রসায়ন অলিম্পিয়াড ২০২৫

BDOC Bangladesh Olympiad Challenge

Chemistry Olympiad 2025

Junior Category Syllabus

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Preparation for junior category competitors

Chapter 1

Concept of Chemistry

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Introduction to Chemistry:

The branch of science that discusses the structure, nature, change, and transformation of energy during change of matter is called Chemistry.

That is, chemistry is the science of matter and its changes.

Example:

Iron reacts with oxygen in the air to form rust.

Making curd from milk.

Energy is generated when gas is burned.

Origin of the word chemistry:

The English synonym for the word *রসায়ন* is **Chemistry**, which originates from the ancient Greek word **"Chemia."** In ancient times, *Chemia* referred to a special art or technique of transforming one metal into another. Later, in Arabic, this word appeared as **"Al-Kimiya,"** meaning the transformation of metals or alchemy.

During the Middle Ages, alchemy gradually took a scientific form and eventually developed into modern chemistry. The modern word **Chemistry** is derived from the word **Alchemy**.

In the Bengali language, the word **রসায়ন** comes from **"রস + আয়ন,"** meaning the science that deals with the composition, properties, and transformations of matter.

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Chemia (Greek)
        → Al-Kimiya (Arabic)
                → Alchemy (Ancient science)
                        → Chemistry (English)
                                → রস + আয়ন = রসায়ন (Bengali)
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Branches of Chemistry

Chemistry is divided into different branches for easy study—

(a) **Inorganic Chemistry**

Discusses the structure and reactions of inorganic substances such as metals, salts, minerals, etc.

Example: Formation of salt (NaCl).

(b) **Organic Chemistry**

Describes the structure, properties, and reactions of carbon-containing compounds.

Example: Glucose, ethanol, plastic, etc.

(c) **Physical Chemistry**

Describes the energy changes associated with chemical reactions and the physical properties of substances.

Example: Heat generation or absorption, rate of reaction, etc.

(d) **Analytical Chemistry**

Describes the determination and quantification of the elements of substances.

Example: Determining the amount of salt in water.

(e) **Biochemistry**

It deals with the chemical reactions that occur in the body of living organisms.

Examples: digestion, respiration, protein synthesis, etc.

Importance of Chemistry:

In daily life:

• Chemistry is used in the manufacture of soaps, detergents, cosmetics.

• Chemical reactions occur in cooking, cleaning, etc.

In medicine:

• The role of chemistry in the manufacture and preservation of medicines is immense.

• Vaccines, disinfectants, vitamins, etc. are the products of chemistry.

In agriculture:

• Fertilizers, pesticides, and insect repellents are all inventions of chemistry.

In industry:

• Chemistry is essential in the production of paints, plastics, glass, metals, etc.

Chemical Reaction

When one or more substances change chemically to form new substances, it is called a chemical reaction.

Example:

$2Fe + 3O_2 \rightarrow 2Fe_2O_3$ (iron rusts)

Types of chemical reactions:

1. Addition reaction: Two or more substances combine to form a new substance.

2. Dissociation reaction: A substance breaks down to form two or more substances.

3. Replacement reaction: One element replaces another element.

4. Double replacement reaction: There is a partial exchange between two compounds.

History of chemistry

Chemistry began with alchemy in ancient times.

At that time, people tried to make gold or gain immortality by changing metals.

Gradually, that alchemy turned into modern scientific chemistry.

Important scientists:

• Robert Boyle: Father of modern chemistry.

• Antoine Lavoisier: Gave the law of conservation of matter.

• John Dalton: Formulated the atomic theory.

Chemistry is a reliable science today because of the contributions of these scientists.

Chemical Precautions

Chemicals can be dangerous at times. Therefore, it is important to follow the following precautions while using them.

1. Always wear safety glasses and gloves during the test.

2. Chemicals should not be taken into the nose or mouth.

3. Work according to instructions during the test.

4. In case of an accident, the teacher or lab in-charge should be informed immediately.

Scientific symbols of chemicals

Scientific symbols are used to represent each element or substance.

Example:

Substance	symbol
Hydrogen	H
Oxygen	O
Iron	Fe
Nitrogen	N
Carbon	C

Example:

Water → H_2O

Salt → NaCl

Sugar → $C_6H_{12}O_6$

Practice

(Multiple Choice Questions – MCQ)

Question 1: What does chemistry discuss?

a) Structure, properties and changes of matter

b) Animal behavior

c) Earth's shape

d) Plant growth

Question 3: Who is the father of modern chemistry?

a) John Dalton

b) Robert Boyle

c) Newton

d) Rutherford

Question 4: Which formula did Lavoisier formulate?

a) Energy conservation law

b) Mass conservation law

c) Gas law

d) Atomic law

Question 5: What substances does "organic chemistry" work with?

a) Metals

b) Carbon compounds of living organisms

c) Minerals

d) Gases

Question 6: What type of reaction causes iron to rust?
a) Addition reaction
b) Analysis reaction
c) Replacement reaction
d) Oxidation reaction

Question 7: In which branch is the analysis of the composition of matter carried out?
a) Analytical chemistry
b) Organic chemistry
c) Physical chemistry
d) Inorganic chemistry

Question 8: Which is an inorganic compound?
a) Glucose
b) Ethanol
c) Salt (NaCl)
d) Protein

Question 9: Which of the following is an example of a chemical change?
a) Melting ice
b) Burning paper
c) Boiling water
d) Breaking glass

Question 10: What is meant by H_2O?
a) Carbon dioxide
b) Water
c) Oxygen
d) Nitrogen

Question 11: In which branch is energy and temperature discussed during a reaction?
a) Organic chemistry
b) Physical chemistry
c) Analytical chemistry
d) Biochemistry

Question 12: Which of the following scientists gave the atomic theory?
a) John Dalton
b) Rutherford
c) Boyle
d) Curie

Question 13: What is the English meaning of the word chemistry?
a) Physics
b) Biology
c) Chemistry
d) Ecology

Question 14: Which of the following is not produced with the help of chemistry?
a) Medicine
b) Plastic
c) Fertilizer
d) Sun

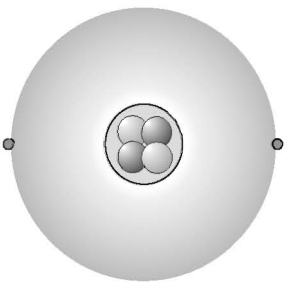
Question 15: "New substances are formed during a reaction"—is this the definition of which process?

a) Change of matter
b) Chemical reaction
c) Analysis
d) Substance

Chapter Six

The Structure of Atoms

Everything that you see around you is made of tiny particles called atoms. Atoms are far too small to be seen. yet the Scientists have developed ideas about the structure of atoms indirectly through various experiments and observations. Different particles have different chararacterestics because they are built by different type of atoms which have different number of electrons, protons and neutrons.



At the end of this chapter we will be able to –

- explain the structure of the atom.
- explain the atomic number and mass number.
- explain what is isotope.
- explain the distribution of electrons in atoms.
- explain how ions are formed.
- distinguish between cation and anion.
- formulate the chemical formula by using anion and cation.
- describe the use of isotope.
- appreciate the importance of isotopes in our life.

