

Name: Rafi Thalheim

- 93
- A dilute, aqueous potassium nitrate solution is *best* classified as a
 - heterogeneous mixture
 - homogeneous compound
 - heterogeneous compound
 - homogeneous mixture
 - Hydrogen bonding is a type of
 - strong intermolecular force
 - strong covalent bond
 - weak intermolecular force
 - weak ionic bond
 - A substance that conducts an electrical current when dissolved in water is called
 - a nonelectrolyte
 - a catalyst
 - a metalloid
 - an electrolyte
 - What is a unit that can be used to express the concentration of a solution?
 - ppm
 - L/s
 - J/g
 - kPa
 - Under which conditions of temperature and pressure is a gas *most* soluble in water?
 - high temperature and low pressure
 - low temperature and high pressure
 - high temperature and high pressure
 - low temperature and low pressure
 - The solubility of KCl(s) in water depends on the
 - rate of stirring
 - temperature of the water
 - size of the KCl sample
 - pressure on the solution
 - The molarity of an aqueous solution of NaCl is defined as the
 - grams of NaCl per liter of water
 - grams of NaCl per liter of solution
 - moles of NaCl per liter of solution
 - moles of NaCl per liter of water
 - A 3.0 M HCl(aq) solution contains a total of
 - 3.0 moles of HCl per liter of solution
 - 3.0 grams of HCl per liter of water
 - 3.0 grams of HCl per mole of solution
 - 3.0 moles of HCl per mole of water
 - What is the molarity of 1.5 liters of an aqueous solution that contains 52 grams of lithium fluoride, LiF? [gram-formula mass = 26 grams/mole]
 - 3.0 M
 - 1.3 M
 - 2.0 M
 - 0.75 M
 - How many total moles of KNO_3 must be dissolved in water to make 1.5 liters of a 2.0 M solution?
 - 1.3 mol
 - 2.0 mol
 - 3.0 mol
 - 0.50 mol
 - Which solution has the *lowest* freezing point?
 40. g of KI dissolved in 200. g of water
 30. g of KI dissolved in 100. g of water
 20. g of KI dissolved in 200. g of water
 10. g of KI dissolved in 100. g of water
 - Which sample, when dissolved in 1.0 liter of water, produces a solution with the *lowest* freezing point?
 - 0.1 mol of LiBr
 - 0.2 mol of $\text{C}_6\text{H}_{12}\text{O}_6$
 - 0.1 mol of $\text{C}_2\text{H}_5\text{OH}$
 - 0.2 mol of CaCl_2
 - Compared to the freezing point and boiling point of water at 1 atmosphere, a solution of a salt and water at 1 atmosphere has a
 - lower freezing point and a lower boiling point
 - higher freezing point and a lower boiling point
 - lower freezing point and a higher boiling point
 - higher freezing point and a higher boiling point
 - Which solution has the *highest* boiling point at standard pressure?
 - 0.10 M K_3PO_4 (aq)
 - 0.10 M K_2SO_4 (aq)
 - 0.10 M KCl(aq)
 - 0.10 M KNO_3 (aq)
 - When 5 grams of KCl are dissolved in 50. grams of water at 25°C, the resulting mixture can be described as
 - heterogeneous and unsaturated
 - homogeneous and supersaturated
 - homogeneous and unsaturated
 - heterogeneous and supersaturated
 - 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
 - KCl
 - NaCl
 - NaNO_3
 - KNO_3

- 17) What is the total mass of KNO_3 that must be dissolved in 50. grams of H_2O at $60.^\circ\text{C}$ to make a saturated solution?
 A) 64 g B) 32 g C) 106 g D) 53 g
- 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 $20.^\circ\text{C}$)
1	KI	120. g
2	NaNO_3	88 g
3	KCl	25 g
4	KClO_3	5 g

- Which solution is saturated?
 A) 1 B) 2 C) 3 D) 4
- 19) Which of the following compounds is *least* soluble in water at $60.^\circ\text{C}$?
 A) NaCl B) KClO_3 C) NH_4Cl D) KNO_3
- 20) Which compound becomes *less* soluble in water as the temperature of the solution is increased?
 A) HCl B) NaCl C) KCl D) NH_4Cl
- 21) Which one of the following compounds is insoluble in water?
 A) KClO_3 B) CaCrO_4 C) Na_2S D) BaSO_4
- 22) The relatively high boiling point of water is due to water having
 A) nonpolar covalent bonding C) metallic bonding
 B) hydrogen bonding D) strong ionic bonding

