# Chemistry

## Periodic Table

Topics: ① Introduction

② Modern Periodic table

③ Characteristics of modern periodic table

④ classification of elements based electronic configuration

⑤ Period and group determination for electronic Configuration

⑥ Periodicity

## Introduction:

1. Dobereiner's Triads: In 1817 a German chemist Dobereiner identified certain groups of three elements. These groups of three elements having similiar properties was called triads. When three elements were arranged in order of their increasing atomic masses, the atomic mass of the middle element was roughly the mean of the atomic masses of the other two element.

2. New Lands Law of octaves: When elements were arranged in order of their increasing relative atomic masses. The properties of every eight elements were similar to the first one,

like the eighth note of a musical scale. This repitition in the Properties of elements is just like the repetition of eighth note in an octave of music.

## 3. Mendeleev's Periodic Table:

Mendeleev's periodic law - " The physical and chemical properties of elements are the periodic function of their atomic masses. (Periodic law)

## Properties of modern periodic table: / Characteristics

① The modern periodic table consists of 7 horizontal rows call periods namely 1 to 7.

② The table consists of 18 vertical groups columns called groups namely 1 to 18.

③ The 1st period contains only 2 elements -that's why, it is called very short period.

④ The 2nd and 3rd period ~~he~~ contains 8 elements each that's why these are called short period.

⑤ The 4th and 5th period contains 18 elements each -that's why these are called long period.

⑥ The 6th and 7th period contains 32 element each that's why these are called very long period.

⑦ Lanthanides and Actinides elements are placed in separate panels at the bottom.

## Classification on elements based on electronic configuration:

The elements are classified into four block depending on the type of atomic orbital that are being filled with electron.

They are: ① s block
② p block
③ d block
④ f block

### ① s - Block Elements:

In electronic configuration, the elements whose last electron goes to s orbital are called s-block elements.

⇒ The elements of Group 1 (alkali metals) and Group 2 (alkaline earth metals) belong to the s block elements.

Example: $H(1) \rightarrow 1s^1$

$He(2) \rightarrow 1s^2$

$Na(11) \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^1$

### ② p-block elements:

In electronic configuration, the elements whose last electron goes to p-orbital are called p-block elements.

⇒ The elements of group -13 to group-18 belongs to p block elements. And these together with the s-block elements are called the Representative elements or main group elements. The outermost electronic configuration Varies from $ns^2np^1$ to $ns^2np^6$ in each period.

~~② d- Block elements:~~

Example: $C(6) - 1s^2\ 2s^2\ 2p^2$

$S(16) - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

$Cl(17) - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

→ (Transition)

③ d- Block Elements: In electronic configuration, the elements whose last electron goes to d- orbital are called d-Block Elements.

⇒ These are the elements of Group 3 to 12 in the centre of the periodic table.

⇒ Outer electronic configuration $(n-1)d^{1-10}\ ns^{0-2}$

Example: $Sc(21) - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

$Cr(24) - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ \sout{3d^1}\ 4s^1\ 3d^5$

$Cu(29) - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$

④ f-block elements (Inner transition):

In electronic configuration, the elements whose last electron goes to f- orbital are called f-block elements.

⇒ Lanthanides, $Ce(Z=58) - Lu(Z=71)$ and Actinides, $Th(Z=90) - Lr(Z=103)$ are the elements of f block.

⇒ Outer electronic configuration : $(n-2)f^{1-4}\ (n-1)d^{0-2}\ ns^2$

⇒ The last electron added to each element is filled in f-orbital. These two series of elements are called the Inner-Transition elements.

Example: La (57) - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^1$

Ce (58) - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^2$

Main Group / Representative Elements: S Block
P Block

Noble Gases: The gases elements of group 18 are called noble gases. Outermost electronic configuration of noble gase is $ns^2np^6$

- 'He' exceptionally $1s^2$ configuration.

Question pattern: Discuss the classifications of elements based on electronic configuration

→ Electronic configuration of Noble gases:

He (2) - $1s^2$

Ne (10) - $1s^2\ 2s^2\ 2p^6$

Ar (18) - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Kr (36) - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6$

Xe (54) - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6$

Rn (86) - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6$

## Period and group determination from electronic configuration:

Rules: ① Highest number of n is the period.

② For group determination following formulae will be used: $(n-1)d + ns + np$

N.B: If electron is in both 's' and 'p' but not in 'd' then 10 should be added

Example: 2n (30)

The electronic configuration by the aufbau principle:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$

Now arranging the configuration according to principle quantam number:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2$

Period = 4

Group = $(n-1)d + ns + np$

$= 3d + 4s + 4p$

$= 10 + 2 + 0$

$= 12$

∴ So, 2n (30) is in period 4 and in Group 12

Question pattern: Determine the period and group of given element.

Determine the elements from the Period and Group

B(5) – $1s^2\ 2s^2\ 2p^1$

Period – 2

Group – $(n-1)d + ns + np$

$= (2-1)d + 2s + 2p$

$= 1d + 2s + 2p$

$= 0 + 2 + 1$

$= 3 + 10$

$= 13$

Ne(10) – $1s^2\ 2s^2\ 2p^6$

Period – 2

Group = $(n-1)d + ns + np$

$= (2-1)d + 2s + 2p$

$= 1d + 2s + 2p$

$= 0 + 2 + 6$

$= 8 + 10$

$= 18$ .

Na(11) – $1s^2\ 2s^2\ 2p^6\ 3s^1$

Period – 3

Group = $(n-1)d + ns + np$

$= (3-1)d + 3s + 3p$

$= 2d + 3s + 3p$

$= 0 + 1 + 0$

$= 1$

Al(13) – $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

Period – 3

Group = $(n-1)d + ns + np$

$= 2d + 3s + 3p$

$= 0 + 2 + 1$

$= 3 + 10$

$= 13$

Cr(24) – $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

Period – 4

Group = $(4-1)d + 4s + 4p$

$= 3d + 4s + 4p$

$= 5 + 1 + 0$

$= 6$