AIM 15 | What is a decomposition reaction?

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 com puh ZISH un]. Decomposition is a *chemical* process.

Let's 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:

$$\underset{\text{Sodium chloride (compound)}}{2NaCl} \xrightarrow[\text{into}]{\text{breaks down}} \underset{\text{Sodium (element)}}{2Na} + \underset{\text{Chlorine (element)}}{Cl_2}$$

The decomposition of a compound by means of electricity is called *electrolysis* [i lek TROL i sis]. Only certain compounds can be decomposed by electrolysis. Usually these compounds are liquids.

2. Potassium chlorate ($KClO_3$) 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:

$$\underset{\text{Potassium chlorate (compound)}}{2KClO_3} \longrightarrow \underset{\text{Potassium chloride (a simpler compound)}}{2KCl} + \underset{\text{Oxygen (element)}}{3O_2}$$

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.

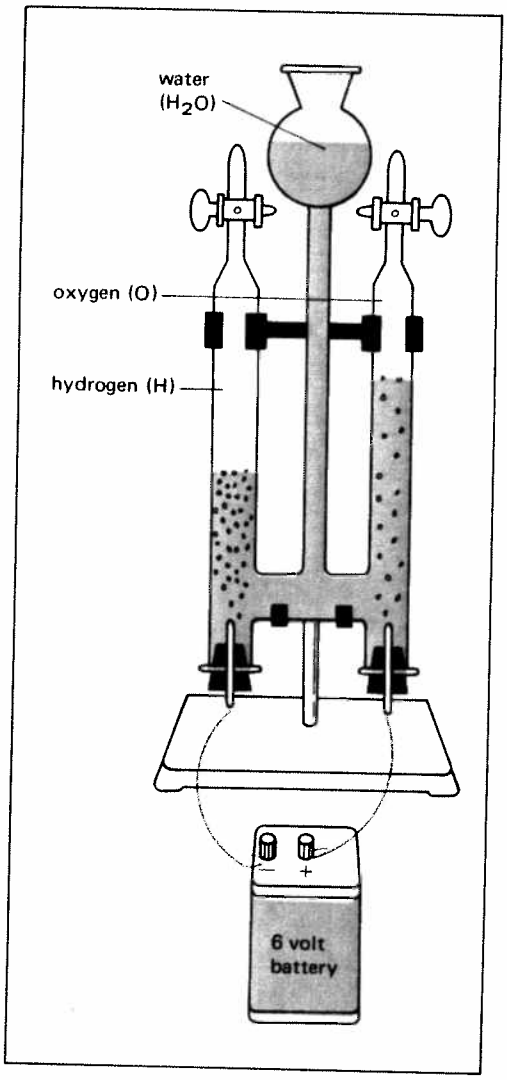

Figure A

Look at Figures A and B. Then answer the questions or fill in the blanks.

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

$$\underset{\text{Water}}{2H_2O} \rightarrow \underset{\text{Hydrogen}}{2H_2} + \underset{\text{Oxygen}}{O_2}$$

1. What is the formula for water? _____

2. Water is _____ .
(an element, a compound)

3. Name the elements that make up water.

_____ _____

4. **a)** Name the *process* that decomposes water. _____

b) What kind of *energy* is used?

_____

5. When water decomposes, it changes to the elements _____ and _____ .

6. Water is in the _____ state.
(solid, liquid, gas)

7. Hydrogen is in the _____ state.
(solid, liquid, gas)

8. Oxygen is in the _____ state.
(solid, liquid, gas)

9. Which is simpler, water or the atoms that make up water? _____

10. Decomposition _____ compounds.
(builds up, breaks down)

11. Can electrolysis decompose every compound? _____

12. Name another compound that can be decomposed with electrolysis.

_____

13. A compound that can be separated by electrolysis must be in which state of matter?

_____

Look at Figure B.

Mercuric oxide is a solid. Heat decomposes mercuric oxide. This is the equation for the reaction:

$$\underset{\text{Mercuric oxide}}{2HgO} \xrightarrow{\text{heat}} \underset{\text{Mercury}}{2Hg} + \underset{\text{Oxygen}}{O_2}$$

