

P R E F A C E

The idea of the book entitled **“Inorganic Chemistry: SET PYQ’s”** was born because of the lack of any comprehensive book covering all the aspects of various entry level chemistry competitive examinations in particular conducted by CSIR, GATE, TIFR State and National Eligibility Test, but not limited to.

This book covers all PYQ’s with topic wise sorted question and solution

1. Chemical Periodicity
2. Chemical Bonding
3. Main Group Element
4. Coordination Chemistry
5. Inner Transition Element
6. Organometallic Chemistry
7. Bioinorganic Chemistry
8. EPR Spectroscopy
9. Nuclear Chemistry
10. Chemistry of Acid and Base
11. Analytical Chemistry
12. General Chemistry.

The ultimate purpose of this book is to equip the reader with brainstorming challenges and solution for inorganic chemistry and applied aspect examinations. It contains predigested information on the entire academic subject of inorganic chemistry for good understanding, assimilation, self-evaluation, and reproducibility. Although we have made every effort to make the book error free, we are under no illusion. We welcome comments, criticism and suggestions from the readers to evolve the contents.

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CHEMICAL PERIODICITY

PREVIOUS YEAR EXAM QUESTIONS

ANDHRA PRADESH SET

(AP-SET 2014)

(AP-SET 2012)

1. The correct increasing order of second ionization energy of elements X, Y, Z with respective atomic numbers 19, 20, 38 is
- (A) X, Y, Z (B) X, Z, Y
(C) Z, Y, X (D) Z, X, Y

(AP-SET 2013)

2. The correct statements among the following:
- (1) Na^+ and Ne are isoelectronic but ionization energy of Na^+ is more than Ne
(2) Na^+ and Ne are isoelectronic but ionization energy of Ne is more than Na^+
(3) O^{2-} and F^- are isoelectronic but F^- has higher radius than O^{2-}
(4) O^{2-} and F^- are isoelectronic but O^{2-} has higher radius than F^-
- (A) 1, 2, 3, 4 are correct (B) 1 and 3 are correct
(C) 1 and 4 are correct (D) 2 and 4 are correct

(AP-SET 2013)

3. The correct order of ionic radii of given ions:
- (A) $\text{K}^+ > \text{Ca}^{2+} > \text{Cl}^- > \text{S}^{2-}$ (B) $\text{S}^{2-} > \text{Cl}^- > \text{K}^+ > \text{Ca}^{2+}$
(C) $\text{Ca}^{2+} > \text{Cl}^- > \text{S}^{2-} > \text{K}^+$ (D) $\text{K}^+ > \text{Ca}^{2+} > \text{S}^{2-} > \text{Cl}^-$

(AP-SET 2014)

4. The correct decreasing order of the first ionization energy of the elements P, S, Cl is:
- (A) Cl, S, P (B) Cl, P, S
(C) P, Cl, S (D) S, Cl, P

(AP-SET 2014)

5. The number of radial nodes for a 3s orbital is:
- (A) 0 (B) 1
(C) 2 (D) 3

(AP-SET 2014)

6. Which of the following has the highest Pauling's electronegativity value?
- (A) Be (B) Mg
(C) Ca (D) Ba

7. Match the following

List – I	List – II
I. Orbital angular momentum quantum number	1. M_l
II. Magnetic quantum number	2. l
III. Spin quantum number	3. J
IV. Total angular momentum quantum number	4. S

1	2	3	4
(A) I	II	III	IV
(B) I	III	II	IV
(C) II	I	IV	III
(D) III	IV	I	II

(AP-SET 2014)

8. Among the halogens from Cl to I, decreasing trend is observed with respect to:
- I. Ionization energy
II. Electro positivity
III. Electronegativity
IV. Metallic character
- the correct combination is
- (A) I, II (B) I, III
(C) II, III (D) II, IV

(AP-SET 2018)

9. A 3d atomic orbital has:
- (A) one radial node and one angular node
(B) Two angular nodes
(C) Two radial nodes
(D) No nodes

CHHATTISGARH SET

(CG-SET 2017: 2 Mark)

1. The correct quantum numbers for the unpaired electron of chlorine atom is:
- (A) $n=2; l=1; m_l=0$ (B) $n=2; l=1; m_l=1$
(C) $n=3; l=1; m_l=1$ (D) $n=3; l=0; m_l=0$

GUJARAT SET

(GJ-SET 2003)

1. The ionic radii are:
 (A) directly proportional to effective nuclear charge
 (B) directly proportional to square of effective nuclear charge
 (C) inversely proportional to effective nuclear charge
 (D) inversely proportional to square of effective nuclear charge

(GJ-SET 2004)

2. The correct order of IP of B, C, N, O are
 (A) $N > O > B > C$ (B) $O > N > B > C$
 (C) $N > O > C > B$ (D) $O > N > C > B$

