

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES**Single Correct Answer Type**

- NH_3 has higher boiling point than expected, because :
 - With water it forms NH_4OH
 - It has strong intermolecular hydrogen bonds
 - It has strong intermolecular covalent bonds
 - Its density decreases in freezing
- In NO_3^- ion, number of bond pair and lone pair electrons are respectively:
 - 2, 2
 - 3, 1
 - 1, 3
 - 4, 8
- Which of the following has largest ionic radius?
 - Na^+
 - K^+
 - Li^+
 - Cs^+
- For alkali metals, which one of the following trends is incorrect?
 - Hydration energy : $\text{Li} > \text{Na} > \text{K} > \text{Rb}$
 - Ionisation energy : $\text{Li} > \text{Na} > \text{K} > \text{Rb}$
 - Density : $\text{Li} < \text{Na} < \text{K} < \text{Rb}$
 - Atomic size : $\text{Li} < \text{Na} < \text{K} < \text{Rb}$
- In which of the following arrangements, the sequence is not strictly according to the property written against it?
 - $\text{CO}_2 < \text{SiO}_2 < \text{SnO}_2 < \text{PbO}_2$: increasing oxidising power
 - $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$: increasing acid strength
 - $\text{NH}_3 > \text{PH}_3 < \text{AsH}_3 < \text{SbH}_3$: increasing basic strength
 - $\text{B} < \text{C} < \text{O} < \text{N}$: increasing first ionisation enthalpy
- The molecule having three folds of axis of symmetry is:
 - NH_3
 - PCl_5
 - SO_2
 - CO_2
- Which one of the following is an amphoteric oxide?
 - ZnO
 - Na_2O
 - SO_2
 - B_2O_3
- The correct order of increasing electron affinity of halogens is
 - $\text{F} < \text{Cl} < \text{Br} < \text{I}$
 - $\text{I} < \text{Br} < \text{F} < \text{Cl}$
 - $\text{I} > \text{Br} > \text{Cl} > \text{F}$
 - $\text{Br} > \text{I} > \text{F} > \text{Cl}$
- Which of the following statements is wrong?
 - Metals are more than non-metals.
 - There are only few metalloids.
 - Hydrogen can be placed with alkali metals as well as with halogen in Periodic Table.
 - Non-metals are more than metals.
- 1, 3-butadiene has:
 - 6σ and 2π -bonds
 - 2σ and 2π -bonds
 - 9σ and 2π -bonds
 - 6σ and 2π -bonds
- The bond order is maximum in:
 - H_2
 - H_2^+
 - He_2
 - He_2^+
- In which of the following bond angle is maximum?
 - NH_3
 - NH_4^+
 - PCl_5
 - SCl_2
- Which among the following has the largest dipole moment?
 - NH_3
 - H_2O
 - HI
 - SO_3
- Point out the wrong statement. On moving horizontally from left to right across a period in the Periodic Table
 - Metallic character decreases
 - Electronegativity increases

- c) Gram atomic volume first decreases and then increases
d) Size of the atoms increases for normal elements
15. Intramolecular hydrogen bonding is found in:
a) Salicylaldehyde b) Water c) Acetaldehyde d) Phenol
16. Identify the transition element.
a) $1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^2$ b) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^2$
c) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^2$ d) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^1$
17. The hybridization of P in PO_4^{3-} is same as in:
a) I in ICl_4^- b) S in SO_3 c) N in NO_3^- d) S in SO_4^{2-}
18. Among the following elements Ca, Mg, P and Cl the order of increasing atomic radius is:
a) $Mg < Ca < Cl < P$ b) $Cl < P < Mg < Ca$ c) $P < Cl < Ca < Mg$ d) $Ca < Mg < P < Cl$
19. The total number of valency electrons in PH_4^+ ion is:
a) 8 b) 9 c) 6 d) 14
20. The correct order of increasing oxidising power is
a) $F_2 < Cl_2 < I_2 > Br_2$ b) $F_2 < Br_2 < Cl_2 < I_2$ c) $Cl_2 < Br_2 < F_2 < I_2$ d) $I_2 < Br_2 < Cl_2 < F_2$
21. Which one of the following has not triangular pyramidal shape?
a) NH_3 b) NCl_3 c) PF_3 d) BCl_3
22. Two ice cubes are pressed over each other and unite to form one cube. Which force is responsible for holding them together?
a) van der Waals' forces
b) Covalent attraction
c) Hydrogen bond formation
d) Dipole-dipole attraction
23. According to molecular orbital theory for O_2^+ :
a) Bond order is less than O_2 and O_2^+ is paramagnetic
b) Bond order is more than O_2 and O_2^+ is paramagnetic
c) Bond order is less than O_2 and O_2^+ is diamagnetic
d) Bond order is more than O_2 and O_2^+ is diamagnetic
24. Generally, the first ionisation energy increases along a period. But there are some exceptions. One which is not an exception is
a) N and O b) Na and Mg c) Mg and Al d) Be and B
25. Which are true statements among the following?
(1) PH_5 and $BiCl_5$ does not exist
(2) $p\pi - d\pi$ bonds are present in SO_2
(3) Electrons travel with speed of light
(4) SeF_4 and CH_4 has same shape
(5) I_3^+ has bent geometry
a) 1, 3 b) 1, 2, 5 c) 1, 3, 5 d) 1, 2, 4
26. Which of the following is a false statement?
a) Fluorine is more electronegative than chlorine b) Nitrogen has greater IE_1 than oxygen
c) Lithium is amphoteric d) Chlorine is an oxidising agent
27. Which oxide of nitrogen is isoelectronic with CO_2 ?
a) NO_2 b) N_2O c) NO d) N_2O_2
28. The correct order of increasing bond angles in the following triatomic species is:
a) $NO_2^- < NO_2 < NO_2^+$ b) $NO_2^+ < NO_2 < NO_2^-$ c) $NO_2^+ < NO_2^- < NO_2$ d) $NO_2^- < NO_2^+ < NO_2$
29. The order of first ionisation energies of the element Li, Be, B, Na is
a) $Li > Be > B > Na$ b) $Be > B > Li > Na$ c) $Na > Li > B > Be$ d) $Be > Li > B > Na$

