FLINN SCIENTIFIC

Name_____

Kinetics of a First-Order Reaction Worksheet

Perform calculations on a separate sheet of paper.

Volume Added 0.1 M NaOH (mL)	Time (sec)	V_{total}	$V_{inf} - V_{total}$	$[(CH_3)_3CCl]_t$	$\ln[(CH_3)_3CCl]_t$
1.0		1.0			
1.0		2.0			
1.0		3.0			
1.0		4.0			
1.0		5.0			
1.0		6.0			
1.0		7.0			
1.0		8.0			
1.0		9.0			
1.0		10.0			
	∞				

rate constant, k _____ sec^{-1} $[(CH_3)_3CCl]_0$ _____ moles/L

Calculations

1. The concentration of *tert*-butyl chloride at each time a color change occurs can be calculated from the values of total volume of sodium hydroxide added at each time, Vol_{total} and the total volume of sodium hydroxide added at time = ∞, Vol_{inf}.

$$[(CH_3)_3CCl]_t = (Vol_{inf} - Vol_{total}) \times (0.1\ M)/4400\ mL\ solution \qquad \textit{Equation 11}$$

a. Calculate ($Vol_{inf} - Vol_{total}$) for each time recorded. Enter these values in the Data Table.

b. Calculate $[(CH_3)_3CCl]_t$ for each time recorded. Enter these values in the Data Table. Enter $[(CH_3)_3CCl]_0$ on the line below the Data Table.

c. Calculate $\ln[(CH_3)_3CCl]_t$ for each time recorded. Enter these values in the Data Table.

2. Have students plot $\ln[(CH_3)_3CCl]_t$ versus time, in seconds, on their graph paper. From the graph, have students determine the rate constant *k* (– slope). Enter this value on the line below the Data Table. Did the reaction follow first-order kinetics?
3. The half-life of a reaction ($t_{1/2}$) is the time it takes for one-half the reactants to be consumed.

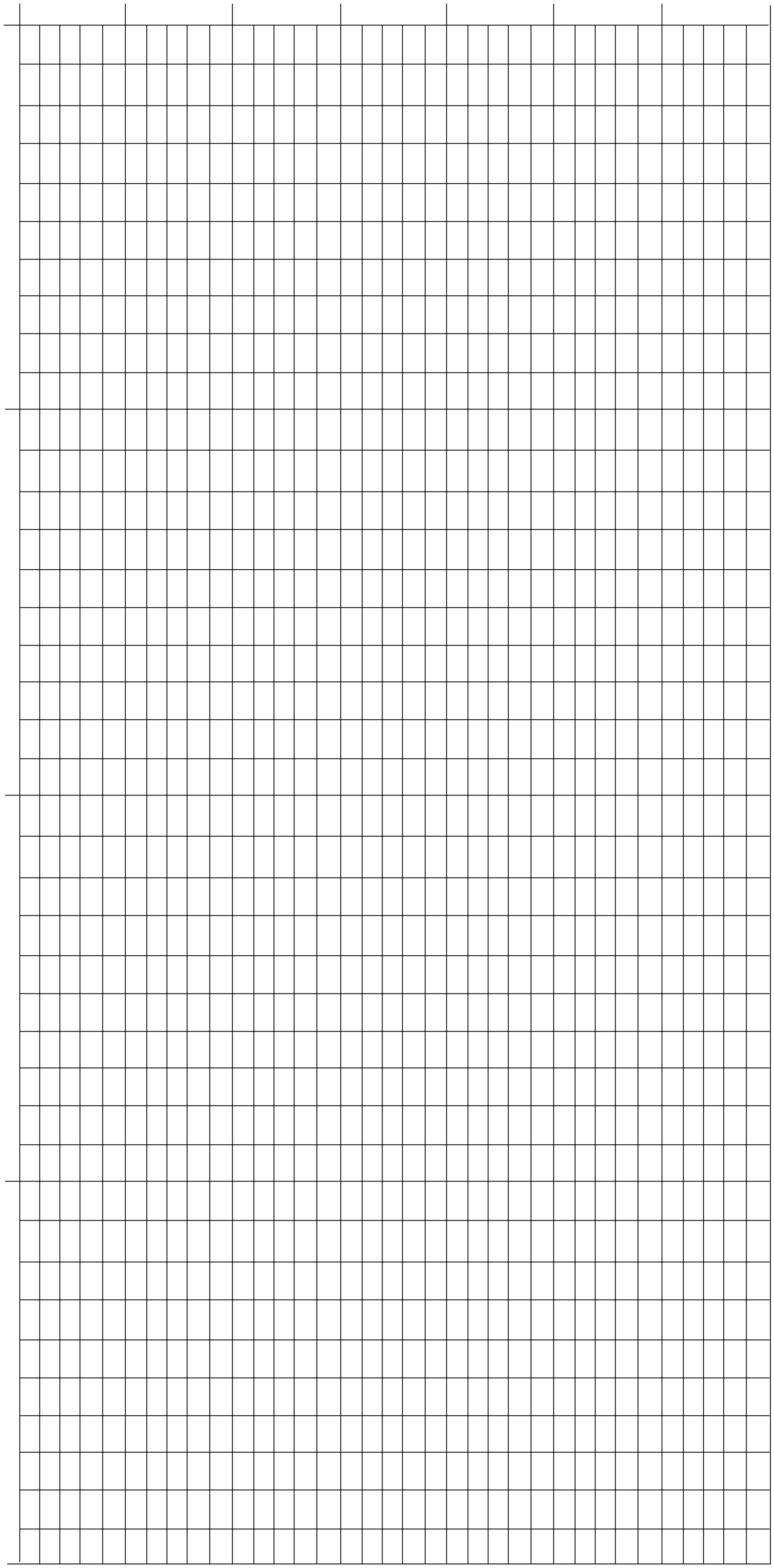
For a first-order reaction

$$t_{1/2} = \frac{0.693}{k} \qquad \textit{Equation 12}$$

Calculate the half-life for the reaction.

tert-Butyl Chloride Hydrolysis

$\ln[(CH_3)_3CCl]$



Time (sec)

