

Lesson 18: Phase Diagrams, Raoult's and Henry's laws

text: 240-252, 262-267

what to know:

- phase diagrams (water and carbon dioxide) and related terms, §6-5
- concept of critical temperature and pressure, §6-5
- mass percentage, mole fraction and molality and interconversions with molarity, p-245-250
- ideal solutions, Raoult's law, p-250-251,
- Henry's law, distillation, p-262-267

questions:

1. When solid carbon dioxide (dry ice) is left open at room temperature it disappears without melting. Explain what happens and why it happens. How could you observe liquid CO₂?
2. Compare and contrast the phase diagrams for water and carbon dioxide.
3. Under what conditions do the solid, liquid and vapor phases of water coexist in equilibrium?
4. Lead is a poisonous metal that especially affects children. Lead levels of 0.250 ppm in a child cause delayed cognitive development. How many moles of lead are present in 1.00 g of the child's blood would 0.250 ppm represent?
5. A 100 g sample of water from a lake is found to contain 1.36×10^{-3} mg of mercury. What is the concentration of the mercury in ppm?
6. Complete the following table for water solutions of oxalic acid, H₂C₂O₄.

	Mass Solute	Moles Solute	Volume Solution	Molarity
a.	12.5 g	_____	456 mL	_____
b.	_____	0.0375	_____	0.138
c.	_____	_____	1.75 L	0.496

7. The density of a 60.0% aqueous solution of sugar is 1.290 g/mL. Molar masses are 342 for sugar and 18.0 for water.
 - a. What is the molarity of the sugar solution?
 - b. What is the mole fraction of water in the solution?
 - c. What is the molality of the sugar solution?
 - d. Which of the above expressions of concentration are temperature dependent, molarity, mole fraction or molality?
8. Explain why the solubility of a gas in a liquid always decreases with an increase in temperature.
9. At 25 °C the vapor pressure of pure benzene is 0.125 atm. What is the mole fraction of any nonvolatile solute which would result in a solution vapor pressure of 0.100 atm?
10. A mixture of hexane (C₆H₁₄) and heptane (C₇H₁₆) is 0.50 mole fraction in hexane. What can you say about the composition of the vapor above the liquid? Describe how these can be separated by distillation.
11. Relate Henry's law to a can of soda.
12. What is an ideal solution?