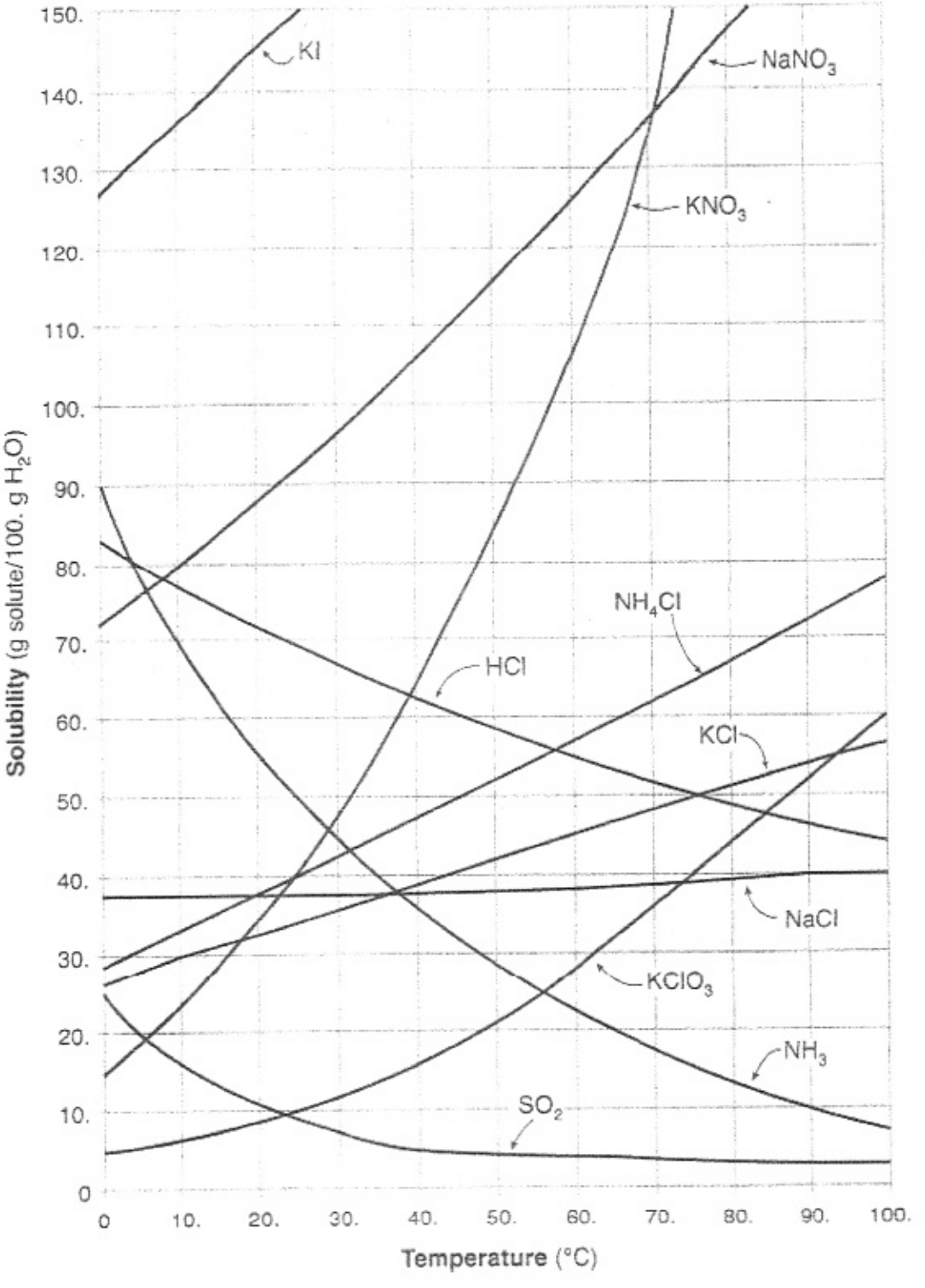
4/20 Work

## Table G
## Solubility Curves at Standard Pressure



4/20 Work

Use Reference Table G to answer the following questions:

1. How many grams of sodium nitrate ($NaNO_3$) will dissolve in 100g of water at 20°C? 87g
2. How many grams of sodium nitrate will dissolve in 100 g of water at 60°C? 125-126g
3. How many grams of ammonium chloride will dissolve in 1000 ml of water at 50°C? $NH_4Cl$ $52 \times 10 = 520g$ 1g = 1mL → 100g x 10 = 1000
4. Ninety grams of potassium nitrate is added to 100 grams of water at 0°C. To what temperature must the solution be raised to produce a saturated solution? 52°C (move over until you reach $KNO_3$ line)
5. A saturated solution of potassium chlorate was made with 300 g of water at 40°C. How much potassium chlorate could be recovered by evaporating the solution to dryness? $KClO_3$ 15-16 = 45-48g (multiply by 3)
6. Five hundred grams of water are used to make a saturated solution of potassium nitrate ($KNO_3$) at 10°C. How many more grams of potassium nitrate could be dissolved if the temperature was raised to 50°C? $23 \times 5 = 115g$ $84 \times 5 = 420g$ 420 - 115 = 305g
7. A saturated solution of ammonia gas ($NH_3$) in 200 grams of water at 20°C is heated to 50°C. How much gas will come out of solution? $28 \times 2 = 56g$ $56 \times 2 = 112g$ 112 - 56 = 56g
8. According to the solubility table approximately how many grams of potassium chlorate ($KClO_3$) are needed to saturate 100 grams of water at 40°C? 36-37g
9. How many grams of potassium nitrate ($KNO_3$) are needed to saturate 50 grams of water at 70°C? 133-134 ÷ 2 = 66.5g or 67g
10. A solution contains 14 grams of sodium chloride in 100 grams of water at 40°C. What is the minimum amount of sodium chloride that must be added to make this a saturated solution? 38g 38 - 14 = 24g
11. Classify the following solutions as saturated, unsaturated or supersaturated. above the line: supersaturated; on line: saturated; under the line: unsaturated

    a. 14 g of KCl in 100 grams of water at 40°C unsaturated

    b. 90 g of $KNO_3$ in 100 grams of water at 50°C supersaturated

    c. 30 g of $SO_2$ in 50 grams of water at 80°C supersaturated
    → 60g in 100g of $H_2O$

    d. 145 g of KI in 200 grams of water at 20°C unsaturated
    72.5g in 100g $H_2O$

    e. 100 g of KCl in 200 grams of water at 75°C saturated
    50g in 100g of water

Regents Chemistry
Mr. Dolgos

# Saturation & Solubility Curves

1. Which compound is *least* soluble in 100 grams of water at 40°C?

A) NaCl B) $NH_4Cl$
C) $SO_2$ D) $KClO_3$

2. According to Reference Table *G*, which of these substances is most soluble at 60°C?

A) NaCl B) $NH_4Cl$
C) $KClO_3$ D) KCl

3. An unsaturated solution is formed when 80. grams of a salt is dissolved in 100. grams of water at 40.°C. This salt could be

A) $KNO_3$ B) NaCl
C) $NaNO_3$ below the line D) KCl

4. As additional $KNO_3(s)$ is added to a saturated solution of $KNO_3$ at constant temperature, the concentration of the solution

A) decreases B) increases
C) remains the same

5. According to Reference Table G, which is the best description of the system prepared by dissolving 30 grams of $NH_3(g)$ in 100 grams of water at 20°C?

A) a saturated solution of $NH_3$ in contact with excess $NH_3(g)$
B) an unsaturated solution of $NH_3$ with no excess $NH_3(g)$ below line
C) a saturated solution of $NH_3$ with no excess $NH_3(g)$
D) an unsaturated solution of $NH_3$ in contact with excess $NH_3(g)$

6. A student tested the solubility of a salt at different temperatures and then used Reference Table *g* to identify the salt. The student's data table appears below.

| Temperature (°C) | g of salt per 10 g of water |
|---|---|
| 30 | 1.2 |
| 50 | 2.2 |
| 62 | 3.0 |
| 76 | 4.0 |

10 x 10 = 100g

4.0 x 10 = 40g

What is the identity of the salt?

A) ammonium chloride
B) potassium nitrate
C) potassium chlorate
D) sodium chloride

7. A solution contains 100 grams of a nitrate salt dissolved in 100 grams of water at 50°C. The solution could be a

A) supersaturated solution of $NaNO_3$
B) supersaturated solution of $KNO_3$ point is above $KNO_3$ line
C) saturated solution of $NaNO_3$
D) saturated solution of $KNO_3$

8. Which compound is *least* soluble in water at 60. °C?

A) $NH_4Cl$ B) $KNO_3$
C) $KClO_3$ D) NaCl

9. An unsaturated aqueous solution of $NH_3$ is at 90°C in 100. grams of water. According to Reference Table *G*, how many grams of $NH_3$ could this unsaturated solution contain?