-4 -71.7

order

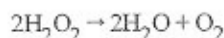
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- 1) An aqueous solution has 0.0070 gram of oxygen dissolved in 1,000. grams of water. Calculate the dissolved oxygen concentration of this solution in parts per million. [Your response must include both a correct numerical setup and the calculated result.]

$$\text{ppm} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 1,000,000$$

$$\frac{0.0070}{1000.000} \times 1,000,000 = 7 \text{ ppm}$$

- 2) Hydrogen peroxide, H_2O_2 , is a water-soluble compound. The concentration of an aqueous hydrogen peroxide solution that is 3% by mass H_2O_2 is used as an antiseptic. When the solution is poured on a small cut in the skin, H_2O_2 reacts according to the balanced equation below.



Using the given information, calculate the total mass of H_2O_2 in 20.0 grams of an aqueous H_2O_2 solution that is used as an antiseptic. [Your response must include both a numerical setup and the calculated result.]

$$\% \text{ Comp by mass} = \frac{\text{mass of part}}{\text{mass of whole}} \times 100$$

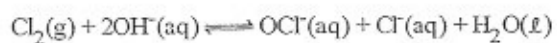
$$\frac{3}{20} \times 100 = 15\%$$

- 3) A soft-drink bottling plant makes a colorless, slightly acidic carbonated beverage called soda water. During production of the beverage, $\text{CO}_2(\text{g})$ is dissolved in water at a pressure greater than 1 atmosphere. The bottle containing the solution is capped to maintain that pressure above the solution. As soon as the bottle is opened, fizzing occurs due to $\text{CO}_2(\text{g})$ being released from the solution.

Explain why $\text{CO}_2(\text{g})$ is released when the bottle of soda water described in the passage is opened.

b/c It can now release into the air
but before hand the cap was holding the CO_2 in the bottle

- 4) The equilibrium equation below is related to the manufacture of a bleaching solution. In this equation, $\text{Cl}^-(\text{aq})$ means that chloride ions are surrounded by water molecules.



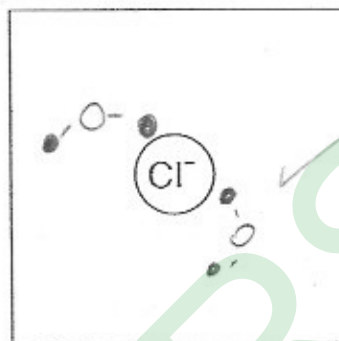
Use the key to draw *two* water molecules in the box provided, showing the correct orientation of each water molecule toward the chloride ion.

KEY:

● = hydrogen atom

○ = oxygen atom

●●
○ = water molecule



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- When 5 grams of KCl are dissolved in 50. grams of water at 25°C, the resulting mixture can be described as
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- 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
 - KCl
 - NaCl
 - KNO₃
 - NaNO₃
- What is the total mass of KNO₃ that must be dissolved in 50. grams of H₂O at 60.°C to make a saturated solution?
 - 106 g
 - 64 g
 - 53 g
 - 32 g
- What is the mass of NH₄Cl that must dissolve in 200. grams of water at 50.°C to make a saturated solution?
 - 104 g
 - 84 g
 - 26 g
 - 42 g
- 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**

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1	KI	120. g
2	NaNO ₃	88 g
3	KCl	25 g
4	KClO ₃	5 g

- Which solution is saturated?
- 1
 - 2
 - 3
 - 4
- An unsaturated aqueous solution of NH₃ is at 90.°C in 100. grams of water. According to the *Solubility Curves at Standard Pressure* chemistry reference table, how many grams of NH₃ could this unsaturated solution contain?
 10. g
 - 15 g
 - 5 g
 20. g
 - Which of the following compounds is *least* soluble in water at 60.°C?
 - NH₄Cl
 - KNO₃
 - NaCl
 - KClO₃
 - Which compound becomes *less* soluble in water as the temperature of the solution is increased?
 - NaCl
 - HCl
 - NH₄Cl
 - KCl
 - According to the *Solubility Guidelines for Aqueous Solutions* chemistry reference table, which one of the following compounds is soluble in water?
 - calcium sulfate
 - silver iodide
 - barium phosphate
 - sodium perchlorate
 - Which one of the following compounds is insoluble in water?
 - potassium bromide
 - silver bromide
 - sodium bromide
 - calcium bromide
 - Which one of the following compounds is insoluble in water?
 - BaSO₄
 - KClO₃
 - Na₂S
 - CaCrO₄
 - Which one of the following compounds is insoluble in water?
 - Na₃PO₄
 - KOH
 - NH₄Cl
 - PbSO₄
 - Which barium salt is insoluble in water?
 - BaCl₂
 - Ba(ClO₄)₂
 - BaCO₃
 - Ba(NO₃)₂

