

Physical state at room temperature

Red = Solid
Blue = Liquid
Yellow = Gas

Alkali and alkaline earth metals
Transition elements
Metalloids
Non-metals
Rare gases
Lanthanides
Actinides

Atomic number
Symbol
Name
Electronic configuration

Mass number of most stable or best-known isotope
Mass of the isotope of longest half-life

How elements in the periodic table are arranged?

What are well known families of elements in the Periodic table?

How alloys are formed?

05

Periodic Table

Students' Learning Outcomes

After studying this chapter, students will be able to:

- Recognize Periodic Table as a way of classifying the elements in groups and periods.
- Identify the names and location of the first 18 elements only.
- Identify properties of metals and non-metals.
- Relate the properties to the uses of metals.

We have already learnt that every thing in this world is made of matter and is called a material thing. All the material things do not have same type of matter present in them. Rather they may contain different types of matter called **Element**, the basic constituent of matter. An element is a substance, which cannot be split into two or more substances by ordinary chemical changes. The basic particle of an element is called an **atom**. All the atoms of an element are similar but these are different from the atoms of other elements. There are near about 118 elements, 92 of which are naturally occurring. Scientists have arranged the elements in a table called Periodic Table of elements (Figure 5.1).

Key Hydrogen 1 H 1.0 → Atomic number → Symbol → Mass number → Name																		Groups																	
1																		18																	
1																		2																	
2																		10																	
3																		17																	
4																		36																	
5																		54																	
6																		86																	
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Figure 5.1 The Periodic Table of Elements

Reminder

- Proton, electron, neutron, etc., are the fundamental particles of an atom.
- The number of protons present in an atom of an element is called **atomic number (Z)** of that element.
- In an atom, the number of protons is equal to the number of electrons.
- The number of protons plus the number of neutrons present in an atom of an element is called **mass number (A)** of that element.

5.1 PERIODIC TABLE OF ELEMENTS

Elements in the Periodic Table are arranged in an ascending order of their atomic numbers. When arranged in such a way, the elements form horizontal rows which are called **Periods** and the vertical columns which are named as **Groups**. In the periods, elements are arranged from left to right in a continuous manner. There are seven periods in the Periodic Table. First period is called short period. It consists of two elements, hydrogen (H) and helium (He). Second and third periods are called normal periods, each having 8 elements in it. Eight elements of second period are lithium (Li), beryllium (Be), boron (B), carbon (C), nitrogen (N), oxygen (O), fluorine (F) and neon (Ne). Eight elements of third period are sodium (Na), magnesium (Mg), aluminium (Al), silicon (Si), phosphorus (P), sulphur (S), chlorine (Cl) and argon (Ar). Fourth and fifth periods are called long periods, each having 18 elements in it.

Sixth and seventh periods are very long periods, each containing 32 elements shown in the Periodic Table. Elements in a period have different properties. Period number of an element is equal to number of shells it has.

Table 5.1 Different Periods of the Periodic Table

Period No.	Name of the Period	Number of Elements	Range of Atomic Numbers
1 st	Short Period	2	1 to 2
2 nd	Normal Period	8	3 to 10
3 rd	Normal Period	8	11 to 18
4 th	Long Period	18	19 to 36
5 th	Long Period	18	37 to 54
6 th	Very Long Period	32	55 to 86
7 th	Very Long Period	[32]*	87 to 118*

* Since new elements are expected to be discovered, it is an incomplete period.



Activity 5.1

Look at the Periodic Table and write names and symbols of the elements given in its fourth and fifth periods.

Period	Names and Symbols of Elements
4 th	
5 th	

There are eighteen groups in the Periodic Table. Groups are numbered on the basis of number of electrons present in the outermost shell or valence shell of their atoms. For example, each element of group 1 contains one electron in the outermost shell or valence shell of its atoms. Each element of group 2 contains two electrons in the outermost shell or valence shell of their atoms. Elements in a group have similar properties as they have same number of valance electrons.

Groups 1 and 2 and 13 to 17 contain normal elements. Groups 3 to 12 contain transition elements. The elements of group 18 are called noble gases. Their valance shells are completely filled. Table 5.2 given below shows distribution of different families of elements in groups 1 to 18.

Table 5.2 Different Groups of the Periodic Table

Group No.	Number electrons in the valence shell	Family name of elements Present in the group
1	1	Alkali metals
2	2	Alkaline earth metals
3 to 12		Transition metals
13	3	Boron family
14	4	Carbon family
15	5	Nitrogen family
16	6	Oxygen family
17	7	Halogen family
18	8	Noble gases

5.2 FIRST 18 ELEMENTS OF THE PERIODIC TABLE

Names, symbols, atomic number and mass number of the first eighteen elements are shown in table 5.3.

