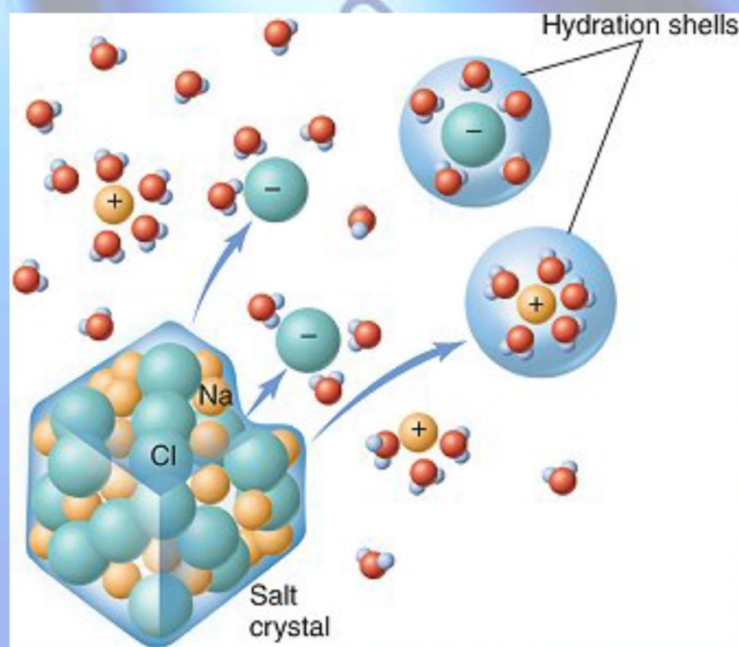


# NGSS Regents Chemistry

## PRACTICE PACKET

### Unit 7: Solutions



## Regents Chemistry

## Mixtures &amp; Separation Techniques

1. An example of a heterogeneous mixture is

- A) carbon monoxide    **B) soil**  
 C) sugar                    D) carbon dioxide

2. Which mixture can be separated by using the equipment shown below?



- A)  $\text{CO}_2(\text{aq})$  and  $\text{NaCl}(\text{aq})$   
 B)  $\text{CO}_2(\text{aq})$  and  $\text{C}_6\text{H}_{12}\text{O}_6(\text{aq})$   
**C)  $\text{NaCl}(\text{aq})$  and  $\text{SiO}_2(\text{s})$**   
 D)  $\text{NaCl}(\text{aq})$  and  $\text{C}_6\text{H}_{12}\text{O}_6(\text{aq})$

3. Which formula represents a mixture?

- A)  $\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$                     **B)  $\text{LiCl}(\text{aq})$**   
 C)  $\text{C}_6\text{H}_{12}\text{O}_6(\ell)$                     D)  $\text{LiCl}(\text{s})$

4. Recovering the salt from a mixture of salt and water could best be accomplished by

- A) evaporation**  
 B) paper chromatography  
 C) density determination  
 D) filtration

5. Which statement is an identifying characteristic of a mixture?

- A) A mixture must be homogeneous.  
 B) A mixture must have a definite composition by weight.  
**C) A mixture can be separated by physical means.**  
 D) A mixture can consist of a single element.

6. When a mixture of water, sand, and salt is filtered, what passes through the filter paper?

- A) water and sand, only  
 B) water, sand, and salt  
**C) water and salt, only**  
 D) water, only

7. Petroleum can be separated by distillation because the hydrocarbons in petroleum are

- A) elements with identical boiling points  
 B) compounds with identical boiling points  
 C) elements with different boiling points  
**D) compounds with different boiling point**

8. Which sample of matter can be separated into different substances by physical means?

- A)  $\text{NH}_3(\ell)$                     **B)  $\text{LiCl}(\text{aq})$**   
 C)  $\text{NH}_3(\text{g})$                     D)  $\text{LiCl}(\text{s})$

9. A mixture of sand and table salt can be separated by filtration because the substances in the mixture differ in

- A) density at STP  
 B) freezing point  
 C) boiling point  
**D) solubility in water**

