

Chapter

3

Classification of Elements and Periodicity in Properties

TYPE A : MULTIPLE CHOICE QUESTIONS

- The first ionisation potential is maximum for:
(a) Lithium (b) Uranium [1998]
(c) Iron (d) Hydrogen
- Which element has high electron affinity?
(a) Na (b) Cl [1998]
(c) Be (d) Ca
- Which group of periodic table contains no metal:
(a) IA (b) IIIA [1999]
(c) VIIA (d) VIII
- Which of the following is the atomic number of metal? [2000]
(a) 32 (b) 34 (c) 36 (d) 38
- The correct order of hydration energy of alkali is [2000]
(a) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+$
(b) $\text{Rb}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$
(c) $\text{Na}^+ > \text{K}^+ > \text{Li}^+ > \text{Rb}^+$
(d) $\text{K}^+ > \text{Rb}^+ > \text{Na}^+ > \text{Li}^+$
- Sodium forms Na^+ ion but it does not form Na^{2+} because of [2001]
(a) very low value of 1st and IInd I.E.
(b) very high value of 1st and IInd I.E.
(c) high value of 1st I.E. and low value of IInd I.E.
(d) low value of 1st I.E. and high value of IInd I.E.
- Which of the following has maximum energy? [2002]

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- Which of the following does not have valence electron in 3d-subshell? [2002]
(a) Fe(III) (b) Cr(I)
(c) Mn(II) (d) P(0)
- Which of the following statement is correct about ionization potential? [2010]
(a) It is independent of atomic radii
(b) It remains constant with change in atomic radii
(c) It increases with an increase in atomic radii
(d) It decreases with an increase in atomic radii
- Consider the following statements [2012]
I. The radius of an anion is larger than that of the parent atom.
II. The ionization energy generally increases with increasing atomic number in a period.
III. The electronegativity of an element is the tendency of an isolated atom to attract an electron.
Which of the above statements is/are correct?
(a) I alone (b) II alone
(c) I and II (d) II and III
- Which of the order for ionization energy is correct? [2013]
(a) $\text{Be} < \text{B} < \text{C} < \text{N} < \text{O}$
(b) $\text{B} < \text{Be} < \text{C} < \text{O} < \text{N}$
(c) $\text{Be} > \text{B} > \text{C} > \text{N} > \text{O}$
(d) $\text{B} < \text{Be} < \text{N} < \text{C} < \text{O}$
- The element with atomic number 117 has not been discovered yet. In which family would you place this element if discovered? [2014]
(a) Alkali metals
(b) Alkaline earth metals
(c) Halogens
(d) Noble gases
- In which of the following arrangements, the order is NOT according to the property indicated against it? [2015]
(a) $\text{Li} < \text{Na} < \text{K} < \text{Rb}$:
Increasing metallic radius

- (b) $I < Br < F < Cl$:
Increasing electron gain enthalpy
(with negative sign)
- (c) $B < C < N < O$
Increasing first ionization enthalpy
- (d) $Al^{3+} < Mg^{2+} < Na^+ < F^-$
Increasing ionic size
14. The correct decreasing order of first ionisation enthalpies of five elements of the second period is [2016]
(a) $Be > B > C > N > F$ (b) $N > F > C > B > Be$
(c) $F > N > C > Be > B$ (d) $N > F > B > C > Be$
15. The law of triads is applicable to a group of [2017]
(a) Cl, Br, I (b) C, N, O
(c) Na, K, Rb (d) H, O, N
- TYPE B : ASSERTION REASON QUESTIONS**
- Directions for (Qs.16-19) :** Each of these questions contains an Assertion followed by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.
- (a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
- (b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
- (c) If Assertion is correct but Reason is incorrect.
- (d) If both the Assertion and Reason are incorrect.
16. **Assertion :** First ionization energy for nitrogen is lower than oxygen.
Reason : Across a period effective nuclear charge decreases. [2005]
17. **Assertion :** Electron affinity refers to an isolated atom's attraction for an additional electron while electronegativity is the ability of an atom of an element to attract electrons towards itself in a shared pair of electrons.
Reason : Electron affinity is a relative number and electronegativity is experimentally measurable. [2010]
18. **Assertion :** Element has a tendency to lose the electron(s) to attain the stable configuration.
Reason : Ionization enthalpy is the energy released to remove an electron from an isolated gaseous atom in its ground state. [2011]
19. **Assertion :** Both Be and Al can form complexes such as BeF_4^{2-} and AlF_6^{3-} respectively, BeF_6^{3-} is not formed. [2015]
Reason : In case of Be, no vacant d-orbitals are present in its outermost shell.

