#420412

Topic: Atomic radius

Given below are densities of some solids and liquids. Give rough estimates of the size of their atoms :

Substance	Atomic Mass (u)	Density (10^3 kg m^{-3}
Carbon (diamond)	12.01	2.22
Gold	197.00	19.32
Nitrogen (liquid)	14.01	1.00
Lithium	6.94	0.53
Fluorine (liquid)	19.00	1.14

[Hint: Assume the atoms to be 'tightly packed' in a solid or liquid phase, and use the known value of Avogadro's number. You should, however, not take the actual numbers you obtain for various atomic sizes too literally because of the crudeness of the tight packing approximation, the results only indicate that atomic sizes are in the range of a few $\mathring{A}$].

Solution

If r is the radius of the atom, then volume of each atom$= 4/3\,\pi/r^3$

Volume of all atoms in one mole of substance$= 4/3\,\pi\,r^3 \times N = M/\rho$

$\therefore r = [3M/4\pi\rho N]^{1/3}$

For Carbon,

$M = 12.01 \times 10^{-3} Kg$

$\rho = 2.22 \times 10^3 Kg\,m^{-3}$

$$r = \frac{3 \times 12.01 \times 10^{-3}}{4 \times \frac{22}{7} \times (2.22 \times 10^{23}) \times (6.023 \times 10^{23})}$$

$= 1.29 \times 10^{-10} m$

$= 1.29\mathring{A}$

Similarly,

for gold, $r = 1.59\mathring{A}$

for lithium, $r = 1.73\mathring{A}$

for liquid fluorine, $r = 1.88\mathring{A}$

#422740

Topic: Atomic radius

Which of the following are isoelectronic species, i.e., those having the same number of electrons?

$Na^+,\ K^+,\ Mg^{2+},\ Ca^{2+},\ S^{2-},\ Ar$

Solution

Na^+, Mg^{2+}, Ca^{2+} are isoelectronic species. They contain 10 electrons each.

$Ar, S^{2-} and \quad K^+$ are isoelectronic species. They contain 18 electrons each.

#423024

Topic: Modern periodic table

What is the basis theme of organisation in the periodic table?

Solution

The periodic table is organized to simplify and systematize the study of numerous properties of all the elements and their compounds. Similar elements are placed together and dissimilar elements are separated from one another. The study is simple to remember as the properties of elements are studied in the form of groups or families having similar properties rather than studying these elements individually.

The long form of the periodic table is based on the fact that the physical and chemical properties of the elements are the periodic functions of their atomic numbers (Modern periodic law). The elements are arranged in the increasing order of their atomic numbers.

#423027

Topic: Introduction and historical development of the periodic table

Which important property did Mendeleev use to classify the element in his periodic table and did he stick to that?

Solution

The important property that Mendeleev used for the classification of elements was atomic weight. He arranged all known elements in the form of periodic table. Some of the elements did not fit very well if the order of atomic weight was strictly followed. For these elements, he ignored the order of atomic weight (as atomic weight measurements can be incorrect) and placed the elements with similar properties together. Thus, iodine having lower atomic weight than tellurium (of group VI) was placed in group VII along with fluorine, chlorine and bromine due to similar properties and left some gaps for undiscovered elements. By considering the properties the adjacent elements, he predicted the properties of undiscovered elements. Later on, these elements were discovered and their properties were similar to those predicted by Mendeleev.

Thus, Mendeleev left gaps for gallium and germanium. He named these elements as exa-aluminium and eka-silicon. When these elements were discovered, their properties were similar to those predicted by Mendeleev.

#423028

Topic: Modern periodic table

What is the basic difference between the Mendeleev's Periodic Law and the Modern Periodic Law?

Solution

As per Mendeleev's Periodic Law, the physical and chemical properties of the elements are periodic function of their atomic weight.

Whereas as per the Modern Periodic Law the physical and chemical properties of the elements are periodic function of their atomic number.

#423029

Topic: Modern periodic table

On the basis of quantum numbers, justify that the sixth period of the periodic table should have 32 elements.

Solution

In the sixth period (n = 6) of the periodic table, 6s, 4f, 5d and 6p orbitals are filled in the increasing order of the energy. Total 16 orbitals are available each of which contains a maximum 2 electrons. Thus, the sixth period can accommodate maximum 32 elements.

#423030

Topic: Period and group

In terms of period and group where would you locate the element with Z = 114?