(GJ-SET 2014)

3. Which SET of quantum numbers is possible for an element?
 (A) $n = 1, l = 1, m = 0, s = -1/2$
 (B) $n = 2, l = 1, m = 0, s = +1/2$
 (C) $n = 2, l = 0, m = -2, s = +1/2$
 (D) $n = 1, l = 0, m = 1, s = -1/2$

(GJ-SET 2014)

4. The strongest van der Waals interaction is present in:
 (A) F_2 (B) Cl_2
 (C) Br_2 (D) I_2

(GJ-SET 2014)

5. Greater the number of lone pairs on a central atom, the contraction caused in the bond angle will be:
 (A) Less (B) More
 (C) no effect (D) Balance the angle

(GJ-SET 2014)

6. Comparing structure and properties of:
 (I) $Na^+(CH_2C_6H_5)^-$ and (II) $Na^+(C_6H_5)^-$
 Which of the following statements is not correct?
 (A) Both (I) and (II) belongs to the class of ionic organometallic compounds
 (B) The nucleophilic character of (I) is less than (II)
 (C) (I) is stabilized by resonance while (II) is not
 (D) Reactivity of (I) > (II)

(GJ-SET 2014)

7. The correct order of second ionization potential of C, N, O and F is:
 (A) $C > N > O > F$ (B) $O > N > F > C$
 (C) $O > F > N > C$ (D) $F > O > N > C$

(GJ-SET 2014)

8. Fluorine has the highest electronegativity amongst ns^2np^5 group but electron affinity of F is less than that of Cl because:
 (A) The atomic number of F is less than that of Cl
 (B) F behaves in unusual manner
 (C) Cl can accommodate an electron better than F by utilizing its vacant 3d orbital
 (D) High electron density makes an addition of an electron less favorable than Cl.

(GJ-SET 2014)

9. Most substances expand when heated in all temperature ranges. Water exhibits anomalous behavior. It contracts when heated between 0° and $4^\circ C$. Which of the following statements is the appropriate to this behavior?
 (A) Ice has an open cage like structure
 (B) In ice, water molecules are both covalently as well as hydrogen bonded
 (C) When ice melts, density increases as water molecules come closer together to filling up empty spaces in the cage structure
 (D) In ice, water molecules are tetrahedrally oriented with respect to each other.

(GJ-SET 2017)

10. Which of the following species has the largest dissociation energy?
 (A) CN (B) BN
 (C) CN^- (D) NO

(GJ-SET 2018)

11. The van der Waals radii of O, N, Cl, F and Ne increase in the order:
 (A) F, O, N, Ne, Cl (B) N, O, F, Ne, Cl
 (C) Ne, F, O, N, Cl (D) F, Cl, O, N, Ne

(GJ-SET 2019)

12. The radial part of an atomic orbital wave function depends upon:
 (A) l only (B) n only
 (C) n, l and m (D) m only

(GJ-SET 2019)

13. The values of electronegativity of atoms M and N are 2.5 and 1.05, respectively. The % ionic character of M-N bond is:
 (A) 28.80% (B) 34.20%
 (C) 38.50% (D) 45%

(GJ-Set 2022)

14. Which of the following represents the correct order of electron affinities of halides?
 (A) $\text{HCl} > \text{HF} > \text{HBr} > \text{HI}$
 (B) $\text{HI} > \text{HBr} > \text{HF} > \text{HCl}$
 (C) $\text{HBr} > \text{HI} > \text{HCl} > \text{HF}$
 (D) $\text{HF} < \text{HCl} < \text{HI} < \text{HBr}$

(GJ-SET 2022)

15. Which of the following order is correct with respect to first ionization energies (in kJ mol^{-1}) ?
 (A) $\text{Li} < \text{K} < \text{Mg} < \text{Al}$ (B) $\text{K} < \text{Li} < \text{Al} < \text{Mg}$
 (C) $\text{Al} < \text{Li} < \text{Mg} < \text{K}$ (D) $\text{Li} < \text{Al} < \text{Mg} < \text{K}$

(GJ-Set 2023)

16. Choose the incorrect statement from the following with respect to the enthalpy of atomization of an element (in kJ/mol).
 (A) It is a measure of the enthalpy of the energy required to form gaseous atoms
 (B) It is higher for d-block elements than those of s-and p-block elements
 (C) It decreases down the group in s-and p-block, but increases down a group in d-block
 (D) It increases down the group in s-and p-blocks, but decreases down a group in d-block

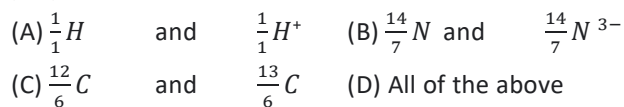
(GJ-Set 2023)

