

9th class

Foundation

4th Chapter.

Periodic Properties-I

Atomic & Ionic Radius Ionisation Energy.

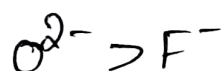
Teaching Task

JEE Main Level.

Q1) Ans:- 1

Solution:- F, F^-, O & O^{2-} .

O^{2-} & F^- are iso electronic species.



O & F are belongs to 2nd period. From left to right of period atomic radius decreases.



Q2) Ans:- 1

Solution:- Cl^-, Ar, K^+ are iso electronic species.



Calcium is larger than Ar but smaller than Cl^-

Q3) Ans:- 1

Solution:- While going down the group size increases due to the addition of a shell.

$$\therefore \text{Mg} > \text{Be}.$$

Left to right in a period atomic size decreases

$$\text{Na} > \text{Mg}.$$

$$\therefore \text{Na} > \text{Mg} > \text{Be}$$

Q4) Ans:- 3.

Solution:- Na^+ , Mg^{2+} , F^- and O^{2-} are iso electronic.

The ion with highest negative charge has the largest radius.

O^{2-} has the largest radius.

Q5) Ans:- 3.

Solution:- When a neutral atom is converted into cation more effectively nuclear charge experienced by electrons.

$$\text{Size} \propto \frac{1}{\text{Nuclear charge}}.$$

In formation of cation, nuclear charge increases. ~~So~~ size decreases.

Q6) Ans:- 1

Solution:- Be has stable fully filled s-orbital.

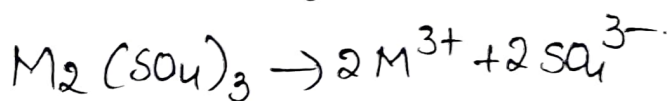
B will attain this configuration after losing one electron. Thus, B loses an electron more easily. Therefore, B has less ionization energy than Be.

Q7) Ans:- 2.

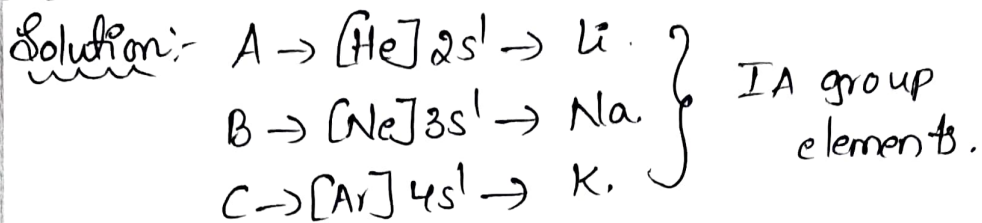
Solution:- Alkaline earth metals have high 3rd ionization energy as they attain noble gas configuration after losing two electrons. It is very difficult to remove electron from penultimate shell. Thus the value of x should be $>> 18 \text{ eV}$.

Q8) Ans:- 2.

Solution:- The given element has high fourth ionization potential. Thus it should have three valence electrons. Therefore the formula of its sulphate will be $M_2(SO_4)_3$.



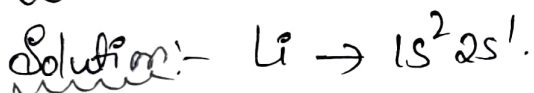
Q9) Ans:- 1



Ionization potential decreases down the group as the attraction over outer electrons decreases.

$$\therefore A > B > C$$

Q10) Ans:- 1



$\text{Li}^+ \rightarrow 1s^2 \rightarrow$ achieves a noble gas configuration.

So it is difficult to remove an electron from Li^+ .

So Li^+ has the largest ionization potential.

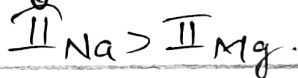
Q11) Ans:- 1

Solution:- From left to right, in a period Ionisation energy increases.

So alkali metals have the lowest I.P and noble gases have the highest I.P.

Q12) Ans:- 4.

Solution:- After losing one electron sodium acquires stable noble gas configuration & thus 2nd I.P of Na is very large.



Q13) Ans:- 1, 2, 3.

Solution:- Factors effecting atomic radii,

1) Effective nuclear charge.

2) Atomic number 3) Shielding effect.

Q14) Ans:- 1, 2.

Solution:- The ionization potential of elements in any group decreases from top to bottom.

This is due to both increase in the size of an atom and increase in the screening effect. Due to this, the effective nuclear charge decreases. Thus, nuclear charge decreases, I.P also decreases.

