What is a decomposition reaction?

**KEY TERMS**
- decomposition: breakdown of a substance into simpler substances
- electrolysis: decomposition of a substance by means of electricity

\[ 2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2 \]
Synthesis reactions build compounds. Anything that can be built can also be taken apart. The breakdown of a compound into simpler substances is called decomposition [dee-kahm-puh-ZISH-un]. Decomposition is a chemical process.

Let us look at two examples.

1. Common table salt (sodium chloride) is a compound. It is composed of the elements sodium and chlorine.

   Sodium chloride can be melted. If electricity is passed through melted sodium chloride, it decomposes. The molecules unlock. They change back to atoms of sodium and chlorine. This equation shows the reaction:

   \[ 2\text{NaCl} \xrightarrow{\text{breaks down into}} 2\text{Na} + \text{Cl}_2 \]

   The decomposition of a compound by means of electricity is called electrolysis [i-lek-TRAHL-uh-sis]. Only certain compounds can be decomposed by electrolysis.

2. Potassium chlorate (KClO₃) is a compound. It is composed of the elements potassium, chlorine, and oxygen.

   Heat decomposes potassium chlorate. Potassium chlorate changes to oxygen and potassium chloride (a simpler compound). This equation shows the reaction:

   \[ 2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2 \]

   Notice that the decomposition is not complete. The oxygen has been separated. But the potassium and chlorine are still joined to form the compound potassium chloride. Another kind of decomposition reaction can separate potassium chloride into its elements.

Only certain compounds are decomposed with heat.
UNDERSTANDING DECOMPOSITION REACTIONS

Look at Figure A. Then answer the questions or fill in the blanks.

Electrolysis decomposes water. This is the equation for the reaction:

\[2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2\]

Water \(\rightarrow\) Hydrogen + Oxygen

1. What is the formula for water? __________
2. Water is __________ an element, a compound
3. Name the elements that make up water.
   __________
4. Name the process that decomposes water.
   __________
5. What kind of energy is used?
   __________
6. When water decomposes, it changes to the elements __________ and __________.
7. Water is in the __________ state.
   solid, liquid, gas
8. Hydrogen is in the __________ state.
   solid, liquid, gas
9. Oxygen is in the __________ state.
   solid, liquid, gas
10. Which is simpler, water or the elements that make up water? __________
11. Decomposition __________ compounds.
    builds up, breaks down
12. Can electrolysis decompose every compound? __________
13. Name another compound that can be decomposed with electrolysis.
   __________
Look at Figure B. Answer the questions.

Mercury (II) oxide is a solid. Heat decomposes mercury (II) oxide. This is the equation for the reaction.

\[ 2\text{HgO} \xrightarrow{\text{heat}} 2\text{Hg} + \text{O}_2 \]

1. What is the formula for mercury (II) oxide? ______________
2. Mercury (II) oxide is _____________.
   - an element, a compound
3. Name the elements that make up mercury (II) oxide. ________________________________
4. What happens when mercury (II) oxide is heated? _________________________________
5. What kind of energy decomposes mercury (II) oxide? ______________________________
6. When mercury (II) oxide decomposes, it changes to the elements ___________ and ___________.
7. Mercury (II) oxide is in the ___________ state.
   - solid, liquid, gas
8. Mercury is in the _______ state.
   solid, liquid, gas

9. Oxygen is in the _______ state.
   solid, liquid, gas

10. Which is simpler: mercury (II) oxide or the elements that made up mercury (II) oxide?
   ____________________________

11. The mercury ________ stays in the test tube, escapes into the air.

12. The oxygen ________ stays in the test tube, escapes into the air.

13. Can heat decompose every compound? ______________

14. Name another compound that can be decomposed by heat. ______________

**FILL IN THE BLANK**

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided.

- heating
- potassium chlorate
- liquid
- mercury (II) oxide
- synthesis
- fewer
- electrolysis
- molten sodium chloride
- decomposition
- water

1. The combining of substances to form a compound is called ______________.

2. The breakdown of a compound into simpler substances is called ______________.

3. Two methods used to decompose compounds are ______________ and ______________.

4. For a compound to decompose by electrolysis, it must be in a ______________ state.

6. Two compounds that can be decomposed by electrolysis are ______________ and ______________.

7. Two compounds that can be decomposed by heat are ______________ and ______________.

8. KCl is a simpler compound than KClO₃ because KCl has ______________ elements and atoms.
MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. synthesis reaction</td>
<td>a) breaks down compounds</td>
</tr>
<tr>
<td>2. decomposition reaction</td>
<td>b) uses electricity</td>
</tr>
<tr>
<td>3. electrolysis and heat</td>
<td>c) methods of decomposition</td>
</tr>
<tr>
<td>4. electrolysis</td>
<td>d) simpler than a compound</td>
</tr>
<tr>
<td>5. an element</td>
<td>e) builds compounds</td>
</tr>
</tbody>
</table>

IDENTIFYING DECOMPOSITION REACTIONS

Ten chemical equations are listed below. Some are decomposition reactions. Some are not. Mark a (✓) in the correct box next to each equation.

<table>
<thead>
<tr>
<th>Equation</th>
<th>Decomposition Reaction</th>
<th>Not a Decomposition Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CuCl₂ → Cu + Cl₂</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2. 3Hf + 2N₂ → Hf₃N₄</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3. Zn + 2HCl → ZnCl₂ + H₂</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4. H₂CO₃ → H₂O + CO₂</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5. 2NaOH → 2Na + O₂ + H₂</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>6. Fe + S → FeS</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>7. CaCO₃ → CaO + CO₂</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8. 4P + 5O₂ → 2P₂O₅</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>9. C + O₂ → CO₂</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>10. Ca(OH)₂ → CaO + H₂O</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

REACHING OUT

1. Does boiling decompose water? ________________
2. What does boiling do to water? ________________