NAME (Please print)_____

CHEMISTRY 101 SPRING 2010

FINAL FORM A 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. Which of the following is a non-polar covalent bond?

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

3&4. Titanium (Ti) conducts electricity as a solid. It melts at 1675^{o}C to give a liquid that also conducts electricity. Solid Ti can probably be classified as a _____ solid.

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

5&6. The correct Lewis dot structure of BeF_2 uses a total of _____ valence electrons.

(a) 2 (b) 4 (c) 8 (d) 16 (e) 24

7&8. Which element is paramagnetic with 2 unpaired electrons?

(a) Mg (b) F (c) B (d) O (e) Be

9&10. In Bronsted-Lowry Theory of acids and bases, a base is defined as:

(a) a proton donor (b) a hydroxide donor (c) an electron-pair acceptor

(d) a water-former (e) a proton acceptor

11&12. One formula unit of K_2SO_4 contains:

(a) 2 ions of K^+
(b) 1 mole of K_2SO_4
(c) 32 g of S
(d) 4 moles of SO_4^{2-} anions
(e) Avogadro's number of sulfur atoms

13&14. Which of the following statements is/are **true** about $^{56}Fe^{3+}$?

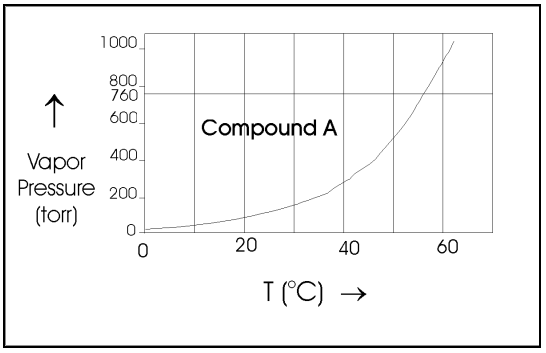
(1) this ion has 29 electrons (2) this ion has 26 neutrons (3) this ion has 26 protons

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

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

(a) Po [Xe] $6s^2\ 5d^{10}\ 6p^4$
(b) Ni [Ar] $3d^8\ 4s^2$
(c) Cr [Ar] $3d^5\ 4s^1$
(d) Mg $1s^2\ 2s^2\ 2p^6\ 3s^2$
(e) As [Ar] $3d^{10}\ 4s^2\ 4p^3$

17&18. Consider the diagram when choosing the CORRECT statement from the following:



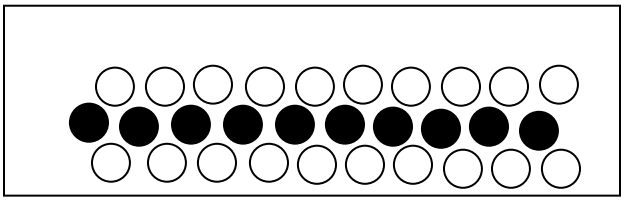
(a) The vapor pressure is always equal to the atmospheric barometric pressure.
(b) Compound A's vapor pressure is independent of the temperature.
(c) The boiling point of Compound A is always equal to or greater than about 56°C.
(d) At the top of a very high mountain, the boiling point is about 56°C.
(e) In a closed container, the vapor is in equilibrium with the liquid.

19&20. The ionic geometry of SF_3^- is:

(a) trigonal pyramidal (b) trigonal planar (c) trigonal bipyramidal

(d) T-shaped (e) see-saw

21&22. In the following drawing, the white spheres represent cations and the black spheres represent anions. The following drawing of an ionic compound is a representation of which compound?



(a) $Ba(ClO_3)_2$ (b) $(NH_4)_2CO_3$ (c) NaBr (d) $AlBr_3$ (e) $Ca_3(PO_4)_2$

23&24. Consider this acid-base net ionic equation: $2H^+(aq) + Ni(OH)_2(s) \rightarrow Ni^{2+}(aq) + 2H_2O(\ell)$

Which of the following statements is TRUE?

