

STUDY GUIDE – CHAPTER 4**CHANGES IN MATTER**

- 1) **RECOGNIZE AN ACID-BASE NEUTRALIZATION USING THE APPROPRIATE EQUATION; GIVE EXAMPLES OF ACID-BASE NEUTRALIZATION REACTIONS (ex. Liming of a lake); NAME THE PRODUCTS FORMED DURING ACID-BASE NEUTRALIZATION (salt and water)**

CHARACTERISTICS OF ACIDS

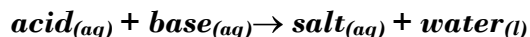
- Acids are chemical substances that **release H⁺** ions in aqueous solutions (when dissolved in water).
- They **neutralize** bases.
- Their **pH < 7**
- Acids **turn blue litmus paper red.**
- The formula for acids is: **H - Nonmetal** Ex: HCl

CHARACTERISTICS OF BASES

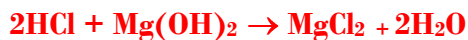
- Bases are substances that **release OH⁻** ions in aqueous solutions.
- They **neutralize** acids.
- Their **pH > 7**
- Bases **turn red litmus paper blue.**
- The formula for bases is: **Metal – OH**; Ex: NaOH

Neutralization:

- Chemical change in which an **acid** and a **base** react together to form a **salt** and **water**.
- The equation for the acid-base neutralization is:

**SAMPLE QUESTIONS**

1. When hydrochloric acid, HCl, is neutralized by magnesium hydroxide, Mg(OH)₂, magnesium chloride, MgCl₂, and water, H₂O, are formed. **Write the balanced equation that represents this neutralization reaction:**



2. Sophie analyzes the reaction between two solutions she used in an experiment. The following is a description of her work.

Properties observed:

SOLUTION 1	SOLUTION 2
<ul style="list-style-type: none">is a good conductor of electricity,is colourless,turns blue litmus paper red,turns cobalt chloride paper pink. ACID	<ul style="list-style-type: none">is a good conductor of electricity,is colourless,turns red litmus paper blue,turns cobalt chloride paper pink. BASE

Preparation of SOLUTION 3

She prepares the third solution by mixing equal amounts of solutions 1 and 2.

Properties of SOLUTION 3

- it is a good conductor of electricity
- it is colourless
- it does not change the colour of litmus paper
- it turns cobalt chloride paper pink

SALT

Which equation could precisely represent the reaction between solutions 1 and 2?

- A) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$ (THIS EQUATION SHOWS SOLUTION 1 AS BEING A BASE AND SOLUTION 2 BEING AN ACID)
- B) $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- C) $\text{NaOH} + \text{HCl} \rightarrow \text{NaOH} + \text{HCl}$
- D) $\text{NaCl} + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{NaOH}$

3. In an acid-base neutralization reaction, what happens to the pH of the acid solution? Explain your answer.

BECOMES 7; The acid, that has a pH less than 7 reacts with a base, that has a pH greater than 7, to produce a salt and water. Both salt and the water have a PH of 7.

4. Consider the chemical reactions represented by the equations below. *Which one represents a neutralization equation in which the law of conservation of matter is respected?*

- A) $2 \text{NO} + \text{O}_2 \rightarrow \text{NO}_2$
- B) $2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2$
- C) $\text{H}_3\text{PO}_4 + 3 \text{KOH} \rightarrow \text{K}_3\text{PO}_4 + 3 \text{H}_2\text{O}$

2) **EXPLAIN A COMBUSTION REACTION USING THE FIRE TRIANGLE; DESCRIBE THE PERCEIVABLE MANIFESTATIONS OF RAPID COMBUSTION (e.g. heat, light)**

- Combustion is a chemical reaction in which substances combine with oxygen. It always releases energy. Ex: burning of gasoline, rotting food, fermentation, forest fires etc.
- There are three types of combustion:
 - **SLOW COMBUSTION** Ex: cut apples turning brown; iron rusting; cellular respiration etc.
 - **RAPID COMBUSTION** The type of combustion in which substances burn with a flame. Ex: wood burning, propane gas burning etc.
 - **SPONTANEOUS COMBUSTION** Form of combustion in which substances start burning on their own, without the help of another source of fire like a match a lighter, a sparkle etc. Ex: a forest fire; a pan with frying oil forgotten on a stove etc.

RAPID COMBUSTION is of great interest for this program, as this type of combustion (more precise the combustion of fossil fuels) is involved in the increase of the greenhouse effect.

During rapid combustion a great deal of energy is released in the form of **heat** and **light** within a short period of time (for example, a campfire).

To have substances burn with a flame, three conditions must be met:

- 1) We need something to burn; we need a **FUEL**.
- 2) We need oxygen (or another gas) to burn the fuel: We call this an **OXYDIZING AGENT**.
- 3) We need an external source of energy to start the burning process. We say that this source helps the fuel (at the beginning) reach the **IGNITION TEMPERATURE**.