Solution

The element with Z = 114 will have the electronic configuration $[Rn]5f^{14}6d^{10}7s^{2}7p^{2}$.

Thus, the element belongs to the seventh period. The electron enters p orbital. Hence, it belongs to p block. The group number is $10+4=14$

Hence, the element belongs to seventh period and 14th group.

#423031

Topic: Period and group

Write the atomic number of the element present in the third period and seventeenth group of the periodic table

Solution

The valence shell electronic configuration is $3s^{2}3p^{5}$. The atomic number of element is 17. It is chlorine.

#423032

Topic: Modern periodic table

Which element do you think would have been named by (i) Lawrence Berkeley Laboratory and (ii) Seaborg's group?

Solution

(i) Lawrencium (Z=103).

(ii) Seaborgium (Z=106)

#423033

Topic: Period and group

Why do elements in the same group have similar physical and chemical properties?

Solution

In the same group, the elements have similar valence shell electronic configuration. Hence, they have similar physical and chemical properties.

#423034

Topic: Atomic radius

What does atomic radius and ionic radius really mean to you?

#423035

Topic: Atomic radius

How do atomic radius vary in a period and in a group? How do you explain the variation?

Solution

In a period, from left to right, with increase in the atomic number, the atomic radius decreases due to increase in the nuclear charge which increases the attraction of the nucleus for the valence electrons.

In a group, on moving from top to bottom, the ionic radius increases as a new energy level is added at each succeeding element but the number of valence electrons remains same.

#423037

Topic: Atomic radius

What do you understand by isoelectronic species? Name a species that will be isoelectronic with each of the following atoms or ions.

(i) F^- (ii) Ar (iii) Mg^{2+} (iii) Rb^+

Solution

Isoelectronic species contain same number of electrons.

(i) Both F^- and O^{2-} contain 10 electrons each. Hence, they are isolectronic.

(ii) Both Ar and Cl^- contains 18 electrons each. Hence, they are isoelectronic.

(iii) Both Mg^{2+} and Na^+ contain 10 electrons each. Hence, they are isoelectronic.

(iv) Both Rb^+ and Kr contain 36 electrons. Hence, they are isoelectronic.

#423039

Topic: Atomic radius

Consider the following species:

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

(a) What is common in them?

(b) Arrange them in the order of increasing ionic radii.

Solution

(a) All the given species contain same number of electrons (10). Hence, they are isoelectronic species. With increase in the nuclear charge, the ionic size decreases.

(b) The increasing order of ionic radii is $Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$.

#423043

Topic: Atomic radius

Explain why cation are smaller and anions larger in radii than their parent atoms?

Solution

A gaseous atom looses one or more electrons to form cation. The nuclear charge remains same but the number of electrons decreases. Same nuclear charge acts on lesser number of electrons. The effective nuclear charge per electron increases. The electrons are more strongly attracted and pulled towards the nucleus. Thus, the size decreases.

A gaseous atom gains one or more electrons to form anion. The nuclear charge remains same but the number of electrons increases. Same nuclear charge acts on greater number of electrons. The effective nuclear charge per electron increases. The electrons are less strongly attracted and pulled away from the nucleus. Thus, the size decreases.

#423045

Topic: Ionization enthalpy and valency

What is the significance of the terms 'isolated gaseous atom' and 'ground state' while defining the ionization enthalpy and electron gain enthalpy?

Solution

When an atom is free from other atoms in gaseous state, it is called isolated gaseous atom. No energy is required to separate it further from other atoms. The lowest energy state possible for an atom is the ground state.

#423048

Topic: Ionization enthalpy and valency

Energy of an electron in the ground state of the hydrogen atom is $-2.18 \times 10^{-18} J$. Calculate the ionization enthalpy of atomic hydrogen in terms of J mol^{-1}.

Solution

The ionization enthalpy is the amount of energy required to remove an electron from ground state to infinity. The energy of electron in the ground state is $-2.18 \times 10^{-18} J$.

The energy of electron at infity is zero.

The energy required to remove electron is $0-(-21.8 \times 10^{-18} J) = 2.18 \times 10^{-18} J$

To remove 1 mole of electrons, the amount of energy required is $2.18 \times 10^{-18} \times 6.023 \times 10^{23} = 13.130 \times 10^5 J/mol$This is the ionization enthalpy of hydrogen.

