Class - IX

Periodic Properties

Electron Affinity, Electro Negativity, Electron Affinity, Oxidising and Reducing properties

Teaching Task

JEE Main Level

Q1) Ans:- 3.

Solution:- Fluorine atom, due to small size, repels incoming electron. Hence, among fluorine and chlorine, the electron affinity of chlorine is high. In general, the electron affinities of halogen atoms are high.

Q2) Ans:- 3.

Solution:- For IIA group elements, filled 's' subshell discourages the addition of an electron. The electron affinity is almost zero. EA is a positive value for the Mg atom.

Q3) Ans:- 3.

Solution:- Halogen's has higher electron affinity and it is supposed to be for fluorine, but chlorine has higher electron affinity than fluorine due to fluorine's smaller size.

Q4) Ans:- 1

Solutions:- Halogens have high E.A. Hence if an element belongs to group VII A of periodic table its E.A will be high.

Q5) Ans:- 1

Solution:- The electron affinity of an atom is numerically equal to the ionization potential of uninegative ion.

$X^- - e^- \rightarrow X$ ⇒ Ionization potential of atoms uninegative ion

$X + e^- \longrightarrow X^-$ ⇒ Electron affinity of the atom.

Q6) Ans:- 3.

Solution:- Cesium is the most electropositive element in the entire periodic table. The configuration $[Xe]6s^1$ corresponds to that of cesium.

Q7) Ans:- 4.

Solution:- Electronegativity is a property of bonded atoms in a molecule. It is the tendency of an atom in a molecule to attract a shared pair of electron towards itself.

Q8) Ans:- 1

Solution:- Electronegativity is the measure of the capacity of an atom to attract electrons.

Q9) Ans:- 1.

Solution:- In moving down to the halogen group E.N decreases hence Iodine has lowest electronegati-vity.

Q10) Ans:- 1

Solution:- In a group, from top to bottom nuclear charge decreases, so E.N value also decreases. Phosphorous has the maximum electronegative character.

Q11) Ans:- 2, 3.

Solution:- The formation of the oxide ion $O^{-2}(g)$ required first an exothermic & then an exothermic steps as shown below.

$O + e^- \longrightarrow O^-_{(g)}$ +142 KJ/mole, This is because oxygen has high electron affinity.

$O^- + e^- \longrightarrow O^{-2}_{(g)}$ - 844 KJ/mole, This is because anion formed resists addition of another electron.

JEE Advanced level Questions

Q11) Ans:- 1, 2, 4.

Solution:-

→ Greater is the nuclear charge, greater is the electron gain enthalpy.

→ Nitrogen has zero electron gain enthalpy, it has stable half filled Configuration. → Cl has high electron gain enthalpy.

→ From top to bottom Cl to I electron gain enthalpy increases

Q12) Ans:- A.

Solution:- Fluorine has lower electron gain enthalpy than chlorine due to Fluorine small size.
So statement-I is correct statement-II incorrect.

Matrix Matching

Q13) Ans:- a) 5. b) 4. c) 1 d) 3.

Solution:-

a) Highest electronegative value → 5) F.

b) Least electronegative element → 4) Cs.

c) Electronegativity α → 1) Effective nuclear charge.

d) Electronegativity $\frac{1}{\alpha}$ → 3) Size of the atom.

Q14) Ans:- 2.

Solution:- The tendency of an atom of an element to attract the shared pair of electrons in a covalent bond towards its own direction is called Electronegativity.

Q15) Ans:- 1.

Solution:- In periodic table from group I to group VII electronegativity decreases due to increase in atomic size.

Q16) Ans:- 2.

Solution:- C, N, O, F are belongs to 2nd period, the electronegativity increases from left to right due to increase in nuclear charge.

Learner's Task

Conceptual Understanding Questions

Q1) Ans:- 1

Solution:- From left to right of period, Electron affinity increases.

F > O > N.

In group electron affinity decreases due to decrease in nuclear charge

F > I

Q2) Ans:- 1

Solution:- Electron affinity is the energy released per mole of gaseous atom in order to form an anion.

Hence, its unit is energy/mol or J/mol or cal/mol or kcal/mol.

Q3) Ans:- 4.

Solution:-

→ Small atomic size, the EA increases.

→ If the screening effect increases, EA increases due to increase in inner electron repulsions.

→ EA increases with increase in Nuclear charge

Q4) Ans:- 1

Solution:- He → $1s^2$. He is a noble gas, it will have low electron affinity value almost equal to zero.

Q5) Ans:- 3.

Solution:- Electronegativity = $\frac{I \cdot E + E \cdot A}{2}$

Q6) Ans:- 1

Solution:- Hydrogen is the reference element in pauling scale of electronegativity, with EN value 2.20.

Q7) Ans:- 3.

Solution:- If the E.N difference > 1.7 then it is ionic.

→ E.N < 1.7, the nature of compound is covalent.

→ If Electronegative difference = 1.7 then nature of bond will be 50% ionic and 50% covalent.

Q8) Ans:- 2

Solution:- As halogens need one electron to get octet. From left to right of period EN increases. So VII A group elements have more electronegativity.

