Name _____

Student number _____

Chem 115
Sample Examination #1

This exam consists of seven (7) pages, including this cover page. Be sure your copy is complete before beginning your work. If this test packet is defective, ask for another one.

A copy of the Periodic Table is attached to the end of this exam. You may remove it and use the back side as scratch paper. No work on scratch paper will be graded or collected.

The following information may be useful:

Constants of nature	Conversions/Metric Prefixes
Avogadro's number $N_A = 6.022 \times 10^{23}$ units = 1 mole of units	1 mL = 1 cm^3

DO NOT WRITE BELOW THIS LINE

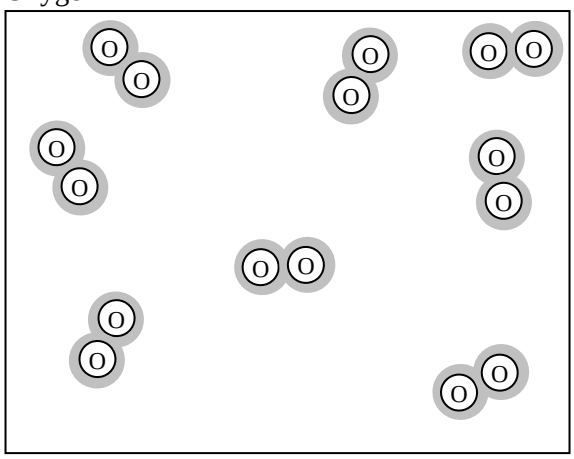
Part I: Multiple-choice	Part II: Problems	Part III: Laboratory
Q1-18 _____ (max 54)	Problem 1 _____ (max 20) Problem 2 _____ (max 16) Extra credit _____ (max 4)	*omitted from this sample exam since laboratory is now a separate course*

Total (out of 100 points) = *due to Part III omission, no longer sums to 100*

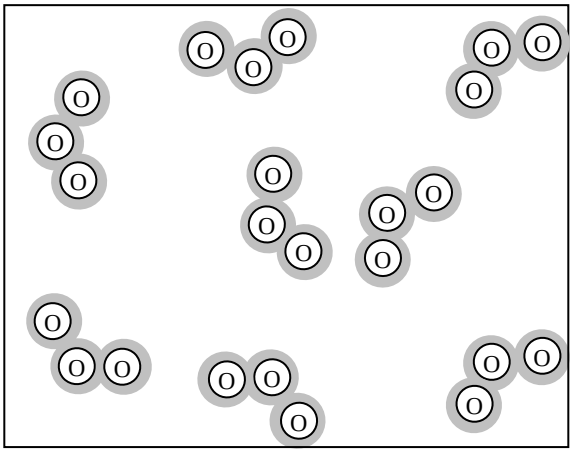
Part I. Multiple-Choice or Short Response

Each multiple-choice question is worth 3 points. This part of the exam is worth 54% of the total points.

Oxygen



Ozone



1. Oxygen and ozone (pictured above) are

A) the same substance and the same element.
B) the same element, but two different substances.
C) the same substance, but two different elements.
D) two different substances and two different elements.

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2. What is the molar mass (in $g \cdot mol^{-1}$) of anhydrous iron (III) sulfate, to the nearest whole number?

Atomic molar masses	
Fe	55.8 $g \cdot mol^{-1}$
O	16.0 $g \cdot mol^{-1}$
S	32.1 $g \cdot mol^{-1}$

A) 104 B) 152 C) 248 D) 336 E) 400

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3. The species designated as $^{56}_{24}X$ is

A) Fe B) Ge C) Ba D) Cr

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4. Which pair of particles has the same number of electrons?

A) F^-, Mg^{2+}
B) Ne, Ar
C) Br^-, Se
D) Al^{3+}, P^{3-}

5. The ions present in solid silver chromate, Ag_2CrO_4, are

A) Ag^{+} and CrO_4^{2-} C) Ag^{+} and Cr^{6+} and O^{2-}

B) Ag^{2+} and CrO_4^{4-} D) Ag^{+} and Cr^{3+} and O^{2-}

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6. Which represents an isotope of element "E"?

$$^{27}_{13}\mathrm{E}$$

A) ^{26}Al B) ^{27}Si C) ^{27}Co D) ^{25}Mg

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7. What is the correctly reported mass of water based on these data?

Mass of beaker and water	29.62 g
Mass of beaker only	28.3220 g

A) 1.3 g B) 1.30 g C) 1.298 g D) 1.2980 g

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8. Based on their positions in the periodic table, which is most likely to replace selenium, Se, in a biological system?

A) Te B) Br C) As D) I

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9. Balance the equation

$$? \ N_2H_4 + ? \ N_2O_4 \rightarrow ? \ N_2 + ? \ H_2O$$

How many moles of N_2 will be produced for every mole of N_2O_4 that reacts?

A) one B) two C) three D) four

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10. Which procedure can be used to demonstrate experimentally that the reaction

$$2 \ Mg + O_2 \rightarrow 2 \ MgO$$

A) Take a mass of 1.000 g of Mg ribbon, burn it in pure O_2, and compare the mass of the product with the original mass of the Mg.

