In the circuit shown the capacitor is initially discharged. The switch is placed in position A for 5.0 seconds, and then moved to position B.

(a) Calculate the potential across $R_3$ 7.0 seconds after the switch is moved to B.
(b) Calculate the charge on the capacitor 7.0 seconds after the switch is moved to B.
(c) The capacitor is charged for 5.0 sec with the switch at A. Then the switch is opened, and a dielectric of $K = 3.00$ is inserted in the capacitor. Then the switch is moved to B. Now calculate the charge AND the potential on the capacitor 7.0 seconds after the switch is thrown to B.

\[ e = 12.0 \text{ V} \]
\[ R_1 = 6.7 \times 10^5 \text{ } \Omega \]
\[ R_2 = 4.2 \times 10^5 \text{ } \Omega \]
\[ R_3 = 7.8 \times 10^5 \text{ } \Omega \]
\[ C = 12.0 \times 10^{-6} \text{ F} \]

\[ V_c = e \left(1 - e^{-\frac{t}{C}}\right) \]
\[ T = R_1 C \quad \text{when } t = 5.05 \text{ s} \]
\[ V_c = 12 \left(1 - e^{-\frac{5.05}{12 \times 10^{-6}}}\right) = 5.56 \text{ V} \]
\[ Q = V_c \cdot C = 6.67 \times 10^{-5} \text{ C} \]

\[ \frac{C}{C_{discharge}} = \frac{t}{T} \quad V_0 = \frac{V_c \cdot C}{R_2 + R_3} = \frac{5.56}{4.2 \times 10^5 + 7.8 \times 10^5} = 4.63 \times 10^{-6} \text{ A} \]

\[ T = (R_2 + R_3) C = (4.2 + 7.8) \times 10^5 \times 12 \times 10^{-6} = 14.45 \text{ s} \]

\[ V_{R_3} = C \cdot R_3 = R_3 \cdot V_0 \cdot e^{-\frac{t}{T}} \]
\[ \text{When } t = 7.05 \text{ s}. \quad V_{R_3} = 7.8 \times 10^5 \times 4.63 \times 10^{-6} A \cdot e^{-\frac{7}{14.45}} = 2.22 \text{ V} \]

\[ V_c = (R_2 + R_3) e^{\frac{t}{T}} = 3.42 \text{ V} \quad Q_c = C \cdot V_c = 12 \times 10^{-6} \times 3.42 = 4.1 \times 10^{-5} \text{ C} \]

\[ T' = (R_2 + R_3) K' C = 14.4 \times 3 = 43.25 \text{ s} \]
\[ V_c = \frac{1}{3} \cdot 5.56 \text{ V} = 1.85 \text{ V} \]
\[ V_c = 1.85 \cdot e^{-\frac{t}{T'}} = 1.85 \cdot e^{-\frac{7}{43.25}} = 1.57 \text{ V} \]
\[ Q = V_c \cdot C = 1.57 \times 3 \times 12 \times 10^{-6} = 5.67 \times 10^{-5} \text{ C} \]