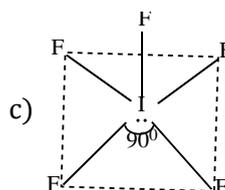
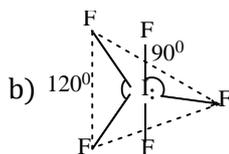
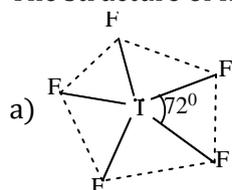


49. Which is likely to have the highest melting point?
 a) He b) CsF c) NH₃ d) CHCl₃
50. The halogen that most easily reduced is
 a) F₂ b) Cl₂ c) Br₂ d) I₂
51. Pauling's electronegativity values for elements are useful in predicting:
 a) Polarity of bonds in molecules
 b) Position of elements in electromotive series
 c) Coordination number
 d) Dipole moment of various molecules
52. Dipole moment is exhibited by:
 a) 1, 4-dichlorobenzene
 b) 1, 2-dichlorobenzene
 c) *Trans*-1, 2-dichloroethene
 d) *Trans*-1, 2-dichloro-2-butene
53. The increase in bond order results in:
 a) Decrease in bond length and increase in bond energy
 b) Decrease in bond length and bond energy
 c) Increase in bond length and bond energy
 d) None of the above
54. Which represents a collection of isoelectronic species?
 a) Be, Al³⁺, Cl⁻ b) Ca²⁺, Cs⁺, Br c) Na⁺, Ca²⁺, Mg²⁺ d) N³⁻, F⁻, Na⁺
55. Be resembles much with
 a) Li b) Al c) Zn d) Ra
56. CCl₄ is insoluble in water because:
 a) CCl₄ is non-polar and water is polar
 b) Water is non-polar and CCl₄ is polar
 c) Water and CCl₄ both are polar
 d) None of the above
57. Identify the correct order in which the covalent radius of the following elements increases
 (I)Ti (II) Ca (III) Sc
 a) (I), (II), (III) b) (III), (II), (I) c) (II), (I), (III) d) (I), (III), (II)
58. The bond order of CO molecule on the basis of molecular orbital theory is:
 a) Zero b) 2 c) 3 d) 1
59. Linear combination of two hybridized orbitals, belonging to two atoms and each having one electron leads to:
 a) Sigma-bond
 b) Double-bond
 c) Coordinate covalent bond
 d) Pi-bond
60. Among Na⁺, Na, Mg and Mg²⁺, the largest particle is
 a) Mg²⁺ b) Mg c) Na d) Na⁺
61. The oxide of an element whose electronic configuration is 1s², 2s², 2p⁶, 3s¹ is
 a) Neutral b) Amphoteric c) Basic d) Acidic
62. Among O, C, F, Cl, Br the correct order of increasing atomic radii is:
 a) F < O < C < Cl < Br b) F < C < O < Br < Cl c) F < Cl < Br < O < C d) C < O < F < Cl < Br
63. The values of electronegativity of atom A and B are 1.20 and 4.0 respectively. The percentage of ionic character of A – B bond is



