

This chapter combines mathematical concepts and reactions which are included in the AP Chemistry curriculum under Big Ideas 1, 2, 3, 4, and 5, as well as forming foundational concepts for Big Idea 6. Understanding the different types of reactions, their reactants, products and how to predict them will be valuable tools to use in the laboratory section of your course.

12.1 Thirsty Solutions: Why You Shouldn't Drink Seawater

1. Definitions:

Solute:

Solvent:

Solution:

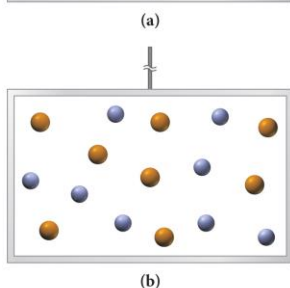
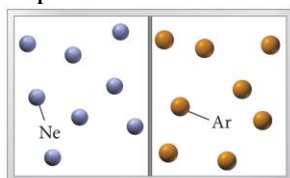
2. Which way does nature tend to mix solutions?

12.2 Types of Solutions and Solubility

3. Give examples of all types of solutions provided below:

Solution Phase	Solute Phase	Solvent Phase	Example
Gaseous Phase	Gas	Gas	
Liquid Phase	Gas	Liquid	
	Liquid	Liquid	
	Solid	Liquid	
Solid Phase	Solid	Solid	

4. Explain what is occurring in the below figure:



5. Define the following vocabulary:

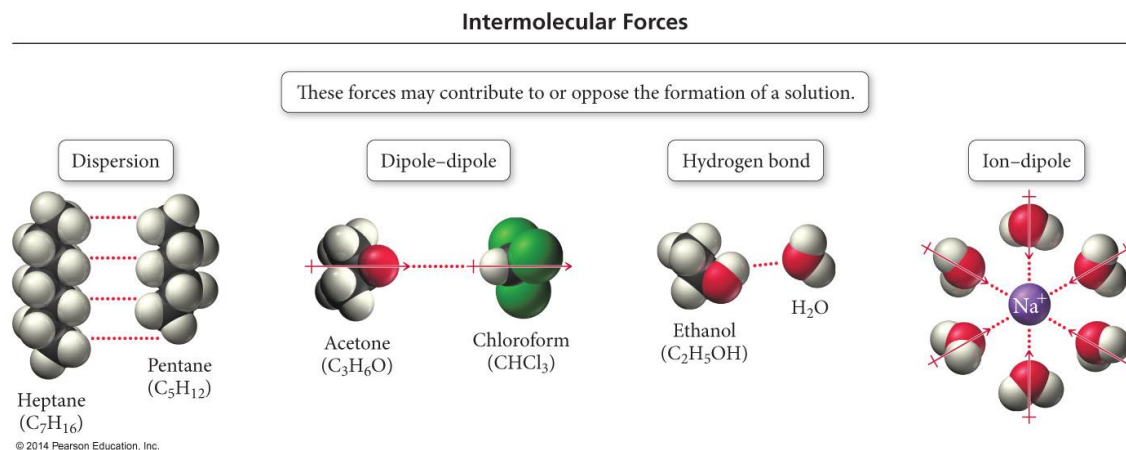
Soluble:

Insoluble:

Entropy:

Miscible:

6. Use the following figure to explain the effect intermolecular forces have on the formation of a solution:



7. Explain the types of interactions that lead to solution formation and the types of interactions that do not lead to solution formation.

12.3 Energetics of Solution Formation

8. Vocabulary:

Enthalpy of solution:

Exothermic:

Endothermic:

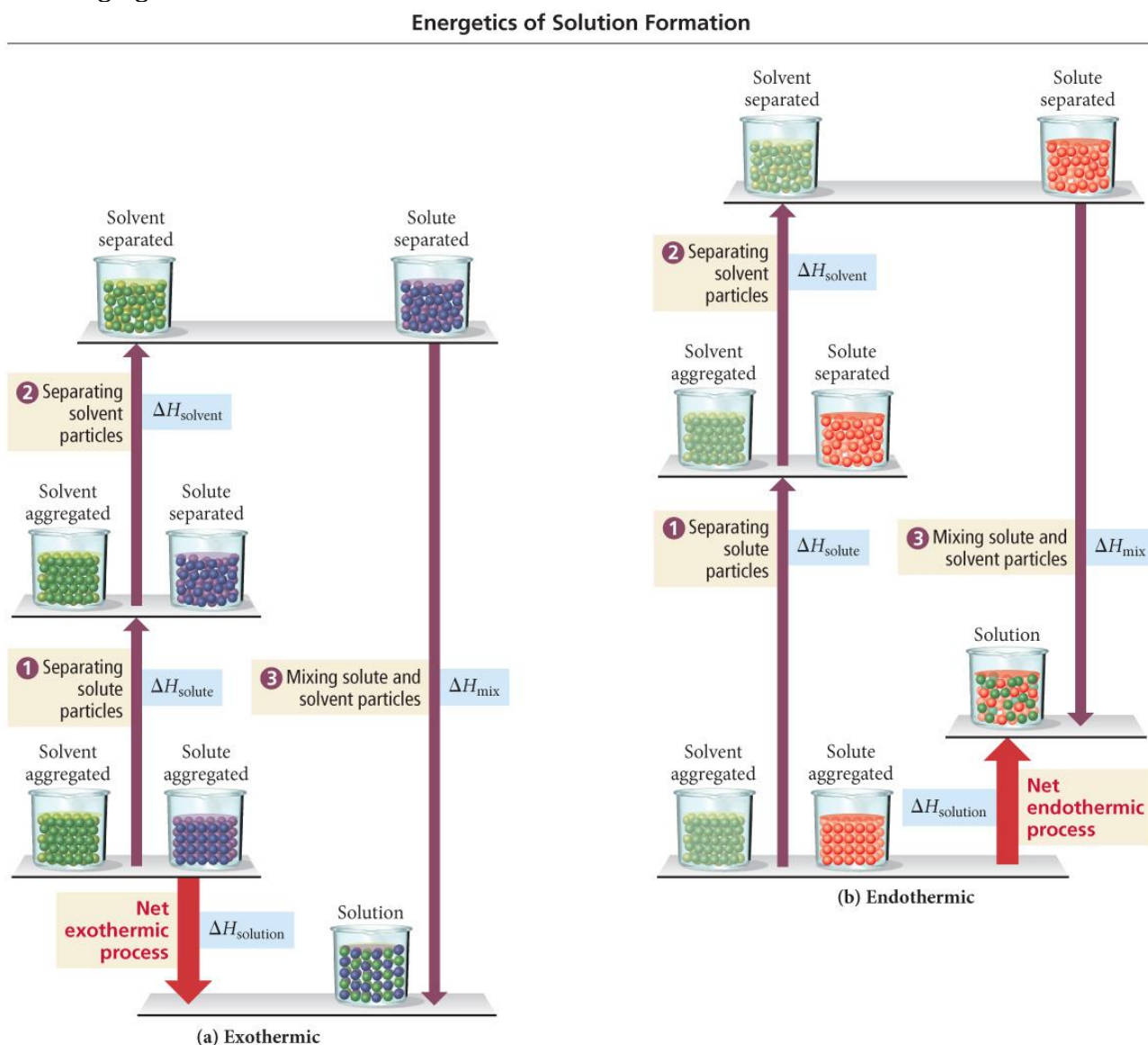
Heat of hydration:

9. What are the three steps needed for a solution to form? For each step, include the general ΔH .

10. Using the three steps in Question #8, explain how the solution process can be exothermic or endothermic.

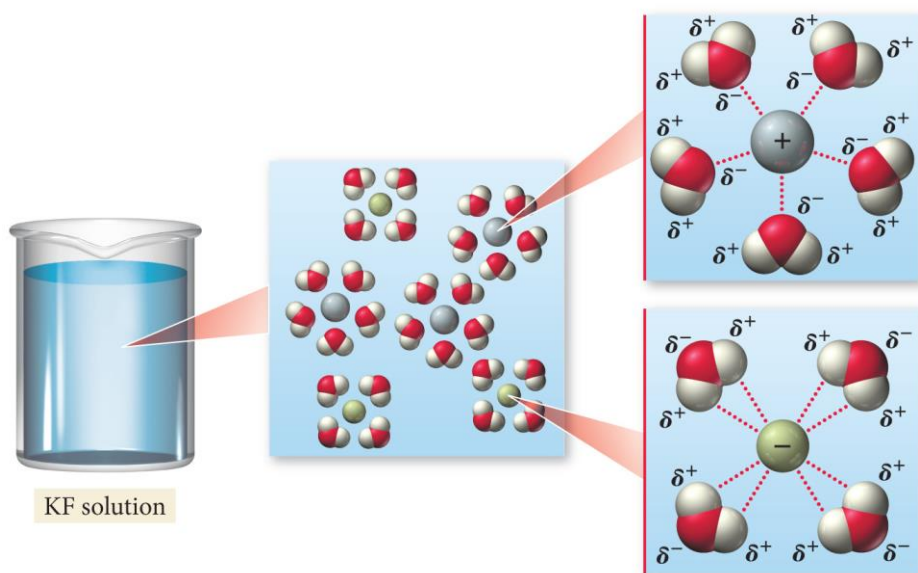
11. Draw a graph showing what would happen to the temperature of the solution when: a) an exothermic solution forms, and b) an endothermic solution forms.

12. Identify the steps leading to the formation of an exothermic and an endothermic solution on the following figures:



13. What two terms combine to yield the heat of solution?

14. Explain what is occurring in each of these diagrams:
Ion-Dipole Interactions



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15. What is the relationship between the enthalpy of solute and the enthalpy of hydration in a exothermic solution? In an endothermic solution?

12.4 Solution Equilibrium and Factors Affecting Solubility

16. Use the following pictures to explain how a dynamic equilibrium of a solution is reached.

Solution Equilibrium

<p style="text-align: center;">$\text{NaCl}(s)$</p> <p style="text-align: center; background-color: #fff9c4;">When sodium chloride is first added to water, sodium and chloride ions begin to dissolve into the water.</p>	<p style="text-align: center;">$\text{NaCl}(s) \longrightarrow \text{Na}^+(aq) + \text{Cl}^-(aq)$</p> <p style="text-align: center; background-color: #fff9c4;">As the solution becomes more concentrated, some of the sodium and chloride ions can begin to recrystallize as solid sodium chloride.</p>	<p style="text-align: center;">$\text{NaCl}(s) \rightleftharpoons \text{Na}^+(aq) + \text{Cl}^-(aq)$</p> <p style="text-align: center; background-color: #fff9c4;">When the rate of dissolution equals the rate of recrystallization, dynamic equilibrium has been reached.</p>
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(a) Initial

Rate of dissolution > Rate of recrystallization

(b) Dissolving

Rate of dissolution = Rate of recrystallization

(c) Dynamic equilibrium

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17. Define the following vocabulary terms:

Saturated solution:

Unsaturated solution:

Supersaturated solution:

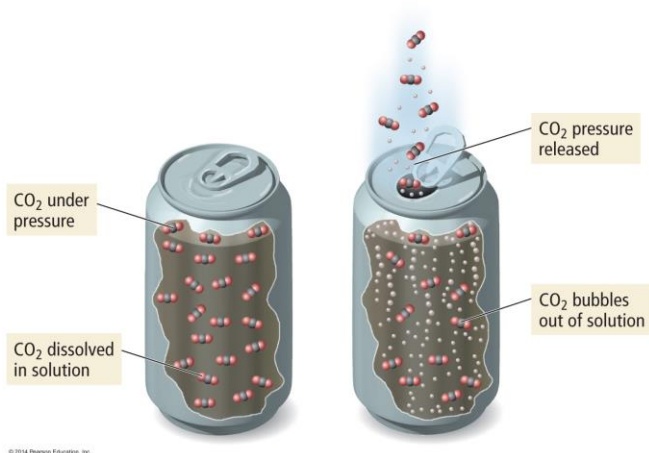
18. How can you determine if a solution is saturated or unsaturated?

