NS H5 (pg 1 of 2) Synthesis and Decomposition Reactions

Name_____Per____

During synthesis, two or more reactant combine into <u>one product</u>. The reactant substances can be elements or compounds. Remember, a synthesis reaction will be a redox type if elements are involved. Often heat may be needed to start the reaction.

Written using generic symbols, it is usually shown as:

$$A + B \rightarrow AB$$

During decomposition, <u>one reactant</u> compound splits apart into two (or more) substances. The product substances can be elements or compounds. Remember, the reaction will be a redox type if elements are involved. Generally heat is used to induce the decomposition. Essentially a decomposition is the reverse of a synthesis reaction.

Written using generic symbols, it is usually shown as:

$$AB \rightarrow A + B$$

Important Points to Remember

- Remember to always write the diatomic gases as X_2 (ie H_2 N_2 O_2 F_2 Cl_2 Br_2 I_2)
  All other elements will be written as X (no subscript) unless you are told otherwise.
- As required by the decomposition of hydrogen peroxide in class, some reactions require a catalyst, which is a substance that changes the speed of a chemical reaction without itself undergoing a permanent chemical change in the process.
- These reactions are always oxidation reduction reactions if at least one element is in the reaction (on either side).
- We will not write net ionic eqauations for these reactions since most of them do not occur in solution, thus there wouyld not be separated ions and no spectators to cross off.
- You will notice that some of the synthesis reactions will also fit into the combustion category as long as the reaction occurred fast and involved flames, which you can not always tell from the description.
- We will use oxidation numbers to determine the number of electrons transferred during redox reactions. The number of electrons loost must always equal the number of electrons gained.

Practice these examples: Write the skeleton equation, then balance.

Indicate if the reaction is oxidation reduction and if so, identify the oxidation numbers for each element, and the total number of electrons transferred.

1. Solid mercury(I) oxide decomposes into its elements (a gas and a liquid).

2. Calcium oxide reacts with carbon dioxide to produce calcium carbonate.

3. Solid potassium chlorate decomposes into solid potassium chloride and oxygen gas.

4. Upon sparking, hydrogen gas and oxygen gas react exploosively to produce water.

5. When heated, magnesium hydroxide decomposes into magnesium oxide and water.

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ANSWERS

1. skeleton: $Hg_2O \rightarrow Hg + O_2$ balanced: $2\ Hg_2O \rightarrow 4\ Hg + O_2$
   - This is a redox reaction which we can tell because of the two elements in the reaction.
   - mercury starts with an oxidation # of +1 and changes to 0, oxygen starts with an oxidation # of −2 and changes to 0
   - 1 e− is gained by each mercury, which happens four times = 4e− gained.
   - 2 e− are lost by each oxygen, which happens twice = 4 e− total are lost.
2. skeleton: $CaO + CO_2 \rightarrow CaCO_3$ already balanced
   - This is NOT redox reaction which we can tell because there are NO elements in standard form in the reaction.
   - NO electrons lost or gained
3. skeleton: $KClO_3 \rightarrow KCl + O_2$ balanced: $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$
   - This is a redox reaction which we can tell because of oxygen in elemental form in the reaction.
   - potassium starts and ends with an oxidation number of +1 (K is neither oxidized nor reduced)
   - oxygen starts with an oxidation # of −2 and changes to 0, chlorine starts with an oxidation # of +5 and changes to −1
   - 2 e− are lost by each oxygen, which happens six times = 12 e− total are lost.
   - 6 e− are gained by each chlorine, which happens twice = 12e− gained.
4. skeleton: $H_2 + O_2 \rightarrow H_2O$ balanced: $2\ H_2 + O_2 \rightarrow 2\ H_2O$
   - This is a redox reaction which we can tell because of the two elements in the reaction.
   - hydrogen starts with an oxidation # of 0 and changes to +1, oxygen starts with an oxidation # of 0 and changes to −2
   - 2 e− are lost by each oxygen, which happens twice = 4 e− total are lost.
   - 1 e− is gained by each hydrogen, which happens four times = 4e− gained.
5. skeleton: $Mg(OH)_2 \rightarrow MgO + H_2O$ already balanced
   - This is NOT redox reaction which we can tell because there are NO elements in standard form in the reaction.
   - NO electrons lost or gained