10. Which particle diagram represents a mixture of an element and a compound?

Key	
○	= an atom of an element
●	= an atom of a different element

A)

**B)**

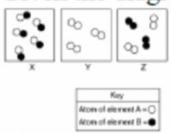
C)

D)

11. One similarity between all mixtures and compounds is that both

- A) combine in a definite ratio  
 B) are heterogeneous  
 C) are homogeneous  
**D) consist of two or more substances**

### Mixtures & Separation Techniques

12. A mixture of crystals of salt and sugar is added to water and stirred until all solids have dissolved. Which statement best describes the resulting mixture?
- A) The mixture is heterogeneous and can be separated by filtration.  
 B) The mixture is homogeneous and cannot be separated by filtration.  
 C) The mixture is heterogeneous and cannot be separated by filtration.  
 D) The mixture is homogeneous and can be separated by filtration.
13. A bottle of rubbing alcohol contains both 2-propanol and water. These liquids can be separated by the process of distillation because the 2-propanol and water
- A) have combined chemically and have the same boiling point  
 B) have combined physically and have the same boiling point  
 C) have combined physically and retain their different boiling points  
 D) have combined chemically and retain their different boiling points
14. Which property makes it possible to separate the oxygen and the nitrogen from a sample of liquefied air?
- A) hardness                      B) electronegativity  
 C) boiling point                  D) conductivity
15. A dilute, aqueous potassium nitrate solution is best classified as a
- A) homogeneous compound  
 B) homogeneous mixture  
 C) heterogeneous compound  
 D) heterogeneous mixture
16. Which must be a mixture of substances?
- A) solution                      B) liquid  
 C) solid                          D) gas
17. Which of these contains only one substance?
- A) distilled water              B) rainwater  
 C) saltwater                      D) sugar water
18. A dry mixture of  $\text{KNO}_3$  and sand could be separated by
- A) adding water to the mixture and evaporating  
 B) heating the mixture to a high temperature  
 C) adding water to the mixture and filtering  
 D) cooling the mixture to a low temperature
19. Which material is a mixture?
- A) magnesium                  B) water  
 C) methane                       D) air
20. Given the diagrams X, Y, and Z below:
- 
- Which diagram or diagrams represent a mixture of elements A and B?
- A) X and Y                      B) X, only  
 C) Z, only                          D) X and Z
21. At room temperature, a mixture of sand and water can be separated by
- A) combustion                   B) filtration  
 C) sublimation                  D) ionization
22. Which formula represents a homogeneous mixture?
- A)  $\text{NaH}(s)$                       B)  $\text{H}_2\text{O}(l)$   
 C)  $\text{H}_2\text{S}(g)$                        D)  $\text{HCl}(aq)$
23. Which of these terms refers to matter that could be heterogeneous?
- A) mixture                      B) solution  
 C) compound                      D) element
24. Which process would most effectively separate two liquids with different molecular polarities?
- A) conductivity                  B) fermentation  
 C) filtration                       D) distillation

## Solubility Curves

Using **Table G** in your Reference Tables, answer the following questions:

**Questions 1-5:** For each question an amount of solute is given and a temperature is stated. If all of the solute could be dissolved in 100g of water at the stated temperature, would the resulting solution be unsaturated, saturated, or supersaturated?

- 1) 60 g KCl at 70°C SS  
 2) 90 g KNO<sub>3</sub> at 60°C U  
 3) 110 g NaNO<sub>3</sub> at 45°C S  
 4) 10 g KClO<sub>3</sub> at 10°C SS  
 5) 60 g NH<sub>4</sub>Cl at 70°C U

**Questions 6-10:** For each question a solute and temperature are given. Tell how many grams of each solute must be added to 100 g of water to form a saturated solution at the temperature given.

