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10. PERIODIC PROPERTIES - (E.A, E.N, Ox. & Red. PROPERTIES)

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. Electronegativity is the tendency of an atom to:

A) Attract electrons **B) Attract protons**

C) Repel electrons **D) Repel protons**

Answer:A

Solution:Electronegativity measures an atom's ability to attract shared electrons in a bond

2. Electronegativity is a property observed in:

A) Isolated gaseous atoms **B) Isolated solid atoms**

C) Bonded atoms in a molecule **D) Inert gas elements**

Answer:C

Solution:Electronegativity is relevant only in chemical bonds, not isolated atoms

3. Which of the following elements has the lowest electronegativity?

A) Fluorine **B) Chlorine** **C) Bromine** **D) Iodine**

Answer:D

Solution:Electronegativity decreases down Group 17: F > Cl > Br > I

4. Based on periodic trends, the element with highest electronegative character is:

A) Phosphorus **B) Arsenic** **C) Antimony** **D) Bismuth**

Answer:A

Solution:

In Group 15, electronegativity decreases as you move down: P > As > Sb > Bi.

5. Which electronic configuration corresponds to the most electropositive character?

A) $[He]2s^1$ **B) $[He]2s^2$** **C) $[Xe]6s^1$** **D) $[Xe]6s^2$**

Answer:C

Solution:Cs ($[Xe]6s^1$) is the most electropositive due to its large size and single valence electron.

6. Which of the following elements is likely to have a first electron affinity close to zero or positive?

A) Sulfur **B) Oxygen** **C) Magnesium** **D) Chlorine**

Answer:C

Solution:Mg has near-zero/positive EA because adding an electron to its filled 3s subshell is energetically unfavorable

7. The highest electron affinity is observed in:

A) Fluorine B) Nitrogen C) Chlorine D) Oxygen

Answer:C

Solution:Cl has higher EA than F due to optimal balance of nuclear charge and electron repulsion in its 3p subshell

8. Which of the following explains why chlorine has a higher electron affinity than fluorine?

A) High electronegativity of fluorine

B) Low bond dissociation energy of fluorine

C) Fluorine repels the added electron due to its small size

D) Chlorine has a smaller atomic radius

Answer:C

Solution:F's compact 2p subshell causes electron-electron repulsion, reducing its EA slightly below Cl's.

9. The energy released when an electron is added to a neutral atom is highest when the element is in:

A) Group VIIA B) Group VA C) Group VIA D) Group IIA

Answer:A

Solution:Halogens (Group 17) release the most energy when gaining an electron to achieve a stable octet.

10. Electron affinity of an atom is approximately equal in magnitude to the:

A) Ionization potential of its uninegative ion

B) Effective nuclear charge of its unipositive ion

C) Ionization potential of its dinegative ion

D) Ionization potential of its unipositive ion

Answer:A

Solution:EA ˜ Energy required to remove an electron from A^- (i.e., IE of A^-).
Example: EA(Cl) ˜ IE(Cl^-)

11. The formation of the oxide ion O^{2-} involves an exothermic step followed by an endothermic one because:

A) The O^- ion is larger than O

B) Oxygen has high electron affinity

C) O^- resists gaining another electron

D) Oxygen is highly electronegative

Answer:C

Solution:Forming O^{2-} from O^- is endothermic because the second electron addition is opposed by repulsion in the already negative ion

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

12. Which one of the following statements are correct ?

A) Greater is the nuclear charge, greater is the electron gain enthalpy.

B) Nitrogen has zero electron gain enthalpy.

C) Electron gain enthalpy decreases from chlorine to iodine in the group.

D) Chlorine has highest electron gain enthalpy.

Answer:B,C,D

Solution:

B)Correct

Nitrogen's electron gain enthalpy is nearly zero because adding an electron to its half-filled 2p subshell ($1s^2\ 2s^2\ 2p^3$) is energetically unfavorable due to increased repulsion.

C)Correct

In Group 17 (halogens), electron gain enthalpy becomes less negative down the group (Cl > Br > I) because larger atomic size reduces nuclear attraction for the added electron.

D)Correct

Chlorine (Cl) has the most negative electron gain enthalpy in its group due to its optimal balance of nuclear charge and atomic size (smaller than Br/I but less repulsive than F).

A)Incorrect

While nuclear charge matters, electron gain enthalpy also depends on atomic size and electron repulsion. For example, F (high Z) has lower affinity than Cl due to repulsion in its compact 2p subshell.

Statement Type:

A) Statement-I, Statement-II both are true and Statement-II is the correct explanation of Statement-I.

B) Statement-I, Statement-II both are true but Statement-II is not the correct explanation of Statement-I.

C) Statement-I is true, Statement-II is false.

