**1. Outer electronic configurations of K, Cu and Cr are respectively:**

(a)    4s1, 3d10 and 3d5

(b)    4s2, 3d10 and 3d4

(c)    4s1, 3d9 and 3d4

(d)    4s2, 3d9 and 3d4

**2. The formation of the oxide ion, O2– (g) require first an exothermic and then an endothermic step as shown below:**

**O(g) + e  O– (g)    H = – 142 kJ mol–1**

**O–(g) + e  O2– (g)    H = 844 kJ mol–1**

**This is because:**

(a)    Oxygen is more electronegative

(b)    Oxygen has high electron affinity

(c)    O– ion will tend to resist the addition of another electron

(d)    O– has comparatively larger size than oxygen atom

**3. For electron affinity of halogens, which of the following is correct?**

(a)    Br > F

(b)    F > Cl

(c)    Br > Cl

(d)    F > I

**4. Which one of the following arrangement represents the correct order of electron gain enthalpy (with negative sign) of the given atomic species?**

(a)    S < O < Cl < F

(b)    Cl < F < S < O

(c)    F < Cl < O < S

(d)    O < S < F < Cl

**5. In correct order regarding the mobility of the alkali metal ions in aqueous solution is:**

(a)    K+ > Rb+ > Na+ > Li+

(b)    Rb+ > K+ > Na+ > Li+

(c)    Li+ > Na+ > K+ > Rb+

(d)    Na+ > K+ > Rb+ > Li+

**6. In which of the following arrangements, the order is not according to the property indicated against it?**

(a)    Li < Na < K < Ph    Increasing metallic radius

(b)    I < Br < F < Cl    Increasing electron gain enthalpy with negative sign

(c)    B < C < N < O    Increasing first ionisation enthalpy

(d)    Al3+ < Mg2+ < Na+ < F–     Increasing ionic size

**7. The ionic mobility of alkali metal ions in aqueous solution maximum for:**

(a)    K+

(b)    Rb+

(c)    Li+

(d)    Ma+

**8. The increasing order of first ionisation enthalpies of element B, P, S and F (lowest first) is:**

(a)    F < S < P < B

(b)    P < S < B < F

(c)    B < P < S < F

(d)    B < S < P < F

**9. Which one of the following sets of ions represents a collection of isoelectronic species?**

(a)    K+, Cl–, Ca2+, Sc3+

(b)    Ba2+, Sr2+, K+, Ca2+

(c)    N3–, O2–, F2–, S2+

(d)    Li+, Na+, Mg2+, Ca2+

**10. In the following, the element with the highest ionisation energy is:**

(a)    [Ne] 3s23p1

(b)    [Ne] 3s23p3

(c)    [Ne] 3s23p2

(d)    [Ne] 3s23p4

**11. The successive ionisation energies for an element X are given below:**

1. **1st IE = 410 kJ/mol**
2. **2st IE = 820 kJ/mol**
3. **3st IE = 1100 kJ/mol**
4. **4st IE = 1500 kJ/mol**
5. **5st IE = 3200 kJ/mol**

**Find the number of valence electrons for the atom X.**

(a)    4

(b)    3

(c)    5

(d)    2

**12. Identify the correct order of the size of the following**

(a)    Ca2+ < K+ < Ar < Cl– < S2–

(b)    Ar < Ca2+ < K+ < Cl– < S2–

(c)    Ca2+ < Ar < K+ < Cl– < S2–

(d)    Ca2+ < K+ < Ar < S2– < Cl–

**13. With which of the following electronic configuration an atom has the lowest ionization enthalpy?**

(a)    1s2 2s2 2p3

(b)    1s2 2s2 2p6 3s1

(c)    1s2 2s2 2p6

(d)    1s2 2s2 2p5

**14.**

|  |  |
| --- | --- |
| **Column I** | **Column II** |
| **(A)** | **He** | **(i)** | **High electron gain enthalpy** |
| **(B)** | **Cl** | **(ii)** | **Most electropositive element** |
| **(C)** | **Ca** | **(iii)** | **Strongest reducing agent in solution** |
| **(D)** | **Li** | **(iv)** | **Highest ionization energy** |

