NAME (Please print)_____

CHEMISTRY 101 SPRING 2010

FINAL FORM D 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 species H_2O can be described by all of these terms EXCEPT:

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

3&4. Which of the following is a non-polar covalent bond?

(a) P-As (b) H-Cl (c) O-S (d) Na-Ca (e) Te-I

5&6. Which compound **cannot** exhibit London forces?

(a) CH_4 (b) HCl (c) C_2H_2 (d) CaS (e) OF_2

7&8. The compound CH_3-C≡C-H, has _____ pi bonds and _____ sigma bonds.

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

9&10. Which ground state electronic configuration is **NOT** correct?

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

(e) Bi [Xe] $6s^2\ 5d^{10}\ 6p^3$

11&12. You can find 4 atoms of oxygen in

(a) 1 mole of K_2SO_4

(b) 4 moles of Na_2O

(c) 1 formula unit of Na_3PO_4

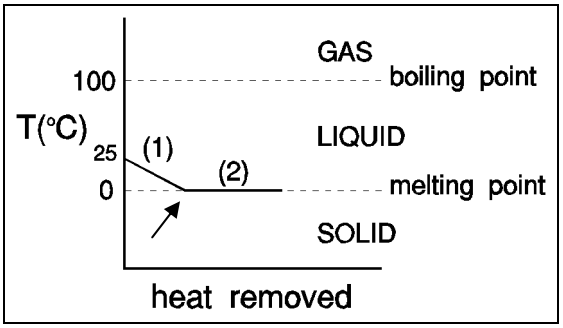
(d) 2 molecules of H_2O

(e) 2 grams of $Ba(OH)_2$

13&14. How many electrons can be found in an ion of the isotope $^{90}Sr^{2+}$?

(a) 90 (b) 88 (c) 40 (d) 52 (e) 36

15&16. Consider this illustration. Which statement is FALSE?



(a) The substance may be water.

(b) For Step 1: heat = Sp.Ht. x mass x ΔT

(c) For Step 2: heat = Ht. of fusion x mass

(d) The substance is being cooled to a solid at its freezing point.

(e) At the intersection where Step 1 and Step 2 meet, the substance is a solid.

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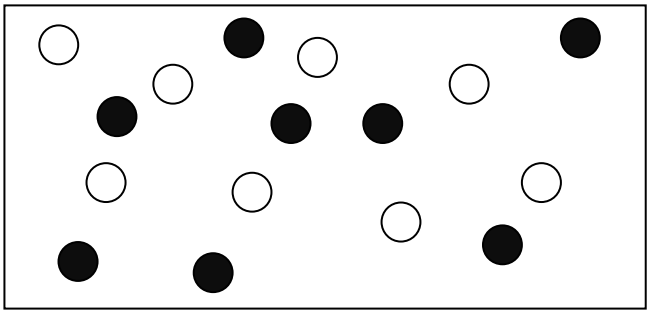
17&18. Here is a particle view of a substance in water. Pick the compound that is represented by this particle view.



○ = cation or H

● = anion

(a) RbOH (b) AgOH (c) NH_3 (d) HF (e) FeS

19&20. For which of the following reactions would the ΔH^o for the reaction be labeled ΔH_f^o?

(a) $1/2\ N_2O(g) + 1/4\ O_2(g) \rightarrow NO(g)$

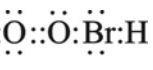
(b) $PCl_3(g) + 1/2\ O_2(g) \rightarrow POCl_3(g)$

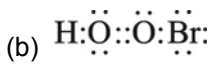
(c) $Al(s) + 3/2\ O_2(g) + 3/2\ H_2(g) \rightarrow Al(OH)_3(s)$

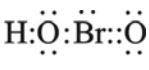
(d) $CaO(s) + SO_2(g) \rightarrow CaSO_3(s)$

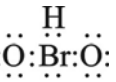
(e) The ΔH^o for all the reactions would be labeled ΔH_f^o.

