

Key

Solutions Review

DIRECTIONS: On the line rewrite the question substituting one of the vocabulary words for the underlined words. Then circle the correct answer or answer on the second line.

Ex: Which substance undergoes a phase change from the liquid to the gas state at 100°C?
vaporization

- (1) CO₂ (2) H₂ (3) H₂O (4) O₂

| WORD BANK | | | |
|-------------------------|------------|--------------|------------|
| saturated solution | solution | dilute | soluble |
| unsaturated solution | solute | concentrated | insoluble |
| supersaturated solution | solvent | equilibrium | miscible |
| distillation | solubility | dissociation | immiscible |

1. Which is a homogeneous mixture? *solution*

- (1) NaCl (s) (2) NaCl (l) (3) NaCl (g) (4) NaCl (aq)

2. a. What is the dissolved substance in NH₄Cl(aq)? *solute* NH₄Cl

dissolved in water

b. What is the substance that does the dissolving in NH₄Cl(aq)? *solvent* water

3. A state of balance between dissolved and undissolved solute exists in which type of solution? *equilibrium*

- (1) saturated (2) unsaturated (3) supersaturated

4. Which substance does not dissolve in water? (Hint: use Table F) *insoluble*

- (1) Ca(NO₃)₂ (2) CaCrO₄ (3) Ca(OH)₂ (4) CaCO₃ *insol.*

5. Which substance dissolves easily in water? (Hint: use Table F) *soluble*

- (1) KCl (2) AgCl (3) PbCl₂ (4) Hg₂Cl₂

6. As temperature increases, the number of grams dissolved in a given quantity of solvent of which substance increases? *solubility*

- (1) HCl gas (2) KClO₃ (3) NH₃ gas (4) SO₂ *look @ Table G*

7. Which pair are liquids that mix to form a solution? *miscible* water is polar

- (1) hexane (nonpolar) and water (2) CCl₄ (nonpolar) and water (3) ethanol (polar) and water

8. Which is a solution that contains more solute than will normally dissolve at 70°C? *(like dissolves like) supersaturated*

- (1) 10g SO₂ in 100 g of water *super sat* (3) 30g KClO₃ in 100 g water *unsat*
(2) 10g NH₃ in 100 g of water *unsat.* (4) 30g NaCl in 100 g water *unsat.*

9. Which is a solution that contains less solute than will normally dissolve at 50°C? *unsaturated*

- (1) 84g SO₂ in 100g of water *super* (3) 84g KNO₃ in 100g water *sat.*
(2) 84g NH₄Cl in 100g of water *super* (4) 84g NaNO₃ in 100g water *unsat*

10. At 25°C, which is a solution that contains relatively little dissolved solute? *dilute*

- (1) a saturated solution of NaNO₃(aq) (2) a saturated solution of KClO₃ *lower solubility*

Practice Questions by Topic

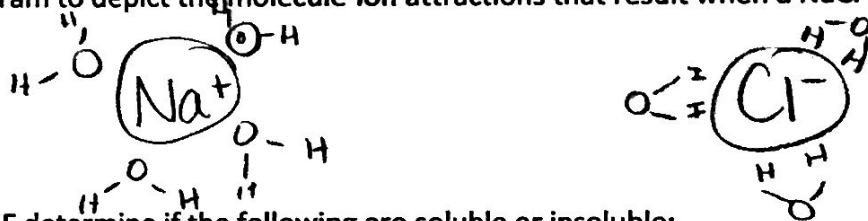
Solubility: Table F

Solubility depends on the nature of the solution, temperature, and pressure.

- a. Acetone is an active ingredient in nailpolish remover. It is a nonpolar molecule. Water is not effective in removing nail polish. Explain, in terms of molecular polarity, why acetone is able to dissolve nail polish but water is not.

Acetone & nailpolish are both polar.
Nonpolar solutes dissolve in nonpolar solvents. Water is polar

- b. Draw a diagram to depict the molecule-ion attractions that result when a NaCl (s) is dissolved in water.



- c. Using Table F determine if the following are soluble or insoluble:

| | | | |
|--------------------------------------|----------|------------------------|----------|
| 1) NaNO ₃ | <u>S</u> | 3) Magnesium hydroxide | <u>I</u> |
| 2) Ammonium carbonate (exception) | <u>S</u> | 4) CaCO ₃ | <u>I</u> |

- d. Under what conditions of temperature and pressure would gas bubbles, such as those found in soda, be most soluble?

low temp, high pressure
(sealed soda bottle in fridge)

- e. What trend is observed between solubility of a solid solute and temperature?