- 6) NaNO<sub>3</sub> at 30°C 95g  
 7) KClO<sub>3</sub> at 70°C 35g  
 8) KNO<sub>3</sub> at 45°C 75g  
 9) KCl at 40°C 38g  
 10) NaCl at 90°C 40g

**Questions 11-13:** For each question, tell which solution is more concentrated.

- 11) At 50°C (A) a saturated solution of KNO<sub>3</sub> or (B) a saturated solution of NH<sub>4</sub>Cl  
 12) At 50°C (A) a saturated solution of KNO<sub>3</sub> or (B) an unsaturated solution of NaNO<sub>3</sub> consisting of 100 g of the solute dissolved in 100 g of water.  
 13) At 50°C (A) a saturated solution of NaNO<sub>3</sub> or (B) a supersaturated solution of NH<sub>4</sub>Cl consisting of 60 g of the solute dissolved in 100 g of water.

**Questions 14-18:**

- 14) If 130 g KNO<sub>3</sub> are added to 100 g of water at 40°C, how many grams do not dissolve? 65g  
 15) If 50 g KClO<sub>3</sub> are added to 100 g of water at 10°C, how many grams do not dissolve? 43g  
 16) Table G shows that at 76°C, the same mass of two solutes will each dissolve in equal masses of water to form saturated solutions. What are these two solutes? KCl and HCl  
 17) What mass of NH<sub>4</sub>Cl would be needed to form a saturated solution if the NH<sub>4</sub>Cl was dissolved in 200 g of water at 50°C? 104g  
 18) Equal masses of three different solutes will dissolve in equal masses of water at one particular temperature. What are the three solutes and what is the temperature? KCl, NaCl, NH<sub>3</sub> at 37°C

## Regents Chemistry

## Saturation &amp; Solubility Curves

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

- A) NaCl                      B) NH<sub>4</sub>Cl  
C) SO<sub>2</sub>                      D) KClO<sub>3</sub>

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

- A) NaCl                      B) NH<sub>4</sub>Cl  
C) KClO<sub>3</sub>                      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<sub>3</sub>                      B) NaCl  
C) NaNO<sub>3</sub>                      D) KCl

4. As additional KNO<sub>3</sub>(s) is added to a saturated solution of KNO<sub>3</sub> 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<sub>3</sub>(g) in 100 grams of water at 20°C?

A) a saturated solution of NH<sub>3</sub> in contact with excess NH<sub>3</sub>(g)

B) an unsaturated solution of NH<sub>3</sub> with no excess NH<sub>3</sub>(g)

C) a saturated solution of NH<sub>3</sub> with no excess NH<sub>3</sub>(g)

D) an unsaturated solution of NH<sub>3</sub> in contact with excess NH<sub>3</sub>(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

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<sub>3</sub>

B) supersaturated solution of KNO<sub>3</sub>

C) saturated solution of NaNO<sub>3</sub>

D) saturated solution of KNO<sub>3</sub>

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

A) NH<sub>4</sub>Cl                      B) KNO<sub>3</sub>

C) KClO<sub>3</sub>                      D) NaCl

9. An unsaturated aqueous solution of NH<sub>3</sub> is at 90°C in 100. grams of water. According to Reference Table G, how many grams of NH<sub>3</sub> 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<sub>4</sub>Cl                      B) NaCl