#423050

Topic: Ionization enthalpy and valency

Among the second period elements the actual ionization enthalpies are in the order $Li < B < Be < C < O < N < F < Ne$

With the help of information given above, explain the followng:

(i) Be has higher Δ_i H than B.

(ii) O has lower Δ_i H than N and F.

Solution

(i) The electronic configuration of Be is $1s^2 2s^2$.

The electronic configuration of B is $1s^2 2s^2 2p^1$.

Be has higher $\Delta_i H$ than B due to following reasons.

(a) The electronic configuration of Be has higher stability than the electronic configuration of B due to completely filled 2s orbital.

(b) During ionization of Be, s electron is removed.

During ionization of B, p electron is removed.

2s electron penetrates to the nucleus to greater extent than 2p electron. Thus, 2p electron is more shielded than 2s electron. The attraction of nucleus for 2s electron is higher than the attraction of nucleus for 2p electron. Thus, removal of 2s electron requires higher energy than the removal of 2p electron. Therefore, the ionization enthalpy of Be is higher than the ionization enthalpy of B.

(ii) The electronic configuration of oxygen is $1s^2 2s^2 2p^4$.

The 2p orbital contains 4 electrons out of which 2 are present in the same 2p-orbital. Due to this, the electron repulsion increases. N has stable half filled configuration. F has greater nuclear charge. Hence, the ionization enthalpy of O is lower than that of N and F.

#423051

Topic: Ionization enthalpy and valency

How would you explain the fact that the first ionization enthalpy of sodium is lower then that of magnesium but its second ionization enthalpy is higher than that of magnesium?

Solution

Na and Mg have electronic configurations $[Ne]3s^1$ and $[Ne]3s^2$ respectively. Since, Mg has completely filled s orbital than Na, the electronic configuration of Mg is more stable than that of Na. Hence, Mg has higher first ionization energy than Na. When an electron is lost from Na, it acquires stable electronic configuration of noble gas Ne. When Mg loses one electron, it acquires the electronic configuration $[Ne]3s^1$. Hence, Na^+ has more stable electronic configuration than Mg^+. Thus, Na has much larger second ionization enthalpy than Mg.

#423052

Topic: Ionization enthalpy and valency

What are the various factors due to which the ionization enthalpy of the main group elements tends to decrease down a group?

Solution

On moving down the group, in main group elements the ionization energy regularly decreases due to the following factors.

(i) Atomic size: On moving down the group, as additional shells are added, the atomic size increases.

(ii) Shielding effect: As the number of inner electrons increases, the shielding effect on the outermost electrons increases.

(iii) Nuclear charge: On moving from top to down in a group, the nuclear charge increases. The effect of increase in he atomic size and the shielding effect is much more significant than the nuclear charge. The electron becomes less lightly held to the nucleus on moving down the group. Due to this, the ionization enthalpies gradually decrease on moving down the group.

#423054

Topic: Ionization enthalpy and valency

The first ionization enthalpy values (in kJ mol^{-1}) of group 13 element are :

B	Al	Ga	In	Tl
801	577	579	558	589

How would you explain this deviation from the general trend ?

Solution

On moving down the group, the ionization enthalpy decreases. This is true for B and Al. The ionization enthalpy of Ga is unexpectedly higher than that of Al. Ga contains 10d electrons in inner shell which are less penetrating. Their shielding is less effective than that of s and p electrons. The outer electron is held fairly strongly by the nucleus. The ionization enthalpy increases slightly. A similar increase is observed from In to Tl due to presence of 14f electrons in the inner shell of Tl which have poor shielding effect.

#423055

Topic: Electronegativity and oxidation state

Which of the following pair of elements would have a more negative electron gain enthalpy?

(i) O or F (ii) F or Cl

Solution

(i) Among O and F, F has more negative electron gain enthalpy.

(ii) Among F and Cl, Cl has more negative electron gain enthalpy.

#423058

Topic: Electron gain enthalpy

Would you expect the second electron gain enthalpy of oxygen as positive, more negative or less negative than the first? Justify your answer.

Solution

The second electron gain enthalpy of oxygen is positive and the first electron gain enthalpy is negative due to electrostatic repulsion between the electron and the uninegative anion.

#423059

Topic: Electronegativity and oxidation state

What is the basic difference between the terms electron gain enthalpy and electronegativity?

