

18 REACTION RATES AND EQUILIBRIUM 20314

Practice Problems

In your notebook, solve the following problems.

SECTION 18.1 RATES OF REACTION

- List three ways that reaction rates can generally be increased. *1) ↑ temp 2) ↑ conc. 3) ↓ size 4) catalyst*
- Ethyl acetate (C₄H₈O₂) reacts with a solution of sodium hydroxide (NaOH) in water to form sodium acetate (C₂H₃O₂Na) and ethyl alcohol (C₂H₅O). Suppose at 25°C two moles of ethyl acetate react completely in four hours. How would you express the rate of reaction? *2 mol / 4h = 0.5 mol/h*
- How would the following actions likely change the rate of the reaction in problem 2?
 - the temperature is lowered to 4°C. *↓ rate*
 - the concentration of sodium hydroxide in water is increased. *↑ rate*
- Ethyl acetate and water are not miscible; thus, the reaction in problem 2 only occurs at the interface of the two liquids. What would be the effect on the reaction rate of adding a solvent to make the reaction homogeneous? *↑ rate*

SECTION 18.2 REVERSIBLE REACTIONS AND EQUILIBRIUM

- Write the expression for the equilibrium constant for this reaction: $2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$

$$K = \frac{[NO_2]^4 [O_2]}{[N_2O_5]^2}$$
- Calculate the equilibrium constant for the reaction in problem 1 if the equilibrium concentrations are [N₂O₅] = 0.50 mol/L, [NO₂] = 0.80 mol/L, [O₂] = 0.20 mol/L. *(.80)⁴(.20) / (.50)² = 0.33*
- How would the equilibrium position for the equation in problem 1 be affected by
 - an addition of O₂ to the reaction vessel? *shift left*
 - a decrease in the pressure? *shift right*
- The equilibrium constant for the reaction of nitrogen dioxide to form dinitrogen tetroxide is 5.6. $2NO_2(g) \rightleftharpoons N_2O_4(g)$

$$K = \frac{[N_2O_4]}{[NO_2]^2} = 5.6$$

In a one-liter container, the amount of N₂O₄ at equilibrium is 0.66 mol. What is the equilibrium concentration of NO₂? *NO₂ = √(0.66 / 5.6) = 0.34*

Write the equilibrium constant expression for each of the following reactions.

 - $4NO(g) + 2O_2(g) \rightleftharpoons 2N_2O_4(g)$
 - $2NO(g) + Br_2(g) \rightleftharpoons 2NOBr(g)$
 - $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$
 - $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$
- What effect would an increase in pressure have on the equilibrium position of each reaction in problem 5?

5) a) $\frac{[N_2O_4]^2}{[NO]^4 [O_2]^2}$ c) $\frac{[CH_3OH]}{[CO][H_2]^2}$

b) $\frac{[NOBr]^2}{[NO]^2 [Br_2]}$ d) $\frac{[SO_3][NO]}{[SO_2][NO_2]}$

6) a) 6 to 2 moles right b) 3:2 right c) 3:1 right d) No shift