**The correct match of contents in column I with those in column II is:**

(a)    (A–iii), (B–i), (C–ii), (D–iv)

(b)    (A–iv), (B–iii), (C–ii), (D–i)

(c)    (A–iv), (B–i), (C–ii), (D–iii)

(d)    (A–ii), (B–iv), (C–i), (D–iii)

**15. The electronic configurations of four elements are given below: Arrange these elements in the correct order of the magnitude (Without sign) of their electron gain enthalpy?**

**(i)    2s2 2p5**

**(ii)    3s2 3p5**

**(iii)    2s2 2p4**

**(iv)    3s2 3p4**

**Select the correct answer using the codes given below:**

(a)    (i) < (ii) < (iii) < (iv)

(b)    (ii) < (i) < (iv) < (iii)

(c)    (i) < (iii) < (iv) < (ii)

(d)    (iii) < (iv) < (ii) < (i)

**16.** Which of the following is the period number of the element whose atomic number is 98

(A) 4 (B) 7 (C) 5 (D) 6

**Ans.** B

**Sol.** The electronic configuration of the elementwith atomic number 98 is as follow

1s2 , 2s2 , 2p6, 3s2, 3p6, 4s2 , 3d10, 4p6, 5s2, 4d10 , 5p6, 6s2, 4f14, 5d10, 6p6, 7s2, 5f 10

The last electron enters in f orbital, so it belongs to f block in the period.

**17.** The nuclei of elementsX,YandZhave same number of protons, but different numbers of neutrons.

According toMendeleef periodic table, the elementsX,Yand Z

(A) belong to same group and same period

(B) belong to different groups and different periods

(C) belong to same group and different periods

(D) are isotopes,which do not have different positions

**Ans.** D

**Sol.** Isotopes have same number of protons (i.e. same atomic number). So theyoccupy same position in the periodic table.However, due to different numbers of neutrons their atomicweights are different.

**18.** Which of the following has the same number of electrons in its outermost shell and penultimate shell ?

(1)Al3+ (2) Ca2+ (3) F– (4) N3–

**Ans.** 2

**19.** Which of the following statement is not correct about the electronic configuration of chromiumatom(Cr

with atomic number = 24)?

(1) It has five electrons in 3d - sub - shell

(2) It has one electrons in 4s-orbital

(3) The principal quantumnumbers of its valence electrons are 3 and 4.

(4) It has six electrons in 3d-sub-shell

**Ans.** 4

|  |
| --- |
| **20. Which of the following is a bridge element?** |
| Be |
| Cl |
| K |
| P. |
| **ANSWER : : Be** |

|  |
| --- |
| **21.The ionization energy of nitrogen is more than that of oxygen because** |
| Nitrogen has half-filled p-orbital |
| Nitrogen atom is smaller in size than oxygen atom |
| Nitrogen atom is smaller in size than oxygen atom |
| Nitrogen is less electronegative. |
| **ANSWER : : Nitrogen has half-filled p-orbital** |

|  |
| --- |
| **22.In the long form of periodic table, elements are arranged according to** |
| increasing atomic number |
| decreasing atomic number |
| increasing atomic mass |
| decreasing atomic mass. |
| **ANSWER : : increasing atomic number** |

|  |
| --- |
| **23.The most electronegative and the most electropositive elements of the first period is/are** |
| H and He |
| Na and Cl |
| Li and F |
| H and H. |
| **ANSWER : : H and H.** |

|  |
| --- |
| **24.Which of the following statements is not correct?** |
| Among halogens, oxidizing behaviour increases down the group |
| Among alkali metals, reducing character increases down the group |
| Fluorine is the most electronegative elements |
| Lithium is the hardest metal among alkali metals. |

**IONIZATION ENERGY QUESTIONS MCQ  
IIT JEE**

**1) Which of the following order is correct for the first ionization energies of their elements?**

**(EAMCET 2009)**

1) B < Be < N < O

2) Be < B < N < O

3) B < Be < O < N

4) B < O < Be < N

**Logic:**

\* Ionization energy, in general, increases with decrease in the atomic radius across the period from left to right. However there are exceptions.

