





	QUESTION				
If we have the re of A follows:	If we have the reaction $A(g) \rightarrow 2B(g)$ and the number of moles of A follows:				
time moles A	0 5 min 10 min 0.100 0.085 0.070				
What is the num	What is the number of moles of B at 10 min?				
A. B. C. D. E.	0.060 mol 0.200 mol 0.140 mol 0.100 mol 0.030 mol				

Average rate = $\frac{\Delta t}{\Delta t}$ = $\frac{(\text{moles of B at } t = 10) - (\text{moles of B at } t = 0)}{10 \text{ min} - 0 \text{ min}}$ = $\frac{0.26 \text{ mol} - 0 \text{ mol}}{10 \text{ min} - 0 \text{ min}} = 0.026 \text{ mol/min}$				
Гіте <i>, t</i> (min)	Moles of A	Moles of	в	Average Rate (mol/min) per 10-min-interval
0 10 20 50 50	1.00 0.74 0.54 0.40 0.30 0.22	0 0.26 0.46 0.60 0.70 0.78		0.026 0.020 0.014 0.010 0.008 0.006

Expressions of a Rate of Reaction For the Chemical Reaction: $aA + bB \rightarrow cC + dD$ Rate $= -\frac{1}{a}\frac{\Delta[A]}{\Delta t} = -\frac{1}{b}\frac{\Delta[B]}{\Delta t} = \frac{1}{c}\frac{\Delta[C]}{\Delta t} = \frac{1}{d}\frac{\Delta[D]}{\Delta t}$

QUESTION

Chlorine dioxide (ClO_2) is a disinfectant used in municipal watertreatment plants. It dissolves in basic solution producing $ClO_3^$ and ClO_2^- :

 $2\text{ClO}_2(aq) + 2\text{OH}^-(aq) \rightarrow \text{ClO}_3^-(aq) + \text{ClO}_2^-(aq) + \text{H}_2\text{O}(l)$

Of the following, which would not be a proper expression to relate information about the rate of the reaction?

- A. $-\Delta \text{ClO}_2/\Delta t = 2\Delta \text{ClO}_3^-/\Delta t$
- B. $-\Delta \text{ClO}_2/\Delta t = \Delta \text{OH}^{-}/\Delta t$ C. $-\Delta \text{ClO}_2/\Delta t = \Delta \text{ClO}_2^{-}/\Delta t$
- D. $-\Delta OH^{-}/\Delta t = 2\Delta ClO_2^{-}/\Delta t$



 $C_4H_9Cl(aq) + H_2O(l) \rightarrow C_4H_9OH(aq) + HCl(aq)$

- The *average rate* can be expressed in terms of the disappearance of C_4H_9Cl .
- **t** The units for *average rate* are mol/L s or *M/s*.
- **t** The *average rate* decreases over time.
- ★ Data and plotting [C₄H₉Cl] versus time:

$C_4H_9Cl(aq) + H_2O(l) \rightarrow C_4H_9OH(aq) + HCl(aq)$				
		Average		
Time, t (s)	$[C_4H_9Cl](M)$	Rate (M/s)		

0.0	0.1000	 10×10^{-4}
50.0	0.0905	1.9×10^{-4}
100.0	0.0820	 1.7×10^{-4}
150.0	0.0741	1.6×10^{-4}
200.0	0.0671	1.4×10^{-4}
300.0	0.0549	 1.22×10^{-4}
400.0	0.0448	1.01×10^{-4}
500.0	0.0368	 0.80×10^{-4}
800.0	0.0200	 0.560×10^{-3}
10,000	0	





























Q	UF	EST	ΓΙΟΝ
A kinetic study of ti yielding the followi Experiment 1 2 3 4 What is the rate lat	he react ng resul [A], (Λ 0.10 0.05 0.10 0.20 w for the	ion 2A + ts: 1) [B], (M 0.10 0.20 0.30 0.10 e reaction	2B → products was conducted) Initial Rate, <i>M</i> / s 25 100 225 25 25
A. B. C. D. E.	Rate = Rate = Rate = Rate = Rate =	= <i>k</i> [A][B] = <i>k</i> [B] ² = <i>k</i> [A] ² [B] = <i>k</i> [A] ² = <i>k</i> [A] ² [B]	2













QUESTION			
$2\text{CIO}_2(aq) + 2\text{OH}^-(aq) \rightarrow \text{CIO}_3^-(aq) + \text{CIO}_2^-(aq) + \text{H}_2\text{O}(l)$ The following kinetic data were obtained for the reaction:			
Experiment #	$[ClO_2]_0$ M	[OH ⁻], M	Initial rate (M/s)
1	0.060	0.030	0.0248
2	0.020	0.030	0.00827
3	0.020	0.045	0.0124
4	0.030	0.050	0.0206
etermine the rate la A. Rate = k [ClO2 B. Rate = k [ClO2 C. Rate = k [ClO2 D. Rate = k [ClO2	aw <u>and</u> the ra 2][OH–]; $k =$ 2][OH–]; $k =$ 2][OH–]; $k =$ 2][OH–]; $k =$	ate constant = 14 L/mol s 0.073 L/mo = 14 s = 0.073 L/m	for this reaction. s bl s nol s