C) HCl                      D) KCl

## Saturation &amp; Solubility Curves

11. According to your Reference Tables, which substance forms an unsaturated solution when 80 grams of the substance is dissolved in 100 grams of  $\text{H}_2\text{O}$  at  $10^\circ\text{C}$ ?
- A)  $\text{NaNO}_3$                       B)  $\text{KNO}_3$   
 C)  $\text{KI}$                               D)  $\text{NaCl}$
12. A saturated solution of  $\text{NaNO}_3$  is prepared at  $60^\circ\text{C}$  using 100. grams of water. As this solution is cooled to  $10^\circ\text{C}$ ,  $\text{NaNO}_3$  precipitates (settles) out of the solution. The resulting solution is saturated. Approximately how many grams of  $\text{NaNO}_3$  settled out of the original solution?
- A) 85 g                              B) 126 g  
 C) 46 g                              D) 61 g
13. A student adds solid  $\text{KCl}$  to water in a flask. The flask is sealed with a stopper and thoroughly shaken until no more solid  $\text{KCl}$  dissolves. Some solid  $\text{KCl}$  is still visible in the flask. The solution in the flask is
- A) saturated and is at equilibrium with the solid  $\text{KCl}$   
 B) unsaturated and is not at equilibrium with the solid  $\text{KCl}$   
 C) unsaturated and is at equilibrium with the solid  $\text{KCl}$   
 D) saturated and is not at equilibrium with the solid  $\text{KCl}$
14. Based on Reference Table G, what is the maximum number of grams of  $\text{KCl}(s)$  that will dissolve in 200 grams of water at  $50^\circ\text{C}$  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  $40^\circ\text{C}$  to  $20^\circ\text{C}$  affect the solubility of  $\text{NH}_3$  and  $\text{KCl}$ ?
- A) The solubility of  $\text{NH}_3$  increases, and the solubility of  $\text{KCl}$  increases.  
 B) The solubility of  $\text{NH}_3$  increases, and the solubility of  $\text{KCl}$  decreases.  
 C) The solubility of  $\text{NH}_3$  decreases, and the solubility of  $\text{KCl}$  increases.  
 D) The solubility of  $\text{NH}_3$  decreases, and the solubility of  $\text{KCl}$  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  $\text{KNO}_3$  per 100. grams of  $\text{H}_2\text{O}$  at  $50^\circ\text{C}$  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 $\text{H}_2\text{O}$ at $20^\circ\text{C}$ ) |
|-----------------|-----------------|--------------------------------------------------------------------------------------|
| 1               | $\text{KI}$     | 120. g                                                                               |
| 2               | $\text{NaNO}_3$ | 88 g                                                                                 |
| 3               | $\text{KCl}$    | 25 g                                                                                 |
| 4               | $\text{KClO}_3$ | 5 g                                                                                  |
- Which solution is saturated?
- A) 2    B) 3    C) 1    D) 4
19. What is the total mass of  $\text{KNO}_3$  that must be dissolved in 50. grams of  $\text{H}_2\text{O}$  at  $60^\circ\text{C}$  to make a saturated solution?
- A) 106 g                              B) 32 g  
 C) 53 g                              D) 64 g
20. How many grams of  $\text{NaNO}_3$  would have to be added to 100. grams of water at  $45^\circ\text{C}$  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.

		SOLVENT			
		Water	Octane (nonpolar)	Hexane (nonpolar)	Ethanol (polar)
<b>SOLUTE</b>	NaCl Nature: <i>Ionic</i>	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble
	HCl Nature: <i>Polar covalent</i>	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble
	O <sub>2</sub> Nature: <i>non polar covalent</i>	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble
	KCl Nature: <i>Ionic</i>	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble
	CO <sub>2</sub> <i>:O=C=O:</i> Nature: <i>non polar covalent</i>	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble	Soluble Insoluble

## Regents Chemistry

## Nature of Solute &amp; Solubility Factors

- 
1. The attraction between water molecules and an  $\text{Na}^+$  ion or a  $\text{Cl}^-$  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)  $\text{H}_2\text{O}$       **C) KCl**      D) Cl
3. Under which conditions of temperature and pressure is a gas most soluble in water?
- 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**
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**
-



**Table F - Soluble or Insoluble?**

Using Table F write the name for the following salts and then determine if they are soluble or insoluble in water.

