ARJUNA NEET BATCH

CLASSIFICATION OF ELEMENTS & PERIODICITY IN PROPERTIES

DPP-05

same period

The first ionisation potentials of Na, Mg, Al and Si are in the order

(A) Na < Mg > Al < Si
(B) Na < Mg < Al > Si ✗
(C) Na > Mg > Al > Si ✗
(D) Na > Mg > Al < Si

In General, I.E. (Ionization energy) increases as we move along a period.

(Na → Mg ——— Al Si)

Expected order : Si > Al > Mg > Na ✗

Mg (Z = 12) → $1s^2\ 2s^2\ 2p^6\ 3s^2$ → filled filled orbital extra stable. More energy is required to remove valence e-

Al (Z = 13) → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ ← not more stable than Mg

Ans.

Actual I.E order : Na < Al < Mg < Si

Na < Mg > Al < Si

∴ less energy is required than Mg to remove e-

Which among the following elements has the highest value for third ionisation energy?

I.E.

(A) Mg
(B) Al
(C) Na
(D) Ar

3rd I.E. → Energy required to remove an electron from bipositive (E^{2+}) isolated gaseous ion.

(Z = 12) $Mg^{2+} \longrightarrow 10e^- \longrightarrow 1s^2 2s^2 2p^6$ → noble gas configuration → most stable among all ∴ highest I.E.

(Z = 13) $Al^{2+} \rightarrow 11e^- \rightarrow 1s^2 2s^2 2p^6 3s^1$

(Z = 11) $Na^{2+} \rightarrow 9e^- \rightarrow 1s^2 2s^2 2p^5$

$Ar^{2+} \rightarrow 16e^- \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^4$ (Z = 18)

↓ highly stable

High amount of energy is required to remove 1 mole electron

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Which of the following configuration is associated with the biggest jump between first and second ionization energy?

(A) $1s^2\ 2s^2\ 2p^5$
(B) $1s^2\ 2s^2\ 2p^6\ 3s^1$
(C) $1s^2\ 2s^2\ 2p^4$
(D) $1s^2\ 2s^1$

Biggest jump b/w I^{st} and II^{nd} I.E → After removing 1 e⁻, the element acquire stable electronic configuration so, for removal of 2nd electron, we require high amount of energy

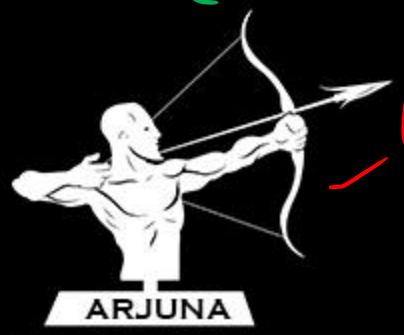
(A) $1s^2\ 2s^2\ 2p^5 \xrightarrow{-e^-} 1s^2\ 2s^2\ 2p^4$

(B) $1s^2\ 2s^2\ 2p^6\ 3s^1 \xrightarrow{-e^-} 1s^2\ 2s^2\ 2p^6$ noble gas configuration (highly stable) → Neon

(C) $1s^2\ 2s^2\ 2p^4 \xrightarrow{-e^-} 1s^2\ 2s^2\ 2p^3$ → half filled, extra stable but not more than noble gas configuration

(D) $1s^2\ 2s^1 \xrightarrow{-e^-} 1s^2$ → noble gas configuration → Helium

In $1s^2$, s orbital is present close to nucleus whereas in $1s^2\ 2s^1\ 2p^0$, 2p orbital is away from nucleus as compared to



1s orbital in Helium ($1s^2$)

∴ High amount of energy is required to remove electron from $1s^2$ due to high effective nuclear charge.

∴ biggest jump b/w Ist and IInd I.E is shown by

$1s^2\ 2s^1$

A sudden large jump between the values of second and third ionisation energies of an element would be associated with the electronic configuration

(A) $1s^2, 2s^2, 2p^6, 3s^1$ $\xrightarrow{-2e^-}$ $1s^2 2s^2 2p^5$

(B) $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$ $\xrightarrow{-2e^-}$ $1s^2 2s^2 2p^6 3s^1$

(C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$ $\xrightarrow{-2e^-}$ $1s^2 2s^2 2p^6 3s^2$ → fully filled orbital → extra stable

(D) $1s^2, 2s^2, 2p^6, 3s^2$ $\xrightarrow{-2e^-}$ $1s^2 2s^2 2p^6$ → noble gas configuration → most stable

Largest jump b/w 2nd and 3rd I.E → After removal of 2nd electron (E^{2+}), the element must have acquired stable electronic configuration, so high amount of energy is required to remove 3rd electron.