17. The correct values for the electron affinity (in kJ/mol) of the formation of O and O^{2-} from O are _____ and _____, respectively.
 (A) $-142, -702$ (B) $-142, 702$
 (C) $-142, -142$ (D) $142, -702$

HIMANCHAL PRADESH SET

[HP-SET 2014]

1. In which of the following pairs do the two species resemble each other most closely in chemical properties?



(HP –SET 2019)

2. An atomic orbital has two angular nodes and one radial node. It is a:
 (A) 2p orbital (B) 3p orbital
 (C) 3d orbital (D) 4d orbital

JAMMU KASHMIR SET

(JK-SET 2011)

1. The second ionization energies of Li, Be, B and C are in the order:
 (A) $\text{Li} > \text{C} > \text{B} > \text{Be}$ (B) $\text{Li} > \text{B} > \text{C} > \text{Be}$
 (C) $\text{B} > \text{C} > \text{Be} > \text{Li}$ (D) $\text{Be} > \text{C} > \text{B} > \text{Li}$

(JK-SET 2011)

2. All Cu (II) halides are known except the iodide. The reason for is that:
 (A) iodide is a bulky ion
 (B) Cu^{2+} oxidizes iodide to iodine
 (C) Cu^{2+} (aq) has much more negative hydration enthalpy
 (D) Cu^{2+} ion has smaller size

(JK-SET 2011)

3. Maximum number of electrons in a shell with principal quantum number 'n' is given by:
 (A) n (B) 2n
 (C) n^2 (D) $2n^2$

(JK-SET 2011)

4. The second ionization energies of Li, Be, B and C are in the order:
 (A) $\text{Li} > \text{C} > \text{B} > \text{Be}$ (B) $\text{Li} > \text{B} > \text{C} > \text{Be}$
 (C) $\text{B} > \text{C} > \text{Be} > \text{Li}$ (D) $\text{Be} > \text{C} > \text{B} > \text{Li}$

(JK-SET 2011)

5. Which of the following is the largest in size?
 (A) Cl^- (B) S^{2-}
 (C) Na^+ (D) F^-

(JK-SET 2011)

6. The correct order of reducing character of alkali metals is:
 (A) $\text{Rb} < \text{K} < \text{Na} < \text{Li}$ (B) $\text{Li} < \text{Na} < \text{K} < \text{Rb}$
 (C) $\text{Na} < \text{K} < \text{Rb} < \text{Li}$ (D) $\text{Rb} < \text{Na} < \text{K} < \text{Li}$

(JK-SET 2012)

7. The correct order of electron gain enthalpy with negative sign of F, Cl, Br, and I having atomic number 9, 17, 35, and 53 respectively is:
 (A) $\text{F} < \text{Cl} < \text{Br} < \text{I}$ (B) $\text{Cl} < \text{F} < \text{Br} < \text{I}$
 (C) $\text{I} < \text{Br} < \text{F} < \text{Cl}$ (D) $\text{Cl} < \text{Br} < \text{I} < \text{F}$

(JK-SET 2012)

8. Properties of elements are periodic function of number of _____ present in the nucleus:
 (A) Protons (B) Electrons
 (C) Neutrons (D) Mesons

(JK-SET 2012)

9. Which of the following elements has the highest value of electron affinity?

(A) O (B) S
(C) Se (D) Te

(JK-SET 2016)

10. Electronegativities of atoms changes _____ rapidly when crossing d block than while crossing the p block elements.

(A) less (B) more
(C) very less (D) huge

(JK-SET 2016)

11. Which of the following pair of reagents will not react to form product?

(A) $\text{PF}_5 + \text{CsF}$ (B) $\text{XeF}_6 + \text{BF}_3$
(C) $\text{RbBr} + \text{BaBr}_2$ (D) $\text{NaF} + \text{AlF}_3$

(JK-SET 2018)

12. Which of the following has the highest Pauling's electronegativity value?

(A) Be (B) Mg
(C) Ca (D) Ba

(JK-SET 2018)

13. The number of radial nodes for a 3s orbital is

(A) 0 (B) 1
(C) 2 (D) 3

(JK-SET 2018)

14. The correct decreasing order of the first ionization energy of the elements P, S, Cl is

(A) Cl, S, P (B) Cl, P, S
(C) P, Cl, S (D) S, Cl, P

(JK-SET 2018)

15. Match the following

List – I	List – II
I. Orbital angular momentum	1. M_l quantum number
II. Magnetic quantum	2. l number
III. Spin quantum	3. j number
IV. Total angular momentum	4. s quantum number

1	2	3	4
(A) I	II	III	IV
(B) I	III	II	IV
(C) II	I	IV	III
(D) III	IV	I	II

(JK-SET 2018)

16. Among the halogens from Cl to I, a decreasing trend is observed with respect to

- I. Ionization energy
II. Electropositivity
III. Electronegativity
IV. Metallic character

The correct combination is

(A) I, II (B) I, III
(C) II, III (D) II, IV

(JK-SET 2018)

17. Assertion (A): The radius of Fe^{3+} is less than that of Fe^{2+} .
Reason (R): Fe^{3+} has a lower effective nuclear charge than Fe^{2+} .