Lesson1-3 : The evolution of the idea of atoms and their structure

By now you know that all materials are formed by tiny particles. These particles can stay in two forms-one is called atom which is the smallest particle and the other is molecule, where more than one atom form a stable structure. About the tiny particles different scientists and philosophers have expressed different opinions. The Greek philosopher Democritus put forward for the first time in 400BC, the idea that all matters are formed of tiny particles. According to him these particles are indivisible, which cannot be divided further. He called it atom. The word atom was chosen from the Greek word atomos which means indivisible. Other two contemporary philosophers Plato and Aristotle

maintained different opinions. According to Aristotle, matter is continuous and as such particles of matter can be divided into smaller and smaller parts with work limit. Based on experimental evidence, the English scientists John Dalton said that the smallest particle of an element is an atom which cannot be divided any further. Dalton's idea got acceptance and the idea of Aristotle was rejected. In fact atoms are not indivisible and are not the smallest particles of matter. Atoms can be divided. Atoms consist of smaller particles which are electrons, protons and neutrons.

To remove the limitations of the atomic concepts of Dalton, later others proposed alternate models of atom. Out of these models the most accepted atomic model is the model proposed by Rutherford and Bohr.

Rutherford and his co-workers at one stage carried out an important experiment to find out the correct structure of the atom. From the results of the experiment, Rutherford arrived at the conclusion that the whole of the positive charge and mass is confined to a small area at the center of the atom. This is now called the nucleus. He also explained that most of the space in an atom is empty and the negative charge is carried by the electrons, which have negligible mass and revolves around the central positive charge.

Rutherford- model is similar to the model of the solar system but he did not say anything definitely about the orbit of the electron. Niels Bohr (in 1913) put forward the idea that the negative charge carrying particles revolve in certain allowed orbits. He used the quantum theory of Planks in this model.

From the above discussions, we can say that atoms are not indivisible. Atoms are formed by electrons, protons and the neutrons. At the centre of the atom there exists the nucleus. In the nucleus there are protons with positive charges and neutrons which are without charge. Most of the mass of the atom is concentrated at the nucleus. The space between the electrons and the nucleus is empty. In fact most of the space in the atom is void.

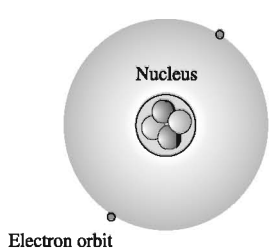


Fig. 6.1: Electron, Proton and Neutron in Helium Atom

Lesson 4-6 : Atomic number, mass number and isotopes

Different elements have different types of atoms. For example, the atom of hydrogen is different from the atom of oxygen. The atom of one element is different from the atom of another element in respect of atomic size, atomic mass and characteristics. Why is this difference? The difference in behavior of atoms arises from the difference in the number of protons and electrons. In a normal atom the net charge is zero. Therefore, the number of electrons and the number of protons are the same. To explain the behaviour of an atom, the number of protons is usually used. The number of protons in the nucleus of an atom of an element is it's atomic number. There is only one proton in the hydrogen atom, therefore the atomic number is 1. There are 8 protons in an oxygen atom and its atomic number is 8. What information can you get from the atomic number?

Carbon has atomic number 6. Since the atomic number indicates the number of protons in the atom of a particular element and the number of protons is equal to the number of electrons in each atom, we can understand that Carbon atom must have 6 electrons.

Is it possible to know how many neutrons are there in an atom from its atomic number? No, it is not possible to know the number of neutrons in an atom from its atomic number. To know the number of neutrons in an atom one has to know the atomic number and the mass number of the atom.

The mass of the electrons in an atom is negligible. Most of the mass of an atom is due to the mass of the nucleus. Again the mass of a proton is nearly equal to the mass of a neutron. The mass number of an atom of an element is expressed as the total number of protons and neutrons in the atom. Thus the mass number of an element is equal to the number of protons in an atom of the element plus the number of neutrons in the atom.

For example, there are 8 protons and 8 neutrons in an oxygen atom, therefore, the mass number of oxygen is 16. In the case of Sodium there are eleven protons and 12 neutrons. So the mass number of Sodium is 11 + 12=23. It has been discussed before that, if the atomic number and the mass number are known, the number of neutrons in the atom can be found out. You will see it clearly from the following example.

Example: For an element A the atomic number is 17 and the mass number is 5. Find the number of protons and the number of neutrons in an atom of the element?

Solution: The atomic number of element A is 17. Since the atomic number is equal to the number of protons the number of protons in the atom of the element is 17. Again the number of electrons in an atom is equal to the number of the protons. So the number of electrons is 17.

In an atom the number of protons + the numbers of neutrons = mass number of an atom.

Therefore the number of neutrons in an atom of the element A = Mass number of the element A-the number of protons in the atom of element A

Thus the number of neutron of an atom of element A = 35-17 = 18

Isotope: Already you have come to know that the atom of an element have definite number of proton and electron but an element may have different mass number. This is because the atoms of an element may have different number of neutrons.

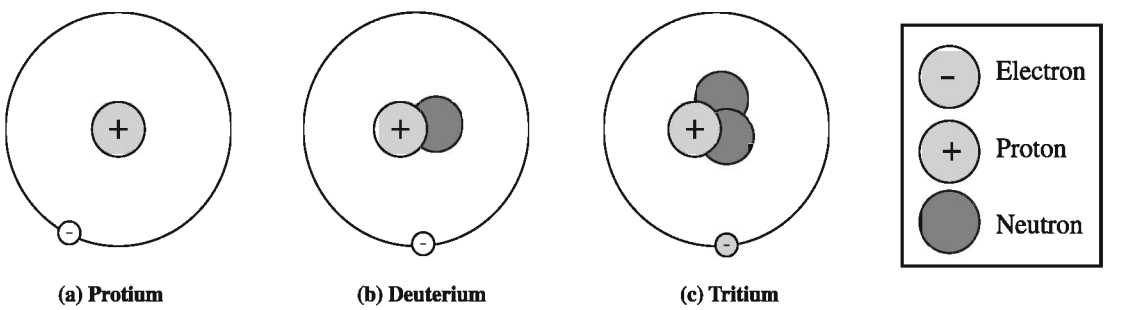


Figure 6.2: Hydrogen isotope

For example, every hydrogen atom has one electron and one proton. Most of hydrogen atoms have no neutrons. But some hydrogen atoms have one neutron. These atoms have mass number 2. Again some hydrogen atoms have two neutron and its mass number 3. These isotopes are shown in the fig. 6.2. In the same way the different atoms of an element which have the same number of protons and electrons but different mass number are called isotopes of that element. Most of the carbon atoms have 6 protons and 6 neutrons in their nuclei. But some atoms have 7 or 8 neutrons in their nuclei. Thus carbon has three isotopes.

Lesson7 and 8 : The properties and application of isotopes

Since the number of protons and electrons in different isotopes of an element are the same, there is no difference in their electrical and chemical properties. This is because it is the distribution of electrons in the atom that are responsible for all the electrical and chemical properties. But the isotopes can be separated due to the difference in their masses.

