Unit No 3:

Periodic Table and Periodicity of properties

Short Question:-

Q No 1

Why are noble gases not reactive?

Ans:-

Noble gases do have 2 or 8 electrons in their valence shells. It means that all the noble gases have their valence shells completely filled. Their atoms do not have vacent spaces in their valence shells to accomodate extra electrons. That is why noble gases are not very reactive.

Q No 2

Why Cesium (at. no. 55) requires little energy to release its one electron present in the outermost shell?

Ans:-

Cesium requires little energy to release its outermost electron because it has bigger atomic number, high shielding effect and

Scanned with CamScanner

low ionization energy due to which the nucleus hold of nucleus on valence electron becomes very week.

Q No 3

How is periodicity of properties dependent upon number of protons in an atom?

Ans:

Chemical properties of element depend upon electronic configuration which is based upon atomic number or number of protons. So arrangement of elements according to increasing atomic number shows the periodicity in the electronic configuration of the elements that leads the periodicity in their properties.

Q No 4

Why shielding effect of electrons makes cation formation easily?

Ans:

The shielding effects of electrons makes the cation formation easy because the electrons present

Scanned with CamScanner

between the nucleus and the outermost shell of an atom; reduce the nuclear charge felt by the electrons present in the outermost shell.

Q No 5

What is the difference between Mendeleev's periodic law and modern periodic law?

Ans:

Mendeleev's Periodic Law	Modern Periodic law
Properties of elements are the periodic function of their atomic masses.	Properties of element are the periodic function of their atomic number. (K, L, M, N).

Q No 6

Why do you mean by groups and periods in the periodic table?

Ans:

Groups:

Vertical columns in the periodic table are called groups. They are studied from top to bottom. There are 18 groups.

Scanned with CamScanner

Periods:

Horizontal rows in the periodic table are called periods. They are studied from left to right. There are 7 periods.

(Q no 7)

Why and how element are arranged in 4th period?

Ans:

The elements are arranged in 4th period because they are all having four electronic shells and are arranged by increasing atomic number from left to right in the period.

Q no 8

Why the size of atom does not decrease regularly in a period?

Ans:

Atomic number increases across a period, so the number of electrons also go on increasing in same shell (valence shell). Due to repulsion of these electrons, the size of atom does not decrease regularly in a period.

Scanned with CamScanner

Q No 9

Give the trend of ionization energy in a period?

Ans:

Ionization energy decreases while moving from top to bottom in a group.

Reason:

Because the size of atom reduces and valence shells electron are held strongly by the electrostatic force of attraction of nucleus. It increases from left to right in a period.

Reason:

Because in group more and more shells lie between the valence shells and nucleus. Which reduce the electrostatic force of attraction between nucleus and valence electron so they are taken away easily.

Scanned with CamScanner

Chapter No 3:- "Periodic Table and Periodicity of properties"

Long Questions:-

Q No 1

Explain the contribution of Mendeleev for the arrangement of element in his periodic table?

Ans:-

Mendeleev's Periodic table:-

Russian chemist, Mendeleev arranged the known elements (only 63) in order of increasing atomic masses, in horizontal rows called periods. So that elements with similar properties were placed in the same vertical columns; Thus arrangement of elements are called periodic Table. He put forward the results of his work in the form of periodic table.

Mendeleev's Periodic Law:-

"Properties of the elements are periodic function of their atomic masses."

Demerits of Mendeleev's Periodic table:-

Althought, Mendeleev's periodic table was the

Scanned with CamScanner

first ever attempt to arrange the elements, yet it has a few demerits in it. (i) He did not explains the position of isotopes. (ii) There was wrong order of the atomic masses of some elements. So, it was suggested that atomic mass of an element cannot serve as the basis for the arrangement of elements.

Q No 2

Show why in a 'period' the size of an atom decreases if one moves from left to right?

Ans:

When we move from left to right in a period althought atomic number increases, yet the size of atoms decreases gradually. It is because with the increase of atomic number, the effective nuclear charge increases gradually because of addition of more and more protons in the nucleus. But on the other hand addition of electrons takes place in the same valence shells i.e. shells do not increase. There is gradual increase of effective nuclear charge which increases

Scanned with CamScanner

due to addition of protons. The force pulls down or contracts the outermost shell towards the nucleus. For example, atomic size in the period 2 decreases from Li (152 pm) to Ne (69 pm).

