

Name: \_\_\_\_\_  
 Chemistry 112, Section B  
 Sample Hour Exam 3

General Instructions: Read each question carefully and express your answers in the expected format, using proper English grammar and punctuation. Show your work for all calculation problems and include units on answers where appropriate. To speed calculations, round all atomic weights to one decimal place. Draw a box around your final answer. If you need a calculator, pencil, etc., raise your hand.

Part A. Definitions (2 points each)

1. Solution - is a uniform mixture of two or more pure substances.
2. Kinetic energy is energy from a molecule being in motion.
3. solubility is the term used to describe the amount of solute that will dissolve in solvent.
4. Solute - is the part of a solution present in lesser amount
5. Electrolyte is a molecule that will conduct electricity in solution.
6. Colligative properties are properties that depend on the number of moles of solute dissolved.
7. Colloid - A type of solution which is composed of solutes large enough to scatter light.
8. Solvent is the part of a solution present in greater number of moles.
9. Percent solution (w/v) - A unit of concentration expressed as the grams solid solute per 100 mL solution.
10. Potential energy - is energy which is stored in chemical bonds.

Part B

11. Explain the following postulate of the kinetic molecular theory (KMT): As the temperature increases, the distance between particles increases. (5 points)

An increase in temperature causes particles to collide with greater kinetic energy. Because energy is conserved in a collision, the particles end up bouncing far apart from one another.

12. Describe a solid in terms of the KMT. (5 points)

A solid is particles which are tightly packed in a very ordered fashion. Movement of the particles is restricted to vibration about a fixed position.

13. List the three intermolecular forces and describe how they work, how strong they are, etc. (10 points)

	<u>London forces</u>	<u>Dipole-dipole interaction</u>	<u>Hydrogen bond</u>
how they work	electrons get on one side of the nucleus	$\delta^+$ and $\delta^-$ regions are attracted to each other	$\delta^+$ H becomes attracted to $\delta^-$ lone pairs on a second O, N or F atom
relative strength	weakest	stronger	strongest
molecules involved	all	polar	ones with H attached to O,N,F

14. List the three colligative properties and the effect of 1 mol solute on 1 kg water has on each of them. (5 points)

melting point	decreases by $1.86^\circ\text{C}/\text{mol}$
boiling point	increases by $0.51^\circ\text{C}/\text{mol}$
osmotic pressure	increases

15. What is the molarity of a solution containing 257 g sucrose ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) in 500.0 mL water? (5 points)

$$\frac{257 \text{ g} * 1 \text{ mol}/342.0 \text{ g}}{0.50000 \text{ L}} = 1.50 \text{ M}$$

16. What is the normality, with respect to chloride, if 527 g  $\text{MgCl}_2 \cdot 7\text{H}_2\text{O}$  are dissolved in 250.0 mL  $\text{H}_2\text{O}$ ? (5 points)

$$\text{equivalent weight} = \frac{221 \text{ g/mol}}{2 \text{ equivalents/1 mol}} = 110.6612 \text{ g/eq.}$$

$$N = \text{eq/L} \\ = \frac{527 \text{ g} * 1 \text{ eq/110.6612 g}}{0.2500 \text{ L}}$$

$$N = 19.0 \text{ eq/L}$$

17. How many calories does it take to convert 52.0 g ice at  $-10.0^{\circ}\text{C}$  to water at  $27.0^{\circ}\text{C}$ ? The heat of fusion is 79.6 cal/g and the specific heat is 1.00 cal/g $^{\circ}\text{C}$ . (5 points)

$$\text{warm up the ice: } 1.00 \text{ cal/g}^{\circ}\text{C} * 52.0 \text{ g} * 10.0^{\circ}\text{C} = 520.0 \text{ cal}$$

$$\text{melt the ice: } 79.6 \text{ cal/g} * 52.0 \text{ g} = 4139.2 \text{ cal}$$

$$\text{warm the water: } 1.00 \text{ cal/g}^{\circ}\text{C} * 52.0 \text{ g} * 27.0^{\circ}\text{C} = \underline{1404.0 \text{ cal}} \\ = 6060 \text{ cal}$$

