R-C Circuits

PHYS 296

Your name Key **Lab section**

PRE-LAB QUIZZES

1. What will we investigate in this lab?

R-C Circuits

2. For the R-C circuit shown in Figure 1 on Page 2, the capacitor is initially not charged and a DC voltage is applied to the circuit at $t = 0$, such that $V(t) = 0$ for $t < 0$ and $V(t) = V_0$ for $t \geq 0$. Obtain the formula for the charge $q(t)$ on the capacitor and the current, $I(t)=dq(t)/dt$, in the circuit.

$q(t) = CV_0(1-e^{-t/RC})$ $\quad I = \frac{dq}{dt}$

$\frac{dq}{dt} = \frac{V_0}{R}e^{-t/RC}$ $\quad$ so $\quad I = \frac{V_0}{R}e^{-t/RC}$

3. What is the time constant of the R-C circuit?

$\tau = RC$

4. What is the current in the circuit at $t = 0$? Does it immediately reach the maximal value?

at $t=0$ $\quad I(0) = \frac{V_0}{R}e^0 = \frac{V_0}{R}$ $\quad$ Yes!

5. What is the magnitude of the current in the circuit?

at $t = RC$: $\quad I(RC) = \frac{V_0}{R}e^{-\frac{RC}{RC}} = \frac{V_0}{eR}$

at $t = \infty$: $\quad I(\infty) \to 0$

6. What is the voltage on the capacitor at $t = 0$? Does it immediately reach maximum?

$V(0) = V_0(1-e^{-0/RC}) = V_0 - V_0 = 0$ $\quad$ NO

7. What is the magnitude of the voltage $V_C(t)$ on the capacitor?

at $t = RC$: $\quad V(RC) = V_0 - V_0e^{-1}$

at $t = \infty$: $\quad V(\infty) = V_0$

8. Draw the $I(t)$ and $V_C(t)$ curves in the following graphs.