Chapter 13 Reading Guide **Name:**

AP Chemistry 2016-2017 **Date:** **Period:**

Chemical kinetics is the focus of Big Idea 4 in the AP Chemistry curriculum. Determining orders from experimental data, writing rate laws, and understanding mechanisms are skills needed to master. In particular, the AP Chemistry Curriculum places some degree of emphasis on mechanisms.

13.2 The Rate of a Chemical Reaction

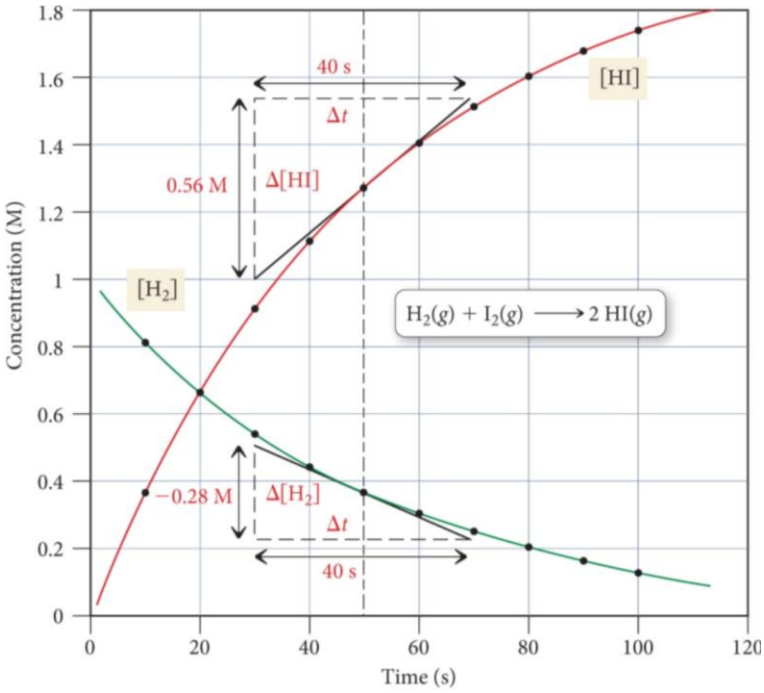
1. How is a rate measured for a chemical reaction? What are the usual units for a rate of reaction?

2. Why does the reaction rate for a reactant have a negative sign and a product have a positive sign?

3. Write the general rate for each reactant and product in the following reaction:

$$2H_2(g) + O_2(g) \rightarrow 2H_2O\ (g)$$

4. Explain how to determine the instantaneous rate for H_2 and HI at 80 seconds. Use the graph below to calculate each rate:



5. Using the same graph from problem 4, calculate the rate of reaction for I_2 at 80 seconds, knowing the chemical equation for the reaction in question #4 is $H_{2\,(g)} + I_{2\,(g)} \rightarrow 2\ HI_{\,(g)}$.

6. For the reaction aA + bB → cC + dD, write how to determine the reaction rate of each species.

7. What is the difference between average rate and instantaneous rate?

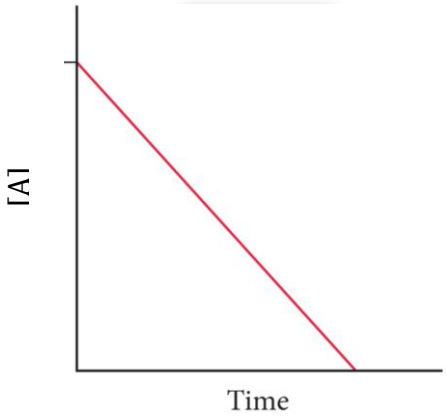
8. What types of reactions can use spectroscopy to measure the rate of reaction as a reaction proceeds? Give an example.

13.3 The Rate Law: The Effect of Concentration on a Reaction Rate

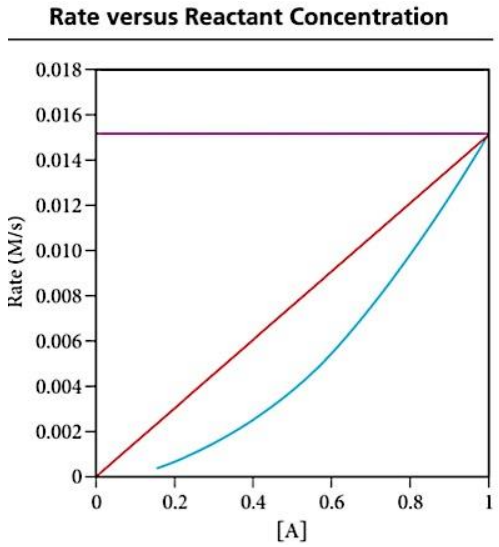
9. What is the general form of the rate law? Indicate what each variable represents.