In option (D), after removing $2e^-$, the element acquire noble gas configuration which is most stable among all. ∴ 3rd I.E is highest and jump b/w 2nd and 3rd I.E is largest.

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The element which has highest 2nd ionisation energy is

(A) Na
(B) Mg
(C) Ca
(D) Ar

2nd I.E. → Energy required to remove an electron from unipositive (E^+) isolated gaseous ion.

$Na^+ \rightarrow 1s^2 2s^2 2p^6$ → Noble gas configuration → Extra/most stable

$Mg^+ \rightarrow 1s^2 2s^2 2p^6 3s^1$

$Ca^+ \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

$Ar^+ \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^5$

(Z = 20)

(Z = 18)

high energy is required to remove 1 more electron.

Highest 2nd I.E.

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In which of the following the energy change corresponds to first ionisation potential only:-

(A) $X_{(g)} \longrightarrow X^+_{(g)} + e^-$

(B) $X_{2(g)} \longrightarrow X^+_{(g)} + e^-$ — Molecule ✗ ion

(C) $X_{(s)} \longrightarrow X^+_{(g)} + e^-$ — solid X

(D) $X_{(aq)} \longrightarrow X^+_{(aq)} + e^-$ — aqueous ✗

Ist Ionization potential : Energy required to remove an electron from isolated gaseous atom

atom $\leftarrow X_{(g)} \longrightarrow X^+_{(g)} + e^-$

$X_{(g)}$ → gaseous

The correct order of decreasing second ionization energy of Li, Be, Ne, C, B

(A) Ne > B > Li > C > Be

(B) Li > Ne > C > B > Be

(C) Ne > C > B > Be > Li

(D) Li > Ne > B > C > Be

2nd I.E. → Energy required to remove an electron from unipositive (E_{g}^{+}) isolated gaseous ion.

$Li^+ \rightarrow 1s^2$ (Z = 3)

$Be^+ \rightarrow 1s^2 2s^1$ (Z = 4)

$Ne^+ \rightarrow 1s^2 2s^2 2p^5$ (Z = 10)

$C^+ \rightarrow 1s^2 2s^2 2p^1$ (Z = 6)

$B^+ \rightarrow 1s^2 2s^2 2p^1$ (Z = 5)

I.E. increases along a period

Period 2 ← $Li^+ < Ne^+ > B^+ > C^+ > Be^+$ → Period 3

Period 2 I.E > Period 3

Li^+: Noble gas configuration

Ne^+: outmost shell is completely filled

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Which of the following element has highest value of ionisation energy

(A) Ti
(B) Zr
(C) Hf
(D) None of these

Group 3 Group 4

Ti] decrease Ti > Zr

Zr] Increase

→ (f block elements) Hf

→ poor shielding effect → Effective nuclear charge is high

So, high amount of energy is required to remove n electron.

. Highest I.E.

Down the group I.E decreases.

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Minimum first ionisation energy is shown by which electronic configuration:-

(A) $1s^2\ 2s^2\ 2p^5$ → Fluorine → period 2

(B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ → 14 → Silicon → period 3

(C) $1s^2\ 2s^2\ 2p^6\ 3s^1$ → Na → period 3
Sodium

(D) $1s^2\ 2s^2\ 2p^6$ → Neon → noble gas → period 2
↳ most stable
↓
highest I.E.

I.E increases along a period from left to right

I.E decreases down the groups

∴ Na has minimum I.E, After removal of 1e⁻, it acquire noble gas configuration.

So, very less energy is required to remove e⁻ from Na

The energy needed to remove one electron from unipositive ion is abbreviated as:-

(A) 1st I.P.
(B) 3rd I.P.
(C) 2nd I.P.
(D) 1st E.A.

Electron affinity : tendency to accept an electron.

Energy required to remove an electron from isolated gaseous atom $= I^{st}$ I.E.

$X_{(g)} \xrightarrow{I^{st}\ I.E.} X^{+}_{(g)} + e^-$

unipositive ion

$\downarrow$ II^{nd} I.E.

$X^{2+}_{(g)} + e^-$

bipositive.

Energy required to remove an e- from unipositive isolated gaseous ion is called 2^{nd} I.E.

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Thank You