Exam 1 Chm 203 (Dr Mattson) 20 September 2012

Academic Integrity Pledge: *In keeping with Creighton University's ideals and with the Academic Integrity Code, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.*

Signature:

Instructions: Show all work whenever a calculation is required! Write legibly. Include units whenever appropriate. BOX YOUR ANSWERS! You will receive credit for how you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in the answer box and then attach the periodic table. At your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks and purses must be stored in the front of the room. Cell phones must be OFF and placed at the front of the room. Note: [SF] means significant figures count for this problem.

1. (5 pts) Give **one** example (atomic symbol) for each:

	Type of Element:	Example:
(a)	Alkali metal	
(b)	Noble gas	
(c)	Semi-metal	
(d)	Non-metal	
(e)	Transition metal	

2. (4 pts) Convert the volume of a chemical tank car, 114,000 L, into units of m^3. [SF]

3. (4 pts) The diameter of a soccer ball is about 22 cm and the diameter of a gold atom is 260 pm. How many gold atoms, lined up end-to-end, would it take to equal the diameter of a soccer ball? [SF]

4. (3 pts) Metric Sense. Circle the three statements below that are reasonable.
   (a) A rock with a diameter of 1×10^{13} pm is too heavy to lift by just one person.
   (b) The filled swimming pool held 400 m^3 of water.
   (c) The mass of a H atom is 1.6×10^{24} g.
   (d) My cat has a mass of 4.5×10^{-3} g
   (e) In town, cars usually drive around 500 cm/hr.
   (f) A mass of 4 kg is typical for a baby human.

5. (3 pts) How many protons and neutrons are in each of the following?

	protons	neutrons
$^{87}_{38}Sr$		
$^{81}_{35}Br$		
$^{201}_{80}Hg$		

6. (3 pts) A piece of cobalt with an irregular shape has a mass of 407 g. Knowing the density of cobalt is 8.90 g/cm^3, what is the volume (in cm^3) of the object? Show your work. [SF]

7. (4 pts) Boron exists in two isotopic forms. Given: ^{10}B has an abundance of 19.9%, and an isotopic mass of 10.0129 amu. Use the atomic mass of boron from your periodic table, to calculate the isotopic mass of the second isotope in amu?

8. (4 pts) Use Avogadro's number (6.02×10^{23}) to determine how many gold atoms are in an old coin, known to be pure gold, with mass of 28 g? [SF]

9. Rhodium exists with only one stable isotope, ^{103}Rh.

9a. (2 pts) Write the nuclear transformation that occurs for the unstable isotope ^{107}Rh.

9b. (1 pt) The isotope ^{101}Rh decays with the production of ^{101}Ru. Emission of what particle would cause this?

A. alpha B. beta C. positron D. none of these

9c. (2 pts) In cases where the neutron-to-proton ratio is very low, isotopes can emit an α-particle. Predict the outcome of an α-emission from ^{96}Rh.

10. (10 pts) Nomenclature. Complete the table. (Skip this question if you are nomenclature certified.)

Formula:	Name:
SO_3	
$Mg(NO_3)_2$	
CaF_2	
N_2O_3	
$KC_2H_3O_2$	
	sodium chloride
	phosphorus pentafluoride
	lithium carbonate
	titanium(IV) sulfite
	ammonium nitrate

11. (3 pts) Balance the following equation with the smallest whole number coefficients. (No partial credit)

___ N_2O_4 + ___ NH_3 → ___ N_2 + ___ H_2O

12. (3 pts) How many moles of oxygen atoms are in 172 g of KIO_4? [SF]

13. Heating dry Na_2SO_3 leads to decomposition according to the reaction given below. [Given molar masses (in g/mol): Na_2SO_3: 126.06; Na_2S: 78.05; Na_2SO_4: 142.05]

$$4\ Na_2SO_3 \rightarrow Na_2S + 3\ Na_2SO_4$$

13a. (4 pts) How many moles of Na_2SO_4 are expected from the reaction 64.0 g of Na_2SO_3?

13b. (4 pts) What mass of Na_2S is expected from the decomposition of 9.2 mol Na_2SO_3?

13c. (4 pts) Referring to your answer in above, what is the percent yield if the actual yield is 155 g?

14. Consider the balanced reaction:

$$6\ SnCl_2 + 8\ HCl + 2\ SO_2 \rightarrow 5\ SnCl_4 + SnS_2 + 4\ H_2O$$

[MM (g/mol): $SnCl_2$: 189.61; HCl: 36.46; SO_2: 64.07]

14a. (4 pts) Suppose 5.02 g $SnCl_2$, 3.81 g HCl, and 2.02 g SO_2 are used in the reaction. Which is the limiting reagent? No credit unless work is carefully shown.

14b. (4 pts) Based on your answer to problem 14a, what is the theoretical yield of tin(IV) chloride, in moles?

14c. (4 pts) What volume, in mL, of 12.1 M HCl(aq) is required to react completely with 7.551 g $SnCl_2$, assuming excess SO_2? (See balanced equation above.)

15. (5 pts) Sodium disulfate consists of sodium, sulfur and oxygen. Elemental analysis gives 20.70 % Na and 28.88 % S. What is the empirical formula?

For DocM to complete:

Subtotal from exam: _____

Homework: (20 max) _____

Total: _____

Answers:

1. (5 pts) Give **one** example (atomic symbol) for each:

	Type of Element:	Example:
(a)	Alkali metal	Li, Na, K, Rb, etc
(b)	Noble gas	He, Ne, Ar, Kr, etc.
(c)	Semi-metal	Si, Ge, As, Sb, etc.
(d)	Non-metal	O, N, F, H, etc.
(e)	Transition metal	Sc, Ti, V, Fe, etc.

2. 114 m^3

3. 8.5 x 10^8 Au atoms

4. a, b, f

5.

	protons	neutrons
$^{87}_{38}Sr$	38	49
$^{81}_{35}Br$	35	46
$^{201}_{80}Hg$	80	121

6. 45.7 cm^3

7. 11.008 amu?

8. 8.6 x 10^{22} gold atoms

9a. $^{107}_{45}Rh \rightarrow {}^{0}_{-1}e + {}^{107}_{46}Pd$

9b. C

9c. $^{96}_{45}Rh \rightarrow {}^{4}_{2}\alpha + {}^{92}_{43}Tc$

10.

Formula:	Name:
SO_3	sulfur trioxide
$Mg(NO_3)_2$	magnesium nitrate
CaF_2	calcium fluoride
N_2O_3	dinitrogen trioxide
$KC_2H_3O_2$	Potassium acetate
NaCl	sodium chloride
PF_5	phosphorus pentafluoride
Li_2CO_3	lithium carbonate
$Ti(SO_3)_2$	titanium(IV) sulfite
NH_4NO_3	ammonium nitrate

11. 3 N_2O_4 + 8 NH_3 → 7 N_2 + 12 H_2O

12. 2.99 moles of oxygen atoms

13a. 0.381 moles Na_2SO_4

13b. 179.5 g Na_2S

13c. 86.3%

14a. $SnCl_2$

14b. 0.0221 mol $SnCl_4$

14c. 4.39 mL HCl(aq)

15. $Na_2S_2O_7$