Solution

Electron gain enthalpy is the tendency of an isolated atom in its gaseous state to accept an additional electron to form a negative ion. It is the property of isolated atoms.

Electronegtivity is the tendency of an atom to attract the shared pair of electrons towards it in a covalent bond. It is the property of atoms in molecules.

#423060

Topic: Electronegativity and oxidation state

How would you react on this statement?

Electronegativity of nitrogen (N) on Pauling scale is 3.0 in all the nitrogen compounds.

Solution

It is not possible to have value of 3.0 for electronegativity of N in all its compounds. The electronegativity of N depends upon other atoms attached to it. The hybridization and the oxidation state of N also affects its electronegativity.

#423063

Topic: Atomic radius

Describe the theory associated with the radius of an atom as it :

(a) gains an electron

(b) loses an electron.

Solution

(a) When an atom gains an electron, it forms anion. The atomic radius is smaller than the radius of the anion. This is because, the number of electrons has increased but the nuclear charge remains same. Hence, the electrons are less tightly held by the nucleus due to which the size increases.

(b) When an atom loses an electron, it forma a cation. The atomic radius is larger than the ionic radius. The nuclear charge remains the same but the number of electrons decreases by 1. Hence, the effective nuclear charge per electron increases. The attraction between the nucleus and the valence electrons increases. Due to this the radius decreases.

#423066

Topic: Ionization enthalpy and valency

Would you expect the first ionization enthalpies for two isotopes of the same element to be the same or different? Justify your answer.

Solution

Atoms of same element having same atomic number but different mass number are known as isotopes. They have same number of electrons and protons (nuclear charge). Thus, their ionization enthalpies have identical values.

#423067

Topic: Metallic and non-metallic character

What are the major differences between metals and non-metals?

Solution

Metals have strong tendency to lose electrons to form cations. Metals are strong reducing agents with low ionization enthalpies, low negative electron enthalpies and low electronegativities. They form basic oxides and ionic compounds.

Non-metals have strong tendency to accept electrons to form anions. Non-metals are strong oxidizing agents with high ionisation enthalpies, high negative electron gain enthalpies and high electronegativities. They form acidic oxides and covalent compounds.

#423070

Topic: Modern periodic table

Use the periodic table to answer the following questions.

(a) Identify an element with five electrons in the outer subshell.

(b) Identify an element that would tend to lose two electrons.

(c) Identify and element that would tend to gain two electrons.

(d) Identify the group having metal non-metal liquid as well as gas at the room

temperature.

Solution

(a) Chromium (Z=24) contains five electrons in 3d subshell.

(b) Magnesium (Z=12), an alkaline earth metal, can readily lose two electrons to form Mg^{2+}.

(c) Oxygen (Z=8) gains 2 electrons to form O^{2-}.

(d) Halogens (goup 17) contains metal (iodine), non metals (F,Cl and Br), liquid bromine and gases.

#423072

Topic: Periodic properties of elements

The increasing order of reactivity among group 1 element is $Li < Na < Rb < Cs$ whereas that among group 17 element is $F > CI > Br > I$. Explain?

Solution

Group 1 elements contain one electron in the valence shell. They have strong tendency to lose valence electron. The tendency to loose valence electron depends upon the ionization enthalpy. On moving down the group, the ionization enthalpy decreases. Due to this, the reactivity of the group increases in the same order $Li < Na < K < Rb < Cs$.

In the valence shell of group 17 elements, 7 electrons are present. They have strong tendency to accept on more electron. This tendency depends upon the electrode potentials of group 17 elements which decreases from F to I. Their reactivities also decreases in the same order $F > Cl > Br > I$

#423079

Topic: Elements

Write the general outer electronic configuration of s, p, d and f block elements.

Solution

The general outer electronic configuration of s block elements is $ns^{(1-2)}$.

The general outer electronic configuration of p block elements is $ns^2np^{(1-6)}$.

The general outer electronic configuration of d block elements is $(n-1)d^{(1-10)}ns^{(0-2)}$.

The general outer electronic configuration of f– block elements is $(n-2)f^{(0-14)}(n-1)d^{(0-1)}ns^2$.

#423084

Topic: Period and group

Assign the position of the element having outer electronic configuration,

(i) ns^2np^4 for n=3,

(ii) (n-1)d^2ns^2 for n=4, and

(iii) (n-2) f^7(n-1)d^1 ns^2 for n=6 in the periodic table.