- a) 58.3% b) 48% c) 79.6% d) 73.6%
64. Which of the following electronic configuration represents noble gas?
a) ns^2np^6 b) ns^2np^5 c) ns^2np^4 d) ns^2np^3
65. Which element has the highest electronegativity?
a) C b) O c) Mg d) S
66. Which of the following is largest ion?
a) Na^+ b) Mg^{2+} c) O^{2-} d) F^-
67. Which has a giant covalent structure?
a) PbO_2 b) SiO_2 c) NaCl d) $AlCl_3$
68. In which of the following $p\pi - d\pi$ bonding is observed?
a) NO_3^- b) SO_3^{2-} c) BO_3^{3-} d) CO_3^{2-}
69. The elements with atomic numbers 9, 17, 35, 53, 85 are all
a) Halogens b) Noble gases c) Heavy metals d) Light metals
70. The angle between two covalent bonds is maximum in:
a) CH_4 b) H_2O c) CO_2 d) SO_3
71. Which of the following has unchanged valency?
a) H b) Na c) Fe d) O
72. Which bond angle, θ would result in the maximum dipole moment for the triatomic molecule XY_2 shown below?
a) $\theta = 90^\circ$ b) $\theta = 120^\circ$ c) $\theta = 150^\circ$ d) $\theta = 180^\circ$
73. The highest first ionisation potential is of
a) Carbon b) Boron c) Oxygen d) Nitrogen
74. The number of unpaired electrons in O_2 molecule is:
a) Zero b) 1 c) 2 d) 3
75. Chemical bond formation takes place when:
a) Energy is absorbed
b) Forces of attraction overcome forces of repulsion
c) Forces of repulsion overcome forces of attraction
d) Forces of attraction are equal to forces of repulsion
76. With respect to chlorine, hydrogen will be
a) Electropositive b) Electronegative c) Neutral d) None of these
77. The outermost configuration of the least reactive element is
a) ns^2p^3 b) ns^2p^4 c) ns^2p^5 d) ns^2p^6
78. The correct order of ionisation energy of C, N, O, F is
a) $F < O < N < C$ b) $F < N < C < O$ c) $C < N < O < F$ d) $C < O < N < F$
79. Compound formed by sp^3d -hybridization will have structure:
a) Trigonal bipyramidal
b) T-shaped
c) Linear
d) Either of these depending on number of lone pair of electrons of central atom
80. The correct order of dipole moment is:
a) $CH_4 < NF_3 < NH_3 < H_2O$
b) $NF_3 < CH_4 < NH_3 < H_2O$
c) $NH_3 < NF_3 < CH_4 < H_2O$
d) $H_2O < NH_3 < NF_3 < CH_4$
81. Elements of which group form anions most readily?
a) Halogens b) Alkali metals c) Oxygen family d) Nitrogen group

82. During change of O_2 to O_2^- ion, the electron adds on which one of the following orbitals?
 a) π^* orbital b) π orbital c) σ^* orbital d) σ orbital
83. The molecule having smallest bond angle is:
 a) $AsCl_3$ b) $SbCl_3$ c) PCl_3 d) NCl_3
84. Which statement is correct?
 a) X^+ ion is larger than X^- ion
 b) X^- ion is larger in size than X atom
 c) X^+ and X^- have the same size
 d) X^+ ion is larger in size than X atom
85. The structure of IF_5 can be best demonstrated as:



d) None of these

86. In which of the following process energy is liberated?
 a) $Cl \rightarrow Cl^+ + e$ b) $HCl \rightarrow H^+ + Cl^-$ c) $Cl + e \rightarrow Cl^-$ d) $O^- + e \rightarrow O^{2-}$
87. The energy of antibonding molecular orbitals is:
 a) Greater than the bonding M. O.
 b) Smaller than the bonding M. O.
 c) Equal to that of bonding M. O.
 d) None of the above
88. The hybridization of phosphorus in $POCl_3$ is same as in:
 a) P in PCl_3 b) S in SF_6 c) Cl and ClF_3 d) B in BCl_3
89. Which has highest melting point?
 a) $LiCl$ b) $BeCl_2$ c) BCl_3 d) CCl_4
90. The elements present in the core of earth are collectively known as
 a) Lithophiles b) Nucleophiles c) Chalcophiles d) Siderophiles
91. The ionization potential order for which set is correct?
 a) $Li > K > Cs$ b) $B > Li > K$ c) $Cs > Li > B$ d) $Cs < Li < K$
92. Which pair has both members from the same period of Periodic Table?
 a) Cl, Br b) Ca, Cl c) Na, Ca d) Na, Cl
93. When ionic compounds get dissolved in water:
 a) They involve heat changes
 b) Inter-ionic attraction is reduced
 c) Ions show dipole-ion attraction with water molecules
 d) All are correct
94. Which of the following pairs show reverse properties on moving along a period from left to right and from top to down in a group?
 a) Nuclear charge and electron affinity b) Ionisation radius and electron affinity
 c) Atomic radius and electron affinity d) None of the above
95. Which has the lowest bond angle?
 a) NH_3 b) BeF_2 c) H_3O^+ d) CH_4
96. The lowest ionization energy would be associated with the electronic structure:
 a) $1s^2, 2s^2 2p^6, 3s^1$ b) $1s^2, 2s^2 2p^5$ c) $1s^2, 2s^2 2p^6$ d) $1s^2, 2s^2 2p^6, 3s^2$
97. Which of the following is correct?
 a) Decreases in bond length means increase in bond strength

