NAME (Please print )_____

# CHEMISTRY 101 SPRING 2010

## FINAL FORM C DR. KEENEY-KENNICUTT

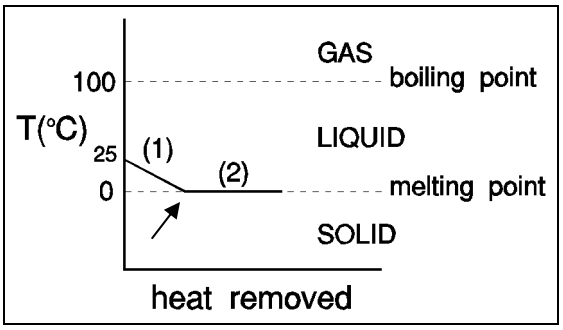
Directions: (1) Put your name on PART 1 and your name and signature on PART 2 of the exam where indicated.
(2) Sign the Aggie Code on PART 2 of this exam.
(3) Each multiple choice question is actually 2 questions on your scanning sheet. If you are sure of an answer, **put the same answer down for both questions** for 5 pts. If you cannot decide between two answers, put your BEST answer down for the ODD/FIRST question for 3 pts and your SECOND BEST answer down for the EVEN/SECOND question for 2 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 both parts of the exam in the envelope with the scanning sheet. You can leave during announced times.
(6) There are a total of 64 questions (34 actual questions with 2 pts extra credit). Total value is 170 + 2 points.

# PART 1

**1&2.** The correct formula for aluminum sulfite is:

(a) $Al_2S_3$ (b) $AlSO_4$ (c) $Al_2(SO_4)_3$ (d) $AlSO_3$ (e) $Al_2(SO_3)_3$

**3&4.** Consider this illustration. Which statement is FALSE?




(a) At the intersection where Step 1 and Step 2 meet, the substance is a solid.
(b) For Step 2: heat = Ht. of fusion x mass
(c) The substance may be water.
(d) For Step 1: heat = Sp.Ht. x mass x $\Delta T$
(e) The substance is being cooled to a solid at its freezing point.

**5&6.** A sample of $H_2O$ gas begins to exhibit non-ideal behavior near which temperature?

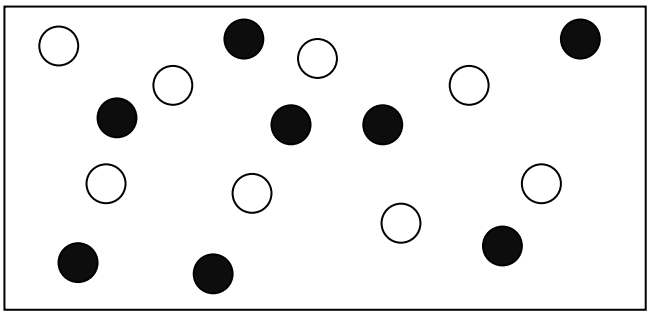
(a) boiling point (b) melting point (c) 22.4 $^oC$
(d) 0 K (e) 273 K

**7&8.** You can find 2 atoms of sulfur in

(a) 2 moles of NaOH
(b) 1 mole of $H_2SO_4$
(c) 1 molecule of $H_2SO_4$
(d) 2 formula units of BaS

(e) 2 grams of S

**9&10.** Here is a particle view of a substance in water. Pick the compound that is represented by this particle view.




(a) HF (b) CuS (c) KOH (d) $NH_3$ (e) AgOH

**11&12.** For which of the following reactions would the $\Delta H^o$ for the reaction be labeled $\Delta H_f^o$?

(1) $Mg(s) + 1/2\ O_2(g) \rightarrow MgO(s)$

(2) $BaO(s) + SO_3(g) \rightarrow BaSO_4(s)$

(3) $CO(g) + 1/2\ O_2(g) \rightarrow CO_2(g)$

(4) $1/2\ H_2(g) + 1/2\ Br_2(\ell) \rightarrow HBr(g)$

(5) $C_2H_4(g) \rightarrow 2\ C(s,graphite) + 2\ H_2(g)$

(a) 1 only (b) 1 and 2 (c) 1 and 4 (d) 3 and 4 (e) 1 and 5

**13&14.** The species $NH_3$ can be described by all of these terms EXCEPT:

(a) pyramidal molecular geometry (b) nonpolar (c) contains polar covalent bonds
(d) tetrahedral electronic geometry (e) $sp^3$ hybridized

**15&16.** Which ground state electronic configuration is **NOT** correct?

(a) Na $1s^2\ 2s^2\ 2p^6\ 3s^1$
(b) As $[Ar]\ 3d^{10}\ 4s^2\ 4p^3$
(c) Cu $[Ar]\ 3d^{10}\ 4s^1$
(d) Bi $[Xe]\ 6s^2\ 5d^{10}\ 6p^3$
(e) Mn $[Ar]\ 3d^5\ 4s^2$

