NAME ____________________________________________

# CHEMISTRY 101 SPRING 2005

**FINAL FORM A SECTIONS 501-511 DR. KEENEY-KENNICUTT**

Directions: (1) Put your name and signature on PART 1 and PART 2 of the exam where indicated.
(2) Sign the Aggie Code on PART 2 of this exam.
(3) 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.
(4) Do NOT write on the envelope.
(5) When finished, put everything in the envelope and wait to be excused. At the table, take everything out of the envelope. You can pick up the multiple choice part with the answers outside my office after the exam.
(6) There are a total of 59 questions (32 actual questions).

## PART 1

**1&2.** The oxidation state of phosphorus in $NaHPO_3$ is _______.

(a) +1 (b) +3 (c) +4 (d) 0 (e) -3

**3&4.** The following ground state atomic configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$ corresponds to

(a) Cu (b) Cr (c) K (d) Zn (e) Ca

**5&6.** A sample of $CH_4$ gas behaves most ideally at:

(a) $0^oC$ and 1 atm (b) $100^oC$ and 1 atm (c) $0^oC$ and 10 atm
(d) $100^oC$ and 10 atm (e) $0^oC$ and 5 atm

**7&8.** The substance $H_2O(s)$ would be classified as a(n) _____________ solid.

(a) amorphous (b) covalent (network) (c) ionic
(d) metallic (e) molecular

**9&10.** An appropriate set of 4 quantum numbers for the "last" electron to go into an atom of platinum (Pt, atomic number 78) could be:

| | n | $\ell$ | $m_\ell$ | $m_s$ |
|---|---|---|---|---|
| (a) | 5 | 3 | -3 | +1/2 |
| (b) | 4 | 3 | 0 | -1/2 |
| (c) | 5 | 2 | 2 | +1/2 |
| (d) | 4 | 2 | -2 | -1/2 |
| (e) | 5 | 1 | 0 | -1/2 |

**11&12.** Which of the following statements is FALSE concerning the compound $Fe(NO_3)_3$?

(a) Each formula unit of $Fe(NO_3)_3$ contains 9 atoms of oxygen.
(b) Each mole of $Fe(NO_3)_3$ contains 55.85 g of iron.
(c) Each formula unit of $Fe(NO_3)_3$ contains 3 nitrate ions.
(d) Each mole of $Fe(NO_3)_3$ contains 4 moles of ions.
(e) Each mole of $Fe(NO_3)_3$ contains $6.02 \times 10^{23}$ atoms of nitrogen.

**13&14.** A hypothetical molecule, $AB_3$, has two (2) lone pairs of electrons on the center atom, A. The hybridization of A is _______ .

(a) sp (b) $sp^2$ (c) $sp^3$ (d) $sp^3d$ (e) $sp^3d^2$

**15&16.** Which of the following substances is INSOLUBLE?

(a) $HNO_3$ (b) $H_2S$ (c) $Ba_3(PO_4)_2$
(d) $Ba(OH)_2$ (e) all are soluble

**17&18.** The correct dot structure for $SF_4$ contains ______ lone pair(s) of electrons around the central atom.

(a) 0 (b) 1 (c) 2 (d) 3 (e) 4

**19&20.** Valence Bond Theory uses the concept of resonance to explain the structure of _______.

(a) $CH_4$ (b) $SO_4^{2-}$ (c) $CO_3^{2-}$ (d) $H_2O$ (e) $PO_4^{3-}$

**21&22.** According to Bronsted-Lowry Theory, which acid is INCORRECTLY matched with its conjugate base?

| | ACID | CONJUGATE BASE |
|---|---|---|
| (a) | HCl | $Cl^-$ |
| (b) | $H_2F^+$ | HF |
| (c) | $HCO_3^-$ | $CO_3^{2-}$ |
| (d) | $H_3O^+$ | $OH^-$ |
| (e) | $H_2PO_4^-$ | $HPO_4^{2-}$ |

**23&24.** The number of $\pi$ bonds in a molecule of benzene is:

(a) 0 (b) 1 (c) 2 (d) 3 (e) more than 3

**25&26.** Which of the following species is INCORRECTLY paired with its molecular or ionic geometry?

(a) $CO_2$ linear
(b) $SO_2$ linear
(c) $SO_3$ trigonal planar
(d) $SO_3^{2-}$ pyramidal
(e) $AsF_5$ trigonal bipyramidal

**27&28.** Which statement is WRONG?

(a) A carbon atom is smaller than a silicon atom.
(b) The most stable calcium ion is $Ca^{2+}$.
(c) A magnesium cation is smaller than a magnesium atom.
(d) The atomic weight of oxygen is about 16.
(e) Oxygen has a less negative electron affinity than nitrogen.