- b) Covalent radius of carbon is less than that of nitrogen
c) Single bonds are stronger than double bonds
d) Fe (III) chloride cannot exist in the dimeric form Fe_2Cl_6
98. Which compound among the following has more covalent character?
a) AlCl_3 b) AlI_3 c) MgI_2 d) NaI
99. Greater the dipole moment:
a) Greater is the ionic nature
b) Lesser the polarity
c) Smaller the ionic nature
d) None of these
100. The ionisation energy will be maximum for the process:
a) $\text{Ba} \rightarrow \text{Ba}^{2+}$ b) $\text{Be} \rightarrow \text{Be}^{2+}$ c) $\text{Cs} \rightarrow \text{Cs}^+$ d) $\text{Li} \rightarrow \text{Li}^+$
101. The trivalent ion having largest size in lanthanide series is
a) Ti b) Zr c) Hf d) La
102. The $\text{Cl} - \text{C} - \text{Cl}$ angle in 1, 1, 2, 2-tetrachloroethene and tetrachloromethane respectively will be about:
a) 109.5° and 90° b) 120° and 109.5° c) 90° and 109.5° d) 109.5° and 120°
103. Which set has strongest tendency to form anions?
a) Ga, In, Te b) Na, Mg, Al c) N, O, F d) V, Cr, Mn
104. In the electronic structure of acetic acid there are:
a) 16 shared and 8 unshared valency electrons
b) 8 shared and 16 unshared valency electrons
c) 12 shared and 12 unshared valency electrons
d) 18 shared and 6 unshared valency electrons
105. What is the dominant intermolecular force or bond that must be overcome in converting liquid CH_3OH to a gas?
a) London dispersion force
b) Hydrogen bonding
c) Dipole-dipole interaction
d) Covalent bond
106. Maximum covalence of an atom of an element is equal to:
a) Number of unpaired electrons in the s - and p -orbitals of valency shell
b) Number of unpaired electrons in the p -orbitals of valency shell
c) Total number of electrons in the s - and p -orbitals of valency shell
d) Total number of electrons in the p -orbitals of valency shell
107. Which of the following statements is wrong?
a) The stability of hydrides increases from NH_3 to BiH_3 in group 15 of the Periodic Table.
b) Nitrogen cannot form $d\pi - p\pi$ bond.
c) Single $\text{N} - \text{N}$ bond is weaker than the single $\text{P} - \text{P}$ bond.
d) N_2O_4 has two resonance structures.
108. The set representing the correct order of first ionisation energy is
a) $\text{K} > \text{Na} > \text{Li}$ b) $\text{Be} > \text{Mg} > \text{Ca}$ c) $\text{B} > \text{C} > \text{N}$ d) $\text{Ge} > \text{Si} > \text{C}$
109. Which of the following elements never show positive oxidation number?
a) O b) Fe c) Ga d) F
110. Which one of the following elements has lower value of ionisation energy?
a) Mg b) Rb c) Li d) Ca
111. The pair of amphoteric hydroxides is
a) LiOH , $\text{Al}(\text{OH})_3$ b) $\text{Be}(\text{OH})_2$, $\text{Mg}(\text{OH})_2$ c) $\text{B}(\text{OH})_2$, $\text{Be}(\text{OH})_2$ d) $\text{Be}(\text{OH})_2$, $\text{Zn}(\text{OH})_2$
112. Which one of the following has maximum ionisation potential?

: ANSWER KEY :

1)	b	2)	d	3)	d	4)	c	5)	c	6)	a	7)	a	8)	b
9)	d	10)	c	11)	a	12)	b	13)	b	14)	d	15)	a	16)	b
17)	d	18)	b	19)	a	20)	d	21)	d	22)	c	23)	b	24)	b
25)	b	26)	c	27)	b	28)	a	29)	b	30)	b	31)	b	32)	a
33)	a	34)	b	35)	a	36)	a	37)	c	38)	c	39)	a	40)	d
41)	d	42)	b	43)	d	44)	d	45)	d	46)	b	47)	a	48)	d
49)	b	50)	a	51)	a	52)	b	53)	a	54)	d	55)	b	56)	a
57)	d	58)	c	59)	a	60)	c	61)	c	62)	a	63)	d	64)	a
65)	b	66)	c	67)	b	68)	b	69)	a	70)	c	71)	b	72)	a
73)	d	74)	c	75)	b	76)	a	77)	d	78)	d	79)	d	80)	a
81)	a	82)	a	83)	a	84)	b	85)	c	86)	c	87)	a	88)	a
89)	a	90)	d	91)	b	92)	d	93)	d	94)	c	95)	a	96)	a
97)	a	98)	b	99)	a	100)	b	101)	d	102)	b	103)	c	104)	a
105)	b	106)	c	107)	a	108)	b	109)	d	110)	b	111)	d	112)	b
113)	c	114)	b	115)	d	116)	d	117)	b	118)	c	119)	b	120)	a
121)	b	122)	d	123)	b	124)	b	125)	b	126)	d	127)	a	128)	d

