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Deg.-I(H) Inorganic
Periodic Properties
Ionisation Potential

Def:- The minimum amount of energy required to remove most loosely bounded electrons from an isolated gaseous atom as to convert into monovalent gaseous cations.

$$M(g) \xrightarrow{I.P.I} M^{+}(g) + \bar{e}$$

Successive I.P:— It is possible to remove more than one electron successively called their successive IPs.

$$M^{+}(g) \xrightarrow{I.P.II} M^{+2}(g) + \bar{e}$$

$$M^{+}(g) \xrightarrow{I.P.III} M^{+2}(g) + \bar{e}$$

Remember:→ we see that the order of increasing I.P follow the given order

I.P-III > I.P-II > I.P-I

Cause:- By regular loss of electrons the outermost electron in an ion are more strongly attached towards nucleus & more energy required to remove successive electrons.

The increase in their values also explained on the basis of Effective nuclear charge increases from $M(g) \to M^{+}(g)$

Factors upon which IE depends

(i) **Size of atom** — Larger the size of atom, smaller is the value of IE due to large size the outer electrons are far away from the nucleus & thus weakly attracted by nucleus and hence can be easily removed.

(ii) **Nature of element:** — metals have low IE than non-metals because metal have electron donor tendency whereas non-metals are electron-acceptor.

(iii) **Effective nuclear charge (Z_{eff})** higher the Z_{eff} value (lower the screening effect) greater is their IE value.

(iv) **Nature of sub shell:** s-orbitals are more close to the nucleus than p, d & f-orbitals. Thus the order of IE

IE of $s > p > d > f$

(v) **Stability of orbitals:** — The atom having half filled & full filled orbitals are more stable than more than or less than half filled. Thus it require more energy to remove their electrons.

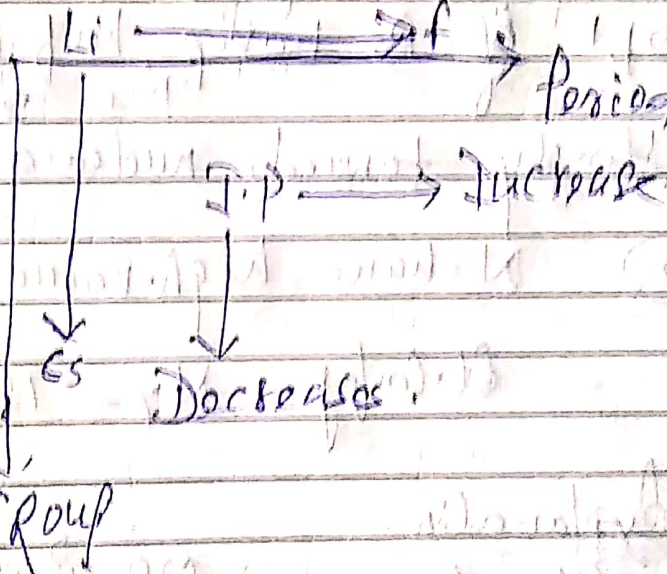
Thus p^3 is more stable than p^2 & p^4. p^6 is much more stable.

Stability $p^2 < p^3 > p^4$

Variation of I.P in the Periodic Table

(1). In a Group:- The I.P. value decrease down the group (Top → bottom). Moving down the group, the atomic size increases gradually due to addition of one or more (new) orbits.

By increasing atomic, the inner shell electrons also increase which increases their screening effect. The force of attraction of nucleus (Z^+) value decreases & thus small energy required to remove such valence electrons.



(2). In a Period:- Moving from left to Right in a Period. The value of I.P. Increases (not regularly).

It is due to increasing nuclear charge & decrease its atomic radius. Due to greater force of attraction of nucleus, the highest energy required to remove electrons.

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Exception:-

(1) Be-have greatter I.P than B.

I.P-order in Period

I.P- Li < Be < B < C < N < O < F

$Be_4 - 1s^2 2s^2$ ⟶ (1) 2s

$B_5 - 1s^2 2s^2 2p^1$ ⟶ 1 | | 2p

Although the nuclear Charge of B is greatter than Be, the I.P of Be > B.

It can be explained on the basis of relative stability of configuration. Be have $2s^2$-Config. is more stable than $2p^1$ of B having half-filled.

The 2p-electrons is not strongly towards nucleus as 2s-electrons.

(2) N-have high-value of I.P than O.

El.Config - $N_7 - 1s^2 2s^2 2p^3$

1 | 1 | 1

Half filled more stable

Explanation:-

Due to more Coulomb-repulsion of Config. $2p^4$. Electron is not easily removed than the $2p^4$ electrons.

$O_8 - 1s^2 2s^2 2p^4$

1↓ | 1 | 1

more than half but less stable.