1. Name 5 factors that influence the speed of a reaction. Explain each effect.

2. What is meant by the term "activation energy"? Draw a labeled potential energy diagram and indicate what activation energy means on this diagram. b) How does this concept explain why reactions are made faster by an increase in temperature or by the presence

of a catalyst?

3. In many reactions the rate of the slowest of a series of steps determines the overall rate

of the reaction. Explain.

4. The rate equation or rate law cannot be determined by simply

examining the balanced chemical equation. Why not?

5. Explain the effect of a catalyst on a chemical reaction in regard to

a)change in rate b) effect on equilibrium position of the reaction c)the effect on the activation energy d) describe one theory as to how catalysts function.

6. X moles of H2 gas and Y moles of I2 gas are injected into a 1 liter box. The gases react

at a rate directly proportional to the concentration of H2 and directly proportional to theconc. of I2. What effect will there be on the rate of reaction if

a) the temperature is decreased b)a catalyst is introduced c) the H2 conc. is doubled

d) the I2 conc. is halved. e) the volume of the box is double

7. The kinetics of the reaction A + 2 B + C → D (all gases) is to be studied. By doubling

the conc. of A or B we double the rate of reaction, but doubling the conc. of C does not affect the rate. Devise a possible mechanism for the reaction, indicating which steps are fast and which are slow.

8. Distinguish between first order reactions and second order reactions. How can we

determine by the plotting of graphs whether a particular reaction is first or second order?

9. What is the Arrhenius equation? Why does the rate of a slow reaction increase more

rapidly with a rise in temperature than can be explained by the increase in the frequency of molecular collisions?

10. A certain reaction is known to be first order for A. If the initial [A] is 2.00M, the [A] after 10 minutes is found to be 1.00M

a) If the initial [A] were 10 M what would the conc. be after 20 minutes?

b) What is the value of the rate constant, k ?

c) Ben Kildare reasons as follows: Rate = k[A] . The rate of disappearance of A was 1.00 mole in 10 minutes, or 0.100 M/min. Then 0.100 = k(2.00) and k = 0.050 min-1. Is his method valid? Explain.

11. The kinetics of a reaction are being studied with respect to component B. When [B] is initially 1.000 M, after one second the conc. of B is 0.9990M.If the kinetics are first order...

a) What is the initial rate? B) What is the value of the rate constant, k ?

c) What would the conc. of B be after 693 seconds had elapsed? d) Suppose the reaction is actually second order for B. What is the value of the rate constant, k ?(include units.) e) Would it take longer to use up half of B if the reaction were first order or second order? Why? f) If the reaction is second order, what is the value of [B] after 1000 seconds?

12. The following data are acquired in a study of the reaction A+B+C → D

Initial conc. in M Initial rate of formation of D (M/sec)

A B C

0.2 0.2 0.2 6.0 X 10-3

0.2 0.1 0.2 1.5 X 10-3

0.1 0.4 0.2 2.4 X 10-2

0.1 0.1 0.1 7.5 X 10-4

a) Find the rate law for the reaction.

b) Find the value of the specific rate constant, k. (include units)

c)What would the initial rate be if all initial concentrations were 1.00M?

13. Consider the reaction 2 NO + 2 H2 → N2 + 2 H2O

Initial rate ( M/sec) Initial conc. [NO] [H2] (M)

5.6 X 10-7 0.020 0.030

1.4 X 10-7 0.010 0.030

4.2 X 10-7 0.030 0.010

a) What is the rate expression, or rate law, for this reaction?

b) What is the value of the rate constant, k ?

c) If the initial step in the reaction is 2 NO ➞N2O2

propose a series of reactions which would result in the complete reaction above, with the rate law you found. Indicate which is the rate determining step.

14. What is meant by the rate order of a chemical reaction?

15. If doubling the concentration of A doubles the rate of reaction, and doubling the

concentration of B quadrouples the rate, what is the rate law? What is the overall rate order? Assuming that A and B are gases, what is the effect of halving the size of the vessel in which the reaction is taking place?

16. In the reaction 2 A + B → 3 C + 4 D , -d[A]/dt =

1) 2/3 d[C]/dt 2) -2/3 d[C]/dt 3) 3/2 d[C]/dt 4) -3/2 d[C]/dt

17. The activation energy of a reaction can be determined by finding the rate constant at

several different temperatures. When the determination is done graphically, what are the x and y coordinates? Sketch such a graph, and indicate how the value of the activation energy is derived.

18. The formation of ammonia from free hydrogen and nitrogen gas has a high equilibrium constant (about 1 x 105) at room temp. Yet when hydrogen gas is released into a room no ammonia formation is observed even though the air is about 80 % nitrogen. Why ? What does it mean for a reaction to be thermodynamically feasible but kinetically unfeasible?

19. Two experiments are carried out with respect to the reaction 2 A + 2 B → C .

First, 0.010 M A is reacted with a large excess of B. The concentration of A is recorded at various times. It is found that a graph of Ln [A] against time produces a straight line. Next, 0.010 M B is reacted with a large excess of A. It is found under these conditions, that although a plot of Ln [B] against time does NOT give a straight line, a plot of 1/B vs time does give a straight line.

a) Write the rate law for the reaction.

b) Why does the graph in one case have a positive slope, and in the other

a negative slope?

20. For the reaction A → B + C the following data were obtained.

Time in minutes [A] (in M)

0 0.200 From this information

30 0.141 determine the rate law, and

60 0.100 calculate the value of the

90 0.071 specific rate constant.

21. What is meant by "synthetic rate order"? How does it simplify the study of kinetics?

22. A mixture of hydrogen and chlorine is stable when stored in the dark, but explosive when

exposed to ultra-violet radiation. Explain the difference in the rate of reaction

EQUILIBRIUM

23. Y (s) + 2 W (g) → Z (g) Kc = 0.64 M-1

What concentration of Z will be in equilibrium with 0.10 mole of Y and 0.50 mole of W in a 1.0 liter container?

24. SO2 gas and O2 gas are mixed in a mole ratio of 2:1 (SO2 to O2) and brought to equilibrium at 500oC and a total pressure of 6.0 atm. At equilibrium 20.% of the gas molecules in the mixture are SO3. ( 2SO2 + O2 2 SO3 )

a) Express the equilibrium concentrations of the three gases as partial pressures in atm.

b) Find the value of the equilibrium constant, (Kp) under the given conditions. Include the correct unit of Kp.

25. 14.0 moles of X and 20.0 moles of Y are introduced into an empty 2.0 liter container. They react, reaching equilibrium according to the equation

X + 2 Y 2 Z (all gases) .

If the equilibrium concentration of Z is 6.0 M , find the value of the Kc .

26. At a certain temperature the K = 51.5 for the reaction H2 + I2 2 HI

(all gases ) If 1.000 mole of H2 and 1.000 mole of I2 are introduced into an empty 1.000 liter container at that temperature, find the equilibrium concentrations of the three gases. (You needn't use the quadratic formula in this one.)

27. For the same reaction at a different temperature, the K = 6.0

A certain quantity of HI is introduced into a 1.00 liter vessel at that temperature.

At equilibrium it is found that there are 1.8 moles of I2 vapor present. How many moles of HI were introduced originally?