a. \[ \frac{d[A]}{dt} = -k_1 - k_2 [A]^2 \]

b. \[ \int \frac{d[A]}{k_1/k_2 + [A]^2} = \int -k_2 dt \]

\[ \sqrt{\frac{k_2}{k_1}} \tan^{-1} \left( \sqrt{\frac{k_2}{k_1}} [A] \right) = -k_2 t + C \]

\[ [A] = \sqrt{\frac{k_1}{k_2}} \tan \left( -\sqrt{\frac{k_1}{k_2}} t + C \right) \]

Since [A] at \( t = 0 \) is equal to 1 molar, \( C = \tan^{-1} \left( \sqrt{\frac{k_2}{k_1}} \right) \)

c. This is when \( [A] = 0 \) which happens when \( -\sqrt{k_1 k_2} t + C = 0 \) or when

\[ t_f = \frac{\tan^{-1} \left( \sqrt{\frac{k_2}{k_1}} \right)}{\sqrt{k_1 k_2}} \]

d. The concentration of [B] after a certain time is \( k_1 t \). The total amount of [A] decomposed after a time is \( 1 - \sqrt{\frac{k_1}{k_2}} \tan \left( -\sqrt{k_1 k_2} t + C \right) \), so the concentration of [C] after a certain time is

\[ 1 - \sqrt{\frac{k_1}{k_2}} \tan \left( -\sqrt{k_1 k_2} t + C \right) - k_1 t. \]

After the time found in part c elapses, the ratio of B to C is \( \frac{k_1 t_f}{1 - k_1 t_f} \).