Science 9 Chapter 2 Lab – Reactions with metals and non-metals

Purpose: To explore the relationship of metals and non-metals in chemical reactions and to see how their ion charges affect their ability to bind with each other.

Materials: safety goggles: these must be worn at all times during the lab
           test tubes
           test tube holder
           small beaker of hydrochloric acid HCl
           solution of silver acetate AgCH$_3$COO
           ingots of zinc metal Zn
           aluminum metal Al

Procedure: Be sure to wear your safety goggles

- Collect the test tube holder with the three test tubes and the beaker with the hydrochloric acid in it. Transport them to your work station carefully. The tubes are empty for the moment. Take special care with the hydrochloric acid.
- The teacher will come around with an ingot of metal or with a solution of silver acetate. The substance will be placed in one of the empty test tubes.
- Obtain a pen or pencil and be prepared to take notes on what happens. When ready, pour the acid into the test tube:
  - for the ingot, fill the test tube half full
  - for the silver acetate solution, pour acid in so that it is about 3/4 of the way to the top.
- Pour the solution in. Record the following information:
  - immediate reaction notes
  - reaction notes after 1 minute
  - reaction notes after 5 minutes
  - did the test tube get colder, warmer, or hot (caution with the aluminum)
- Draw what you saw in the test tube in the space provided on the following page.
- Repeat the process for the next sample and after that the last sample.
- When finished process for the next sample and after that the last sample.
- When finished clean everything up. Wash your hands.

Results:
Test tube A: reactant: ________________________ Observations after:
immediate: __________________________________________________________________________
one minute: __________________________________________________________________________
5 minutes: __________________________________________________________________________
Test tube B: reactant: ________________________ Observations after:
immediate: __________________________________________________________________________
one minute: __________________________________________________________________________
5 minutes: __________________________________________________________________________
Test tube B: reactant: _______________________ Observations after:
immediate: _____________________________________________________________
one minute: ___________________________________________________________
5 minutes: _____________________________________________________________

In the space below draw what you observed. Put some effort into the diagram. Label all your diagrams accordingly.

Part A  Part B  Part C

__________________  __________________  __________________

(write the names of the reactant which you mixed together in the lines above)

The three reactions are as follows:

<table>
<thead>
<tr>
<th>Reactant</th>
<th>Reaction</th>
<th>What you saw</th>
</tr>
</thead>
<tbody>
<tr>
<td>silver acetate: AgCH₃COO + HCl → AgCl + CH₃COOH</td>
<td>Silver chloride precipitates</td>
<td></td>
</tr>
<tr>
<td>zinc:         Zn + 2 HCl → ZnCl₂ + H₂</td>
<td>Hydrogen gas is released</td>
<td></td>
</tr>
<tr>
<td>aluminum:     2 Al + 6 HCl → 2 AlCl₃ +3 H₂</td>
<td>Aluminum chloride precipitates</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydrogen gas is released</td>
</tr>
</tbody>
</table>

Discussion: Answer all questions in full sentences where appropriate. You will need your text for definitions and to use the periodic table.

1. Define the following terms (use your glossary):
   a) ion: _____________________________________________________________
   b) ion charge: _____________________________________________________
   c) reactants: _____________________________________________________
   d) products: _____________________________________________________
   e) precipitate: a solid that forms in a solution from a chemical reaction (copy this out below)
2. Turn to page 98 in your textbook and read the section on Evidence of Chemical Change. Answer the following questions:

a) Fill in the blanks: A chemical change produces new _______________ with new _______________ and is always accompanied by _______________ changes, which might or might not be _______________. In a _______________ change, new _______________ are formed while other _______________ are broken.

b) What are the 4 pieces of evidence that chemical change has occurred:

3. What was the evidence of chemical change with:

a) silver acetate? ____________________________________________________________

b) zinc? ____________________________________________________________

c) aluminum? ____________________________________________________________

4. How were the zinc and aluminum reactions with hydrochloric acid …

a) the same? ____________________________________________________________

b) different? ____________________________________________________________

5. How were the silver acetate and aluminum reactions with hydrochloric acid …

a) the same? ____________________________________________________________

b) different? ____________________________________________________________

6. Refer to the periodic table. Record the charges on the ions of:

a) chlorine: _____ b) silver: _____ c) zinc: _____ d) aluminum: _____

7. The chemical formula for each of the three new products produced are:

a) silver chloride = AgCl b) zinc chloride = ZnCl₂ c) aluminum chloride = AlCl₃

**This is important:** The silver ion has a +1 charge, the chlorine ion a -1 charge. When they combine they do so in a 1:1 ratio so that the charges balance out. Each molecule of silver chloride is neutral because the charges balance out. The zinc ion needs two chlorine ions to balance out its +2 charge. That is why its formula is ZnCl₂. The aluminum ion needs 3 chlorine ions.
8. Predict what the formulas would be for the compounds listed below. Examples are given.

<table>
<thead>
<tr>
<th>Name of elements</th>
<th>ions involved (+ first, - second)</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Sodium and oxygen</td>
<td>Na&lt;sup&gt;+&lt;/sup&gt; O&lt;sup&gt;-2&lt;/sup&gt;</td>
<td>need 2 Na&lt;sup&gt;+&lt;/sup&gt; to balance O&lt;sup&gt;-2&lt;/sup&gt;</td>
</tr>
<tr>
<td>b) Calcium and sulphur</td>
<td>Ca&lt;sup&gt;+2&lt;/sup&gt; S&lt;sup&gt;-2&lt;/sup&gt;</td>
<td>need 1 Ca&lt;sup&gt;+&lt;/sup&gt; to balance O&lt;sup&gt;-2&lt;/sup&gt;</td>
</tr>
<tr>
<td>c) Aluminum and iodine</td>
<td>Al&lt;sup&gt;+3&lt;/sup&gt; Br&lt;sup&gt;-&lt;/sup&gt;</td>
<td>need 3 Br&lt;sup&gt;-&lt;/sup&gt; to balance Al&lt;sup&gt;+3&lt;/sup&gt;</td>
</tr>
<tr>
<td>d) Zinc and oxygen</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>e) Sodium and oxygen</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>f) Magnesium and chlorine</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>g) Potassium and flourine</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>h) Calcium and iodine</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>i) Strontium and nitrogen</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>j) Barium and sulphur</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>k) Aluminum and oxygen</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>l) Hydrogen and fluorine</td>
<td>___ ___</td>
<td>______________</td>
</tr>
<tr>
<td>m) Lithium and nitrogen</td>
<td>___ ___</td>
<td>______________</td>
</tr>
</tbody>
</table>

Conclusion: State what the lab was about – be sure to use the underlined words; be specific.