Q15) Ans:- A

Solution:- 2nd I.E > 1st I.E because after removal of first e^- , the nuclear charge increases & e^- are held tightly by the nucleus. This makes the removal of second electrons difficult & hence requires more energy.

Q16) Ans:- 3. A.

Solution:- Increase in atomic size IP decreases. With increase in Nuclear charge IP increases.

Matrix Matching

Q17) Ans:- a) 4. b) 2 c) 3. d) 1 & 5

Solution:-

a) Ionization energy $\propto$ 4) Nuclear charge.

b) Units of I.E

2) eV/atom or K.cal/mole

c) I.E decreases

3) On moving down the group.

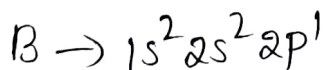
d) I.E increases $\rightarrow$ 1) On moving left to right in a period
5) Stable electronic Configuration.

Q18) Ans:- 2.

Solution:- On going from left to right in a period I.P increases due to increase in effective nuclear charge. Thus, I.P of Li is less than that of Be.

Q19) Ans:- 1

Solution:- Be $\rightarrow 1s^2 2s^2 \rightarrow$ stable Configuration.



In Be, s-orbital is completely filled. So it is difficult to remove.

In B, p-orbital is incompletely filled. So it is easy to remove.

Learner's Task

Q1) Ans:- 1

Solution:- I.P of an element on going from left to right in a period increases with increase in nuclear charge.

Q2) Ans:- 1

Solution:- The atomic radius decreases across a period because the effective nuclear charge increases.

Q3) Ans:- 3.

Solution:- Gaining electrons increases the electron cloud around the nucleus, leading to a larger ionic radius compared to the neutral atom.

Q4) Ans:- 4.

Solution:- Radius $\propto \frac{1}{\text{charge}}$

$$p^{3+} > p^{5+}.$$

Q5) Ans:- 2.

Solution:- The energy required to remove an electron from a gaseous atom from its ground state is called ionization energy or ionization potential.

Q6) Ans:- 3.

Solution:- Ionization energy increases from left to right in a period and decreases from top to bottom in a group. Therefore, an inert gas will have the highest ionization energy.

'He' has more ionisation energy.

Q7) Ans:- 1

Solution:- Metals have low ionisation energy & Non-metals have highest ionisation energy.

Q8) Ans:- 3.

Solution:- $O^+ \rightarrow 1s^2 2s^2 2p^3 \rightarrow$ half filled Configuration.

$F^+ \rightarrow 1s^2 2s^2 2p^4.$

$N^+ \rightarrow 1s^2 2s^2 2p^2$

$C^+ \rightarrow 1s^2 2s^2 2p^1.$

From left to right ionisation energy increases due to increase in nuclear charge.

$O > F > N > C.$

Q9) Ans:- 3.

Solution:- Na & K are IA group elements.

I.P decreases from top to bottom of a group.

So I.P of K $<$ I.P of Na
 $\therefore$ I.P of K = 4.34 eV.

Q10) Ans:- 4.

Solution:- The transition $M^{2+}(g) \rightarrow M^{3+}(g)$ involves maximum amount of energy. It is very difficult to remove an electron from dipositive cation as the effective nuclear charge per electron is maximum.

JEE Main Level Questions

Q11) Ans:- 1

Solution:- The 3rd I.P of the given element is very large as compared to 1st & 2nd I.P.

$\therefore$ The given element should have two electrons in the outermost shell.

Calcium has 2 electrons in its outermost shell.

Q12) Ans:- 2.

Solution:- As the atomic no. of elements increases within the same period, the I.P value increases.

Q13) Ans:- 4

Solution:- $I_1 < I_2 \ll I_3 < I_4 < I_5$

I_1 & I_2 are very less compared to I_3 . So the element consists of 2 electrons in last shell.

$\therefore$ Alkaline earth metals have 2 electrons in last shell.

Q14) Ans:- 1.

Solution:- Nitrogen $\rightarrow 1s^2 2s^2 2p^3 \rightarrow$ half filled more stable.

Oxygen $\rightarrow 1s^2 2s^2 2p^4$
 $\boxed{\uparrow\downarrow \uparrow \uparrow} \rightarrow$ one electron more than half filled.

Q15) Ans:- 2.

Solution:- Variation of first I.P in 2nd period elements is $Li < B < Be < C < O < N < F < Ne$

$Li \rightarrow I.P \rightarrow 5.4 \text{ eV/atom}$

$Be \rightarrow I.P \rightarrow 9.32 \text{ eV/atom}$

B in b/w Li & Be. $\therefore$ I.P of B = 8.29 eV/atom.

