Name: _____ I.D. Number: _____

CHEMISTRY 205 - SECTION 53 - MID TERM EXAM

March 2rd, 2015, 18:00 – 19:15 Instructor: P.H. Bird

Instructions: THIS IS A CLOSED BOOK EXAM and NO MATERIALS ARE TO BE SHARED. Please attempt all questions. The periodic table attached is the only one you are allowed to use. No electronic dictionaries are allowed. No calculators with extended memory, or cell phones being used as calculators are allowed.

Page 6 is left blank for extra space for rough work, or extra space for the answers to section III. You can also do rough work on the back of the periodic table.

Please do not write in this space.

Section I	Section II	Section III	Total

Section I. Complete each of the following five statements with the appropriate word(s). They are worth 1 mark each.

1. The mixture of salt and sand spread on icy sidewalks is called a/~~an~~ ___heterogeneous_____ mixture.
2. A/~~an~~ _beta or β_particle has a mass of about 0.00055 u, and a charge of about -1.6×10^{-19} C. (or electron)
3. A series of measurements which agree very closely with each other would be called _precise_.
4. The elements in group 16 of the periodic table are called the __chalcogens__.
5. The compound P_2O_3 would be called ___diphosphorus trioxide___.

Section II. The following 15 questions are multiple choice. They are worth 2 marks each. You may do rough work on your exam paper, but it will not be marked. You *must* mark your answers *using a pencil* on the machine readable answer form provided and circle them on this paper. *Do not forget to mark your name and student number (your birth date is not required).*

1. Which of the following separations could be best achieved by distillation?
   a. Sugar from a mixture of sand and sugar.
   b. Iron from its ore, Fe_2O_3.
   c. Pure water from sea water.
   d. Sodium ions from sodium chloride.
   e. Calcium Oxide, CaO, from limestone, $CaCO_3$.
2. All of the following are examples of chemical change EXCEPT
   a. the tarnishing (darkening) of silver.
   b. the rusting of iron.
   c. the combustion of propane gas.
   d. the dissolution of sugar in water.
   e. the generation of electricity from hydrogen gas and oxygen gas in a fuel cell.
3. A common wavelength of light emitted from a red laser pointer is 6.50×10^{-7} m. What is the wavelength in nanometers?
   a. 6.50×10^{0} nm
   b. 6.50×10^{1} nm
   c. 6.50×10^{2} nm
   d. 6.50×10^{3} nm
   e. 6.50×10^{4} nm
4. From the results of his experiment in which he bombarded gold foil with alpha particles, Ernest Rutherford determined
   a. the charge on an electron.
   b. the numbers of numbers of neutrons and protons in a gold atom.
   c. that the atoms of gold had a small, positively charged nucleus
   d. the distribution (abundance) of gold isotopes.
   e. that alpha particles are helium nuclei.

5. Lithium has two stable isotopes with masses of 6.01512 u and 7.01600 u. The average atomic mass of Li is 6.941 u. What is the percent abundance of each isotope?

   a. 62.99% Li-6 and 37.01% Li-7
   b. 50.00% Li-6 and 50.00% Li-7
   c. 12.22% Li-6 and 87.78% Li-7
   d. 7.493% Li-6 and 92.51% Li-7
   e. 5.821% Li-6 and 94.18% Li-7

   Weighted average = $6.01512*x + 7.01600*(1 - x) = 6.941$
   $\therefore x = 0.075$ (7.5%)

6. Identify the ions present when NH_4HSO_4 is dissolved in water

   a. N^{3-}, H^+, S^{2-}, and O^{2-}
   b. NH_3^+ and $H_2SO_4^-$
   c. NH_4^+ and HSO_4^-
   d. NH_4^{2+} and HSO_4^{2-}
   e. NH_5^+ and SO_4^-

7. Which atom is most likely to form a 3+ ion?

   a. K
   b. C
   c. Ga
   d. Ba
   e. Se

8. What is the empirical formula for aluminum sulfide?

   a. $AlSO_3$
   b. $Al_2(SO_4)_3$
   c. Al_4S_6
   d. $Al_3(SO_3)_2$
   e. Al_2S_3

9. What is the correct name of $Al_2(SO_4)_3$?

   a. dialuminum trisulfate
   b. aluminum(III) sulfate
   c. aluminum(III) sulfite
   d. aluminum(III) sulfur tetraoxide
   e. aluminum sulfate

10. What is the molar mass of cobalt(II) chloride hexahydrate?

    a. 94.39 g/mol
    b. 202.5 g/mol
    c. 237.9 g/mol
    d. 135.9 g/mol
    e. 129.8 g/mol

    Formula: $CoCl_2.6H_2O$ $\therefore$ mol mass = 58.93 + 2*35.45 + 6*(16.00 + 2*1.008)

11. Which one of the following compounds is a *strong acid* in water?

    a. Acetic acid, CH_3COOH
    b. Sulphuric acid, H_2SO_4
    c. Sodium hydroxide, NaOH
    d. Ethanol, CH_3CH_2OH
    e. Potassium hydrogen sulphate, $KHSO_4$