**29&30.** The correct ranking of substances according to their boiling points from lowest boiling point to highest boiling point is:

(a) He < $CH_4$ < $NH_3$ < NaCl
(b) He < $NH_3$ < $CH_4$ < NaCl
(c) He < $CH_4$ < NaCl < $NH_3$
(d) $CH_4$ < He < $NH_3$ < NaCl
(e) NaCl < He < $CH_4$ < $NH_3$

**31&32.** A species having 28 electrons and 30 protons could be:

(a) $Ni^{2+}$ (b) $Zn^{2+}$ (c) $Ni^{2-}$ (d) $Zn^{2-}$ (e) something else

**33&34.** Which of the following species is polar?

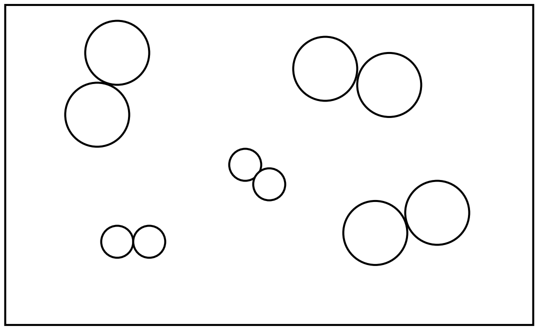
(a) $BeF_2$ (b) $CF_4$ (c) $CF_3^-$ (d) $PF_4^+$ (e) $SF_6$

**35&36.** What is the percent of oxygen by mass in vanillin, $C_8H_8O_3$?

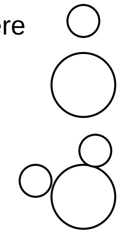
(a) 31.5% (b) 19.2% (c) 15.8%
(d) 25.8% (e) 10.5%

**37&38.** Consider the reaction: $H_2(g) + O_2(g) \rightarrow H_2O(g)$ **UNBALANCED**

The initial system before the reaction began is represented by the following particle view:



where



is a hydrogen atom

is an oxygen atom

is a water molecule

Give the limiting reactant and the number of molecules of $H_2O$ that can be produced.

(a) $H_2$, 1 (b) $H_2$, 2 (c) $O_2$, 1 (d) $O_2$, 2 (e) another answer

**39&40.** How many grams of $Na_2O_2$ (FW - 78.0 g/mol) can be produced from the reaction of 10.0 g of sodium metal with excess oxygen gas if the percent yield of the reaction is only 55%?

$$2\,Na + O_2 \rightarrow Na_2O_2$$

(a) 5.8 g (b) 12.2 g (c) 8.6 g (d) 6.8 g (e) 9.3 g

**41&42.** Air bags for automobiles are inflated during a collision by the explosion of sodium azide, $NaN_3$ (FW = 65.0 g/mol). The equation for the decomposition is:

$$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$$

What mass of sodium azide is needed to inflate a 25.0 L bag to a pressure of 1.40 atm at 20$^o$C?

(a) 14.4 g (b) 88.1 g (c) 93.1 g (d) 63.1 g (e) 155 g

**43&44.** What volume (in mL) of 0.45 M NaBr can be prepared from 25 g of NaBr (FW = 103 g/mol)?

(a) 320 mL (b) 480 mL (c) 610 mL (d) 540 mL (e) 270 mL

**45&46.** You are given the data for all the isotopes of the newly discovered element, Aggiedaddium:

| Abundance (%) | Isotopic Mass (amu) |
|---|---|
| 10.00 | 122.00 |
| 50.00 | 125.00 |
| 40.00 | 128.00 |

The atomic weight of Aggiedaddium (in amu) is (to 4 significant figures):

(a) 125.9 (b) 125.0 (c) 125.6 (d) 124.7 (e) 126.0

**47&48.** A student must prepare a 0.100 N solution of $KMnO_4$ which will be used in this UNBALANCED net ionic reaction occurring in acidic solution:

$$MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$$

How many grams of $KMnO_4$ must be used to make 1000 mL of this 0.100 N solution?

