NAME (Please print)_____

CHEMISTRY 101 SPRING 2010

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

3&4. Which of the following statements is/are **true** about $^{55}Mn^{4+}$?

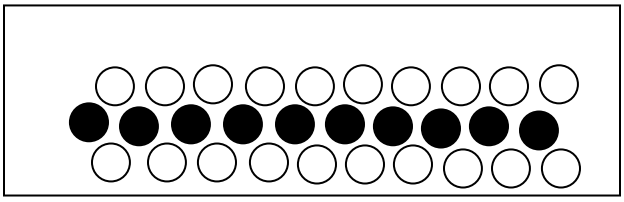
(1) this ion has 25 protons (2) this ion has 25 neutrons (3) this ion has 29 electrons

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

5&6. The compound $BaCl_2$ forms hard clear crystals that don't conduct electricity. When the crystals melt at 963^{o}C, the resulting liquid does conduct electricity. The type of solid formed by $BaCl_2$ is probably classified as _____ .

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

7&8. In the following drawing, the white spheres represent anions and the black spheres represent cations. The following drawing of an ionic compound is a representation of which compound?



(a) NaBr (b) $(NH_4)_2CO_3$ (c) $Ba(BrO_3)_2$ (d) $AlBr_3$ (e) $Ca_3(PO_4)_2$

9&10. The correct Lewis dot structure of BF_3 uses a total of _____ valence electrons.

(a) 3 (b) 6 (c) 8 (d) 24 (e) 32

11&12. Give the ions present and their numbers that appear in the correct formula for iron(II) sulfate.

(a) 2 Fe^{2+} and 2 SO_4^{2-} (b) 1 Fe^{2+} and 1 SO_4^{2-} (c) 3 Fe^{2+} and 2 SO_4^{2-}

(d) 2 Fe^{3+} and 3 SO_4^{2-} (e) 3 Fe^{3+} and 2 SO_4^{2-}

13&14. Which ground state electronic configuration is **NOT** correct?

(a) Mg $1s^2\ 2s^2\ 2p^6\ 3s^2$

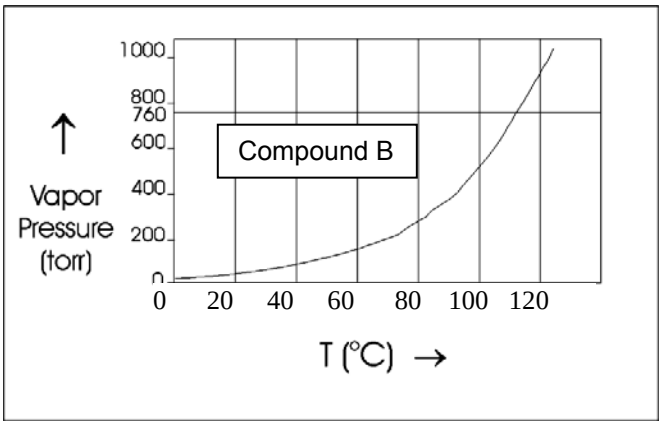
(b) As $[Ar]\ 3d^{10}\ 4s^2\ 4p^3$

(c) Cu $[Ar]\ 3d^{10}\ 4s^1$

(d) Po $[Xe]\ 6s^2\ 5d^{10}\ 6p^4$

(e) Ni $[Ar]\ 3d^8\ 4s^2$

15&16. Consider the diagram when determining the CORRECT statement.



(a) In a closed container, the vapor is in equilibrium with the liquid.

(b) At the top of a very high mountain, the boiling point is about 112°C.

(c) The vapor pressure is always equal to the atmospheric barometric pressure.

(d) The boiling point of Compound B is always equal to or greater than about 112°C.

(e) Compound B's vapor pressure is independent of the temperature.

17&18. Which element is paramagnetic with 2 unpaired electrons?

(a) Mg (b) S (c) Na (d) Al (e) Cl

19&20. Which one of the following statements about gases is FALSE?

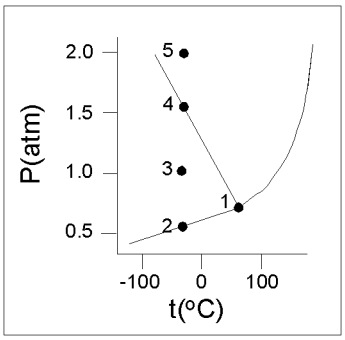
(a) The volume of the molecules of a gas is very small compared to the total volume in which the gas is contained.
(b) Gases consist of large numbers of particles in rapid random motion.
(c) The average kinetic energy of the molecules is proportional to the absolute temperature.
(d) The attractive forces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

21&22. Determine the oxidation number of carbon in the carbonate ion, CO_3^{2-}.

(a) +2 (b) +3 (c) +4 (d) +6 (e) +8

23&24. Which one of the following statements about this phase diagram is FALSE?

(a) At Point 2, the solid phase is in equilibrium with gas phase.
(b) Point 1 is called the triple point.
(c) At STP, the substance is a liquid.
(d) At Point 4, the liquid phase is in equilibrium with the solid phase.
(e) When the conditions change from Point 5 to Point 3, the temperature stays constant and the pressure changes.



