CHEMISTRY (XII) CHAPTER 1 (Periodic Classification of Elements)

Short Questions:

1. **What are hydrides? What is the trend of boiling points of hydrides of group VI down the group?**
   The binary compounds of hydrogen with other elements are called hydrides.
   E.g. NaH, H2O, H2S.
   The boiling point of hydrides of group VIA increases down the group except H2O which due to hydrogen bonding, have higher boiling point than might be expected.

Group VIA (Hydrides)	Boiling point (°C)
H2O	100
H2S	-60.3
H2Se	-42
H2Te	-2

2. **Write name and symbol of an element from s block that has zero oxidation state. Also write its electronic configuration.**
   Helium (He) is the element from s black that has zero oxidation state. The electronic configuration is $1s^2$.

3. **Why melting and boiling points of elements belonging to groups VA to VIIA are lower? Discuss the trend of ionization energy in the periodic table.**
   When we move from left to right in a period the number of electrons go on increasing in the outermost shell. The tendency to un-pair the electron increase up to group IVA. In this way, the binding forces increase, hence melting and boiling points increase up to group IVA. After that, the pairing of electrons starts and binding force become less. That's why, the melting and boiling points of elements belonging to groups VA to VIIA are lower.

   Trend in Period:
   Ionization energy increases from left to right in a period.
   Reasons:
   - Due to increase in proton number effective nuclear charge increases.
   - Shielding effect remains the same.
   - Number of shells remain the same.
   - Atomic size decreases.

   Trend in Group:
   Ionization energy decreases from top to down in a group.

   Reasons:
   - Due to decrease in proton number effective nuclear charge decreases.
   - Shielding effect increases.
   - Number of shells increases down the group.
   - Atomic size increases.

4. **Give two defects of Mendeleev's periodic table**.

Following are two defects of Mendeleev's periodic table:

- Position of hydrogen was not decided by him.
- His table did not give the idea of structure of atom.

5. **Define Mendeleev's and modern periodic law.**

Mendeleev' Periodic law

"If the elements are arranged in ascending order of their atomic masses, their chemical properties repeat in a periodic manner".

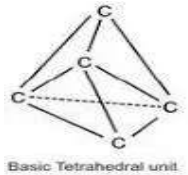
Modern periodic law:

"If the elements are arranged in ascending order of their atomic numbers, their chemical properties repeat in a periodic manner".

6. **Give four improvements made in Mendeleev's periodic law**.
   - **Correct arrangement of some elements**
     Ar should be placed before K. Co should be placed before nickel. Te should be placed before I.
   - **Position of rare earths**
     Position of rare earths of lanthanides and actinides was adjusted
   - **Position of Isotopes**
     The position of isotopes was corrected.
   - **Position of noble gases**
     He arranged nobles in a separate group VIIIA.
7. **Why diamond is a non-conductor and graphite fairly a good conductor of electricity?**

Diamond is a non- conductor:

In diamond, unit cell is tetrahedral. Each carbon atom is sp3 hybridized and forms 4 sigma bonds with 4 other carbon atoms and this trend extends throughout the crystal. All the four electrons of each carbon atom are tightly bound in these covalent bonds. As a result, no free electron are available in diamond so it is a nonconductor of heat and electricity.



Basic Tetrahedral unit

Graphite is a good conductor:

In Graphite, each carbon atom is sp2 hybridized and bonded to 3 neighbor carbon atoms so one of its four valance electrons is relatively free to move along the layers. Hence, graphite is a conductor parallel to the layers and non-conductor perpendicular to the layer.

8. **Define electron affinity. Discuss its trend in the periodic table.**

The electron affinity is the amount of energy released or absorbed when an electron is added to a gaseous atom to form a negative ion.

Trend in Period:

Electron affinity increases from left to right in a period.

Reasons:

- Due to increase in proton number effective nuclear charge increases.
- Shielding effect remains the same.
- Number of shells remain the same.
- Atomic size decreases.

Trend in Group:

Electron affinity decreases from top to down in a group.

Reasons:

- Due to decrease in proton number effective nuclear charge decreases.
- Shielding effect increases.
- Number of shells increases down the group.
- Atomic size increases.

9. How do you justify the position of hydrogen at the top of alkali metals (group IA)?

Hydrogen can be placed at the top of the group IA because the properties of hydrogen resemble with those of the elements of group IA. Some of these are:

- Hydrogen has one electron in 1s subshell like the alkali metals.
- Both hydrogen and alkali metals have a strong tendency to combine with electronegative elements such as halogens.
- Both show oxidation state of +1.
- Both form ionic compounds.

10. How does hydrogen resemble with alkali metals?

Hydrogen can be placed at the top of alkali metals because the properties of hydrogen resemble with those of the alkali metals. Some of these are:

- Hydrogen has one electron in 1s subshell like the alkali metals.
- Both hydrogen and alkali metals have a strong tendency to combine with electronegative elements such as halogens.
- Both show oxidation state of +1.
- Both form ionic compounds.

