CHEMISTRY 101   SPRING 2001
FINAL   FORM A   SECTIONS 501-509   DR. KEENEY-KENNICUTT

Directions: (1) Put your name, S.I.D. number and signature on the free response part of the exam where indicated.
      (2) Each multiple choice question is actually 2 questions on your scanning sheet. If you are sure of an answer, put the same answer down for both questions for 5 pts. If you cannot decide between two answers, put one answer down for one question and the other answer down for the other question. If you get one correct you'll get half credit for 2.5 pts. If there is an ambiguous multiple choice question, use the last page to explain your answer.
      (3) Do NOT write on the envelope.
      (4) Bubble in OPTION A on the scanning sheet IF you want your grade posted.
      (5) When finished, put the free response answers in the envelope with the scanning sheet. You can keep the multiple choice part - the answers will be given to you as you leave.
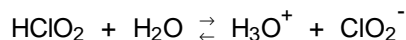   (6) There are a total of 58 questions (32 actual questions).

PART 1

1&2. Consider the ^{55}Mn isotope. An atom of this isotope contains _____ neutrons.

(a) 45   (b) 25   (c) 55   (d) 30   (e) 35

3&4. Which compound can exhibit hydrogen bonding?

(a) Ar   (b) CO_2 (c) CaH_2 (d) NaCl   (e) HF

**5&6.** For the system given below, Bronsted would classify basic species as:

$$HClO_2 + H_2O \rightleftharpoons H_3O^+ + ClO_2^-$$

(a) $HClO_2$ and H_2O (b) H_3O^+ and ClO_2^- (c) $HClO_2$ and H_3O^+
(d) H_2O and ClO_2^- (e) $HClO_2$ and ClO_2^-

7&8. Which one of the following is a strong, soluble base?

(a) $Cu(OH)_2$ (b) $Fe(OH)_3$ (c) $Sr(OH)_2$ (d) $Al(OH)_3$ (e) $Mg(OH)_2$

A1

9&10. Which one of the following statements about this phase diagram is FALSE?

(a) At Point 1, the substance is a solid.
(b) Point 5 is called the triple point.
(c) At Point 3, the liquid phase is in equilibrium with gas phase.
(d) When the substance moves from the conditions at Point 1 to
.   the conditions at Point 2, the substance boils.
(e) When the conditions change from Point 2 to Point 4, the
     temperature changes and the pressure stays constant.
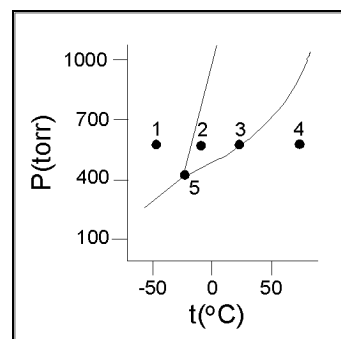
11&12. The compound Na_2S forms hard white crystals that don't conduct electricity. When the solid melts at $1180^{\circ}C$, the resulting liquid does conduct electricity. Solid Na_2S can probably be classified as a(an) _____ solid.

(a) ionic   (b) metallic   (c) polar   (d) molecular   (e) covalent

13&14. What is the assigned oxidation number for nitrogen in $NaNO_2$?

(a) -3   (b) +2   (c) +3   (d) -2   (e) +5

15&16. For an ideal gas, pressure is inversely proportional to _____ if the other variables are held constant.

(a) V   (b) n   (c) T   (d) R   (e) mass

17&18. Which of the following bonds would you expect to be the **least** polar?

(a) S-F   (b) N-H   (c) O-F   (d) Mg-Te   (e) Ba-Cl

19&20. The formula for the simple ionic compound of calcium and nitrogen is _____.

    (a) CaN   (b) Ca_2N (c) Ca_2N_3 (d) CaN_2 (e) Ca_3N_2

21&22. Which statement is **wrong**?

    (a) The atomic weight of oxygen is about 16.
    (b) The most stable magnesium ion is Mg^+.
    (c) The atomic radius of oxygen is smaller than the ionic radius of the oxide anion.
    (d) A lithium cation is smaller than a lithium atom.
    (e) The first ionization energy of helium is greater than that of neon.

