

Name: _____

Period: _____

Seat#: _____

Directions: Show all work in a way that would earn you credit on the AP Test!

1) Consider the reaction: $2 \text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2 \text{NO}_2(\text{g})$

The following data were obtained from three experiments using the method of initial rates:

	Initial [NO] mol L ⁻¹	Initial [O ₂] mol L ⁻¹	Initial Rate [NO] mol L ⁻¹ s ⁻¹
Exp. 1	0.010	0.010	2.5×10^{-5}
Exp. 2	0.020	0.010	1.0×10^{-4}
Exp. 3	0.010	0.020	5.0×10^{-5}

<p>a) Determine the order of the rxn for each reactant.</p>	<p>b) Write the rate equation for the reaction</p>
<p>c) Calculate the rate constant.</p> <p style="text-align: right;"><u>$25 \text{ L}^2 \cdot \text{mol}^2 \cdot \text{s}^{-1}$</u></p>	<p>d) Calculate the rate (in mol L⁻¹s⁻¹) at the instant when [NO] = 0.015 mol L⁻¹ and [O₂] = 0.0050 mol L⁻¹</p> <p style="text-align: right;"><u>$2.8 \times 10^{-5} \text{ M} \cdot \text{s}^{-1}$</u></p>
<p>e. At the instant when NO is reacting at the rate $1.0 \times 10^{-4} \text{ mol L}^{-1}\text{s}^{-1}$, what is the rate at which O₂ is reactant and NO₂ is forming? (Hint: Use coefficients)</p> <p style="text-align: right;"><u>$5.0 \times 10^{-5}, 1.0 \times 10^{-4}$</u></p>	

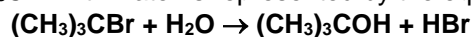
2) The reaction $2 \text{NO}(\text{g}) + 2 \text{H}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g})$ was studied at 904 °C, and the data in the table were collected.

	Initial [NO] mol L ⁻¹	Initial [H ₂] mol L ⁻¹	Initial Rate [N ₂] mol L ⁻¹ s ⁻¹
Exp. 1	0.420	0.122	0.136
Exp. 2	0.210	0.122	0.0339
Exp. 3	0.210	0.244	0.0678
Exp. 4	0.105	0.488	0.0339

<p>a) Determine the order of the reaction for each reactant.</p>	<p>b) Write the rate equation for the reaction</p>
<p>c) Calculate the rate constant at 904 °C.</p> <p style="text-align: right;"><u>$6.32 \text{ L}^2 \cdot \text{mol}^2 \cdot \text{s}^{-1}$</u></p>	<p>d) Find the rate of appearance of N₂ at the instant when [NO] = 0.350 M and [H₂] = 0.205 M</p> <p style="text-align: right;"><u>$0.159 \text{ M} \cdot \text{s}^{-1}$</u></p>

Dougherty Valley HS Chemistry - AP
Kinetics – Method of Initial Rates

3) The reaction of tbutyl-bromide (CH₃)₃CBr with water is represented by the equation:

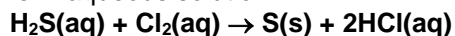


The following data were obtained from three experiments using the method of initial rates:

	Initial [(CH ₃) ₃ CBr] mol L ⁻¹	Initial [H ₂ O] mol L ⁻¹	Initial Rate [NO] mol L ⁻¹ s ⁻¹
Exp. 1	5.0 x 10 ⁻²	2.0 x 10 ⁻²	2.0 x 10 ⁻⁶
Exp. 2	5.0 x 10 ⁻²	4.0 x 10 ⁻²	2.0 x 10 ⁻⁶
Exp. 3	1.0 x 10 ⁻¹	4.0 x 10 ⁻²	4.0 x 10 ⁻⁶

a) What is the order with respect to (CH ₃) ₃ CBr?	b) What is the order with respect to H ₂ O?
c) What is the overall order of the reaction?	d) Write the rate equation
e) e. Calculate the rate constant, k, for the reaction.	
<i>4.0 E-5 sec⁻¹</i>	

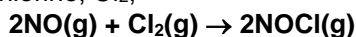
4) Hydrogen Sulfide is oxidized by chlorine in aqueous solution.



The experimental rate law is: Rate = k[H₂S][Cl₂]

a) What is the reaction order with respect to H ₂ S?	b) What is the reaction order with respect to Cl ₂ ?	c) What is the overall order?
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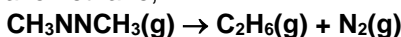
5) For the reaction of nitric oxide, NO, with chlorine, Cl₂,



The observed rate law is: Rate = k[NO]²[Cl₂];

a) What is the reaction order with respect to NO?	b) What is the reaction order with respect to Cl ₂ ?	c) What is the overall order?
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6) In experiments on the decomposition of azomethane,



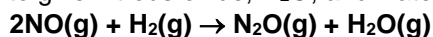
The following data were obtained:

	Initial [CH ₃ NNCH ₃] mol L ⁻¹	Initial Rate mol L ⁻¹ s ⁻¹
Exp. 1	1.13 x 10 ⁻²	2.8 x 10 ⁻⁶
Exp. 2	2.26 x 10 ⁻²	5.6 x 10 ⁻⁶

a) What is the rate law?	b) What is the value of the rate constant?
<i>k = 2.5 E-4 s⁻¹</i>	

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Kinetics – Method of Initial Rates

7) Nitric Oxide, NO, reacts with hydrogen to give nitrous oxide, N₂O, and water:



In a series of experiments, the following initial rates of disappearance of NO were obtained:

	Initial [NO(g)] mol L ⁻¹	Initial [H ₂ (g)] mol L ⁻¹	Initial Rate [NO] mol L ⁻¹ s ⁻¹
Exp. 1	6.4 x 10 ⁻³	2.2 x 10 ⁻³	2.6 x 10 ⁻⁵
Exp. 2	12.8 x 10 ⁻³	2.2 x 10 ⁻³	1.0 x 10 ⁻⁴
Exp. 3	6.4 x 10 ⁻³	4.5 x 10 ⁻³	5.1 x 10 ⁻⁵

<p>a) What is the rate law?</p>	<p>b) What is the value of the rate constant?</p>
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k = 2.9 E2 M²s⁻¹

8) Chlorine dioxide, ClO₂, is a reddish-yellow gas that is soluble in water. In basic solution it gives ClO₃⁻ and ClO₂⁻ ions.



To obtain the rate law for this reaction, the following experiments were run and, for each, the initial rate of reaction of ClO₂ was determined. Obtain the rate law and the value of the rate constant.

	Initial [ClO ₂] mol L ⁻¹	Initial [OH ⁻] mol L ⁻¹	Initial Rate mol L ⁻¹ s ⁻¹
Exp. 1	0.060	0.030	0.0248
Exp. 2	0.020	0.030	0.00276
Exp. 3	0.020	0.090	0.00828

<p>a) What is the rate law?</p>	<p>b) What is the value of the rate constant?</p>
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k = 2.3 E2 M²s⁻¹