FIRST LETTER OF YOUR LAST NAME

CHEMISTRY 1127   **FINAL EXAM**   **December 13, 2014**

NAME (PRINT) _____   SECTION_____

SIGNATURE _____   TA _____

PLEASE READ THE FOLLOWING INSTRUCTIONS

Do NOT begin the exam until asked to do so.

There are 13 numbered pages, a useful information page and a periodic table in this exam. Check to see that they are all here before you begin the exam. Return all these papers when you are finished. Write your name on every page.

On the multiple choice section of the test fill out all answers in #2 pencil on the answer sheet. Label the answer sheet with your name, Peoplesoft # (Column A-G) and the last two digits of your section # (column L-M). Make sure to erase completely; there will be no regrades on the multiple choice portion of the test.

Long answer portion of the exam should be done in pen with blue or black ink. Exams done in pencil, erasable ink, or where white-out, liquid paper, etc. have been used are *ineligible for regrades*.

Be sure to follow the directions in answering all questions. Write your final answers in the blanks provided. In working problems, you must **SHOW ALL WORK**. No credit will be given unless all work is clearly shown and the method of solution is logically correct. Use correct units and significant figures.

Do not write below this line

Page	Total	Grader	Page	Total	Grader
6	_____ / 16		10	_____ / 13	
7	_____ / 16		11	_____ / 10	
8	_____ / 14		12	_____ / 12	
9	_____ / 21		13	_____ /16	

MCQ _____/132 LA _____/118 Total Grade _____ /250 Checked by _____

I. **On the multiple choice section of the test fill out all answers in #2 pencil on the answer sheet. Label the answer sheet with your name, Peoplesoft # (Column A-G) and the last two digits of your section # (column L-M). Make sure to erase completely there will be no regrades on the multiple choice portion of the test.**
(Exam 1 covers questions 1-9)

1. Which term best describes sugar?

   a. Element   b. Compound   c. Distillation

   d. Homogeneous mixture   e. Heterogeneous mixture

2. What is the correct answer to the expression below?

$$\frac{(2.560)(8.8)}{25.15} - 5 =$$

   a. 4.1   b. -4.10   c. -4

   d. -4.104   e. -4.1

3. Copper can be drawn into thin wires. How many meters of 34-gauge wire with a diameter of 6.304×10^{-3} in (inches) can be produced from the copper in 5.01 lb of corvellite, an ore of copper that is 66% copper by mass? The wire is a cylinder and the volume of the cylinder is $\pi r^2 h$ and the density of copper is 8.95 g/cm^3)
1lb = 453.6 g, 1in= 2.54 cm

   a. 8.32×10^5 m   b. 3.28×10^5 m   c. 1.50×10^3 m

   d. 1.26×10^4 m   e. 8.32×10^3 m

4. How many protons, neutrons, and electrons are in a Cr^{+3} ion with a mass number of 52?

   a. 24 protons, 28 neutrons, 24 electrons

   b. 21 protons, 31 neutrons, 21 electrons

   c. 24 protons, 28 neutrons, 21 electrons

   d. 21 protons, 24 neutrons, 24 electrons

   e. 52 protons, 24 neutrons, 21 electrons

5. What is the mass (in grams) of a S atom?

   a. 32.06 g   b. 1.80×10^{-23} g   c. 4.260×10^{-22} g   d. 5.324×10^{-23} g   e. 1.54×10^{-25} g

6. 500 g of sucrose per 100g H_2O is soluble at 100°C. A 25 mL (d = 1.0 g/mL) sample of saturated 100°C sucrose solution is cooled to 25° resulting in 70.0 g of sucrose precipitate. What is the solubility at 25°C in g/100g?

   a. 55 g/100g   b. 430g/100g   c. 220g/100g   d. 70g/100g   e. 125g/100g

_____

7. Magnesium has three naturally occurring isotopes, `with the following abundances and masses:

abundance	mass (amu)
78.99%	23.9850
10.00%	24.9858
11.01%	???

