Suva Sangam College

Year 10 Basic Science Notes

Strand: Matter

Sub Strand: Investigating Matter

Week 1 – 5th – 9th , July, 2021

Achievement Indicators:

- Identify different sub-atomic particles in an atom

- Draw and label the structure of an atom

- Calculate the number of electrons, protons, neutrons, atomic number/ mass and mass number in an atom.

Matter

- anything that has mass and occupies space eg desk, book, plant, water, oxygen, etc

- made up of very small particles

Investigating Matter

Structure and Constituents of an Atom

Atom:

- the smallest neutral particle of an element that cannot be divided any further

- the building block of matter.

- can take part in a chemical reaction

- different elements contain different types of atoms eg iron (Fe) contains iron atoms only which is grey in colour, sulphur (S) contains sulphur atoms only which is yellow in colour.

Atom is made up of three kinds of sub-atomic particles

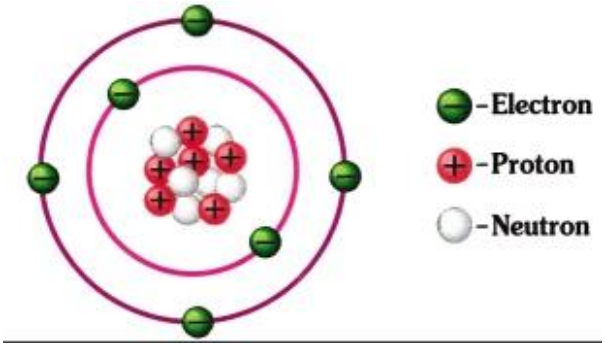
Sub-atomic particle	Symbol	Relative charge	Location
Protons	p^+	+1 (positively charged)	Found in the nuclues
Neutrons	n^o	0 (neutral)	Found in the nucleus
Electrons	e^-	-1 (negatively charged)	Moving around the nucleus in shells

Note:

1. Proton and neutron are heavier than electron

2. Number of proton is equal to number of electron

3. Negative charge electron balances the positive charge of proton



Example: Carbon $_{12}C^{6}$

- has 6 electrons

- has 6 protons

- has 6 neutrons

Electron configuration= 2, 4

1 st shell- has two 2 electrons and the 2nd shell has 4 electrons

$_{Z}X^{A}$ X- symbol of the element

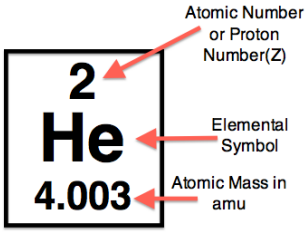
Z- is the atomic number

A- is the mass number

Atomic Number (Z)

- is the number of protons and also the of electrons in any atom.

Example



- elements are arranged in ascending order of atomic number in the Periodic Table

Mass Number (A)

- the total number of protons and neutrons in an atom

mass number = no: of proton + no: of neutrons

Note:

In a neutral atom, the number of protons and electrons are always equal

E.g If an oxygen atom (atomic number=8) has 8 protons, it must also have 8 electrons as well

Exercise

1. An atom of Fluorine has atomic symbol $_{19}F^{9}$. How many protons does fluorine have?

_____
_____
_____

2. An atom of argon has 18 protons and 22 neutrons. Write the atomic symbol of symbol and also its electron configuration.

_____
_____

Week 2 – 12th – 16th , July, 2021

Achievement Indicators:

- Define isotopes and give examples

- Calculate electron configuration and draw atomic structures

Isotopes

- two atoms of the same element which have different number of neutrons

- they have the same atomic number but different mass numbers

- they have the same number of protons but different numbers of neutrons

- isotopes have same chemical properties but different physical properties

Example

$_{35}CI^{17}$ $_{37}Cl^{17}$

Element	$_{35}CI^{17}$	$_{37}Cl^{17}$
Z	17	17
A	35	37
p+	17	17
n^{0}	18	20
e^{-}	17	17

Electrons

-number of electrons in an atom is equal to the number of protons.

Electron shells/ energy level

- Is the region of an atom in which electrons move around the nucleus.
- Each shell has different energy.
- Shell closest to the nucleus has lowest energy.
- Shell further away from the nucleus has highest energy .