Usually a particular isotope of an element is more abundant because this isotope is more stable compared to other isotopes. The unstable isotopes radiate different radiations and particles due to radioactive decay. These are called radioactive isotopes. The properties of radioactive isotopes are used in different fields. Some of the uses of radioactive isotopes are described below:

Medical uses of isotopes: Isotopes are used in the diagnosis and treatment of diseases. If there is any defect in a narrow artery, it can be detected by sending radioactive isotope through the blood flowing in the artery. In the same way the affected cell of a cancer patient can be determined by sending radioactive isotopes. Again radioactive isotope can be used to destroy the cancer affected cells. Another use of radioactive materials is to use its radiation to sterilize medical instruments.

Application in agriculture: In agriculture the radiation from isotopes are used to control insects. Also it can be used to find out what type of fertilizer and what amount of fertilizer is needed for a specific crop.

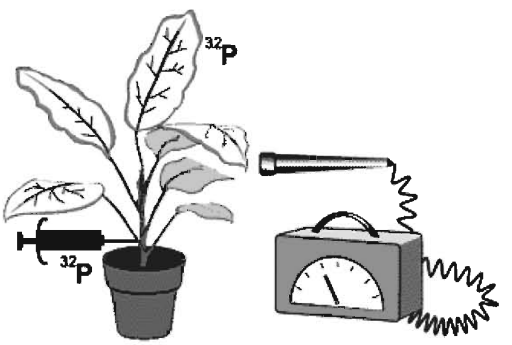


Fig. 6.3: The use of isotopes in agriculture

Food production: Germs and bacteria can be killed by the radiation from radioactive isotopes. Therefore radioactive isotopes can be used to make food and fruits free from germs.

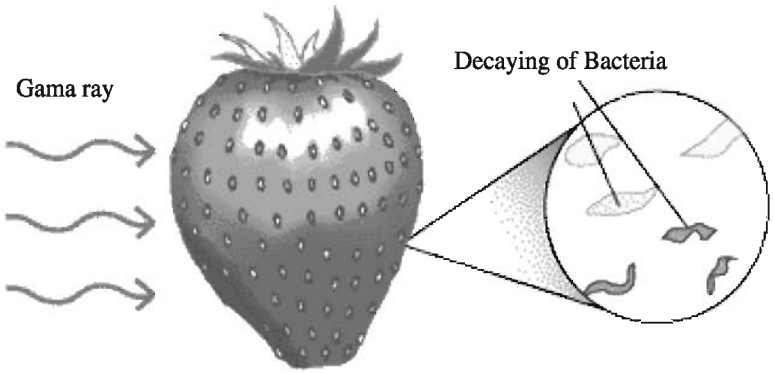


Fig. 6.4: Use of rays from radioactive materials for bacteria free food.

Use of Isotopes in geological research: You often have heard the news that fossils have been discovered which are many million years old. How do the scientists come to know the age of the fossils? It can be found out from the decay of the isotopes. From the ratio of the stable and unstable isotopes, it is possible to find out how old the fossil is.

Lesson 9-11 : The way the electrons are distributed in an atom

You have known that electrons revolve around the nucleus. The electron has definite orbits. Now the question is how many electrons will stay in an orbit? Look at the diagram 6.2 which represents a hydrogen atom. In the hydrogen atom there is one electron in its orbit. In helium atom (Fig. 6.1) two electrons revolve around the nucleus in a single orbit. The rule by which the electrons are distributed in the orbits is given by 2n2 (here n = 1,2,3 ... are the successive numbers of orbits). This is the rule for the allowed orbits. Some of these orbits can be filled and the rest can be empty. According to this a lithium atom has three electrons. Of these two electrons are in the first orbit and the third is in the second orbit. In the same way a carbon has six electrons, of which two are in the first orbit and the remaining four electrons are in the second orbit. According to the rule, the maximum number of allowed electrons in the first orbit is two, in the second orbit the number is eight. And in the third orbit the number is eighteen. These orbits are called energy levels, because each orbit corresponds to definite energy for the electron in it.

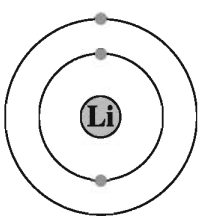


Fig. 6.5: Lithium atom

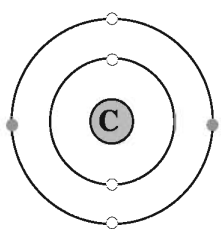


Fig. 6.6: Carbon atom

Now electron distribution of Sodium atom may be seen. There are eleven electrons in a sodium atom. How these electrons are distributed in different orbits? They must be in the order 2, 8, 1. This means in the first orbit there will be 2 electrons, in the second orbit there will be 8 electrons and in the third orbit there will be 1 electron.

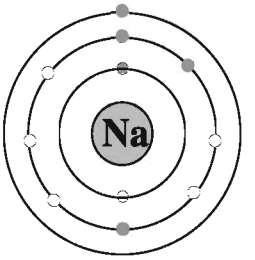


Fig. 6.7: Sodium atom

In the above diagram we have shown the distribution of electrons which is easy to visualize. But to write down the distribution of electrons in a sodium atom, we can express it as 2, 8, 1. We have shown below the distribution of electrons in the first 18 elements. Starting from the lowest atomic number

Element	Atomic Number	Symbol	Electronic configaration
Hydrogen	1		
Helium	2		
Lithium	3	Li	2, 1
Beryllium	4		
Boron	5		
Carbon	6		
Nitrogen	7	N	2, 5
Oxygen	8		
Fluorine	9		
Neon	10		
Sodium	11	Na	2, 8, 1
Magnesium	12		
Aluminium	13		
Silicon	14		
Phosphorus	15		
Sulphur	16		
Chlorine	17	Cl	2, 8, 7
Argon	18		

Lesson 12 and 13: The electron distribution and properties of elements

The properties of elements are basically determined by the electron distribution in their orbits. Generally atoms become active or inactive or charged due to diffeence in electron distribution.

If the last orbit has all the electrons that are allowed in that energy level, then that orbit is completely filled. This type of atoms is inert. For examples, there are two electrons in a helium atom. The first orbit is allowed to have two electrons. Therefore the helium atom is inert and stable. Every atom tends to go to such a stable state.

If the number of electrons in the last orbit or the highest state is such that it can complete it either by borrowing electrons or losing electrons, it will tend to do so. This is because, when the outermost orbit is complete, the negative charge of the electrons shield the equal number of protons in the nucleus. This reduces the energy of the system and the atom becomes more stable. This redistribution of the outer electron takes place by sharing the electron with the neighbouring atoms. For example consider the case of Sodium atom, it has 2 electrons in the first orbit, 8 electrons in the second orbit and 1 electron in the third orbit. If the sodium atom can lose the single electron in the third orbit, its outer most second orbit becomes full and the atom will become stable.

The sodium atom will easily lose one electron from the third orbit if some neighbouring atom has the tendency to grab an electron to fill its outermost orbit. But when the sodium atom lose one electrons it is no longer charge neutral. Normal sodium atom is charge neutral, because it has the same number of protons in the nucleus as the number of electrons in the orbits. By losing one electron the sodium atom becomes positively charged. This charged atom is called an ion. If the charge is positive it is called cation. Thus sodium atom by losing an electron becomes anion.

Now let us take another example. Florin atom has electron distribution as 2,7.Is it a stable state? Surely not. For stability it needs 8 electrons in the outermost orbit. It can either lose 7 electrons from the second orbit or can grabs one extra electron to complete the second orbit. From the energy consideration it is far more favourable to snatch one extra electron to complete the second orbit. In the vicinity of sodium atoms it can easily take one electron from the sodium atom. After receiving one electron from outside the florine atom becomes negatively charged. This makes it a negatively charged ion. It is called anion.