Determine the mass of third element element.

a. 2.677 amu   b. 18.95 amu   c. 24.49 amu

d. 25.98 amu   e. None of the above

8. Of the naturally occurring elements in group 15, how many are nonmetals, metalloids, and metals?

a. 0 nonmetals, 3 metalloids, and 2 metals

b. 1 nonmetal, 2 metalloids, and 2 metals

c. 2 nonmetals, 2 metalloids, and 1 metal

d. 2 nonmetals, 1 metalloid, and 2 metals

e. 3 nonmetals, 0 metalloids, and 2 metals

9. If 5.15 g $Ca(OH)_2$ is dissolved in enough water to make exactly 250.0 mL of solution, what is the molar concentration of hydroxide ion? (MM of $Ca(OH)_2$ = 74.09 g/mol)

a. 0.0695 M   b. 0.556 M   c. 0.463 M   d. 0.278 M   e. 0.927 M

_____

(Exam 2 covers questions 10-17)

10. What is the net ionic equation for the reaction of hydrochloric acid with ammonia?

    a. $HCl(aq) + NH_3(aq) \rightarrow H_2O(l) + NH_4^+(aq) + Cl^-(aq)$

    b. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

    c. $2HCl(aq) + NH_3(aq) \rightarrow H_2O(l) + HCl(aq) + NH_4Cl(aq)$

    d. $H^+(aq) + NH_3(aq) \rightarrow NH_4^+(aq)$

    e. none of the above

11. If 35.21 mL of 0.1894 M $Sr(OH)_2$ is required to neutralize 25.00 mL of an aqueous solution of arsenic acid (H_3AsO_4), what is the concentration of the arsenic acid solution?
    $H_3AsO_4(aq) + 3OH^-(aq) \rightarrow AsO_4^{3-}(aq) + 3H_2O(l)$

    a. 0.2668 M   b. 0.1334 M   c. 0.08892 M   d. 0.1345 M   e. 0.1778 M

12. How many moles of CO_2 are in a 1 L container at 0 °C has the same pressure as 0.0305 moles of N_2 in a 0.50 L container at 27°C?

    a. 0.03045   b. 0.0669   c. 0.682   d. 0.0033   e. 0.0335

13. If 1.50 L of helium at 20.0°C is allowed to expand to 5.81 L, with the pressure remaining the same, what is the new temperature?

    a. 58.7°C   b. 586°C   c. 862°C   d. 98.9°C   e. -174°C

14. When 0.34 moles of Ar are mixed with 0.51 moles of Ne in a flask, the total pressure in the flask found to be 5.0 atm. What is the partial pressure of Ne in this flask?

    a. 0.85 atm   b. 1.5 atm   c. 2.0 atm   d. 3.0 atm   e. 5.0 atm

15. Nitrogen dioxide gas can be broken down to form nitrogen and oxygen gas:
    $2NO_2(g) \rightarrow 2O_2(g) + N_2(g)$
    At a certain temperature and pressure, 5.0 L of NO_2 is reacted. If temperature and pressure are held constant how much N_2 is produced?

    a. 5.0 L   b. 10 L   c. 2.5 L   d. 0.109 L   e. 9.3 L

16. Which of the following gases has the greatest density at 25°C and 2 atm?

    a. N_2 b. O_2 c. F_2 d. Ne   e. Kr

17. An empty 149 mL flask weighs 68.322 g before a sample of volatile liquid is added. The flask is then placed in a hot (95.0°C) water bath; the barometric pressure is 740 mm Hg. The liquid vaporizes and the gas fills the flask. After cooling the flask and condensed liquid together weigh 68.697 g. What is the molar mass of the volatile liquid?

    a. 9.73 g/mol   b. 78.09 g/mol   c. 4.80×10^{-3} g/mol   d. 49.6 g/mol   e. 44.01 g/mol

_____

(Exam 3 covers questions 18-26)