D) Statement-I is false, Statement-II is true.

13. Statement I : The lower electron gain enthalpy of fluorine than that of chlorine.

Statement I :Chlorine is smaller in size than fluorine.

Answer:C

Solution:The actual reason for fluorine's lower electron gain enthalpy is its small atomic size (not chlorine's size), which causes greater repulsion for the added electron compared to chlorine.

Chlorine has a more favorable (more negative) electron gain enthalpy because its larger 3p subshell can accommodate the extra electron with less repulsion, despite being farther from the nucleus.

Matrix Matching Type:

14.

Column-I	**Column-II**
a) Highest electronegativity value	**1) Effective nuclear charge**
b) Least electronegative element	**2) S - character in hybrid orbital**
c) Electronegativity α	**3) Size of the atom**
d) Electronegativity $\frac{1}{\alpha}$	**4) Cs**
	5) F

Answer:a-5,b-4,c-3,d-3

Solution:

a) Highest electronegativity 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

Comprehension Type:

On moving from left to right in a period electronegativity values increases because atomic size decreases and effective nuclear charge increases.On moving down in a group, electronegativity desreases because atomic size increases.

15. Electronegativity is a measure of the capacity of an atom to:

A) Repel electrons

B) Attaract shared pair of electron

C) Share electrons with another atom

D) Combine with protons.

Answer:B

Solution:Electronegativity quantifies an atom's ability to pull shared electrons (in a covalent bond) toward itself.

16. In periodic table from I group to VII group electronegativity of elements:

A) Decreases **B) Increases**

C) Remains constant **D) All of these**

Answer:B

Solution:Electronegativity increases left to right across a period (Group I $\rightarrow$ Group VII) due to:

Decreasing atomic size.

Increasing effective nuclear charge.

17. In the series carbon, nitrogen , oxygen and fluorine the electronegativity :

A) Decreases from carbon to fluorine.

B) Increases from carbon to fluorine.

C) Remains constant.

D) Decreases from carbon to oxygen and then increases.

Answer:B
Solution:Trend: C (2.5) < N (3.0) < O (3.5) < F (4.0) on the Pauling scale.
Reason: Increasing effective nuclear charge and decreasing atomic size across the period.

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ'S)

1. An atom can become an ion by:
A) Oxidation **B) Reduction**
C) Either oxidation or reduction **D) Neither oxidation nor reduction**
Answer:C
Solution:Atoms become ions by losing electrons (oxidation) or gaining electrons (reduction).

2. The units of electron affinity are:
A) kcal/mol **B) erg·sec** **C) Ångström (Å)** **D) No units**
Answer:A
Solution:Electron affinity is typically measured in energy units like kcal/mol or kJ/mol

3. Which of the following elements has the highest electron affinity?
A) Fluorine **B) Oxygen** **C) Iodine** **D) Nitrogen**
Answer:A
Solution:Fluorine has the highest electron affinity among the given options due to its small size and high nuclear charge.

4. Which element has the highest electronegativity?
A) Nitrogen **B) Hydrogen** **C) Chlorine** **D) Fluorine**
Answer:D
Solution:Fluorine is the most electronegative element on the Pauling scale (4.0)

5. Elements with relatively high electronegativities belong to:
A) Alkali metals **B) Alkaline earth metals**
C) Halogens **D) All the above**
Answer:C
Solution:Halogens (e.g., F, Cl) have high electronegativities compared to alkali/alkaline earth metals.

6. The reference element in Pauling's scale of electronegativity is:
A) Hydrogen **B) Oxygen** **C) Nitrogen** **D) Chlorine**
Answer:A
Solution:Pauling's scale originally used hydrogen (assigned 2.2) as a reference for electronegativity

7. The electronegativity difference between bonded atoms is 1.7. The bond formed is:

A) >50% Ionic **B) <50% Ionic**

C) 50% Ionic and 50% Covalent **D) 100% Ionic**

Answer:A

Solution:An electronegativity difference =1.7 typically indicates a bond with >50% ionic character.

8. The magnitude of electron affinity depends on:

A) Atomic size **B) Nuclear charge**

C) Shielding effect **D) All of the above**

Answer:D

Solution:Electron affinity depends on atomic size, nuclear charge, and shielding effects.

9. Among the following, which electronic configuration is expected to have the lowest electron affinity?

A) $1s^2$ **B) $1s^2\ 2s^2$**

C) $1s^2\ 2s^2\ 2p^4$ **D) $1s^2\ 2s^2\ 2p^5$**

Answer:A

Solution: Helium-like configuration $\rightarrow$ full shell $\rightarrow$ very low (almost zero) electron affinity.

