



2) **Required Practice 2:** Predict the products created when these substances decompose, then balance the equation. **{Answers are on page 3.}**

1.  $\text{CaO}_{(s)} + \text{energy} \rightarrow$
2.  $\text{NO}_{(g)} + \text{energy} \rightarrow$
3.  $\text{LiCl}_{(l)} + \text{energy} \rightarrow$
4.  $\text{CaF}_{2(l)} + \text{energy} \rightarrow$
5.  $\text{MgS}_{(s)} + \text{energy} \rightarrow$
6.  $\text{K}_2\text{O}_{(s)} + \text{energy} \rightarrow$
7. Explain why the above reactions are *decomposition reactions*.

III) **COMBUSTION IN AIR:** *A COMBUSTION IN AIR REACTION occurs when a substance reacts with  $\text{O}_{2(g)}$  to produce an oxide and energy.* Since energy is produced, *combustion in air reactions* are *exothermic*. **NOTE:** *Combustion in air reactions are often called combustion reactions for simplicity.*

A) In order for a *combustion reaction* to occur, **three things must be present: oxygen, fuel and heat.**

1) **FIRST:**  $\text{O}_{2(g)}$  must be present because by definition a *combustion reaction* is a reaction of a substance with  $\text{O}_{2(g)}$ . **SECOND:** Fuel must be present. The fuel is the substance (element, molecule or compound) that reacts with the  $\text{O}_{2(g)}$ . **THIRD:** Heat must be supplied. In order to begin the reaction a small amount of heat energy must be added to the reactants in order to start the reaction. Because heat must be supplied to start the reaction, it is tempting to classify *combustion reactions* as *endothermic reactions*, however, *combustion reactions* are *exothermic* because they produce significantly more heat than is required to start them.

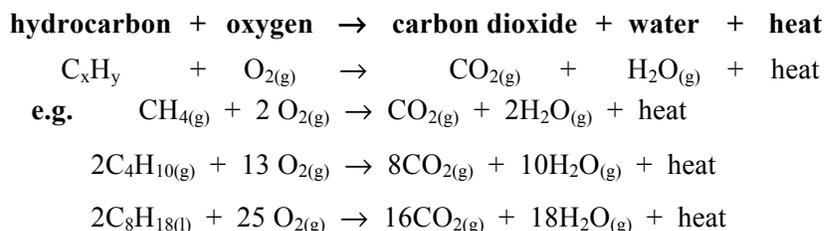
B) When non-metal elements are burned in oxygen, the primary product most common oxide. *An oxide is a compound composed of an element bonded to oxygen.* Below are the reaction equations produced when the elemental fuels carbon, hydrogen, sulphur and nitrogen are burned in air. **It is helpful to be familiar with these four patterns.**



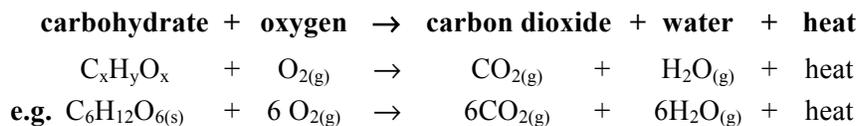
1) **NOTICE** that the above four reactions also follow the *synthesis* pattern of two elements reacting together (see page 1 of these notes). However, they are classified as *combustion reactions* because  $\text{O}_{2(g)}$  is involved in the reaction, the reaction only occurs when energy is supplied, and they are *exothermic*. Many *synthesis reactions* do not require the initial addition of heat for them to occur, as well, many are *endothermic*.

C) **Combustion of hydrocarbon.** *A hydrocarbon is a compound consisting of only carbon atoms and hydrogen atoms: e.g.  $\text{CH}_{4(g)}$ ,  $\text{C}_2\text{H}_{6(g)}$ ,  $\text{C}_3\text{H}_{8(g)}$ ,  $\text{C}_4\text{H}_{10(l)}$ ,  $\text{C}_8\text{H}_{18(l)}$ , etc. A COMBUSTION OF A HYDROCARBON REACTION occurs when a hydrocarbon reacts with  $\text{O}_{2(g)}$  to produce an carbon dioxide, water vapour and energy.*

**MEMORIZE THE PATTERN FOR COMBUSTION OF A HYDROCARBON.**



D) **Combustion of carbohydrate.** *A carbohydrate is a compound consisting of carbon, hydrogen, and oxygen atoms: e.g.  $\text{C}_3\text{H}_6\text{O}_{2(l)}$ ,  $\text{C}_6\text{H}_{12}\text{O}_{6(s)}$ , etc. A COMBUSTION OF A CARBOHYDRATE REACTION occurs when a carbohydrate reacts with  $\text{O}_{2(g)}$  to produce an carbon dioxide, water vapour and energy. MEMORIZE THE PATTERN FOR COMBUSTION OF A CARBOHYDRATE.*