Very often these three condition are referred to as “**the triangle of fire**”



SAMPLE QUESTIONS

1. *What is the difference between an oxidizing agent and a fuel?* Give an example of each.

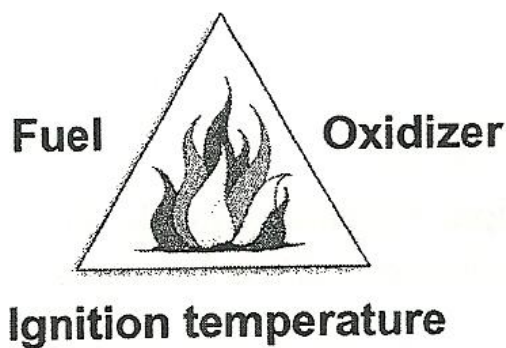
An oxidizing agent causes combustion. Example: oxygen.

A fuel undergoes combustion (contains energy) Example: wood.

2. For each of the following examples of combustion, write the oxidizing agent and the fuel in the appropriate columns.

Example of combustion	Oxidizing agent	Fuel
Food is digested.	OXYGEN	GLUCOSE
A propane burner is used to cook.	OXYGEN	PROPANE GAS
Dry wood starts burning in a forest.	OXYGEN	WOOD

3. A fire is extinguished by removing at least one of the three conditions required for combustion to occur. These conditions are indicated in the fire triangle below.



The following table describes three functions of a CO₂ extinguisher.

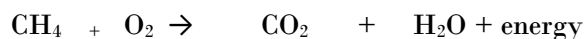
Table 1 – functions of a CO₂ extinguisher

1	The main function of the carbon dioxide (CO ₂) is to smother the fire by reducing the amount of oxygen gas (O ₂) that feeds it. OXIDIZER
2	In the very early stages of a fire, the CO ₂ has a cooling effect, since it comes out of the extinguisher at a temperature of -78°C. IGNITION TEMPERATURE
3	The gas comes out of the extinguisher as a powerful spray that puts out small paper fires by scattering the pieces of material involved. FUEL

Which of the following shows the correct match between the numbered functions of the CO₂ extinguisher and the conditions required for combustion to occur?

- | | | |
|----------------------------|---------------------------------|--------------------------|
| A) 1- fuel | 2 - ignition temperature | 3 – oxidizer |
| B) 1- oxidizer | 2 - ignition temperature | 3 – fuel |
| C) 1- ignition temperature | 2 - oxidizer | 3 – fuel |
| D) 1- fuel | 2 - oxidizer | 3 – ignition temperature |

4. A variety of human activities involve the combustion of fossil fuels (coal, natural gas and other hydrocarbon derivatives). For example, when methane (CH₄), burns it reacts with oxygen gas to produce carbon dioxide (CO₂) and water. The **unbalanced** chemical equation is written below:



Write the balanced chemical equation for this reaction and represent it using the particle model.

Symbols: ● carbon ○ oxygen ⊕ hydrogen

Balanced chemical equation:

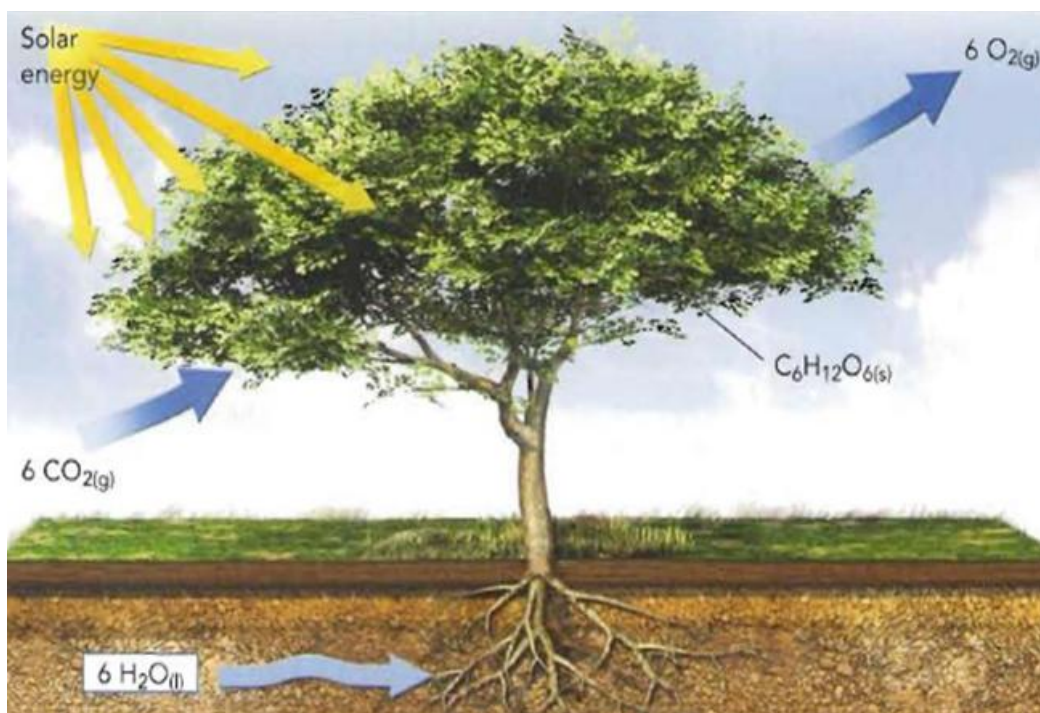
$$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{energy}$$