: HINTS AND SOLUTIONS :

- 1 (b)
Due to H-bonding in NH_3 .
- 3 (d)
Cation radius increases down the group.
- 4 (c)
In general, density increases on moving downward in a group but density of potassium (K) is lesser than that of the sodium (Na). This is because of the abnormal increase in atomic size on moving from Na (86 pm) to K (227 pm).
Thus, the correct order of density is
 $\text{Li} < \text{K} < \text{Na} < \text{Rb}$
- 5 (c)
The correct increasing basic strength: $\text{SbH}_3 < \text{AsH}_3 < \text{PH}_3 < \text{NH}_3$
 NH_3 is the most basic because of its small size, the electron density of electron pair is concentrated over small region. As the size increases, the electron density gets diffused over a large surface area and hence the ability to donate the electron pair (basicity) decreases.
- 6 (a)
 NH_3 has pyramidal shape and thus, possesses three folds axis of symmetry.
- 7 (a)
ZnO can react with acid and base both
 $\text{ZnO} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2\text{O}$
 $\text{ZnO} + 2\text{NaOH} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2\text{O}$
- 8 (b)
The value of electron affinity decreases with increase in size of atom, because the nuclear attraction decreases as the atomic number increases. Fluorine due to its very small size has lower electron affinity than chlorine. Hence, the increasing order of electron affinity of halogen is
 $\text{I} < \text{Br} < \text{F} < \text{Cl}$.
- 9 (d)
Non-metals are more than metals is the wrong statement.
- 10 (c)
Butadiene is $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$.
- 11 (a)
The bond orders for H_2 , H_2^+ , He_2 and He_2^+ are 1.0, 0.5, 0.0 and 0.5 respectively.
- 12 (b)
 NH_4^+ has angle of $109^\circ 28'$.
- 13 (b)
It is a fact.
- 14 (b)
Transition elements are those elements which have partially filled d -subshells in their elementary form. Therefore, the general electronic configuration of d -block element is $(n - 1)d^{1-10}ns^{1-2}$.
- 17 (d)
P in PO_4^{3-} has sp^3 -hybridization like S in SO_4^{2-} .
- 18 (b)
The atomic radii decreases along the period and increases down the gp.
- 19 (a)
 $5 (\text{on P}) + 4 (\text{on H}) - 1 = 8$.
- 20 (d)

Halogens are strong oxidising agents. The oxidising power halogen decreases from fluorine to iodine, because their reduction potential decreases from fluorine to iodine. The increasing order of their oxidising power is as



Reduction

potential +0.54 +1.06 +1.36 +2.87

21

(d)

BCl_3 has sp^2 -hybridization. Rest all have sp^3 -hybridization having one lone pair of electron and thus, pyramidal in nature.

22

(c)

H_2O possesses the tendency for H – bonding.

23

(b)

Bond order for $O_2 = 2$ and for $O_2^+ = 2.5$

Both are paramagnetic (O_2 has 2 unpaired electron, O_2^+ has one unpaired electron).

24

(b)

Na belongs to IA group and Mg belongs to IIA group. On moving from left to right in a period, first ionisation energy increases, thus, IE of Mg is greater than the IE of Na.

IE order

$Mg > Na$

25

(b)

These are facts.

26

(c)

Lithium is basic in nature and hence, it is not amphoteric.

27

(b)

Each has 22 electrons.

29

(b)

Ionisation energies increase in a period on moving left to right while it decreases in a group on moving downward. The IE of Be is greater than B due to completely filled s-orbital. Hence, the order of IE is as

$Be > B > Li > Na$.

30

(b)

As the number of shells increases, ionic radii increases

31

(b)

Only P has d-orbitals.

34

(b)

They have high electron density.

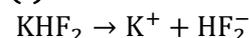
35

(a)

Thus, excitation of 2s-electron in N is not possible.

37

(c)



38

(c)

N atom in NH_3 provides electron pair to H^+ to form coordinate or dative bond ($H_3N \rightarrow H$).

39

(a)

Both are linear.

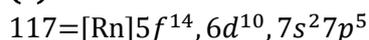
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(d)

Valency is according to valence shell configuration which here is $1s^2, 2s^2, 2p^3$, ie, 5

41

(d)





Since, the last electron enters in p -orbital, it will be a p -block element and its group number $=5+2=7$ (VIIA)

So, the element would be placed in halogen family.