Solution

(i) For $n = 3$, the period in which the element belongs is third. The electronic configuration is $3d^2 3d^4$ and the element belongs to p block. The group number of the element is $10+$ number of electrons in the valence shell.

$= 10 + 6 = 16$

Thus, the element belongs to third period and sixteenth group.

(ii) For $n = 4$, the period in which the element belongs is fourth. The electronic configuration is $3d^2 4s^2$ and the element belongs to d block. The group number of the element is $10+$ number of electrons in the $n-2$subshell $+$ number of electrons in ns subshell$= 2 + 2 = 4$

Thus, the element belongs to fourth period and fourth group.

(iii) For $n = 6$, the period in which the element belongs is sixth. The electronic configuration is $4f^7 5d^1 6s^2$ and the element belongs to f block. All f block elements belong to third group.

Thus, the element belongs to sixth period and third group.

#423096

Topic: Ionization enthalpy and valency

The first $(\Delta_i H_1)$ and the second $(\Delta_i H_2)$ ionization enthalpies (in kJ mol^{-1}) and the $(\Delta_{eg} H)$ electron gain enthalpy (in kJ mol^{-1}) of a few elements are given below:

Elements	ΔH_1	ΔH_2	Δ_{eg}H
I	520	7300	-60
II	419	3051	-48
III	1681	3374	-328
IV	1008	1846	-295
V	2372	5251	+48
VI	738	1451	-40

Which of the above elements is likely to be :

(a) the least reactive element,

(b) the most reactive metal,

(c) the most reactive non-metal,

(d) the least reactive non-metal,

(e) the metal which can form a stable binary halide of the formula MX_2 (X=halogen) and

(f) the metal which can form a predominantly stable covalent halide of the formula MX (X=halogen)?

Solution

(a) The element V is the least reactive element as it has highest value of first ionization energy and positive electron gain enthalpy.

(b) The metal II is the most reactive metal. It has very low value of first ionization energy.

(c) The element III is the most reactive non metal. Its electron gain enthalpy is most negative.

(d) The element IV is the least reactive non metal as it has least negative electron gain enthalpy among the non metals.

(e) The metal VI can form a stable binary halide of the formula MX_2 as it has lowest value of second ionization enthalpy.

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#423098

Topic: Ionization enthalpy and valency

Predict the formulas of the stable binary compounds that would be formed by the combination of the following pairs of elements.

(a) Lithium and oxygen

(b) Magnesium and nitrogen

(c) Aluminium and iodine

(d) Silicon and oxygen

(e) Phosphorus and fluorine

(f) Element 71 and fluorine

Solution

(i) Alkali metal lithium (with 1 valence electron) combine with group 16 element oxygen (having valence of 2) to form Li_2O.

(ii) Alkaline earth metal magnesium (with 2 valence electrons) combines with group 5 element nitrogen (having valence 3) to form Mg_3N_2.

(iii) Group 13 element aluminum (with 3 valence electrons) combines with group 17 element iodine (a halogen with valence 1) to form AlI_3.

(iv) Group 14 element silicon (with a valence of 4) combines with group 16 element oxygen (having valence 2) to form SiO_2 .

(v) Group 15 element phosphorous (with valence 3 or 5) combines with group 17 element fluorine (a halogen with valence 1) to form PF_3 or PF_5.

(vi) Element 71 with 3 electrons in the valence shell $(4f^{14}5d^16s^2)$ combines with group 17 element fluorine (a halogen with valence 1) to form EF_3 where E is the symbol of the element.

#423100

Topic: Modern periodic table

In the modern periodic table the period indicates the value of:

1. atomic number

2. atomic mass

3. principal quantum number

4. azimuthal quantum number

Solution

In the modern periodic table the period indicates the value of the principal quantum number. Thus, for the third period, the value of the In the modern periodic table the period indicates the value of the principal quantum number, n is 3 .

#423101

Topic: Modern periodic table

Which of the following statements related to the modern periodic table is incorrect?

(a) The p-block has 6 columns because a maximum of 6 electrons can occupy all the orbitals in a p-shell

(b) The d-block has 8 columns because a maximum of 8 electrons can occupy all the orbitals in a d-subshell

(c) Each block contains a number of columns equal to the number of electrons that can occupy that subshell

(d) The block indicates value of azimuthal quantum number (l) for the last subshell that received electrons in building up the electronic configuration

Solution

The option (b) represents incorrect statement. It states that

"The d-block has 8 columns because a maximum of 8 electrons can occupy all the orbitals in a d-subshell."