11. Why hydrogen can be placed over group IVA of the periodic table?

Hydrogen can be placed at the top of the group IVA because the properties of hydrogen resemble with those of the elements of group IVA. Some of these are:

- Valence shell of hydrogen is half filled like those of group IVA elements.
- Both hydrogen and group IVA elements combine with other elements through covalent bonding.
- Like carbon, hydrogen also possesses remarkable reducing properties

$$CuO + H_2 \longrightarrow Cu + H_2O$$
$$SnO_2 + C \longrightarrow Sn + CO_2$$

12. Why the oxidation states of noble gases are usually zero?

The oxidation state of an element is directly or indirectly related to the number of its valance electrons or the number of vacancies available in its valence shell. In case of noble gases, their outermost shells are completely filled with electrons and no vacancy is available in their outermost shells. Thus, these gases usually show zero oxidation state. That's why they are often called zero group elements.

13. Why metallic character increases from top to bottom in a group of metal?

Metallic character increases from top to bottom in a group of metal because atomic size increases from top to bottom in a group. As a result, the removal of electrons from the outermost shell becomes easier, effective nuclear charge decreases and metallic character enhanced.

14. Why do metals conduct electricity? OR Why the metals are good conductors?

Each atom in a metal crystal loses all of its valence electrons and all metal atoms become positively charged. When electric field is applied mobile electrons start moving towards positive pole. Hence, a new electron coming from negative pole finds the space. Hence due to the movement of free electrons metals conduct electricity.

15. Why alkali metals give ionic hydrides?

Alkali metals are more electro positive than hydrogen. They have strong tendency to lose electron and form a uni-positive ion. This electron is accepted by hydrogen to form a hydride ion (H^-). These cations and anions then combine to form ionic bond. That's why alkali metals give ionic hydrides. E.g. $Na^+ H^-$ and K^+H^-

16. Zn, Cd, Hg were placed along with alkaline earth metals in Mendeleev's periodic table. How this confusion was removed in Modern periodic table?

In modern periodic table, the groups were divided into the subgroups to separate the elements of different categories. Zn, Cd and Hg were arranged separately into the subgroup of group II that is IIB. In Mendeleev's periodic table, Zn, Cd and Hg were placed along with the alkaline earth metals however, their properties do not resemble.

17. What is Lanthanide contraction?

The gradual or progressive decrease in the atomic size of the elements in the lanthanide series is significant and is called lanthanide contraction. Same decrease is observed in actinide series. This is due to poor shielding effect of f sub-shell which is being gradually filled along the series.

18. Name various classes of hydrides.

There are three classes of hydrides:

- Ionic hydrides
- Polymeric or intermediate hydrides
- Covalent hydrides

19. Oxidation states usually remain same in a group. Why?

The number of electrons in the outermost shells go on changing in period from left to right, so oxidation states go on changing but, the number of electrons in the outermost shell remains same in a group so the oxidation states remains the same. Anyhow, the process of un-pairing of electrons may happen in a group and oxidation states may change.

20. Give any two resemblances of hydrogen with IVA elements.

Hydrogen can be placed at the top of the group IVA because the properties of hydrogen resemble with those of the elements of group IVA. Some of these are:

- Valence shell of hydrogen is half filled like those of group IVA elements.
- Both hydrogen and group IVA elements combine with other elements through covalent bonding.

21. What are amphoteric oxides? Give an example.

The oxides which show both acidic and basic properties are called amphoteric oxides.
E.g. ZnO, BeO, Al_2O_3, Bi_2O_3

22. Hydration energies of ions are in the following order. Al+3>Mg+2>Na+1 justify it.

Hydration energy depends upon the charge to size ratio, greater the charge to size ratio greater the hydration energy. Hence, in the given order (Al+3>Mg+2>Na+1), Al+3 has greater charge to size ratio than Mg+2, and Na+1. That's why, the hydration energies are in this order.

Al+3>Mg+2>Na+1
-4613 > -1903 > -510

23. Why do ionization energies decrease down the group and increase left to right?

Trend in Period:

Ionization energy increases from left to right in a period.

Reasons:

- Due to increase in proton number effective nuclear charge increases.
- Shielding effect remains the same.
- Number of shells remain the same.
- Atomic size decreases.

Trend in Group:

Ionization energy decreases from top to down in a group.

Reasons:

- Due to decrease in proton number effective nuclear charge decreases.
- Shielding effect increases.
- Number of shells increases down the group.

- Atomic size increases.

24. Why PbCl2 is ionic but PbCl4 is fairly covalent compound?

When a metal forms more than one halide, the halides in which metal has lower oxidation state tends to be ionic while that in higher oxidation state is covalent. Similarly, high polarizing power of Pb+4 as compare to Pb+2 makes PbCL2 mainly ionic but, PbCL4 fairly covalent.

25. What happens when acidic and basic oxides combine with each other?

Basic oxides and acidic oxides react with one another to give salts.

For example: $Na_2O + SO_3 \longrightarrow Na_2SO_4$

(basic oxide) (acidic oxide) (salt)