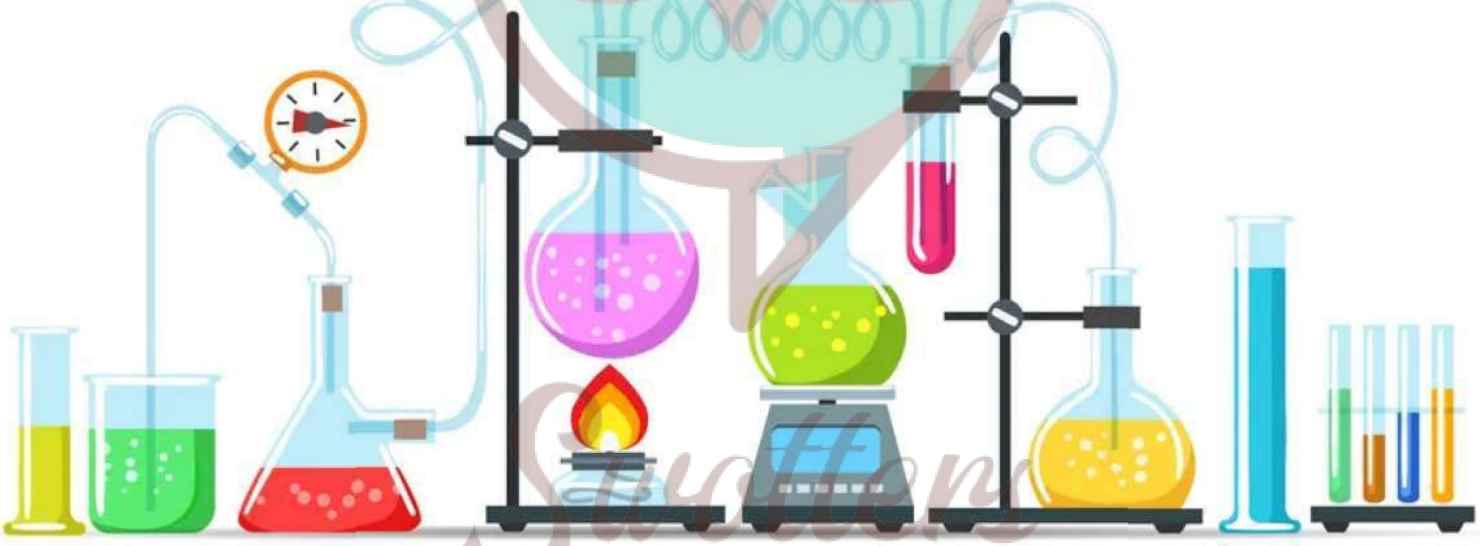
CHEMISTRY



Important Questions

Multiple Choice questions-

Question 1. The group number, number of valence electrons, and valency of an element with the atomic number 15, respectively, are:

(a) 16, 5 and 2

(b) 15, 5 and 3

(c) 16, 6 and 3

(d) 15, 6 and 2

Question 2. The d-block elements consist mostly of

(a) Monovalent metals

(b) All non-metals

(c) Elements which generally form stoichiometric metal oxide

(d) Many metals with catalytic properties

Question 3. Which of the following has the highest boiling point?

(a) Ne

(b) Xe

(c) Ar

(d) Kr.

Question 4. The chemistry of lithium is very similar to that of magnesium even though they are placed in different groups. Its reason is:

(a) Both are found together in nature

(b) Both have nearly the same size

(c) Both have similar electronic configuration

(d) The ratio of their charge and size (i.e. charge density) is nearly the same

Question 5. Which one of the following groupings represents a collection of isoelectronic species? (At. nos: Cs-55, Br-35)

(a) Na^{+}, Ca^{2+}, Mg^{2+}

(b) N^{3-}, F–, Na+

(c) Be, Al^{3}+, Cl^{-}

(d) Ca^{2+}, Cs^{+}, Br

Question 6. Which of the following has the maximum number of unpaired electrons?

(a) Mg^{2+}

(b) Ti^{3+}

(c) V^{3+}

(d) Fe^{2+}

Question 7. In the periodic table, the element with atomic number 16 will be placed in the group

(a) Third

(b) Fourth

(c) Fifth

(d) Sixth

Question 8. Representative elements are those which belong to

(a) p and d – Block

(b) s and d – Block

(c) s and p – Block

(d) s and f – Block

Question 9. Which pair of elements belongs to same group?