23&24. These sketches represents the 90% probability surface for five different atomic orbitals. Select the one which represents a d_{xz} orbital.
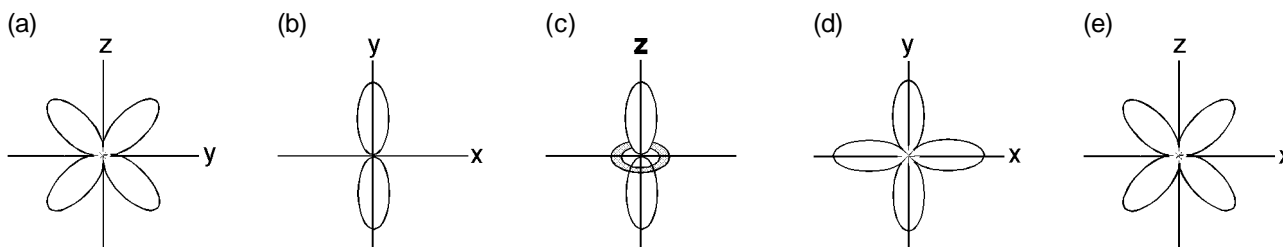

25&26. One molecule of water contains:

    (a) 1 mole of O   (b) 32.0 grams of O_2 (c) 1 atom of O

    (d) 2.016 grams of H   (e) 1/2 mole of O_2

27&28. Which of the following statements is **FALSE**?

    (a) Molecules of an ideal gas are assumed to have no attractive forces between each other.
    (b) The gas, NH_3, behaves more ideally at 10 atm than it does at 0.1 atm.
    (c) Real gases do not always obey the ideal gas laws.
    (d) Oxygen gas behaves more ideally at 400K than it does at 200K.
    (e) Ideal gas molecules always move in straight lines.

        A3

29&30. Complete and balance the following redox reaction. What is the coefficient of H_2O when the equation is balanced with the set of smallest whole number coefficients?

$$Cu + NO_3^- \rightarrow Cu^{2+} + NO \quad \text{(in acidic solution)}$$
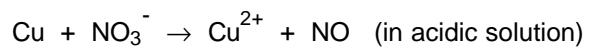
(a) 3   (b) 4   (c) 5   (d) 8   (e) 10

31&32. A sample of nitrogen occupies a volume of 546 mL at STP. What volume would the nitrogen occupy at $177^{\circ}C$ under a pressure of 380 torr?

(a) 91 mL   (b) 273 mL   (c) 900 mL   (d) 1090 mL   (e) 1800 mL

A4

33&34. Calculate the number of C_4H_9OH molecules in 10. g of C_4H_9OH.

(a) 2.1×10^{23} (b) 8.1×10^{22} (c) 2.9×10^{22} (d) 8.8×10^{22} (e) 7.8×10^{22}

35&36. What is the percentage, by weight of oxygen in ethanol, C_2H_5OH?

(a) 11.1%   (b) 30.7%   (c) 34.7%   (d) 39.2%   (e) 41.3%

37&38. The imaginary element Y has the following natural abundances and isotopic masses:

^{100}Y 100.00 amu   80.00%

^{102}Y 102.00 amu   20.00%

What is the average atomic mass of Y?

(a) 100.40 amu   (b) 100.60 amu   (c) 101.00 amu   (d) 101.60 amu   (e) 104.00 amu

39&40. An unknown organic compound composed of carbon, hydrogen and oxygen was analyzed and found to be 47.06% carbon, 5.92% hydrogen, and 47.02% oxygen by weight. Which of the following represents the correct empirical formula for the compound?

(a) $C_4H_6O_3$ (b) $C_3H_6O_2$ (c) $C_4H_5O_2$ (d) $C_3H_2O_2$ (e) $C_4H_4O_3$

A6

41&42. When 10.0 g of hydrogen, H_2, react with an excess amount of nitrogen, N_2, to give an actual yield of 25.0 g of ammonia, NH_3, what is the percentage yield for this reaction? (You'll need to balance the equation).

(a) 22.3%   (b) 38.3%   (c) 52.3%   (d) 50.7%   (e) 44.4%

43&44. What is the molarity of a NaBr solution if 46.2 grams of NaBr (FW = 102.9 g/mol) were dissolved in enough water to prepare 675 mL of solution?

(a) 0.325 M   (b) 0.465 M   (c) 0.975 M   (d) 0.665 M   (e) 0.245 M

45&46. Consider the **unbalanced** oxidation-reduction reaction:

$$Bi + MnO_4^- \rightarrow Bi(OH)_3 + MnO_2 \quad \text{(in basic solution)}$$
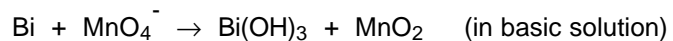
If 0.612 g of $KMnO_4$ (FW = 158 g/mol) are dissolved in enough water to prepare 100 mL of solution, what is the normality of the $KMnO_4$ solution used in the above reaction?
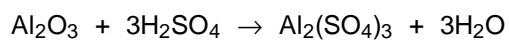
(a) 0.0115 N (b) 0.232 N (c) 0.0398 N (d) 0.116 N (e) 0.0775 N