10. What does it mean if $n = 0$, $n = 1$, $n = 2$?

11. Explain why this graph represents a zero order reaction.



12. Explain why the horizontal line represents a zero order kinetics and the straight diagonal line represents first order kinetics.



13. What is the only way to determine a reaction order?

14. When comparing experimental evidence, what changes will be observed in the change of reaction rate for a
    a. zero order reaction?

    b. First order?

    c. Second order?

15. What are the units of the rate constant for a…
    a. zero order reaction?

    b. First order?

    c. Second order?

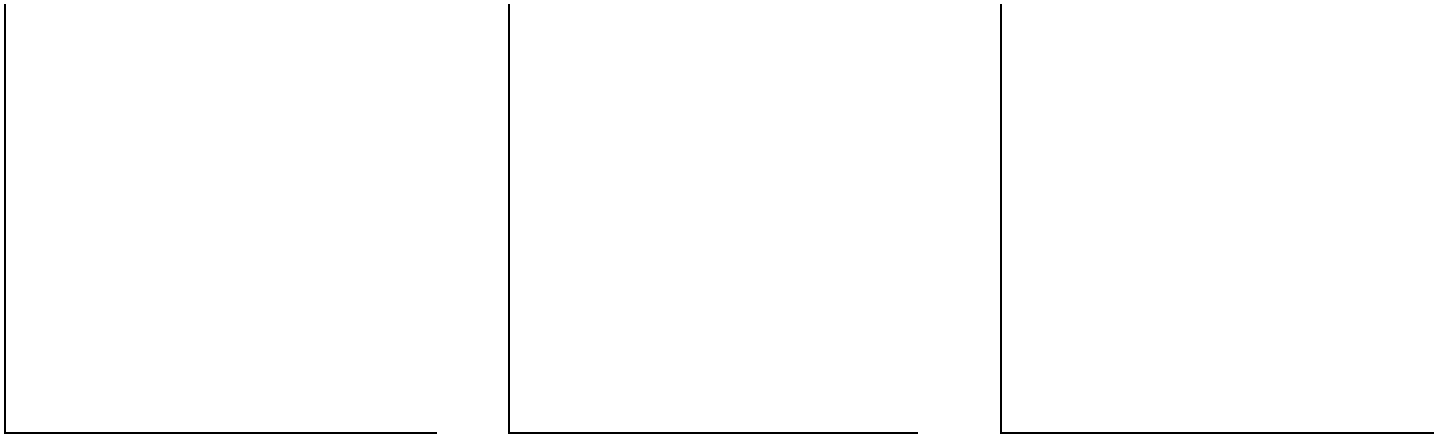
16. How do you write a general rate law when there are multiple reactants?

