Electron Affinity Chemistry Questions with Solutions

Q-1: The process requires absorption of energy is

a) $F \rightarrow F^-$
b) $Cl \rightarrow Cl^-$
c) $O^- \rightarrow O^{2-}$
d) $H \rightarrow H^-$

Answer: c) $O^- \rightarrow O^{2-}$

Explanation: Addition of an electron to an isolated gaseous atom always releases energy,but adding electrons to an anion requires energy due to interelectronic repulsions.

Hence, $O^- \rightarrow O^{2-}$ is an endothermic reaction(requires energy).

Q-2: Which of the following elements will possess the highest electron affinity?

a) As
b) O
c) S
d) Se

Answer: c) S
Explanation:

In general, when the atomic number increases over time, electron affinity becomes more negative. Over time, the effective nuclear charge increases from left to right, making it easier to add an electron to a smaller atom because the additional electron will be closer to the positively charged nucleus on average. We should expect electron affinity to become less negative as we travel down a group because the size of the atom rises and the new electron is farther from the nucleus, This is often the case.

The electron affinity of O, on the other hand, is less negative than that of the following element. This is due to the fact that when an electron is added to O,the new electron is repelled by the other electrons in the n = 2 quantum level, which is smaller. The extra electron occupies a bigger patch of space in the n = 3 quantum level (S or Cl), and the electron-electron repulsion is significantly weaker.

Q-3: Electron affinity vary in

a) Inverse proportion to the effective nuclear charge
b) Direct proportion to the effective nuclear charge

c) Inverse proportion to the square of the effective nuclear charge
d) Direct proportion to the square of the effective nuclear charge

Answer: b) Direct proportion to the effective nuclear charge

The charge on the nucleus(z_{eff}) increases as the number of protons increases as a result the addition of electrons to the valence shell of an atom becomes easy with release of more energy. This shows that electron gain enthalpy rises with increasing nuclear charge.

Q-4: Electronegativity(EN) of an element X is E_1 and ionisation potential(IP) is E_2. Hence EA will be

a) E_2
b) $2E_1$-E_2
c) E_1-E_2/2
d) E_1+E_2/2

Answer: b) $2E_1$-E_2

Explanation: Electronegativity(EN) is the tendency of an atom in a bonded system to attract the electron pairs towards itself.

We measure electronegativity on several scales such as Pauling scale , Mulliken -Jaffe scale and Allred-Rochow scale.

On the mulliken scale, electronegativity of an atom is the average sum of I.P and E.A of an atom.

EN= (IP+EA)/2
E_1= (E_2 + EA)/2

This implies, EA= $2E_1$-E_2

Q-5: Which of the following electron gain enthalpies is the most negative and which is the least negative? P, S, Cl, and F. Explain your response.

Answer: As we proceed from left to right, the electron gain enthalpy generally becomes more negative. The electron gain enthalpy decreases as one moves along a group. Adding an electron to the smaller 2p-orbital, on the other hand, causes more repulsion than adding an electron to the bigger 3p-orbital. As a result, chlorine has the highest negative electron gain enthalpy, while phosphorus has the lowest negative electron gain enthalpy.

Q-6: Which condition is not favourable for the formation of ionic compound A^+B^-?

a) Electron gain enthalpy of B is high

b) Ionisation energy of A is low
c) Lattice energy of AB is high
d) Lattice energy of AB is low

Answer: d) Lattice energy of AB is low

Explanation: One atom must lose one or more electrons to produce a cation during the creation of an ionic bond. In general, elements with low ionisation energy have a better likelihood of forming a cation, which means they are more likely to create ionic bonds.
The other atom involved in the production of an ionic compound must gain an electron to become an anion (s). The production of an anion is favoured by higher electron affinity.
The value of the lattice energy of an ionic compound corresponds to the strength of the ionic bonding. More the lattice energy, the more is the strength of the ionic bond.

Q-7: How does the tendency to gain electrons alter as we move down the periodic table? Why is it changing in this manner?

Answer: Due to the addition of a shell at each step, the potential to gain electrons reduces.As the size of the atom grows larger, the nucleus has a harder time attracting the incoming electron.

Q-8: What is a period in the periodic table? In which part of a period would you expect the elements to have (i) the greatest non-metallic character (ii) the largest electron gain enthalpy ?
Answer:
Periods are referred to as the horizontal rows in the periodic table.

i) The ability of an atom to accept electrons determines its nonmetallic character. We know that elements on the right of the periodic table have a higher tendency to gain electrons, therefore non-metallic character will be more prevalent.

ii) Electron gain enthalpy will be more towards the right side of the periodic table.

Q-9: Name the element with the characteristic stated below for each of the following triads:

Element	Least Electronegativity	Chemically more reactive
a) F,Cl,Br **b) Be,Mg,Ca**	_____ _____	_____ _____

Answer:

a) In case of non metals, chemical reactivity is defined in terms of the potential of an element to gain electrons. It decreases as one moves down the group. Among F,Cl and Br, F is more reactive and Br is least electronegative.

b) The chemical reactivity of metals is their tendency to lose electrons. Ca is more reactive and is also less electronegative.

