JEE Main Previous Year Solved Questions on Periodic Table

1. The radius of La^{3+} (Atomic number of La=57) is 1.06A. Which one of the following given values will be closest to the radius of Lu3+ (Atomic number of Lu = 71)?

(1) 40 A

(2) 1.06 A

(3) 0.85 A

(4) 1.60 A

Solution:

Radius, $r \propto 1/Z$

$r_1/r_2 = Z_2/Z_1$

$1.06/r_2 = 71/57$

So $r_2 = 1.06 \times 57/71 = 0.85$

Hence option (3) is the answer.

2. The increasing order of the ionic radii of the given isoelectronic species is?

(1) K^+, S^{2-}, Ca^{2+}, Cl^-

(2) Cl^-, Ca^{2+}, K^+,S^{2-}

(3) S^{2-}, Cl^-, Ca^{2+}, K^+

(4) Ca^{2+}, K^+, Cl^-, S^{2-}

Solution:

If the atom or molecule is negatively charged, as an additional electron occupies an outer orbital, there is increased electron-electron repulsion and cause increased shielding, which pushes the electrons further apart. Since the electrons now outnumber the protons in the ion, the protons cannot pull the extra electrons as tightly toward the nucleus which results in decreased Z_{eff}. Hence, the ionic radii

increase whereas it is vice versa when it is positively charged. The increasing order of the ionic radii of the given isoelectronic species is Ca^{2+}, K^{+}, Cl^{-}, S^{2-}.

Hence option (4) is the correct answer.

3. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^{+}will be?

(1) – 2.55 eV

(2) – 5.1 eV

(3) – 10.2 eV

(4) + 2.55 eV

Solution:

The ionization energy of an atom or molecule describes the minimum amount of energy required to remove an electron from the atom or molecule in the gaseous state. But electron gain enthalpy is the amount of energy released when an isolated gaseous atom accepts an electron to become a monovalent gaseous anion. Here ΔH = -5.1 eV.

Hence option (2) is the correct answer.

4. According to the Periodic Law of elements, the variation in properties of elements is related to their.

(1) nuclear masses

(2) atomic numbers

(3) nuclear neutron-proton number ratios

(4) atomic masses

Solution:

The properties of elements change with a change in atomic number

Hence option (2) is the correct answer.

5. Which one of the following is an amphoteric oxide?

(1) Na_20

(2) $S0_2$

(3) B_20_3

(4) ZnO

Solution:

ZnO reacts with HCl and NaOH.

Hence option (4) is the answer.

6. The order of increasing sizes of atomic radii among the elements O, S, Se and As is?

(1) As < S < O < Se

(2) O < S < As < Se

(3) Se < S < As < O

(4) O < S < Se < As

Solution:

On moving top to bottom, the size of atomic radii increases. On moving left to right, the size decreases. Hence O < S < Se < As.

Hence option (4) is the correct answer.

7. Beryllium and aluminium exhibit many properties which are similar. But the two elements differ in

(1) exhibiting maximum covalency in compound

(2) exhibiting amphoteric nature in their oxides

(3) forming covalent halides

(4) forming polymeric hydrides

Solution:

Beryllium belongs to the second period, and aluminium to the third. As a result of their different electronic configurations and atomic numbers, beryllium and aluminium have different covalencies.

Be and Al have a diagonal relationship. They possess similar properties but they differ in exhibiting maximum covalency in compound.

Hence, option (1) is the correct answer.

8. Which is the correct order of second ionization potential of C, N, O and F in the following?

(1) O > F > N > C

(2) O > N > F > C

(3) C > N > O > F

(4) F > O > N > C

Solution:

C, N, O and F are elements of the same period. The ground state electronic configuration is shown below.

C - $2s^2\ 2p^2$

N - $2s^2\ 2p^3$

O - $2s^2\ 2p^4$

F - $2s^2\ 2p^5$

After removing one electron,

C - $2s^2\ 2p^1$ It will occupy ideal gas configuration. Hence it will easily give away the second electron which has a very low second IP.

N - $2s^2\ 2p^2$ It will have only one electron in the outermost p subshell.

O - $2s^2\ 2p^3$ It will have two electrons in p subshell which makes it very unstable. So it will have high IP.