10. For univalent elements, the average of first ionization energy and first electron affinity is a measure of:

A) Polarizing power **B) Dipole moment**

C) Covalent radius **D) Electronegativity**

Answer:D

Solution:For univalent elements, the average of IE_1 and EA_1 approximates electronegativity (Mulliken scale)

JEE MAINS LEVEL QUESTIONS

11. Electronegativity is a measure of the ability of an atom to:

A) Attract electrons **B) Attract protons**

C) Repel electrons **D) Repel protons**

Answer:A

Solution:Electronegativity measures an atom's ability to attract shared electrons in a bond.

12. Which of the following elements has the most metallic electron arrangement?

A) 2, 8, 4 **B) 2, 8, 8** **C) 2, 8, 8, 1** **D) 2, 8, 8, 7**

Answer:C

Solution:This is the configuration of an alkali metal (e.g., K), which has the most

metallic character due to its single valence electron.

13. In a period from alkali metals to halogens, the electronegativity generally:

A) Increases

B) Decreases

C) Increases except in IIA and VIA elements

D) Decreases except in IIA and VIA elements

Answer:A

Solution:Electronegativity increases left to right across a period, peaking at halogens

14. Going from fluorine to iodine in Group 17, the electronegativity:

A) Increases **B) Decreases**

C) Increases then decreases **D) Changes randomly**

Answer:B

Solution:Electronegativity decreases down Group 17: F > Cl > Br > I due to increasing atomic size.

15. Which of the following sets is correctly arranged in decreasing electronegativity?

A) F > O > Cl > S **B) F < O < Cl < S**

C) O > F > Cl > S **D) Cl > F > O > S**

Answer:A

Solution:Correct order: F (4.0) > O (3.5) > Cl (3.0) > S (2.5)

16. Which element is expected to have the highest electronegativity?

A) Mg (Z=12) **B) S (Z=16)** **C) B (Z=5)** **D) Te (Z=52)**

Answer:B

Solution:Among the options, sulfur (S) has the highest electronegativity (2.5). Fluorine (not listed) is the overall highest

17. Which bond among the following is the most polar?

A) O–H **B) N–H** **C) H–Cl** **D) H–F**

Answer:D

Solution:H–F is the most polar bond due to the largest electronegativity difference (ΔEN = 1.9).

18. Which of the following shows the correct trend in electronegativity values?

A) F > N > O > C **B) F > O > N > C**

C) F < N < O < C **D) F > N > O < C**

Answer:B

Solution:Correct Pauling values: F (4.0) > O (3.5) > N (3.0) > C (2.5).

19. Pauling's electronegativity scale is primarily based on:

A) Ionization energy **B) Bond energy**

C) Electron affinity **D) Atomic radius**

Answer:B

Solution:Pauling's scale is based on bond dissociation energies of A–B vs. A–A/B–B bonds.

20. Which factor is most important in making fluorine the strongest oxidizing halogen?

A) Bond dissociation energy **B) Ionization enthalpy**

C) Hydration enthalpy **D) Electron affinity**

Answer:C

Solution:

Hydration enthalpy is the energy change when one mole of gaseous ions dissolves in water to form infinitely dilute solutions. Fluorine, being the smallest halogen, has the highest hydration enthalpy because its small size allows for strong electrostatic interactions with water molecules, releasing a large amount of energy. This large release of energy makes it easier for fluorine to pull electrons away from other substances, thus making it a strong oxidizing agent.

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

21. On which of the following factors, electron affinity depends?

A) Atomic size **B) Nuclear charge**

C) Electronic configuration **D) None**

Answer:A,B,C

Solution:Atomic size: Smaller atoms (e.g., F) have higher electron affinity due to stronger nuclear attraction.

Nuclear charge: Higher charge increases electron affinity (e.g., Cl > S).

Electronic configuration: Stable configurations (e.g., half-filled/full-filled orbitals) may reduce affinity (e.g., N has lower EA than O).

22. Which one of the following factors affects the electronegativity?

A) Effective nuclear charge **B) Screening effect**

C) Size of the atom **D) Oxidation state**

Answer:A,B,C,D

Solution:Effective nuclear charge (Z_{eff}): Higher Z_{eff} increases electronegativity (e.g., F > Li).

Screening effect: More shielding reduces electronegativity (e.g., Cs < K).

Atomic size: Smaller atoms are more electronegative (e.g., O > Te).

Oxidation state: Higher oxidation states increase electronegativity (e.g., $Fe^{3+} > Fe^{2+}$).

23. Which of the following is/are correct order of increasing electronegativity in group?

A) Cs < Li **B) Ba < Be**

C) Sn < C **D) None of the above**

Answer:A,B,C

Solution:

A) Cs < Li (Group 1: Electronegativity decreases down the group.)

