Periodic Classifications Of Elements:

Page No. 110

Intext Questions:

Q1. Yes, lithium, sodium and potassium constitute a Dobereiner's Triads. e.g., if we consider lithium as the first element then the eighth element from it is sodium and similarly if we consid sodium as the first element then the eighth element from it is potassium. Thus, Dobereiner's Triad exist in the columns of Newlands Octaves.

Page No. 114

Q3. i). The formulae of hydrides and oxides formed by an element were treated as one of the basic properties of an element for its classification.

ii. It is based upon Mendeleev's periodic law which predicts that the properties of the elements are the periodic function of their atomic masses.

Q4. These gases were discovered very late because they are very inert and placing them in a sep. rate group, does not disturb the existing order put forward by Mendeleev.

Page No. 118

Q1. i. Isotopes of an elements occupy same position in the periodic table due to same atomic numbe

ii. There is a logical separation of elements into sub groups.

iii. It is based upon the fundamental property of an element. i.e., atomic number.

iv. Prediction of new elements

Q2. Elements of group second such as beryllium, Calcium, Strontium etc. show similar properties.

Q4. a. Lithium, Sodium and potassium all react with water to form alkalies with the liberation of hydrogen gas. All these metals have one electron in their respective outermost shell.

b. Helium and neon are noble gases. They have completely filled shells. Helium has k-shell and neon have k and L shells.

Q5. The first ten elements are H, He, Li, Be, B, C, N, O, F and Ne. Among these elements, only two elements i.e, Lithium are Beryllium are metals.

Q6. Metallic character decreases from left to right in a period and increases down a group. So, Be and Ga are expected to be most metallic. Out of these two Ga is bigger in size so has greater tendency to lose electrons. So, Ga is more metallic than Be. Page No. 119-120

Q4. a. All the electrons which lie in the same column as that of boron belongs to group 13. So, they have three electrons in their respective valence shells. Except Boron, which is a non-metal all others are metals.

b. The elements which lie in the same column as fluorine are called halogens. They belong to group 17 and thus have 7 electrons in the valence shell. Their valency is 1 and all are non-metals.

Q6. a. Element A is in group 17. Now group 17 is on right side of the periodic table where non-metals, i.e. halogens are placed. So element A is non-metal. It is a halogen.

b. In group 17 of halogen, the chemical reactivity decreases on going down in a group. Thus, element C will be less reactive than element A.

c. On going from left to right in a period, the size of atom decreases. So, the atom of C will be smaller in size than an atom of B.

d. Element A of group 17 has 7 valence electrons. So it will accept 1 electron to form a negatively charged ion, A^-. The negatively charged ion is called an anion. Thus, element A will form an anion.

Q7. Nitrogen: Atomic No. 7. Electronic Configuration of Nitrogen = 2, 5. (K L M)

Phosphorus: Atomic No. 15. Electronic Configuration of Phosphorus = 2, 8, 5. (K L M)

Both elements have 5 electrons in their respective valence shells. As we go down in a group of the periodic table one more electron shell is added to the atom at every step and so size of the atom

increasing due to which atom cannot form ions easily. So, nitrogen is more electronegative than Phosphorus.

Q8. By knowing the electronic configuration of an element, we can know its period number from the number of shells present in its atom and from number of electrons in the valence shell of its atoms we can know its group number. e.g., Consider the case of sodium atom.

Atomic number of sodium = 11 Its electronic configuration = 2, 8, 1 (K L M)

Number of shells = 3 ∴ Sodium belongs to 3rd period.

Also sodium atom has one electron in its valence shell.

∴ Its present group is first group.

Hence, sodium lies in the first group and third period of Modern Periodic Table.

Q9. The atomic number of Calcium is 20, therefore, electronic configuration is 2, 8, 8, 2. So, it has two valence electrons. Elements which has two valence electrons will have physical and chemical properties resembling that of Calcium.

So, elements with electronic configuration 12 and 38 will have physical and chemical properties resembling that of calcium.

Periodic Classification Of Elements:

Q10. Similarities:

i. In both the elements are arranged in groups and periods.

ii. In both similar elements are placed in same group.

iii. Both the classification make the study of elements simple and systematic.

Differences:

Mendeleev's Periodic Table	Modern Periodic Table.
1. Elements are arranged in increasing order of their atomic masses.	Elements are arranged in increasing order of their atomic number.
2. Electronic Configuration of an element can't be predicted from its position in the periodic table.	Electronic Configuration of an element can be easily predicted from its position in the periodic table.
3. There is no provision for separate positions for isotopes of an element since their atomic masses are different.	Separate position for isotopes of an element are not required as they have same atomic number.

Periodic Classification Of Elements:

4. Many metals and non-metals are grouped together.	Metals and non-metals are widely separately from each other.
5. There are only 8 vertical columns called groups.	There are 18 vertical columns called groups.
6. The inert gases were not known at the time of Mendeleev.	The inert gases have been placed at the end of periods 1 to 6 i.e group 18.
7. All groups other than VIII have divided into two sub-groups A and B. Group VIII however, contains three sets of three elements each.	Each group has one vertical column of elements and there is no sub-division of groups.

Q. Characteristic of Periods:

1. Valence Electron Or Outer most Electrons:

	11	12	13	14	15	16	17	18
Elements of 3rd Period:	Na	Mg	Al	Si	P	S	Cl	Ar
Electronic Configuration:	2,8,1	2,8,2	2,8,3	2,8,4	2,8,5	2,8,6	2,8,7	2,8,8
No. of Valence Electrons:	1	2	3	4	5	6	7	8

On moving from left to right in a period, the number of valence electrons in elements

Periodic Classification Of Elements:

increases from 1 to 8 but in the period first it increases from one to two.