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Question 1 refers to the following:

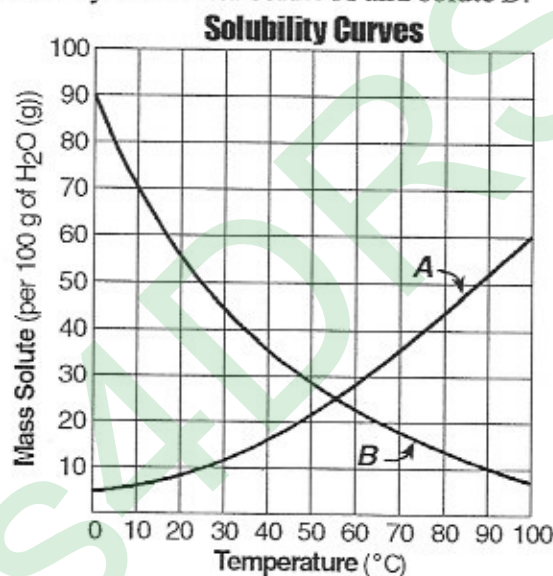
A gas that behaves exactly as predicted by the kinetic theory of gases is called an ideal gas. The behavior of real gases deviates slightly from the kinetic theory.

- 1) State two reasons why real gases are *not* ideal. Do not reply only with "There's no ideal". Instead state 2 properties that real gases possess and ideal gases do not.
- 1) There is a greater average kinetic energy b/c more ^{particles} are hitting each other
 - 2) In a real gas the particles are closer to each other

2/5

Question 2 refers to the following:

The graph below represents the solubility curves for solute A and solute B.



- 2) Which solute, A or B, is most likely a gas? [Explain why.]

B, because gases are ~~more~~ less soluble at higher temperatures

- 3) What is the percent by mass of water in $\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$? [Round atomic masses from the Periodic Table to the nearest tenth. Show all work.]

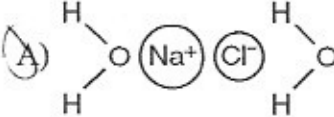
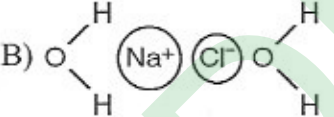
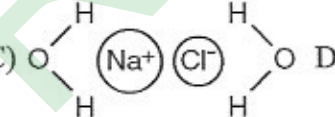
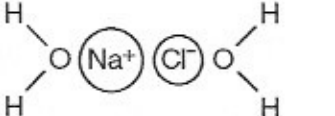
$$23 + 23 + 32 + 18 + 144 \quad \frac{162}{240} \times 100 = 67.5\%$$

- 4) In water treatment plants, chlorine is added to source water to kill harmful bacteria. In the United States, the maximum amount of chlorine that may remain in drinking water is 0.004 grams per 1,000 grams of water. What is the maximum amount of chlorine that may remain in drinking water expressed in parts per million (ppm)? [Write the correct formula. Show all work.]

