NAME _____ DATE _____

Student Progress Sheet: Evaluate Reaction Mechanisms and Rate Data

You will examine experimental data of reactant concentrations versus time in order to determine the rate law for a reaction. You will evaluate reaction mechanisms using particulate and graphical representations, and the collision theory to justify a claim as to whether or not the mechanism matches experimental data. You will be able to interpret energy profiles to determine the activation energy, effects of adding a catalyst, and the rate-determining step in a reaction mechanism.

Part 1: Misunderstanding check

To check the accuracy of your understandings about evaluating reaction mechanisms and rate data, mark whether you agree or disagree with each statement below. Then, provide a reason for your response.

Agree	Disagree	Statement	Reasoning
		The reaction order of a reactant is equal to the number of moles present in the balanced chemical reaction.	
		$A\,(g) + B(g) \leftrightarrow AB\,(g)$ $\Delta H° = -4$ kJ/mol$_{rxn}$ Increasing the temperature decreases the rate of the forward reaction.	
		$A(g) + A(g) \leftrightarrow A_2\,(g)$ (fast) $A_2\,(g) + B\,(g) \rightarrow A_2B\,(g)$ (slow) The rate law for the reaction mechanism above is third order.	
		If the plot of ln [A] vs. time is a linear relationship, then this indicates that the reaction is first order in terms of [A] and the specific rate constant has units of Ms^{-1}	
		The true reaction mechanism can be determined by finding a mechanism that matches the experimental rate law and the net chemical reaction.	
		When a mixture of hydrogen and oxygen gas explodes, the reaction occurs in a single step represented by the equation, $2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O(g)$.	
		The overall order for a reaction that has the rate law of **rate = *k*[A][B]^2** is second-order.	

Agree	Disagree	Statement	Reasoning
		A catalyst does not take part in the reaction mechanism.	
		The value of the rate constant, *k*, will increase when a catalyst is added to a reaction.	

Part 2: Track your progress

Check your ability to relate rates of chemical reactions to molecular collisions, reaction mechanisms, and graphical representations by assigning a rating to your understanding of the concepts below and providing evidence to support your evaluations. For your reflection use the scale: (1=no understanding and 5=excellent understanding).

Challenge Area	Success Criteria	Reflect	Justify your rating What assignments, homework or assessments provide evidence to support this rating?
Evaluate Reaction Mechanisms and Rate Data	Can you evaluate alternative explanations, as expressed by reaction mechanisms, to determine which are consistent with data regarding the overall rate of a reaction and with data that can be used to infer the presence of a reaction intermediate?	**1 2 3 4 5**	
	Can you connect the rate law for an elementary reaction to the frequency and success of molecular collisions, including connecting the frequency and success to the order and the rate constant, respectively?	**1 2 3 4 5**	
	Can you make a claim about factors that influence the rate of a chemical reaction, and can justify the claim using representations (e.g., Boltzmann diagrams, energy profiles, and particulate diagrams) and relevant theories (e.g., collision theory and kinetic molecular theory)?	**1 2 3 4 5**	

Challenge Area	Success Criteria	Reflect	Justify your rating What assignments, homework or assessments provide evidence to support this rating?
Building Block A:			
Concentration vs. Time	Can you analyze concentration vs. time data to determine the rate law for a zeroth-, first-, or second-order reaction?	**1 2 3 4 5**	
	Can you design and/or interpret the results of an experiment regarding the factors (e.g., temperature, concentration, surface area) that may influence the rate of a reaction?	**1 2 3 4 5**	
Building Block B:			
Energy Profiles	Can you use energy profiles and Boltzmann distributions of thermal energy to analyze differences in reaction rate?	**1 2 3 4 5**	
Building Block C:			
Reaction Mechanisms	Can you evaluate different reaction mechanisms with the rate-limiting step as the first step, in order to determine which one matches the experimental data?	**1 2 3 4 5**	
Building Block D:			
Catalyzed Pathways and Energy Diagrams	Can you translate among reaction energy profile representations, particulate representations, and symbolic representations (chemical equations) of a chemical reaction occurring in the presence and absence of a catalyst?	**1 2 3 4 5**	
	Can you explain the role of a catalyst in changing the rate of a chemical reaction?	**1 2 3 4 5**	

Terms: Can you describe these concepts and how they relate to rates of chemical reactions, reaction mechanisms, and graphical representations? *This list is just a sample of the terms that can be related to concepts of chemical kinetics. Throughout this unit, add other terms as you learn them.*

reaction rate

rate law

reaction order

reaction mechanism

rate-determining step

zeroth-order reaction

first-order reaction

second-order reaction

half-life

natural log (ln)

integrated rate law

energy profile

activation energy

uni-molecular

Maxwell-Boltzmann distributions

elementary reaction

reaction intermediate

catalyst

enzyme