Competitive Exams: Chemistry MCQs (Practice-Test 9 of 31)

1. Based on the rate law given in the preceding problem, which step is the rate-limiting step?

   a. Step (1)

   b. Step (2)

   c. Both Steps (1) & (2)

   d. Either Steps (1) or (2)

2. Consider the following reaction in aqueous solution, I- (aq) + OCl- (aq) → IO- (aq) + Cl- (aq) and the following initial concentration and initial rate data for this reaction: [I-], M[OCl-], Minitial rate, M s − 1 0.10000. 05003.05 × 10 − 4 0.20000. 05006.10 × 10 − 4 0.30000. 01001.83 × 10 − 4 0.30000. 02003.66 × 10 − 4 Which of the following is the correct rate law for this reaction?

   a. Rate = k[I-]

   b. Rate = k[OCl-]

   c. Rate = k[I-]2

   d. Rate = k[I-][OCl-]

   e. Rate = k[I-]2[OCl-]

3. Which of the following statements best describes how the "Method of Initial Rates" is used to measure the initial rate of an equilibrium reaction?

   a. The rate of the reaction is measured when the reaction is very close to equilibrium.

   b. The rate of the reaction is measured immediately after the reaction is started.

   c. The rate of the reaction is measured when the reaction is about one-half complete.

   d. The rate of the reaction is measured after five half-lives.

   e. The rate of an equilibrium reaction cannot be measured using this method.

4. Which of the following are the correct units for the rate constant, k, for a zero-order reaction?

   a. M s − 1

b. $M - 1 s - 1$

c. $M - 2 s - 1$

d. $M - 3 s - 1$

e. M

5. Which of the following statements is TRUE?

a. The existence of certain intermediates in a reaction mechanism can sometimes be proven because intermediates can sometimes be trapped and identified.

b. Intermediates in a reaction mechanism cannot be isolated because they do not have finite lifetimes.

c. Reaction mechanisms cannot have any more than one intermediate.

d. Intermediates in a reaction mechanism appear in the overall, balanced equation for the reaction.

e. None of the above statements is TRUE.

6. Which of the following statements best describes how a catalyst works?

a. A catalyst changes the potential energies of the reactants and products.

b. A catalyst decreases the temperature of the reaction which leads to a faster rate.

c. A catalyst lowers the activation energy for the reaction by providing a different reaction mechanism.

d. A catalyst destroys some of the reactants, which lowers the concentration of the reactants.

e. A catalyst raises the activation energy for the reaction which produces a faster rate.

7. In terms of the “Collision Theory of Chemical Kinetics” the rate of a chemical reaction is proportional to:

a. the change in free energy per second.

b. the change in temperature per second.

c. the number of collisions per second.

d. the number of product molecules.

e. none of the above:

8. Nitrogen monoxide, NO, reacts with hydrogen, H_2, according to the following equation: 2 NO (g) + 2 H_2 (g) → N_2 (g) + 2 H_2O (g) If the mechanism for this reaction were, 2NO (g) + H_2 (g) → N_2 (g) + H_2O_2 (g) slow H_2O_2 (g) + H_2 (g) → 2H_2O (g) fast which of the following rate laws would we expect to obtain experimentally?

   a. Rate = k[H_2O_2][H_2]

   b. Rate = k[NO]2[H_2]

   c. Rate = k[NO]2[H_2]2

   d. Rate = k[NO][H_2]

   e. Rate = k[N_2][H_2O_2]

9. Consider the following reaction in aqueous solution, 5 Br- (aq) + BrO_3- (aq) + 6 H + (aq) → 3 Br_2 (aq) + 3 H_2O (l) If the rate of disappearance of Br- (aq) at a particular moment during the reaction is 3.5 × 10 − 4 M s − 1, what is the rate of appearance of Br_2 (aq) at that moment?