17. How do you determine the overall order of a reaction?

13.4 The Integrated Rate Law: The Dependence of Concentration on Time

18. What is an integrated rate law?

19. Draw a straight-line graph, **including labeled axes**, for a zero-, first- and second-order reaction.

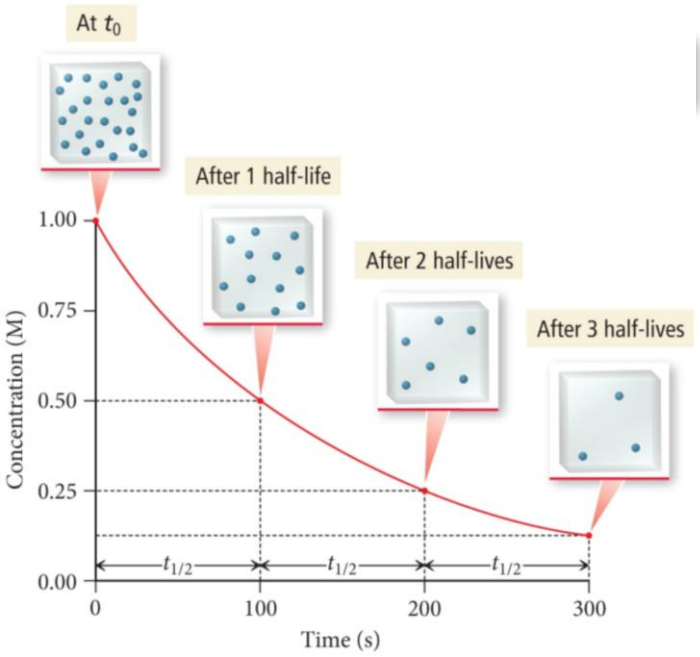


20. What does the y-intercept of each graph in #20 represent?

21. Write the integrated rate law for each reaction in #16.

22. What is a half-life of a reaction?

23. Explain how this graph of half-lives shows this is a first-order reaction.



24. What is the equation for the half-life reaction of a first-order reaction?

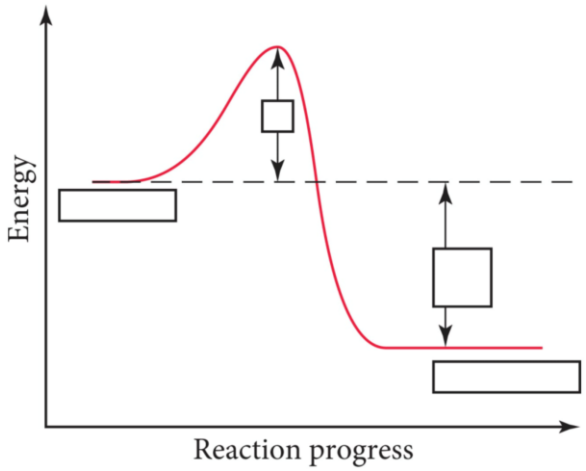
25. What is the equation for the half-life of a second-order reaction? What happens to the half-life time as the concentration decreases?

26. What is the equation for the half-life of a zero-order reaction? What happens to the half-life times as the concentration decreases?

13.5 The Effect of Temperature on Reaction Rate

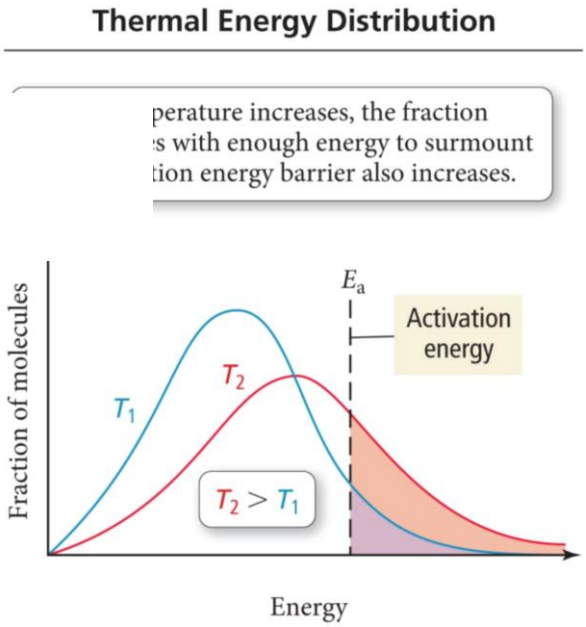
27. Explain how the Arrhenius equation indicates that the rate constant is dependent on the temperature.

28. Label the following graph. Is this an exothermic or endothermic reaction? How do you know?



29. What is the relationship between the activation energy and the rate of reaction?

30. Explain the relationship among T_1, T_2, and the fraction of molecules with enough energy to meet the activation energy barrier. How are the fractions of molecules affected by temperature?



31. What is the collision model? Explain what makes an effective collision.

32. Explain why not all collisions result in the formation of a product.

13.6 Reaction Mechanisms

33. Explain the difference between a balanced chemical reaction and a reaction mechanism.

34. What do elementary steps represent?

35. What is a reaction intermediate? How is one identified in a reaction mechanism?

36. What is the difference among unimolecular, bimolecular, and termolecular steps? Why are termolecular steps rare?

37. Explain how to deduce the rate-law of an elementary step. From the elementary step rate laws, explain how to deduce the overall rate law of the reaction.

38. Fill in the molecularity and rate law of each of the following elementary steps. What is the relationship between the molecularity and the overall order of the step?

Rate Laws for Elementary Steps		
Elementary Step	**Molecularity**	**Rate Law**
A → products		
A + A → products		
A + B → products		
A + A + A →products		
A + A + B →products		
A + B + C → products		

39. What is a rate-determining step? How is one determined?

40. Explain how it can be determined that this reaction has a two-step mechanism.

13.7 Catalysis

41. What does a catalyst do?