Table 5.3 First Eighteen Elements of Periodic Table

Name	Symbol	Atomic Number	Mass Number
Hydrogen	H	1	1
Helium	He	2	4
Lithium	Li	3	7
Beryllium	Be	4	9
Boron	B	5	11
Carbon	C	6	12
Nitrogen	N	7	14
Oxygen	O	8	16
Fluorine	F	9	19
Neon	Ne	10	20
Sodium	Na	11	23
Magnesium	Mg	12	24
Aluminium	Al	13	27
Silicon	Si	14	28
Phosphorus	P	15	31
Sulphur	S	16	32
Chlorine	Cl	17	35
Argon	Ar	18	40

Activity 5.2

Examine

The Periodic Table of Elements is shown in Figure 5.1. Write down the period number and the group number of the following elements

Element	Period No.	Group No.
1. Phosphorus (P)		
2. Aluminum (Al)		
3. Silver (Ag)		
4. Mercury (Hg)		

5.3 METALS AND NON-METALS

Metals are those elements, which are mostly solid and hard. They reflect light from their surfaces and are good conductors of heat and electricity. Some metals are ductile, i.e., these can be pulled into wires. Some metals are malleable, i.e., these can be bent or hammered into desired shapes or sheets. Iron, gold, silver, copper, sodium, potassium, mercury, etc., are the examples of metals.

Non-metals are usually soft and bad conductors of heat and electricity. However, graphite (a form of carbon) is a good conductor of electricity. Non-metals cannot be drawn into wires or sheets because they are brittle. Non-metals except bromine exist, both in solid and gaseous states. Bromine is the only liquid non-metal. Examples are carbon, sulphur, chlorine, bromine, hydrogen, oxygen, nitrogen etc.

5.3.1 Properties and Uses of Metals

i. State

Most of the metals are found in solid state at room temperature. Mercury (Hg) is the metal which exists in liquid state and is filled in the bulbs of thermometers to measure temperature. (Figure 5.2)



Figure 5.2 Mercury filled in thermometer

ii. Hardness

Generally metals are hard solids. Due to this property, iron is used to make steel, railway tracks and ships, etc. (Figure 5.3)



Steel products



Railway track



Ship

Figure 5.3 Uses of metals due to hardness

Can you tell?

Why is silver not used in pure form?

iii. Lustre

Metals have brilliant and shiny surfaces. Due to this property aluminium is used to make reflectors of light, picture frames and mirrors, etc. Silver and gold are used to make jewellery. (Figure 5.4)



Aluminium reflector of light



Silver jewellery



Gold jewellery

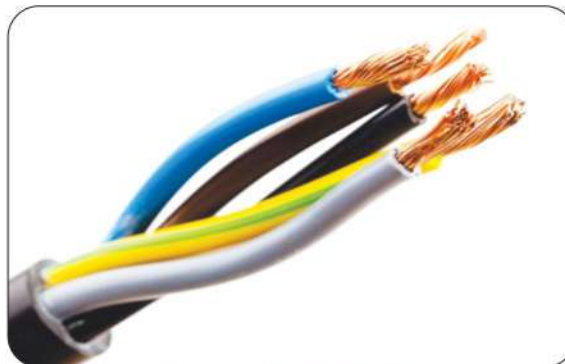
Figure 5.4 Uses of aluminium, silver and gold

iv. Conductance

Metals are good conductors of heat and electricity. Due to good conductor of heat, aluminum and copper are used to make cooking pots and pans. Due to good conductor of electricity, copper and aluminum are used to make electrical wires.



Aluminium cooking pan



Copper electrical wires

Figure 5.5 Uses of aluminium and copper

V. Malleability and ductility

Generally metals are malleable and ductile. Due to this property, metals are used to make sheets, wires, springs and other desired shapes, etc.

Do you know?

1. A metal which can be hammered into sheets is called malleable.
2. A metal which can be drawn into wires is called ductile.



Aluminium sheet



Metallic spring



Aluminium wire

Figure 5.6 Property of metals due to malleability and ductility

vi. Melting and boiling points

Metals have high melting and boiling points. Due to this property, some of these metals are used to make kitchen utensils.



Figure 5.7 Kitchen utensils

vii. Alloy formation

Molten forms of different metals are mixed to form alloys like, German silver and brass. Alloys are corrosion resistant having higher strength and better thermal property. German silver is an alloy of copper, zinc, and nickel. It is used to make jewellery and decorative objects. Brass is an alloy of copper and zinc. It is used to make pipes, nozzles and jewellery.



Plate made of german silver



Pot made of brass

Figure 5.8 Objects made of brass and german silver

5.3.2 Properties and Uses of Non-metals

Non-metals are usually soft and bad conductors of heat and electricity.

