

Chem12 Kinetics : Exam problems-50

1) Given : $\text{BaCO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Ba}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g}) + \text{heat}$. A change that would decrease the rate of formation of $\text{CO}_2(\text{g})$ is :

- a) finely powder the $\text{BaCO}_3(\text{s})$ b) increase the temperature
c) add water to the system d) increase concentration of H^+

2) Which one of the following is the basic premise of "Collision Theory".

- a) At high temperature, more gas particles collide than at low temperature.
b) Chemical reactions can occur only if reacting particles collide.
c) In order to react, particles must have the correct collision geometry.
d) Catalysts affect the rate at which the reacting particles collide.

3) A reacts with B to form C and the rate data are as follows :

Experiment	initial [A]	initial [B]	initial rate of formation of C in moles/sec
1	0.15	0.15	0.30
2	0.30	0.15	0.60
3	0.15	0.30	1.20
4	0.30	0.30	2.40

What is the rate law expression for this reaction ?

- a) rate = $k[\text{A}][\text{B}]$ b) rate = $k[\text{A}]^2[\text{B}]$ c) rate = $k[\text{A}][\text{B}]^2$ d)
rate = $k[\text{A}]^2[\text{B}]^2$

4) At 25°C and considering only the nature of the reactants, which one of the following reactions most probably has the highest rate ?

- a) $\text{Ca}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CaCO}_3(\text{s})$ b) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightarrow 2\text{HI}(\text{g})$
c) $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$ d) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$

5) Given : $\text{CaCO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g}) + \text{heat}$, which one of the following changes would increase the rate of evolution of $\text{CO}_2(\text{g})$?

- a) Decrease the temperature b) Increase the Ca^{2+} concentration

c) Finely powder the $\text{CaCO}_3(\text{s})$ d) Add water to the system

6) Which one of the following describes one effect of a catalyst ?

- a) It increases the total energy of the products
- b) It decreases the energy released in a reaction
- c) It provides a new mechanism for the reaction involving a lower reaction energy
- d) It speeds up the rate of reaction but is used up in the overall process

7) Which one of the following terms refers to the slowest step in a reaction mechanism ?

- a) not catalyzed b) Rate-determining c) Activated complex
- d) Activation energy

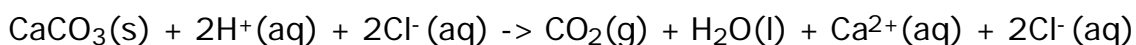
8) In a closed system, the following reaction occurs:



Which of the following, would be useful in measuring the reaction rate?

- a) mass b) $[\text{H}_2\text{O}]$ c) pressure d) $[\text{Cl}^-]$

9) The following reaction occurs at constant T and constant volume in a closed system :



Changes in which of the following would be useful in experimentally measuring the rate of the reaction ?

- a) The system's mass b) The system pressure
- c) The concentration of water d) The concentration of the $\text{Cl}^-(\text{aq})$

10) An elementary process is one in which :

- a) two or more elements unite to form a compound
- b) a compound breaks up into its constituent elements
- c) particles collide with less than the energy of activation
- d) usually two particles collide and undergo chemical change

11) For the reaction: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$,

the reaction rate for the formation of $\text{NH}_3 = 4.0 \times 10^{-4}$ mol/s. Find the rate of consumption of H_2 in mol/s.

- a) 2.0×10^{-4} b) 6.0×10^{-4} c) 1.2×10^{-3} d) 4.0×10^{-4}

12) $\text{ZnO}(\text{s}) + \text{CO}(\text{g}) \rightarrow \text{Zn}(\text{g}) + \text{CO}_2(\text{g})$ $H < 0$, What is the change in the Gibbs free energy (G).

- a) $G < 0$ b) $G > 0$ c) $G = 0$ d) G could be + or - , but not zero.

13) Which one of the following reactions has the highest rate at room temp?

- a) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$
b) $\text{Mg}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s})$
c) $\text{C}_2\text{H}_5\text{OH}(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{g})$
d) $2\text{MnO}_4^-(\text{aq}) + 16\text{H}^+(\text{aq}) + 5\text{C}_2\text{O}_4^{2-}(\text{aq}) \rightarrow 2\text{Mn}^{2+}(\text{aq}) + 10\text{CO}_2(\text{g}) + 8\text{H}_2\text{O}(\text{g})$

14) $\text{Zn}(\text{s}) + 2\text{H}^+(\text{aq}) + 2\text{Cl}^-(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) + \text{H}_2(\text{g})$
 $H = -95\text{kJ}$ $[\text{HCl}] = 0.2 \text{ M}$

a) Give two ways (other than by using a catalyst) in which the rate of the reaction can be speeded up.

b) Calculate the energy released in the above reaction if 2.3g of Zn reacts with excess acid.

15) For the reaction, $\text{A}(\text{g}) + 2\text{B}(\text{g}) \rightarrow \text{C}(\text{g})$, the rate law is $\text{Rate} = k[\text{A}][\text{B}]$.