B) Ba < Be (Group 2: Same trend as Group 1.)

C) Sn < C (Group 14: C (2.55) > Sn (1.96).

24. Which of the following scales are used to express electronegativity ?

A) Pauling's scale **B) Allred and Rochow scale**

C) Mulliken's scale **D) None**

Answer:A,B,C

Solution:

A) Pauling's scale (Most common, based on bond energies.)

B) Allred and Rochow scale (Uses Z_{eff} and covalent radius.)

C) Mulliken's scale (Average of ionization energy and electron affinity.)

Statement Type:

A) Statement-I, Statement-II both are true and Statement-II is the correct explanation of Statement-I.

B) Statement-I, Statement-II both are true but Statement-II is not the correct explanation of Statement-I.

C) Statement-I is true, Statement-II is false.

D) Statement-I is false, Statement-II is true.

25. Statement I : Electron affinity is numerically equal to ionization energy but opposite to each other.

Statement II : Halogens have the highest electron affinity in their respective periods.

Answer:B

Solution:

Ionization energy and electron affinity are related but opposite processes.

- Ionization energy involves the removal of an electron (energy is absorbed), while electron affinity involves the addition of an electron (energy is released).

Halogens (Group 17) have the highest EA in their periods due to their strong attraction for an extra electron to achieve a stable octet.

26. Statement I : An atom in higher oxidation state is more electronegative.

Statement I : Atom having less effective nuclear charge is more electronegative.

Answer:C

Solution:Statement I is true: Higher oxidation states (e.g., Fe^{3+} vs. Fe^{2+}) increase electronegativity because the atom attracts electrons more strongly to compensate for the positive charge.
Statement II is false: Electronegativity increases with higher effective nuclear charge (e.g., F > Li), not lower.

Matrix Matching Type:

27.

Column-I		**Column-II**
Element		**Electronegativity on pauling scale**
a)	**Chlorine**	**1) Strong Reducing Agent**
b)	**Fluorine**	**2) Zero Electron Affinity**
c)	**Argon**	**3) High Electron Affinity**
d)	**Cesium**	**4) Strong Oxidizing Agent**

Answer: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

Comprehension Type:

According to Mulliken, electronegativity of an atom is average of I.E. and E.A.

$$\chi_M = \frac{I.E + E.A.}{2}$$

I.E. and E.A. are ionization energy and electron affinity in electron volts. Mulliken values are $\approx$ 2.8 times greater than pauling values.Pauling based his scale on thermochemical data. He concluded that the bond formed between the two atoms A and B must be stronger than the average of single bond energies A —— A and B —— B molecules. According to him the electronegativity difference between two atoms A and B ($\chi_A \sim \chi_B$) is given by:

$$\chi_A \sim \chi_B = 0.208\sqrt{\Delta}$$

28. Pauling's electronegativity scale is based on experimental value of:

A) Atomic radii **B) Bond energies**
C) Bond lengths **D) Electron affinity**

Answer:B

Solution:Pauling's scale is derived from bond dissociation energies of A–B bonds compared to A–A and B–B bonds. The electronegativity difference is calculated using:

$$\chi_A \sim \chi_B = 0.208\sqrt{\Delta}$$

where Δ is the difference in bond energies.

29. An atom with high electronegativity generally has:

A) Tendency to form +ve ions **B) High ionisation potential**

C) Large atomic size **D) Low electron affinity.**

Answer:B

Solution:High electronegativity correlates with high ionization energy (harder to remove electrons) and high electron affinity (stronger attraction for electrons).

30. The element among the following having maximum electronegativity is

A) A*l* **B) P** **C) Si** **D) S**

Answer:D

Solution:Pauling electronegativity values:

Al (1.61) < Si (1.90) < P (2.19) < S (2.58).

KEY

				TEACHING TASK					
				JEE MAINS& ADVANCED LEVEL QUESTIONS					
1	2	3	4	5	6	7	8	9	10
A	C	D	A	C	C	C	C	A	A
11	12	13	14		15	16	17		
C	B,C,D	C	a-5,b-4,c-3,d-3		B	B	B		
				LEARNERS TASK					
				Conceptual Understanding Questions (CUQ'S)					
1	2	3	4	5	6	7	8	9	10
C	A	A	D	C	A	A	D	A	D
				JEE MAINS LEVEL QUESTIONS					
11	12	13	14	15	16	17	18	19	20
A	C	A	B	A	B	D	B	B	C
				JEE ADVANCED LEVEL QUESTIONS					
21	22	23	24	25	26	27		28	29
A,B,C	A,B,C,D	A,B,C	A,B,C	B	C	a-3,b-4,c-2,d-1		B	B
30									
D									