Q No 3

Describe the trends of electronegativity in a period and in a group?

Ans:

Electronegativity:

The ability of an attom to attract the shared pair of electrons towards itself in a molecule, is called electronegativity.

It is an important property especially when covalent type of bonding of elements is under consideration.

Trends in period:

It increase in period form left to right.

Reason:

Higher effective nuclear charge (Z_{eff}) shortens distance from the nucleus of the shared pair of electrons. This

Scanned with CamScanner

enhances the power to attract the shared pair of electrons. For example, electronegativity values of 2nd period are given as fellow:

2^{nd} period elements	^{3}Li	^{4}Be	^{5}B	^{6}C	^{7}N	^{8}O	^{9}F
Electronegativity	1.0	1.6	2.0	2.6	3.0	3.4	4.0

Trends in group:

It generally decreases down a group.

Reason:

As the size of the atom increases, this attraction for the shared pair of electrons weakens. For example, electronegativity value of group 17 (halogens) are presented here.

Q No 4

Discuss the important features of modern Periodic Table.

Ans:

These are following salient features of long form of periodic table:

i) The table consists of seven horizontal rows called

Scanned with CamScanner

periods.

(2) First period consists of only two elements. Second and third periods consist of 8 elements each. Fourth and fifth periods consist of 18 elements each. Sixth period has 32 elements while seventh period has 32 element and is incomplete.

(3) Elements of a period show different properties.

(4) There are 18 vertical columns in the periodic table numbered 1 to 18 from left to right, which are called groups.

(5) The elements of a group show similar chemical properties.

(6) Elements are classified into four blocks depending upon the type of the subshell which gets the last electron.

Q No 5

What do you mean by blocks in a periodic table and why elements were placed in blocks?

Ans:

Block of elements:

On the basis of completion of a particular sunshell,

Scanned with CamScanner

elements with similar sunshell electronic configuration are refered as a block of elements.

Tyes of block:-

There are four block in a periodic table named after the name of the subshell which is in the process of completion by the electrons.

These are s, p, d and f blocks.

s-block:-

Elements of group 1 and 2 have valence electrons in 's' subshell. Therefore, they are called s-block elements. Helium ($_2He$) is also number of s-block due to $1s^2$ electronic configuration.

p-block:-

Elements of group 13 to 18 (except He) have their valence electrons in 'p' subshell. Therefore, they are refered as p-block elements.

d-block:-

The blocks lies between the s and p blocks, d blocks constitutes period 4, 5 and 6. Each period in d-block consists of ten groups starting from group 3 to

Scanned with CamScanner

group 12. These are called outer transition metals.

f-block:-

f-blocks lies seperately at the bottom of the periodic table and consist of Lanthanides and actinides. These are called inner transition metals.

Q no 6

Discuss in detail the periods in periodic Table?

Ans:-

Periods:-

Horizontal rows of element in the Periodic Table are called Periods. There are seven periods in the modern Periodic Table.

First period:-

First period is called 'short period'. It consist of only two elements hydroge (H) and helium (He).

Second & Third Period:-

Second and third periods are called 'normal periods'. Each of them has eight elements in it. Second period consist of lithium (Li), beryllium (Be), carbon (C), nitrogen (N), Oxygen (O), Fluosine (F) and

Scanned with CamScanner

end at neon (Ne), a noble gas.

Fourth & Fifth Period:

Fourth and fifth periods are called 'long periods'. Each one of them consist of eighteen elements.

Sixth & Seventh Period:

Sixth and seventh periods are called 'very long periods'. Sixth period consist 32 elements whereas seventh period is incomplete.

Lanthanides and Actinides:

In sixth and seventh periods after atomic number 57 and 89, two series of fourteen elements each, were accomodated, Since the two series start after Lanthanum (Z = 57) and Actinides (Z = 89), so these two series of elements are named as Lanthanides and Actinides respectively. Because of space problem, these two series were placed seperately below the normal periodic table to keep it in a manageable and presentable form.

All the periods except the first period start with an alkali metal and end at a noble gas. It

Scanned with CamScanner

is to be observed that number of elements in a period is fixed because of maximum number of electron which can be accomodated in the particular valence shells of the electrons.

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

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

Q No 7

Why and how elements are arranged in a Periodic Table?

