During Class Invention

Half-Life

Name___________________________

TA Name _______________________

Lab Section #______

1a. The reaction:

$$A(g) \rightarrow \text{products}$$

follows simple first order kinetics. When the $[A]_o = 0.400$ M what will the concentration of A be after one half-life?

**The half-life of a chemical reaction is defined as the time required for the initial concentration, $[A]_0$, to fall to half its value.**

$$[A]_{t_{1/2}} = 0.400 \text{ M}/2 = 0.200 \text{ M}$$

b. What additional information would you need to determine the concentration of the products in the reaction after one half-life?

**We would need to know the exact nature of the products and the coefficients for each product and the reactant so that we could calculate using the stoichiometry of the balanced chemical equation.**

2. Derive a mathematical equation for the half-life for a reaction which follows simple first order kinetics.

**The half-life of a chemical reaction is defined as the time required for the initial concentration, $[A]_0$, to fall to half its value. This can be described using the mathematical equation;**

$$[A_{t1/2}] = 0.5[A]_0.$$

$$\ln\left(\frac{[A]}{[A]_0}\right) = -kt$$

**Substituting**

$$\ln\left(\frac{0.5[A]_0}{[A]_0}\right) = -kt_{1/2}$$

$$\ln\ (0.5) = -kt_{1/2}$$

$$-0.693 = -kt_{1/2}$$

$$\frac{0.693}{k} = t_{1/2}$$

3. The decomposition of $H_2O_2$ to $H_2O$ and $O_2$ follows first order kinetics with a rate constant of $0.0410\ \text{min}^{-1}$ at a particular temperature.

$$H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$$

how long would it take for half of the $H_2O_2$ to decompose?

$$\mathbf{t_{1/2} = \frac{0.693}{k}}$$

$$\mathbf{= \frac{0.693}{0.041\ min^{-1}}}$$

**= 16.9 mins**