(A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true but R is not the correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

(JK-SET 2018)

18. The correct ground state configuration for Chromium is:

(A) $[\text{Ar}] 3d^4 4s^2$ (B) $[\text{Ar}] 3d^5 4s^1$
(C) $[\text{Ne}] 3d^5 4s^1$ (D) $[\text{Ne}] 3d^4 4s^2$

KARNATAKA SET

(KA-SET 2014)

1. Which one of the following is incorrect with respect to the property indicated?

(A) Electronegativity: $\text{F}_2 > \text{Cl}_2 > \text{Br}_2$
(B) Electron affinity: $\text{Cl}_2 > \text{F}_2 > \text{Br}_2$
(C) Oxidizing power: $\text{F}_2 > \text{Cl}_2 > \text{Br}_2$
(D) Bond energy: $\text{F}_2 > \text{Cl}_2 > \text{Br}_2$

(KA-SET 2014)

2. Which one of the following SETs indicate the correct variation in electro negativities?

(A) $\text{F} > \text{N} < \text{O} > \text{C}$ (B) $\text{F} > \text{N} > \text{O} > \text{C}$
(C) $\text{F} < \text{N} < \text{O} < \text{C}$ (D) $\text{F} < \text{O} > \text{N} > \text{C}$

(KA-SET 2015)

3. The reduced ionization energy within a given family of non-transition elements is due to:

(A) increase in size
(B) increase in shielding
(C) combined effect of increased size and shielding
(D) combined effect of increased size and decreased shielding

(KA-SET 2015)

4. Which of the following pair of elements form covalent compounds:

- (1) C and S
(2) Na and Cl
(3) S and O
(4) Ca and H

Codes:

- (A) 1 and 2 (B) 1 and 3
(C) 2 and 4 (D) 2 and 3

5. The electronegativity difference is the highest for the pair:

- (A) Na, F (B) Li, F
(C) Li, Cl (D) K, F

6. The correct order of decreasing electronegativity and ionic size is as follows

- (A) $Al > Ca > S > As$; $K^+ > Cl^- > Ca^{2+} > S^{2-}$
(B) $S > As > Al > Ca$; $S^{2-} > Cl^- > K^+ > Ca^{2+}$
(C) $S > As > Ca > Al$; $S^{2-} > Cl^- > K^+ > Ca^{2+}$
(D) $As > Al > Ca > S$; $K^+ > Ca^{2+} > S^{2-} > Cl^-$

(KA-SET 2016)

7. Which of the following pairs has the highest difference in their first ionization energy?

- (A) Xe, Cs (B) Ne, Na
(C) Kr, Rb (D) Ar, K

(KA-SET 2017)

8. The atom with the highest ionization potential is:

- (A) Boron (B) Carbon
(C) Nitrogen (D) Oxygen

(KA-SET 2017)

9. H_2S gas is passed through an acidic solution containing Pb^{2+} , Zn^{2+} , Cu^{2+} and Ni^{+2} ions. The precipitate will consist of:

- (A) ZnS and PbS (B) PbS and NiS
(C) NiS and CuS (D) CuS and PbS

(KA-SET 2017)

10. Which of the following can be acceptable electronic configuration of xenon atom in the first excited state?

- (A) $5s^25p^6$ (B) $5s^25p^45d^2$
(C) $5s^25p^55d^1$ (D) $5s^25p^35d^3$

(KA-SET 2020)

11. The filling of molecular orbitals takes place according to:

- (A) The Aufbau principle
(B) Pauli Exclusion principle
(C) Hund's rule of maximum multiplicity
(D) All of the mentioned above

MADHYA PRADESH SET

(MP-SET 2018)

1. Choose the correct order for electron affinity
(A) $F > Cl > Br > I$ (B) $F < Cl > Br > I$
(C) $F < Cl < Br < I$ (D) None of these

(MP-SET 2018)

2. Out of the following ionic substances, which one has the greatest lattice enthalpy?

- (A) MgO (B) MgS
(C) NaF (D) $NaBr$

MAHARASHTRA SET

(MH-SET 25 Nov. 2011)

1. The number of nodes in a 3s orbital is:

- (A) 0 (B) 1
(C) 2 (D) 3

(MH-SET 25 Nov. 2011)

2. The three unpaired electrons on the nitrogen atom is ascribed to :

- (A) Pauli's exclusion principle
(B) Aufbau principle
(C) Hund's rule
(D) Uncertainty principle

(MH-SET 25 Nov. 2011)

