Date: 16/10/2021

Q1. An atom loses electrons successively to form Al^{+}, Al^{2+} and Al^{3+} ions. Which step will have highest ionisation enthalpy?

Q2. Arrange the following elements in the increasing order of electronegativity: Si, C, P and N.

Q3. Arrange the following species in the increasing order of ionic radii:

N^{3-}, O^{2-}, Na^{+}, Al^{3+}.

Q4. Find out the position of the element in the periodic table satisfying the electronic configuration $(n-1)\,d^3\,ns^2$ for $n = 4$.

Q5. Determine the group number and period of element with atomic number 38.

Q6. A monoatoic anion of unit charge contains 45 neutrons and 36 electrons. What is the atomic mass of the element and in which group of the periodic table does it lie?

Q7. (a) Arrange the followig elements, in the order of their chemical reactivity in terms of oxidising property: F, Cl, O, N.

(b) Arrange the following species in decreasing ordr of size: I^{-}, I^{+}, I.

Q8. (a) The electronic configuration of a dipositive ion M^{2+} is 2, 8, 14 and its mass number is 56. How many neutrons are present in it?

(b) What is the most probable radius for finding the electron in He^{+}?

(c) What is the shape of the orbital with the value of $l = 2$ and $m = 0$?

Q9. (a) Among the elements B, Al, C and Si

(i) Which element has the highest first ionisation enthalpy?

(ii) which element is the most metallic? Justify your answer in each case.

(b) Arrange the following compounds in decreasing order of melting poing.

KF, KBr, KCl and KI

Q10. (a) Arrange the elements N, P, O and S in the order of

(i) increasing first ionisation enthalpy. (ii) increasing non-metallic character.

Give reason for the arrangement assigned.

(b) Which of the following will have the most negative and least negative electron gain enthalph? P, S, Cl, F.

Q11. (a) What is the correct order of second ionisation potential of C, N, O and F?

(b) The electronic configuration of an element is $1s^2$, $2s^2$, $3s^2$ $3p^6$, $3p^3$. What are the group number and atomic number of the element *X* which is just below the above element in the periodic table?

(c) Chlorine can be converted into chloride ion more easily as compared to fluoride ion from fluorine. Why?

Q12. (a) Which one among the following elements has the lowest first ionisation enthalpy and which one has the highest first ionisation enthalpy?

Li, K, Ca, S and Kr

(b) Arrange the following ions in order of their increasing ionic radii:

Li^+, Mg^{2+}, K^+ and Al^{3+}

(c) Arrange the following in the decreasing order of electropositive character:

Cu, Fe and Mg

Q13. (a) Electron gain enthalpy value of inert gases are zero. Why?

(b) Arrange the following in increasing order of first ionisation potential:

Na, Al, Mg and Si.

(c) Among the following oxides, which is most acidic?

MgO, Al_2O_3, P_2O_5 and SiO_2.

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S1. $Al^{2+} \longrightarrow Al^{3+} + e^-$; $IE_3 = 2740$ kJ mol^{-1}.

Larger the positive charge on the cation from which the electron is lost, higher is the ionisation enthalpy.

S2. On moving along a period from left to right in the periodic table, electronegativity increases (due to decrease in size) while moving downward in a group, electronegativity decreases. Thus, the correct order of electronegativity is

$$\underset{(1.8)}{Si} < \underset{(2.1)}{P} < \underset{(2.5)}{C} < \underset{(3.0)}{N}$$

S3. All the given species contain same number of electrons, *i.e.*, equal to 10. Thus, they are isoelectronic in nature. The ionic radii of of isoelectronic ions increase with decrease in atomic number (or magnitude in the nuclear charge). Therefore, their ionic radii will be in the order,

$$\text{(Atomic number)} \quad \underset{(13)}{Al^{3+}} < \underset{(11)}{Na^+} < \underset{(8)}{O^{2-}} < \underset{(7)}{N^{3-}}$$

S4. If $n = 4$ then electronic configuration can be written as:

$$(4-1)\,d^3\,4s^2 = 3d^3\,4s^2$$

This configuration is related to vanadium which is a d-block element.

Group number = Number of electrons in $(n-1)\,d$ subshell + Number of electrons in the n^{th} shell

$= 3 + 2 = 5.$

S5. The electronic configuration of atomic number 38 is

X (38) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 5s^2$.

Hence, it beelongs to II A group and 5th period. It is strontium (Sr).

S6. Given, Number of neutrons of the monoatomic anion = 45

and Number of electrons of monoatomic anion = 36

$\therefore$ Number of protons of monoatoic atom = 36 – 1 = 35

Thus, the atomic number of the atom is 35, the atom is bromine and belongs to group 17.

$\therefore$ Atomic mass = Number of neutrons + Number of protons

$= 45 + 35 = 80.$

S7. (a) Within a period, the oxidising character increases from left to right. Therefore, among F, O and N. Oxidising power decreases in the order: F > O > N. However, within a group, oxidising power decreases from top to bottom. Therefore, F is a stronger oxidising agent than Cl. Further, because O is more electronegative than Cl, therefore O is a stronger oxidising agent than Cl. Hence, the overall order of oxidising power is F > O > Cl > N.

(b) Anion has larger size than its neutral atom as extra electron(s) added results in repulsion among outer shel electrons and subsequently, expansion of the outer shell. While in cation, lesser electrons are more effectively pulled by the nucleus resulting in decrease of size, in compasion to neutral atom.

Thus $I^- > I > I^+$.