The correct statement is

"(b) The d-block has 10 columns because a maximum of 10 electrons can occupy all the orbitals in a d-subshell"

#423109

Topic: Modern periodic table

Anything that influences the valence electrons will affect the chemistry of the element. Nuclear mass effects chemistry of valence electrons.

A True

$\boxed{B}$ False

Solution

Nuclear mass includes the mass of protons and the mass of neutrons. It does not affect the valence shell.

The following factors affect the valence shell.

(a) Valence principle quantum number (n)

(b) Nuclear charge (Z)

(d) Number of core electrons

#423114

Topic: Atomic radius

The size of isoelectronic species F^- , Ne and Na^+ is affected by

(a) nuclear charge (Z)

(b) valence principal quantum number (n)

(c) electron-electron interaction in the outer orbitals

(d) none of the factors because their size are the same

Solution

The size of isoelectronic species - F$^-$, Ne and Na$^+$ is affected by nuclear charge (Z).

Higher is the nuclear charge, higher will be the attraction between the nucleus and the valence electrons and lower will be the ionic size. Thus, the ionic size of Na^+ is lowest and the ionic size of F^- ion is highest.

#423120

Topic: Ionization enthalpy and valency

Which one of the following statements is incorrect in relation to ionization enthalpy?

(a) Ionization enthalpy increases for each successive electron.

(b) The greatest increases in ionization enthalpy is experienced on removal of electron from core noble gas configuration.

(c) End of valence electrons is marked by a big jump in ionization enthalpy.

(d) Removal of electron from orbitals bearing lower n value is easier than from orbital having higher n value.

Solution

The option (d) represents incorrect statement. It states that

"Removal of electron from orbitals bearing lower n value is easier than from orbital having higher n value".

The correct statement is "Removal of electron from orbitals bearing lower n value is difficult than from orbital having higher n value".

The attraction between the nucleus and the electron present in orbital having lower n value is higher than the attraction between the nucleus and the electron present in orbital having higher n value.

#423126

Topic: Electronegativity and oxidation state

Define electronegativity? How does it differ from electron gain enthalpy ?

Solution

Electronegativity is the tendency of an atom to attract the shared pair of electrons towards it in a covalent bond. It is the property of atoms in molecules.

Electron gain enthalpy is the tendency of an isolated atom in its gaseous state to accept an additional electron to form a negative ion. It is the property of isolated atoms.

#423152

Topic: Metallic and non-metallic character

Considering the element B, Al, Mg and K the correct order of their metallic character is :

(a) $B > Al > Mg > K$ (b) $Al > Mg > B > K$

(c) $Mg > Al > K > B$ (d) $K > Mg > Al > B$

Solution

The option (d) $K > Mg > Al > B$represents the correct order of metallic character.

On going from left to right in a period, the metallic character decreases. Thus the order $K > Mg > Al$ On moving down the group, the metallic character decreases.Hence, B is less metallic than Al.

#423161

Topic: Metallic and non-metallic character

Considering the elements B, C, N, F and Si the correct order of their

non-metallic character is:

(a)$B > C > Si > N > F$ (b) $Si > C > B > N > F$

(c) $F > N > C > B > Si$ (d) $F > N > C > Si > B$

Solution

The correct order of non metallic character is $F > N > C > B > Si$

On going from left to right in a period, the non-metallic character increases.

On moving down the group, the non-metallic character increases.

#423167

Topic: Periodic properties of elements

Considering the elements F, Cl, O and N the correct order of their

chemical reactivity in terms of oxidizing property is:

(a) F > Cl > O > N (b) F > O > Cl > N

(c) Cl > F > O > N (d) O > F > N > Cl

Solution

In a period, from left to right, with an increase in the atomic number, the oxidizing character increases due to the presence of vacant d orbitals in their valence shells.

Hence, the decreasing order of oxidizing character is F > O > N.

On moving down the group, the oxidizing character decreases. hence, F > Cl.

But O has higher oxidizing character than Cl thus, O > Cl.

Thus, the correct order of chemical reactivity of F, Cl, O, and N in terms of their oxidizing property is F > O > Cl > N.

