

## Announcements

Wednesday, April 29, 2009

Ch 12/13 MC due Mon May 4.

**Exam 3** Mon, May 4, covering chapters 10, 18, 12, and 13. A study guide is up now (updated slightly Wed AM)

**Discussion assignment 2:** Phase 3 post due Friday, May 8. Replies due before final exam

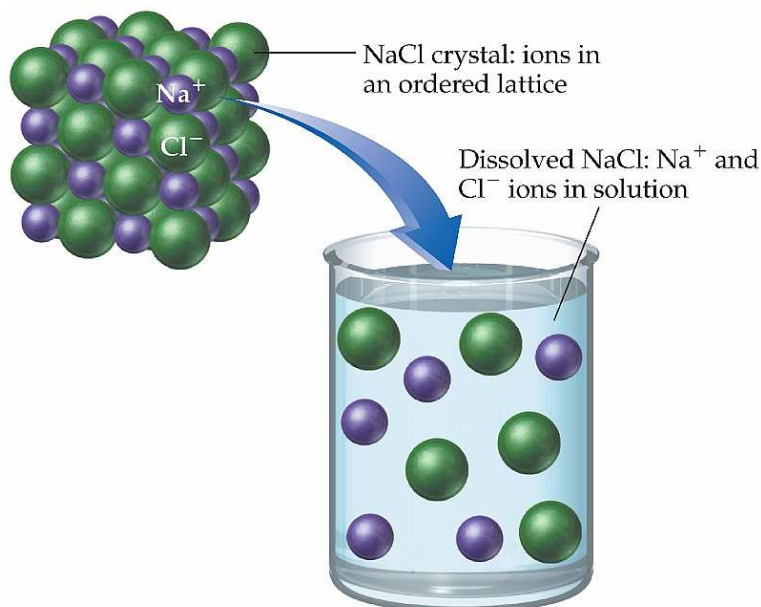
**Extra credit opportunities:** do experiments 11 (egg-speriment) and 12 (red cabbage) at home. Bring completed worksheets to final exam for max 5 points extra credit each.

**Comprehensive final exam:** Wed, May 13 10 am - noon.

- 50 multiple choice questions = 150 points
- % will replace lowest exam score if improvement
- Slight additional emphasis on chapter 14.

# Dissolving an ionic compound

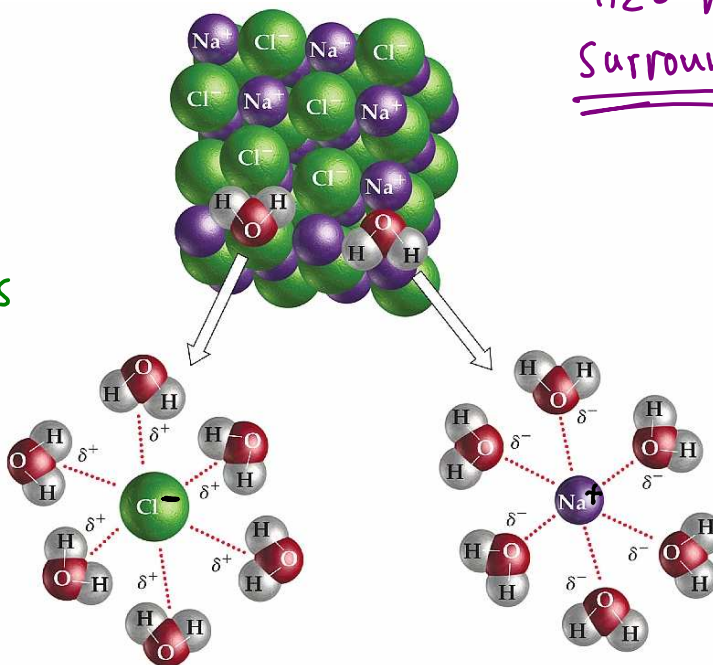
When an ionic compound dissolves, its ions separate!



Copyright © 2009 Pearson Prentice Hall, Inc.

only polar  
solvents can  
surround  
dissolved ions

H<sub>2</sub>O molecules  
surround ions



(...but only if the ionic compound is soluble. Insoluble compounds remain in the ionic lattice)

## Saturation

Even soluble compounds have a limit to how much solute will dissolve

Solubility of NaCl: 36 g per 100 mL H<sub>2</sub>O

- **Saturated solution**: holds the maximum amount of solute
- **Unsaturated solution**: holds less than the max
- **Supersaturated solution**: temporarily has dissolved **more** than the maximum amount of solute

Examples:

- 15 g salt dissolved in 100 mL H<sub>2</sub>O *un sat .*
- 50 g salt poured into 100 mL H<sub>2</sub>O, with undissolved solid on the bottom *Saturated*
- 38 g salt completely dissolved in 100 mL H<sub>2</sub>O *supersaturated*

*Supersaturated*



(a)



(b)

*saturated*



(c)

Copyright © 2009 Pearson Prentice Hall, Inc.