$$\text{ppm} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 1,000,000$$

$$\frac{0.004}{1000} \times 1,000,000 = 4$$

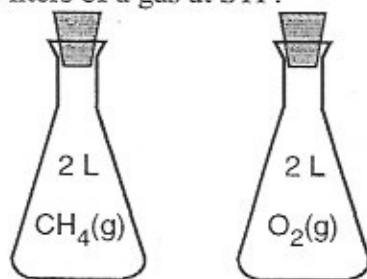
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- 1) A change in pressure would have the greatest effect on the solubility of a
 A) liquid in a liquid B) solid in a liquid C) liquid in a solid ☒ D) gas in a liquid
- 2) Which gas is least likely to obey the ideal gas laws at very high pressures and very low temperatures?
 A) Ne B) He C) Kr ☒ D) Xe
- 3) Ionic solids will most likely dissolve in
 A) $\text{H}_2\text{O}(\ell)$, which is a nonpolar solvent B) $\text{CCl}_4(\ell)$, which is a polar solvent
☒ C) $\text{H}_2\text{O}(\ell)$, which is a polar solvent D) $\text{CCl}_4(\ell)$, which is a nonpolar solvent
- 4) If 0.50 liter of a 12-molar solution is diluted to 1.0 liter, the molarity of the new solution is
 A) 12 M $12 = \frac{x}{0.50}$ ☒ B) 6.0 M $x = \frac{6}{1}$ $\frac{6}{1} = 6$ C) 2.4 M ☒ D) 24 M
- 5) A solution of $\text{KCl}(\text{aq})$ contains 15 grams of solute in 85 grams of water. What is the concentration of the solution in percent by mass?
 A) 2.0% B) 6.0% $\frac{15}{85} = \frac{x}{100}$ ☒ C) 15% D) 0.20%
- 6) Which diagram best illustrates the ion-molecule attractions that occur when the ions of $\text{NaCl}(\text{s})$ are added to water?
- ☒ A)  B)  C)  D) 
- 7) A 200. gram sample of a salt solution contains 0.050 grams of NaCl . What is the concentration of the solution in parts per million (ppm)?
 A) 2.5×10^{-4} ppm ☒ B) 250. ppm C) 5.0×10^4 ppm D) 50. ppm
- 8) What is the mass of NaCl in 50 grams of a 10% solution?
☒ A) 5 g B) 0.5 g $10\% = \frac{x}{50}$ C) 0.2 g D) 10 g
- 9) As the space between molecules in a gas sample decreases, the tendency for the behavior of this gas to deviate from the ideal gas laws
 A) remains the same B) decreases ☒ C) increases
- 10) 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
- 11) The molarity (M) of a solution is equal to the
 A) $\frac{\text{number}}{\text{liter}}$ B) $\frac{\text{number}}{\text{liter}}$ C) $\frac{\text{number}}{\text{liter}}$ ☒ D) $\frac{\text{number}}{\text{liter}}$
- 12) In an aqueous solution of potassium chloride, the solute is
☒ A) KCl B) K ☒ C) Cl D) H_2O

- 13) At which pressure would carbon dioxide gas be most soluble in 100 grams of water at a temperature of 25°C ?

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

- 14) Each stoppered flask below contains 2 liters of a gas at STP.



Each gas sample has the same

A) number of atoms B) density C) mass **D) number of molecules**

- 15) Under the same conditions of temperature and pressure, which gas would behave most like an ideal gas?

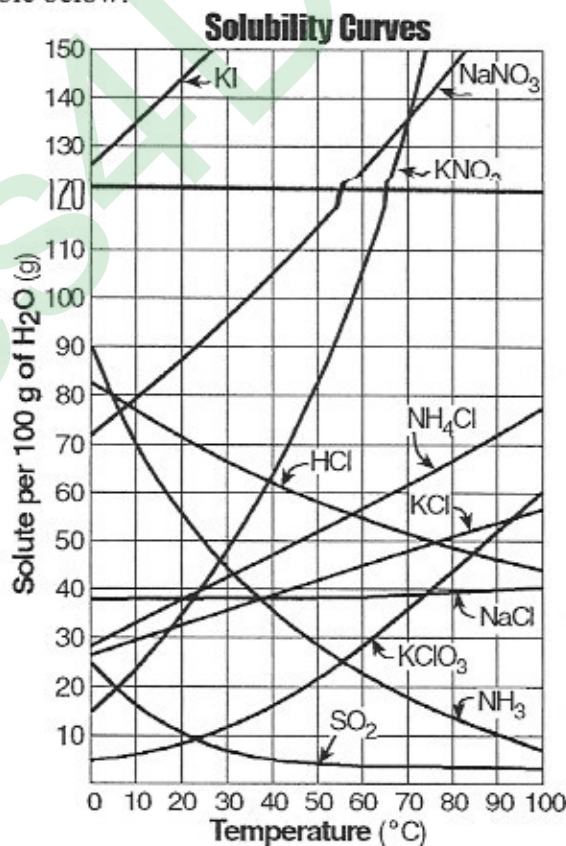
A) $\text{CO}_2(\text{g})$ B) $\text{NH}_3(\text{g})$ **C) $\text{He}(\text{g})$** D) $\text{Cl}_2(\text{g})$

- 16) What is the molarity of an H_2SO_4 solution if 0.25 liter of the solution contains 0.75 mole of H_2SO_4 ?

