Simulation Worksheet: RC Circuit

Name: _____ Date: _____

1. First, simply experiment with the circuit by pressing the Charge and Discharge buttons. If the resistor is a light bulb, what happens to the brightness of the bulb, as a function of time, after you press the "Charge" button?

2. After you have let the capacitor charge for a while, what happens to the brightness of the light bulb, as a function of time, after you press the "Discharge" button?

3. The Voltage vs. Time plot shows two different graphs. What does the black graph represent? What does the red graph represent?

4. On the Current vs. Time graph, when is the current shown as a positive value? When is the current shown as a negative value? What, physically, does the sign of the current represent?

5. What is the value of the battery voltage in this simulation? How do you know?

Worksheet to accompany the RC Circuit simulation

6. What is the equation for the voltage across a resistor, in terms of the current and the resistance? What is the equation for the voltage across a capacitor, in terms of the charge on the capacitor and the capacitance?

   $\Delta V_R =$ $\Delta V_C =$

7. Kirchoff's loop rule states that the sum of the potential differences around a closed loop in a circuit equals zero. Use Kirchoff's loop rule to show the connection between the battery voltage, the resistor voltage, and the capacitor voltage when the switch is in the "Charge" position.

8. Now, use Kirchoff's loop rule to show the connection between the resistor voltage and the capacitor voltage when the switch is in the "Discharge" position.

9. Explain why the capacitor takes less time to charge (and to discharge) when the resistance is decreased. Explain why the capacitor takes less time to charge (and to discharge) when the capacitance is decreased.

10. When the capacitor is being charged, starting from a capacitor voltage of zero, the capacitor voltage as a function of time is given by: $V_C(t) = \varepsilon\left(1 - e^{-t/(RC)}\right)$, where $t = 0$ represents the time when the switch is moved to the charge position, and ε is the battery voltage. Note that, when R has units of ohms and C has units of farads, the product RC has units of seconds. If the resistance is 1 ohm and the capacitance is 1 F, at what time does the capacitor voltage reach 5.0 V?