- a) What is the total order ?
b) What is the effect of doubling the concentrations of A and B ?

16) Which of the following statements about catalysts is true ?

- a) Catalysts provide energy for reactions
b) Catalysts provide a lower energy pathway for a chemical reaction
c) Catalysts are always in the same phase as the reactant molecules
d) Catalysts can change endothermic reactions into exothermic reactions

17) For the reaction $A_2(g) + B_2(g) \rightarrow 2AB(g)$, the rate law expression is :

rate = $[A_2][B_2]^2$. Give the reaction order . a) 1 b) 2 c) 3 d) 4

18) Coal dust is found to burn more rapidly than a lump of coal. The factor that increases the rate of this chemical reaction is the :

- a) presence of a catalyst
- b) surface area of the reactants
- c) concentration of the reactants
- d) chemical properties of the reactants

19) Define : Activated Complex

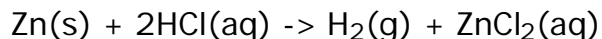
20) The following data were obtained for an experiment on reaction rates in which equal volumes of reagents were added to acidified 0.05 M MnO_4^- solution.

REAGENT	TEMPERATURE (°C)	REACTION TIME (S)
0.1 M Fe^{2+}	20	2
0.1 M $C_2O_4^{2-}$	40	20

The factor that accounts for the longer reaction time for $C_2O_4^{2-}$ is :

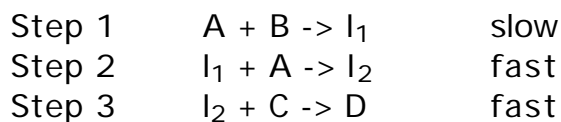
- a) temperature
- b) surface area
- c) concentration
- d) nature of the reactants

21) Which of the following would increase the rate for the reaction,



- a) increase the temperature
- b) decrease the temperature
- c) increase the pressure
- d) decrease the pressure

22) The reaction : $2A + B + C \rightarrow D$ takes place through the following mechanism in which I_1 and I_2 are the reaction intermediates.



How can you produce a significant increase in the overall reaction rate ?

- a) increase [B] b) decrease [B] c) increase [C] d) decrease [A]

23) Explain how a catalyst increases the rate of a chemical reaction.

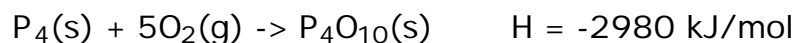
24) Which of the following reactions would be expected to proceed at the greatest rate at room temperature ?

- a) $\text{Mg(s)} + (1/2)\text{O}_2(\text{g}) \rightarrow \text{MgO}$
b) $\text{Br}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{BrCl}(\text{g})$
c) $2\text{Ag}^+(\text{aq}) + \text{CrO}_4^{2-}(\text{aq}) \rightarrow \text{Ag}_2\text{CrO}_4(\text{s})$
d) $2\text{BrO}_3^-(\text{aq}) + 10\text{Fe}^{2+}(\text{aq}) + 12\text{H}^+(\text{aq}) \rightarrow 10\text{Fe}^{3+}(\text{aq}) + \text{Br}_2(\text{aq}) + 6\text{H}_2\text{O}(\text{l})$

25) Which of the following is true for an activated complex?

- a) stable and high PE b) stable and low PE
c) unstable and high PE d) unstable and low PE

26) Phosphorus ignites readily on exposure to the air, according to the equation :



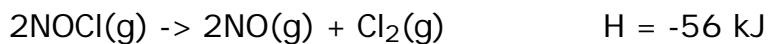
At a given temperature, which of the following set of factors determines the rate of the above reaction ?

- a) the partial pressure of oxygen only
b) the concentration of phosphorus and the volume of oxygen
c) the concentration of phosphorus and the partial pressure of oxygen
d) the surface area of the phosphorus and the partial pressure of oxygen

27) When the temperature of a gaseous mixture is increased from 10°C to 20°C, it is found that the reaction rate is doubled. Which of the following could be deduced from this information ?

- a) at higher temperatures all collisions lead to reactions
b) the average kinetic energy has been doubled by increasing T
c) the frequency of effective collisions has been doubled
d) the activation energy has been reduced by increasing T

28) Describe two ways of increasing the rate of the following reaction, other than by using a catalyst, and explaining in terms of molecular behavior why each method would be successful.



Answers : 1) c, 2) b, 3) c, 4) a, 5) c, 6) c, 7) b, 8) c, 9) b, 10) d(single step) 11) b, 12) a, 13) b, 14) a) add more H^+ , powder $\text{Zn}(\text{s})$, increase T, b) 3.3kJ, 15) 2, rate quadruples, 16) b, 17) c, 18) b, 19) It is a short-lived molecule formed at the potential energy peak during a collision, 20) d, 21) a, 22) a, 23) It lowers the activation energy of a collision., 24) c, 25) c, 26) d, 27) c, 28) Increase T, or increase $[\text{NOCl}]$. Both will increase the collision rate between reactant molecules which increases the reaction rate.