## % Concentration

**Concentration:** a measure of how much solute is dissolved in a solution

### Mass percent concentration:

$$\text{mass \%} = \frac{\text{mass solute}}{\text{mass solution}} \times 100\%$$

↖ solute + solvent

12.1 g NaCl are dissolved in 120.1 g H<sub>2</sub>O. What is the mass percent concentration?

$$\frac{12.1\text{g}}{(12.1\text{g} + 120.1\text{g})} \times 100\% = \boxed{9.15\%}$$

↖ solvent

Bleach is a 6.25% NaOCl (sodium hypochlorite) solution in H<sub>2</sub>O. What mass NaOCl is in 487 g bleach?

Solution

When you're given a mass %, make a conversion factor out of it! **100 g solution** contains 6.25 g NaOCl.

$$487\text{ g bleach} \times \frac{6.25\text{ g NaOCl}}{100\text{ g bleach soln}} = \boxed{30.4\text{ g NaOCl}}$$

Vinegar is 5.0% acetic acid in H<sub>2</sub>O. How many grams of vinegar will 17.2 g acetic acid make?

$$17.2\text{ g acetic acid} \times \frac{100\text{ g vinegar}}{5.0\text{ g acetic acid}} = \boxed{340\text{ g vinegar}}$$

Molarity

$$M = \text{mol/L}$$

$$\text{Molarity (M)} = \frac{\text{moles solute}}{\text{liters solution}} = \frac{\text{mol}}{\text{L}}$$

14.2 g NaCl is dissolved in H<sub>2</sub>O to make 250. mL solution. What is the molarity of the solution?

$$M = \frac{\text{mol solute}}{\text{L solution}} = \frac{0.24298 \text{ mol NaCl}}{0.250 \text{ L solution}} = \frac{0.972 \text{ M}}{0.972 \text{ mol/L}}$$

$$14.2 \text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58.44 \text{ g NaCl}} = 0.24298 \text{ mol NaCl}$$

$$250 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.250 \text{ L}$$

What mass of NaCl(s) is required to make 250. mL of 3.5 M NaCl(aq) solution? (prepare soln by dissolving solid)

Molarity is a conversion factor between: mol solute ↔ L soln

$$250. \text{ mL solution} \times \frac{1 \text{ L soln}}{1000 \text{ mL soln}} \times \frac{3.5 \text{ mol NaCl}}{1 \text{ L soln}} \times \frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}} = 51 \text{ g NaCl}$$

$$3.5 \text{ M} = \frac{3.5 \text{ mol solute}}{1 \text{ L soln}}$$

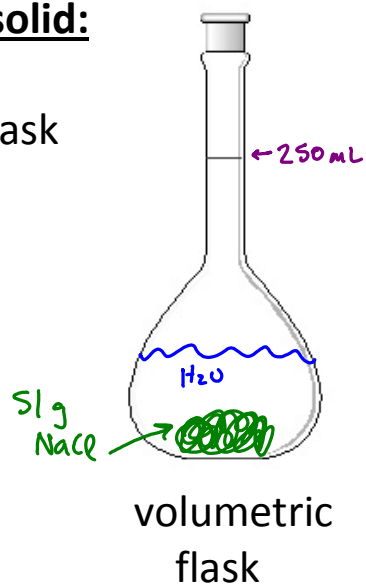
↑  
mol/L



**To prepare a solution by dissolving a solid:**

1. Measure mass of solid
2. Add to correct size volumetric flask
3. Dissolve the solid in water
4. Add H<sub>2</sub>O to the line  
(to make correct vol. of solution.)

How do you prepare 1.5 L of a 2.75 M Cu(NO<sub>3</sub>)<sub>2</sub>(aq) solution by dissolving Cu(NO<sub>3</sub>)<sub>2</sub>(s)?



How many mL of solution will 2.87 g CaCl<sub>2</sub>(s) make if the solution is 0.85 M?

$$2.87 \text{ g CaCl}_2 \times \frac{1 \text{ mol CaCl}_2}{116.98 \text{ g CaCl}_2} \times \frac{1 \text{ L soln}}{0.85 \text{ mol CaCl}_2} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \boxed{30. \text{ mL Soln}}$$

## Dilution

**Dilution**: adding solvent to an existing solution

Dilution will decrease the concentration.

**The dilution equation**:  $M_1V_1 = M_2V_2$   
before dilution      after dilution

How do you prepare 500. mL of a 1.5 M solution by dilution of a 6.0 M stock solution?

have:  $M_1$  6.0 M stock solution

want: 500. mL 1.5 M diluted solution  
 $V_2$        $M_2$

Solve for  $V_1$

$$V_1 = \frac{M_2 V_2}{M_1} = \frac{(1.5 M)(500. \text{ mL})}{(6.0 M)} = \boxed{130 \text{ mL}} \text{ of the stock (6.0 M) solution}$$

If 75.0 mL of 12 M HCl(aq) are diluted to 425 mL, what is the final concentration?

$$M_1 V_1 = M_2 V_2$$

solve for  $M_2$

$$M_2 = \frac{M_1 V_1}{V_2} = \frac{(12 M)(75.0 \text{ mL})}{(425 \text{ mL})} = \boxed{2.1 M}$$