3. Which of the following species have distorted octahedral structures?

- (A) SF_6 (B) $[PF_6]^-$
(C) SbF_5 (D) XeF_6

(MH-SET 25 Nov. 2011)

4. Which one of the following compounds readily forms dimers?

- (A) $AsCl_3$ (B) $AlCl_3$
(C) PCl_3 (D) BCl_3

(MH-SET 2015)

5. The strength of hydrogen bonds follow the order:

- (A) $ClH \dots Cl > NH \dots N > OH \dots O > FH \dots F$
(B) $ClH \dots Cl < NH \dots N < OH \dots O < FH \dots F$
(C) $ClH \dots Cl < NH \dots N > OH \dots O > FH \dots F$
(D) $ClH \dots Cl < NH \dots N < OH \dots O > FH \dots F$

(MH-SET 2015)

6. First and second ionization energies of Mg are 7.646 and 15.035 eV respectively. The amount of energy in kJ needed to convert all the atoms of magnesium into Mg^{2+} ions present in 12 mg of magnesium vapors is:

- (A) 1.5 (B) 2.0
(C) 1.1 (D) 0.5

(MH-SET 2015)

7. Which of the following is the correct order of 1st Ionization Potential:
 (A) Ca > Sr > Ba > Mg (B) Ba > Mg > Ca > Sr
 (C) Sr > Ca > Mg > Ba (D) Mg > Ca > Sr > Ba

(MH-SET 2015)

8. The correct order of the basicity of the following oxides:
 (A) NO₂ < CO₂ < Na₂O < Al₂O₃ (B) CO₂ < NO₂ < Al₂O₃ < Na₂O
 (C) NO₂ < CO₂ < Al₂O₃ < Na₂O (D) Al₂O₃ < Na₂O < NO₂ < CO₂

(MH-SET 2018)

9. The correct order of First Ionization energy of group 13 elements is:
 (A) B > Tl > Ga > Al > In (B) B > Tl > Al > Ga > In
 (C) B > Al > Ga > In > Tl (D) B > Ga > Tl > In > Al

(MH-SET 2018)

10. The ionophore valinomycin is highly selective for:
 (A) K⁺ (B) Na⁺
 (C) Mg²⁺ (D) Ca²⁺

(MH-SET 2019)

11. Size of the d orbitals for Si, P, S and Cl follow the order:
 (A) Si > P > S > Cl (B) Cl > P > S > Si
 (C) Cl > S > P > Si (D) P > S > Si > Cl

(MH-SET 2020)

12. The hydrogen bond strength in
 (i) O—H.....O
 (ii) O—H.....Cl
 (iii) O—H.....N will follow the order:
 (A) (i) > (iii) > (ii) (B) (ii) > (i) > (iii)
 (C) (i) = (ii) > (iii) (D) (i) > (ii) > (iii)

(MH-SET 2020)

13. The strength of hardness of the isoelectronic ions F⁻, OH⁻, NH₂⁻ and CH₃⁻ follows the order:
 (A) CH₃⁻ > OH⁻ > NH₂⁻ > F⁻ (B) CH₃⁻ > F⁻ > OH⁻ > NH₂⁻
 (C) F⁻ > OH⁻ > NH₂⁻ > CH₃⁻ (D) CH₃⁻ > NH₂⁻ > OH⁻ > F⁻

RAJASTHAN SET

(RAJ-SET 2012)

1. Which of the following has the highest Ionization potential:
 (A) Na (B) Al
 (C) Mg (D) K

(RAJ-SET 2012)

2. The screening effect is maximum for electron in:
 (A) s – orbital (B) p – orbital
 (C) d – orbital (D) f – orbital

(RAJ-SET 2012)

3. The inert pair effect is maximum in:
 (A) N (B) P
 (C) As (D) Bi

(RAJ-SET 2012)

4. Select the correct sequence of first ionization energy:
 (A) Be < B < N < O (B) Be < B < O < N
 (C) B < Be < O < N (D) B < Be < N < O

(RAJ-SET 2013)

5. Which order are correct?
 (I) Thermal stability: BeSO₄ < MgSO₄ < CaSO₄ < SrSO₄ < BaSO₄
 (II) Basic nature: ZnO > BeO > MgO > CaO
 (III) Solubility in water: LiOH > NaOH > KOH > RbOH > CsOH
 (IV) Melting point: NaCl > KCl > RbCl > CsCl > LiCl

Codes:

- (A) (I) and (IV) (B) (II) and (III)
 (C) (I) and (III) (D) (II) and (IV)

(RAJ-SET 2013)

6. Which of the following possesses lowest value of first ionization energy?
 (A) Al (B) Ga
 (C) In (D) Tl

(RAJ-SET 2013)

7. The atomic number of Cr and Cu is 24, 29 and its electronic configuration is:
 (A) 3d⁵ 4s¹ and 3d¹⁰ 4s¹ (B) 3d⁴ 4s² and 3d¹⁰ 4s¹
 (C) 3d⁵ 4s¹ and 3d⁹ 4s² (D) 3d⁴ 4s² and 3d⁹ 4s²