Arrangement of Electrons in an Atom

Electron configuration

- Refers to the arrangement of electrons in shells or energy levels of an atom.
- These electrons in the atom are restricted to certain permitted energies**.**

They obey the following rules:

- ✓ The number of electrons in each shell is limited.
- ✓ The 1^{st} shell can hold a maximum of 2 electrons.
- ✓ From the 2^{nd} and 3^{rd} shell, each can accommodate a maximum of 8 electrons.
- ✓ 4^{th} shell can hold 18 electrons.
- ✓ The shell nearest to the nucleus fills up first.

To work out the electron arrangement of an atom

Look up the atomic number in the Periodic table-making sure to choose the right number if two numbers are given.

- The atomic number will always be the smaller one.
- This tells the number of protons , and therefore the number of electrons.
- Arrange the electrons in levels, always filling up an inner level before going to an outer one.

Example Electron configuration and electron diagram for sodium

$^{23}_{11}Na$

Sodium atomic number is 11 (smaller number). Thus:

Number of protons = 11

Number of electrons = 11

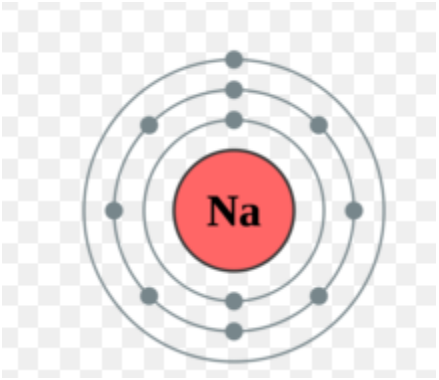
Electron configuration = (2, 8, 1)

1^{st} shell =2 electrons

2^{nd} shell= 8 electrons

3^{rd} shell= 1electrons

Electron structure diagram:



Electron configuration of Na(11) : (2,8,1)

The electronic configuration of the first 20 elements

H 1							He 2
Li 2,1	Be 2,2	B 2,3	C 2,4	N 2,5	O 2,6	F 2,7	Ne 2,8
Na 2,8,1	Mg 2,8,2	Al 2,8,3	Si 2,8,4	P 2,8,5	S 2,8,6	Cl 2,8,7	Ar 2,8,8
K 2,8,8,1	Ca 2,8,8,2						

Valence electrons

- Is the outer most electrons.

Valence shell/outer shell

- the last electron shell.
- Physical and chemical property of element depends upon electrons in the valence shell.
- Metals have 1 or 2 electrons in the valence shell.
- Non-metals have 3 or more electrons.

Octet

- Refers to 8 electrons in a single electron shell.
- Atoms with an octet valence shell are very stable and unreactive.

NOTE

- **Other atoms achieve octet by sharing electrons with other atoms or by gaining or losing electrons.**
- **The valency of an element denotes the number of electrons an atom has to lose or gain to have stable configuration.**

Two important generalizations

1. The number of electrons in the outer level is the same as the group number except with helium which has only 2 electrons.
2. This pattern extends throughout the Periodic Table for the main groups (ie. Not including the transition elements.)

Example

- Boron is in group 3, it has 3 electrons in its outer energy level.
- Chlorine (Group 7) has 7 electrons in its outer level.
- Noble gases have full outer levels.

Exercise

Draw the electron structure diagram for the following:

i. Oxygen
ii. Sulphur
iii. Aluminium

2. Complete the table. There is enough information given for each element to determine all the missing information.

Symbol	Atomic Number	Mass Number	Number of Protons	Number of Electrons	Number of Neutrons
K		40		19	
Cl^-					
O^{2-}			8		8

Week 3 – 19th – 23rd July, 2021

Achievement Indicators:

- Identify the first 20 elements of the periodic table

- Lbel groups and periods in the periodic table

- Explain the some trends in the periodic table

Elements

- an element is a pure substance

- it is made of only one kind of atom

- there are more than 100 elements

- a chemical reaction will not be able to change an element

- there are two main groups of elements , metals and Non- metals.

- scientist have organised elements into groups when they found that some elements had things in common.