18. What configuration of quantum numbers would be impossible?
    a. $n = 2$, $\ell = 1$, $m_\ell = 0$ $m_s = +1/2$
    b. $n = 3$, $\ell = 3$, $m_\ell = +1$ $m_s = +1/2$
    c. $n = 3$, $\ell = 2$, $m_\ell = -2$ $m_s = -1/2$
    d. $n = 1$, $\ell = 0$, $m_\ell = 0$ $m_s = +1/2$
    e. $n = 2$, $\ell = 1$, $m_\ell = 0$ $m_s = -1/2$

19. You wish to calculate how much energy goes into melting an ice cube. The ice cube weighs 20.0g and starts out at -5° C. It ends up as 25° C liquid. The specific heat of water is 4.18 J/g °C, and of ice is 2.11 J/g °C. The enthalpy of fusion of water is 6.00 kJ/mol.

    a. 4365 J   b. 8967 J   c. 2301 J   d. 2508 J   e. 2421 J

20. Identify the correct electron configuration for a manganese +2 (Mn^{2+}) cation.

    a. $[Ar]3d^5$ b. $[Ar]3d^3$ c. $[Ar]4s^2 3d^3$ d. $[Ar]4s^2 3d^5$ e. $[Ar]4s^1 3d^5$

21. The molecule $C\ell F_3$ exhibits which of the following molecular geometry?

    a. Trigonal pyramidal   b. Tetrahedron   c. Trigonal bipyramidal
    d. Trigonal bipyramidal   e. T-shaped

22. Using formal charges and the octet rule, determine which Lewis structure of a molecule made up of 1 atom of hydrogen, oxygen and nitrogen is most stable.

    a. H—O≡N:

    b. H—O=N

    c. H—N=O

    d. N=H=O

    e. H=N=O
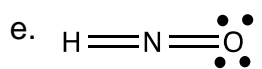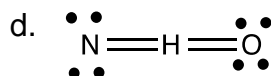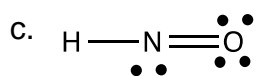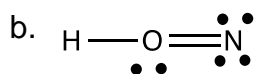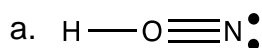
23. If 25 J are required to change the temperature of 31.25 g of substance A by 2.0°C. What is the specific heat of substance A?

    a. 250 J/g·°C   b. 63 J/g·°C   c. 10.0 J/g·°C   d. 2.5 J/g·°C   e. 0.40 J/g·°C

_____

24. When 50 grams of brass at 95.0°C is placed with an unknown mass of water at a temperature of 25.0°C, the final temperature of the resulting mixture is 45.0°C. What was the mass of the water? (specific heat of water is 4.18 J/ g·°C, brass = 0.362 j/g °C)

    a. 125 g   b. 10.8 g   c. 1443 g   d. 4.33 g   e. 25.0 g

25. When two solutions are mixed, the container "feels cold". Thus
    a. the reaction is endothermic.
    b. the reaction is exothermic.
    c. the energy of the universe is increased.
    d. the energy of both the system and the surroundings is decreased.
    e. the energy of the system is decreased.

26. For the reaction

    $$2MgO \; (s) \rightarrow 2Mg \; (s) + O_2 \; (g) \qquad\qquad \Delta H° = 1203.4 \; kJ$$

    $\Delta H_f°$ for MgO (s) in kJ/mol is

    a.   -1203.4 kJ   b. 1203.4kJ   c. 601.7 kJ   d. -601.7 kJ   e. None of these

(Chapter 9 covers questions 27-32)

27. Which of the following would NOT show hydrogen bonding?

    a. H_2O b. Ammonia   c. HF   d. CH_3OH e.   None of the these

28. The strongest intermolecular force that must be overcome to boil nitric oxide (NO) is:

    a. metallic   b. ionic   c. dispersion   d. dipole   e. hydrogen bonding

For the following questions choose the most appropriate answer to fill in the blank.