25&26. One formula unit of Li_3PO_4 contains:

(a) Avogadro's number of phosphorus atoms
(b) 3 ions of Li^+
(c) 4 moles of PO_4^{3-} anions
(d) 1 mole of Li_3PO_4
(e) 31 g of P

27&28. 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.

$$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$$

(a) 21 (b) 42 (c) 19 (d) 11 (e) 10

29&30. The ionic geometry of BrF_4^+ is:

(a) tetrahedral (b) square planar (c) trigonal bipyramidal
(d) T-shaped (e) see-saw

31&32. In Bronsted-Lowry Theory of acids and bases, an acid is defined as:

(a) a water-former (b) a hydroxide donor (c) an electron-pair acceptor
(d) a proton donor (e) a proton acceptor

33&34. The following set of 4 quantum numbers: n = 4, $\ell = 2$, $m_\ell = -1$, $m_s = -1/2$ 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) V (c) Ca (d) Se (e) Kr

35&36. Consider this acid-base net ionic equation: $CH_3COOH(aq) + OH^-(aq) \rightarrow CH_3COO^-(aq) + H_2O(\ell)$

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

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

37&38. The formula weight of $(NH_4)_2SO_4$ is:

(a) 132 amu (b) 63 amu (c) 118 amu (d) 114 amu (e) 86 amu

39&40. If the pH of a solution is 3.56, what is the molarity of H^+ ions in the solution?

(a) 0.55 M (b) 1.27 M (c) 3.56 M (d) 0.028 M (e) 2.8×10^{-4} M

41&42. A sample of CO_2 occupies 3.70 liters at 20°C and 1.50 atm. What volume does it occupy at STP?

(a) 3.24 L (b) 5.17 L (c) 75.0 L (d) 16.3 L (e) 40.2 L

43&44. An oxide of lead contains 89.62 % Pb by mass. The empirical formula is:

(a) PbO_2 (b) Pb_2O_3 (c) Pb_3O_4 (d) PbO (e) PbO_3

45&46. If a system loses 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

47&48. Using bond energies, calculate ΔH_{rxn} for the reaction: H–C≡C–H(g) $\rightarrow$ 2C(g) + H_2(g)

where $\Delta_{C\text{-}H}$ = +413 kJ/mol
$\Delta_{C\equiv C}$ = +835 kJ/mol
$\Delta_{H\text{-}H}$ = +436 kJ/mol

(a) −14 kJ (b) +32 kJ (c) +1684 kJ (d) −215 kJ (e) +1225 kJ

49&50. Laughing gas (nitrous oxide or dinitrogen oxide) can be produced by carefully heating ammonium nitrate:

$$NH_4NO_3(s) \rightarrow N_2O(g) + 2H_2O(g)$$

Calculate the standard enthalpy change associated with the decomposition of 1.00 mol of $NH_4NO_3(s)$.

Compound	ΔH^o_f (kJ/mol)
Ammonium nitrate (s)	−366
Nitrous oxide (g)	+82
Water (g)	−242

(a) +103 kJ (b) −526 kJ (c) −36 kJ (d) +38 kJ (e) −206 kJ

51&52. How many moles of NH_3 will be produced when 8.94 moles of H_2O are also produced according to the following equation?

$$Ce_2O_3 + 6\ NH_4Cl \rightarrow 2\ CeCl_3 + 3\ H_2O + 6\ NH_3$$

(a) 4.47 mol (b) 13.4 mol (c) 6.00 mol (d) 17.9 mol (e) 2.24 mol

53&54. Consider the reaction:

$$2\ KCrO_2 + 3\ H_2O_2 + 2\ KOH \rightarrow 2\ K_2CrO_4 + 4\ H_2O$$

FW (g/mol)	123.1	34.0	56.1	194.2	18.0

If 20.0 g of each reactant were used for this reaction, the limiting reactant would be:

(a) $KCrO_2$ (b) H_2O_2 (c) KOH (d) K_2CrO_4 (e) H_2O

55&56. 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 released to convert 1.00 g of gaseous benzene at 80.0°C to liquid benzene at 6.0°C.

(a) 395 J (b) 131 J (c) 114 J (d) 524 J (e) 439 J

57&58. Naturally occurring thallium (atomic number 81) consists of two isotopes: ^{203}Tl with mass 202.97 amu and ^{205}Tl with mass 204.97 amu. What is the percent abundance of ^{203}Tl?

(a) 30% (b) 40% (c) 50% (d) 60% (e) 70%

59&60. The valuable solvent, carbon tetrachloride can be produced by the gas phase reaction of chlorine gas with methane.

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

Assuming this process is 87% efficient, how many kilograms of chlorine (FW=70.9 g/mol) are required for the production of 35 kg of CCl_4 (153.8 g/mol), assuming excess CH_4?

(a) 56 kg (b) 18 kg (c) 67 kg (d) 83 kg (e) 74 kg

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.** A 3.00 g sample of $KClO_3$ decomposes to yield oxygen at 25.0°C and 735 torr. What volume of oxygen is collected?

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

(3 pts) **62.** (a) Put the following compounds in order of increasing boiling point: H_2O KBr Kr HBr.

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

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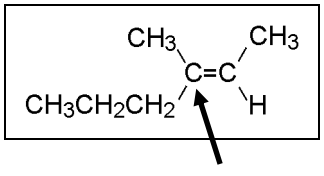
(5 pts) **63.** How many milliliters of 0.500 M HNO_3 would be required to react with 1.00 g of Al_2O_3?

$$Al_2O_3 + HNO_3 \rightarrow Al(NO_3)_3 + H_2O \quad \text{(UNBALANCED)}$$

(4 pts) **64** How many sigma and pi bonds are in the following compound?



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

SCRAP PAPER OR COMMENTS ON EXAM

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