

AP Chemistry: Kinetics Practice Problems

Directions: Write your answers to the following questions in the space provided. For problem solving, show all of your work. Make sure that your answers show proper units, notation, and significant digits. Do not use a calculator on the multiple choice questions.

- Three major methods used to increase the rate of a reaction are adding a catalyst, increasing the temperature, and increasing the concentration of a reactant. From the perspective of collision theory, explain how each of these methods increases the reaction rate.
 - adding a catalyst
Adding a suitable catalyst lowers the energy demands of the reaction (the activation energy) by providing a less demanding pathway. It does this by forming a different activated complex with a lower activation energy.
 - increasing the temperature
Increasing the temperature increases the average kinetic energy of the molecules. However, what is most important here is that the fraction of molecules that have the energy necessary to react (the activation energy) is increased.
 - increasing the concentration of the reactants
Increasing the concentration of a reactant increases the probability of collisions, and therefore increases the possibility of reaction, for the particles must collide to react. Note that not all collisions result in successful reactions.
- Why do large crystals of sugar burn more slowly than finely ground sugar?
The rate of combustion is proportional to the surface area of sugar exposed to oxygen. Smaller crystals have more surface area and burn faster.
- How do homogeneous catalysts and heterogeneous catalyst differ?
A homogeneous catalyst is a catalyst that exists in the same phase (liquid or gas) as the reactants. A heterogeneous catalyst, on the other hand, is a catalyst that exists in a different phase from the reactants.
- Express the rate of reaction in terms of the rate of change of each reactant and each product in the following.
 - $3\text{ClO}^-(\text{aq}) \rightarrow \text{ClO}_3^-(\text{aq}) + 2\text{Cl}^-(\text{aq})$
$$\text{rate of reaction} = -\frac{\Delta[\text{ClO}^-]}{3\Delta t} = \frac{\Delta[\text{ClO}_3^-]}{\Delta t} = \frac{\Delta[\text{Cl}^-]}{2\Delta t}$$
 - $3\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$
$$\text{rate of reaction} = -\frac{\Delta[\text{SO}_2]}{3\Delta t} = -\frac{\Delta[\text{O}_2]}{\Delta t} = \frac{\Delta[\text{SO}_3]}{2\Delta t}$$
 - $\text{C}_2\text{H}_4(\text{g}) + \text{Br}_2(\text{g}) \rightarrow \text{C}_2\text{H}_4\text{Br}_2(\text{g})$
$$\text{rate of reaction} = -\frac{\Delta[\text{C}_2\text{H}_4]}{\Delta t} = -\frac{\Delta[\text{Br}_2]}{\Delta t} = \frac{\Delta[\text{C}_2\text{H}_4\text{Br}_2]}{\Delta t}$$
- In the Haber process for the production of ammonia,
$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$$

What is the relationship between the rate of production of ammonia and the rate of consumption of hydrogen?
$$\text{rate of reaction} = -\frac{\Delta[\text{H}_2]}{3\Delta t} = \frac{\Delta[\text{NH}_3]}{2\Delta t}$$
- The rate constant
 - always shows an exponential increase with the Kelvin or absolute temperature.
 - increases with increasing concentration.
 - usually increases with increased pressure for gases.
 - never changes (it is a constant).
 - is the same for a given reaction at the same Kelvin or absolute temperature.

Answer: (E) In this question be sure to note that it is the rate constant that is involved. Refer to the Arrhenius equation for the specific relationship.

Unit 3 Petroleum Study Guide Answers

Victor M. Corman



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