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

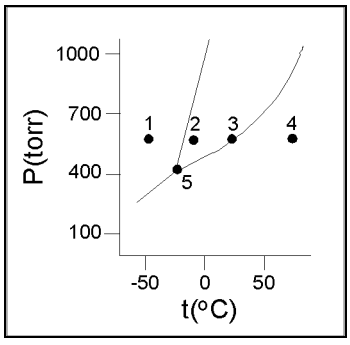
25&26. Determine the oxidation number of sulfur in the sulfate ion, SO_4^{2-}.

(a) +2 (b) +4 (c) +6 (d) +7 (e) +8

27&28. The following set of 4 quantum numbers: $n = 5$, $\ell = 2$, $m_\ell = +2$, $m_s = +1/2$ could be an appropriate set for the last electron to go into an atom of: (Assume that the element is not an exception to the normal filling rule.)

(a) Zr (b) Kr (c) Sr (d) Sn (e) W

29&30. Which one of the following statements about this phase diagram is FALSE?



(a) At Point 4, the substance is a gas.
(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 2 to the conditions at Point 4, the substance sublimes.
(e) When the conditions change from Point 1 to Point 3, the temperature changes and the pressure stays constant.

31&32. Give the ions present and their numbers that appear in the correct formula for copper(II) carbonate.

(a) 2 Cu^{2+} and 1 CO_3^{2-} (b) 2 Cu^{2+} and 2 CO_3^{2-} (c) 2 Cu^{2+} and 3 CO_3^{2-}
(d) 1 Cu^{2+} and 1 CO_3^{2-} (e) 1 Cu^{3+} and 2 CO_3^{2-}

33&34. Balance the equation with the SMALLEST WHOLE NUMBER COEFFICIENTS possible. Choose the number that is the SUM of the coefficients in the balanced equation. Don't forget coefficients of one.

$$Na_2SO_3 + HCl \rightarrow NaCl + H_2O + SO_2$$

(a) 5 (b) 7 (c) 9 (d) 12 (e) 15

35&36. Which one of the following statements about gases is FALSE?

(a) Gases consist of large numbers of particles in rapid random motion.
(b) The volume of the molecules of a gas is very small compared to the total volume in which the gas is contained.
(c) The average kinetic energy of the molecules is proportional to the absolute temperature.
(d) The average kinetic energies of ideal gases are different at different temperatures.
(e) The attractive forces between the molecules of a gas become significant only at high temperatures and low pressures.

37&38. The formula weight of $Mg_3(PO_4)_2$ is:

(a) 168 amu (b) 239 amu (c) 358 amu (d) 214 amu (e) 263 amu

39&40. If a system gains 20 J of heat and does 30 J of work on the surroundings, the change in internal energy is

(a) −50 J (b) +50 J (c) −10 J (d) +10 J (e) 0 J

41&42. If the pH of a solution is 2.11, what is the molarity of H^+ ions in the solution?

(a) 7.8×10^{-3} M (b) 0.75 M (c) 0.32 M (d) 0.12 M (e) 2.11 M

43&44. An oxide of iron contains 72.36% Fe by mass. The empirical formula is:

(a) FeO (b) Fe_3O_4 (c) Fe_2O_3 (d) FeO_2 (e) Fe_3O_2

45&46. How many moles of P_4S_{10} will be produced when 0.50 moles of S_8 reacts with excess P_4 according to the following equation?

$$4\ P_4 + 5\ S_8 \rightarrow 4\ P_4S_{10}$$

(a) 0.32 mol (b) 0.46 mol (c) 0.40 mol (d) 0.50 mol (e) 0.54 mol

47&48. The microorganisms causing "gas gangrene" produce the gas by fermenting "muscle sugar":

$C_6H_{12}O_6(s) \rightarrow 2C_2H_5OH(\ell) + 2CO_2(g)$ in the presence of bacteria

What would be the standard enthalpy change for the fermentation of 1.00 mole of the sugar?