Chapter-2: Structure of the Atom – Question

Concept and Structure

1. What is at the center of an atom?
   A) Electrons and neutrons
   B) Protons and electrons
   C) Protons and neutrons
   D) Only electrons
   E) Only protons

2. Which scientist named the smallest unit of matter "atom" around 400 BC?
   A) John Dalton
   B) Aristotle
   C) Plato
   D) Rutherford
   E) Democritus

3. The word "atom" comes from the Greek word "atomos." What does it mean?
   A) Divisible
   B) Indivisible
   C) Smallest
   D) Large particle
   E) Positively charged

4. According to which scientist is matter continuous, and if you keep dividing it, the particles will become smaller and smaller without end?
   A) John Dalton
   B) Democritus
   C) Aristotle
   D) Rutherford
   E) Bohr

5. What was John Dalton's view (1803) about the smallest particle of matter?
   A) Atoms are divisible
   B) Atoms are made of electrons
   C) Atoms are the smallest particles of elements and cannot be broken down further
   D) Most of the atom is empty space
   E) Atoms form cations

6. Which scientists' model later overcame the limitations of Dalton's atomic theory?
   A) Democritus and Aristotle
   B) Plato and Aristotle
   C) Rutherford and Bohr
   D) Dalton and Bohr
   E) Plato and Democritus

7. From his experiment, what name did Rutherford give to the tiny region containing the positive charge and almost all the mass of the atom?

A) Orbit
B) Electron
C) Anion
D) Nucleus
E) Proton

8. What was the main limitation of Rutherford's model?
   A) He did not mention the nucleus
   B) He did not mention electron orbits
   C) He did not specify any fixed orbits
   D) He said atoms are divisible
   E) He did not mention positive charge

9. What idea did Bohr add that improved Rutherford's model?
   A) Neutrons are in the nucleus
   B) Electron mass is negligible
   C) Negatively charged particles move in certain fixed orbits
   D) Most of the atom is empty space
   E) Electrons reside in the nucleus

10. Why is most of an atom empty space?
    A) The nucleus is neutral
    B) The region between electrons and nucleus is mostly empty
    C) There are few protons
    D) There are many neutrons
    E) Proton and neutron masses are equal

Atomic Number, Mass Number, and Isotopes

11. The number of protons in one atom of an element is called the:
    A) Mass number
    B) Neutron number
    C) Electron number
    D) Atomic number
    E) Atomic mass

12. A hydrogen atom has one proton. What is its atomic number?
    A) 0
    B) 2
    C) 1
    D) 3
    E) 4

13. If an oxygen atom has 8 protons, what is its atomic number?
    A) 7
    B) 9
    C) 6
    D) 16
    E) 8

14. In a neutral atom, what is the relation between the numbers of electrons and protons?
    A) Electrons are more
    B) Protons are more
    C) They are equal
    D) Electrons are fewer
    E) Relationship is uncertain

15. If carbon's atomic number is 6, how many electrons are in one atom?
    A) 0
    B) 3
    C) 5
    D) 6
    E) 12

16. To find the neutron number of an element, which two values are needed?
    A) Only proton number
    B) Only electron number
    C) Electron number and mass number
    D) Atomic number and mass number
    E) Electron number and proton number

17. Where is almost all the mass of an atom located?
    A) In electron orbits
    B) In the nucleus
    C) In protons
    D) In neutrons
    E) In electrons

18. If an oxygen atom has 8 protons and 8 neutrons, what is its mass number?
    A) 8
    B) 24
    C) 16
    D) 17
    E) 32

19. A sodium atom has 11 protons and 12 neutrons. What is its mass number?
    A) 11
    B) 12
    C) 22
    D) 23
    E) 24

20. If element K has atomic number 17 and mass number 35, how many neutrons does it have?
    A) 17
    B) 35
    C) 52
    D) 18 (35 − 17)
    E) 12

21. In isotopes, which particle's number can differ?
    A) Protons
    B) Electrons
    C) Neutrons
    D) Positrons
    E) Mesons

22. Which isotope of hydrogen has no neutron?
    A) Deuterium
    B) Tritium
    C) Protium
    D) Hydrogen-2
    E) Hydrogen-3

23. Why is the mass number of deuterium 2?
    A) It has 2 protons
    B) It has 2 electrons
    C) It has 1 proton and 1 neutron
    D) It has 2 neutrons
    E) It has 1 proton and 2 neutrons

24. What is the mass number of tritium, and why?
    A) 2, because it has 2 protons
    B) 2, because it has 2 neutrons
    C) 3, because it has 1 proton and 2 neutrons
    D) 3, because it has 2 protons and 1 neutron
    E) 1, because it has no neutron

25. Most carbon atoms have 6 protons and 6 neutrons. How many neutrons do the other two isotopes of carbon have?
    A) 6 or 7
    B) 6 or 9
    C) 7 or 8
    D) 8 or 9
    E) 5 or 7

Uses of Isotopes

26. Why do isotopes have very similar chemical properties?
    A) Because their masses differ
    B) Because their proton and electron numbers are equal
    C) Because their neutron numbers differ
    D) Because they are temporary
    E) Because they are radioactive

27. What do we call unstable isotopes?
    A) Stable isotopes
    B) Common isotopes
    C) Inactive isotopes

D) Radioactive isotopes
E) Isobars

28. In medicine, which task is done using isotopes?
A) Measuring blood pressure
B) Dental treatment
C) Detecting damaged capillaries
D) Controlling body temperature
E) Muscle exercise

29. Which property of isotopes is used to destroy cancer cells?
A) Mass
B) Taste
C) Radioactive emission
D) Density
E) Charge

30. What is used to sterilize medical instruments?
A) Ordinary light
B) Heat
C) Chemicals
D) Radioactive rays
E) Steam

31. In agriculture, radioactive isotopes are used for which two tasks?
A) Sowing and harvesting
B) Plowing and irrigation
C) Pest control and determining fertilizer amount
D) Weather study and soil testing
E) Yield counting and storage

32. What is the purpose of using radiation to preserve food?
A) Make food tastier
B) Brighten food color
C) Sterilize food by killing bacteria and germs
D) Increase nutritional value
E) Cool the food

33. The ages of million-year-old fossils are determined from the decay of what?
A) Radioactivity
B) Mass
C) Electrons
D) Radioactive isotopes (isotope decay)
E) Neutrons

34. In geology, which ratio is used to determine fossil ages?
A) Electrons to protons
B) Neutrons to protons
C) Cations to anions

D) Stable to unstable isotopes
E) Mass number to atomic number

Electron Configuration and Properties of Elements

35. By the electron configuration rule, what is the maximum number of electrons in the first shell (n = 1)?
    A) 1
    B) 2 ($2n^2 = 2\times1^2 = 2$)
    C) 4
    D) 8
    E) 18

36. By the electron configuration rule, what is the maximum number of electrons in the second shell (n = 2)?
    A) 4
    B) 6
    C) 8 ($2n^2 = 2\times2^2 = 8$)
    D) 10
    E) 16

37. What is the maximum number of electrons in the third shell (n = 3)?
    A) 9
    B) 12
    C) 14
    D) 18 ($2n^2 = 2\times3^2 = 18$)
    E) 32