WEST BENGAL SET

(WB-SET)

1. The difference in the electronegativity scale between the two atom is 1.9, the nature of the bond is
 (A) 75% ionic (B) 50% ionic
 (C) 25% ionic (D) 100% ionic

(WB-SET 2015)

2. The correct order of stability in water is:
 (A) LiI < NaI < KI < CsI (B) LiI < NaI < KI < CsI
 (C) CsI > LiI > NaI > KI (D) LiI < NaI < KI < CsI

(WB-SET 2015)

3. Which of the following is the correct order of 1st ionization potential:
 (A) Ca > Sr > Be > Mg (B) Be > Mg > Ca > Sr
 (C) Sr > Ca > Mg > Be (D) Mg > Be > Sr > Ca

(WB-SET 2017)

4. For the molecule
- OCF_2
- the correct statement is:

(A) Both $\angle \text{FCF}$ and $\angle \text{FCO}$ are 120°
 (B) $\angle \text{FCF} > 120$ but $\angle \text{FCO} < 120$
 (C) $\angle \text{FCF} < 120$ but $\angle \text{FCO} > 120$
 (D) $\angle \text{FCF}$ and $\angle \text{FCO} > 120$

(WB-SET 2017)

5. An element has valence shell configurations
- $5d^5 6s^1$
- . Which group and period does it belong to?

(A) 1st Group and 6th period
 (B) 6th group and 5th period
 (C) 6th group and 6th period
 (D) 5th group and 6th period

[WB-Set 2021: 2Mark]

6. The correct order of lattice energy of the fluorides of
- Cr^{2+}
- ,
- Mn^{2+}
- and
- Ni^{2+}
- is:

(A) $\text{Ni}^{2+} > \text{Mn}^{2+} > \text{Cr}^{2+}$
 (B) $\text{Ni}^{2+} > \text{Cr}^{2+} > \text{Mn}^{2+}$
 (C) $\text{Cr}^{2+} > \text{Ni}^{2+} > \text{Mn}^{2+}$
 (D) $\text{Cr}^{2+} > \text{Mn}^{2+} > \text{Ni}^{2+}$

[WB-Set 2021: 2Mark]

7. The correct order of energy required to remove the highest energy electron from the following species is:

(A) $\text{N} > \text{N}_2 > \text{NO}$ (B) $\text{N}_2 > \text{N} > \text{NO}$
 (C) $\text{NO} > \text{N} > \text{N}_2$ (D) $\text{N}_2 > \text{NO} > \text{N}$

(WB-set 2022: 2 Mark)

8. The correct set of quantum numbers representing the outer most electron in the ground state of Boron atom is

(A) $n = 2, l = 0, m = +1, s = +1/2$
 (B) $n = 2, l = 1, m = -1, s = +1/2$
 (C) $n = 2, l = 1, m = +2, s = +1/2$
 (D) $n = 2, l = 0, m = 0, s = +1/2$

(WB- SET 2023: 2 Mark)

9. Which one of the following has the highest -ve
- ΔH
- of formation from their corresponding atom?

(A) O^- (B) O^{2-}
 (C) F^- (D) Cl^-

(WB- SET 2023: 2 Mark)

10. The atomic numbers of the elements unnilhexium and ununennium are respectively

(A) 106 and 107 (B) 106 and 119
 (C) 109 and 119 (D) 116 and 108

ANSWER KEY									
ANDHRA PRADESH									
1	2	3	4	5	6	7	8	9	
C	C	B	B	B	A	C	B	B	
CHHATTISGARH									
1									
C									
GUJRAT									
1	2	3	4	5	6	7	8	9	10
C	C	B	D	B	D	C	C	C	C
11	12	13	14	15	16	17			
D	A,B	A	A	B	D	B			
HIMANCHAL PRADESH									
1	2								
C	D								
JAMMU KASHMIR									
1	2	3	4	5	6	7	8	9	10
B	B	D	B	B	B	C	A	A	A
11	12	13	14	15	16	17	18		
C	A	C	B	C	B	C	B		
KARNATAKA									
1	2	3	4	5	6	7	8	9	10
D	A	C	B	A	B	B	C	D	B
11									
D									
MADHYA PRADESH									
1	2								
B	A								
MAHARASTRA									
1	2	3	4	5	6	7	8	9	10
C	C	D	B	B	C	D	B	A	A
11	12	13							
A	D	C							
RAJASTHAN									
1	2	3	4	5	6	7			
C	A	D	C	A	D	A			
WEST BENGAL									
1	2	3	4	5	6	7	8	9	10
B	D	B	C	C	B	B	B	D	B

:: SOLUTIONS ::

ANDHRA PRADESH SET

1. Solution: (C)

Elements X, Y and Z with atomic numbers 19, 37, 55 lie in group 1 (alkali metals). Within a group, IE decreases from top to bottom. Therefore, IE of Y could be between those of X and Z.

