1. Over the course of the reaction $3\,H_2(g) + N_2(g) \longrightarrow 2\,NH_3(g)$, the following data was obtained:

Time (min)	$[H_2]$ (mol/L)	$[N_2]$ (mol/L)	$[NH_3]$ (mol/L)
0	0.99	1.00	0.00
1	0.70	0.90	0.20
2	0.54	0.84	0.31
3	0.47	0.82	0.35

   (a) Calculate the average rates of change of $[H_2]$, $[N_2]$, and $[NH_3]$ over the first 3.0 minutes of the reaction (include units).

   (b) Calculate the average reaction rate over the first 3.0 minutes of the reaction (include units).

2. What are the units of k for each type of reaction?

   (a) zero-order

   (b) first-order

   (c) second-order

3. Consider the reaction: X + Y $\longrightarrow$ Z. From the following data, obtained at 360 K:

   (a) Determine the order of the reaction.

   (b) Determine the initial rate of change of [X] when the concentration of X is 0.30 M and that of Y is 0.40 M.

Initial rate of disappearance of X (M/s)	[X] (M)	[Y] (M)
-0.053	0.10	0.50
-0.127	0.20	0.30
-1.02	0.40	0.60
-0.254	0.20	0.60
-0.509	0.40	0.30

4. This reaction is first order in N_2O_5 with a rate constant (at a given temperature) of $k = 0.053\ s^{-1}$.

   $N_2O_5(g) \longrightarrow NO_3(g) + NO_2(g)$

   (a) Calculate the rate of the reaction when $[N_2O_5] = 0.055$ M.

   (b) What would the rate of the reaction be at the concentration indicated in part a if the reaction were second order? What about zero order? (Assume the same numerical value for k, but the units would be different, but you knew that already).

5. The rate constant for the second-order reaction

   $2\,\mathrm{NOBr(g)} \longrightarrow 2\,\mathrm{NO(g)} + \mathrm{Br_2(g)}$

   is 0.80 $M^{-1}s^{-1}$ at $10\,^{\circ}\mathrm{C}$.

   (a) Starting with a concentration of 0.086 M, calculate the concentration of NOBr after 22 s.

   (b) Calculate the half-lives when $[\mathrm{NOBr}]_0$ = 0.072 M and $[\mathrm{NOBr}]_0$ = 0.054 M.

6. This reaction was monitored as a function of time:

   $A \longrightarrow B + C$

   A plot of $ln[A]$ versus time yields a straight line with slope of $-0.0045\ s^{-1}$.

   (a) What is the value of the rate constant, k, for this reaction at this temperature?
   (b) Write the rate law for the reaction.
   (c) What is the half-life?
   (d) If the initial concentration of A is 0.250 M, what is the concentration after 225 s?