(a) Elements with atomic no. 17 and 38

(b) Elements with atomic no. 20 and 40

(c) Elements with atomic no. 17 and 53

(d) Elements with atomic no. 11 and 33

Question 10. The most electronegative element of the periodic table is

(a) Iodine

(b) Sulphur

(c) Oxygen

(d) Fluorine.

Question 11. In the third period of the Periodic Table the element having smallest size is

(a) Na

(b) Ar

(c) Cl

(d) Si

Question 12. The element with highest second ionization energy is

(a) Cl

(b) S

(c) Na

(d) Mg

Question 13. Which of the following properties generally decreases along a period?

(a) Ionization Energy

(b) Metallic Character

(c) Electron Affinity

(d) Valency.

Question 14. Increasing order of electronegativity is

(a) Bi < P < S < Cl

(b) P < Bi < S < Cl

(c) S < Bi < P < Cl

(d) Cl < S < Bi < P

Question 15. Which of the following oxides is amphoteric in character?

(a) SnO_2

(b) CO_2

(c) SiO_2

(d) CaO

Very Short:

1. An element is present in the third period of the p-block. It has 5 electrons in its outermost shell. Predict its group. How many unpaired electrons does it have?

2. An element X with Z = 112 has been recently discovered. Predict its electronic configuration and suggest the group in which it is present.

3. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$. Name the period and the group to which it belongs?

4. Arrange Cl, Cl–, Cl^+ ion in order of increasing size.

5. Arrange the following in increasing order of size.

N^{3-}, Na^+, F^-, O^{2-}, Mg^{2+}

6. Give the formula of one species positively charged and one negatively charged that will be isoelectronic with Ne.

7. Argon has atomic number 18 and belongs to the 3rd period and 18th group. Predict the

group and period for the element having atomic number 19.

Short Questions:

1. Do elements with high I.E. have high E.A.?
2. What is a periodic classification of elements?
3. Distinguish between s and p block elements.
4. Explain why ionization enthalpies decrease down a group of the Periodic Table.
5. Why does the first ionization enthalpy increase as we go . from left to right across a given period of the Periodic Table.
6. How do atomic radii vary across a period with an atomic number in the periodic table?

Long Questions:

1. Electronic configuration of the four elements are given below: Arrange these elements in increasing order of their metallic character. Give reasons for your answer.
   (i) $[Ar]4^{s2}$
   (ii) (ii) $[Ar]3d^{10}\ 4s^2$
   (iii) $[Ar]3d^{10}\ 4s^2\ 4p^6\ 5s^2$
   (iv) [Arl $3d^{10}\ 4s^2\ 4p^6\ 5s^1$
2. Explain the important general characteristics of groups in the modem periodic table in brief.
3. Explain the electronic configuration in periods in the periodic table. „
4. Explain the variation of valence in the periodic table.

Assertion Reason Questions:

1. In the following questions, a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

   Assertion (A) : Generally, ionisation enthalpy increases from left to right in a period.

   Reason (R) : When successive electrons are added to the orbitals in the same principal quantum level, the shielding effect of inner core of electrons does not increase very much to compensate for the increased attraction of the electron to the nucleus.

   (i) Assertion is correct statement and reason is wrong statement.

(ii) Assertion and reason both are correct statements and reason is correct explanation of assertion.

(iii) Assertion and reason both are wrong statements.

(iv) Assertion is wrong statement and reason is correct statement.

2. In the following questions, a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

Assertion (A) : Boron has a smaller first ionisation enthalpy than beryllium.

Reason (R) : The penetration of a 2s electron to the nucleus is more than the 2p electron hence 2p electron is more shielded by the inner core of electrons than the 2s electrons.

(i) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(ii) Assertion is correct statement but reason is wrong statement.

(iii) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(iv) Assertion and reason both are wrong statements.

Case Study Based Question:

1. Comprehension given below is followed by some multiple choice questions. Each question has one correct option. Choose the correct option. In the modern periodic table, elements are arranged in order of increasing atomic numbers which is related to the electronic configuration. Depending upon the type of orbitals receiving the last electron, the elements in the periodic table have been divided into four blocks, viz, s, p, d and f. The modern periodic table consists of 7 periods and 18 groups. Each period begins with the filling of a new energy shell. In accordance with the Arfbau principle, the seven periods (1 to 7) have 2, 8, 8, 18, 18, 32 and 32 elements respectively. The seventh period is still incomplete. To avoid the periodic table being too long, the two series of f-block elements, called lanthanoids and actinoids are placed at the bottom of the main body of the periodic table.