Q9) Ans:- 3.

Solution:- From left to right of period, E.N value increases.

EN of H → 2.2.

E.N of F > N.

From top to bottom, E.N value decreases.

F > Cl.

Q10) Ans:- 3.

Solution:- Oxidation is the process of loss of electrons. Reduction is the process of gain of electrons. Atom becomes ion by loss or gain of electrons. Thus, atom becomes ion either by oxidation or reduction.

JEE Main Level

Q1) Ans:- 3.

Solution:- 2, 8, 8, 1 → $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ → K

Metals have tendency to lose electron. K is electropositive in nature because in its outermost shell consists of 1 electron.

Q2) Ans:- 2

Solution:- C, N, O, F are 2nd period elements, in periods E.N values increases from left to right due to higher nuclear charge.

F > O > N > C.

Q3). Ans:- 4.

Solution:- The one in which the E.N difference is maximum will have the highest polarity.

1) O - H.
$\Delta EN = 3.5 - 2.1 = 1.4$

2) N - H.
$3 - 2.1 = 0.9$

3) H - Cl
$3.0 - 2.1 = 0.9$.

4) H - F.
$4 - 2.1 = 1.9$.

Fluorine have E.N 4, So the difference is very high with H. So H-F is highly polar.

Q4). Ans:- 1

Solution:- E.N is the tendency to attract shared pair of electron which are in bond towards itself

Q5) Ans:- 1

Solution:- On moving from left to right EN increases → O < F. S < Cl
From top to bottom EN decreases → O > S, F > Cl
So F > O > Cl > S

Q6) Ans:- 2

Solution:- Pauling's values of E.N are depends upon bond energies.

$$X_A - X_B = 0.208\sqrt{\Delta_{(A-B)}}$$

where, X_A & X_B are E.N of A & B.

$\Delta_{(A-B)}$ = Difference of bond energies.

Q7) Ans:- 1

Solution:- In periods the E.N values gradually increases from alkali metals to halogens because from left to right nuclear charge increases, then tendency attract electrons also increases.

Q8) Ans:- 3.

Solution:- F, Cl, Br & I are belongs VII A group elements. In periods from top to bottom, E.N values decreases due to higher atomic size which leads to decrease in nuclear charge.

Q9) Ans:- 2

Solution:- As sulphur needs only 2 electrons to get octet configuration, it is more electronegative than other atoms, as others are more electropositive metals and non-metals.

Q10) Ans:- 3.

Solution:- Oxidising power of an element depends on the ability to accept electrons on the hydration energy.

→ Hydration enthalpy is the heat released at constant temperature and pressure towards the water.

→ It depends on the charge to radius ratio, F due to its small size has high hydration enthalpy.

→ F has greater positive electrode potential, so has greater oxidizing power.

JEE Advanced Level Questions

Q1) Ans:- 1, 2, 3.

Solution:- Electron affinity depends on

→ Atomic size increases electron affinity decreases due to decrease in nuclear charge.

→ Nuclear charge increases electron affinity also increases because if charge increases it is difficult to add extra electron.

→ Electronic configuration is stable it is difficult to add electron, so electron affinity is low.

Q2) Ans:- 1, 2, 3, 4.

→ Nuclear charge increases E.N value increases.

→ More screening effect, the repulsive forces blw inner electrons increasing. Therefore possibility of entry of electron will be less. Therefore EN decreases.

→ Atomic size increases EN decreases.

→ Higher oxidation state is more electronegative.

Q3) Ans:- 1, 2, 3.

Solution:- In groups E.N values decreases from top to bottom because of increasing in atomic size which leads to decrease in nuclear charge.

Cs < Li , Ba < Be , Sn < C.

Q4) Ans:- 1, 2, 3.

Solution:- Pauling's , Allred & Rochow, Mulliken's scales are used to express electronegativity.

Q5) Ans:- D.

Solution:- Electron affinity is the amount of energy released when an electron is added to a gaseous atom.

→ I.E is amount of energy required to remove electron.

→ So EA & I.E are not equal.

→ But EA equals to I.E of its uninegative ion.

→ Halogens have the highest electron affinity.

So statement-I is incorrect but II is correct.

Q6) Ans:- C.

Solution:-

→ An atom in higher oxidation state is more electronegative.

→ Atom having less effective nuclear charge is less electronegative.

Statement-I correct, Statement-II incorrect.

Q7) Ans:- a) 3 b) 4 c) 2 d) 1

Solution:-

a) Chlorine → 3) High electron affinity.

b) Fluorine → 4) Strong oxidizing agent.

c) Argon → 2) Zero electron affinity

d) Cesium → 1) Strong reducing agent.

Q8) Ans:- 2

Solution:- Pauling's electronegativity scale based on bond energies.

Q9) Ans:- 2

Solution:- An electronegative element has a tendency to accept electrons not to lose an electron. So they will be having high ionisation potential.

Q10) Ans:- 4.

Solution:- EN values are increases from left to right of period. So Al<Si<P<S.

'S' having more electronegativity.