29. The vapor pressure of X is 250 mm Hg at 57°C. Given a sealed flask at 57°C that contains only gas, the pressure in the flask _____ 245 mm Hg.

    a. LT (less than) b. GT (greater than) c. ET (equal to) d. MI (need More Information)

30. At 50°C, benzene has a vapor pressure of 269 mm Hg. A flask that contains both benzene liquid and vapor at 50°C has a pressure _____ 269 mm Hg.

    a. LT (less than) b. GT (greater than) c. ET (equal to) d. MI (need More Information)

31. The dispersion forces present in butane, C_4H_{10}, _____ the dispersion forces present in naphthalene, $C_{10}H_8$.

    a. LT (less than) b. GT (greater than) c. ET (equal to) d. MI (need More Information)

32. The vapor pressure of Br_2 _____ the vapor pressure of ICl at a given temperature.

    a. LT (less than) b. GT (greater than) c. ET (equal to) d. MI (need More Information)

33. The boiling point of CH_3Cl _____ the boiling point of CH_3I.

    a. LT (less than) b. GT (greater than) c. ET (equal to) d. MI (need More Information)

_____

(Exam 1 covers questions A-C)

    A. (16 points) A compound contains only carbon, hydrogen and nitrogen. A sample weighing 21.742 g is burned in excess oxygen generating three products: CO_2 = 30.8 g, NO_2 = 32.2g and H_2O = 31.5 g.

      a. What is the number of moles of Carbon in the sample?

_____

      b. What is the percent mass of Hydrogen in the sample?

_____

      c. What is the simplest formula of the compound?

_____

      d. Assuming that the sample that was burned was 0.35 moles of the compound what is the molecular formula?

_____

_____

    B. (6 points) Write the formulas of the following:

        a.   Carbon tetrachloride   _____

        b.   Iron(II) phosphate   _____

        c.   Hydrazine   _____

    C. (4 points) Write the names of the following:

        a. $HClO_2(aq)$ _____

        b. $Mn_2(SO_3)_3$ _____

(Exam 2 covers questions D-H)

    D. (6 points) An artificial fruit beverage contains 12.0 g of tartaric acid, $H_2C_4H_4O_6$ (MM=150.04 g/mole), to achieve tartness. It is titrated with a basic solution that has a density of 1.045 g/cm^3 and contains 5.00 M KOH. What volume of basic solution is required? (One mole of tartaric acid reacts with 2 moles of hydroxide ion.)
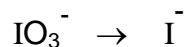
_____

_____

E. (14 points) Write your answer in the blank provided.

Examine the following balanced half-reaction:

$$2H_2O + Mn^{2+} \rightarrow MnO_2 + 2e^- + 4H^+$$

_____ 1. (2 point) Is this an oxidation or a reduction?

_____ 2. (2 point) What element is oxidized or reduced?

Balance the following half-equation in acid.

$$IO_3^- \rightarrow I^-$$

_____ 3. (4 points) What is the coefficient of H^+ in your balanced equation?

The above reaction occurs along with the reaction given above before Part 1 of this problem. Write a balanced equation for the **overall reaction** that occurs.


_____ 4. **(4 points)** What is the coefficient of water in the balanced overall equation?

_____ 5. **(2 points)** Which reactant is the oxidizing agent?

_____

F. (6 points) Two containers of gas are connected by a valve. One container is 2.00L in size and contains 0.247 atm of argon, the other container is 1.00L and has 0.45 atm of helium inside. What is the total pressure of the system when the valve is opened between the two containers?

_____

G. (8 points) In 20.0 min, 29.7 mL of He effuses through a small hole. Under the same conditions of pressure and temperature, 20.0 mL of a mixture of CO and CO_2 effuses through the hole in in 40.0 min of time. What is the percent composition by volume?

_____

H. (7 points) The sample of zinc metal reacts completely with an excess of hydrochloric acid:

$Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(aq)$
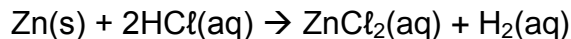
The hydrogen gas produced is collected over water at 25.0°C. The volume of the gas is 7.80 L, and the pressure is 0.980 atm. What is the mass of zinc metal in grams consumed in the reaction? (Vapor pressure of water at 25°C = 23.8 mm Hg).