18. Complete the following table. (5 points)

Molecule	Soluble in Water	Soluble in $\text{C}_8\text{H}_{18}$	Electrolyte in Water
NaCl	<u>Y</u>	<u>N</u>	<u>Y</u>
$\text{Ca}(\text{NO}_3)_2$	<u>Y</u>	<u>N</u>	<u>Y</u>
$\text{Ca}(\text{OH})_2$	<u>Y</u>	<u>N</u>	<u>Y</u>
$\text{C}_6\text{H}_{12}\text{O}_6$	<u>Y</u>	<u>N</u>	<u>N</u>
$\text{C}_6\text{H}_{12}$	<u>N</u>	<u>Y</u>	<u>N</u>

19. What volume will 556 g of krypton occupy at  $22.0^{\circ}\text{C}$  and 742 mm Hg? (5 points)

$$V = nRT/P \\ = \frac{(556 \text{ g}/83.3 \text{ g/mol})(0.0821 \text{ L atm/mol K})(295 \text{ K})}{742 \text{ mm Hg} * 1 \text{ atm}/760 \text{ mm Hg}}$$

$$V = 166 \text{ L}$$

20. The volume of a gas at  $37.0^{\circ}\text{C}$  and 1 atmosphere is 349 mL. What will the pressure be if I decreases the volume to 125 mL? Assume the temperature remains constant. (5 points)

$$P_1V_1 = P_2V_2 \text{ or } P_2 = \frac{P_1V_1}{V_2} \\ = \frac{1 \text{ atm} * 349 \text{ mL}}{125 \text{ mL}} \\ P_2 = 2.79 \text{ atm}$$

21. If a mixture of 350 ppm Argon gas and 550 ppm cyanide gas (HCN) are released simultaneously, which gas will be detected first from a distances of 10 m? How much sooner? (5 points)

Argon has a molar mass of 39.9 g/mol, cyanide 27.0 g/mol; therefor, cyanide will be detected first (at any distance).

$$\text{rate HCN/Ar} = \text{sq.rt} (\text{Mr Ar}/\text{Mr HCN}) = 1.22 \text{ times sooner}$$

Part C. Multiple choice (2 points each)

22. The state of matter in which the intermolecular forces are weakest is

- a. solid   b. liquid   c. gas   d. none of the above

23. The intermolecular forces between 2 molecules of ethyl alcohol,  $\text{CH}_3\text{CH}_2\text{OH}$  is(are)

- a. London forces   b. hydrogen bonds   c. Dipole-Dipole

- d. "a" and "b"   e. "b" and "c"   f. "a" and "b" and "c"
24. What is the state of ionic compounds at room temperature?  
a. solid   b. liquid   c. gas   d. plasma
25. 1.05 atmospheres is equal to  
a. 1.05 mm Hg   b. 105 mm Hg   c. 724 mm Hg   d. 798 mm Hg
26. A gas mixture with 56% O<sub>2</sub>, 14% CO<sub>2</sub>, and 30% N<sub>2</sub> has a total pressure of 565 mm Hg  
What is the partial pressure of CO<sub>2</sub>?  
a. 14 mm Hg   b. 79 mm Hg   c. 40 mm Hg   d. none of the above
27. Which of the following transformations is condensation?  
a. Liquid ----> solid   b. Solid ----> liquid   c. Gas ----> liquid   d. Solid ----> gas
28. Which of the following compounds exhibits hydrogen bonding?  
a. HCl   b. NaF   c. NaCl   d. HF
29. Which of the following would have the highest boiling point?  
a. CO<sub>2</sub>   b. I<sub>2</sub>   c. He   d. F<sub>2</sub>
30. The amount of energy it takes to change from a liquid to a solid is  
a. heat of vaporization   b. heat of fusion   c. specific heat   d. none of the above
31. The element requiring the greatest amount of energy to melt is  
a. I<sub>2</sub>   b. Cl<sub>2</sub>   c. Br<sub>2</sub>   d. F<sub>2</sub>