Q16) Ans:- 4.

Solution:- The four consecutive elements are B, C, N, O.

I.E₁ of N higher than I.E₁ of Oxygen.

$\therefore$ I.E₁ of N = 14.5

Q17) Ans:- 2.

Solution:- It is given that X, Y & Z have atomic numbers 19, 37 & 55 respectively. $\therefore$ they belong to Group-1.

I.E decreases from top to bottom of group.

$\therefore$ 'Y' have I.E b/w X & Z.

Q18) Ans:- 1

Solution:- Magnesium has a stable full-filled configuration. It is difficult to remove an electron from such a configuration.

Thus, I.P of Mg is greater than that of Al.

Q19) Ans:- 4.

Solution:- The sudden large jump b/w the values of 2nd & 3rd I.E of an element is because after losing 2 electrons it has acquired stable configuration. So in order to remove 3rd electron much higher energy is needed.

So correct answer is $1s^2 2s^2 2p^6 3s^2$.

Q20) Ans:- 2.

Solution:- After removal of an electron Na acquires stable noble gas configuration. It is difficult to remove electron from stable noble gas configuration species.

$\therefore$ 2nd I.E of Mg < 2nd I.E of Na.

JEE Advanced Level Questions

Q21) Ans:- 1, 2, 3

Solution:- Factors affecting atomic radius,
* Effective nuclear charge.
* No. of orbits.
* Shielding effect.

Q22) Ans:- 2.

Solution:-

Covalent radius < Crystal radius < Vanderwaal radius



Q23) Ans:- 2

Solution:- Covalent radius is mostly used for non-metals.

→ Vanderwaal's radius is 40% greater than covalent radius.

Q24) Ans:- 1

Solution:- The decreasing order of radii is

Anion > Atom > Cation.

→ Neutral atom gains one or more electrons, anion is formed, leading to increased electron repulsion & expansion of electron cloud.

Matrix Matching

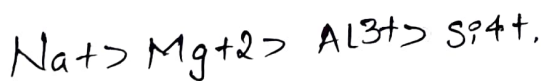
Q25) Ans:- a) 5 b) 3 c) 2 d) 1.

Solution:-

- a) Size of anion $\propto$ → 5) Electronic Repulsion.
b) Size of cation $\frac{1}{\propto}$ → 3) Effective nuclear charge.
c) Atomic radii in a → 2) Decreases.
period
d) Atomic radii in a → 1) Increases.
group

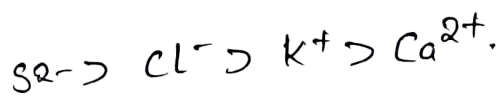
Q26) Ans:- 4.

Solution:- When ions are isoelectronic, the ion with the higher positive charge will be smaller because the same no. of electrons are being attracted by a greater nuclear charge.



Q27) Ans:- 4.

Solution:- The ion with greater negative charge will be larger due to increased electron repulsions.

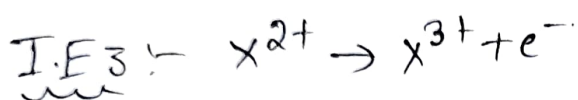
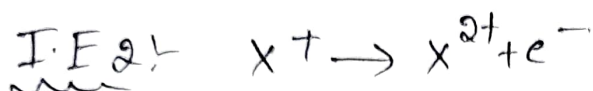


Integer Type.

Q28) Ans:- +2.

Solution:-

1st I.P (I₁):-



I.E₃ is the removal of an electron from an ion with a +2 charge.

Q29) Ans:- 40%.

Solution:- Vanderwaals radius is approximately 40% greater than the covalent radius.

4. PERIODIC PROPERTIES - (A.R, I.R & I.E)

KEY

TEACHING TASK										
	1	2	3	4	5	6	7	8	9	10
A	A	A	C	C	A	B	B	A	A	
	11	12	13	14	15	16	17		18	19
A	D	A,B,C	A,B	A	A	a-4,b-2,c-3,d-1,2		B	A	
LEARNERS TASK										
	1	2	3	4	5	6	7	8	9	10
A	A	C	D	B	C	A	C	C	D	
	11	12	13	14	15	16	17	18	19	20
A	B	D	A	B	D	B	A	D	B	
	21	22	23	24	25		26	27	28	29
A,B,C	B	B	A	a-5,b-3,c-2,d-1		D	D		2	40%