1. Graphite is a form of carbon. It is mixed with clay to use in lead pencils.
2. Diamond is another form of carbon. It is the hardest matter on the Earth. It is used to cut glass. It is a shiny matter and is used in jewellery.
3. Phosphorous is used in match industry.
4. Hydrogen when burnt with oxygen gives a very hot flame which is used for cutting and welding metals. Hydrogen is also used for the manufacture of banaspati ghee from vegetable oils.
5. Oxygen cylinders are used in hospitals for curing patients feeling breathing problems.
6. Hydrogen and nitrogen are used for the manufacture of urea (fertilizer).



Lead pencils



Diamonds



Matchsticks



Hydrogen flame



Banaspati ghee



Oxygen cylinder



Urea (Fertilizer)

Figure 5.9 Uses on non-metals

Can you tell?

Two wires of equal length, one of copper and the other of some alloy have the same thickness, which one can be used for:

- (a) Electrical transmission lines.
- (b) Electric heating devices.

Give reason of your answer.

KEY POINTS

- There are about 118 elements, 92 of which are naturally occurring.
- Scientists have arranged the elements in a table called Periodic Table.
- Horizontal rows of elements in the Periodic Table are called periods.
- Vertical column in the Periodic Table are called groups.
- In the periods, elements are arranged from left to right in a continuous increasing order of their atomic numbers.
- Groups are numbered on the basis of number of electrons in the outermost shell or valence shell of their atoms.
- Metals reflect light from their surface and are good conductors of heat and electricity.
- Some metals are ductile and can be pulled into wires. Some are malleable and can form thin sheets.
- Non-metals are usually soft and poor conductors of heat and electricity. They cannot be drawn into wires or sheets because they are brittle.

QUESTIONS

1. Encircle the correct option.

- (i) An element of the third period in the Periodic Table:
(a) H (b) P
(c) He (d) Li
- (ii) Mg belongs to the period of the Periodic Table:
(a) 1st (b) 2nd
(c) 3rd (d) 4th
- (iii) An alkali metal:
(a) F (d) Be
(c) Al (d) Na
- (iv) Ne belongs to:
(a) nitrogen family (b) fluorine family
(c) noble gases (d) alkaline earth metals
- (v) An element of group 17 of the Periodic Table:
(a) Cl (b) Ar
(c) S (d) Si

- (vi) Atomic number of the element at fourth position in second period:
(a) 4 (b) 5
(c) 6 (d) 7
- (vii) How many periods are there in the Periodic Table?
(a) Five (b) Six
(c) Seven (d) Eight
- (viii) A metal:
(a) Cu (b) C
(c) Cl (d) Ne
- (ix) A non-metal:
(a) H (b) Na
(c) Li (d) Be
- (x) An atom containing two electrons:
(a) H (b) He
(c) Li (d) Be

2. Write short answers.

- (i) What is meant by a period in the Periodic Table?
(ii) What is meant by a group in the Periodic Table?
(iii) Define element.
(iv) What do you mean by an atomic number?
(v) How many electrons are there in the valence shell of H?

3. Constructed response questions

- (i) Oxygen is a non-metallic element.
(a) What is the atomic number of oxygen?
(b) In which group of the Periodic Table, oxygen is located?
(c) In which period of the Periodic Table, oxygen is located?
(d) How many electrons are required by oxygen atom to complete its valence shell?
(e) State any two uses of oxygen in daily life.
- (ii) Sodium is a metallic element.
(a) What is the symbol of sodium?
(b) What is the atomic number of sodium?
(c) In which period of the Periodic Table, sodium is located?
(d) What is the group number of sodium in the Periodic Table?
(e) Name the family of metals to which sodium belongs?
- (iii) Name the members of the following families in the Periodic Table?

- (a) Alkali metals
- (b) Alkaline earth metals
- (c) Halogens
- (d) Noble gases
- (e) Name the element having same period number and group number.
- (iv) Relate the following properties of metals with their uses in daily life.
 - (a) Conductance of heat
 - (b) Conductance of electricity
 - (c) Malleability and ductility
 - (d) Hardness
 - (e) Lustre

4. Investigate

- (i) Why the chemical properties of the elements present in a group are similar?
- (ii) Why is mercury used in the thermometer to measure the body temperature?
- (iii) Magnesium and Calcium are kept in the same group of the Periodic Table. Explain why?

Project

Manage and conduct a discussion with your teacher and classmates on the following:

- (i) Trends of atomic number and atomic size of the elements when we move from left to right in different periods of the Periodic Table.
- (ii) Trends of number of valence shell electrons and atomic size of the elements when we move from top to bottom in different groups of the Periodic Table.