42

(b)

IA—Alkali metals

IIA—Alkaline earth metals

IB—Coinage metals

43

(d)

Resultant of two opposite vectors produces zero dipole moment.

44

(d)

The order of electron affinity among the halogens is

 $\text{Cl} > \text{F} > \text{Br} > \text{I}$

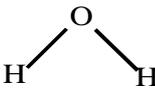
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(d)

 $\text{HC} \equiv \text{C} - \text{HC} = \text{CH} - \text{CH}_3$ $10\sigma, 3\pi$

46

(b)

H_2O has  bonding.

47

(a)

 C_6H_6 has regular hexagonal geometry.

48

(d)

Examine the positions in Periodic Table.

B C N O F

P S

Phosphorus is having stable half-filled configuration.

Hence, order is $\text{B} < \text{S} < \text{P} < \text{F}$

49

(b)

It is an ionic compound. The most ionic compound is CsF.

50

(a)

Fluorine being most electronegative atom, has a high tendency to gain electron. Thus, it readily forms anions

51

(a)

Electronegativity difference in two atoms involved in bonding is a measure of polarity in molecule.

53

(a)

It is a fact derived from bond order.

54

(d)

Each has 10 electrons

56

(a)

Like gets dissolved in like. It is theory.

57

(d)

 ${}_{20}\text{Ca} = [\text{Ar}]4s^2$ ${}_{21}\text{Sc} = [\text{Ar}]4s^2, 3d^1$ ${}_{22}\text{Ti} = [\text{Ar}]4s^2, 3d^2$ As d -orbital have diffused shape, hence their electron shields nuclear charge upto lesser extent.Hence, due to increase in effective nuclear charge (Z_{eff}) atomic size decrease, in the following order $\text{Ca} > \text{Sc} > \text{Ti}$

58

(c)

Bond order $= \frac{1}{2}[\text{bonding electrons} - \text{antibonding electrons}]$

- 59 (a)
Head on overlapping give rise to σ -bond formation.
- 60 (c)
Reason being, as we move in period atomic radii decreases from left to right due to increase of effective nuclear charge.
 \therefore Na is larger in size than Mg and a neutral atom is larger than its positive ion.
- 61 (c)
Na(11) : $1s^2, 2s^2 2p^6, 3s^1$
It is an alkali metal. Alkali metal oxides are basic in nature.
- 62 (a)
Atomic radius decreases along the period, increases down the group.
- 63 (d)
If the EN difference is 1.9, then bond is 50% ionic. The difference in electronegativity is 2.8, therefore, percentage ionic character due to EN difference of 2.8 is
 $\frac{2.8}{1.9} \times 50 = 73.6\%$
- 64 (a)
Noble gases have fully filled valence shell electronic configuration. Therefore, it represents $ns^2 np^6$.
- 65 (b)
Because of small atomic size and high nuclear charge, oxygen has the highest electronegativity among the given
- 66 (c)
Anions are larger in size than their parent atom.
- 67 (b)
SiO₂ possesses giant molecular structure due to tetra valence and catenation nature of Si
- 68 (b)
Only sulphur has *d*-orbitals.
- 69 (a)
These atomic numbers give the configuration $ns^2 np^5$ which is of halogen group or VIIth group
- 70 (c)
Carbon in CO₂ has *sp*-hybridization.
- 71 (b)
Alkali metals are always univalent.
- 72 (a)
 $\mu = \sqrt{\mu_1^2 + \mu_2^2 + \mu_1 \mu_2 \cos \theta}$, if $\theta = 90^\circ$ μ is maximum.
- 73 (d)
Ionisation potential is the amount of energy required to take out most loosely bonded electron from isolated gaseous atom. Its value increases in a period. Element having stable configuration have exceptionally high ionisation potential
N has highest ionisation potential among
C, B, O and N (\because N has $2p^3$ stable configuration).
- 74 (c)
M.O. configuration of O₂ is
 $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p^2,$
 $\pi 2p_x^2, \pi 2p_y^2, \pi^* 2p_x^1, \pi^* 2p_y^1$
- 75 (b)
The bond formation process is exothermic and thus resultant acquires lower energy level.
- 78 (d)



Ionisation energy generally increases from left to right in a period but ionisation energy of nitrogen is greater than oxygen due to stable p^3 configuration. Hence, the order is as



79 (d)

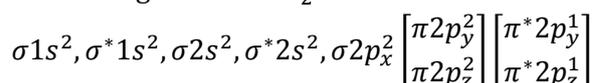
sp^3d -hybridisation leads to trigonal bipyramidal geometry if no lone pair is present, *e.g.*, PCl_5 ; in ClF_3 geometry is T shaped due to the presence of two lone pair of electron. In XeF_2 , geometry is linear due to the presence of three lone pair of electrons.