First-Order and Second-Order Reactions			
An Overview of First-Order and Simple Second-Order Reactions			
	First Order	Second Order	
Rate law	rate = $k[A]$	rate = $k[A]^2$	
Units for k	I/s	L/mol · s	
Integrated rate law in straight-line form	$\ln [A]_t = -kt + \ln [A]_0$	$1/[A]_t = kt + 1/[A]_0$	
Plot for straight line	In [A], vs. t	1/[A], vs. t	
Slope, y intercept	-k. In [A] ₀	k. 1/[A]0	
Half life	$(\ln 2)/k$	1/k[A]0	

Unimolecular (1st Order) Reaction

- One treatment of hyperthyroidism is the oral administration of radioactive iodine, which concentrates in the thyroid and slows the thyroid's hormone production.
- 1) 131 I decays by a first order reaction with the emission of a Beta particle, which has a half life of ~8 days. The biological half life of iodine is ~100 days. Write the rate law for the 131 I decay.
- 2) If 1.00 gram of ¹³¹I is taken by a patient, how much remains after 1 week? After 1 month? After 1 year?

QUESTION

Consider the hydrolysis of *t*-butyliodide, the equation for which is $(CH_3)_3C-I + H_2O \rightarrow (CH_3)_3COH + HI$. The equation governing the rate of this reaction is rate = $k[(CH_3)_3C-I]$. What is the order of each reactant and the overall order of the reaction?

- A. The order of *t*-butyliodide is 0, the order of water is 1, and the reaction order is 1.
- B. The order of *t*-butyliodide is 1, the order of water is 1, and the reaction order is 1.
- C. The order of *t*-butyliodide is 1, the order of water is 0, and the reaction order is 2.
- D. The order of *t*-butyliodide is 1, the order of water is 0, and the reaction order is 1.
- E. The order of *t*-butyliodide is 1, the order of water is 1, and the reaction order is 2.

QUESTION

A reaction is shown to be first order with respect to one reactant, with a second order dependency on another reactant. Which statement makes an accurate comment about these two observations?

- A. Assuming no temperature change, doubling the concentration of both reactants would cause the reaction rate to double.
- B. Assuming no temperature change, doubling the concentration of both reactants would cause the reaction rate to increase by a factor of four.
- C. Assuming no temperature change, doubling the concentration of both reactants would cause the reaction rate to increase by a factor of five.
- D. Assuming no temperature change, doubling the concentration of both reactants would cause the reaction rate to increase by a factor of eight.

The Arrhenius Equation

$$k = Ae^{-E_a/RT}$$

- k is the rate constant, E_a is the activation energy, R is the gas constant (8.314 J/K mol) and T is the temperature in K.
- $\bigstar A$ is called the frequency factor.
- *A* is a measure of the probability of a favorable collision.
- Both A and E_a are specific to a given reaction.

The Arrhenius Equation

• With sufficient data, E_a and A can be determined graphically by rearranging the Arrhenius equation:

$$\ln k = -\frac{E_a}{RT} + \ln A$$

• With only two sets of data:

$$\ln\frac{k_1}{k_2} = \frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$



QUESTION

Use the Arrhenius activation energy equation to determine the activation energy for a reaction that has, at 25.0°C, a specific rate constant of 0.010 s⁻¹ and at 50.0°C a specific rate constant of 0.020 s⁻¹. (R = 8.3145 J/K mol)

А.	290 J
В.	320 J
0	22 000 T

- C. 22 000 J D. -22 000 J
- E. None of the above







Rate Laws for General Elementary Steps				
Elementary Step	Molecularity	Rate Law		
A \longrightarrow product	Unimolecular	Rate = $k[A]$		
2A → product	Bimolecular	Rate = $k[A]^2$		
$A + B \longrightarrow product$	Bimolecular	Rate = k[A][B]		
Least likely of the elementary 2A + B → product	steps. Why? Termolecular	Rate = $k[A]^2[B]$		







QUESTION

Two reactions have the same rate. One reaction is first order whereas the other is second order. Which comment about the half lives of both reactions is accurate?

- A. As their rates are equal, their half lives will be equal.
- B. The half life of the second order reaction will be twice that of the other.
- C. The half life of the second order reaction will be 1/2 that of the other.
- D. No direct comparison can be made with only that information.























http://chemconnections.org/general/movies/Enzymes-Energy.mov_