↑ temp, ↑ solubility of a solid

Solubility Curves: Table G

Very soluble solutes are found near the top of Table G. Those are also more concentrated. Points that fall above a line for a solute are called supersaturated. Points below are called unsaturated. Points on the line show saturated solutions. Watch out for the amount of solvent (water) in the question; Table G is for 100g of water, so if you are given a different amount you must multiple or divide the solubility accordingly.

- a. What solid is the most concentrated at 10°C? KI Which gas? HCl
(down slopes highest on y axis) (up slopes)
- b. How much KNO₃ dissolves at 70°C in 100 grams of water? 135g
- c. At what temperature will 20g of SO₂ dissolve in 100g of water? 0°C
- d. At what temperature will 40 grams of KNO₃ dissolve in 200g of water? 7°C
20g in 100g of water ÷ 2

- e. How many grams of NaCl will dissolve in 50 grams of water at 100C? $40 \div 2 = 20g$
- f. How many grams of KCl will precipitate out of 100 gram of water if the solution is cooled from 80C to 20C?

$32g$ $51 - 32g = 19g$ $51g$

- g. What type of solution is created when 50 grams of NaNO₃ are dissolved in 50 grams of water at 20C?
 can hold $88 \div 2 = 44g$, $80 \div 2$ **Supersaturated**

Concentration: Table T

Molarity is expressed as the moles of solute per liter of solution. It is the most common unit of concentration. Percent by mass and part per million formulas are both on Table T and both require the amount of SOLUTION on the denominator. NOT water or solvent!

- a. What is the molarity of 5.0 moles of NaCl in 400mL of water? *convert to L = .400 L*

$$M = \frac{\text{moles solute}}{\text{L solution}} = \frac{5.0}{.400} = 12.5 M = 13 M$$

- b. What is the volume that would hold 2.0 moles of 3.0M K?

$$M = \frac{\text{mol}}{\text{L}} \quad \left. \vphantom{M} \right\} \quad 3.0 M = \frac{2.0}{x} \quad x = 0.66\bar{6} = 0.67 L$$

- c. Calculate the percent by mass of a solution containing 50g of KNO₃ in 250g of water.

$$\% \text{ by mass} = \frac{\text{g solute}}{\text{g solution}} \times 100 = \frac{50g}{(250 + 50g)} \times 100 = 17\%$$

solute + solvent

- d. Calculate the percent by mass of a solution containing 25.0g of NaClO₃ in 250g of solution.

same formula

$$= \frac{25.0}{250} \times 100 = 10\%$$

g solute g solution

- e. Calculate the parts per million of a solution containing 5.0g of KNO₃ in 25000g of water.

$$\text{ppm} = \frac{\text{g solute}}{\text{g solution}} \times 1,000,000 = \frac{5.0}{25000 + 5.0} \times 1,000,000 = 200 \text{ ppm}$$

g solute g solvent

- f. Calculate the parts per million of a solution containing 1.25g of KNO₃ in 100,000g of solution.

same formula

$$\text{ppm} = \frac{1.25}{100,000} \times 1,000,000 = 12.5 \text{ ppm}$$

g solute g solution

Colligative Properties

When a solute is added to a liquid the strength of IMF increase and more energy is required to change phases. Therefore, the solution's boiling point increases and the freezing point decreases when a solute is added. The higher the concentration of dissolved particles, the higher the boiling point and the lower the freezing point. To determine which solute will have the greatest effect on boiling point elevation and freezing point depression, it is important to take the nature of the solute into account. Molecular (covalently bonded) solutes do not break apart into solution. Ionic solutes, however, do break into component ions in solution, resulting in a greater concentration of dissolved particles, so have a greater effect on the colligative properties of a solution.

1. Compare the freezing point of a solution containing 1.25 mol of dissolved sodium chloride in 2.50 L of solution to a solution containing 0.75 mol of dissolved sodium chloride in 2.50 L of solution.

The fp of the solution containing 1.25 mol solute will be lower b/c the concentration is higher.

2. Which solution will have the highest boiling point? —



ionic
2 particles



molecular
(1 particle)



ionic
5 particles



ionic
2 particles

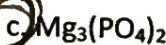
3. Which solution will have the lowest freezing point?



2



1



5



2

4. A substance that conducts electricity in solution is known as an electrolyte.

-ionic