80 (a)

Dipole moment of $\text{CH}_4 = 0$.

81 (a)

M.O. configuration of O_2 :



Molecular orbitals $\pi^* 2p$ gains electron when O_2^- is formed from O_2 .

83 (a)

The bond angle of AX_3 type molecules with one lone pair decreases down the gp due to decreasing electronegativity of central atom which causes lower repulsion between lone pair-bond pair electrons.

84 (b)

Anions are always larger than parent atom; cations are always lesser than parent atom.

85 (c)

IF_5 has sp^3d^2 -hybridization with one lone pair on I atom.

86 (c)

First electron affinity is energy releasing process.

87 (a)

Bonding molecular orbitals possess lower energy levels than antibonding orbitals.

88 (a)

In PCl_3 and POCl_3 , P atom is sp^3 -hybridized.

89 (a)

BeCl_2 has the highest melting point due to ionic bond

90 (d)

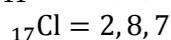
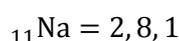
The elements present in the earth's core are collectively called siderophiles. These are found in their native state. These elements generally have a low reactivity and exhibit an affinity to form metallic bonds. *e.g.*, Pt, Ru, Pd, Ir, Os etc.

91 (b)

IP_1 of B $>$ IP_1 of Li ENC of boron is more than Li. Also IP_1 of Li $>$ IP_1 of K because removal of electron in K occurs from 4s.

92 (d)

Sodium and chlorine are in same period



Both have 3- shells, hence they both are placed in 3rd period of Periodic Table.

93 (d)

If the lattice energy $<$ hydration energy, then only ionic compounds are soluble.

94 (c)

(a) Nuclear charge and electron affinity both increase in period and decrease in group.

(b) Ionisation energy and electron affinity both increase from left to right in a period and top to bottom in a group.



- 111 (d)
Be(OH)₂ and Zn(OH)₂ are amphoteric in nature
- 112 (b)
The ionisation potential increases in a period on moving left to right while in a group it is decreases on moving from top to bottom. Hence, Be has maximum ionisation potential.
- 113 (c)
It is experimental value.
- 114 (b)
These are isoelectronic species and their radii decreases with increasing their atomic number due to increasing effective nuclear charge (Z_{eff})

$$(Z_{\text{eff}}) = Z - \sigma$$
 where, Z_{eff} =effective nuclear charge, Z =atomic number and σ =screening constant. For F^- , O^{2-} and N^{3-} , the value of σ is constant due to equal number of electrons. So, order of Z_{eff} is $F^- < O^{2-} > N^{3-}$
 hence, order of radii
 $= F^- < O^{2-} < N^{3-}$ (radii $\propto \frac{1}{Z_{\text{eff}}}$).
- 115 (d)
The element of II period show similar properties as the elements of III period, which are diagonally placed to them. This is known as diagonal relationship. Hence, Li shows diagonal relationship with Mg and Be shows diagonal relationship with Al.
- IInd period
 Li Be B C N
 ↘ ↘ ↘ ↘
 Na Mg Al Si P
- IIIrd period
- 116 (d)
Ionisation enthalpy increases along the period and decreases down the group
- 117 (b)
Cs⁺ is largest cation and F⁻ is smallest anion.
- 118 (c)
Na⁺ is cation; Cl⁻, PO₄³⁻ are anion.
- 119 (b)
Electron affinity is the energy change, when an electron is added. When O⁻ changes into O²⁻ the electron affinity is positive *i.e.*, change is endothermic. The reason is that O⁻ repels the incoming electron due to similar charge, hence, it needs energy to accept the electron. Hence, electron affinity is positive.
- 120 (a)
The stability and bond angle order for hydrides in a group is
 $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.
- 121 (b)
o-, *m*-, *p*-derivatives has $\alpha = 60^\circ, 120^\circ$ and 180° and thus, resultant vector has zero dipole moment in *p*-derivative. Also dipole moment of *m*-dichlorobenzene is more than toluene.
- 122 (d)
Effective nuclear charge increases in this order.
- 123 (b)
A characteristic of resonance.

- 124 (b)
Dry ice is CO_2 having C – O covalent bonds.
- 125 (b)
 sp -hybridization leads to bond angle of 180° .
- 126 (d)
F is more electronegative.
- 127 (a)
The tendency to show lower ionic state increases down the group due to inert pair effect.
- 128 (d)
Electronic configuration of Cu is $1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1, 3d^{10}$ and electronic configuration of Cu^{2+} is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^9$. Hence, the given configuration represents metallic cation.