Salt	Name of Salt	Soluble or Insoluble?
1) $\text{CaCO}_3$	Calcium carbonate	Insoluble
2) $\text{Na}_2\text{CrO}_4$	Sodium chromate	Soluble
3) $\text{Mg}(\text{OH})_2$	Magnesium hydroxide	Insoluble
4) $\text{AgCl}$	Silver chloride	Insoluble
5) $\text{CaS}$	Calcium sulfide	Insoluble
6) $\text{NH}_4\text{ClO}_3$	Ammonium chlorate	Soluble
7) $\text{PbBr}_2$	Lead II Bromide	Insoluble
8) $\text{Zn}(\text{HCO}_3)_2$	Zinc hydrogen carbonate	Soluble
9) $\text{KC}_2\text{H}_3\text{O}_2$	Potassium acetate	Soluble
10) $\text{NaOH}$	Sodium hydroxide	Soluble
11) $\text{LiNO}_3$	Lithium nitrate	Soluble
12) $\text{BaSO}_4$	Barium sulfate	Insoluble
13) $\text{Hg}_2\text{I}_2$	Mercury I Iodide	Insoluble
14) $\text{Sr}_3(\text{PO}_4)_2$	Strontium Phosphate	Insoluble
15) $\text{Ra}(\text{ClO}_4)_2$	Radium perchlorate	Soluble
16) $\text{PbSO}_4$	Lead II sulfate	Insoluble
17) $\text{CuCl}_2$	Copper II chloride	Soluble
18) $\text{Zn}(\text{NO}_3)_2$	Zinc nitrate	Soluble
19) $\text{AgBr}$	Silver bromide	Insoluble
20) $\text{Al}(\text{OH})_3$	Aluminum hydroxide	Insoluble
21) $\text{SnS}$	Tin II sulfide	Insoluble
22) $\text{Mg}_3(\text{PO}_4)_2$	Magnesium phosphate	Insoluble
23) $\text{Na}_2\text{CO}_3$	Sodium carbonate	Soluble
24) $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$	Ammonium acetate	Soluble
25) $\text{Hg}_2(\text{ClO}_4)_2$	Mercury I perchlorate	Soluble

## Regents Chemistry

## Concentration

1. What is the total number of moles of NaCl(s) needed to make 3.0 liters of a 2.0 M NaCl solution?  
A) 1.0 mol                      B) 8.0 mol  
 C) 6.0 mol                      D) 0.70 mol
2. How many grams of KOH are needed to prepare 250. milliliters of a 2.00 M solution of KOH (formula mass = 56.0)?  
A) 1.00 g                      B) 2.00 g  
 C) 28.0 g                      D) 112 g
3. What is the total number of grams of HI in 0.500 liter of 1.00 M HI?  
A) 1.00 g                      B) 0.500 g  
 C) 64.0 g                      D) 128 g
4. When 20. milliliters of 1.0 M HCl is diluted to a total volume of 60. milliliters, the concentration of the resulting solution is  
A) 1.0 M                      B) 0.50 M  
 C) 0.33 M                      D) 0.25 M
5. What is the concentration of O<sub>2</sub>(g), in parts per million, in a solution that contains 0.008 gram of O<sub>2</sub>(g) dissolved in 1000. grams of H<sub>2</sub>O(l)?  
 A) 8 ppm                      B) 80 ppm  
C) 800 ppm                      D) 0.8 ppm
6. The concentration of a solution can be expressed in  
A) joules per gram  
B) grams per kelvin  
 C) parts per million  
D) milliliters per minute
7. The molarity of an aqueous solution of NaCl is defined as the  
A) grams of NaCl per liter of solution  
B) moles of NaCl per liter of water  
 C) moles of NaCl per liter of solution  
D) grams of NaCl per liter of water
8. Based on your reference tables, which compound could form a concentrated solution?  
A) Ag<sub>2</sub>CO<sub>3</sub>                      B) AgCl  
 C) AgNO<sub>3</sub>                      D) AgBr
9. Which preparation produces a 2.0 M solution of C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>? [molecular mass = 180.0]  
A) 90.0 g of C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> dissolved in 1000. mL of solution  
B) 90.0 g of C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> dissolved in 500.0 mL of solution  
C) 180.0 g of C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> dissolved in 1000. mL of solution  
 D) 180.0 g of C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> dissolved in 500.0 mL of solution
10. What is the concentration expressed in parts per million of a solution containing 30.0 grams of NaNO<sub>3</sub> in 70.0 grams of H<sub>2</sub>O?  
A)  $3.33 \times 10^6$  ppm                       B)  $3.00 \times 10^5$  ppm  
C)  $2.33 \times 10^6$  ppm                      D)  $4.29 \times 10^5$  ppm
11. Which solution is most concentrated?  
A) 0.1 mole of solute dissolved in 400 ml of solvent  
B) 0.2 mole of solute dissolved in 300 ml of solvent  
C) 0.3 mole of solute dissolved in 200 ml of solvent  
 D) 0.4 mole of solute dissolved in 100 ml of solvent
12. If 0.50 liters of a 2.0M HCl is diluted with H<sub>2</sub>O to a volume of 1.0 liters, the molarity of the new solution will be  
 A) 1.0 M                      B) 2.0 M  
C) .25 M                      D) .50 M
13. Which unit can be used to express solution concentration?  
A) mol/s                      B) J/mol  
C) L/mol                       D) mol/L
14. Which unit can be used to express the concentration of a solution?  
 A) ppm                      B) L/s                      C) kPa                      D) J/g