(1) The element with atomic number 57 belongs to

(a) s-block

(b) p-block

(c) d-block

(d) f-block

(2) The last element of the p-block in 6th period is represented by the outermost electronic configuration.

(a) 7s2 7p6

(b) 5f14 6d10 7s2 7p0

(c) 4f14 5d10 6s2 6p6

(d) 4f14 5d10 6s2 6p4

(3) Which of the elements whose atomic numbers are given below, cannot be accommodated in the present set up of the long form of the periodic table?

(a) 107

(b) 118

(c) 126

(d) 102

(4) The electronic configuration of the element which is just above the element with atomic number 43 in the same group is _____.

(a) 1s2 2s2 2p6 3s2 3p6 3d5 4s2

(b) 1s2 2s2 2p6 3s2 3p6 3d5 4s3 4p6

(c) 1s2 2s2 2p6 3s2 3p6 3d6 4s2

(d) 1s2 2s2 2p6 3s2 3p6 3d7 4s2

(5) The elements with atomic numbers 35, 53 and 85 are all _____.

(a) Noble gases

(b) Halogens

(c) Heavy metals

(d) Light metals

2. Read the passage given below and answer the following questions:

When an electron is added to a gaseous atom in its ground state to convert it into a negative ion, the enthalpy change accompanying the process is called the electron gain enthalpy (Δe_g H). It is a direct measure of the ease with which an atom attracts an electron to form anion.

$$X(g) + e^- \longrightarrow X^-(g); \Delta H = \Delta e_g H$$

The most stable state of an atom is the ground state. If an isolated gaseous atom is in excited state, comparatively lesser energy will be released on adding an electron. So, electron gain enthalpies of gaseous atoms must be determined in their ground states. Therefore, the terms ground state and isolated gaseous atom has been also included in

the definition of electron gain enthalpy. Like ionisation enthalpy, electron gain enthalpy is measure either in electron volts per atom or kJ per mole.

(1) Noble gases have positive electron gain enthalpy due to:

(a) Stable configuration

(b) Large size

(c) High reactivity

(d) Unstable configuration

(2) The electron gain enthalpy of O or F is less than that of S or Cl. It is due to:

(a) Small size

(b) Less repulsion

(c) Large size

(d) High electronegativity

(3) The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine, respectively, are:

(a) -333, -325, -349 and -296

(b) -296, -325, -333 and -349

(c) -333, -349, -325 and -296

(d) -349, -333, -325 and -296

(4) Why beryllium has higher ionization enthalpy than boron?

(a) More penetration of s-electron

(b) More penetration of p-electron

(c) Large size

(d) Small size

Answer Key:

MCQ

1. (a) 15, 5 and 3
2. (d) Many metals with catalytic properties
3. (b) Xe
4. (d) The ratio of their charge and size (i.e. charge density) is nearly the same
5. (b) N^{3-}, F^{-}, Na+
6. (d) Fe^{2+}

7. (d) Sixth
8. (c) s and p – Block
9. (c) Elements with atomic no. 17 and 53
10. (d) Fluorine.
11. (b) Ar
12. (c) Na
13. (b) Metallic Character
14. (a) Bi < P < S < Cl
15. (a) SnO_2

Very Short Answer:

1. It belongs to the 15th group (P). It has 3 unpaired electrons.
2. Rn] $5f^{14}$ $6d^{10}$ $7s^2$. It belongs to the 12th group.
3. Third-period Group 17.
4. CP < Cl < CP.
5. Mg^2 + < Na^+< F^- < O^{2-} < N^{3-}
6. Na^+, F^-.
7. Group I, Period 4th.

Short Answer:

Ans: 1. Normally is true that the elements with haying high value of I.E. have a high value of E affinity. But however, there are marked exceptions. It is seen that elements, with stable electronic configurations, have very high values of I-Energies as it is difficult to remove electrons as is the case with 15th and 18th group elements but in such case, electron cannot be added easily so that is why elements of 15th group have almost zero E.A. and elements of 18th group have got zero E.A. whereas their Ionization energy values are very high.

Ans: 2. By periodic classification of the elements we mean the arrangement of the elements in such a way that the elements with similar physical and chemical properties are grouped together and for this various scientists made contributions but however the contributions made by Mendeleev are of great significance and he gave a periodic table which called as Mendeleev's Periodic 'Table which was older and replaced by the long form of the periodic table.