12. What is the *net ionic* equation for the reaction of sodium hydroxide with nickel(II) nitrate?

    a. $2\ Na^+(aq) + Ni^{2+}(aq) \rightarrow Na_2Ni(s)$
    b. $2\ NaOH(aq) + Ni(NO_3)_2(aq) \rightarrow Ni(OH)_2(s) + 2\ NaNO_3(aq)$
    c. $Ni^{2+}(aq) + 2\ NO_3^-(aq) \rightarrow Ni(NO_3)_2(s)$
    d. $Ni^{2+}(aq) + 2\ OH^-(aq) \rightarrow Ni(OH)_2(s)$
    e. $Na^+(aq) + NO_3^-(aq) \rightarrow NaNO_3(s)$

13. What is the oxidation number of Cr in $K_2Cr_2O_7$?

    a. –6
    b. –4
    c. +2
    d. +4
    e. +6

    This is $2\ K^+$ and $Cr_2O_7^{2-}$ so: $2x - 2*7 = -2$

14. If 300.00 mL of 1.66×10^{-1} M NaCl solution is evapourated to exactly 125 mL with water, what is the concentration of the resulting solution?

    a. 0.0692 M
    b. 0.398 M
    c. 2.51 M
    d. 14.5 M
    e. 2.40 M

    $C_1*V_1 = C_2*V_2$
    $300*0.166 = 125*x$

15. Epsom salts are a hydrated ionic compound with the formula: $MgSO_4.xH_2O$. A 4.93 g sample of Epsom salts was heated to drive off the water of crystallization. After complete dehydration, the mass of the sample was 2.41 g. Find the formula of Epsom salts.

    a. $MgSO_4.4H_2O$
    b. $MgSO_4.5H_2O$
    c. $MgSO_4.6H_2O$
    d. $MgSO_4.7H_2O$
    e. $MgSO_4.8H_2O$

    Mass of water lost = 4.93 – 2.41 = 2.52 g ≡ 2.52/18.02 = 0.1398 mol
    Mass of $MgSO_4$ = 2.41 g ≡ 2.41/(32.07+4*16.00) = 0.0200 mol
    Mole ratio of $MgSO_4 : H_2O = 0.0200 : 0.1398 \approx 1 : 7$

Section III. Answer the following 2 question with complete written answers on this exam paper. They are worth 5 marks each. *Be sure to provide adequate explanations or details to justify your answers where it is appropriate*. No explanation and correct answer- half-marks *max*. No explanation and wrong answer – zero.

1. Vitamin C, $C_6H_8O_6$, is a weak acid, and also a reducing agent. One method of determining the amount of vitamin C in a sample is to titrate it with an aqueous solution of the oxidizing agent bromine, Br_2.

$$C_6H_8O_6(aq) + Br_2(aq) \rightarrow 2HBr(aq) + C_6H_6O_6(aq)$$

A titration of a 1.00 g tablet containing vitamin C dissolved in 25.0 mL of water requires 27.85 mL of 0.102 M Br_2 solution to reach the equivalence point. What percentage (by mass) of vitamin C was in the tablet.

n Br_2 = 0.102 x 27.85/1000 = 0.0028407 mol
n $C_6H_8O_6$ = 0.0028407 because the mole ratio in the equation is 1:1.
0.0028407 mol of $C_6H_8O_6$ ≡ 0.0028407 x (6*12.01 + 8*1.008 + 6*32.00) = 0.500 g
Percentage of vitamin C in the 1 g tablet = (0.500/1.0)*100 %

"n" is often used as an abbreviation for "number of moles".

Note that the tablet was only partly vitamin C: the question asked for the percentage.

The fact that the tablet had been dissolved in 25 mL of water was irrelevant. Any reasonable quantity of water would have been OK for the titration.

2. Nitric oxide is made from the oxidation of ammonia.

$$NH_3(g) + O_2(g) \rightarrow NO(g) + H_2O(g) \qquad \text{(NOT balanced!)}$$

How many moles of nitric oxide can be made from the reaction of 4.50 mol NH_3 with 4.95 mol O_2?

Balance H (and N): $2\ NH_3(g) + O_2(g) \rightarrow 2\ NO(g) + 3\ H_2O(g)$
Balance O: $2\ NH_3(g) + 5/2\ O_2(g) \rightarrow 2\ NO(g) + 3\ H_2O(g)$
or: $4\ NH_3(g) + 5\ O_2(g) \rightarrow 4\ NO(g) + 6\ H_2O(g)$

Ideal mole ratio of $NH_3 : O_2 = 4 : 5 = 0.800$
Actual mole ratio = 4.5 : 4.95 = 0.909 ∴ NH_3 is in excess, or O_2 is limiting reagent

∴ n NO produced is based on the amount of O_2 available = 4.95 x 4/5 = 3.96 mol

Use this page for rough work, or if you need extra space for section III questions. You can also use the back of the periodic table for rough work.

Periodic Table of the Elements

1																	18
1 **H** 1.008	2											13	14	15	16	17	2 **He** 4.00
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (97.91)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	**La-Lu**	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** 208.98	85 **At** 209.99	86 **Rn** 222.02
87 **Fr** 223	88 **Ra** 226.03	**Ac-Lr**	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)									

57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.35	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
89 **Ac** 227.03	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (245)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)