## Concentration

15. Which solution is the most concentrated?
- A) 1 mole of solute dissolved in 1 liter of solution  
B) 2 moles of solute dissolved in 3 liters of solution  
C) 6 moles of solute dissolved in 4 liters of solution  
D) 4 moles of solute dissolved in 8 liters of solution
16. A 2400.-gram sample of an aqueous solution contains 0.012 gram of  $\text{NH}_3$ . What is the concentration of  $\text{NH}_3$  in the solution, expressed as parts per million?
- A) 5.0 ppm      B) 15 ppm  
C) 20. ppm      D) 50. ppm
17. A 3.0 M  $\text{HCl}(\text{aq})$  solution contains a total of
- A) 3.0 grams of  $\text{HCl}$  per mole of solution  
B) 3.0 moles of  $\text{HCl}$  per liter of solution  
C) 3.0 moles of  $\text{HCl}$  per mole of water  
D) 3.0 grams of  $\text{HCl}$  per liter of water
18. How many moles of solute are contained in 200 milliliters of a 1 M solution?
- A) 0.2    B) 0.8    C) 1    D) 200
19. What is the molarity of 1.5 liters of an aqueous solution that contains 52 grams of lithium fluoride,  $\text{LiF}$ , (gram-formula mass = 26 grams/mole)?
- A) 1.3 M      B) 2.0 M  
C) 3.0 M      D) 0.75 M
20. What is the molarity of a solution of  $\text{NaOH}$  if 2 liters of the solution contains 4 moles of  $\text{NaOH}$ ?
- A) 0.5 M      B) 2 M  
C) 8 M      D) 80 M
21. If 100. milliliters of a 1.0-molar  $\text{NaCl}$  solution is evaporated to 25 milliliters, what will be the concentration of the resulting  $\text{NaCl}$  solution?
- A) 0.25 M      B) 2.0 M  
C) 0.50 M      D) 4.0 M
22. How many grams of  $\text{KOH}$  should be dissolved in water to make 2000.0 grams of a 10.0 ppm solution?
- A)  $2.0 \times 10^{-1}$  g      B)  $2.0 \times 10^{-3}$  g  
C) 2.00 g      D)  $2.0 \times 10^{-2}$  g
23. How many grams of  $\text{NaCl}$  are needed to be dissolved in water to make 1.0 gram of a 100.0 ppm solution?
- A)  $1.0 \times 10^{-1}$  g      B)  $1.0 \times 10^{-2}$  g  
C)  $1.0 \times 10^{-4}$  g      D)  $1.0 \times 10^{-3}$  g
24. Which type of concentration is calculated when the grams of solute is divided by the grams of the solution, and the result is multiplied by 1,000,000?
- A) parts per million  
B) percent by mass  
C) percent by volume  
D) molarity
25. What is the concentration expressed in parts per million of a solution containing 5.0 grams of  $\text{NH}_4\text{Cl}$  in 95.0 grams of  $\text{H}_2\text{O}$ ?
- A)  $2.0 \times 10^7$  ppm      B)  $5.3 \times 10^4$  ppm  
C)  $1.9 \times 10^7$  ppm      D)  $5.0 \times 10^4$  ppm
26. The concentration of a solution can be expressed in
- A) joules per kilogram  
B) kelvins  
C) milliliters  
D) moles per liter
27. What is the concentration of a solution which contains 1 mole of  $\text{CaCl}_2$  dissolved in 2,000 milliliters of solution?
- A) 1 M      B) 2 M  
C) 0.5 M      D) 0.25 M
28. What is the total number of grams of  $\text{NaOH}$  (formula mass = 40.) needed to make 1.0 liter of a 0.20 M solution?
- A) 20. g    B) 2.0 g    C) 80. g    D) 8.0 g