HINTS & SOLUTIONS

Type A : Multiple Choice Questions

1. (d) First ionisation potential is maximum for hydrogen, as electron is withdrawn from the first orbital which is very near to nucleus.
2. (b) Cl has high electron affinity.
3. (c) Group IA and III A contain mostly metals. Group VIII contains transition elements which are metals. Group VII A contains mostly non-metals (F, Cl, Br).
4. (d) Elements having 1, 2 or 3 electrons in its last shell act as metals.
 $32 = [\text{Ar}] 3d^{10} 4s^2 p^2$
 $34 = [\text{Ar}] 3d^{10} 4s^2 p^4$
 $36 = [\text{Ar}] 3d^{10} 4s^2 p^6$
 $38 = [\text{Ar}] 3d^{10}, 4s^2 p^6, 5s^2$
5. (a) Hydration energy $\propto \frac{1}{\text{Size}}$
 In a group, size increases on going down the group from top to bottom i.e.,
 $\text{Rb}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$
 \therefore Increasing order of hydration energy
 $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+$
6. (d) Na ($Z = 11$; $1s^2, 2s^2 2p^6, 3s^1$) readily gives one electron because the resulting Na^+ ($1s^2 2s^2 2p^6$) has stable configuration. Thus the first IE of Na is less. However, removal of an electron from a stable (noble gas) configuration requires high energy and thus IE_2 of Na will be very high.
7. (c) The atomic no of this element is highest which indicates that it will have highest energy.
8. (d) Electronic configuration of Cr (I) is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$.
 Electronic configuration of Fe(III) is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$.
 Electronic configuration of Mn (II) is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$.
 So, all these have valence electrons in $3d$ -subshell. So, option (d) is correct answer.
9. (d) The ionisation potential decreases with increase in atomic radii.
10. (c)
11. (b)
12. (c)
13. (c) In a period the value of ionisation potential increases from left to right with breaks where the atoms have some what stable configuration. In this case N has half filled stable orbital. Hence has highest ionisation energy. Thus the correct order is
 $\text{B} < \text{C} < \text{O} < \text{N}$ not $\text{B} < \text{C} < \text{N} < \text{O}$
14. (c) As we move along the period, the atomic size decreases due to increase in nuclear charge. Therefore, it is more difficult to remove electron from an atom. Hence the sequence of first ionization enthalpy in decreasing order is
 $\text{F} > \text{N} > \text{C} > \text{Be} > \text{B}$
 But ionization enthalpy of boron is less as compared to beryllium because first electron in boron is to be removed from p -orbital while in beryllium, it is to be removed from s -orbital.
 As s -orbital is closer to nucleus in comparison to p -orbital thus energy required to remove an electron from s -orbital is greater.
15. (a) According to the law of triads the atomic wt of the middle element is arithmetic mean of I and III.

$$\text{At wt of Br} = \frac{\text{At.wt of Cl} + \text{At wt of I}}{2}$$

Type B : Assertion Reason Questions

16. (d) The ionisation energy of N is more than that of O because N has exactly half filled valence p orbital.
 ${}_7\text{N } 1s^2 2s^2 p^3$ ${}_8\text{O } 1s^2 2s^2 p^4$
 The nuclear charge increases across a period.
17. (c) Assertion is true but Reason is false. Electron affinity is experimentally measurable while electronegativity is a relative number.
18. (c) Ionization enthalpy is the energy required to remove an electron from an isolated gaseous atom in its ground state.
19. (a) Both assertion and reason are correct and reason is correct explanation of assertion.