P.103



An isolated large-plate capacitor (not connected to anything) originally has a potential difference of 1090 volts with an air gap of 2 mm. Then a plastic slab 1 mm thick, with dielectric constant 5.1, is inserted into the middle of the air gap as shown in the figure. As shown in the diagram, location 1 is at the left plate of the capacitor, location 2 is at the left edge of the plastic slab, location 3 is at the right edge of the slab, and location 4 is at the right plate of the capacitor. All of these locations are near the center of the capacitor. Calculate the following potential differences.

$V_1 - V_2 =$ 272.5 ✓ V

$V_2 - V_3 =$ 106.86 ✓ V

$V_3 - V_4 =$ 272.5 ✓ V

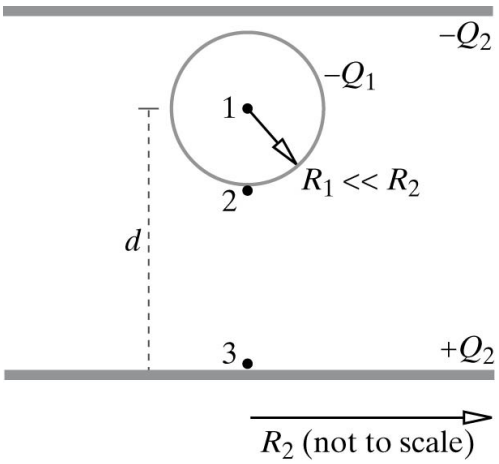
$V_1 - V_4 =$ 651.86 ✓ V What assumptions or approximations did you make in this calculation?

- [x] Assume that the field due to the polarized plastic slab was negligible in the air gaps
- [ ] Assume the electric field inside the plastic slab is zero
- [ ] Assume the plastic slab did not polarize
- [x] Assume the radius of the plates was much larger than the distance between the plates
- [ ] Assume the positive plate of the capacitor does not contribute to the electric field in the gap between the plastic and the negative plate

✓

- *Read the eBook*
- Section 17.8

4. 10/10 points | Previous Answers MI3 17.5.P.069



A thin spherical shell made of plastic carries a uniformly distributed negative charge -7e-10 coulombs (indicated as $-Q_1$ in the diagram). Two large thin disks made of glass carry uniformly distributed positive and negative charges 1.5e-05 coulombs and -1.5e-05 coulombs (indicated as $+Q_2$ and $-Q_2$ in the figure). The radius R_1 of the plastic spherical shell is 8 mm, and the radius R_2 of the glass disks is 4 meters. The distance d from the center of the spherical shell to the positive disk is 19 mm.

(a) Find the potential difference $V_1 - V_2$. Point 1 is at the center of the plastic sphere, and point 2 is just outside the sphere.

-269.75 volts

(b) Find the potential difference $V_2 - V_3$. Point 2 is just below the sphere, and point 3 is right beside the positive glass disk.

-826.832 volts

Remember that the sign of the potential difference is important.

- *Read the eBook*
- Section 17.5

5. 1/1 points | Previous Answers MI3 17.9.X.017

The energy density inside a certain capacitor is 7 J/m^3. What is the magnitude of the electric field inside the capacitor?

1.258e6 V/m

- *Read the eBook*
- Section 17.9