A) 10. g B) 15 g C) 20. g D) 5 g

10. Which compound becomes *less* soluble in water as the temperature of the solution is increased?

A) $NH_4Cl$ B) NaCl
C) HCl D) KCl

↓ line curves down

11. According to your Reference Tables, which substance forms an unsaturated solution when 80 grams of the substance is dissolved in 100 grams of $H_2O$ at 10°C?

A) $NaNO_3$ B) $KNO_3$
C) KI D) NaCl

12. A saturated solution of $NaNO_3$ is prepared at 60.°C using 100. grams of water. As this solution is cooled to 10.°C, $NaNO_3$ precipitates (settles) out of the solution. The resulting solution is saturated. Approximately how many grams of $NaNO_3$ settled out of the original solution?

A) 85 g B) 126 g
C) 46 g close enough! D) 61 g

125 − 80 = 45g

13. A student adds solid KCl to water in a flask. The flask is sealed with a stopper and thoroughly shaken until no more solid KCl dissolves. Some solid KCl is still visible in the flask. The solution in the flask is

A) saturated and is at equilibrium with the solid KCl
B) unsaturated and is not at equilibrium with the solid KCl
C) unsaturated and is at equilibrium with the solid KCl
D) saturated and is not at equilibrium with the solid KCl

14. Based on Reference Table *G*, what is the maximum number of grams of KCl(s) that will dissolve in 200 grams of water at 50°C to produce a saturated solution?

A) 38 g B) 42 g C) 58 g D) 84 g

15. According to Reference Table G, how does a decrease in temperature from 40°C to 20°C affect the solubility of $NH_3$ and KCl?

A) The solubility of $NH_3$ increases, and the solubility of KCl increases.
B) The solubility of $NH_3$ increases, and the solubility of KCl decreases.
C) The solubility of $NH_3$ decreases, and the solubility of KCl increases.
D) The solubility of $NH_3$ decreases, and the solubility of KCl decreases.

16. When an equilibrium exists between the dissolved and the undissolved solute in a solution, the solution must be

A) unsaturated B) saturated
C) diluted D) supersaturated

17. A solution containing 90. grams of $KNO_3$ per 100. grams of $H_2O$ at 50.°C is considered to be

A) dilute and supersaturated
B) concentrated and unsaturated
C) dilute and unsaturated
D) concentrated and supersaturated

18. A student prepares four aqueous solutions, each with a different solute. The mass of each dissolved solute is shown in the table below.

**Mass of Dissolved Solute for Four Aqueous Solutions**

| Solution Number | Solute | Mass of Dissolved Solute (per 100. g of $H_2O$ at 20.°C) |
|---|---|---|
| 1 | KI | 120. g unsaturated |
| 2 | $NaNO_3$ | 88 g saturated |
| 3 | KCl | 25 g unsaturated |
| 4 | $KClO_3$ | 5 g unsaturated |

Which solution is saturated?

A) 2 B) 3 C) 1 D) 4

19. What is the total mass of $KNO_3$ that must be dissolved in 50. grams of $H_2O$ at 60.°C to make a saturated solution?

A) 106 g B) 32 g
C) 53 g D) 64 g

≈107 ÷ 2 = 53.5g

20. How many grams of $NaNO_3$ would have to be added to 100. grams of water at 45°C to make a saturated solution of this salt?

A) 120. B) 110. C) 130. D) 100.

# Solubility Factors

**Directions:** Please fill out the following table. For each solute listed determine whether the **NATURE** of the compound is **NONPOLAR COVALENT, POLAR COVALENT, or IONIC**. Then determine if the solute will be soluble or insoluble in the solvent.

Like dissolves like!
Ionic & polar dissolve in polar.

