1. As the capacitor in the RC circuit above reaches its maximum charge:
   a. the rate at which the current changes decreases and the rate at which the charge changes increase
   b. the rate at which the current changes increases and the rate at which the charge changes increases.
   c. both rates decrease.
   d. both rates increase.

2. As the capacitor in the RC circuit above reaches its maximum charge, which of the following statements is FALSE:
   a. the voltage across the capacitor is at its maximum.
   b. the voltage across the resistor is zero.
   c. the sum of the voltages across the capacitor and resistor is equal to the initial voltage across the resistor.
   d. the sum of the voltages across the capacitor and resistor is equal to the initial voltage across the capacitor.

Work Problems
3. In the circuit shown, find (a) the current in the 3 ohm resistor; (b) the unknown emfs E1 and E2; (c) the resistance R. Note that three currents are given.

\[ 5 \pm 3 = 8 \text{A} \]
\[ 4.3 + 8.3 = \left( \frac{\varepsilon_1}{3} = 36 \right) \]
\[ 5.6 + 8.3 = \left( \frac{\varepsilon_2}{4} = 54 \right) \]
\[ 2R + \varepsilon_1 - \varepsilon_2 = 0 \]
\[ 2R + 36 - 54 = 0 \]
\[ 2R = 18 \]
\[ R = 9 \]
4. The 10V battery is flipped around to have opposite polarity, so that its positive terminal is now next to point $a$. Find the (a) current in each branch and (b) the potential difference $V_{ab}$ of point $a$ relative to point $b$.

a) Loop 1: \( 2 \cdot I_1 - 10 + 3 \cdot I_1 + 4 \cdot I_2 - 5 + 1 \cdot I_2 = 0 \)

\[ \Rightarrow \quad 5I_1 + 5I_2 = 0 \]

\[ I_1 = -\frac{1}{4} \]

\[ I_2 = \frac{1}{4} \]

\[ I_3 = \frac{1}{5} \]

Loop 2: \( 10 \cdot I_3 - 1 \cdot I_2 + 5 - 4I_2 = 0 \)

\[ I_1 = I_2 + I_3 \]

\[ I_1 = \frac{1}{4} = 0.16 \ A \]

\[ I_2 = \frac{5}{8} = 1.4 \ A \]

\[ I_3 = \frac{1}{5} = 0.2 \ A \]

b) \( V_{ab} = 3I_1 + 4I_2 = 3 \cdot \frac{5}{8} + 4 \cdot \frac{5}{8} = 4.8 + 5.6 = 10.4 \)

5. A charged 1 mF capacitor is discharged through a 1.00 k-ohm resistor as shown in the diagram. If the original charge on the capacitor is $Q$, approximately what is its charge 1.00 s after the switch is closed?

a. 0.632 Q
b. 0.500 Q
c. 0.368 Q
d. 0.000 Q

\[ Q = 0.37 \cdot Q \]

\[ q(t) = Q_0 \cdot e^{-t/\tau} \]

\[ q(1) = Q_0 \cdot e^{-1/\tau} \]

\[ q(1) = Q_0 \cdot 0.37 \]