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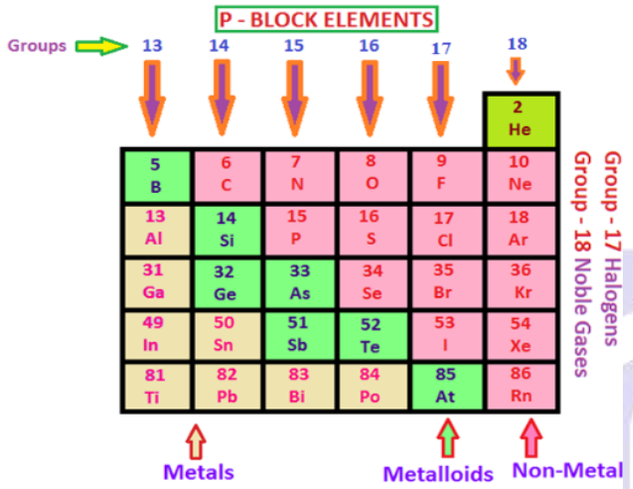
GENERAL CHARACTERISTICS OF THE P-BLOCK ELEMENTS

- The p-block of the periodic table consists of the elements of groups 13, 14, 15, 16, 17 and 18. These elements are characterized by the filling up of electrons in the outermost p-orbitals of their atoms.



OCCURRENCE OF THE P-BLOCK ELEMENTS IN NATURE

- The p-block elements do not follow any set pattern of mode of occurrence in nature. Some of them occur free as well as in the combined state in nature. For example, elements such as oxygen, nitrogen, carbon, sulphur occur in both the forms. Noble gases occur in Free State only.

ELECTRONIC CONFIGURATION

- Elements belonging to groups 13 to 18 of the periodic table are called p-block elements. General electronic configuration:
  ns^2np^{1-6} (except for He)

ATOMIC SIZE

- The atomic radius of the of p-block elements generally decreases on moving across a period from left to right in the periodic table. It is because the addition of electrons takes place in the same valence shell and are subjected to an increased pull of the nuclear charge at each step.

IONIZATION ENTHALPY

- It is the amount of energy required to remove the most loosely bound electron from the outermost shell of a neutral gaseous atom. It is measured in kJ mol^{-1} and is known as first ionization enthalpy.
- The first **ionization enthalpy** of the **p-block elements** generally increases on moving from left to right along a period. It is because as we move from left to right along a period, the atomic size decreases. The larger the atom, the less strongly the electrons are held by the nucleus.

ELECTRON GAIN ENTHALPY

- When an electron is added to a neutral gaseous atom, heat energy is either released or absorbed. The amount of heat energy released or absorbed when an extra electron is added to a neutral gaseous atom is termed as electron gain enthalpy, i.e., energy change for the process:

$$X(g) + e^- \longrightarrow X^-(g)$$

- Electron affinity generally becomes more negative on moving from left to right along a period. It is because on moving across a period, the atomic size decreases.
- On moving down a group, the electron gain enthalpy becomes less negative. This is due to the increase in atomic

size and thus, less attraction for the electrons; the atom will have fewer tendencies to gain an electron. Hence, electron gain enthalpy becomes less negative.

ELECTRO NEGATIVITY

- Electro negativity is defined as a measure of the ability of an atom to attract the shared electron pair in a covalent bond to itself.
- Electro negativity increases along the period and decreases down the group.
- Fluorine is the most electronegative of all the elements. The second most electronegative element is oxygen followed by nitrogen in the third position.

METALLIC AND NON-METALLIC BEHAVIORS

- The metallic and non-metallic character of p-block elements varies as follows: Along the period the metallic character decreases, whereas non-metallic character increases. It is because on moving across the period, the atomic size decreases due to the increased nuclear charge and hence, ionization energy increases.

ANOMALOUS BEHAVIOR OF THE FIRST ELEMENT IN EACH GROUP OF THE p-BLOCK

- The **anomalous behavior** of **first element** of s and **p block elements** of **each group** as compared to other **group** members is due to following reasons: Small size of atom, large charge/radius ratio, high electro negativity and non availability of orbital in their valence shell.