Hence, option (C) is correct.

2. Solution: (C)

Na^+ and Ne have the same electrons that is 10 but Na being positive ion will exhibit more effective nuclear charge and hence its radius will be low.

Similarly, O^{2-} and F^- have same electrons that is 10 but $\text{O}^{(2-)}$ having more negative charge will have higher size because of more polarization.

Hence, option (C) is correct.

3. Solution: (B)

These are isoelectronic species. They have same number of electrons (10 electrons in each ion). Ca^{2+} has max positive charge that is of 20 protons and hence will pull e more inside thus implying smaller radius.

Similarly, S^{2-} has lowest protons 16, hence will be less effectively pulled by nucleus.

Hence, option (B) is correct.

4. Solution: (B)

P has higher ionisation energy than S as P has a half-filled 3p subshell. Removal of an electron from P atom will break the stability of half-filled subshell.

Hence, option (B) is correct.

5. Solution: (B)

No of radial nodes in 3s

$$= n - l - 1 = 3 - 0 - 1 = 2$$

Hence, option (B) is correct.

6. Solution: (A)

Moving right in the periodic table results in an increase in electronegativity and a decrease in electronegativity if we move downwards.

Be being on the top right expected to have a maximum value of electronegativity

Hence, option (A) is correct.

7. Solution: (C)

Orbital angular momentum is denoted by l while magnetic quantum no which defines the orbitals is denoted by m .

Spin quantum no which is $\frac{1}{2}$ or $-\frac{1}{2}$ for an electron is denoted by s Total angular quantum no is denoted by J

Hence, option (C) is correct.

8. Solution: (B)

Decrease in electronegativity is observed if we move downwards. And greater the electronegativity greater would be the amount of energy required to remove an electron from the outermost shell and hence greater would be the ionization energy.

Hence, option (B) is correct.

9. Solution: (B)

3d atomic orbital,

$$\text{Radial nodes} = n - l - 1 = 3 - 2 - 1 = 1$$

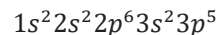
$$\text{Angular nodes} = l = 2$$

Hence, option (B) is correct.

CHHATTISGARH SET

1. Solution: (C)

Chlorine (Cl) has an atomic number of 17, meaning its electron configuration is:



The unpaired electron in chlorine resides in the 3 p orbital (since the 3p subshell contains 5 electrons, which leaves one electron unpaired).

Now, let's break down the quantum numbers:

Principal Quantum Number (n): This represents the energy level of the electron. For the 3 p orbital, $n = 3$.

Azimuthal Quantum Number (l): This represents the angular momentum of the electron and is associated with the type of orbital. For a p orbital, $l = 1$.

Magnetic Quantum Number (m_l): This number specifies the orientation of the orbital. For a p orbital ($l = 1$), the possible values of m_l are $-1, 0$, and 1 .

Spin Quantum Number (m_s): This represents the spin of the electron. The unpaired electron can have $m_s = +\frac{1}{2}$ or $m_s = -\frac{1}{2}$, but since the problem doesn't specify the spin direction, we don't need to focus on that detail for this question.

Hence, option (C) is correct.

GUJARAT SET

1. Solution: (C)

The radius of the ion depends on the effective nuclear charge, more the charge, more heavily the electrons are attracted towards the center and lesser in the size. Hence the ionic radii are inversely proportional to effective nuclear charge.

Hence, option (C) is correct.

2. Solution: (C)

The 1st Ionization Potential increases across a period as atomic size decrease. Given elements are Be, B, C, N, O.

1st Ionization Potential order is $B < C < O < N$.

Hence, option (C) is correct.

3. Solution: (B)

There are total four quantum numbers. Their values can be given in the following manner:

Quantum Number	Symbol	Possible values
Principal quantum number	n	1,2,3,4,.....
Azimuthal quantum number	l	0,1,2,3,4,.....($n-1$)
Magnetic quantum number	m_l	$-l, \dots, -1, 0, 1, \dots, +l$
Spin quantum number	m_s	$+1/2, -1/2$

All the SETs given above in the option, only $n = 2, l = 1, m = 0, s = +1/2$ matches with the above table

Hence, option (B) is correct.

4. Solution: (D)

Van der Waals forces include attraction and repulsions between atoms, molecules, and surfaces, as well as other intermolecular forces. The order of van der Waals interaction present in the halogens is given as $F_2 < Cl_2 < Br_2 < I_2$. This is the same order as that for the increase in the atomic size. Higher is the atomic size, higher will be the van der Waal's force.

Hence, option (D) is correct.