38. What is the electron configuration of lithium (atomic number 3)?
    A) 3
    B) 1, 2
    C) 2, 1
    D) 1, 1, 1
    E) 2, 2

39. What is the electron configuration of carbon (atomic number 6)?
    A) 6
    B) 1, 5
    C) 2, 6
    D) 2, 4
    E) 2, 2, 2

40. What is the electron configuration of sodium (atomic number 11)?
    A) 2, 9
    B) 2, 8, 2
    C) 8, 3
    D) 2, 8, 1
    E) 1, 10

41. The properties of an atom depend primarily on which factor?
    A) Number of protons
    B) Number of neutrons
    C) Mass of the nucleus
    D) Electron configuration of the atom
    E) Size of the nucleus

42. Why is a helium atom inert (noble)?
    A) Its mass is very low
    B) It has no neutrons
    C) Its first shell is full with 2 electrons
    D) It is positively charged
    E) It ejects electrons

43. Why do atoms gain or lose electrons to other atoms?
    A) To become electrically neutral
    B) To increase mass
    C) To achieve a stable (filled) state
    D) To increase atomic number
    E) To decrease neutron number

Ion, Cation, and Anion

44. What is a charged atom called?
    A) Isotope
    B) Molecule
    C) Ion
    D) Elementary particle
    E) Stable atom

45. What is an ion with a positive charge called?
    A) Anion
    B) Neutron
    C) Cation
    D) Positron
    E) Negative ion

46. After a sodium atom loses one electron, what does it become?
    A) Anion
    B) Stable fluorine
    C) Cation
    D) Neutron
    E) Inert atom

47. For fluorine (2, 7) to become stable, what must it do?
    A) Lose 7 electrons
    B) Gain 1 electron
    C) Lose 2 electrons
    D) Lose 8 electrons
    E) Add neutrons

48. After gaining an electron, what does fluorine become?
    A) Positively charged cation
    B) Inert neon
    C) Negatively charged anion
    D) Neutron
    E) Stable sodium

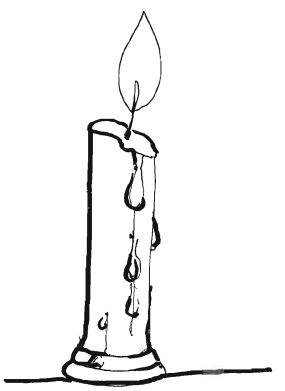
49. What is the primary reason atoms of different elements form compounds?
    A) Same number of electrons
    B) Same mass number
    C) Attractive forces produced by electron gain or loss
    D) Same number of protons
    E) Different numbers of neutrons

50. An atom that loses electrons forms which species?
    A) Negative ion
    B) Neutron
    C) Positive ion (cation)
    D) Stable atom
    E) Proton

Chapter Eight

Chemical Reaction

Different types of chemical reaction are going on around us. There chemical reactions are some times releasing energy, sometimes creating useful new materials and sometimes helping us cure diseases.



At the end of this chapter we will be able to–

- explain different types of chemical reactions.
- explain different types of energy transformations through chemical reactions.
- explain the transformations of energy in dry cells.
- explain electrolysis.
- appreciate the contributions of chemical reactions in our life.
- use properly the chemicals and different instruments in chemical experiments.

Lesson 1 & 2 : Symbol, formula and valency

In class seven, you have got some ideas about symbol and formula. According to structure, chemists have devided all the substances of the world as elements and compounds. Till now, 118 elements have been found out. Generally, symbols are expressed by the first one or two letters of he English or Latin name of the elements. The short expression of the element is called symbol. For example :

Hydrogen H, Oxygen O, Calcium Ca etc.

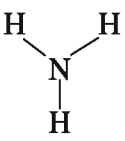
Again, the short expression of molecule of compound is called formula. For example : formula of hydrogen molecule H2, Oxygen molecule 02, Hydrogen chloride molecule HCl etc.

To write the formula of compound, we need to know the valency of the element. According to the number of valency of the element, elements form compounds by chemical bondage. We can compare the valency of elements with our hand. The elements having valency one means it has one hand. Hydrogen and chlorine both are one handed elements. So, their valency is one. Therefore, the formula of hydrogen chloride is HCL The valency of oxygen is two. It means, the one atom of oxygen has two hands. Through these two hands, oxygen can be attached with two atoms of one handed hydrogen. For this reason, the formula of water is H_20.

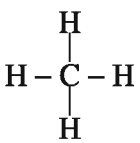
The valency of nitrogen and carbon are 3 and 4 respectively. So, the formula of ammonia is NH_3 and methane is CH_4. The formula of hydrogen chloride, water, ammonia and methane can be shown in the following :

Hydrogen chloride

Water



Ammonia



Methane

It may be mentioned here that some elements have more than example : the valency of sulphur is 2 and 4, Iron is 2 and 3 etc.

Therefore, the valency of the element means the number of hydrogen atom attached to that element. At the time of formation of a compound, it is to be considered that all the hands or valency of an element are satisfied.

Table : The valency of some elements and radicals

Element	Valency-1	Valency-2	Valency-3	Valency-4
Non-metal	Hydeogen (H) Fluorine (F) Chlorine (Cl) Bromine (Br) Iodine (I)	Oxygen (O) Sulphur (S) Carbon (C)	Nitrogen (N) Phosphorus (P)	Carbon (C) Sulphur (S)
Metal	Sodium (Na) Potassium (K) Copper (Cu) (ous) Silver (Ag) Gold (Au) (ous)	Calcium (Ca) Magnesium (Mg) Zinc (Zn) Iron (Fe) (ous) Copper (Cu) (ic) Tin (Sn) (ous) Lead (Pb) (ous)	Aluminium (Al) Iron (Fe) (ic) Gold (Au) (ic)	Tin (Sn) (ic) Lead (Pb) (ic)
Radicals	Ammonium (NH_4^+) Hydroxyl (OH^-) Nitrite (NO_2^-) Nitrate (NO_3^-) Bicarbonate (HCO_3^-)	Carbonate (CO_3^{2-}) Sulphate (SO_4^{2-}) Sulphite (SO_3^{2-})	Phosphate (PO_4^{3-})	

In the above table SO_4^{2-}, CO_3^{2-}, NO_3^-, NH_4^+ etc. group of atoms do not stay independently. They participate in compound formation like elemental atom. This group of atoms is called radical.

To write the molecular formula, the following rules are to be mantioned.

1. If the valency of the element or radical is same, it is not necessary to write valency in the formula. Only element and radical are to be written together. For example: CaO (calcium oxide), NH_4Cl (ammonium chloride), NH_4NO_3 (ammonium nitrate) etc.
2. If the valency of one element is any multiple of valency of another element, the valency of both elements is divided by that multiple. Then the divided result is exchanged and is written as suffix. For example: carbon dioxide $C_2O_4 \rightarrow CO_2$. Here is the valency of carbon dioxide respectively 4 and 2.
3. If the valency of both elements is different but not any multiple like valency of A is X and the valency of B is Y then the formula of compound formed- with A and B is Ay Bx. The valency of element A is written at the suffix on B and the valency of element B is written at the suffix of A. For example alluminium oxide (Al_2O_3)

Lession 3 and 4 : Chemical equation

To describe the chemical reaction we need to know about chemical reaction. A chemical reaction can be divided into two parts.