Assertion - Reasoning Type

This section contain(s) 13 questions numbered 1 to 13. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

- a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1
- b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1
- c) Statement 1 is True, Statement 2 is False
- d) Statement 1 is False, Statement 2 is True

- 1 **Statement 1:** Manganese has a less favourable electron affinity than its neighbours in either side
Statement 2: The magnitude of an element's electron affinity depends on the element's valence shell electrons configuration
- 2 **Statement 1:** The electron attachment enthalpy of fluorine is more negative than that of chlorine
Statement 2: All alkaline earth and noble gas elements have positive value of electron attachment enthalpies
- 3 **Statement 1:** Atomic size of silver is almost equal to that of gold.
Statement 2: d -subshell has low penetration power and produce poor shielding.
- 4 **Statement 1:** In any period, the radius of the noble gas is lowest
Statement 2: He has the highest IE in the Periodic Table
- 5 **Statement 1:** First ionization energy for nitrogen is lower than oxygen.
Statement 2: Across a period effective nuclear charge decreases.
- 6 **Statement 1:** The first ionization energy of Be is greater than B.
Statement 2: $2p$ - orbitals have lower energy than $2s$ - orbitals .
- 7 **Statement 1:** Known elements may contain as many as 32 electrons in an energy level but only s and p sublevel electrons are considered for the octet rule.
Statement 2: For any atom, electrons present in s - and p - subshells assume greater stability.
- 8 **Statement 1:** Plutonium among the transuranic elements is the longest lived element.
Statement 2: Plutonium is not radioactive.
- 9 **Statement 1:** Sulphur atom has higher electron affinity than oxygen.
Statement 2: Oxygen is more electronegative than sulphur, that's why can hold electron better.
- 10 **Statement 1:** Nobel gases have large positive electron gain enthalpy.
Statement 2: Electron has to enter the next higher principal quantum level.
- 11 **Statement 1:** Shielding effect increases as we go down the group
Statement 2: More is the electrons in the penultimate shell, more is shielding
- 12 **Statement 1:** Isoelectronic species are having same number of electrons but different radii.
Statement 2: Higher the charge, smaller the ion.
- 13 **Statement 1:** Ionisation energy of nitrogen (7) is more than that of oxygen (8)
Statement 2: Half-filled p -orbitals in nitrogen ($2p^3$) are more stable



: ANSWER KEY :

1)	b	2)	d	3)	b	4)	b	5)	d	6)	c	7)	b
8)	c	9)	b	10)	a	11)	a	12)	c	13)	a		

: HINTS AND SOLUTIONS :

- 1 (b)
 ${}_{25}\text{Mn} = 3d^5, 4s^2$; ${}_{24}\text{Cr} = 3d^5, 4s^1$; ${}_{26}\text{Fe} = 3d^6, 4s^2$
 Electron affinity of an element depends upon electronic configuration
- 2 (d)
 All alkaline earth metals and noble gases have positive values of electron attachment enthalpies as they have ns^2 and ns^2np^6 (fully-filled) electronic configuration
 Cl has more electron affinity than F because the more compact electronic configuration in F imparts greater electron repulsion to the incoming electron
- 3 (b)
 Atomic size of silver is almost equal to that of gold due to lanthanide contraction.
- 4 (d)
 Statement I is incorrect as in any period, the radius of the noble gas is largest and not the lowest
- 5 (d)
 The ionization energy of N (VA) is more than O VI A because half filled and completely filled orbitals are more stable. Across a period effective nuclear charge increases with increase in atomic number and atomic size in atomic number and atomic size decreases.
- 6 (c)
 The lower IE_1 of B than that of Be is because in boron ($1s^2 2s^2 2p^1$) electron is to be removed from 2 *p* which is easy, while in Be ($1s^2 2s^2$) electron is to be removed from 2 *s*-which is difficult.
- 7 (b)
 Electrons in *d* and *f* sublevels can never be in the outer level of a neutral atom. The *s*- and *p*-electrons are in the highest energy level in the atom and are the electrons involved in the chemical reactions.
- 8 (c)
 ${}_{94}^{238}\text{Pu}$ has longest half-life period. It is used in breeder reactor as a fissionable nucleides and break up by slow neutrons and from fission product. It is a radioactive element.
- 9 (b)
 Sulphur valence shell is less dense than oxygen.
- 10 (a)
 Noble gases have large positive electron gain enthalpy because the electron has to enter the next high principle quantum level leading to a very unstable electronic configuration.
- 11 (a)
 The phenomenon in which the penultimate shell, *ie*, ($n - 1$) electrons act as shield in between nucleus and valence shell electrons thereby reducing the effective nuclear charge is known as shielding effect
- 12 (c)
 Charge is not defined as positive or negative [Isoelectronic species having higher the negative charge, larger the size, higher the positive charge smaller the size].
- 13 (a)
 Symmetrical configuration (half-filled) is stable. Oxygen also gains half-filled configuration by losing an electron