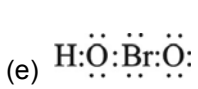
21&22. Which of the following is the CORRECT Lewis structure for bromous acid showing all the valence electrons?

(a) 

(b) 

(c) 

(d) 

(e) 

23&24. Which statement is WRONG?

(a) Br^- and Cl^- are isoelectronic with each other.

(b) Oxygen has a more negative electron affinity than carbon.

(c) A total of 6 electrons can have quantum numbers, n=3 and ℓ=1.

(d) A magnesium cation is smaller than a magnesium atom.

(e) A carbon atom is smaller than a silicon atom.

25&26. If you have 3 moles of calcium, how many moles of oxygen atoms are also present in your sample of $Ca(NO_3)_2 \cdot 6H_2O$?

(a) 12 (b) 36 (c) 15 (d) 21 (e) 33

27&28. The correct ranking of these substances: $CaBr_2$ CO_2 CH_3COOH SeF_4 according to their boiling points from lowest boiling point to highest boiling point is:

(a) $CO_2 < SeF_4 < CH_3COOH < CaBr_2$

(b) $CO_2 < CH_3COOH < CaBr_2 < SeF_4$

(c) $CH_3COOH < SeF_4 < CO_2 < CaBr_2$

(d) $CaBr_2 < CO_2 < SeF_4 < CH_3COOHH$

(e) $CH_3COOH < CaBr_2 < SeF_4 < CO_2$

29&30. The correct formula for sodium sulfite is:

(a) $NaSO_4$ (b) Na_2SO_4 (c) $NaSO_3$ (d) Na_2SO_3 (e) Na_2S

31&32. Assign oxidation numbers to each element in this reaction. The reducing 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) $S_2O_8^{2-}$

33&34. Consider this acid-base net ionic equation: $2H^+(aq) + Cu(OH)_2(s) \rightarrow Cu^{2+}(aq) + 2H_2O(\ell)$

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

(a) The acid is a weak acid.
(b) The spectator ion could have been a NO_3^- ion.
(c) The base is a weak electrolyte.
(d) The salt is insoluble.
(e) The reaction is called a precipitation reaction.

35&36. A sample of SO_3 gas begins to exhibit non-ideal behavior near which temperature?

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

37&38. An unknown organic compound composed of carbon, hydrogen and oxygen was analyzed and found to be 46.15% C, 7.74% H with the rest being oxygen. Which of the following represents the correct empirical formula for the compound?

(a) CH_3O (b) C_2H_3O (c) $C_4H_8O_3$ (d) CH_2O (e) $C_2H_5O_2$

39&40. You are given the data for all the isotopes of the newly discovered element, Aggiedaddium:

Abundance (%)	Isotopic Mass (amu)
10	122.00
50	125.00
40	128.00

The atomic weight of Aggiedaddium (in amu) is:

(a) 125.9 (b) 125.0 (c) 125.6 (d) 124.7 (e) 126.3

41&42. What is the density of the gas XeF_6 (MW = 245.3 g/mol) at STP?

(a) 22.4 g/L (b) 0.091 g/L (c) 1.00 g/L (d) 11.0 g/L (e) 2.55 g/L

43&44. Given the heats of reaction below, calculate ΔH^o for the reaction: $2NO(g) + 1/2\ O_2(g) \rightarrow N_2O_3(g)$

$N_2(g) + O_2(g) \rightarrow 2NO(g)$ $\Delta H^o = +180.5$ kJ

$2N_2(g) + 3O_2(g) \rightarrow 2N_2O_3(g)$ $\Delta H^o = +167.4$ kJ

(a) +91.8 kJ (b) –264.2 kJ (c) +264.2 kJ (d) –6.55 kJ (e) –96.8 kJ

45&46. Using bond energies, calculate ΔH_{rxn} for the reaction: $2\ IF_3(g) \rightarrow 3\ F_2(g) + I_2(g)$

where $D_{I\text{-}F} = +278$ kJ/mol
$D_{F\text{-}F} = +158$ kJ/mol
$D_{I\text{-}I} = +151$ kJ/mol