**17&18.** The compound H-C≡C-$CH_3$, has _____ sigma bonds and _____ pi bonds.

(a) 6,2 (b) 3,2 (c) 2,3 (d) 5,3 (e) another combination

**19&20.** Which compound cannot exhibit London interaction?

(a) $NF_3$ (b) $CO_2$ (c) $CH_3OH$ (d) $Cl_2$ (e) $BaH_2$

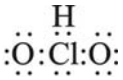
**21&22.** Assign oxidation numbers to each element in this reaction. The oxidizing agent is:

$$16\ H^+ + 2\ MnO_4^- + 10\ SO_4^{2-} \rightarrow 2\ Mn^{2+} + 5\ S_2O_8^{2-} + 8\ H_2O$$

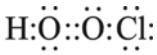
(a) $H^+$ (b) $MnO_4^-$ (c) $SO_4^{2-}$ (d) $Mn^{2+}$ (e) $S_2O_8^{2-}$

**23&24.** Which of the following is the CORRECT Lewis structure for chlorous acid showing all the valence electrons?

(a) 

(b) 

(c) 

(d) 

(e) 

**25&26.** The correct ranking of these substances: $FeCl_2$ $N_2$ $CH_3OH$ $NF_3$ according to their boiling points from lowest boiling point to highest boiling point is:

(a) $N_2 < CH_3OH < FeCl_2 < NF_3$
(b) $FeCl_2 < N_2 < NF_3 < CH_3OH$
(c) $CH_3OH < NF_3 < N_2 < FeCl_2$
(d) $N_2 < NF_3 < CH_3OH < FeCl_2$
(e) $CH_3OH < FeCl_2 < NF_3 < N_2$

**27&28.** Which of the following is a non-polar covalent bond?

(a) O-F (b) H-Cl (c) C-I (d) Na-Ca (e) Te-I

**29&30.** If you have 3 moles of sodium, how many moles of hydrogen atoms are also present in your sample of sodium aluminum sulfate, $NaAl(SO_4)_2 \cdot 12H_2O$?

(a) 12 (b) 24 (c) 72 (d) 6 (e) 36

**31&32.** Which statement is WRONG?

(a) A total of 10 electrons can have quantum numbers, n=4 and $\ell$=2.
(b) A magnesium atom is smaller than a sodium atom.
(c) The sodium cation is smaller than the sodium atom.
(d) $Br^-$ and $Cl^-$ are isoelectronic with each other.
(e) Sodium has a less negative electron affinity than fluorine.

**33&34.** How many electrons can be found in an ion of the isotope $^{31}P^{3-}$?

(a) 31 (b) 28 (c) 34 (d) 12 (e) 18

**35&36.** Consider this acid-base net ionic equation: $HBrO(aq) + OH^-(aq) \rightarrow BrO^-(aq) + H_2O(\ell)$

Which of the following statements is <u>TRUE</u>?

(a) The acid is a strong acid.
(b) The base is insoluble.
(c) The reaction is called a precipitation reaction.
(d) The spectator ion could have been $Na^+$ ion.
(e) The salt is a weak electrolyte.

**37&38.** You are given the data for all the isotopes of the newly discovered element, Aggiemomium:

| Abundance (%) | Isotopic Mass (amu) |
|---|---|
| 30.00 | 143.00 |
| 60.00 | 145.00 |
| 10.00 | 149.00 |

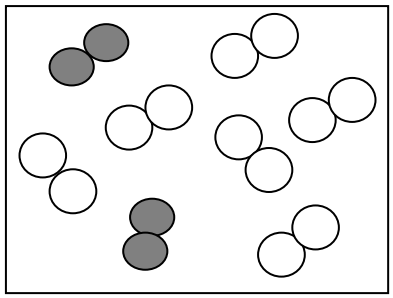
What is the atomic weight of Aggiemomium (in amu)?

(a) 145.5 (b) 146.0 (c) 145.2 (d) 145.0 (e) 144.8

**39&40.** Consider this reaction: $N_2 + O_2 \rightarrow NO_2$ (UNBALANCED).

If you had 2 moles of $N_2$ and 6 moles of $O_2$, how many moles of $NO_2$ can you make?

Let ● = N and ○ = O



Initial system

(a) 2 mol (b) 4 mol (c) 5 mol (d) 6 mol (e) 8 mol

**41&42.** What mass of $O_2$ (FW=32.0 g/mol) could be produced by the decomposition of 25 g of $KIO_3$ (FW=214 g/mol)? The **unbalanced** equation for the reaction is:

$KIO_3 \rightarrow KI + O_2$ (UNBALANCED)

(a) 6.7 g (b) 4.1 g (c) 2.5 g (d) 3.5 g (e) 5.6 g

**43&44.** An unknown organic compound composed of carbon, hydrogen and oxygen was analyzed and found to be 50.84% C, 8.53% H and the rest being oxygen. Which of the following represents the correct empirical formula for the compound?