F - $2s^2\ 2p^4$ It will occupy stable half filled configuration.

So O>F>N>C is the correct order.

Hence option (1) is the answer.

9. The group having isoelectronic species is;

(1) O^{2-}, F^{-}, Na^{+}, Mg^{2+}

(2) O^{-}, F^{-}, Na , Mg^{+}

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

(4) O^{-} , F^{-}, Na^{+}, Mg^{2+}

Solution:

ions	O^{-2}	F^{-}	Na^{+}	Mg^{+2}
Atomic number	8	9	11	12
No. of e^{-}	10	10	10	10

So O^{-2}, F^{-}, Na^{+}, Mg^{+2} are isoelectric.

Hence option (1) is the answer.

10. Which of the following oxides is amphoteric in character?

(1) CaO

(2) $C0_2$

(3) $Si0_2$

(4) $Sn0_2$

Solution:

A molecule or ion that can react both as an acid and as a base is called an amphoteric compound. SnO_2 is amphoteric.

Hence (4) is the answer.

11. Which of the following atoms has the highest first ionization energy?

(1) Sc

(2) Rb

(3) Na

(4) K

Solution:

Because of poor shielding of d-electrons in Sc, Z_{eff} of Sc becomes more so that ionisation energy of Sc is more than Na, K and Rb.

Hence option (1) is the answer.

12. The lanthanide contraction is responsible for the fact that

(1) Zr and Y have about the same radius

(2) Zr and Nb have similar oxidation state

(3) Zr and Hf have about the same radius

(4) Zr and Zn have the same oxidation

Solution:

The lanthanide contraction is responsible for the fact that Zr and Hf have about the same radius.

Hence option (3) is the answer.

13. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing order of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+}, Be^{2+}?

(1)Mg^{2+},Be^{2+},K^+,Ca^{2+}

(2)Be^{2+}, K^+, Ca^{2+}, Mg^{2+}

(3)K^+,Ca^{2+},Mg^{2+},Be^{2+}

(4)Ca^{2+},Mg^{2+},Be^{2+},K^+

Solution:

More the charge or size ratio, higher is the polarizing power.

Hence option (3) is the answer.

14. Iron exhibits +2 and +3 oxidation states.Which of the following statements about iron is incorrect?

(1) Ferrous oxide is more basic in nature than the ferric oxide

(2) Ferrous compounds are relatively more ionic than the corresponding ferric compounds

(3) Ferrous compounds are less volatile than the corresponding ferric compounds

(4) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds

Solution:

Ferrous compounds are less easily hydrolysed than ferric compounds. The ease of hydrolysis is inversely proportional to electropositivity.

Hence option (4) is the answer.

15. The ionic radii (in) of N^{3-}, O^{2-} and F^{-} respectively

(1) 1.36, 1.40 and 1.71

(2) 1.36, 1.71 and 1.40

(3) 1.71, 1.40 and 1.36

(4) 1.71 and 1.36 and 1.40

Solution:

These are isoelectronic species.

Ionic radius increases when negative charge increases.

Hence option (3) is the answer.

16. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements gives the correct picture?

(1) The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group

(2) In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group

(3) Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens

(4) In alkali metals the reactivity increases but in the halogens it decreases with increase in atomic number down the group

Solution:

As we move down, the alkali group size increases, and so does the ability to lose electrons and thus, reactivity increases.

However, in the case of halogens, reactivity decreases for the following reasons:

- Due to a decrease in electronegativity on moving down the group.
- The inert pair effect reduces oxidising ability.
- Increased atomic radius down the group reduces the attraction of valence electrons from other atoms, lowering reactivity.

Hence, option (4) is the correct answer.

17. Which of the following factors may be regarded as the main cause of lanthanide contraction ?

(1)Poor shielding of one of 4f electron by another in the subshell

(2)Effective shielding of one of 4f electrons by another in the subshell

(3)Poorer shielding of 5d electrons by 4f electrons

(4)Greater shielding of 5d electrons by 4f electrons

Solution:

Poor shielding of one of 4f electron by another in the subshell is the main cause of lanthanide contraction.

Hence option (1) is the answer.