Ans:

Elements are arranged in the periodic table in order to study their physical and chemical properties and behaviours.

Scanned with CamScanner

Elements are arranged in order of increasing atomic number in the periodic table.

Significance of atomic number:

The arrangement of elements in the modern periodic table lies in the fact that as electronic configuration is based upon the atomic numbers, so the arrangement of elements according to increase atomic number shows the periodicity (repetition of periodicity after regular intervals) in the electronic configuration of the elements that leads to periodicity in their properties. Hence the arrangement of elements based on their electronic configuration created a long form of the periodic table.

Q No 8

What is ionization energy? Describe its trend in the Periodic Table?

Ans:

Ionization energy:

"The ionization energy is the amount of energy required to remove the most loosely bound

Scanned with CamScanner

electron, from the valence shell of an isolated gaseous atom"

First ionization energy:

If there is only 1 electron in the valence shell, the energy required to remove it will be called first ionization energy. For example, the first ionization energy of sodium atom is +496 $kJmol^{-1}$

$$Na \rightarrow Na^{+} e^{-} \quad \Delta H = +496\ kJmol^{-1}$$

Unit:

It is measured in the units of kilo joule per mole ($kJmol^{-1}$).

Trends in periods:

If we move from left to right in a period, the value of ionization energy increases.

Reason:

Because the size of atoms reduces and valence electrons are held strongly by the electrostatic force of attraction of nucleus. Therefore, elements on left side of the periodic table have low uncle of ionization energy as compared to those on right side of the periodic table.

Scanned with CamScanner

2nd period element	$_3Li$	$_4Be$	$_5B$	$_6C$	$_7N$	$_8O$	$_9F$	$_{10}Ne$
Ionization Energy ($kJ\,mol^{-1}$)	520	899	801	1086	1402	1314	1681	2081

Trends in groups:-

When we move from top to bottom in a group, the value of ionization energy gradually decreases.

Reason:-

Because in the group more and more shells lie between the valence shell and the nucleus of the atom; these additional shells reduce the electrostatic force felt by the electrons present in the outermost shell. Resultantly the valence shell electrons can be taken away easily. Therefore the value of ionization energy decreases from top to bottom in a group.

Q No 9

Define electron affinity; why does it increase in a period and decrease in a group in the Periodic Table?

Ans:-

Electronic Affinity:-

The amount of energy released when an

Scanned with CamScanner

electron is added up in the outermost shell of an isolated gaseous atom is called Electron Affinity.

Unit:

The unit of electron affinity is $kJmol^{-1}$.

Explanation:

Affinity means attraction. Therefore, electron affinty means tendency of an atom to accept an electron to form an anion.

Example:

The electron affinity of fluorine is $-328\ kJmol^{-1}$ ie. one mole of fluorine release 328 kJmol energy to form one mole of fluorine ions.

$$F + 1e \longrightarrow F^-$$

Trends in period:

Electrons affinity increases from left to right in a period.

Reason:

Because the size of atom decreases in a period, the attraction of the nucleus for the incoming electron increases. That means more is attraction for the electron, more energy

Scanned with CamScanner

will be released. Therefore, electron affinity increases from left to right in a period.

2nd Period Element	$_3Li$	$_4Be$	$_5B$	$_6C$	$_7N$	$_8O$	$_9F$	$_{10}Ne$
Electron affinity ($kJmol^{-1}$)	-60	>0	-29	-122	0	-141	-328	0

Trends in group:

In a group electrons affinity values decreases from top to bottom.

Reason:

Because the size of atoms increases down the group and shielding effect increases that results in poor attraction for the incoming electron ie. less energy is released out. Therefore, ektron effinity decreases from top to bottom in a group.

17th group elements	Electron affinity ($kJmol^{-1}$)
$_9F$	-328
$_{17}Cl$	-349
$_{35}Br$	-325
$_{53}I$	-295

Scanned with CamScanner

Q NO 10

Justify the statement, bigger size atoms have more shielding effect thus low ionization energy?

Ans:

As we move down the group more and more shells lie between the valence shell and the nucleus of the atom, these additional shells reduce the electrostatic force felt by the electron present in the outermost shell which results more shielding effect by such bigger size atoms. Resultantly the valence shell electron can be taken away easily. Therefore, bigger size atoms have more shielding effect and low ionization energies.

Scanned with CamScanner