Please read the lab manual first then show your work here.

\[ V = \frac{Q}{C} = \left[ \int i(t)dt \right] / C \]

Differentiating this equation, we obtain \( i(t) = C \frac{dV}{dt} \)

1. If a constant current of 1.0 mA were to flow into a 200 \( \mu \)F (microfarad) capacitor, what would be the voltage across the capacitor after 3 seconds?

2. Describe what would happen theoretically if you were to connect an ideal current source to the following circuits. Use time plots to illustrate.

a)
3. An RC (resistor + capacitor) circuit will have an exponential voltage response of the form $v(t) = A + B e^{-t/RC}$ where A and B are constants that express the final voltage and the difference between the initial voltage and the final voltage, respectively.

a. Given $R = 10 \, \text{k}\Omega$ and $C = 0.1 \, \mu\text{F}$, a starting voltage of 5 volts and an ending voltage of 0 volts, what will the voltage be at $t = 1 \, \text{ms}$?

b. At what time will the voltage be 0.5 volts?

4. Suppose you were given two black boxes that contain either a series or parallel combination of R and C. In the case of the series RC, you would not be able to touch a probe between the R and the C in the black box, so how would you go about determining R and C using the signal generator, the oscilloscope and an external resistance? (Hint: read the lab)