2. Valency:

Elements of 3rd Period:	Na	Mg	Al	Si	P	S	Cl	Ar
Valency	1	2	3	4	3	2	1	0

On moving from left to right in each short period, the valency of elements increases from 1 to 4 and then decreases to zero.

3. Atomic Size:

Elements of 3rd Period:	Na	Mg	Al	Si	P	S	Cl
Atomic radius (Pm)*:	186	160	143	118	110	103	99

On moving from left to right in a period of a periodic table, the size of atoms decreases. As we move from left to right in a period, the atomic number of elements increases i.e., the number of protons and electrons in the atoms increases. Due to large positive charge on the nucleus, the electrons are pulled in more close to the nucleus and the size of the atom decreases. Thus, in any period, the alkali metal like Li, Na, k etc is the biggest in size where as the halogen atom like F, Cl, Br etc is the smallest in size.

* Pm = Picometre = 10^{-12} metre

Periodic Classification of Elements:

4. Metallic Character:

Elements of 3rd Period: Na Mg Al Si P S Cl

Nature of Elements: Metals Metalloid Non-metals

Metallic character decreases. →

← Non-Metallic character increases.

On moving from left to right in a period, the metallic character of elements decreases but the non-metallic character increases. e.g., in third of the periodic table, Na, Mg and Al are metals. The properties of Si are in between those of a metal and a non-metal, therefore, silicon is a metalloid.

The next elements P, S and Cl are non-metals. The metallic character decreases from Na to Mg to Al; silicon is a metalloid and non-metal metallic character increasing from phosphorous to sulphur to chlorine. Thus, in the third period of the periodic table, Na is the most metallic element where as chlorine is the most non-metallic element.

5. Nature of Oxides:

Periodic Classification of Elements:

Elements of 3rd Period : Na Mg Al Si P S Cl

Nature of oxides: Highly Basic | Amphoteric oxide | Highly Basic

Basic nature of oxides decreases →
Acidic nature of oxides Increases

On moving from left to right in a period, the basic nature of oxides decreases and the acidic nature of oxides increases. e.g., in the third period of the periodic table, sodium oxide is highly basic in nature and magnesium oxide is comparatively less basic. The aluminium and silicon oxides are amphoteric in nature. Phosphorus oxides are acidic, sulphur oxides are more acidic whereas chlorine oxides are highly acidic in nature.

—o—

Q Characteristic Nature of Groups:

1. Valence Electrons Or Outermost Electrons:

All the elements of a group of the periodic table have the same number of valence electrons. e.g., all the elements of group I of the periodic table like lithium, sodium and potassium have one

Periodic Classification of Elements:

Valence electron each in their atoms.

Group I	Electronic Configurations	No. of valence electrons
Lithium (Li)	2,1	1
Sodium (Na)	2,8,1	1
Potassium (k)	2,8,8,1	1

Since all the elements in a group have similar number of valence electrons, they show similar chemical properties. Thus, elements in a group show similar chemical properties.

2. Valency:

Since the number of valence electrons in a group is the same, all the elements in a group have the same valency. e.g., group I elements like li, Na and k etc, all have one valence electron each, so all the elements of group I have the same valency of 1.

3. Size of Atoms Or Atomic size Or Atomic radius:

On going down in a group of the periodic Table, the size of atoms increases. e.g., in group I of alkali metals, lithium atom is at the top of the group so it is the smallest atom where as francium atom

is at the bottom of the group and hence it is the biggest atom in this group of the periodic table.

When we move from top to bottom in a group, a new shell of electrons is added to the atoms at every step. In this way, the number of electron shells in the atoms increases gradually due to which the size of atoms also increases. e.g. lithium atom has only electron shells k and L in it where as sodium atom has three electron shells k, L and M in it. Since a sodium atom has one more electron shell than a lithium atom, thus, a sodium atom is bigger in size than lithium atom.

Group I	Atomic radii (Pm)	
Lithium	152	Smallest atom
Sodium	186	
Potassium	231	Atomic size increases
Rubidium	244	
Cesium	262	
Francium	270	Biggest atom

4. Metallic Character:

On going down in a group of the periodic table, the metallic character of elements increases. E.g., When we move down in group I of the periodic table, the metallic character increases from lithium to francium.

Periodic Classification of Elements:

As we go down in a group of the periodic table, one more electron shell is added at every stage and size of the atom increases. The valence electrons becomes more and more away from the nucleus and hold of the nucleus on valence electrons decreases. Due to this the atom can lose valence electrons more easily to form positive ions and hence the electropositive character increases. Thus, in group I of alkali metals, lithium is the least metallic element whereas francium is the most metallic element.

Group I

Lithium	Least metallic element
Sodium	
Potassium	
Rubidium	
Cesium	
Francium	Most metallic element

Metallic character increases

Therefore, the greatest metallic character is found in the elements in the lowest part of a group.

5. Nature Of oxides:

On going down in a group of the periodic table, there is no change in the nature of oxides of elements. The nature of oxides of all the elements of a group is the same. e.g., all the elements of group I i.e., Li, Na, K form basic oxides, whereas all the elements of group 17 i.e., F, Cl, Br form acidic oxides.