### 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?

$$M = \frac{0.4}{0.5} = \boxed{0.8 M}$$

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

$$\frac{5.0}{2.0} = \boxed{2.5 M}$$

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)?

$$\frac{60.0 \text{ mol}}{10.0 M} = 6.0 \text{ L}$$

~~$10 \times x = \frac{60}{10} = 6 \text{ L}$~~

4. Which solution is most concentrated?

- a) 5 M HCl                      b) 3 M HCl  
c) 0.09 M HCl                d) 23 M HCl

5. Which solution is most dilute?

- a) 5 M HCl                      b) 3 M HCl  
c) 0.09 M HCl                d) 23 M HCl

6. What is the molarity of a solution with 1.75 moles of KNO<sub>3</sub> in 3.0 L of solution?

$$\frac{1.75}{3.0} = \boxed{0.58 M}$$

7. \*\*What is the molarity of a solution that contains 65.1 g of NH<sub>4</sub>Cl in 3.50-L of solution?

$$\textcircled{1} \text{ moles} = \frac{\text{given mass}}{\text{gfm}} = \frac{65.1}{153.491} = 1.21 \text{ mol}$$

$$\textcircled{2} \frac{1.21 \text{ mol}}{3.50 \text{ L}} = \boxed{0.348 M}$$

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?

$$\begin{aligned} \text{moles} &= \text{Molarity} \times \text{Liters of soln} \\ &= 1.90 M \times 3.0 \text{ L} \\ &= 5.70 \text{ mol} \end{aligned}$$

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

$$\text{moles} = \frac{\text{given mass}}{\text{gfm}}$$

$$5.70 = \frac{x}{39.99}$$

$$x = 5.70 \times 39.99 = 227.9 \text{ g}$$

9. What is the molarity of a solution that has 2.5 moles of solute in 3.0 liters of solution?

$$M = \frac{2.5}{3.0} = \boxed{0.83 \text{ M}}$$

10. How many moles are present in 0.50 liters of a 12 molar solution?

$$12 \text{ M} = \frac{x}{0.5 \text{ Liter of Soln}} \quad x = 12 \times 0.5 = \boxed{6 \text{ moles}}$$

11. \*\* What is the molarity of a NaCl solution that has 58 grams of NaCl dissolved in 4.0 liters of water?

$$\textcircled{1} \text{ moles} = \frac{\text{given mass}}{\text{gfm}} = \frac{58}{58.443} = 0.99 \text{ mol}$$

$$\textcircled{2} M = \frac{0.99 \text{ mol}}{4.0 \text{ Liter of Soln}} = \boxed{0.25 \text{ M}}$$

12. \*\* If a solution has a molarity of 5.0 M, how many moles are present in 5.0 mL?

$$V = 5.0 \text{ mL} = 0.005 \text{ L}$$

$$M = 5$$

$$M = \frac{\text{moles}}{\text{Liter of Soln}}$$

$$5 = \frac{x}{0.005} \quad x = 5 \times 0.005 = \boxed{0.025 \text{ mol}}$$

13. What is the molarity of a  $\text{CaCl}_2$  solution containing 330. grams of  $\text{CaCl}_2$  in 1 liter of solution?

$$\textcircled{1} \text{ moles} = \frac{\text{given mass}}{\text{gfm}} = \frac{330}{110.986} = 2.97 \text{ mol}$$

$$\textcircled{2} M = \frac{2.97 \text{ mol}}{1 \text{ Liter of Soln}} = \boxed{2.97 \text{ M}}$$