(a) +845 kJ (b) +1043 kJ (c) +410 kJ (d) +665 kJ (e) +721 kJ

47&48. What mass of SiF_4 (FW=104.1 g/mol) could be produced by the reaction of 15 g of HF (FW=20.0 g/mol) with an excess of SiO_2? The **unbalanced** equation for the reaction is:

$$SiO_2 + HF \rightarrow SiF_4 + H_2O \quad \text{(UNBALANCED)}$$

(a) 19.5 g (b) 1.21 g (c) 3.02 g (d) 10.4 g (e) 15.0 g

49&50. If the pH of an $HClO_4$ solution is 2.94, what is the concentration of $HClO_4$?

(a) 0.47 M (b) 0.0011 M (c) 1.08 M (d) 0.053 M (e) 0.34 M

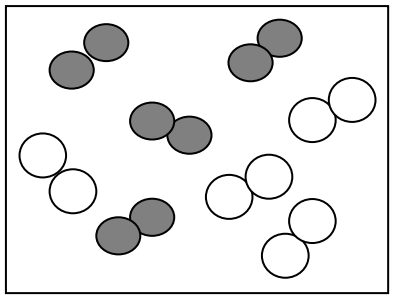
51&52. A 13.8 g chunk of zinc is heated to 98.8°C. It is then immersed in 45.0 g water originally at 25.0°C. The final temperature of both the iron and the water is 27.1°C. Calculate the specific heat of iron. The specific heat of water is 4.18 J/g•°C.

(a) 0.31 J/g°C (b) 0.40 J/g°C (c) 0.15 J/g°C (d) 0.21 J/g°C (e) 0.67 J/g°C

53&54. Consider this reaction: $N_2 + O_2 \rightarrow NO_2$ (UNBALANCED).

If you had 4 moles of N_2 and 4 moles of O_2, how many moles of NO_2 can you make?

Let ● = N and ○ = O



Initial system

(a) 1 mol (b) 2 mol (c) 4 mol (d) 6 mol (e) 8 mol

55&56. What is the percentage yield of elemental sulfur if 7.54 grams of sulfur are obtained from the reaction of 6.00 grams of SO_2 with an excess of H_2S?

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

(a) 76.1% (b) 79.4% (c) 83.8% (d) 88.4% (e) 91.4%

57&58. 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	ΔH^o_f (kJ/mol)
Ammonium nitrate (s)	−366
Water (g)	−242

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

59&60. You have 7.50 g of liquid cyclohexanol ($C_6H_{11}OH$ – FW=100.1 g/mol). How many atoms of hydrogen atoms do you have?

(a) 5.4×10^{23} (b) 3.2×10^{23} (c) 2.9×10^{22} (d) 4.3×10^{22} (e) 6.0×10^{23}

PART 2

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

(4 pts) **61.** (a) How much faster will helium gas effuse through a tiny hole than sulfur trioxide gas?

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

(5 pts) **62.** Gold can be dissolved from gold-bearing ore by treating the rock with sodium cyanide in the presence of oxygen gas, according to:

$$4\ Au + 8\ NaCN + O_2 + 2\ H_2O \rightarrow 4\ NaAu(CN)_2 + 4\ NaOH$$

If 20.0 mL of 0.0750 M NaCN are required to react with all the gold in 1550 g of rock, what is the percentage of gold in the ore sample?

OVER→

(5 pts) **63.** What total gas pressure measured at 600°C in a 43.0 L container, would result from the complete combustion of 2.20 g of hexene, C_6H_{12} (MW = 84.2 g/mol) with a stoichiometric amount of oxygen gas according to:

$$C_6H_{12}(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g)$$

(5 pts) **64.** 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.

Extra credit:
(1 pt) Cr forms a _____ solid.

(1 pt) NaCl forms a _____ solid.

SCRAP PAPER OR COMMENTS ON EXAM

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