You have mastered this topic when you can:

1) apply the **LAW OF CONSERVATION OF MATTER/MASS** to a formula equation of a reaction to demonstrate that atoms are conserved in the reaction.
2) balance equations of several chemical reactions.
3) use subscripts to represent solids, liquids, gases, and aqueous solutions.

BALANCING CHEMICAL EQUATIONS FOR CARBOHYDRATE REACTIONS

I) ***CARBOHYDRATES ARE ORGANIC COMPOUNDS CONTAINING C, H AND O***

A) An carbohydrate is a molecular compound containing only carbon, hydrogen and oxygen.

e.g. $CH_3OH_{(g)}$, $C_2H_5OH_{(g)}$, $C_3H_7OH_{(g)}$, $C_4H_9OH_{(g)}$, $C_5H_{11}OH_{(g)}$, etc.

1) When an carbohydrate reacts with oxygen it is burning, combusting, and it will produce carbon dioxide and water.

e.g. $2CH_3OH_{(g)} + 3\,O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O_{(g)}$

B) ***USE THESE STEPS TO BALANCE COMBUSTION (BURNING) OF A CARBOHYDRATE REACTIONS***

(1) Balance carbons first.

(2) Balance hydrogen next.

(3) Balance oxygen last with the last number placed in front of the $O_{2(g)}$. REMEMBER each side has 2 formulae with oxygen.

C) **Sample Problems 1**

1. Balance: $CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

(1) Balance carbon first: $CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

(2) Balance hydrogen next: $CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

(3) Balance oxygen last with the last number placed in front of the $O_{2(g)}$. REMEMBER each side has 2 formulae with oxygen:

$$CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$$

It is impossible to have 2.5 molecules of O_2, thus we double each coefficient to ensure all coefficients are whole numbers.

$$CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$$

$$CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$$

The balanced equation is: $\mathbf{CH_3OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}}$

2. Balance: $C_2H_5OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

(1) Balance carbon first: $C_2H_5OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

(2) Balance hydrogen next: $C_2H_5OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

(3) Balance oxygen last with the last number placed in front of the $O_{2(g)}$. REMEMBER each side has 2 formulae with oxygen:

$$C_2H_5OH_{g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$$

The balanced equation is: $\mathbf{C_2H_5OH_{(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}}$

D) **Required Practice 1:** Balance these Chemical Equations. **{Answers are on page 6.}**

1. ___ $C_3H_7OH_{(g)}$ + ___ $O_{2(g)}$ → ___ $CO_{2(g)}$ + ___ $H_2O_{(g)}$

2. ___ $C_4H_9OH_{(g)}$ + ___ $O_{2(g)}$ → ___ $CO_{2(g)}$ + ___ $H_2O_{(g)}$

3. ___ $C_5H_{11}OH_{(g)}$ + ___ $O_{2(g)}$ → ___ $CO_{2(g)}$ + ___ $H_2O_{(g)}$

4. ___ $C_6H_{13}OH_{(l)}$ + ___ $O_{2(g)}$ → ___ $CO_{2(g)}$ + ___ $H_2O_{(g)}$

WRITING CHEMICAL EQUATIONS FROM WORD EQUATIONS

I) ***USE THESE STEPS TO WRITE CHEMICAL EQUATIONS FROM WORD EQUATIONS***

(1) Write the formula of each reactant and product in a skeleton equation. Commas and the words 'and' and 'react' mean '+' in the chemical equation. Words such as 'yield', 'produce', 'create' and 'decompose' mean '→' in the chemical equation.

(2) Balance the skeleton equation as outlined in T31 and on page 1 above.

A) **Sample Problems 2:** Write a balanced chemical equation for these reactions:

1. Solid copper and solid sulphur react to produce solid copper(I) sulphide.

(1) Write the formula of each reactant and product particle in a skeleton equation.

(2) Balance the skeleton equation as outlined on pages 2 − 4 above.

2. Solid potassium chlorate decomposes to produce solid potassium chloride and oxygen gas.

(1) Write the formula of each reactant and product particle in a skeleton equation.

(2) Balance the skeleton equation as outlined on pages 2 − 4 above.

3. Solid potassium nitrate, solid sulphur and solid carbon yield solid potassium sulphide, carbon dioxide gas and nitrogen gas.

(1) Write the formula of each reactant and product particle in a skeleton equation.

(2) Balance the skeleton equation as outlined on pages 2 − 4 above.