(a) 3.16 g (b) 7.04 g (c) 10.2 g (d) 15.1 g (e) 19.8 g

**49&50.** What could be the identity of a gas if its density is 3.74 g/L at STP?

(a) $C\ell_2$ (b) $AsH_3$ (c) Kr (d) $SO_2$ (e) Ne

**51&52.** This is the question being replaced by your doing the evaluation of the course on the web.

**PERMISSION SLIP** **SPRING 2005**

I, (print your name) ____________________________________________________ give permission to Dr. Wendy Keeney-Kennicutt to anonymously use any of my work done in her Chemistry 101 class during Spring 2005 as examples to illustrate to others how she teaches in her class. This includes homework, abstracts, CPR assignments, free response part of exams, labs, etc.

Signed: ____________________________________________________________________

Date: _______________________________________

**CHEMISTRY 101** **SPRING 2005** NAME ____________________

FINAL S 501-511

Form A Signature ____________________

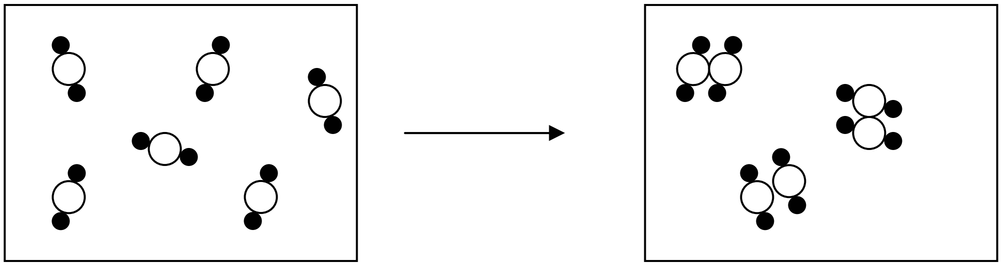
# PART 2

**Please read and sign: "On my honor, as an Aggie, I have neither given nor received unauthorized aid on this exam."** ____________________

(7 pts) **53.** Write a balanced net ionic equation to represent the oxidation of iodide ion ($I^-$) by permanganate ion ($MnO_4^-$) in basic solution to yield molecular iodine ($I_2$) and manganese(IV) dioxide ($MnO_2$). Use smallest whole number coefficients.

**OVER** $\Rightarrow$

(5 pts) **54.** Here is a molecular representation of a reaction occurring in the gas phase at 300 K and 1 atm pressure. If the initial volume is 1.00 L, determine the final volume if the temperature and pressure don't change and explain briefly how you arrived at your answer.



(6 pts) **55.** Draw a typical phase diagram. Label the axes and the areas where solids, liquids and gases can be found. Draw a line segment representing the phase change of a solid to a gas at constant pressure.

(6 pts) **56.** Determine the complete net ionic equation for the reaction between nitric acid and copper(II) hydroxide.

(6 pts) **57.** Given the following data:

| | |
|---|---|
| Specific Heat of ice: | 2.09 J/g$^{o}$C |
| Heat of fusion of ice at 0$^{o}$C | 334 J/g |
| Specific Heat of liquid $H_2O$ | 4.18 J/g$^{o}$C |
| Heat of vaporization of liquid water at 100$^{o}$C | $2.26 \times 10^3$ J/g |
| Specific Heat of steam | 2.03 J/g$^{o}$C |

Calculate the amount of heat (in kJ) required to convert 20.0 g of ice at -40$^{o}$C to liquid water at 50.0$^{o}$C.

(6 pts) **58.** What is the initial boiling point of a solution prepared by dissolving 35.0 g of sodium phosphate in 100.0 g of water? The boiling point of water is 100.00$^{o}$C and $K_b$ for water is 0.512 $^{o}$C/m).

(4 pts) **59.** Draw a picture of the $p_x$ orbital and label the axis.

# SCRAP PAPER OR COMMENTS ON EXAM

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FINAL Form A S 501-511