14. What is concentration of a solution in parts per million if 20.0 grams of  $\text{Na}_2\text{S}$  is dissolved in  $4.00 \times 10^5$  grams of water?

$$\frac{20}{400020} \times 1,000,000 = \boxed{500 \text{ ppm}}$$

15. What are the steps to making a 1.0 L of a 3.0 M solution of KBr?

Pour 357g of solid KBr into a 1 Liter beaker.  
Fill to 1.00L mark with water

$$\textcircled{1} 3 \text{ M} = \frac{x}{1 \text{ L of Soln}}$$

$$\textcircled{2} x = 3 \text{ mol}$$

$$\text{mass} = \text{gfm} \times \text{mol}$$

16. If you add 5.0 moles of NaCl to enough water to make 2.0 L of solution, what is the molarity of the solution?

$$2.5 \text{ M}$$

## Regents Chemistry

## Colligative Properties

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1. As a solute is added to a solvent, what happens to the freezing point and the boiling point of the solution?
- A) The freezing point decreases and the boiling point increases.
- B) The freezing point increases and the boiling point increases.
- C) The freezing point increases and the boiling point decreases.
- D) The freezing point decreases and the boiling point decreases.
2. Compared to the freezing point of 1.0 M KCl(aq) at standard pressure, the freezing point of 1.0 M CaCl<sub>2</sub>(aq) at standard pressure is
- A) lower                      B) higher
- C) the same
3. Which aqueous solution of KI freezes at the lowest temperature?
- A) 1 mol of KI in 500. g of water
- B) 2 mol of KI in 500. g of water
- C) 1 mol of KI in 1000. g of water
- D) 2 mol of KI in 1000. g of water
4. A 1 kilogram sample of water will have the highest freezing point when it contains
- A)  $1 \times 10^{21}$  dissolved particles
- B)  $1 \times 10^{17}$  dissolved particles
- C)  $1 \times 10^{19}$  dissolved particles
- D)  $1 \times 10^{23}$  dissolved particles
5. A solution consists of 0.50 mole of CaCl<sub>2</sub> dissolved in 100. grams of H<sub>2</sub>O at 25°C. Compared to the boiling point and freezing point of 100. grams of H<sub>2</sub>O at standard pressure, the solution at standard pressure has
- A) a higher boiling point and a lower freezing point
- B) a lower boiling point and a lower freezing point
- C) a higher boiling point and a higher freezing point
- D) a lower boiling point and a higher freezing point
6. Which solution will freeze at the *lowest* temperature?
- A) 1 mole of sugar in 500 g of water
- B) 1 mole of sugar in 1,000 g of water
- C) 2 moles of sugar in 1,000 g of water
- D) 2 moles of sugar in 500 g of water
7. Which solution has the highest boiling point at standard pressure?
- A) 0.10 M K<sub>3</sub>PO<sub>4</sub>(aq)
- B) 0.10 M KCl(aq)
- C) 0.10 M KNO<sub>3</sub>(aq)
- D) 0.10 M K<sub>2</sub>SO<sub>4</sub>(aq)
8. Which concentration of a solution of CH<sub>3</sub>OH in water has the *lowest* freezing point?
- A) 0.001 M                       B) 0.1 M
- C) 0.01 M                      D) 0.0001 M
9. How do the boiling point and freezing point of a solution of water and calcium chloride at standard pressure compare to the boiling point and freezing point of water at standard pressure?
- A) Both the freezing point and boiling point of the solution are higher.
- B) The freezing point of the solution is higher and the boiling point of the solution is lower.
- C) The freezing point of the solution is lower and the boiling point of the solution is higher.
- D) Both the freezing point and boiling point of the solution are lower.
10. Compared to a 2.0 M aqueous solution of NaCl at 1 atmosphere, a 3.0 M aqueous solution of NaCl at 1 atmosphere has a
- A) lower boiling point and a higher freezing point
- B) higher boiling point and a higher freezing point
- C) lower boiling point and a lower freezing point
- D) higher boiling point and a lower freezing point
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