B) **Required Practice 2:** Write balanced chemical equation for these reactions. **{Answers are on page 6.}**

1. Liquid water decomposes producing the gases hydrogen and oxygen.

2. Solid magnesium oxide decomposes creating solid magnesium and oxygen gas.

Continued on the next page.

3. Solid iron and solid sulphur yield solid iron(II) sulphide.

4. Solid zinc and hydrochloric acid yield aqueous zinc chloride and hydrogen gas.

5. Solid sodium and water produce aqueous sodium hydroxide and hydrogen gas.

6. Solid iron(III) oxide and solid carbon yield solid iron and carbon dioxide gas.

7. Aqueous calcium hydroxide and hydrogen gas are produced from solid calcium and liquid water.

8. Aqueous copper(I) chloride reacts with solid aluminum producing aqueous aluminum chloride and solid copper.

9. Carbon dioxide gas reacts with aqueous calcium hydroxide producing solid calcium carbonate and liquid water.

10. Aqueous barium bromide and aqueous silver nitrate yield aqueous barium nitrate and solid silver bromide.

11. Candle wax ($C_{25}H_{52}$) and oxygen gas combust producing carbon dioxide gas and water vapor.

ADDITIONAL PRACTICE: Complete the sheets numbered 15 and 19 attached to these notes.

ANSWERS TO THE REQUIRED PRACTICE

Required Practice 1 from page 2

1. $\mathbf{2}\ C_3H_7OH_{(g)} + \mathbf{9}\ O_{2(g)} \rightarrow \mathbf{6}CO_{2(g)} + \mathbf{8}H_2O_{(g)}$
2. $\mathbf{1}C_4H_9OH_{(g)} + \mathbf{6}\ O_{2(g)} \rightarrow \mathbf{4}CO_{2(g)} + \mathbf{5}H_2O_{(g)}$
3. $\mathbf{2}C_5H_{11}OH_{(g)} + \mathbf{15}\ O_{2(g)} \rightarrow \mathbf{10}CO_{2(g)} + \mathbf{12}H_2O_{(g)}$
4. $\mathbf{1}C_6H_{13}OH_{(l)} + \mathbf{9}\ O_{2(g)} \rightarrow \mathbf{6}CO_{2(g)} + \mathbf{7}H_2O_{(g)}$

Required Practice 2 from page 2 & 3

1. $\mathbf{2}H_2O_{(l)} \rightarrow \mathbf{2}H_{2(g)} + \mathbf{1}\ O_{2(g)}$
2. $\mathbf{2}MgO_{(s)} \rightarrow \mathbf{2}Mg + \mathbf{1}\ O_{2(g)}$
3. $\mathbf{1}Fe_{(s)} + \mathbf{1}S_{(s)} \rightarrow \mathbf{1}FeS_{(s)}$
4. $\mathbf{1}Zn_{(s)} + \mathbf{2}\ HCl_{(aq)} \rightarrow \mathbf{1}ZnCl_{2(aq)} + \mathbf{1}H_{2(g)}$
5. $\mathbf{2}Na_{(s)} + \mathbf{2}H_2O_{(l)} \rightarrow \mathbf{2}NaOH_{(aq)} + \mathbf{1}H_{2(g)}$
6. $\mathbf{2}Fe_2O_{3(s)} + \mathbf{3}C_{(s)} \rightarrow \mathbf{4}Fe_{(s)} + \mathbf{3}CO_{2(g)}$
7. $\mathbf{1}Ca_{(s)} + \mathbf{2}H_2O_{(l)} \rightarrow \mathbf{1}Ca(OH)_{2(aq)} + \mathbf{1}H_{2(g)}$
8. $\mathbf{3}CuCl_{(aq)} + \mathbf{1}Al_{(s)} \rightarrow \mathbf{1}AlCl_{3(aq)} + \mathbf{3}Cu_{(s)}$
9. $\mathbf{1}CO_{2(g)} + \mathbf{1}Ca(OH)_{2(aq)} \rightarrow \mathbf{1}CaCO_{3(s)} + \mathbf{1}H_2O_{(l)}$
10. $\mathbf{1}BaBr_{2(aq)} + \mathbf{2}AgNO_{3(aq)} \rightarrow \mathbf{1}Ba(NO_3)_{2(aq)} + \mathbf{2}AgBr_{(s)}$
11. $\mathbf{1}C_{25}H_{52(s)} + \mathbf{38}\ O_{2(g)} \rightarrow \mathbf{25}CO_{2(g)} + \mathbf{26}H_2O_{(g)}$