\* Atoms with half filled and completely filled orbitals in the outer shell are more stable and posses higher ionization energies.

\* s-orbitals have greater penetration power than p-orbitals. Hence the removal of electrons from s-orbitals require more energy.

\* Above atoms belong to same period (2nd) of periodic table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group number** | **2** | **13** | **15** | **16** |
| **Element** | 4**Be** | 5**B** | 7**N** | 8**O** |
| **electronic configuration** | **2s2** | **2s22p1** | **2s22p3** | **2s22p4** |

**Solution:**

\* Boron, B is smaller than beryllium, Be atom. Hence we expect increase in ionization energy from Be to B.

However, Be atom has greater ionization energy than B atom. It is due to stable 2s2 configuration and the presence of valence electron in the s-orbital. Removal of electron from s-orbital requires more energy than from p-orbital as stated above.

\* 2s22p3 configuration is more stable than 2s22p4 due to half filled p-sublevel. Hence nitrogen, N atom has greater ionization energy than oxygen, O atom.

**Conclusion:**

The correct order is: B < Be < O < N

**Related questions**

**2) The first ionization potential of four consecutive elements, present in the second period of the periodic table are 8.3, 11.3, 14.5 and 13.6 eV respectively. Which one of the following is the first ionization potential (in eV) of nitrogen?**

**(Eamcet - 2004-M)**

1) 13.6

2) 11.3

3) 8.3

4) 14.5

**Logic & solution:**

The ionization energies increase regularly for the first three elements. Then there is decrease in the IE value from 3rd to 4th element. This indicates, 3rd element must possess stable configuration. Hence the third element is nitrogen.

**Conclusion:**

The first ionization potential (in eV) of nitrogen is 14.5. The correct option is "4".

**3) The electron configuration of elements A, B and C are [He]2s1, [Ne]3s1 and [Ar]4s1 respectively. Which one of the following order is correct for the first ionization potentials (in kJ mol–1) of A, B and C?**

**(Eamcet - 2001-E)**

1) A > B > C

2) C > B > A

3) B > C >A

4) C > A > C

**Logic & solution:**

The electronic configurations clearly indicate that they belong to same group of periodic table i.e. 1st group. The atomic size increases with increase in the value of principal quantum number, n  of valence orbital (from 2 to 3 to 4). Hence the ionization energy decreases from A to B to C.

**Conclusion:**

The correct option is "1".

**4) The correct order of second ionization energies of C, N, O and F is:**

**(IIT JEE 1991)**

1) C > N > O > F

2) O > N > F > C

3) O > F > N > C

4) F > O > N > C

**Logic & solution:**

The second ionization energy refers to the energy required to remove the electron from the corresponding mono-valent cation of the respective atom. The atoms: C, N, O and F belong to 2nd period of the periodic table.

Just like second ionization energy like the first IE is affected by size, effective nuclear charge, type of orbital from which the electron is being removed and electronic configuration.

It is expected to increase from left to right in the periodic table with decrease in the atomic size. However oxygen has greater second ionization energy than fluorine and also nitrogen.

Reason: Since Oxygen atom gets stable electronic configuration, 2s22p3 after removing one electron, the O+ shows greater ionization energy than F+ as well as N+.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group number** | **14** | **15** | **16** | **17** |
| **Element** | **C** | **N** | **O** | **F** |
| **electronic configuration** | **2s22p2** | **2s22p3** | **2s22p4** | **2s22p5** |
| **After removing one electron** | **| | | ∇** | **| | | ∇** | **| | | ∇** | **| | | ∇** |
| **Monovalent cation** | **C+** | **N+** | **O+** | **F+** |
| **electronic configuration** | **2s22p1** | **2s22p2** | **2s22p3** | **2s22p4** |

Hence the order of second ionization energies of above elements is: O > F > N > C.

**Conclusion:**

The correct option is "3".