INERT PAIR EFFECT

- The **pair** of electrons in valence s-orbital is reluctant to take part in bond formation due to poor shielding **effect** of −d and f-electron in heavier elements. It is called **inert pair effect** due to which lower oxidation state becomes more stable than higher oxidation state in case of **p-block** elements.

GENERAL TRENDS IN THE CHEMISTRY OF THE P-BLOCK ELEMENTS

- The p-block elements except noble gases react with hydrogen, oxygen and halogens to form various hydrides, oxides and halides respectively. A more or less regular trend is observed in the properties of these compounds on increase in the oxidation state of the element forming halides moving down any particular group.

Hydrides

- They are covalent molecules and their bond angles are consistent with VSEPR theory.
- These hydrides are volatile in nature.

Oxides

- *p*-Block elements form a number of oxides on reacting with oxygen.
- The oxides E_2O_n (n = 3, 5 or 7) are the highest oxides formed by the elements in the groups 13, 15 or 17 respectively.
- The oxides EO_n (n = 2, 3 or 4) are formed by the elements in groups 14, 16 or 18 respectively.

Halides

- A review of the properties of halides of *p*-block elements reveals that most of them are covalent halides. In a group the covalent character of halides decreases down the group.

Check Yourself

1. H_2S is more acidic than H_2O because

(A) Oxygen is more electronegative than sulphur.

(B) Atomic number of sulphur is higher than oxygen.

(C) H — S bond dissociation energy is less as compared to H — O bond.

(D) H — O bond dissociation energy is less also compared to H — S bond.

2. The boiling points of hydrides of group 16 are in the order

(A) $H_2O > H_2Te > H_2S > H_2Se$

(B) $H_2O > H_2S > H_2Se > H_2Te$

(C) $H_2O > H_2Te > H_2Se > H_2S$

(D) None of these

3. In the manufacture of sulphuric acid by contact process Tyndall box is used to

(A) Convert SO_2 and SO_3

(B) Test the presence of dust particles

(C) Filter dust particles

(D) Remove impurities

8. Partial hydrolysis of XeF_4 gives

(A) XeO_3 (B) $XeOF_2$

(C) $XeOF_4$ (D) XeF_2

5. The set with correct order of acidity is

(A) $HClO < HClO_2 < HClO_3 < HClO_4$

(B) $HClO_4 < HClO_3 < HClO_2 < HClO$

(C) $HClO < HClO_4 < HClO_3 < HClO_2$

(D) $HClO_4 < HClO_2 < HClO_3 < HClO$

Stretch Yourself

1. Which groups of the 'periodic table' constitute p-block?

2. How does the magnitude of ionization energy of an atom vary along the group in the periodic table?

3. How does electronegativity change along a row of elements in the periodic table?

4. Explain 'Metallic character decreases along a period but increases on moving down a group'.

5. Discuss the trends in the chemistry of p-block elements with respect to:

(i) Acidic and basic nature of the oxides;

(ii) Ionic and covalent nature of the hydrides.

Test Yourself

Question: How does the covalent character of halides of an element change with oxidation state of the element?

Answer: According to, Fajan's rule, smaller the size of cation greater is the covalent character and so the halids of transition metals becomes more covalent with increasing oxidation state.

Answers

Check Yourself

Answer: 1(B); 2(B); 3(B); 4(B); 5(B)

Stretch Yourself

1. Group number from 13 to 18 constitutes p-block in periodic table.

2. It is considered a measure of the tendency of an atom or ion to surrender an electron or the strength of the electron binding. The greater the ionization energy, the more difficult it is to remove an electron. Ionization energy increases from left to right in a period and decreases from top to bottom in a group.

3. As moving along the rows the electronegativity increases as the elements are in need of electrons and they pull the electrons to attain octet state from the electropositive elements (group 1 elements)

4. Do it by yourself.

5. All the alkaline earth metals form oxides having the molecular formula MO. These oxides are highly stable as they possess high lattice energy. All alkaline earth metal oxides are ionic compound except BeO (covalent in nature due to high polarising power of Be).Their stability decreases as the size of the cation increases. The oxides are basic in nature and basicity decrease in the order BeO<MgO<CaO<SrO<BaO. BeO is amphoteric in nature and dissolves in both acid and alkali. Metal oxides dissolve in water to form basic hydroxide. MgO, CaO are insoluble n water due to very high lattice angry.