14. What is the formula for mercuric oxide? _____

15. Mercuric oxide is _____ (an element, a compound).

16. Name the elements that make up mercuric oxide. _____

_____

17. What kind of energy decomposes mercuric oxide? _____

18. When mercuric oxide decomposes, it changes to the elements _____ and _____.

19. Mercuric oxide is in the _____ (solid, liquid, gas) state.

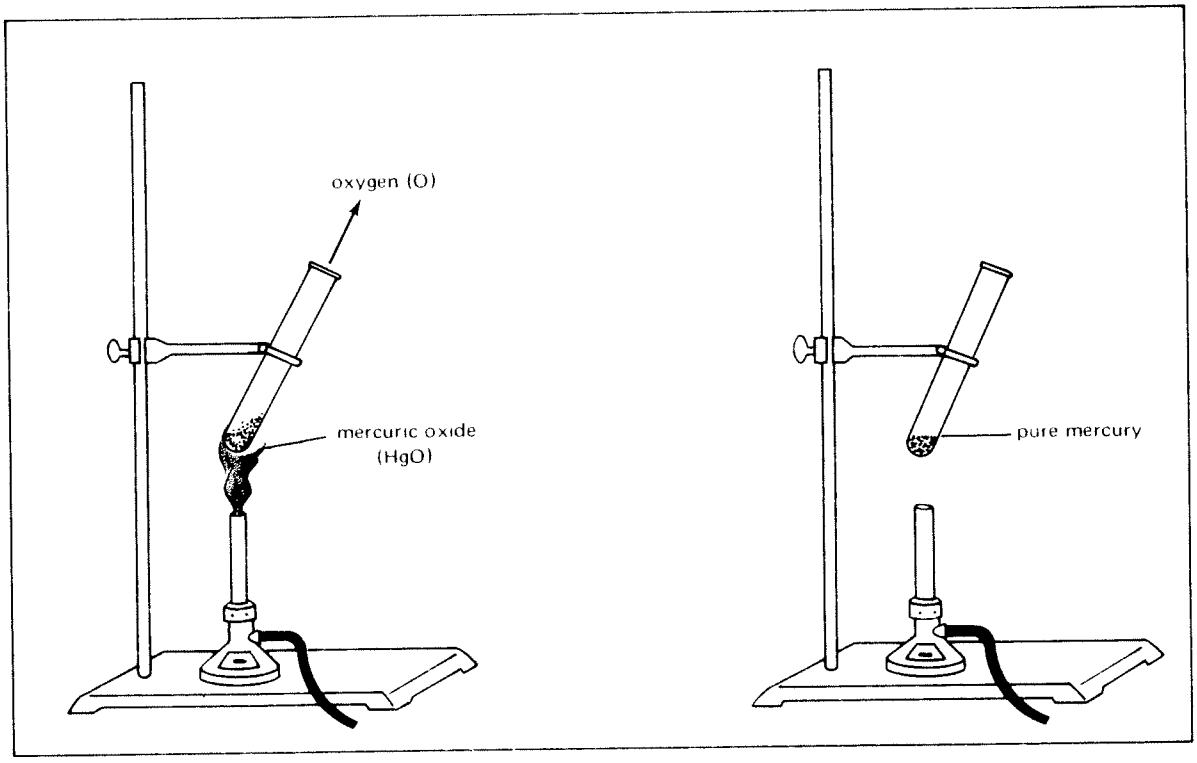

Figure B

20. Mercury is in the _____ state.
solid, liquid, gas

21. Oxygen is in the _____ state.
solid, liquid, gas

22. Which is simpler: mercuric oxide or the elements that make up mercuric oxide?

_____

23. The mercury _____.
stays in the test tube, escapes into the air

24. The oxygen _____.
stays in the test tube, escapes into the air

25. Can heat decompose every compound? _____

26. Name another compound that can be decomposed by heat. _____

COMPLETING SENTENCES

Complete the sentences with the choices below.

heating	mercuric oxide	electrolysis
potassium chlorate	synthesis	molten sodium chloride
liquid	fewer	decomposition
simpler	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.

5. Two compounds that can be decomposed by electrolysis are _____ and _____.

6. Two compounds that can be decomposed by heat are _____ and _____.

7. Atoms are _____ than molecules.

8. KCl is a simpler compound than $KClO_3$ because KCl has _____ elements and atoms.

MATCHING

Match the two lists. Write the correct letter on the line next to each number.

1. _____	synthesis reaction	**a)**	breaks down compounds
2. _____	decomposition reaction	**b)**	uses electricity
3. _____	electrolysis and heat	**c)**	methods of decomposition
4. _____	electrolysis	**d)**	simpler than a compound
5. _____	an element	**e)**	builds compounds

IDENTIFYING DECOMPOSITION REACTIONS

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

Equation	Decomposition Reaction	Not a Decomposition Reaction
1. $CuCl_2 \longrightarrow Cu + Cl_2$		
2. $3Hf + 2N_2 \longrightarrow Hf_3N_4$		
3. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$		
4. $H_2CO_3 \longrightarrow H_2O + CO_2$		
5. $2NaOH \longrightarrow 2Na + O_2 + H_2$		
6. $Fe + S \longrightarrow FeS$		
7. $CaCO_3 \longrightarrow CaO + CO_2$		
8. $4P + 5O_2 \longrightarrow 2P_2O_5$		
9. $C + O_2 \longrightarrow CO_2$		
10. $Ca(OH)_2 \longrightarrow CaO + H_2O$		

REACHING OUT

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

_____