Q-10: Which of the following is incorrect?

a) Elements with high electronegativity always have high electron affinity.
b) Electron affinity is the property of an isolated atom.
c) Electronegativity is the property of bonded atoms.
d) Both electronegativity and electron affinity are usually directly related to nuclear charge.

Answer: a) Elements with high electronegativity always have high electron affinity.
Explanation:

When an atom is free from other atoms in gaseous state, it is called an isolated gaseous atom. No energy is required to separate it further from other atoms. As per the definition of electron affinity, it is the amount of energy released when an electron is added to an isolated gaseous atom.

The potential to attract electrons of bonded atoms is electronegativity which usually increases with increase in atomic number or we can say effective nuclear charge.

High electronegativity elements normally have high electron affinity, but this is not always the case. Nitrogen, for example, has one of the greatest electronegativity values. However, considering its electron affinity, we must provide energy to add the electron because nitrogen has a half-filled structure that is stable.

Q-11: (a) What's the main difference between the electronic configurations of group 15 and group 16 elements?
(b) On the basis of electronic configuration, compare the chemical reactivity of the elements.

Answer:

a) Group 15 elements have the valence shell electron configuration of type ns^2np^3 and on the other hand group 16 elements have the electron configuration as ns^2np^4.
b) We can clearly see that group 16 elements require just 2 electrons to completely fill their p subshell, thus will be more reactive than group 15 which have half filled stable configuration.

Note: The elements that have half filled or fully filled configuration, do not easily lose or gain electrons.

Q-12: Consider order $O^{2-} < F^{-} < Na^{+} < Mg^{2+}$

The incorrect statement is

a) Increasing order of z_{eff}
b) Increasing order of size
c) Increasing order of IE
d) Increasing order of EA

Answer: b) Increasing order of size

Explanation: Ionic radius is the distance between an ion's nucleus and the electron cloud where it exerts effect. Anions have more ionic size as compared to cations and neutral atoms.

More is the negative charge, more is the ionic size

More is the positive charge , less is the ionic size.

The correct order would be

$O^{2-} > F^{-} > Na^{+} > Mg^{2+}$

Q-13: Second and successive electron affinity of an atom

a) Is always positive
b) Is always negative
c) Can be positive or negative
d) Is always zero

Answer: a) is always positive.

Explanation: Successive electron affinity refers to the successive addition of electrons to the already negatively charged species.

If we try to add another electron after the first one, the incoming electron will be repelled by the electrons in the valence shells. As a result, we must offer some energy. As a result, an element's second electron affinity is endothermic. (takes in energy)

Q-14: Why do noble gases have a positive value of electron affinity?

Answer: Noble gases have orbitals that are totally filled and cannot accept any additional electrons. The electron affinities are typically positive as a result of this.

Q-15: Who was the first to discover electron affinity?

Answer: Electron Affinity was discovered in 1901 as a result of Linus Carl Pauling's discovery of electron negativity.

Practise Questions on Electron Affinity

Q-1: Correct order of electron affinities is

a) Cl>Na>Si>Ar
b) Cl>Si>Na>Ar
c) Si>Cl>Ar>Na
d) Ar>Si>Cl>Na

Answer: b) Cl>Si>Na>Ar

Explanation:

Within the same period, the tendency to acquire electrons increases.

Noble gas(Ar) has least electron affinity even less than alkali metal(Na) due to the stable valence shell electronic configuration.

Q-2: Ionisation energy of element X(g) is I and electron affinity of $X^+(g)$ is E, then

a) I=E
b) I=-E
c) I=E/2
d) I=-E/2

Answer: a) I=E

Explanation:

$X \rightarrow X^+ + e^-$ $\Delta_i H = I$

$X^+ + e^- \rightarrow X$ $\Delta_{eg} H = E$

It clearly shows I=E.

Q-3: Which of the following is incorrect?

a) For $A(g) + e^- \rightarrow A^-(g)$ ΔH may be negative
b) $A^-(g) + e^- \rightarrow A^{2-}(g)$ ΔH may be negative
c) $A^-(g) + e^- \rightarrow A^{2-}(g)$ ΔH must be positive
d) $A^{3+}(g) + e^- \rightarrow A^{2+}(g)$ ΔH must be negative

Answer: b) $A^-(g) + e^- \rightarrow A^{2-}(g)$ ΔH may be negative

Explanation:

Addition of electrons(reduction) is accompanied by the release of energy(exothermic). However, adding electrons to already negatively charged species requires energy(endothermic).

Note: For exothermic reactions, $\Delta H<0$

For endothermic reactions,$\Delta H>0$

Q-4: Explain the periodic trend of electron affinity in the modern periodic table.

Answer: Electron affinity is the amount of energy released when an electron is added to a neutral atom to form an anion..Over time, electron affinity rises from left to right. The rise in nuclear attraction causes the general trend over time.

As the group progresses, the electron affinity should decrease as the electron is added further away from the atom. Less firmly bonded and thus closer to a free electron in energy.

Q-5: How electron affinity is related to the oxidising power of an element?

Answer: Oxidising power means to cause oxidation of other species but itself undergoing reduction(gain of electrons.)

Thus, more is the electron affinity more is the oxidising power.