Homework Questions – Section 7

1. Under certain circumstances, insulators can sometimes become conductors.

   a. Describe a case in which this occurs, giving the condition for the material to become a conductor.

   b. Does this provide additional evidence for two kinds of charge? Explain.

   c. Under what condition can the material return to being an insulator?

2. Suppose you were given a charged capacitor. You are asked to discharge it and detect the actual direction of charge flow in the circuit during discharge. Explain carefully how each of these components will or will not enable you to do so.

   a. Round or Long Bulb

   b. Compass

   c. Neon Bulb

3. Explain why the pie-plate capacitor experiment provides evidence of two kinds of charge, instead of simply excess (+) and depletion (-) of <u>one</u> kind of charge.

4. Experiments with neon bulbs suggest that matter should not really be classified as 'either/or', conductor or insulator. Instead, there is a full range of resistance; good conductors have low resistance, poor conductors have high resistance. Some substances, such as graphite (pencil lead) are found midway on this continuum.

Low Resistance **High Resistance**

Metals Graphite Non-Metals

>--------X----------X----------X---<

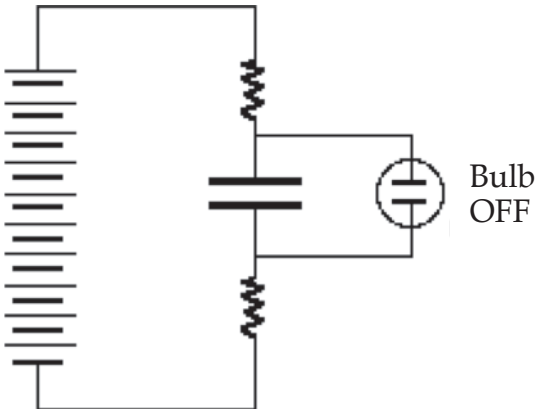
Good Conductors **Poor Conductors**

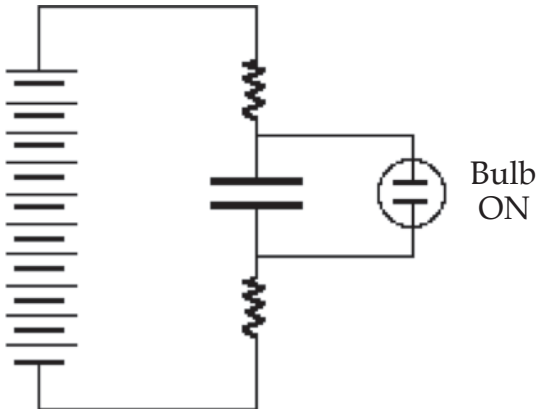
Within this range of conductance/resistance, how would you classify air? Explain.

How would you classify water? (Test it following your prediction, if you have never done so.)

5. The 25,000 μf capacitor is not supposed to be used in circuits in which the electric pressure across it exceeds 25 volts. What does this tell you about the insulating layer between the plates?

6. In Investigation One, you looked at the behavior of a neon bulb in an oscillator circuit. On the circuit diagrams below draw the arrows to represent the direction of conventional charge flow when the neon bulb is off and when the bulb is on. Be sure to include arrows indicating charge flow onto or off of the capacitor plates.



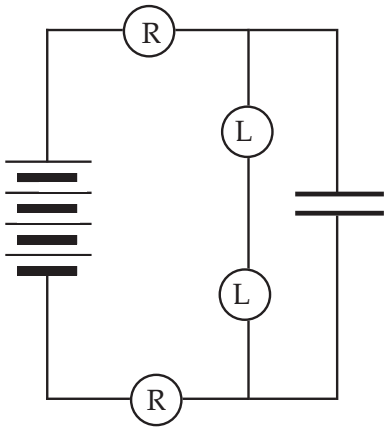


7. In Investigation One, you found how to change the time between flashes by changing the resistance and capacitance in the oscillator circuit. Draw a circuit which would have twice the time between flashes by adding a second pair of 500 kilohm resistors in some fashion.

8. Explain how a neon bulb can be used to detect the direction of charge flow in a circuit. Include in your answer an explanation of what happens to the neon atoms, and identify what is flowing in the wires. Provide a diagram.

9. In an earlier Activity, you analyzed this circuit and explained what was occurring in terms of conventional charge flow.

a. Describe this circuit (at the moment of connection) in terms of electron flow.

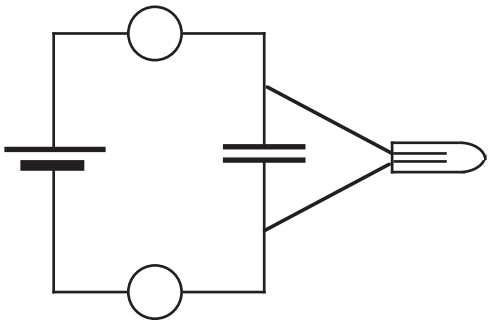


b. Color code the final steady state

c. Compare the results with those for Activity 5.7.

d. Describe and explain what you would observe at the moment the battery is disconnected from this circuit.

10. Consider the circuit below where a neon bulb is connected across the plates of a capacitor. The battery has a ΔV of 100 volts, and the capacitor has a maximum allowable voltage of 150 volts.



a) Sketch a possible graph of pressure difference across the capacitor as a function of time.

b) Indicate on your graph the times that the bulb blinks on.