Compound	ΔH^o_f (kJ/mol)
$C_6H_{12}O_6(s)$	−1255
$C_2H_5OH(\ell)$	−278
$CO_2(g)$	−393

(a) −1926 kJ (b) −87 kJ (c) −584 kJ (d) +584 kJ (e) +91 kJ

49&50. Using bond energies, calculate ΔH_{rxn} for the reaction: $CH_4(g) \rightarrow C(g) + 2H_2(g)$

where $D_{C\text{-}H} = +413$ kJ/mol

$D_{H\text{-}H} = +436$ kJ/mol

(a) –459 kJ (b) +46 kJ (c) +170 kJ (d) +780 kJ (e) +849 kJ

51&52. A sample of neon occupies 4.50 liters at 30°C and 2.50 atm. What volume does it occupy at STP?

(a) 4.19 L (b) 23.6 L (c) 10.1 L (d) 73.2 L (e) 8.45 L

53&54. Naturally occurring gallium (atomic number 31) consists of two isotopes: ^{69}Ga with mass 68.92558 amu and ^{71}Ga with mass 70.924704 amu. What is the percent abundance of ^{71}Ga?

(a) 80% (b) 20% (c) 40% (d) 60% (e) 50%

55&56. Carbon tetrachloride, a valuable commercial solvent, can be produced by the gas phase reaction of methane with chlorine gas.

$$CH_4 + 4\ Cl_2 \rightarrow CCl_4 + 4\ HCl$$

Assuming this process is 64% efficient, how many kilograms of chlorine (FW=70.9 g/mol) are required for the production of 15 kg of CCl_4 (FW=153.8 g/mol), assuming excess CH_4?

(a) 43 kg (b) 18 kg (c) 67 kg (d) 83 kg (e) 96 kg

57&58. Given: benzene (C_6H_6): m.p. 5.5°C, b.p. 80.0°C

heat of fusion = 127 J/g at 5.5°C
heat of vaporization = 395 J/g at 80.°C

specific heat (g) = 1.04 J/g°C
specific heat (ℓ) = 1.74 J/g°C
specific heat (s) = 0.89 J/g°C

Calculate the amount of heat that must be absorbed to convert 1.00 g of solid benzene at 5.5°C to liquid benzene at 70.0°C.

(a) 127 J (b) 239 J (c) 114 J (d) 205 J (e) 263 J

59&60. Consider the reaction:

$$5\ FeCl_2 + KMnO_4 + 8\ HCl \rightarrow MnCl_2 + 5\ FeCl_3 + 4\ H_2O + KCl$$

	$FeCl_2$	$KMnO_4$	HCl	$MnCl_2$	$FeCl_3$
FW (g/mol)	126.7	158.0	36.45	125.8	162.2

If 10.0 g of each reactant were used for this reaction, the limiting reactant would be:

(a) $FeCl_2$ (b) $KMnO_4$ (c) HCl (d) $MnCl_2$ (e) $FeCl_3$

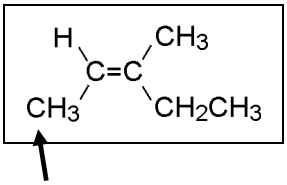
PART 2

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

(5 pts) **61.** How many milliliters of 0.500 M $AgNO_3$ are needed to react with 10.0 g of Cu, according to the following unbalanced equation?

$$AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + Ag \qquad \text{(UNBALANCED)}$$

(4 pts) **62** How many sigma and pi bonds are in the following compound?



Extra Credit (2 pts) What is the hybridization of the carbon identified by the arrow? _____

OVER→

(5 pts) **63.** How many liters (at 300.^{o}C and 1.50 atm) of oxygen can be produced by the decomposition of 25.0 g of potassium chlorate?

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

(3 pts) **64.** (a) Put the following compounds in order of increasing boiling point: NaCl NH_3 H_2 SO_2.

(3 pts) (b) What are the interparticle forces in operation for each compound in the liquid phase?

SCRAP PAPER OR COMMENTS ON EXAM

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FINAL Form A