Particle representation:

3) REPRESENT THE PHOTOSYNTHESIS REACTION IN A BALANCED EQUATION

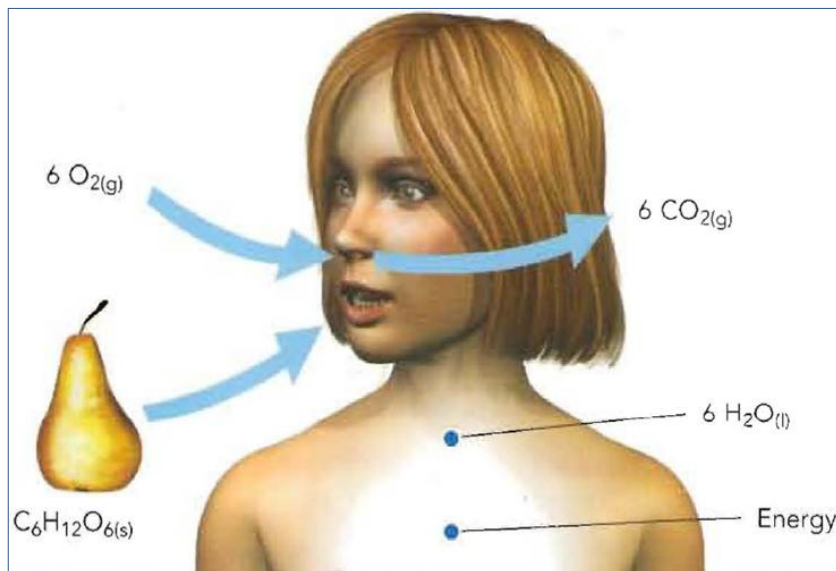
PHOTOSYNTHESIS- chemical reaction in which plant cells use solar energy to produce glucose and oxygen from carbon dioxide and water.

The chemical equation representing the photosynthesis reaction is:

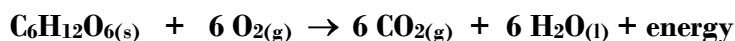


4) REPRESENT THE CELLULAR RESPIRATION REACTION IN A BALANCED EQUATION

CELLULAR RESPIRATION is a chemical change that uses *glucose* and *oxygen* to form carbon dioxide and water, releasing a deal of energy. It takes place in almost all the cells of animal cells and provides the energy needed for the proper functioning of the organism.



The chemical equation representing the cellular respiration reaction is:



SAMPLE QUESTIONS

1. What distinguishes photosynthesis from cellular respiration? Name at least four differences.

Cellular respiration	Photosynthesis
RELEASES ENERGY.	ABSORBS ENERGY.
PRODUCES CARBON DIOXIDE.	CONVERTS (uses) CARBON DIOXIDE.
CONVERTS(uses) OXYGEN.	PRODUCES OXYGEN.
CONVERTS(uses) GLUCOSE.	PRODUCES GLUCOSE.
TAKES PLACE IN ANIMALS.	TAKES PLACE ONLY IN PLANTS.
CONVERTS CHEMICAL ENERGY INTO THERMAL ENERGY AND MECHANICAL ENERGY.	CONVERTS SOLAR ENERGY INTO CHEMICAL ENERGY.

2. The following equation represents the photosynthesis reaction:



Write the chemical equation of the respiration reaction:



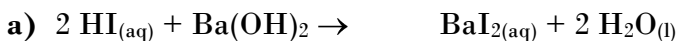
3. The following chemical equation represents a vital reaction that takes place in living organisms:



What type of reaction does it represent?

- A) Neutralization
B) Rapid combustion
C) **Slow combustion**
D) Spontaneous combustion

4. *What type of reaction does each of the following examples describe?*



ACID BASE NEUTRALIZATION

b) sugar that reacts with oxygen and releases energy

CELLULAR RESPIRATION

5. *What type of reaction does each of the following examples describe?*

a) You mix an acid with a base and obtain a pH of 7.

ACID-BASE NEUTRALIZATION

c) Plants produce oxygen.

PHOTOSYNTHESIS

d) You maintain a certain body temperature.

CELLULAR RESPIRATION

e) You set off fireworks at a party.

RAPID COMBUSTION