Ans: 3. They can be distinguished as follows: s block elements:

1. They have got the general configuration of the valence shell, ns^{1-2}.
2. They are all metals.
3. Their compounds are mostly ionic.
4. They are generally strong reducing agents.
5. They mostly impart characteristic color to the flame.
6. They have low ionization energies.
7. They show fixed oxidation states,

p block elements:

1. The valence shell electronic configuration of p block elements in $ns^2\ p^{1-6}$.
2. They are mostly non-metals.
3. Their compounds are mostly covalent.
4. They are generally strong oxidizing agents.
5. Mostly they do not impart color to the flame.
6. They have got a comparatively higher value of I.E.
7. They show variable oxidation states.,

Ans: 4. The decrease in ionization enthalpies down any group is because of the following factors:

1. There is an increase in the number of the main energy shells
2. moving from one element to another.
3. There is also an increase in the magnitude of the screening effect due to the gradual increase in the number of inner electrons.

Ans: 5. The value of ionization enthalpy increases with the increase in atomic number across the period.

This is due to the fact that in moving across the period from left to right.,

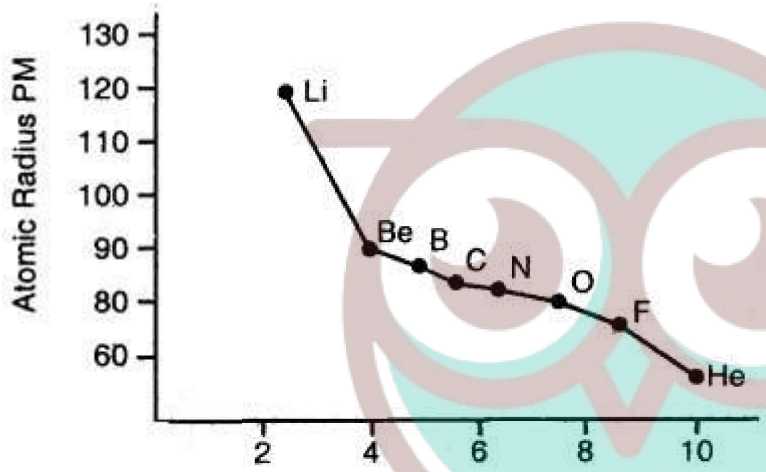
1. Nuclear charge increases regularly by one unit.
2. The progressive addition of electrons occurs at the same level.
3. Atomic size decreases.

This is due to the gradual increase in nuclear charge and a simultaneous decrease in atomic size the electrons are more and more tightly bound to the nucleus. This results in a gradual

increase in ionization energy across the period.

Ans: 6. Variation of Atomic radii across a period: atomic radii decrease with the increase in the atomic number in a period. For example, atomic radii decrease from lithium to fluorine in the second period.

In moving from left to right across the period, the nuclear charge increases progressively by one unit but the additional electron goes" to the same principal shell. As a result, the electron cloud is pulled closer to the nucleus by increased effective nuclear charge. This causes a decrease in atomic size.



Variation of the atomic radius with an atomic number across the second period

Long Answer:

Ans: 1. (i) [Ar]4s2 is Calcium metal with At. no. = 20.

(ii) [Ar]$3d^{10}$ $4s^2$ is Zinc metal with At. no. = 30.

(iii) [Ar]$3d^{10}$ $4s^2$ $4p^6$ $5s^2$ is Strontium metal with At. no. = 38.

(iv) [Ar] $3d^{10}$ $4s^2$ $4p^6$, $5s^1$ is*Rubidium metal with At. no. = 37.

Alkali metals are the most metallic, followed by alkaline earth metals and transition metals. Among alkali metals – Rubidium (37) is the most metallic. Among alkaline earth metals (Ca, Sr) Sr (Strontium) is more metallic than Calcium (Ca) as the metallic character increases from top to bottom in a group. Zinc – the transition metal is the least metallic. Thus metallic character increases from

Zn < Ca < Sr < Rb or (ii) < (i) < (iii) < (iv)

Ans: 2. The elements of a group show the following important similar characteristics.

(0 Electronic configuration. All elements in a particular group have similar outer electronic configuration e.g., all elements of group I', i.e., alkali metals have ns^1 configuration in their valency shell. Similarly, group 2 elements (alkaline Earths) Haye ns^2 outer configuration and halogens (group 17) have ns^2 np5 configuration (where n is the

outermost shell).