#423457

Topic: Ionization enthalpy and valency

Compare the alkali metals and alkaline earth metals with respect to (i) ionisation enthalpy (ii) basicity of oxides and (iii) solubility of hydroxides.

Solution

(i) Ionization enthalpy:

Alkaline earths have higher ionization enthalpy values than alkali metals. This is because the atomic size of alkaline earths is smaller than that of alkali metals.

(ii) Basicity of oxides:

On dissolution in water, the oxides of alkali metals and alkaline earth metals form basic hydroxides. The basicity of alkali metal oxides is higher than that of alkaline earth metal oxides due to lower ionization enthalpy of alkali metals than that of corresponding alkaline earths. Due to this, the M-OH bond in alkali metal hydroxides can more easily ionize.

(iii) Solubility of hydroxides:

Alkaline earths have larger lattice energies than alkali metals due to small size and high charge. Hence, alkaline earth metal hydroxides have lower solubility than alkali metals.

#423529

Topic: Electronegativity and oxidation state

Arrange the following LiH, NaH and CsH in order of increasing ionic character.

Solution

The ionic character of bond depends on electronegativity difference between two atoms. When the electronegativity difference is larger, the ionic character is smaller. On moving down the group of alkali metals, the electronegativity decreases from Li to Cs. Hence the ionic character increases in the order $LiH < NaH < CsH$.

#423534

Topic: Periodic properties of elements

Passage

Arrange the following.

NaH, MgH_2 and H_2O in order of increasing reducing property.

Solution

NaH is an ionic hydride and can easily donate its electrons. It is most reducing. MgH_2 and H_2O are covalent hydrides. H_2O has lower reducing power than MgH_2 as its bond dissociation energy is higher.

Hence, the increasing order of the reducing property is $H_2O < MgH_2 < NaH$.

#464388

Topic: Elements

Give the names of the elements present in the following compounds.

(a) Quick lime

(b) Hydrogen bromide

(c) Baking bromide

(d) Potassium sulphate.

Solution

Compound	Chemical Formula	Elements present
Quick lime	CaO	Calcium, Oxygen
Hydrogen bromide	HBr	Hydrogen, Bromine
Baking powder	$NaHCO_3$	Sodium, Hydrogen, Carbon, Oxygen
Potassium sulphate	K_2SO_4	Potassium, Sulphur, Oxygen

#464775

Topic: Periodic properties of elements

(a) What property do all elements in the same column of the Periodic Table as boron have in common?

(b) What property do all elements in the same column of the Periodic Table as fluorine have in common?

Solution

(a) All the elements in the same column as boron have the same number of valence electrons 3. Hence, they all have valency equal to 3.

(b) All elements belong to same column as fluorine, are non-metals and are highly electronegative in character. All of them have valence electrons equal to seven, and thus can accept one electron to complete their octet.

#464776

Topic: Modern periodic table

An atom has electronic configuration $2, 8, 7$.

(a) What is the atomic number of this element?

(b) To which of the following elements would it be chemically similar?(Atomic numbers are given in parentheses.)?

$N(7) \quad F(9) \quad P(15) \quad Ar(18)$

Solution

(a)The atomic number of element with electronic configuration $2, 8, 7 = 17$.

(b)It has 7 valence electrons, therefore it would be chemically similar to $F(9) = 2, 7$.

#464777

Topic: Periodic properties of elements

The position of three elements A, B and C in the Periodic Table are shown below-

Group 16	Group17
-	-
-	A
-	-
B	C

(a) State whether A is a metal or non-metal.

(b) State whether C is more reactive or less reactive than A.

(c) Will C be larger or smaller in size than B?

(d) Which type of ion, cation or anion, will be formed by element A?

Solution

(a) A belongs to group 17. There are 7 electrons in its valance shell. Therefore it tend to accept one electron to complete octet. Hence, it is a non-metal.

(b) C is less reactive than A. As both elements belong to same group and going down to group size of element increases. A is a smaller than C therefore the cloud of electron density surrounding the nucleus is more compact. The stability of completing the octet for A is greater than for C as A is more keen to obtain an electron than C.

(c) C is smaller than B. C and B belongs to same period. Atomic radius decreases from left to right within a period. This is caused by the increase in the number of protons and electrons across a period. One proton has a greater effect than one electron; thus, electrons are pulled towards the nucleus, resulting in a smaller radius.

(d) A will form anion A^-. A belongs to group 17. There are 7 electrons in its valance shell. Therefore it tend to accept one electron to complete octet and forms anion.

