

HINTS & SOLUTIONS

Classification of Elements and Periodicity in Properties

[Set-1]

SECTION-A

1. (i): The modern periodic table consists of four block (s, p, d and f), eighteen group (1 to 18) and seven periods.
2. (i): $Z = 115$ Ununpentium, Uup
3. (ii): For isoelectronic species, ionic size decreases as charge on the ion increases

$$\text{O}^{2-} > \text{F}^- > \text{Na}^+ > \text{Mg}^{2+}$$
4. (ii): Ionisation enthalpy increases across the period and decreases down the group

$$\underbrace{1s^2 2s^2 2p^2 3s^1}_{\text{Third period}} < \underbrace{1s^2 2s^2}_{\text{Second period}} < 1s^2 2s^2 2p^3 < 1s^2 2s^2 2p^5$$
5. (iv): $1s^2 2s^2 2p^6$ is a noble gas, least affinity for electron, has positive electron gain enthalpy
 $1s^2 2s^2 2p^5$ is just short of one electron to attain the nearest noble gas configuration, has most negative electron gain enthalpy
6. (i) In spite of small size of B than Be, first ionization enthalpy of B is less than Be due to the more effective shielding of 2p electron by 2s electron. Therefore, 2p electron is less tightly held and can easily be removed.
7. (ii): Noble gases have low boiling point due to weak interatomic forces of attraction (weak dispersion forces) due to their fully filled $ns^2 np^6$ electronic configuration.
8. (iii): Metallic character (ability to form positive ions) increases down the group and decreases across the period. (Cesium is the most metallic element)
9. (iv): As the metallic character increases, basicity of oxide increases. Out of the four oxides given K_2O is the most basic and Al_2O_3 is the least basic (in fact amphoteric)
10. (iv): The tendency to lose electron to attain noble gas configuration and stability increases down the group and decreases across the period.
11. (i) Gallium has an electronic configuration of $[\text{Ar}]3d^{10} 4s^2 4p^1$. Due to the presence of fully filled $3d^{10}$ which is highly diffused and has a poor shielding effect and cannot protect the valence electrons from the nucleus effectively. As a result, all valence electrons are drawn closer towards the nucleus and tightly held. Hence, gallium has a smaller atomic radius than aluminium.

(ii) Oxygen has an electronic configuration of $[\text{He}]2s^2 2p^4$. Due to strong shielding effect of 2s electrons, p-electrons are less tightly held. The p-electron can easily be removed. Also, loss of one electron from 2p subshell results in a stable half-filled $2p^3$ configuration. Hence, oxygen has lower $\Delta_i H_1$ than nitrogen.

OR

(i) Name: Ununennium

(ii) Group number: 1

(iii) Formula of oxide: $(\text{Uue})_2\text{O}$

12. Isoelectronic species are those species having same number of electrons.

Smallest ionic size: Ca^{2+}

Largest ionic size: P^{3-}

The order of increasing ionic size is



13. (i) Oxygen is slightly larger in size than nitrogen due to pairing of electron in the 2p subshell. This results in interelectronic repulsion and the electron cloud expands.

(ii) This is due to small size of F and also F is short of just one electron to attain the nearest noble gas configuration of neon. Hence, F has more negative electron gain enthalpy than oxygen.

(iii) Due to small size and high effective nuclear charge, fluorine has more electronegativity than chlorine.

OR

(i) General electronic configuration of d-block elements is $(n-1)d^{1-10} ns^{1-2} \quad n \geq 4$

(ii) **A diagonal relationship** is a relationship between certain pairs of elements present diagonally in the second and third period of the periodic table. These pair are Li and Mg, Be and Al, B and Si. The pair of elements diagonally related show similarity in their chemical properties due to similar charge to radius ratio and similar polarizing power of their ions.

(iii) Two characteristic of f-block elements are

(a) They exhibit variable oxidation state and form coloured ions

(b) They have high melting and boiling points.

14. (i) Element with highest $\Delta_i H_1$ is $\boxed{\text{A} \rightarrow 1s^2}$

(ii) Element with most negative $\Delta_{\text{eg}} H$ is $\boxed{\text{C} \rightarrow 1s^2 2s^2 2p^4}$

(iii) Most electropositive element is $D \rightarrow 1s^2 2s^2 2p^6 3s^1$

(iv) Correct order of increasing atomic size is $A < C < B < D$

15. (i) Most reactive metal is A

(ii) Most reactive non-metal is B

(iii) Least reactive element is D

(iv) Element form a binary halide is $C \rightarrow CX_2$

Where 'X' is a halogen

(v) Element to which addition of electron is most difficult is D

OR

(i) First member of each group in the s and p block of the periodic table shows anomalous behavior due to

(a) small size

(b) high electronegativity and

(c) non-availability of d-atomic orbitals.

Example: (a) B form BF_4^- white Al form AlF_6^{3-}

(b) BeO is amphoteric other group 2 oxides are basic in nature

(ii) B, Al, C and Si are given

(a) Element with highest $\Delta_f H_f$ is C(carbon)

(Carbon is the smallest in size)

(b) Element which is most metallic is Al (aluminium)

(Aluminium is the largest in size)

(c) Order of increasing $\Delta_{eg} H$ is

$Al < Si < B < C$

As atomic size decreases, electron gain enthalpy increases.