One part contains the reactants and in the other part, the prodcuts or the newly formed substances. For example :

S	+	O_2	⟶	SO_2
Sulphur		Oxygen		Sulphur dioxide

Reactants represent the prior state of the reaction and products the resultant state of the chemical reaction. In any chemical reaction, atoms cannot be created or destroyed; but they are rearranged only. The total number of atoms present in the reactants before the reaction always equals the total number of atoms of the prodcut after the reaction. So the reactants and their prodcut have the some number of atoms of a specific element. In the light of the above discussion, chemical equation may be defined as follows:

A chemical equation is a shortened expression of a chemical reaction. It uses some symbols, formulas and some mathematical signs to denote the reactants and the prodcuts. For example :

Zn	+	H_2SO_4	⟶	$ZnSO_4$	+	H_2
Zinc		Sulphuric acid		Zinc sulphate		Hydrogen

The rules of writing chemical equations

1. In a chemical equation the formula or symbols of the reacting substances or reactants are written on the left of the sign of euqality (=) and the symbols or formulas of the prodcuts are written on the right of it.
2. If the reactants or products are more than one, a plus (+) sign is put between the formula and the symbols.
3. If the number of molecule is more than one then the number is used before the formula.
4. An arrow sign ($\longrightarrow$) is used to indicate that the reaction moves towards the prodcuts from the reactants. Instead of an arrow sign, and equals sign (=) may also be used. However, the equation has to be balanced on both sides.
5. The number of atoms of different elements present in the reactants before chemical reaction must be equal to the number of atoms of different elements in the prodcuts formed after the reaction. So, to make balance the symbol or formula must be multiplied by the required number.

To balance the chemical equation

Hydrogen reacts with oxygen to prodcue water. So the formula of hydrogen and oxygen is to be written on the left of the equals sign (=) and the formula of the product will be written on the right. The reaction may be expressed as follows :

$$H_2 \quad + \quad O_2 \quad \longrightarrow \quad H_2O$$

The number of H and O atoms before the reaction and their numbers after the reaction should be same. To make the number equal it will have to multiplied on the right side by 2. The equation now stand as :

$$2H_2 \quad + \quad O_2 \quad = \quad 2H_2O$$

From the above equaltion the total number of oxygen and hydrogen atoms before and after of the reaction can be calculated :

	$2H_2$	+	O_2	=	$2H_2O$
	(2×2)	+	(1×2)	=	$2 \times (2+1)$
or,	4	+	2	=	2×3
or,	6			=	6

Therefore, the number of atoms before and after the reaction is equal.

Lesson 5 : Chemical reaction: addition

Activity: Understanding addition reaction
Necessary components: test tube, mortar, spirit lamp or burner, iron powder, sulphur, balance
Methodology: Properly clean the test tube and dry it. Using the balance measure 1 gram of iron powder and 4 gram of sulphur (keeping the ratio same different amounts of iron and sulphur can be taken) and grind them together in the mortar. Put the powders in the test tube. Now heat the bottom of the test tube using the flame low while heating. When the mixer in the test tube becomes red hot, stop heating, keep the test tube above the mortar so that in case the test tube breaks the materials in it will not be spoiled. After cooling the test tube break it and separate out its contents.

The material that you obtain from the test tube will look deep gray. You will see that the light yellow sulphur or iron in it, became the iron powder and the sulphur chemically combined to produce a new material called ferrous sulphide.

$$\underset{\text{Iron}}{Fe} + \underset{\text{Sulphur}}{S} \longrightarrow \underset{\text{ferrous sulphide}}{FeS}$$

This type of chemical reaction in which more than one element combined to produce a new kind of chemical substance is called synthesizing reaction. In the same way zinc and sulphur can chemically react to produce zinc sulphide.

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Sulphur}}{S} \longrightarrow \underset{\text{Zinc sulphide}}{ZnS}$$

It is to be mentioned here that in the above two reactions compounds are formed from elements. However, it is also possible that two compounds can chemically combine to form a new compound. For example, ammonium chloride is produced by adding hydrogen chloride with ammonia.

$$\underset{\text{Ammonia}}{NH_3} + \underset{\text{Hydrogen Chloride}}{HCl} \longrightarrow \underset{\text{Ammonium Chloride}}{NH_4Cl}$$

Lesson 6 and 7 : Combustion reaction

Activity: Observation of combustion reaction between sulphur and oxygen.
Necessary components: A combustion spoon with a long handle, some amount of sulphur, spirit lamp or burner
Methodology: Take some sulphur in your combustion spoon. Go on heating the spoon with the flame of your burner. What do you find?

First you will see sulphur to melt and then you will see blue flame and smell a pungent smell. This is because due to heating of sulphur it. Chemically react with oxygen in the air and produce sulphur dioxide ($S0_2$) gas which gives pungent smell.

$$S + O_2 \longrightarrow SO_2$$

Sulphur Oxygen Sulphur dioxide

Activity: Observation of combustion reaction between magnesium and oxygen.
Necessary components: Magnesium ribbon, forceps (eight centimeter). Spritlamp or burner
Methodology: Wear protective spectacles. Hold the end of the ribbon on the flame you can do it by a lights also. Observe carefully, what happens?

The ribbon catches fire and a bright flame is seen. It happens because magnesium bums due to the reaction with the oxygen of the air and we see the flame. When all the magnesium is burnt out, the flame will extinguish automatically. Do you find anything like ashes? It is actually magnesium oxide which has been formed through the burning of magnesium in oxygen.

$$2\,Mg + O_2 \longrightarrow 2MgO$$

Magnesium Oxygen Magnesium oxide

Activity: To know the process of burning of a candle.
Necessary components: Candle, match
Methodology: Ignite the candle using a match stick. Observe carefully what is happening? With the passage of time the size of the candle reduces. Due to burning the candle melts at the top by the heat produced. A small part of the melted wax flows down the candle, but most of the melted wax turns into vapour by being sucked up through the wick of the candle. This vapour, by combustion process, reacts with the oxygen in the air and produce heat and light.

Lesson 8-9 : Substitution or displacement reaction

Activity: Observing the reaction between iron and copper sulphate.
Necessary components: Iron powder, copper sulphate, water and test tube
The procedure: Fill the test tube with water to one forth its volume. Take some coppersulphate in it and shake to make a solution of copper sulphate. Now put in some iron powder in this blue solution of copper sulphate and shake thoroughly. Do you find any change? The blue colour of solution gradually turning into green and small particles are forming at the bottom of the test tube. Why the blue colour of the solution turns green?

Here a chemical reaction taken place, as a result ferrous sulphate and copper have been formed. The colour of iron sulphate is light green which turns the blue colour of the solution into light green.

$$\underset{\text{Iron}}{Fe} + \underset{\text{Copper sulphate}}{CuSO_4} \longrightarrow \underset{\text{ferrous sulphate}}{FeSO_4} + \underset{\text{Copper}}{Cu}$$

In this reaction iron is removing copper from copper sulphate and occupying is place to form ferrous sulphate and pure copper.
This type of chemical reaction, where an element replaces another element from a compound band occupies its place producing a new compound is called displacement reaction.
You can add zinc, magnesium etc. and see what type of change occurs.