10. Consider the following gas-phase reaction, 2 HI (g) → H_2 (g) + I_2 (g) and the following experimental data obtained at 555 K, [HI], Mrate, M s − 1 0.05008. 80 × 10 − 10 0.10003. 52 × 10 − 9 0.15007. 92 × 10 − 9 What is the order of the reaction with respect to HI (g)?

    a. N/A

    b. N/A

    c. N/A

    d. N/A

11. Radioactive phosphorus is used in the study of biochemical reaction mechanisms. The isotope phosphorus-33 decays by first-order kinetics with a half-life of 14.3 days. If a chemist initially has a 7.5 M solution of pure phosphorus-33, calculate the concentration (in M) of phosphorus-33 in the solution after 2.4 days.

    a. N/A

    b. N/A

    c. N/A

    d. N/A

12. Hydrogen iodide, HI, decomposes in the gas phase to produce hydrogen, H_2, and iodine, I_2: 2 HI (g) → H_2 (g) + I_2 (g) The value of the rate constant, k, for this reaction was measured at several different temperatures and the data are shown below: Temperature,

Kk, M − 1 s − 1 5556.23 × 10 − 7 5752.42 × 10 − 6 6451.44 × 10 − 4 7002.01 × 10 − 3 Calculate the value of the activation energy (in kJ/mol) for this reaction.

a. N/A

b. N/A

c. N/A

d. N/A

13. Listed below are some statements that pertain to chemical kinetics. For each statement, first decide whether the statement is TRUE orFALSE. If the statement is FALSE, briefly explain why the statement is FALSE. If the statement is TRUE, you do not need to provide any additional explanation.

a. Rate laws for chemical reactions can be determined from the stoichiometry of the overall balanced equation.

b. The rate of a chemical reaction that occurs in solution depends on the concentration, the temperature and the viscosity of the solvent.

c. The “Method of Initial Rates” cannot be used for equilibrium reactions.

d. Experimentally, transition states can sometimes be trapped or isolated whereas intermediates cannot be either trapped or isolated.

14. Consider the following reaction, 2 ClO2 (aq) + 2 OH- (aq) → ClO3- (aq) + ClO2- (aq) + H2O (l) Write an expression that describes the relationship between the rates of disappearance of ClO2 and OH-and the rates of appearance of ClO3-, ClO2-and H2O.

a. N/A

b. N/A

c. N/A

d. N/A

15. A Chemistry 116 student was charged with the task of determining the activation energy, Ea, for a particular first-order reaction. The student measured the value of the rate constant for this reaction at several temperatures and obtained the following data: k, s − 1T, K

a. 94 × 10 − 4384

b. 17 × 10 − 3397

c. 26 × 10 − 2447

d. $63 \times 10 - 1481$

16. Nitrogen monoxide, NO, reacts with ozone, O3, to produce nitrogen dioxide, NO2, and oxygen, O2: NO (g) + O3 (g) → NO2 (g) + O2 (g) The experimentally determined rate law for this reaction is: Rate = k[O3]. Consider the following proposed mechanism for this reaction: Step 1: O3 (g) → O2 (g) + O (g) fast Step 2: NO (g) + O (g) → NO2 (g) slow This proposed mechanism is NOT an acceptable possibility for this reaction. Briefly explain why this mechanism is not acceptable. ALSO, identify the rate-determining step and any intermediates in this proposed mechanism.

    a. N/A

    b. N/A

    c. N/A

    d. N/A

17. Using the information in the previous question, and your knowledge about reaction mechanisms, write an acceptable mechanism for the reaction described in the previous question.

    a. N/A

    b. N/A

    c. N/A

    d. N/A

18. In many kinetics studies, the rate of the reaction is determined almost immediately after the reactants are mixed. The BEST reason for doing this is:

    a. The reaction proceeds faster as time increases.

    b. Intermediates are easier to detect.

    c. The reaction proceeds slower as time increases.

    d. Reverse reactions are avoided.

    e. The concentrations of the reactions hasn't changed much.