_____

_____

(Exam 3 covers questions I – K)

   I.   **(7 points)** A 25.95-g sample of methanol at 35.6ºC is added to a 38.65-g sample of ethanol at 24.7ºC in a calorimeter. If the final temperature of the combined liquids is 28.5ºC and the heat capacity of the calorimeter is 19.3 J/ºC, what is the specific heat of methanol? (specific heat of ethanol is 2.44 J/g·°C)

   _____

   J.   **(6 points)** Draw all possible Lewis structures for the molecule SO_3:

   _____

   _____

K. (10 points) Consider the skeleton structure shown below. (NOT a Lewis structure)
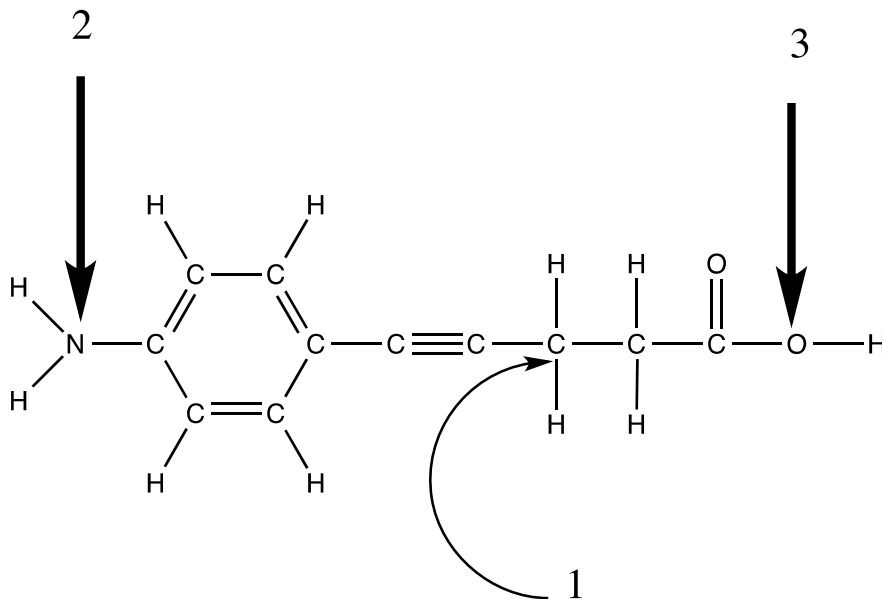

a. What is the approximate value of the angle marked 2? _____

b. What is the approximate value of the angle between atoms on the oxygen marked 3? _____

c. What is the geometry of atoms around the carbon marked 1?_____

d. How many pi bonds are in the molecule?_____

e. What is the hybridization of the oxygen atom marked 3?_____

_____

(27 points) This part of the final covers the material in Chapter 9.

L. (12 points) Consider the phase diagram for CCl_4 given below. Answer the questions about the diagram by writing your answers on the blanks provided.