#464778
Topic: Periodic properties of elements

Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to the group 15 of the Periodic Table. Write the electronic configuration of these two elements. Which of these will be more electronegative and Why?

Solution

The electronic configuration of nitrogen $N(7) = 2, 5$

Phosphorous $P(15) = 2, 8, 5$

N is more electronegative than P.

From top to bottom down a group, electronegativity decreases. This is because atomic number increases down a group, and thus there is an increased distance between the valence electrons and nucleus, or a greater atomic radius.

#464779
Topic: Modern periodic table

How does the electronic configuration of an atom relate to its position in the Modern Periodic Table?

Solution

Electronic configuration of an element gives the information of valence electrons and number of shell present in the element. We get the information of group number after knowing valence electrons. Number of shells present in an element is equal to period number. Thus, by knowing electronic configuration we know the group number and period number of an element, and the position of element in periodic table.

#464780
Topic: Periodic properties of elements

In the Modern Periodic Table, calcium (atomic number 20) is surrounded by elements with atomic numbers $12, 19, 21$ and 38. Which of these have physical and chemical properties resembling calcium?

Solution

The electronic configuration of $Ca(20)$ is $= 2, 8, 8, 2$

Number of valance electrons $= 2$

The elements with atomic number 12 and 38 both have 2 valence electrons in their outer shell but elements with 19 has 1 valance electron and 21 has 3 valance electrons.

Therefore elements with atomic number 12 and 38 have physical and chemical properties resembling calcium.

#464781
Topic: Modern periodic table

Compare and contrast the arrangement of elements in Mendeleev's periodic table and the Modern periodic table.

Solution

Mendeleev's periodic table	Modern periodic table
1.Elements were arranged in increasing order of atomic masses.	1.Elements are arranged in increasing order of atomic numbers.
2.There are 8 groups.	2.There are 18 groups.
3.Each group is divided into subgroups a and b.	3.Groups are not divided into subgroups.
4.The group for noble gases was not present, as noble gases were not discovered at that time.	4.A separate group, i.e. group 18 is present for noble gases.
5.There was no place for isotopes.	5.This problem was rectified, as slots are determined on the basis of atomic number.

#464851

Topic: Modern periodic table

Which element has:

(a) two shells, both of which are completely filled with electrons?

(b) the electronic configuration 2,8,2?

(c) a total of three shells, with four electrons in its valence shell?

(d) a total of two shells, with three electrons in its valence shell?

(e) twice as many electrons in its second shell as in its first shell?

Solution

(a) two shells, both of which are completely filled with electrons: Only noble gas elements has completely filled orbitals. $Neon(10) = 2, 8$ has two shells, both of which are completely filled with electrons.

(b) The element with electronic configuration $2, 8, 2$ has atomic number $= 12$. The element is Mg Magnesium.

(c) A total of three shells, with four electrons in its valence shell. The electronic configuration is $= 2, 8, 4$. Atomic number$= 14$. Element is Si Silicon.

(d) A total of two shells, with three electrons in its valence shell. electronic configuration is $= 2, 3$ Atomic number $= 5$. The element is B Boron.

(e) Twice as many electrons in its second shell as in its first shell. The first shell can have maximum 2 electrons. Therefore the electrons in second shell $= 4$. Atomic number is $= 6$. The element is C Carbon.

#464878

Topic: Periodic properties of elements

Which of the following statements is NOT a correct statement about the trends when going from left to right across the period of Periodic Table?

A The elements become less metallic in nature.

B The number of valence electrons increases.

$\boxed{\text{C}}$ The elements can lose their electrons more easily.

D The oxides become more acidic.

Solution

On moving from left to right across the period, the nonmetallic character increases. Hence the tendency to lose electrons decreases. So the given statement is incorrect.

#464879

Topic: Periodic properties of elements

Element X forms a chloride with the formula XCl_2, which is a solid with a high melting point. X would most likely be in the same group of the Periodic Table as:

A Na

$\boxed{\text{B}}$ Mg

C Al

D Si

Solution

Elements of group Na form XCl hailde.

Elements of group Mg form XCl_2 hailde.

Elements of group Al form XCl_3 hailde.

Elements of group Si form XCl_4 hailde.

As element X forms a chloride with the formula XCl_2, which is a solid with a high melting point. X would most likely be in the same group of Mg.