Decomposition rection

Activity: Observing the decomposition reaction of limestone.
Necessary components: Limestone, spatula or spoon, test tubes, lime water, outlet tube, bunsen burner or spirit lamp, clamp, stand, cork and hand gloves
Methodology: Wear the hand gloves and with the help of the spatula take 5 gram of limestone in the test tube. Now heat the bottom of the test tube with the flame of the burner. Observe very carefully.

Carbon dioxide is being produced. The limestone which was taken in the test tube decomposed into carbon dioxide gas and formed calcium oxide due to heating ..

$$\underset{\text{Calcium carbonate (limestone)}}{CaCO_3} \xrightarrow{\text{heat}} \underset{\text{Calcium oxide}}{CaO} + \underset{\text{Carbon dioxide}}{CO_2}$$

Now you can examine whether the gas is carbon dioxide take 1-2 milliliter of lime water in the other test tube and fix it as shown in the figure. You will see that the lime water is turning opaque. The carbon dioxide thus produced passed through the outlet tube to the second test tube and cased reaction there between lime water and carbon dioxide. The lime water becomes opaque due to the formation of calcium carbonate.

Chapter 3: Chemical Reaction

Symbols, Formulas & Valency

1. What is the shortened form of the full name of an element called?
   A) Formula
   B) Compound
   C) Symbol
   D) Valency
   E) Atomic symbol number

2. How many chemical elements have been identified so far?
   A) 100
   B) 116
   C) 120
   D) 118
   E) 119

3. What is the shortened representation of a molecule of an element or a compound called?
   A) Symbol
   B) Ion
   C) Formula
   D) Radical
   E) Valency

4. Which pair contains two elements with valency 1?
   A) Oxygen and carbon
   B) Magnesium and calcium
   C) Nitrogen and phosphorus
   D) Hydrogen and chlorine
   E) Iron and sulfur

5. Why is the formula of water H_2O?
   A) Hydrogen has valency 2
   B) Oxygen and hydrogen have the same valency
   C) Oxygen has valency 2 and hydrogen has valency 1
   D) Hydrogen has valency 4
   E) Oxygen and water have the same formula

6. Why is the formula of ammonia NH_3?
   A) Hydrogen has valency 3
   B) Carbon has valency 4
   C) Hydrogen has valency 2
   D) Nitrogen has valency 3
   E) It is a radical compound

7. Which element can have more than one valency?
   A) Hydrogen
   B) Carbon
   C) Oxygen
   D) Sodium
   E) Sulfur

8. What is meant by the valency of an element?
   A) The number of molecules of the element
   B) The number of electrons in an atom of the element
   C) The number of hydrogen atoms with which one atom of the element can combine
   D) The number of protons of the element
   E) The mass number of the element

9. Which of the following is an example of a compound radical?
   A) H_2O
   B) CO_2
   C) H_2
   D) NH_4^+ (ammonium)
   E) H_2SO_4

10. What is the valency of the phosphate radical PO_4^{3-}?
    A) 1
    B) 2
    C) 3
    D) 4
    E) 5

11. When writing a molecular formula, if the valencies of the two elements or radicals are the same, what rule applies?
    A) Exchange the valencies
    B) Multiply the valencies
    C) Add the valencies
    D) No valency numbers are needed in the formula
    E) Divide the valencies

12. For carbon dioxide, why is the formula CO_2 rather than C_2O_4?
    A) Carbon has valency 4
    B) Oxygen has valency 2
    C) The valencies are different
    D) The valencies of both elements are multiples of a common number
    E) Carbon discards 4 electrons

13. The formula of aluminum oxide is Al_2O_3. This is an example of which rule?
    A) When valencies are equal
    B) When valencies are multiples of a specific number
    C) When valencies differ and are not simple multiples
    D) When one element has valency 1
    E) When both elements are nonmetals

14. Which statement about radicals is correct?
    A) They exist freely like atoms of elements
    B) They carry no charge
    C) They do not participate in compound formation
    D) They participate in forming compounds much like atoms do
    E) They are formed only by metallic elements

15. In the valency table, which element is listed with both valency 2 and 3?
    A) Sodium (Na)
    B) Magnesium (Mg)
    C) Aluminum (Al)
    D) Iron (Fe)
    E) Zinc (Zn)

Chemical Equations

16. Into how many parts can a chemical reaction be divided?
    A) Three
    B) One
    C) Four
    D) Two (reactants and products)
    E) Five

17. On which side of the arrow are the substances written that undergo reaction in a chemical equation?
    A) Products
    B) Only molecules
    C) Reactants
    D) Evolved gases
    E) Catalyst

18. What happens to atoms in a chemical reaction?
    A) Atoms are destroyed
    B) New atoms are created
    C) Only a rearrangement of atoms occurs
    D) The number of atoms decreases
    E) The number of atoms increases

19. When can an equals sign (=) be placed instead of an arrow in a chemical equation?
    A) When the reaction is fast
    B) When there is only one reactant
    C) When balancing the atoms on both sides is required
    D) When a gas is produced
    E) When heat is produced

20. In the equation $2H_2 + O_2 = 2H_2O$, what is the total number of atoms before and after the reaction?
    A) 4
    B) 5

C) 6
D) 7
E) 8

Types of Reactions — Combination, Combustion & Displacement

21. What do you call the chemical change in which two or more substances combine to form a completely new substance?
A) Combustion reaction
B) Decomposition reaction
C) Displacement reaction
D) Neutralization reaction
E) Combination (synthesis) reaction

22. The reaction that produces ferrous sulfide (FeS) is which type of reaction?
A) Displacement
B) Decomposition
C) Neutralization
D) Combustion
E) Combination (synthesis)

23. What is the name of the compound formed when ammonia (NH_3) combines with hydrogen chloride (HCl)?
A) Nitrogen dioxide
B) Hydrazine
C) Ammonium hydroxide
D) Ammonium nitrate
E) Ammonium chloride (NH_4Cl)

24. What can be formed through combination reactions?
A) Only compounds from elements
B) Only elements from compounds
C) Compounds from elements or compounds from compounds
D) Only solids
E) Only gases

25. Why is a pungent smell noticed when sulfur is heated in a combustion spoon?
A) Hydrogen gas
B) Nitrogen oxides
C) Carbon dioxide
D) Sulfur dioxide gas
E) Water vapor

26. When a strip of magnesium burns in atmospheric oxygen, what is produced?
A) Magnesium carbonate
B) Magnesium hydroxide
C) Magnesium oxide (MgO)
D) Magnesium sulfide
E) White smoke

27. When the ribbon catches fire during the combustion of magnesium with oxygen, what kind of flame is observed?
    A) Mild flame
    B) Reddish flame
    C) Orange flame
    D) Blue flame
    E) Very bright (intense) flame

28. What is meant by a combustion reaction?
    A) Breaking down of a compound due to heat
    B) Displacing one element from a compound by another element
    C) Burning of a substance in the presence of air's oxygen to produce heat and light
    D) Reaction of opposite-natured substances to form a neutral substance
    E) Two compounds combining

29. When a candle burns, the chemical energy stored in wax converts into which forms of energy?
    A) Sound energy and light energy
    B) Electrical energy and chemical energy
    C) Potential energy and heat energy
    D) Heat energy and light energy
    E) Kinetic energy and light energy

30. When iron filings are added to a copper sulfate solution, why does the blue solution turn light green?
    A) Copper dioxide is formed
    B) Sulfur dioxide gas is formed
    C) Copper and sulfur unite
    D) Ferrous sulfate ($FeSO_4$) is produced
    E) Copper is deposited

31. What do you call the reactions in which an element displaces another element from its compound and takes its place to form a new compound?
    A) Decomposition reactions
    B) Combination reactions
    C) Neutralization reactions
    D) Displacement reactions
    E) Combustion reactions

32. In the reaction of iron with blue vitriol, which substance displaces copper (Cu) from copper sulfate ($CuSO_4$)?
    A) Sulfur (S)
    B) Oxygen (O)
    C) Hydrogen (H)
    D) Iron (Fe)
    E) Sulfate (SO_4)

33. In the reaction $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$, which substance starts settling at the bottom of the test tube as particles?

