

# Chapter 10 & 11 – Problems 22, 70 & 12, 19, 26

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## Chapter 10

22. Which is more likely to dissolve in  $\text{CCl}_4$ ? In each case, explain your answer.

(a) benzene or  $\text{KCl}$

Because both molecules hold nonpolar bonds, benzene is more likely to dissolve.

(b) octane or glycerol

Because octane holds nonpolar bonds, and so does  $\text{CCl}_4$ , it is more likely to dissolve.

(c)  $\text{CHCl}_3$  or  $\text{C}_6\text{H}_{11}\text{Cl}_3$

They both have the same dispersion forces.

(d)  $\text{CBr}_4$   $\text{CHBr}_3$

They both have nonpolar bonds.

70. One mole of  $\text{CaCl}_2$  is represented as a square and two circles, where the square represents Ca and each circle represents Cl. Complete the picture showing only the calcium and chloride ions. The water molecules need not be shown. What is the molarity of  $\text{Ca}^{2+}$ ? of  $\text{Cl}^-$ ?

$$\begin{aligned} 4(\text{CaCl}_2) &\rightarrow 4[\text{mol}_{\text{Ca}^{2+}}] \ \& \ 8[\text{mol}_{\text{Cl}^-}] \\ \frac{4}{1} &= 4[\text{M}_{\text{Ca}^{2+}}] \\ \frac{8}{1} &= 8[\text{M}_{\text{Cl}^-}] \end{aligned} \tag{1}$$

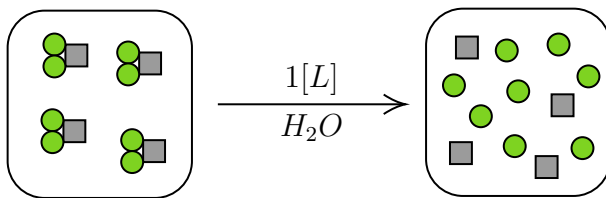


Figure 1: Dissociation of  $\text{CaCl}_2$  atoms

## Chapter 11

12. A reaction has two reactants  $Q$  and  $P$ . What is the order with respect to each reactant and the overall order of the reaction described by the following rate expressions?

(a)  $\text{rate} = k_1$

- $P - 0$
- $Q - 0$
- Overall  $- 0$

(b)  $\text{rate} = k_2[P]^2[Q]$

- $P - 2$
- $Q - 1$
- Overall  $- 3$

(c)  $\text{rate} = k_3[Q]^2$

- $P - 0$
- $Q - 2$
- Overall  $- 2$

(d)  $\text{rate} = k_4[P][Q]$

- $P - 1$
- $Q - 1$
- Overall  $- 2$

19. The decomposition of nitrogen dioxide is a second-order reaction. At  $550[^\circ \text{K}]$ , a  $.25[\text{M}]$  sample decomposes at the rate of  $1.17 \left[ \frac{\text{mol}}{\text{L min}} \right]$ .

- (a) Write the rate expression

$$\text{rate} = k(.25)^2 \tag{2}$$

(b) What is the rate constant at 550[° K]?

$$1.17 = k(.25)^2$$

$$k = 18.72 \left[ \frac{\text{L}}{\text{mol min}} \right] \quad (3)$$

(c) What is the rate of decomposition when  $[\text{NO}_2] = .8[\text{M}]$ ?

$$\text{rate} = 18.72(.8)^2$$

$$\text{rate} = 12 \left[ \frac{\text{mol}}{\text{L min}} \right] \quad (4)$$

26. When nitrogen dioxide reacts with carbon monoxide, the following reaction occurs:  
 $\text{NO}_2(\text{g}) + \text{CO}(\text{g}) \longrightarrow \text{NO}(\text{g}) + \text{CO}_2(\text{g})$ . The following data is obtained:

Expt.	$[\text{NO}_2]$	$[\text{CO}]$	Initial Rate $\left(\frac{\text{mol}}{\text{L s}}\right)$
1	.138	.1	.00565
2	.189	.2	.0106
3	.276	.1	.0226
4	.276	.3	.0226

(a) What is the order of the reaction with respect to  $\text{NO}_2$ ,  $\text{CO}$ , and overall?

$$\frac{.00565}{.0226} = \left( \frac{.138}{.276} \right)^m$$

$$m = 2$$

$$\frac{.0226}{.0226} = \left( \frac{.1}{.3} \right)^n$$

$$n = 0$$

Overall order is 2

(b) Write the rate expression of the reaction.

$$\text{rate} = k[\text{NO}_2]^2[\text{CO}]^0 \quad (6)$$

(c) Calculate  $k$  for the reaction.

$$\text{rate} = k[\text{NO}_2]^2[\text{CO}]^0$$

$$.0226 = k[.276]^2$$

$$k = .297 \left[ \frac{\text{L}}{\text{mol s}} \right] \quad (7)$$

- (d) When  $[\text{NO}_2] = .421[\text{M}]$  and  $[\text{CO}] = .816[\text{M}]$ , what is the rate of the reaction at the temperature of the experiments?

$$\begin{aligned} \text{rate} &= k[\text{NO}_2]^2[\text{CO}]^0 \\ &= .297 \cdot [.421]^2 \\ &= .0526 \left[ \frac{\text{mol}}{\text{L s}} \right] \end{aligned} \tag{8}$$