Instructions:

_Do not open this test until you are told to do so._ Write your name on the front cover of this test and wait until you are told to open the exam. When you are told to proceed, first scan over _all_ the questions and make sure that you have 8 questions written on the next 5 pages.

NB: There is a periodic table attached as the last page of this exam.

Equations and Constants:

\[ N_A = 6.022 \times 10^{23} \]

Answer keys for this exam will be available on ChemBoard, after 5 pm today.

_Hints:_

- Do the problems you find easiest first.
- Show all calculations clearly, display the correct number of significant figures and write down units everywhere to receive full credit.
- Partial credit will be given if you set the problems up correctly.
1. (7 pts) Complete the following table:

<table>
<thead>
<tr>
<th>Nuclear Symbol</th>
<th># Protons</th>
<th># Neutrons</th>
<th># Electrons</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{55}_{25}Mn^{4+}$</td>
<td>________</td>
<td>________</td>
<td>________</td>
<td>+ 4</td>
</tr>
<tr>
<td>________</td>
<td>82</td>
<td>125</td>
<td>81</td>
<td>________</td>
</tr>
<tr>
<td>________</td>
<td>_____</td>
<td>18</td>
<td>18</td>
<td>- 1</td>
</tr>
</tbody>
</table>

2. (18 pts) Complete the following table:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Chemical Name</th>
<th>Formula</th>
<th>Molar Mass</th>
<th># moles</th>
<th># C atoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0 µg</td>
<td>sodium carbonate</td>
<td>__________</td>
<td>106 g/mol</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td></td>
<td>hexane</td>
<td>__________</td>
<td>86 g/mol</td>
<td>________</td>
<td>2.0 x 10$^{28}$</td>
</tr>
<tr>
<td></td>
<td>Fe(ClO$_3$)$_2$</td>
<td>__________</td>
<td>0.150</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

3. (5 pts) What is the mass percent composition of oxygen in tin(IV) hydroxide?
4. A white precipitate forms when 26.0 g of solid calcium nitrate is mixed with $1.00 \times 10^2$ mL of 2.50 M aqueous ammonium sulfate.

(a) (2 pts) Give the chemical formula of the precipitate.

(b) (3 pts) Write the balanced net ionic equation for this reaction.

(c) (8 pts) Assuming 100 % yield, calculate the mass of the precipitate.

(d) (7 pts) Calculate the concentrations of all dissolved ions at the end of the reaction.
5. (8 pts) Consider the following chemical reaction that produces ammonia:

\[ \text{CaO} + 2\text{NH}_4\text{Cl} \rightarrow 2\text{NH}_3 + \text{H}_2\text{O} + \text{CaCl}_2 \]

If 2100 kg of ammonia are produced in this reaction, and the process is known to have only a 82% yield, how many kg of CaO were present initially?

6. (8 pts) There are only two naturally occurring isotopes of copper: \(^{63}\text{Cu}\) and \(^{65}\text{Cu}\). Use the periodic table atomic molar mass value to predict what spectrum you would see if you put a sample of copper into a mass spectrometer. Explain in a few words.
7. Beryllium metal reacts violently with hydrochloric acid to form beryllium ions and hydrogen gas. If 11.5 g of beryllium metal shavings are added to a beaker with 300.0 mL of 3.0 M HCl solution, and the reaction is allowed to go to completion:

(a) (2 pts) Give a balanced equation for this reaction.

(b) (2 pts) What kind of reaction is this? ________
   a) acid-base
   b) precipitation
   c) combustion
   d) redox

(c) (10 pts) If the yield is 100 %, how many grams of hydrogen gas are formed?

(d) (2 pts) Identify the limiting reagent (if any).
8. An odorless organic liquid undergoes a combustion analysis and 0.105 g of this liquid gives 0.262 g of carbon dioxide and 0.129 g of water. In a later experiment, the molar mass is determined to be approximately 88 g/mol.

(a) (12 pts) What is the correct molecular formula for this compound?

(b) (3 pts) Draw a possible line structure for this compound.

(c) (3 pts) Name this compound.