Ch 115 General Chemistry I
EXAMINATION 1
September 18, 2007

Name: ________________________ Rec. Sec.: ______ Rec. Instr.: ______

"I pledge my honor that I have abided by the Stevens Honor System" (signed) ________________________

Each problem 5 points; Bonus problem 10 points for correct answer.

Avogadro = 6.022x10^23 molecules/mole

1. Express 0.00560 in exponential notation.
   A) 5.60 x 10^-3  B) 5.60 x 10^-4  C) 5.60  D) 5.6 x 10^-3  E) none of these

2. A titration was performed to find the concentration of hydrochloric acid with the following results:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Molarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.25 ± 0.01</td>
</tr>
<tr>
<td>2</td>
<td>1.24 ± 0.01</td>
</tr>
<tr>
<td>3</td>
<td>1.26 ± 0.01</td>
</tr>
</tbody>
</table>

   The actual concentration was determined to be 1.000M. The results of the titration are:
   A) precise but inaccurate.
   B) accuracy and precision are impossible to determine with the available information.
   C) both inaccurate and imprecise.
   D) accurate but imprecise.
   E) both accurate and precise.

3. A piece of indium with a mass of 16.56 g is submerged in 46.3 cm³ of water in a graduated cylinder. The water level increases to 48.6 cm³. The correct value for the density of indium from these data is:
   A) 7.2 g/cm³
   B) 0.139 g/cm³
   C) more than 0.1 g/cm³ away from any of these values.
   D) 0.14 g/cm³
   E) 7.200 g/cm³

4. Using the rules of significant figures, calculate the following: 4.0021 - 0.501
   A) 3.5  B) 3.501  C) 4  D) 3.501  E) 3.50

5. Manganese makes up \(1.1\times10^{-4}\) percent by mass of the elements found in a normal healthy body. How many grams of manganese would be found in the body of a person weighing 188 lb? (2.24 lb = 1.0 kg)
   A) 0.11 g  B) 11 g  C) 0.24 g  D) 1.1e3 g  E) none of these is correct

\[ \frac{188\text{ lb}}{2.24\text{ lb}} \times 1\text{ kg} \]
6. The beakers shown below have different precisions as shown.

Suppose you pour the water from these three beakers into one container. What would be the volume in the container reported to the correct number of significant figures?
A) 78.82 mL  B) 78.8 mL  C) 90 mL  D) 79 mL  E) 78.817 mL

7. Which of the following has 61 neutrons, 47 protons, and 46 electrons?
A) {\text{Ag}}^{108}  B) {\text{Ag}}^{108+}  C) {\text{Pm}}^{108}  D) {\text{Ag}}^{108}  E) {\text{Cd}}^{108+}

8. Which of the following are incorrectly paired?
A) Platinum, Pt  B) Potassium, K  C) Palladium, Pd  D) Phosphorus, Pr  E) Lead, Pb

9. Which of the following is incorrectly named?
A) Nitrite ion  B) Phosphate ion  C) Nitric acid  D) Lead(II) nitrate  E) Ammonium perchlorate

10. Write the names of the following compounds:
   a) FeSO$_4$  b) Na$_2$C$_2$H$_3$O$_2$  c) KNO$_2$  d) Ca(OH)$_2$  e) NiCO$_3$

11. Write the chemical formulas for the following compounds or ions.
   a) Nitrate ion  b) Aluminum oxide  c) Ammonium ion  d) Perchloric acid  e) Copper(II) bromide

12. You are given a compound with the formula MCl$_2$, in which M is a metal. You are told that the metal ion has 26 electrons. What is the identity of the metal?
A) Cr  B) Fe  C) Co  D) Ni  E) Al
13. Naturally occurring iron contains 5.82% $^{56}$Fe, 91.66% $^{57}$Fe, 2.19% $^{54}$Fe, and 0.33% $^{55}$Fe. The respective atomic masses are 55.940 amu, 55.935 amu, 56.935 amu, and 57.933 amu. Calculate the average atomic mass of iron.

14. What is the molar mass of Ca$_3$(PO$_4$)$_2$?
   A) 87.05 g/mol  B) 135.05 g/mol  C) 166.02 g/mol  D) 310.18 g/mol  E) 118.02 g/mol

15. You take an aspirin tablet (a compound consisting solely of carbon, hydrogen, and oxygen) with a mass of 1.00 g, burn it in air, and collect 2.20 g of carbon dioxide and 0.400 g water. The molar mass of aspirin is between 100 glmol and 130 glmol. The molecular formula of aspirin is
   A) C$_5$H$_7$O$_5$  B) C$_6$H$_5$O$_4$  C) C$_3$H$_4$O$_2$  D) C$_2$H$_6$O$_5$  E) C$_3$H$_5$O$_3$

16. The hormone epinephrine is released in the human body during stress and increases the body's metabolic rate. Epinephrine, like many biochemical compounds, is composed of carbon, hydrogen, oxygen, and nitrogen. The percentage composition of the hormone is 56.8% C, 6.56% H, 28.4% O, and 8.28% N. Determine the empirical formula.

17. How many grams of H$_2$O will be formed when 32.0 g H$_2$ is mixed with 73.0 g O$_2$ and allowed to react to form water?
   A) 286 g  B) 20.5 g  C) 144 g  D) 41.1 g  E) 82.2 g

18. A 15-g sample of lithium is reacted with 15 g of fluorine to form lithium fluoride: 2Li + F$_2$ → 2LiF. After the reaction is complete, what will be present?
   A) 0.789 moles lithium fluoride only  B) 2.16 moles lithium fluoride and 0.395 moles fluorine
   C) 0.789 moles lithium fluoride and 1.37 moles lithium  D) 2.16 moles lithium fluoride only

19. One of the major commercial uses of sulfuric acid is in the production of phosphoric acid and calcium sulfate. The phosphoric acid is used for fertilizer. The reaction is Ca$_3$(PO$_4$)$_2$ + 3H$_2$SO$_4$ → 3CaSO$_4$ + 2H$_3$PO$_4$. What mass of concentrated H$_2$SO$_4$ (98% by mass) must be used to react completely with 100.00 g of calcium phosphate?

20. Which of the following aqueous solutions contains the greatest number of ions?
   A) 200.0 mL of 0.10 M KBr  B) 400.0 mL of 0.10 M NaCl  C) 300.0 mL of 0.10 M CaCl$_2$
In a metallurgical process, pyrite, FeS₂, is roasted in air:
\[ \text{FeS}_2 + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2 \]
The SO₂ is then converted into H₂SO₄ in the following reactions:
\[ 2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3 \]
\[ \text{SO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{SO}_7 \]
\[ \text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4 \]
Assuming the mineral is 24.0% FeS₂ and the remainder is inert, what mass of H₂SO₄ is produced if 155 g of the mineral is used?

\[
\frac{155}{55} \text{ FeS}_2 \times 2 \text{ mol } (2 \times 32) = \frac{1.293 \text{ mol}}{\text{FeS}_2} \\
\times \frac{3 \times 2 \text{ mol SO}_2}{62 \text{ mol SO}_2} = \frac{0.62 \text{ mol SO}_2}{62 \text{ mol SO}_2} \times \frac{3 \times 119}{62} \text{ mol H}_2\text{SO}_4 = 6.08 \text{ mol H}_2\text{SO}_4
\]

6.08 g H₂SO₄ produced.