B) Show that the sum of 2 atomic momlar masses of Mg plus 1 molar mass of O_2 is equal to 2 molar masses of MgO.

C) Determine the mass of a sealed flash-bulb containing magnesium and oxygen, ignite (light on fire) the mixture, cool, and compare the final mass of bulb plus contents with the original mass of the bulb plus contents.

D) Burn 1.000 g of Mg ribbon in a tall beaker filled with air, scrape out all of the MgO formed, and compare with the original mass of the Mg.

Use the periodic table below for questions 11-12.

	Main Groups							
	1	2	3	4	5	6	7	8
First period								$_{2}$He
Second period							$_{9}$F	
Third period	$_{19}$K	E		M		Q	T	$_{36}$Kr
Fourth period	X	Y						

11. Judging from its position in the periodic table, what type of element is element X?

A) a metal

B) a nonmetal

C) an amphoteric element

D) an inert gas

E) unpredictable in character

12. How many electrons will an atom of element Q need to gain to form a stable ion?

A) 1 B) 2 C) 3 D) 4 E) 7

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13. If 1.0 g samples of each compound were dehydrated, which sample would lose the greatest mass of water?

Molar masses	
$LiCl \bullet H_2O$	60. $g \cdot mol^{-1}$
$MgSO_4 \bullet H_2O$	138. $g \cdot mol^{-1}$
$FeSO_4 \bullet H_2O$	170. $g \cdot mol^{-1}$
$SrC_2O_4 \bullet H_2O$	194. $g \cdot mol^{-1}$

A) $LiCl \bullet H_2O$

B) $MgSO_4 \bullet H_2O$

C) $FeSO_4 \bullet H_2O$

D) $SrC_2O_4 \bullet H_2O$

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14. A compound containing only carbon and hydrogen has this composition: C = 80% and H = 20% by mass. What is the simplest formula of the compound?

Atomic molar masses	
C	12.0 $g \cdot mol^{-1}$
H	1.0 $g \cdot mol^{-1}$

A) CH_4 B) CH_3 C) C_2H_6 D) C_3H_8 E) C_4H

15. What is the percentage of nitrogen by mass in $(NH_4)_3PO_4$?

Atomic molar masses	
H	1.0 g·mol^{-1}
N	14.0 g·mol^{-1}
O	16.0 g·mol^{-1}
P	31.0 g·mol^{-1}

A) (14/62) × 100%
C) (14/113) × 100%
B) (21/80.) × 100%
D) (42/149) × 100%

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16. The element X occurs naturally to the extent of 20.0% ^{12}X and 80.0% ^{13}X. The atomic mass of X is nearest to

A) 12.2 B) 12.5 C) 12.6 D) 12.8 E) 13.0

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17. Why is the following equation incorrect?

$$Mg_3 + N_2 \rightarrow Mg_3N_2$$

A) Some of the subscripts are incorrectly used.
B) The equation is not balanced.
C) The valence (charge) of the nitride ion is incorrect.
D) The valence (charge) of the magnesium ion is incorrect.
E) The coefficient of N_2 is incorrect.

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18. Which of these atoms has the greatest number of neutrons in its nucleus?

A) $^{52}_{26}$Fe B) $^{56}_{25}$Mn C) $^{55}_{26}$Fe D) $^{57}_{27}$Co E) $^{56}_{28}$Ni

Part II. Problems

Points possible per question and per part are indicated in curly braces {…}.

1. {20 pts} Nomenclature: correct spelling and correct symbols matter.

a) Name the following compounds. {10 pts}

NaCl _____

HCl _____

$HClO_2$ _____

CH_4 _____

$Ni(NO_2)_2$ _____

b) Provide chemical formulas for the following compounds. {10 pts}

calcium fluoride _____

dinitrogen tetroxide _____

ammonium permanganate _____

hypobromous acid _____

iron (II) sulfate _____

2. {16 pts} Consider the following reaction:

$$2\ NO_2\ (g)\ +\ Cl_2\ (g)\ \rightarrow\ 2\ NO_2Cl\ (g)$$

Molar masses	
NO_2	46.01 g·mol^{-1}
Cl_2	70.90 g·mol^{-1}
NO_2Cl	81.46 g·mol^{-1}

Notes:
- *The parts of this problem are independent.*
- *You must show your work to receive credit. Partially correct work will receive partial credit. A correct answer with no work shown will receive no credit.*

a) How many molecules of Cl_2 are in 1.39 g of Cl_2? {6 pts}

b) If 1.39 g of Cl_2 reacts with sufficient NO_2 for the reaction to go to completion, how many grams of NO_2Cl will be produced? {10 pts}

Extra credit on this problem: If 2.10 g of NO_2 and 2.00 g of Cl_2 were placed in a reaction vessel and this reaction occurred, which one would be the limiting reagent?
{up to 4 pts extra credit, work must be shown to receive extra credit, use back side of this page if the space below is insufficient}