Practice for Proficiency

Half-Lives

Concept of half-life

$X \rightarrow Y$

1. A 1st order reaction, has a half-life of 10 seconds, after 30 seconds answer the following questions.
   a. How many half lives has the reaction undergone? 3
   b. The reaction is speeding up, slowing down, or remaining the same speed.

ex $10 \xrightarrow{\Delta 5} 5 \xrightarrow{\Delta 2\frac{1}{2}} 2\frac{1}{2} \xrightarrow{\Delta 1\frac{1}{4}} 1\frac{1}{4}$

$X \rightarrow Y$

2. A zero-order reaction has a concentration of 1.0M and after 10seconds the concentration is at 0.5M. Answer the following questions.
   a. Does the rate of this reaction (increase, decrease, remain the same) as the concentration of the reactant changes? zero order
   b. How much will be left of X after the reaction runs for 20 seconds?

$1 \rightarrow .5 \rightarrow 0$ zero

$X \rightarrow Y$

3. In a different first order reaction the concentration of X is 1.5M and has a half-life of 25 seconds. Answer the following questions.
   a. What is the concentration at 50 seconds?
   b. What is the concentration at 75 seconds?

$1.5 \xrightarrow{25} .75 \xrightarrow{50} .375 \xrightarrow{75} .187$

4. Nuclear reactions and drugs in your body are common examples of half-life applications. In both these examples there is only 1 reactant. For all these examples the order for these processes is 1st order?
5. As far as half-lives go, only 1st order reactions work like we commonly think about half lives.

Calculations involving half-lives

$X \rightarrow Y$

6. A reaction X starts at 0.5M and takes 10min to run down to 0.25M.
   a. What is the half-life of this reaction? 10 min
   b. Use the first order integrated rate law to determine how long it will take this reaction to run down to 0.1M

$.5 \rightarrow .25 \rightarrow .125$ (10, 20)

$\ln[\,]_t = -kt + \ln[\,]_0$

get k: $\ln[.5] = -k(10) + \ln[.1]$, $k = .0693$

$\ln(.5)t = -.0693(t) + \ln(.1)$, $t = 23 \text{ min}$

$X \rightarrow Y$

7. The reaction above has rate constant of 1.51/s. Answer the following questions. If it starts at 0.5M, how long will it take to drop to 0.25M.

$$\frac{.693}{k} = t_{1/2} \qquad \frac{.693}{1.51} = .45 \text{ sec} \; (t_{1/2})$$