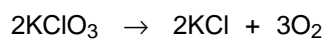**47&48.** If 10.0 g of each reactant in the following reaction were used, the limiting reactant would be:

$$3PbO_2 + Cr_2(SO_4)_3 + K_2SO_4 \rightarrow 3PbSO_4 + K_2Cr_2O_7 + H_2SO_4$$
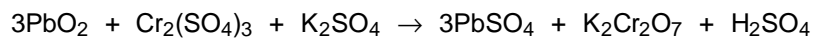
(a) $Cr_2(SO_4)_3$ (b) K_2SO_4 (c) $K_2Cr_2O_7$ (d) H_2SO_4 (e) PbO_2

49&50. How many milliliters of 0.5000 M H_2SO_4 would be required to react with 0.500 g of Al_2O_3?
(FW of Al_2O_3 = 102 g/mol)

$$Al_2O_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2O$$

(a) 29.4 mL   (b) 3.27 mL   (c) 5.67 mL   (d) 4.88 mL   (e) 10.6 mL

51&52 . How many liters (at 200°C and 800 torr) of oxygen can be produced by the decomposition of 49 g of potassium chlorate (FW = 122.6 g/mol)?

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

(a) 9.33 L   (b) 13.4 L   (c) 14.7 L   (d) 22.1 L   (e) 29.4 L

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ID   _____

Signature _____

(5 pts) **53.** Describe the meaning of this diagram in your own words. Include in your mini-discussion,

(1) the meaning of boiling point.

(2) the difference between boiling and evaporation,

(3) what the approximate normal boiling point of Compound A is.

OVER ▶

A11
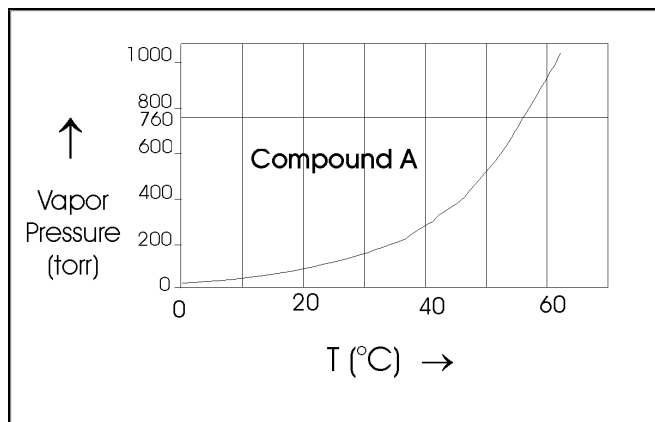
(5 pts) **54.** Given the following data:

Freezing point of benzene	$5.48^{\circ}C$
Boiling point of benzene	$80.1^{\circ}C$
Heat of fusion of benzene at $5.48^{\circ}C$	127 J/g
Specific Heat of liquid benzene	$1.74 \text{ J/g}^{\circ}C$
Heat of vaporization of liquid benzene at $80.1^{\circ}C$	395 J/g
Specific Heat of gaseous benzene	$1.04 \text{ J/g}^{\circ}C$

Calculate the amount of heat (in kJ) released when 25.0 g of gaseous benzene at $80.1^{\circ}C$ is converted to liquid benzene at $40.0^{\circ}C$.

(5 pts) **55.** Determine the correct net ionic equation for the completely neutralized acid-base solution reaction occurring between nitric acid and copper(II) hydroxide.

(5 pts) **56.** What is the initial freezing point of a solution prepared by dissolving 25.0 g of barium nitrate in 300.0 g of water. Assume complete ionization. (See back of envelope for constants.)

(6 pts) **57.** Consider the element, strontium, Sr.

(a) Write out the full electron configuration for this element. DO **NOT** USE THE NOBLE GAS SHORTHAND.

(b) What is an appropriate set of 4 quantum numbers for the last electron assigned to this element?

OVER ☞

(14 pts) **58.** Draw the correct dot structure for the following 2 species. Show all valence electrons. Fill in the appropriate information.

PF$_3$	BrF$_4^-$
(a) Dot structure (3 pts):	(a) Dot structure:
(b) molecular (ionic) geometry (2 pts):	(b) molecular (ionic) geometry:
(c) hybridization of central atom (1 pts):	(c) hybridization of central atom:
(d) polar or nonpolar (1 pt):	(d) polar or nonpolar:

Extra Credit (2 pts):   If you had a choice between doing ChemSkill Builder on the web or with the disk/CD, which would you choose and why? Not doing CSB at all is not an option (smile).

A14

SCRAP PAPER OR COMMENTS ON EXAM

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