Nonpolar only dissolves in nonpolar.

| | | SOLVENT | | | |
|---|---|---|---|---|---|
| | | **Water** Polar | **Octane (nonpolar)** | **Hexane (nonpolar)** | **Ethanol (polar)** |
| **SOLUTE** | NaCl<br>Nature: ionic (metal & nonmetal) | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble |
| | HCl<br>Nature: Polar Covalent | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble |
| | $O_2$<br>Nature: Nonpolar Covalent | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble |
| | KCl<br>Nature: ionic | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble |
| | $CO_2$<br>Nature: Nonpolar Covalent | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble | Soluble<br>Insoluble |

1. The attraction between water molecules and an $Na^+$ ion or a $Cl^-$ ion occurs because water molecules are

   A) nonpolar (B) polar
   C) symmetrical D) linear

2. In an aqueous solution of potassium chloride, the solute is

   A) K (B) $H_2O$ C) KCl D) Cl

3. Under which conditions of temperature and pressure is a gas most soluble in water? Think of pop! It goes flat if left out of fridge.

   A) high temperature and high pressure
   (B) low temperature and high pressure
   C) high temperature and low pressure
   D) low temperature and low pressure

4. At room temperature, the solubility of which solute in water would be most affected by a change in pressure?

   A) sugar B) methanol
   C) sodium nitrate (D) carbon dioxide (gas)

5. As the pressure on a gas confined above a liquid increases, the solubility of the gas in the liquid

   A) decreases (B) increases
   C) remains the same

6. At which temperature can water contain the most dissolved oxygen at a pressure of 1 atmosphere?

   (A) 10.°C B) 20.°C
   C) 30.°C D) 40.°C

7. The solubility of a salt in a given volume of water depends primarily on the

   A) pressure on the surface of the water
   B) rate at which the salt and water are stirred
   C) surface area of the salt crystals
   (D) temperature of the water

## Molarity Worksheet #1

The molarity (M) of a solution is the number of moles of solute per liter of solution. The formula for molarity can be found in Table T of your reference tables and is as follows:

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

**Directions:** Solve the following problems. Include the equation used and show all work. Please state the answer to the correct number of significant figures and box all answers with proper units.

1. What is the molarity of a solution that contains 0.40 moles of KBr in a 0.50 L solution?

$M = \frac{0.40 \text{ moles}}{0.50 \text{ L}} = \boxed{0.8 \text{ M}}$

2. If you have 5.0 moles of NaCl in a 2.0 L solution, what is the molarity of the solution?

$M = \frac{5.0 \text{ moles}}{2.0 \text{ L}} = \boxed{2.5 \text{ M}}$

3. If you have 60. moles of HCl what should the total volume of solution be to make a 10. M solution of HCl(aq)?

$10.\text{M} = \frac{60. \text{ moles}}{x}$

$10x = 60 \quad \boxed{x = 6.0 \text{ L}}$

4. Which solution is most concentrated?

a) 5 M HCl b) 3 M HCl
c) 0.09 M HCl d) 23 M HCl ← highest #

5. Which solution is most dilute?

a) 5 M HCl b) 3 M HCl
c) 0.09 M HCl ← lowest # d) 23 M HCl

6. What is the molarity of a solution with 1.75 moles of $KNO_3$ in 3.0 L of solution?

$M = \frac{1.75 \text{ moles}}{3.0 \text{ L}}$

$\boxed{M = 0.583}$ ← 2 sig figs

7. **What is the molarity of a solution that contains 65.1 g of $NH_4Cl$ in 3.50-L of solution?

$GFM = 1(14) + 4(1) + 1(35) = 53 \text{ g}$

$\text{moles} = \frac{65.1 \text{ g}}{53 \text{ g}} = 1.23 \text{ moles}$

$M = \frac{1.23 \text{ moles}}{3.50 \text{ L}} = \boxed{0.351}$

8. To produce 3.00 L of a 1.90 M solution of sodium hydroxide (NaOH).

a. How many moles of sodium hydroxide must be dissolved?

$1.90\text{M} = \frac{\text{moles}}{3.00 \text{ L}}$

$\text{moles} = 1.90 \times 3.00 = 5.70 \text{ moles}$

b. How many grams of sodium hydroxide must you measure out for the solution?

$GFM \text{ of } NaOH = 1(23) + 1(16) + 1(1) = 40 \text{ g/mole}$

$g = \text{moles} \times GFM$

$g = 5.70 \text{ moles} \times 40 \text{ g/mole} =$

$\boxed{\text{mass } g = 228 \text{ g}}$