HW 10, chemistry 2, 2025

There are two types of rate laws. Let's look at the first one. The differential rate law (or simply rate law) shows how the rate of reaction depends on concentrations (see slide 6 from the presentation). The **proportionality constant (k)** will be introduced for our calculations. We usually try to consider conditions where reverse reaction is unimportant, so the rate law will involve only concentration of reactants. To determine the order of the reaction we **have to** use experiments. The most common way to determine the order of the reaction is the method of initial rates, where several experiments are run at different initial concentration and the initial rates are determined. In the table below we see 4 experiments where the initial concentrations of A and B reactants are different and we see the corresponding reaction rates. If the rate of the reaction does not depend on the reactant concentration we have **zero order reaction** with the following equation for our calculations **rate = k.** If the rate is directly proportional to concentration we have **first order** reaction where **rate = k[A]** (Doubling the concentration of A doubles the reaction rate). If we do not see this effect we can try to square the concentration, plot it versus rate, and see if we get the line on our graph, if so, we have second order reaction: **rate = k[A]^2**, doubling the concentration of A quadruples the reaction rate; tripling the concentration increases the rate by nine times.

Questions

1. Consider reaction 2A + B → C + D

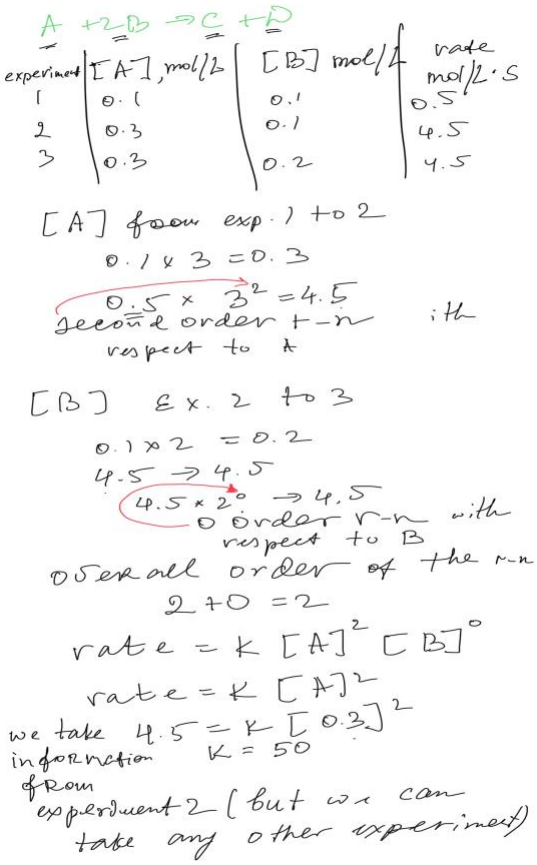
The following data were received

experiment	[A] mol/L	[B] mol/L	Rate mol/L s
1	1.2	2	5×10^{-3}
2	2.4	2	1×10^{-2}
3	6	2	2.5×10^{-2}
4	6	8	0.1

Find the order of the reaction with respect to A

Find the order with respect to B

Find the overall order of the reaction (you add the order with respect to A to the order with respect to B) For help look at what we did in the class:



2. Consider this experimental data from the following reaction:
$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
I graphed it (x – time (s); y – volume (ml) of carbon dioxide produced), and put a tangent line at zero for you. Calculate the initial rate of the reaction.