Ex: Find the voltage, $v_C$, across the capacitor in the circuit below for $t > 0$ if $v_C(t = 0) = 5 \text{ V.}$

$$C = 20 \text{ mF}$$

SOL’N: The same current flows in both the $C$ and $R$, and the voltages are the same except for a minus sign:

$$i_C = C \frac{dv_C}{dt} = -\frac{v_C}{R} = -i_R$$

The form of solution is an exponential.

$$v_C(t) = ke^{-t/RC}$$

The value of the constant, $k$, is chosen to match the initial voltage on $C$, since the exponential has a value of unity at $t = 0$: $e^0 = 1$.

$$v_C(t) = 5 \text{ V} \cdot e^{-t/200 \text{ ms}}$$