SCH4U

RATE LAW EQUATION PROBLEM SET

Part 1: Rate Law Equation Practice

- 1. For a reaction where the rate equation is $r = k[NH_4^+_{(aq)}][NO_2^-_{(aq)}],$
 - a) calculate k at temperature T_1 , if the rate, r, is 2.40×10^{-7} mol/(L \odot s) when [NH₄⁺(aq)] is 0.200 mol/L and [NO₂ (aq)] is 0.00500 mol/L. $\cline{1.5}$
 - b) calculate r at temperature T_2 , if the rate constant, k, is 3.20×10^{-4} L/(mol \odot s) when [NH₄⁺(aq)] is 0.100 mol/L and [NO_{2 (aq)}] is 0.0150 mol/L. $r=4.80 \times 10^{-7}$ mol/L. s
- 2. A series of experiments is performed for the system

- When the initial concentration of A is doubled, the rate increases by a factor of 4.
- When the initial concentration of B is doubled, the rate is doubled.
- When the initial concentration of C is doubled, there is no effect on rate.
- a) What is the order of reaction with respect to each of the reactants? A $\dot{\omega}$ $\stackrel{?}{a}$ $\stackrel{?}{b}$ $\dot{\omega}$ $\stackrel{1}{b}$ $\stackrel{c}{c}$ $\stackrel{c}{b}$
- b) Write an expression for the rate equation.

D + 2E

Part 2: More Rate Law Expressions

1. Consider the data for hydrogen concentration [H₂], iodine concentration [I₂] and rate of reaction (moles per litre per second or mol·L⁻¹/s) for this reaction:

$H_2(g) +$	I ₂ (g)	—→ 2 HI (g)			
	Trial	$[H_2]$ (mol/L)	[l ₂] (mol/L)3	Rate (mol·L ⁻¹ /s)	1
(2000-31-00-0	1	0.01	0.05	0.04	2 = 2
	2	0.01 0.02	0.05	$0.04 > \times 2$ $0.08 > \times 2$	
	3	0.03	0.05	0.12	3
	4	0.05	0.01 x2	0.02 × 8 0.16	$2^{3} = 8$
	5	0.05 0.05	0.02	0.16	
	6	0.05	0.03	0.54	

- a) Determine the rate law expression for this reaction. $V = k L H_2 I L I_2 I^3$ b) What is the overall restriction in a first section.
- b) What is the overall reaction order? 4th order
- c) What would happen to the rate of the reaction if the concentration of both reactants was doubled? 6x faster
- 2. Consider a hypothetical reaction:

Doubling the concentration of A causes the reaction rate to increase by a factor of four. This is done while the concentration of B is held constant. Tripling the concentration of B, while the concentration of A is held constant, causes the reaction rate to increase by a factor of nine.

- a) What is the rate law expression for this reaction? $\Gamma = K LA J^2 LB J$
- b) What would happen to the reaction rate if the concentration of A was tripled and the concentration of B was doubled simultaneously? 36x faster

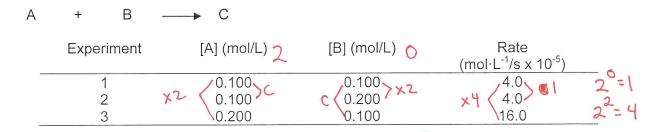
Consider the reaction:

$$NH_4^+$$
 (aq) + NO_2^- (aq) \longrightarrow N_2 (g) + 2 H_2O (I)

Experiment	$[NO_2^-]$ (mol/L)	[NH ₄ ⁺] (mol/L)	Rate (mol·L ⁻¹ /s x 10 ⁻⁷)	
1	0.0100 x2	0.200	5.4	21=2
2	0.0200	0.200	10.8	2
3	0.0400	0.200	21.6	
4	0.200	0.0202 0.0404	10.8 × 2 21.6	21=2
5	0.200	0.0404	21.6	
6	0.200	0.0606	32.4	

Determine the rate law expression for this reaction.

4. Consider a hypothetical reaction:



a) Determine the rate law expression for this reaction. V=K(AJ²)

b) What is the order of reaction with respect to A? to B? A = 2nd order

c) What is the overall reaction order? 2nd order

5. In a reaction involving only one reactant, A, the rate of the reaction increases by a factor of 27 when the concentration of A is tripled. What is the rate law expression for this reaction?

→ C + D $r = k[A]^2[B]^2$ 6. A + B

The rate of the reaction is 1.0 x 10⁻⁴ M/s when the concentration of A is 0.40 M and the concentration of B is 0.30 M. Calculate the rate of the reaction when the concentration of A is 0.85 M and the concentration of B is 0.75 M. Find k first. $\frac{1}{100} = \frac{1}{100} = \frac{1}{10$

 $r = k[A]^2[B]^0$ A + B7.

The rate of the reaction is 4.0×10^{-5} M/s when the concentration of A is 0.100 M. Calculate the rate of the reaction when the concentration of A is 0.550 M. $\times 20.004$ $\times 10^{-3}$ mol/ $\times 10^{-3}$

8. $2HI \longrightarrow H_2 + I_2 \qquad r = k[HI]^2$ The rate of reaction is 2.5×10^{-4} M/s when the concentration of HI is 0.0588 M. Calculate the new rate of reaction if the concentration of HI is 0.0885 M. $K = 7.21 \times 10^{-2}$ L/mol·s $V = 5.64 \times 10^{-4}$ mol/L·S

9. The decomposition of N_2O_5 has the rate law: $r = \kappa_1N_2O_5$. If $k = 1.0 \times 10^{-5}$ 1/s, what is the rate of the reaction when the concentration of N_2O_5 is 0.0010 M?