A) 3.0 M B) 6.0 M C) 0.33 M D) 0.75 M

Questions 17 through 20 refer to the following:

Given the chemistry reference table below:



- 17) A solution contains 14 grams of KCl in 100. grams of water at 40.°C. What is the minimum amount of KCl that must be added to make this a saturated solution?
 A) 14 g B) 44 g ☒ C) 25 g D) 19 g
- 18) Based on the given table, what change will cause the solubility of $\text{KNO}_3(\text{s})$ to increase?
 A) decreasing the pressure B) decreasing the temperature
☒ C) increasing the temperature D) increasing the pressure
- 19) Based on the given table, when 100 grams of water saturated with KNO_3 at 70°C is cooled to 25°C, the total number of grams of KNO_3 that will precipitate is ^{137 - 45}
☒ A) 95 g B) 30 g C) 80 g D) 45 g
- 20) According to the given table, approximately how many grams of KClO_3 are needed to saturate 100 grams of H_2O at 40°C?
 A) 6 g ☒ B) 16 g C) 47 g D) 38 g
-
- 21) Compared to the boiling point of H_2S , the boiling point of H_2O is relatively high. Which type of bonding causes this difference?
 A) network ☒ B) hydrogen C) covalent D) ionic
- 22) Which solution contains the greatest number of moles of solute?
 A) 0.5 L of 0.5 M B) 0.5 L of 2 M C) 2 L of 0.5 M ☒ D) 2 L of 2 M
- $.5 = \frac{x}{.5}$
 $.25$
- $2 = \frac{x}{.5}$
 1
- $.5 = \frac{x}{2}$
 1
- $2 = \frac{x}{2}$
 4

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- 1) What is the molarity of a solution that contains 0.50 mole of NaOH in 0.50 liter of solution?
A) 0.25 M (B) 1.0 M C) 2.0 M D) 0.50 M
- 2) What is the molarity of a solution of NaOH if 2 liters of the solution contains 4 moles of NaOH?
A) 0.5 M B) 80 M (C) 2 M D) 8 M
- 3) What is the molarity of a solution containing 20 grams of NaOH in 500 milliliters of solution?
A) 2 M B) 0.5 M C) 0.04 M (D) 1 M
- 4) How many moles of solute are contained in 200 milliliters of a 1 M solution?
A) 1 (B) 0.2 C) 200 D) 0.8
- 5) What is the total number of moles of NaCl(s) needed to make 3.0 liters of a 2.0 M NaCl solution?
A) 0.70 mol B) 8.0 mol (C) 6.0 mol D) 1.0 mol
- 6) A student wants to prepare a 1.0-liter solution of a specific molarity. The student determines that the mass of the solute needs to be 30. grams. What is the proper procedure to follow?
(A) Add enough solvent to 30. g of solute to make 1.0 L of solution.
B) Add 30. g of solute to 1.0 L of solvent.
C) Add 30. g of solute to 970. mL of solvent to make 1.0 L of solution.
D) Add 1,000. g of solvent to 30. g of solute.
- 7) What is the concentration of a solution, in parts per million, if 0.02 gram of Na_3PO_4 is dissolved in 1,000 grams of water?
A) 0.2 ppm B) 0.02 ppm C) 2 ppm (D) 20 ppm
- 8) If 0.025 gram of $\text{Pb}(\text{NO}_3)_2$ is dissolved in 100. grams of H_2O , what is the concentration of the resulting solution, in parts per million?
A) 4.0×10^3 ppm C) 2.5 ppm
B) 2.5×10^{-4} ppm (D) 250 ppm
- 9) Show a correct numerical setup for determining how many liters of a 1.2 M solution can be prepared with 0.50 mole of $\text{C}_6\text{H}_{12}\text{O}_6$.

$$1.2 = \frac{.5 \text{ mole}}{x \text{ L}}$$

Questions 10 and 11 refer to the following:

A student is instructed to make 0.250 liter of a 0.200 M aqueous solution of $\text{Ca}(\text{NO}_3)_2$.

- 10) Show a correct numerical setup for calculating the total number of moles of $\text{Ca}(\text{NO}_3)_2$ needed to make 0.250 liter of a 0.200 M calcium nitrate solution.

$$.2 = \frac{x}{.25}$$

- 11) In order to prepare the described solution in the laboratory, two quantities must be measured accurately. One of these quantities is the volume of the solution. What other quantity must be measured to prepare this solution?

mass of $\text{Ca}(\text{NO}_3)_2$

- 12) Two alcohols that are used in our everyday lives are rubbing alcohol and ethylene glycol. Rubbing alcohol is used as an antiseptic. Ethylene glycol is the main ingredient in antifreeze, which is used in automobile cooling systems.

Explain, in terms of molecular polarity, why rubbing alcohol, 2-propanol, is soluble in water.

Both are polar like dissolves like