A) Ferrous sulfate
B) Sulfur
C) Iron
D) Copper
E) Ferrous oxide

34. When a candle burns, what rises through the wick and vaporizes due to the heat produced?
A) Water vapor
B) Carbon dioxide
C) Most of the melted wax
D) Oxygen
E) Magnesium oxide

35. "Blue vitriol" is a solution of which substance?
A) Ferrous sulfate
B) Calcium carbonate
C) Copper sulfate
D) Sodium hydroxide
E) Ammonium chloride

Decomposition, Neutralization & Energy Changes

36. In the decomposition of limestone ($CaCO_3$), what are the products?
A) Calcium carbonate and water
B) Calcium hydroxide and carbon dioxide
C) Calcium oxide (CaO) and carbon dioxide (CO_2)
D) Only calcium oxide
E) Copper oxide and carbon dioxide

37. Why does the evolved carbon dioxide turn limewater ($Ca(OH)_2$) milky?
A) Because carbon dioxide is poisonous
B) Because the limewater cools down
C) Because the gas dissolves in limewater
D) Because calcium carbonate ($CaCO_3$) is formed
E) Because carbon dioxide and limewater react to form water

38. What are reactions called in which a single compound breaks down into two or more elements or compounds?
A) Combination reactions
B) Combustion reactions
C) Neutralization reactions
D) Decomposition reactions
E) Displacement reactions

39. When potassium chlorate ($KClO_3$) is heated, what does it decompose to produce?
A) Potassium chloride and water
B) Potassium oxide and chlorine gas
C) Potassium chloride (KCl) and oxygen gas (O_2)

D) Potassium carbonate and chlorine
E) Potassium metal and chlorine gas

40. When touching the test tube during the reaction of baking soda and lemon juice, why does it feel cold?
A) A lot of water vapor forms
B) Sodium citrate is formed
C) Heat is absorbed in this reaction (temperature decreases)
D) A lot of carbon dioxide is formed
E) The lemon juice has a very low temperature

41. Why do many bubbles appear in the reaction of baking soda with lemon juice?
A) Oxygen gas
B) Hydrogen gas
C) Nitrogen gas
D) Chlorine gas
E) Carbon dioxide gas

42. In the reaction of quicklime (CaO) with vinegar, along with calcium acetate and water, what else is produced that makes the beaker feel hot?
A) Light energy
B) Sound energy
C) Electrical energy
D) Kinetic energy
E) A large amount of heat energy

43. What is the reaction called in which substances of opposite nature (acid and base) react to form a neutral substance?
A) Combination reaction
B) Decomposition reaction
C) Displacement reaction
D) Combustion reaction
E) Neutralization reaction

44. When quicklime reacts with water to form calcium hydroxide, what is produced in this reaction?
A) Decrease in heat energy
B) Large amount of light energy
C) Large amount of sound energy
D) Large amount of heat energy
E) Electrical energy

45. What is a saturated solution of $Ca(OH)_2$ called?
A) Acetic acid
B) Milk of lime
C) Limewater
D) Caustic soda
E) Soda lime

Dry Cell and Electrolysis

46. In making a dry cell, ammonium chloride, charcoal powder, and manganese dioxide are mixed with what to make a paste?
    A) Acid
    B) Vinegar
    C) Salt
    D) A small amount of water
    E) Lime

47. In a dry cell, which part acts as the negative electrode (anode)?
    A) Metal cap
    B) Carbon rod
    C) Zinc can
    D) Mixture of manganese dioxide
    E) Pitch coating

48. In a dry cell, which part acts as the positive electrode (cathode)?
    A) Zinc can
    B) Charcoal powder
    C) Carbon rod covered by a metal cap
    D) Ammonium chloride
    E) Manganese dioxide

49. How is the carbon rod placed inside the cylindrical zinc can of a dry cell?
    A) Touching the zinc can
    B) Mixed with the paste
    C) Inside the ammonium chloride
    D) So that it does not touch the zinc can
    E) Without the metal cap

50. When a circuit is made using a dry cell, what energy transformation occurs?
    A) Heat energy → Light energy
    B) Light energy → Heat energy
    C) Chemical energy → Electrical energy → Light energy
    D) Electrical energy → Chemical energy
    E) Kinetic energy → Electrical energy

51. Which substances are used in the internal reactions of a dry cell?
    A) Na, Cl, H_2O
    B) Mg, O_2
    C) Fe, $CuSO_4$
    D) Zinc, ammonium chloride, charcoal powder, and manganese dioxide
    E) Lime, vinegar

52. During electrolysis, when current passes through a solution of sodium chloride, where do the sodium ions (Na^+) go?
    A) To the anode
    B) To the neutral point

C) To the cathode
D) As anions
E) To the nucleus

53. During electrolysis, chloride ions (Cl^-) go to the anode and lose electrons to form what?
A) Chlorine ions
B) Chlorine gas (Cl_2)
C) Hydrogen gas
D) Metallic sodium
E) Sodium hydroxide

54. Sodium ions (Na^+) go to the cathode and gain electrons to become what?
A) Sodium hydroxide
B) Metallic sodium (Na)
C) Hydrogen gas
D) Chlorine gas
E) Chloride ions

55. Later, metallic sodium (Na) reacts with water to produce what?
A) NaH and Cl_2
B) NaH and O_2
C) NaCl and H_2O
D) Sodium hydroxide (NaOH) and hydrogen gas (H_2)
E) Sodium oxide and water

56. A substance through which an electric current causes a chemical change and converts it into another substance is called what?
A) Non-electrolyte
B) Ion
C) Electrolyte
D) Cation
E) Anion

57. What are substances called in which no chemical reaction occurs due to the passage of electricity?
A) Electrolytes
B) Ions
C) Cations
D) Anions
E) Non-electrolytes

58. Which of the following is an example of a non-electrolyte?
A) NaCl
B) NaOH
C) H_2SO_4
D) Sugar
E) NH_4Cl

59. In electrolysis, why do chloride ions (Cl^-) go to the anode and give up electrons?
    A) Because the anode is negative
    B) Because the anode is positive
    C) Because anions carry positive charge
    D) Because they want to gain electrons
    E) Because the anode attracts Na^+

60. In the reaction Fe + S → FeS, after heating is stopped the mixture turns reddish. What is advised then?
    A) Add water to the mixture
    B) Cool the mixture quickly
    C) Hold the test tube over the mortar
    D) Heat further
    E) Shake the mixture