(it) Valency. The valency of an element depends upon the number of electrons in the outermost shell. So elements of a group show the same valency, e.g., elements of group 1 show + 1 valency and group 2 show + 2 valencies i.e. valency i.e., NaCl > MgC^{l2} etc.

(iii) Chemical properties. The chemical properties of the elements are related to the number of electrons in the outermost shell of their atoms. Hence all elements belonging to the same group show similar chemical properties. But the degree of reactivity varies gradually from top to bottom in a group. For example, in group 1 all the elements are highly reactive metals but the degree of reactivity increases from Li to Cs. Similarly, elements of group 17, i.e., halogens: F, Cl, Br, I are all non-metals and they're- reactivity goes on decreasing from top to bottom.

Ans: 3. Each successive period in the periodic table is associated with the filling Up of the next higher principal energy level (n – 1, n – 2, etc.). It can be readily seen that the number of elements in each period is twice the number of atomic orbitals available in the energy level that is being filled. The first period starts with the filling of the lowest level (1s) and has thus the two elements – hydrogen ($1s^1$) and helium ($1s^2$) when the first shell (K) is completed. The second period starts with lithium and the third electron enters the 2s orbital.

The next element, beryllium has four electrons and has the electronic configuration $1s^2\ 2s^2$. Starting from the next element boron, the 2p orbitals are filled with electrons when the L shell is completed' at neon ($2s^2\ 2p^6$). Thus there are 8 elements in the second period. The third period (n = 3) being at sodium, and the added electron enters a 3s orbital. Successive filling of 3s and 3p orbitals give rise to the third period of 8 elements from sodium to argon.

The fourth period (n = 4) starts at potassium with the filling up of 4p of 4s orbital. Before the 4p orbital is filled, the filling up of 3d orbitals becomes energetically favorable and we come across the so-called 3d transition series of elements. The fourth period ends at krypton with the filling up of the 4p orbitals. Altogether we have 18 elements in the fourth period. The fifth period (n = 5) beginning with rubidium is similar to the fourth period and contains the 4d transition series starting at yttrium (Z = 39).

This period ends at xenon with the filling up of the 5p orbitals. The sixth period (n = 6) contains 32 elements and successive electrons enter 6s, 4/, 5d, and 6p orbitals, in that order. Filling up of the 4/ orbitals being with cerium, (Z = 58) and ends at lutetium (Z = 71) to give the 4/-inner transition series which is called the lanthanide series. The seventh period (n = 7) is similar to the sixth period with the successive filling up of the 7s, 5f, 6d, and 7p orbitals and includes most of the man-made radioactive elements.

This period will end at the element with atomic number 118 which would belong to the noble gas family. Filling up of the 5f orbitals after actinium (Z = 89) gives the 5f-inner transition series known as the actinide series. The 4f and 5f transition series of elements

are placed separately in the periodic table to maintain its structure and to preserve the principle of classification by keeping elements with similar properties in a single column.

Ans: 4. Variation of valence in a group as well as across a period in the periodic table occurs as follows:

1. In a group: All elements in a group show the same valency. For example, all alkali metals (group 1) show a valency of 1+. Alkaline earth metals (group 2) show a valency of 2+.

However, the heavier elements of p-block elements (except noble gases) show two valences: one equal to the number of valence electrons or 8-No. of valence electron# and the other two less. For example, thallium (Tl) belongs to group 13. It shows valence of 3+ and 1+.

Lead (Pb) belongs to group 14. If shows valance of 4+ and 2+.

Antimony (Sb) and Bismuth (Bi) belong to group 15. They show valence of 5+ and 3+ being more stable.

This happens due to the non-participation of tie two s-electrons present in the valence shell of these elements. This non-participation of one pair of s-electrons in bonding is called the inert-pair effect.

3. In a period: The number of the valence electrons increases – in going from left to right in a period of the periodic table. Therefore, the valency of the elements in a period first increases, and then decreases.

Assertion Reason Answer:

1. (ii) Assertion and reason both are correct statements and reason is correct.
2. (iii) Assertion and reason both are correct statements and reason is correct.

Case Study Answer:

1. **Answer:**

   (1) (c) d-block

   (2) (c) 4f14 5d10 6s2 6p6

   (3) (c) 126

   (4) (a) 1s2 2s2 2p6 3s2 3p6 3d5 4s2

   (5) (b) Halogens

2. **Answer:**

   (1) (a) Stable configuration

   (2) (a) Small size

   (3) (c) -333, -349, -325 and -296

(4) (a) More penetration of s-electron