

Name: _____

I.D. Number: _____

CHEMISTRY 205 - SECTION 53 - MID TERM EXAM

March 2nd, 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).

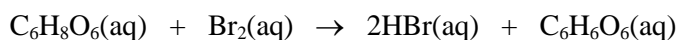
1. Which of the following separations could be best achieved by distillation?
 - a. Sugar from a mixture of sand and sugar.
 - b. Iron from its ore, Fe_2O_3 .
 - c. Pure water from sea water.
 - d. Sodium ions from sodium chloride.
 - e. Calcium Oxide, CaO, from limestone, $CaCO_3$.
2. All of the following 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 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?
- 62.99% Li-6 and 37.01% Li-7
 - 50.00% Li-6 and 50.00% Li-7
 - 12.22% Li-6 and 87.78% Li-7
 - 7.493% Li-6 and 92.51% Li-7
 - 5.821% Li-6 and 94.18% Li-7
- Weighted average =
 $6.01512 \cdot x + 7.01600 \cdot (1 - x) = 6.941$
 $\therefore x = 0.075 \text{ (7.5\%)}$
6. Identify the ions present when NH_4HSO_4 is dissolved in water
- N^{3-} , H^+ , S^{2-} , and O^{2-}
 - NH_3^+ and H_2SO_4^-
 - NH_4^+ and HSO_4^-
 - NH_4^{2+} and HSO_4^{2-}
 - NH_5^+ and SO_4^-
7. Which atom is most likely to form a 3+ ion?
- K
 - C
 - Ga
 - Ba
 - Se
8. What is the empirical formula for aluminum sulfide?
- AlSO_3
 - $\text{Al}_2(\text{SO}_4)_3$
 - Al_4S_6
 - $\text{Al}_3(\text{SO}_3)_2$
 - Al_2S_3
9. What is the correct name of $\text{Al}_2(\text{SO}_4)_3$?
- dialuminum trisulfate
 - aluminum(III) sulfate
 - aluminum(III) sulfite
 - aluminum(III) sulfur tetraoxide
 - aluminum sulfate
10. What is the molar mass of cobalt(II) chloride hexahydrate?
- 94.39 g/mol
 - 202.5 g/mol
 - 237.9 g/mol Formula: $\text{CoCl}_2 \cdot 6\text{H}_2\text{O} \therefore \text{mol mass} = 58.93 + 2 \cdot 35.45 + 6 \cdot (16.00 + 2 \cdot 1.008)$
 - 135.9 g/mol
 - 129.8 g/mol
11. Which one of the following compounds is a *strong acid* in water?
- Acetic acid, CH_3COOH
 - Sulphuric acid, H_2SO_4
 - Sodium hydroxide, NaOH
 - Ethanol, $\text{CH}_3\text{CH}_2\text{OH}$
 - Potassium hydrogen sulphate, KHSO_4

12. What is the *net ionic* equation for the reaction of sodium hydroxide with nickel(II) nitrate?
- $2 \text{Na}^+(\text{aq}) + \text{Ni}^{2+}(\text{aq}) \rightarrow \text{Na}_2\text{Ni}(\text{s})$
 - $2 \text{NaOH}(\text{aq}) + \text{Ni}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{Ni}(\text{OH})_2(\text{s}) + 2 \text{NaNO}_3(\text{aq})$
 - $\text{Ni}^{2+}(\text{aq}) + 2 \text{NO}_3^-(\text{aq}) \rightarrow \text{Ni}(\text{NO}_3)_2(\text{s})$
 - $\text{Ni}^{2+}(\text{aq}) + 2 \text{OH}^-(\text{aq}) \rightarrow \text{Ni}(\text{OH})_2(\text{s})$
 - $\text{Na}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{NaNO}_3(\text{s})$
13. What is the oxidation number of Cr in $\text{K}_2\text{Cr}_2\text{O}_7$?
- 6
 - 4
 - +2 This is 2 K^+ and $\text{Cr}_2\text{O}_7^{2-}$ so: $2x - 2*7 = -2$
 - +4
 - +6
14. If 300.00 mL of $1.66 \times 10^{-1} \text{ M}$ NaCl solution is evaporated to exactly 125 mL with water, what is the concentration of the resulting solution?
- 0.0692 M
 - 0.398 M
 - 2.51 M $C_1*V_1 = C_2*V_2$
 $300*0.166 = 125*x$
 - 14.5 M
 - 2.40 M
15. Epsom salts are a hydrated ionic compound with the formula: $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$. 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.
- $\text{MgSO}_4 \cdot 4\text{H}_2\text{O}$
 - $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$
 - $\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$
 - $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
 - $\text{MgSO}_4 \cdot 8\text{H}_2\text{O}$
- Mass of water lost = $4.93 - 2.41 = 2.52 \text{ g} \equiv 2.52/18.02 = 0.1398 \text{ mol}$
Mass of $\text{MgSO}_4 = 2.41 \text{ g} \equiv 2.41/(32.07+4*16.00) = 0.0200 \text{ mol}$
Mole ratio of $\text{MgSO}_4 : \text{H}_2\text{O} = 0.0200 : 0.1398 \approx 1 : 7$

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 .



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.

$$n Br_2 = 0.102 \times 27.85/1000 = 0.0028407 \text{ mol}$$

$$n C_6H_8O_6 = 0.0028407 \text{ because the mole ratio in the equation is 1:1.}$$

$$0.0028407 \text{ mol of } C_6H_8O_6 \equiv 0.0028407 \times (6 \times 12.01 + 8 \times 1.008 + 6 \times 16.00) = 0.500 \text{ g}$$

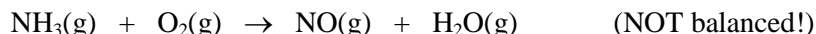
$$\text{Percentage of vitamin C in the 1 g tablet} = (0.500/1.0) \times 100 \%$$

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

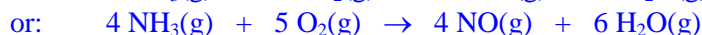
Note that the tablet was only partly vitamin C: the question asked for the percentage.

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.



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



$$\text{Ideal mole ratio of } NH_3 : O_2 = 4 : 5 = 0.800$$

$$\text{Actual mole ratio} = 4.5 : 4.95 = 0.909 \quad \therefore NH_3 \text{ is in excess, or } O_2 \text{ is limiting reagent}$$

$$\therefore n \text{ NO produced is based on the amount of } O_2 \text{ available} = 4.95 \times 4/5 = 3.96 \text{ mol}$$

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	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.008	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	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)