_____ **1.** Point E represents an equilibrium between what phases?

_____ **2.** What is the phase of CCl_4 at point G called?

_____ **3.** Does the melting point decrease as pressure above the liquid is decreased?(Yes or No)

_____ **4.** Is the solid more or less dense than the liquid?

_____ **5.** Name the phase change that occurs as the pressure is decreased from point C.
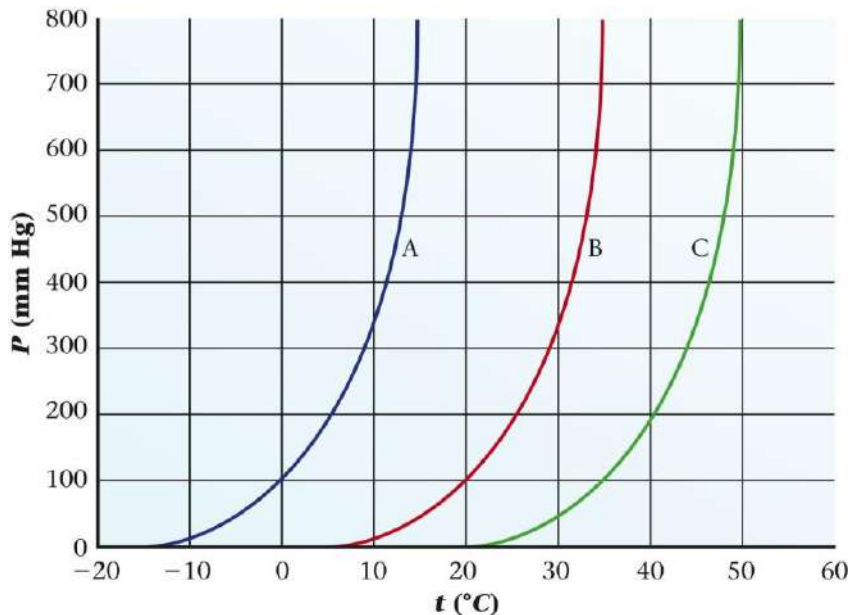
_____ **6.** What is point D called?

_____
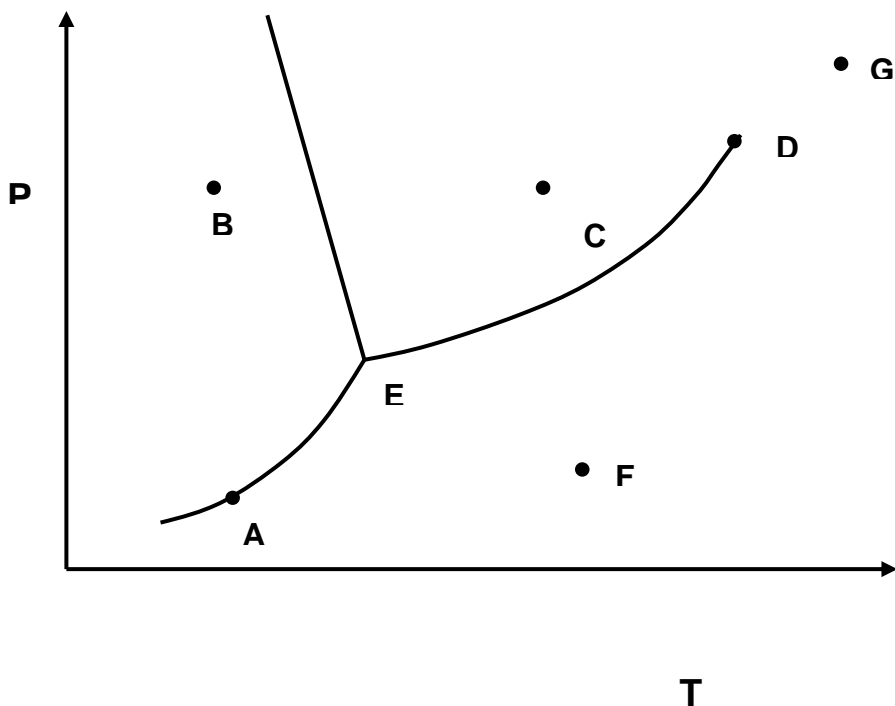
M. (10 points) The vapor pressure of an unknown liquid is 197.0 mm Hg at 23 °C and 448 mm Hg at 45°C.

    a. What is the heat of vaporization of the unknown liquid?

_____

    b. Calculate the vapor pressure of the unknown liquid at 60°C?

_____

N. (6 points) Consider the following vapor pressure curves of molecules A, B, and C.

    a. Which compound A, B, or C has the strongest forces between molecules? _____

    b. What is the normal boiling point of compound B? _____

    c. At what pressure will C boil at 40°C? _____

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_____