E) **Required Practice 3:** Answer these questions. {Answers are on page 3.}

- List the three requirements necessary for a combustion reaction to occur.
- Write balanced equations for the combustion of each of these elements: carbon, nitrogen, sulphur, and hydrogen.
- Name the elements found in a hydrocarbon.
- Name the elements found in a carbohydrate.
- Name and write the formula of the products formed by the combustion of a hydrocarbon or a carbohydrate.
- Write balanced equations for the combustion of these substances.
  - $C_3H_8(g)$
  - $C_2H_6(g)$
  - $C_2H_6O(l)$
  - $C_{12}H_{22}O_{11}(s)$

### ADDITIONAL PRACTICE

I) Complete sheets numbered 8, 9 & 10 attached to these notes.

### ANSWERS TO THE REQUIRED PRACTICE

#### Required Practice 1 from pages 1

- $2Mg_{(s)} + 1O_{2(g)} \rightarrow 2MgO_{(s)}$
- $2Al_{(s)} + 3Cl_{2(g)} \rightarrow 2AlCl_{3(s)}$
- $8Ba_{(s)} + 1S_{8(s)} \rightarrow 8BaS_{(s)}$
- $4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$
- $1Pb_{(s)} + 1Br_{2(g)} \rightarrow 1PbBr_{2(s)}$
- $1Co_{(s)} + 1I_{2(g)} \rightarrow 1CoI_{2(s)}$
- Reactions 1 through 6 are synthesis reactions because they begin with two different elements that can only react together to form a single substance.

#### Required Practice 2 from page 2

- $2CaO_{(s)} + \text{heat} \rightarrow 2Ca_{(s)} + 1O_{2(g)}$
- $2NO_{(l)} + \text{heat} \rightarrow 1N_{2(g)} + 1O_{2(g)}$
- $2LiCl_{(l)} + \text{heat} \rightarrow 2Li_{(l)} + 1Cl_{2(g)}$
- $1CaF_{2(l)} + \text{heat} \rightarrow 1Ca_{(l)} + 1F_{2(g)}$
- $1MgS_{(s)} + \text{heat} \rightarrow 1Mg_{(s)} + 1S_{(g)}$
- $2K_2O_{(s)} + \text{heat} \rightarrow 4K_{(s)} + 1O_{2(g)}$
- The above reactions are decomposition reactions because they begin with a single reactant and thus can only decompose to form two or more products.

#### Required Practice 3 from page 3

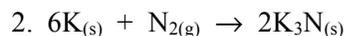
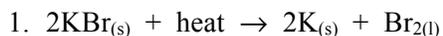
- The three requirements necessary for a combustion reaction to occur are a fuel, oxygen and a small input of energy.
- $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} + \text{heat}$      $S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)} + \text{heat}$      $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)} + \text{heat}$   
 $N_{2(g)} + 2O_{2(g)} \rightarrow 2NO_{2(g)} + \text{heat}$     **3.** Hydrocarbons are composed of carbon and hydrogen.    **4.** Carbohydrates are composed of carbon, hydrogen and oxygen.    **5.** The products of the combustion of a hydrocarbon or a carbohydrate are carbon dioxide,  $CO_{2(g)}$  and water,  $H_2O_{(g)}$ .
- 6a.**  $1C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g) + \text{heat}$
- 6b.**  $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g) + \text{heat}$
- 6c.**  $1C_2H_6O(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g) + \text{heat}$
- 6d.**  $C_{12}H_{22}O_{11}(s) + 12O_2(g) \rightarrow 12CO_2(g) + 11H_2O(g) + \text{heat}$

**ASSIGNMENT**

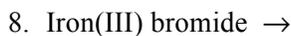
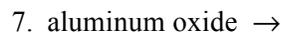
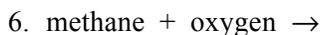
At the top of your assignment, please print “**T33 – Classifying Chemical Reactions**”, your **LAST then First name, block and date**. Complete these questions in the order given here. *[Marks indicated in italicized brackets.]*

**WHEN BALANCING EQUATIONS EVERY FORMULA MUST HAVE A COEFFICIENT**

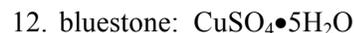
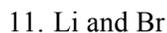
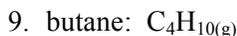
A. Classify these reactions as Synthesis or Decomposition. Justify your choice. *[3]*



B. Write balanced chemical reaction equations for the following. Classify them as synthesis, decomposition or combustion. *[17]*



C. Predict the type of chemical reaction in which the following substances would likely participate. Justify your choice. *[4]*



D. Write balanced equations for the combustion of these substances. *[14]*



*[52 marks in total]*

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