- the system of sorting elements into groups is called the Periodic Table

The Periodic Table

- contain a list of element in order of increasing atomic number

- constructed by a Russian called Dimitri Medeleev

No:	Name	Symbol
1	Hydrogen	H
2	Helium	He
3	Lithium	Li
4	Berrylium	Be
5	Boron	B
6	Carbon	C
7	Nitrogen	N
8	Oxygen	O
9	Fluorine	F
10	Neon	Ne

No:	Name	Symbol
11	Sodium	Na
12	Magnesium	Mg
13	Aluminium	Al
14	Silicon	Si
15	Phosphorus	P
16	Sulphur	S
17	Chlorine	Cl
18	Argon	Ar
19	Potassium	K
20	Calium	Ca

Groups

- the vertical columns in the periodic table are as groups

- there are 8 groups in the periodic table

- elements with similar chemical properties are found in the same group because they have the same number of valence electrons

- Group I elements are known as alkali metals

- Group II elements are known as alkaline elements

- Group III elements are known as metalloids; they have properties of bothmetal and non-metals

- Groups IV, V, VI, and VII are mostly non-metals

- Group VII elements are known as halogens

- Group VIII elements are known as inert or noble gases

Note:

- Transition elements are at the centre of the periodic table

Trends in the Periodic Table

Physical State

- In periods 2 and 3, from groups 1 and 4 are solid and from groups 5 to 8 are gases

Melting Points

- elements in period 2 and 3 change from medium in group 1 to high in group 4 to very low from groups 5 to 8.

Electrical conductivity

- elements on the left side of the periodic table (metals) conduct electricity

- elements in the middle (metalloids) are semi conductors

- elements on the right side (non metals) do not conduct electricity

Electronegativity

- is the strength of an atom attraction for the shared pair of electrons

- increases across the period and decreases down the group

- elements on the right side of the periodic table are more electronegative than on the left side (because of more valence electrons)

Size of an Atom

- decreases across the period and increases down the group.

- the greater the attraction between the nucleus and valence electrons, the smaller the size of an atom.

Exercise

1. In the periodic table, each row is called a_____

2. Each column in the periodic table is called a _____

3. Each of the elements in the same _____ have the same number of _____ in their outer shell.

4. The electron in the outer shell are called _____ electrons

5. Groups 8 elements are known as _____

6. Chlorine belongs to which group?_____

Achievement Indicators

- Define Physical and Chemical Properties of Elements

- Define Reactivity

- Reactivity Series of element

Physical and Chemical Properties of Elements

Physical Properties

- characteristic of a substances that can be observed or measured

- chemical nature of substance does not change

Example

1. Physical State- solid, liquid or gas at room temperature

2. Colour- related to the ability of the substance to reflect visible light

3. Density- is the concentration of matter in a substance. Is the mass per unit of volume in gL^{-1}

4. Melting Point- temperature at which a substance change state from solid to liquid

5. Boiling Point- temperature at which a substance change state from liquid to gas

6. Lustre- describe how well the substance shines

7. Electrical conductivity- the ability of a substance to allow an electric current to pass through it

8. Thermal conductivity- the ability of a substance to allow heat to pass through it.

9. Malleability- the ability of a substance to be beaten into sheet

10. Ductility- the ability of a substance to be drawn into wires

11. Tensile strength- ability to support pressure or load.

Chemical Properties

- change the chemical nature of the substance

- the product is recognized as a separate substance or new substance

- number of electrons in the valence shell determines the chemical property of an element.

Note:

- elements with the same number of electrons in their outer shell have similar properties

- groups of elements with similar properties

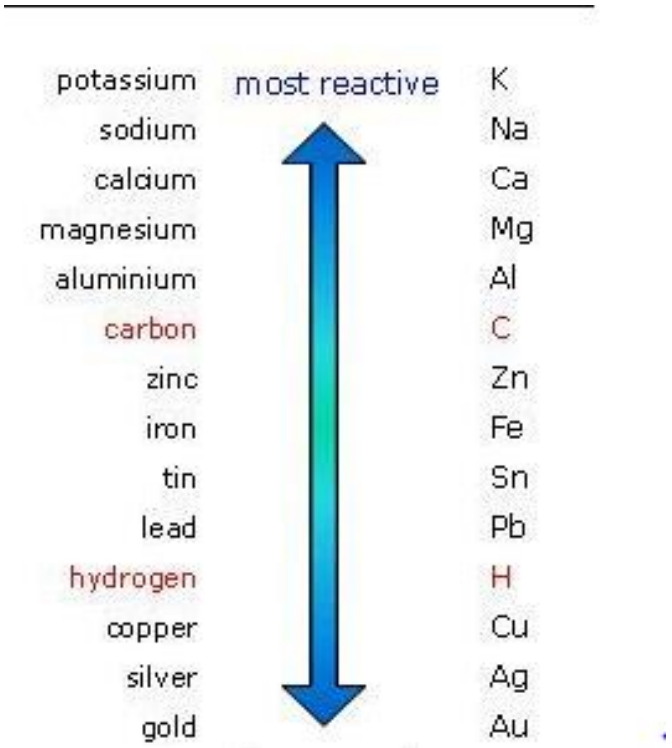
- physical and chemical properties gradually changes down a group.