**5)The incorrect statement among the following is:**

**(IIT JEE 1997)**

1) The first ionization potential of Al is less than the first ionization potential of Mg.

2) The second ionization potential of Mg is greater than the second ionization potential Na.

3) The first ionization potential of Na is less than the first ionization potential of Mg.

4) The third ionization potential of Mg is greater than that of Al.

**Logic & solution:**

The outer electronic configurations of atoms, univalent and divalent cations of elements mentioned in above statement are tabulated below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Group number** | **1** | **2** | **13** |
| **Element** | **Na** | **Mg** | **Al** |
| **electronic configuration** | **2s22p63s1** | **2s22p63s2** | **2s22p63s23p1** |
| **After removing one electron** | **| | | ∇** | **| | | ∇** | **| | | ∇** |
| **univalent cation** | **Na+** | **Mg+** | **Al+** |
| **electronic configuration** | **2s22p6** | **2s22p63s1** | **2s22p63s2** |
| **After removing second electron** | **| | | ∇** | **| | | ∇** | **| | | ∇** |
| **Divalent cation** | **Na2+** | **Mg2+** | **Al2+** |
| **electronic configuration** | **2s22p5** | **2s22p6** | **2s22p63s1** |

Statement-1 is correct since, the electron has to be removed from full filled s-orbital, the first ionization energy of Mg is greater than that of Al.

Statement-2 is incorrect since Na+ has now stable octet configuration(2s22p6) and requires greater energy to remove second electron than in case of Mg+.

Statement-3 is correct because Mg is smaller than Na and has greater effective nuclear charge. Hence the first ionization energy of Mg is higher.

Statement-4 is also correct. It is because of stable octet configuration of Mg2+ formed after removing two electrons from Mg.

**Conclusion:**

The correct option is 2 ( the statement given is incorrect).

**6) The first ionization potentials of Na, Mg, Al and Si are in the order:**

**(IIT JEE 1988)**

1) Na < Mg > Al < Si

2) Na < Mg < Al > Si

3) Na > Mg > Al > Si

4) Na > Mg > Al < Si

**Logic & solution:**

Mg has greater ionization energy than Al due to 2s22p63s2 configuration. It is more difficult to remove electron from 3s orbital than from 3p orbital since s-orbitals have greater penetration power. Moreover, Mg has stable electronic configuration with full filled 3s orbital.

**Conclusion:**

The correct option is "1".

**7) The first ionization energy in electron volts of nitrogen and oxygen atom's are respectively given by:**

**(IIT JEE 1987)**

a) 14.6, 13.6

b) 13.6, 14.6

c) 13.6, 13.6

d) 14.6, 14.6

**Logic & solution:**

Since nitrogen has greater ionization energy than oxygen, the correct option is "a".

**8) Which of the following species has the highest ionization potential?**

**(EAMCET 1998-E)**

1) Li+

2) Mg+

3) Al+

4) Ne

**Logic & solution:**

Li+ has 1s2 configuration, which is the configuration of He atom. Hence it should possess highest IP value.

**Conclusion:**

The correct option is "1".

**9) The set representing correct order of first ionization potential is:**

**(IIT JEE 2001)**

1) K > Na > Li

2) Be > Mg > Ca

3) B > C > N

4) Ge > Si > C

**Logic & solution:**

1) K > Na > Li : Incorrect, since ionization energy decreases down the group with increase in size. These elements belong to  same group (1st). The correct order of first ionization energy should be: K < Na < Li.

|  |  |
| --- | --- |
| **Li** | | | | ionization energy decreases down the group | | ∇ |
| **Na** |
| **K** |

2) Be > Mg > Ca : Correct. These are 2nd group elements and the order correctly reflects trend in ionization energy.

|  |  |
| --- | --- |
| **Be** | | | | ionization energy decreases down the group | | ∇ |
| **Mg** |
| **Ca** |

3) B > C > N: Incorrect. They belong to same period and the order should be reverse since the IP values increase from left to right in a period.

|  |  |  |
| --- | --- | --- |
| **B** | **C** | **N** |
| ----------> ionization energy increases | | |

4) Ge > Si > C : Incorrect: Belong to same group (14th).The order must be in reverse.

|  |  |
| --- | --- |
| **C** | | | | ionization energy decreases down the group | | ∇ |
| **Si** |
| **Ge** |

**Conclusion:**

The correct option is "2".

