

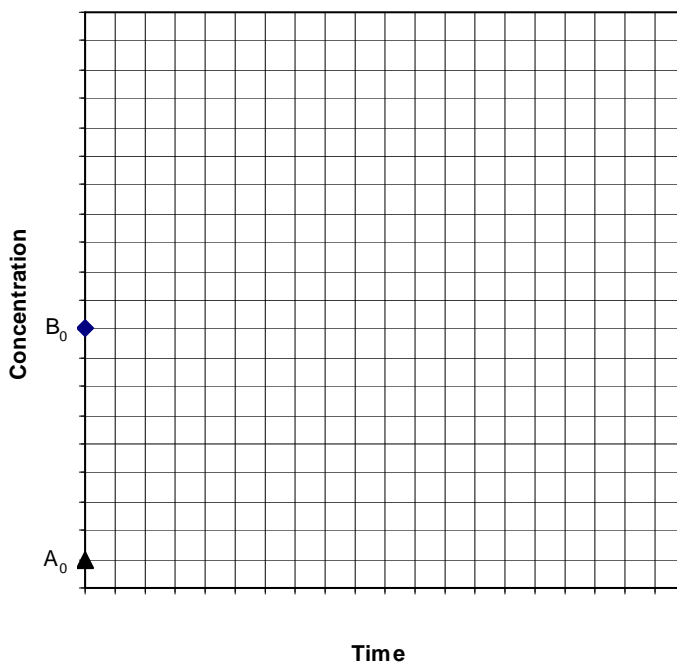
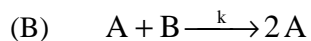
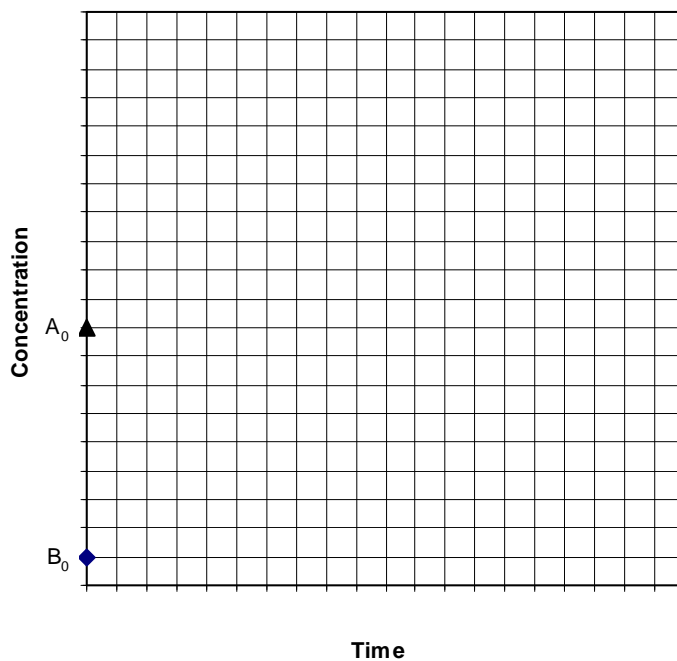
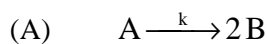
Some useful equations:

for: $\frac{dy}{dt} + y \cdot p(t) = q(t)$ where: $P(t) = \int_0^t p(t) \cdot dt$

the general solution is: $y(t) = y_0 \cdot e^{-P(t)} + e^{-P(t)} \int_0^t e^{P(t)} \cdot q(t) \cdot dt$

For any function: $a = A(x_1, x_2, x_3, \dots)$ $\sigma_a^2 = \sum_i \left(\left(\frac{\partial A}{\partial x_i} \right)^2 \cdot \sigma_{x_i}^2 \right)$ also: $w_i = \frac{1}{\sigma_i^2}$

1. (10 pts) Graph the general shape of each concentration with time for the following kinetic processes. Assume that stoichiometry = reaction order.



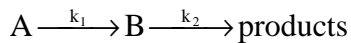
2. (10 pts) A reaction has a first order rate constant of 0.02 min^{-1} , and the initial concentration of the chemical at $t = 0$ is 10 units.

a) Use Euler's method with a stepsize of 5 minutes to calculate the concentration after 10 minutes of reaction. Show all calculations in a simple table.

b) Using the analytical solution for first order decay, calculate the concentration after 10 minutes. Again, show all work.

c) What is the half-life of the chemical?

3. (10 pts) Derive the analytical solution for B ($B =$) as a function of B_0 , k_1 , k_2 , and t , assuming order equals stoichiometry. (Show all work)



4. (10 pts) A researcher measures the octanol water partition coefficient (K_{ow}) of a chemical to be 260 ± 30 , where 30 is the standard deviation. It is typical to report these values as base-10 'log K_{ow} ' values, which in this case would be $\log K_{ow} = 2.41$. What is the standard deviation on this log K_{ow} value?

Recall that:
$$\frac{d(\log X)}{dX} = \frac{1}{2.3 \cdot X}$$

5. (10 pts) For the reaction below, assume that NH_3 and NH_4^+ are always in equilibrium through the equilibrium constant, K_a , but NH_3 is the only reactive species. Let $C_{\text{Tot}} = \text{NH}_3 + \text{NH}_4^+$. Solve for C_{Tot} as a function of t , $C_{\text{Tot},0}$, K_a , k , and H^+ (i.e., develop the analytical solution, $C_{\text{Tot}} =$) Assume that during the reaction, the pH does not change.