(a) $CH_2O$ (b) $C_3H_6O_2$ (c) $C_5H_{10}O_3$ (d) $C_2H_4O$ (e) $C_4H_8O_3$

**45&46.** What is the density of the gas $SO_2$ (MW = 64.1 g/mol) at STP?

(a) 22.4 g/L (b) 2.86 g/L (c) 0.33 g/L (d) 5.11 g/L (e) 1.14 g/L

**47&48.** Using bond energies, calculate $\Delta H_{rxn}$ for the reaction: $Br_2(g) + 3\ F_2(g) \rightarrow 2\ BrF_3(g)$

where $D_{Br\text{-}Br}$ = +192 kJ/mol
$D_{F\text{-}F}$ = +158 kJ/mol
$D_{Br\text{-}F}$ = +197 kJ/mol

(a) –516 kJ (b) –410 kJ (c) –611 kJ (d) –665 kJ (e) –720 kJ

**49&50.** A 588 g chunk of iron is heated to 97.5°C. It is then immersed in 247 grams of water originally at 20.7°C. The final temperature of both the iron and the water is 36.2°C. Calculate the specific heat of iron. The specific heat of water is 4.18 J/g•°C.

(a) 0.444 J/g°C (b) 0.688 J/g°C (c) 0.590 J/g°C (d) 0.211 J/g°C (e) 0.152 J/g°C

**51&52.** If the pH of an $HClO_3$ solution is 1.64, what is the concentration of $HClO_3$?

(a) 0.21 M (b) 0.49 M (c) 0.19 M (d) 0.023 M (e) 0.61 M

**53&54.** What is the percentage yield of elemental sulfur if 3.00 grams of sulfur are obtained from the reaction of 4.00 grams of $H_2S$ with an excess of $SO_2$?

$$2\ H_2S + SO_2 \rightarrow 2\ H_2O + 3\ S$$

(a) 53.2% (b) 48.9% (c) 83.7% (d) 28.4% (e) 45.6%

**55&56.** Given the heats of reaction below, calculate $\Delta H^o$ for the reaction: $SO_2(g) + 1/2\ O_2(g) \rightarrow SO_3(g)$

$S(s) + O_2(g) \rightarrow SO_2(g)$ $\Delta H^o = -297$ kJ

$2S(s) + 3O_2(g) \rightarrow 2SO_3(g)$ $\Delta H^o = -792$ kJ

(a) +297 kJ (b) −693 kJ (c) −99 kJ (d) +693 kJ (e) +99 kJ

**57&58.** You have 5.0 g of liquid ethanol ($C_2H_5OH$ – FW=46 g/mol). How many hydrogen atoms do you have?

(a) $6.7 \times 10^{22}$ (b) $3.2 \times 10^{23}$ (c) $3.9 \times 10^{23}$ (d) $4.1 \times 10^{21}$ (e) $6.0 \times 10^{23}$

**59&60.** Calculate the standard enthalpy change associated with the reaction below as written:

$$2\ NH_4NO_3(s) \rightarrow 2N_2(g) + O_2(g) + 4H_2O(g)$$

| Compound | $\Delta H^o_f$ (kJ/mol) |
|---|---|
| Ammonium nitrate (s) | −366 |
| Water (g) | −242 |

(a) +236 kJ (b) −236 kJ (c) −608 kJ (d) +124 kJ (e) −124 kJ

# PART 2

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

(5 pts) **61.** Nitroglycerin ($C_3H_5N_3O_9$ - MW=227.1 g/mol) is a powerful explosive. Its decomposition can be represented by

$$4\ C_3H_5N_3O_9(s) \rightarrow 6N_2(g) + 12CO_2(g) + 10H_2O(g) + O_2(g)$$

If 5.00 g of nitroglycerine were detonated at 300°C, how much total pressure would be created in a 1.00 L steel container?

(5 pts) **62.** Draw a typical phase diagram.

(a) Label the axes and the areas where solids, liquids and gases can be found.
(b) Label the triple point and the melting curve.

**OVER→**

(5 pts) **63.** The iron in a 5.675 g sample of iron ore was first converted to $Fe^{2+}$ ions, then titrated with 12.42 mL of 0.1467 M $K_2Cr_2O_7$ according to the following balanced net ionic equation:

$$6\ Fe^{2+} + Cr_2O_7^{2-} + 14\ H^+ \rightarrow 6\ Fe^{3+} + 2\ Cr^{3+} + 7\ H_2O$$

What is the percentage of Fe in the ore sample?

(4 pts) **64.** (a) How much faster will hydrogen gas effuse through a tiny hole than xenon tetrafluoride gas?

(1 pt) (b) Why? Does the reason involve the size of the hole?

Extra credit:

(1 pt) $H_2O$ forms a _____ solid.

(1 pt) Fe forms a _____ solid.

# SCRAP PAPER OR COMMENTS ON EXAM

**CHEMISTRY 101** **Spring 2010** NAME_____
FINAL Form C