19. Explain how temperature affects the solubility of solids.

20. Explain how temperature affects the solubility of gases.

21. Explain why fish tend to prefer cold water.

22. Using a can of soda as an example, explain how pressure affects the solubility of gases in the following diagram.



23. What is Henry's law and how does it apply to solutions?

12.5 Expressing Solution Concentration

24. What is the difference between a dilute solution and a concentrated solution?

25. How is each of the following units of concentration calculated? Include the accepted units of each. (units and their calculations will not be assessed on the AP Exam, noted with a *)

Molarity:

Molality:*

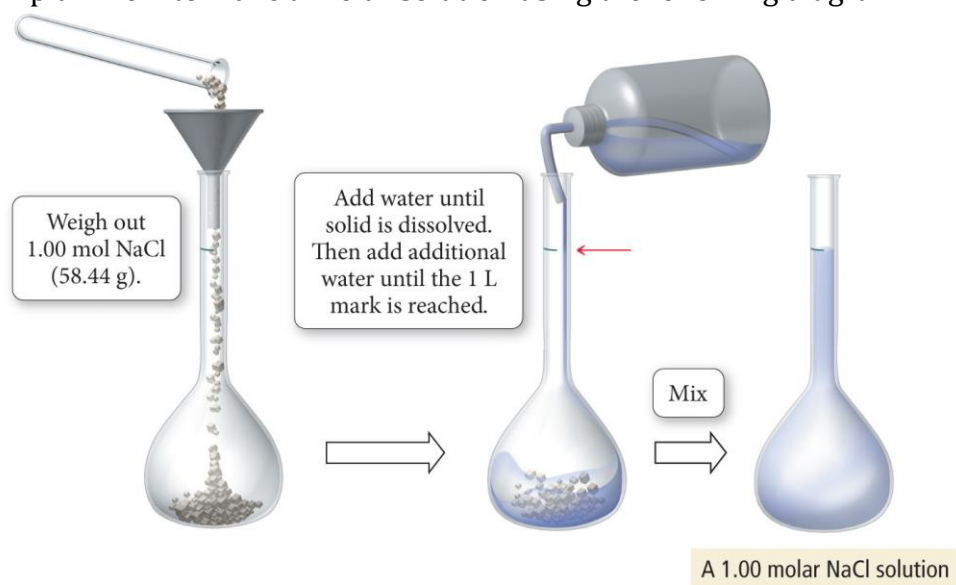
Mole fraction:

Mole percent:

Percent by volume:*

Percent by mass:*

26. Explain how to make a molar solution using the following diagram.



27. What is a POP? (see the dirty dozen on page 564) Why are they hazardous?

12. 6 Colligative Properties: Vapor Pressure Lowering, Freezing Point Depression, Boiling Point Elevation, and Osmotic Pressure (*Colligative properties are not assessed on the AP Chemistry Exam)

28. What are colligative properties? Explain how each of the following is affected by colligative properties and why.*

Vapor Pressure:

Freezing point:

Boiling point:

Osmotic pressure:

29. Explain Raoult's Law*

30. What is an ideal solution?

12.7 Colligative Properties of Strong Electrolyte Solutions

31. What are strong electrolytes?

32. What is the van't Hoff factor? Why is it important in determining colligative properties?*

33. What are hyperosmotic, hyposmotic, and isosmotic solutions? Why are these important in medicine?

12.8 Colloids

34. What are colloids?

35. In the following table, give an example of each type of colloid.

Classification	Dispersing Substance (Solute-like)	Dispersing Medium (Solvent-like)	Example
Aerosol	Liquid	Gas	
Solid Aerosol	Solid	Gas	
Foam	Gas	Liquid	
Emulsion	Liquid	Liquid	
Solid Emulsion	Liquid	Solid	

36. Explain how soap is used to clean.

37. What is Brownian motion? Use a diagram in your answer.

38. What is the Tyndall effect? Use a diagram in your answer.

Self-Assessment Answers

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|----------|----------|----------|-----------|-----------|
| 1. _____ | 4. _____ | 7. _____ | 10. _____ | 13. _____ |
| 2. _____ | 5. _____ | 8. _____ | 11. _____ | 14. _____ |
| 3. _____ | 6. _____ | 9. _____ | 12. _____ | 15. _____ |