S8. (a) Number of electrons in M^{2+} = 24

$\therefore$ Number of electrons in M = 26

i.e., Atomic number (Z) = 26

Mass number (A) = 56

$\therefore$ Number of neutrons = $A - Z = 56 - 26 = 30$

(b) Bohr's radius (r) = $\frac{52.9\, n^2}{2}$ pm

where, n = number of shell, Z = atomic number

$\therefore$ $r = \frac{52.9 \times 1^2}{2}$ pm = 26.45 pm.

(c) For *s*, *p*, *d* and *f*-orbitals, the values of l are 0, 1, 2, and 3 respectively. Thus, if $l = 2$, then the orbital is *d*.

For $l = 2$, m have five values *i.e.*, $m = -2, -1, 0, +1, +2$, *i.e.*, there are five d-orbitals.

***d*-orbital**	**Value of *m***
d_{z^2}	0
d_{x^2}	+1
d_{yz}	–1
$d_{x^2-y^2}$	+2
d_{xy}	–2

Hence, for $l = 2$, m = 0, the orbital is d_{z^2} which has a dought-nut shaped electron cloud.

S9. (a) Arranging the elements B, Al, C and Si in different groups and periods in order of their increasing atomic numbers.

Group ⟶	12	14
Period ↓		
2	B	C
3	Al	Sl

(i) As ionisation enthalpy increases along a period and decreases down a group, therefore C has the highest first ionisation enthalpy.

(ii) Since, metallic character increases down a group and decreases along a period, therefore Al is the most metallic element.

(b) The correct decreasing order of melting point is

$$KF > KCl > KBr > KI$$

Melting point decreases with increase in metallic character. In halogen family, metallic character decreases from fluorine to iodine.

S10. (a) The placing of elements are as

Period	Group 15	Group 16
2^{nd} period	N	O
3^{rd} period	P	S

(i) Ionisation enthalpy of nitrogen is greater than that of oxygen as the former is more stable due to half filled outer subshell (2*p*). Similarly, ionisation enthalpy of phosphorus is greater than that of sulphur. Moreover, ionisation enthalpy decreases down the group. So, the order of first ionisation energy increasing is as

$$P < S < N < O$$

(ii) Non-metallic character across a period (left to right) increases but on moving down the group, it decreases. So, the order is P < S < N < O (Non-metallic character increases).

(b) Arranging the given atoms into different groups and periods in order of increasing atomic numbers.

Group	15	16	17
2^{nd} period	—	—	F
3^{rd} period	P	S	Cl

On moving across a period from left to right, the electron gain enthalpy becomes more and more negative while on moving from top to bottom in a group, it becomes less and less negative. This suggests F should have the most negatie electron gain enthalpy while P should have the least negative electron gain enthalpy. But on adding an electron to smaller 2*p*-orbital of F leads to greater interelectronic repulsions than adding an electron to larger 3*p*-orbital of Cl. Hence, Cl has the most negative electron gain enthalpy while P has the least negative electron gain enthalpy

S11. (a) Along a period, as the number of electrons increases, size decrease, effective nuclear charge increases and hence, IP increases. Thus, the correct order of second IP is

$$O > F > N > C.$$

(b) Atomic number of the given element = 15.

Atomic number of the element (*X*) just below the given element = 33.

Group number of element *x* = 10 + 5 (valence electrons) = 15

Period = 3.

(c) Since, electron gain enthalpy of Cl is more negative than that of F therefore, more energy is released from $Cl \longrightarrow Cl^-$ than from $F \longrightarrow F^-$.

S12. (a) Li belongs to 2^{nd} period, S to the 3^{rd} period and K and Kr belong to 4^{th} period. Both Li and K are alkali metals but the size of K is bigger than that of Li. Further, since along any period, $\Delta_1 H_1$ of alkali metal is the lowest while that of inert gas is the highest.

Therefore, K has the lowest $\Delta_1 H_1$ while Kr has the highest $\Delta_1 H_1$.

(b) The order will be:

$$Al^{3+} < Li^{+} < Mg^{2+} < K^{+}$$

The ionic radii of any cation increases as the number of energy shells increases and decreases as the magnitude of the positive charge increases.

Since, K^+ has highest number of shell (3), therefore ionic radius of K^+ is the largest. Mg^{2+} and Al^{3+} are isoelectronic ions and each one of these has two energy shells. As the positive charge on Al^{3+} is higher than that on Mg^{2+}, thus ionic radii of Al^{3+} is lower than that of Mg^{2+}. Now, Li^+ has one shell and +1 charge but Al^{3+} has two shells and +3 charge. Due to large number of charge Al^{3+} ion there is great attraction between electrons and nucleus which results in excessive decreases of ionic radius of Al^{3+} ion. Therefore, ionic radius of Al^{3+} is lower than that of Li^+.

(c) Electropositive character means tendency to give an electron to form cation. It varies directly with atomic radii. Thus, the correct order is

$$Mg > Fe > Cu$$

S13. (a) In inert gases, all the valence orbitals are fully filled and do not accept any more electrons because of extra stability associated with these orbitals. Addition of any electron has to go to a next higher energy level at which the attractive force is negligible. In other words, such atoms cannot hold the additional electron and hence, possess zero electron affinity.

(b) Generally, ionisation potential increases as we move from left to right in a period. However, the ionisation potential of group II A elements is higher than that of the group III A elements. Hence, the correct order of ionisation potential is

$$Na < Al < Mg < Si.$$

(c) Acidity of oxides increases on moving from left to right in a perood. Therefore, order of increasing acidic characterr among given oxides is

$$MgO < Al_2O_3 < SiO_2 < P_2O_5.$$

Hence, P_2O_5 is the most acidic oxide.