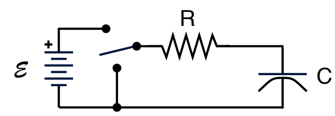
RC Circuits **Name** ______________________________

Physics II **Date** ____________ **Period** ___________

The *RC* circuit shown below has a switch that can be "thrown" to the up position or the down position. The capacitor is initially uncharged.



1. In which position of the switch, up or down, will the capacitor become charged up? **UP / DOWN**
2. After the capacitor has been charged up, in which position of the switch, up or down, will the capacitor discharge? **UP / DOWN**

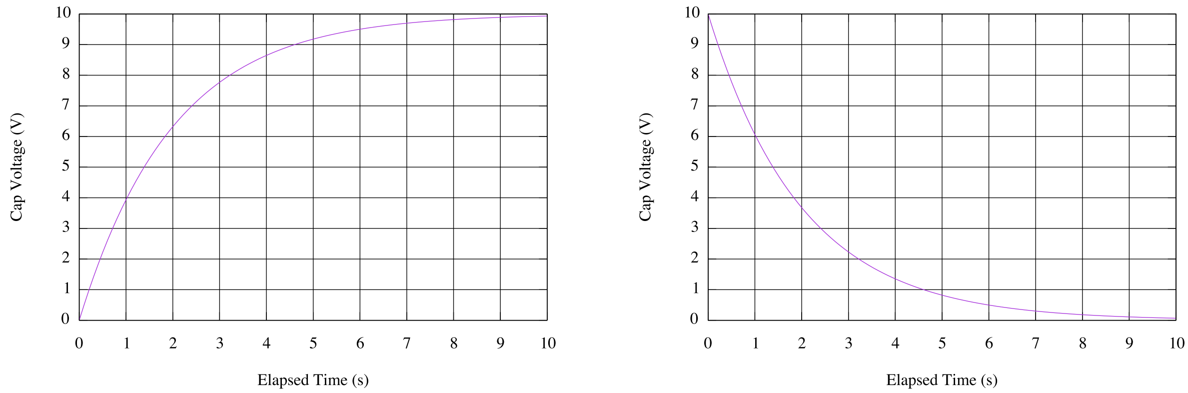
Now suppose the *emf* $\mathcal{E}$ of the power supply in the circuit above is 10 V, the resistance R is 1000 Ω, and the capacitance is 0.003 F. The time t represents how much time passes beginning at the moment when the switch is thrown, either up or down. Let V represent the voltage across the capacitor at any particular moment. Let's use V_0 for the initial voltage across the capacitor.

Equation 1: $V = \mathcal{E}(1 - e^{-\frac{t}{RC}})$

Equation 2: $V = V_0 e^{-\frac{t}{RC}}$

3. What is the value of the time constant in this circuit? ___________
4. Evaluate the potential difference across the capacitor in Equation 1 at $t = 0$. ___________
5. Evaluate the potential difference across the capacitor in Equation 1 at $t =$ one time constant. ___________
6. Evaluate the potential difference across the capacitor in Equation 1 at $t =$ two time constants. ___________
7. Does Equation 1 describe the potential difference across the capacitor as it charges up or as it discharges? ___________
8. Evaluate the potential difference across the capacitor in Equation 2 at $t = 0$. ___________
9. Evaluate the potential difference across the capacitor in Equation 2 at $t =$ one time constant. ___________
10. Evaluate the potential difference across the capacitor in Equation 2 at $t =$ two time constants. ___________
11. Does Equation 2 describe the potential difference across the capacitor as it charges up or as it discharges? ___________
12. By what factor does the capacitor's potential difference change after one time constant goes by according to equation 2? ___________

The following graphs show the voltages across capacitors in RC circuits as a function of time as they charge and discharge.

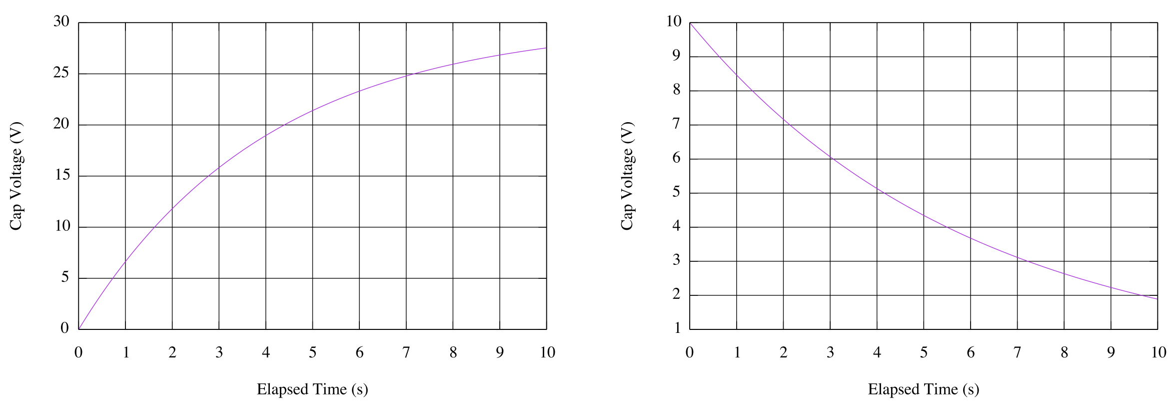


13. What is the value of the time constant for the RC circuit that charges up as shown above on the left?

____

14. What is the value of the time constant for the RC circuit that discharges as shown above on the right?

____



15. What is the value of the time constant for the RC circuit that charges up (ultimately to 30 V) as shown above on the left?

____

16. What is the value of the time constant for the RC circuit that discharges (ultimately to 0 V) as shown above on the right?

____