**10) Amongst the following elements (whose electronic configurations are given below), the one having the highest ionization energy is:**

**(IIT JEE 1990)**

a) [Ne] 3s2 3p1

b) [Ar] 3d10 4s2 4p2

c) [Ne] 3s2 3p2

d) [Ne] 3s2 3p3

**Logic & solution:**

Based on electronic configuration of elements, their positions in the periodic table can be assigned as shown below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **13** | **14** | **15** |
| **Period 3** | [Ne] 3s2 3p1 | [Ne] 3s2 3p2 | [Ne] 3s2 3p3 |
| **Period 4** |  | [Ar] 3d10 4s2 4p2 |  |

The element with electronic configuration [Ne] 3s2 3p3 is on the extreme right and with stable 3p3 configuration (half filled sub level). Hence it should have highest IE value.

**Conclusion:**

The correct option is "d".

**11) The increasing order of the first ionization enthalpies of the elements B, P, S and F (lowest first) is:**

**(AIEEE 2006)**

a) F < S < P < B

b) P < S < B < F

c) B < P < S < F

d) B < S < P < F

**Logic & solution:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **13** | **15** | **16** | **17** |
| **Period 3** | B (800.6 kJ mol-1) |  |  | F (1681 kJ mol-1) |
| **Period 4** |  | P (1012 kJ mol-1) | S (999.6 kJ mol-1) |  |

Fluorine, being the smallest has the highest ionization enthalpy among the given elements.

Phosphorus has 3s23p3 configuration with half filled p-sub level. Hence it has higher IP value than Sulfur.

**Conclusion:**

The correct option is "d".

**Homework**

1) Which element in the periodic table has the highest ionization potential?

2) What is the relation between ionization potential and effective nuclear charge experienced by an electron in nth orbit?

## 1) The electron affinity values (in kJ mol-1) of three halogens X, Y and Z are respectively -349, -333 and -325. Then X, Y and Z respectively are:

(EAMCET 2003-M)

1) F, Cl and Br

2) Cl, F and Br

3) Cl, Br and F

4) Br, Cl and F

Logic:

Electron affinity is the measure of nuclear attraction over the newly added electron. It is the energy liberated when one electron is added to gaseous isolated atom. These values are represented with a negative sign. Greater the negative value greater is the electron affinity.

In smaller atoms, the newly added electron is attracted strongly by the nucleus and hence their electron affinity values are higher. In general, these values increase with decrease in the size.

However, in too small atoms, the new electron not only experiences the attraction from the nucleus but also the repulsions from the core electrons, which may diminish the electron affinity.

Solution:

In halogens, the electron affinity increases from F to Cl and then decreases to I as the atomic size increases. F has less electron affinity than Cl due to very small size.

The order is: F < Cl > Br > I.

But still the electron affinity of F is greater than those of Br and I.

Conclusion:

We can conclude that the correct option is "2" by comparing the electron affinity values.

## Related questions

### 2) The formation of the oxide ion O2-(g) requires first an exothermic and then an endothermic step - as shown below:

### O(g) + e- ====> O-(g) ;    ΔH0= -142 kJ mol-1

### O-(g) + e- ====> O2-(g) ;    ΔH0= +844 kJ mol-1

### This is because:

(AIEEE - 2004)

a) oxygen is more electronegative

b) oxygen has high electron affinity

c) O- ion will tend to resist the addition of another electron

d) O- ion has comparatively larger size than oxygen atom

Solution:

When an electron is added to negatively charged ion, it experiences more repulsion rather than attraction. Hence addition of second electron usually requires energy. As a result, second electron affinity values are positive i.e. endothermic.

Conclusion:

The correct option is: 'c'.