Reactivity

- a measure of how actively a substance(chemical) reacts with another substance(chemical)

	Physical Property	Chemical Property
Down Group 1 (Alkali Metals) Eg Li, Na, K	. All are metal . Less dense(float in water) . silvery and shiny when freshly cut . have low melting and boiling points compared with other metals	Li is least reactive K is the most reactive In group 1, all atoms of all elements have 1 electron in their outer shell
Down Group 7 (Halogen) eg Cl, Br, I	- non metals - coloured (chlorine –green gas, bromine- red liquid, iodine- black solid) - poisonous	Cl- most reactive,it reacts most easily with iron I- least reactive In Group 7,the atoms of the elements have 7 electron in their outer shell.
Down Group 8 (Noble gases) Eg He, Ne, Ar	- non metals - gases - colourless	In group 8, the atoms of all the elements have a full outer shell of electrons thus they are unreactive

Reactivity Series



Exercise

1. Why do elements of the same group have the same chemical properties?

_____
_____

2. Why are inert gages unreactive?

_____
_____

3. Who is the name of the scientist who published the periodic table?

_____

4. How many elements are there in the periodic table?

_____

Week 5 – 2nd – 6th August , 2021

Achievement Indicators

- Identify properties of metals and non metals'
- Uses of metals and non metals
- Carry out conductivity test on metals and non metals

Properties of Metals and Non Metals

Metals

- found on the left of the periodic table

Properties of metals are:

1. Most are solid,except for mercury (the only liquid metal used in thermometer)
2. Usually high melting and boiling points
3. Very good conductors of heat and electricity
4. Shiny appearance (silvery except for copper and gold)
5. Quite strong material
6. Malleable- easily beaten into thin sheets
7. Ductile- can be pulled to make wires
8. High Density
9. Sonorous- they make ringing noise when you strike them
10. React with oxygen to form basic oxide

Note:

- Metals get more reactive as you move to the left of the periodic table

- Group 1 metals are the most reactive.

Non Metals

- are found on the right of the periodic table

Properties of Non Metals

1. Gases, liquid or solids at room temperature
2. Usually have low melting and boiling points
3. Have dull surfaces when solid
4. Non malleable when solid
5. Brittle – breaks easily
6. Poor conductors of heat and electricity
7. Low density
8. Reacts with oxygen to form acidic oxides

Uses of Metals

Metals	Properties	Uses
Aluminium	- low density, does not corrode - conductor of heat and non toxic - malleable and strong	-suitable for bodies of planes -for making saucepans -for cooking foil and milk tops
Copper	-good conductor of electricity - does not react with water -ring sound(sonorous)	- electrical wires as it is a good conductor - water pipes due to its low reactivity - for belly making
Gold	-very good conductor of electricity, unreactive - does not rust and shiny	-electrical connection on circuit boards- due to its conductivity -jewellery due to its lack of reactivity
Steel	-cheap and strong	-suitable for building material, car parts, kitchen sinks, cutlery
Lead	-malleable can be stretch without breaking, heavy and cheap. - resist corrosion (rust)	- suitable for fishing line sinkers and roof sealing - automobile industry (batteries)

Note:

- few metals are most useful in pure form eg copper is good conductor of electricity in pure form

- many metals are most useful in alloy form

Eg Mix iron with carbon will form steel which is harder and stronger for buildings, bridges, ships and car batteries.

Uses of Non Metal

Non Metal	Properties	Uses
Carbon (graphite)	- soft and smooth	-lead of pencils -electrodes in electrolysis and dry cells
Carbon (diamond)	-hard - colourless and transparent	-drill bits for cutting stones - jewellery
Neon gas	-poor conductor	- lights used for billboards
Chlorine	-acidic soluble in water	-kills germs in drinking water, used for making plastic, bleaching powder, and liquid
Phosphorus	- react easily with oxygen	-making matches

Exercise

1) State a property of aluminium that makes it usefiul for use in the following

i) Aeroplanes-_____

ii) Cooking-_____

2. State why steel is mostly used in constrictions of buildings

_____
_____

3. Why copper is used in electrical wires?

_____
_____

4. Phosphorus is used in match sticks, Why?

_____
_____

5. Name the metal which is liquid at room temperature?

_____

6. Identify the characteristics of metal

_____
_____