Quiz #2  1/22/13

Assume: $V_i$ is constant

Knowns: $V_i$, $R$, $C$

Unknowns: $I$, $I_R$, $I_C$, $V_2$

(A) What is always true?

$I = I_R + I_C$

$V_2 - 0 = I_R R$

$C \frac{d(V_2 - 0)}{dt} = I_C$

(B) What else is true when the switch is closed?

$V_2 = V_i + \frac{dV_2}{dt} = 0$

(C) Solve for $I_R$, $I_C$, $V_2$

$V_2 = U_i$

$I_C = C \frac{d(V_2 - 0)}{dt} = C \frac{dV_2}{dt} = 0$

$I_R = \frac{V_2 - 0}{R} = \frac{U_i}{R}$
1. When the switch is open at time $t=0$, what is $V(t)$ for $t>0$?

Assume $V(0) = V_0$

\[ I_C = C \frac{dV_C}{dt} = -I_R = -\frac{V_C}{R} \]

\[ \frac{dV_C}{V_C} = -\frac{dt}{RC} \]

Integrate:

\[ \int_{V_C(0)}^{V_C(t)} \frac{dV_C}{V_C} = \int_{0}^{t} -\frac{1}{RC} dt = -\frac{t}{RC} \]

\[ \ln \frac{V_C(t)}{V_C(0)} = -\frac{t}{RC} \]

\[ \ln \frac{V_C(t)}{V_C(0)} = -\frac{t}{RC} \]

\[ \Rightarrow \frac{V_C(t)}{V_C(0)} = e^{-\frac{t}{RC}} \]

\[ V_C(T) = V_0 e^{-\frac{T}{RC}} \]

Check: $V_C(0)$ at $t=0 = V_0$

$V_C(T)$ at $t=\infty = 0$