5. Solution: (B)

When one or more of the bonding pairs of electrons is replaced with a lone pair, the molecular geometry (actual shape) of the molecule is altered or contracted. The bond angle in the tetrahedral CH_4 molecule is 109.5° . Again, the replacement of one of the bonded electron pairs with a lone pair compresses the angle slightly. The H–N–H angle is approximately 107° . In the

water molecule, two of the electron pairs are lone pairs rather than bonding pairs. The molecular geometry of the water molecule is bent. The H–O–H bond angle is 104.5° , which is smaller than the bond angle in NH_3 .

Hence, option (B) is correct.

6. Solution: (D)

I is stabilized by resonance while II is not. As I is stabilized by resonance it will have less nucleophile character than II. I will react slower than II.

Hence, option (D) is correct.

7. Solution: (C)

Second ionization potential is the amount of energy required to remove an electron from the outer shell of unipositive ion and the electronic configuration of unipositive ions is as follows

$C^+(5) = 1s^2, 2s^2, 2p^1$ and $N^+(6) = 1s^2, 2s^2, 2p^2$

$O^+(7) = 1s^2, 2s^2, 2p^3$ and $F^+(8) = 1s^2, 2s^2, 2p^4$

In O^+ , half-filled p-orbital is present, so its second ionization potential is greater than that of F^+ . Thus, the correct is $O > F > N > C$.

Hence, option (C) is correct.

8. Solution: (C)

A valence-electron in a multi-electron atom is attracted by the nucleus and repelled by the electrons of inner-shells. The combined effect of this attractive and repulsive force acting on the valence-electron experiences less attraction from the nucleus. This is called shielding or screening effect. In Cl, there are empty d-orbitals where it can accommodate its electron and because of this, attraction forces increase and electron affinity also.

Hence, option (C) is correct.

9. Solution: (C)

In the structure of ice, due to Hydrogen bonding each molecule of H_2O is surrounded by three H_2O molecules in hexagonal honey comb manner. So due to large empty space voids are present in ice. When ice melts, density increases as water molecules come closer together to filling up empty spaces.

In the structure of ice each molecule of H_2O is surrounded by three H_2O molecules in hexagonal honey comb manner. Whereas in water, each molecule is surrounded by four neighboring molecules randomly which results in an open cage – like structure. As a result, there are a number of 'hole' or open spaces are present in ice. When ice melts a large number of hydrogen bonds are broken. The molecules of H_2O

occupy the holds or open spaces and come closer to each other than they were in solid state. This results in sharp increase in the density. Therefore, ice has lower density than water at 4°C

Hence, option (C) is correct.

10. Solution: (C)

The concept of dissociation energy depends upon the concept of bond order, bond strength and bond length. *Higher is the bond order, stronger is the bond strength, shorter is the bond length and largest is the bond dissociation energy.* From the options given above, bond order of CN⁻ is the largest (3) than BN (2), CN (2.5) and NO (2.5) and hence it has the largest dissociation energy.

Hence, option (C) is correct.

11. Solution: (D)

Generally, *As the Z_{eff} increase in a period for left to right direction so the radius decreases.* But in the case of Nobel gases, the van der Waal's radius is much larger than other elements. This is because of the more electron-electron repulsion. In a group radius increase down the group. So, the order is-

$F < Cl < O < N < Ne$

Hence, option (D) is correct.

12. Solution: (A), (B)

The radial part of wave function which relates to the position of an electron at a specific point depends on the principal quantum number and azimuthal quantum number.

Hence, option (A) and (B) both are correct.

13. Solution: (A)

Ionic character can be calculated by formula:

$$\% \text{ ionic character} = 16[E_A - E_B] + 3.5[E_A - E_B]^2 = 16[2.5 - 1.05] + 3.5[2.5 - 1.05]^2 = 28.80\%$$

Hence, option (A) is correct.

14. Solution: (A)

The general trend for electron affinities in halogens decreases down the group, with a few exceptions.

Chlorine (Cl) has the highest electron affinity, followed by fluorine (F). Despite fluorine being more electronegative, its small atomic size results in higher electron-electron repulsion, making its electron affinity slightly less than that of chlorine.

Bromine (Br) and iodine (I) follow, with their electron affinities decreasing as you move down the group.

Hence, option (A) is correct.

15. Solution: (B)

Ionization energy decreases down the group but increases from left to right in a period. So $K < Na < Al < Mg$ is the correct order of ionization energy potassium is present in the fourth period. Sodium, aluminum & magnesium.

Hence, option (B) is correct.

16. Solution: (D)

"It increases down the group in s- and p-blocks, but decreases down a group in d-block."

This is incorrect. The correct trend is that it decreases down the group in s- and p-blocks, not increases.

Hence, option (D) is correct.

17. Solution: (B)

The first electron affinity, associated with the formation of O⁻, is generally exothermic (negative energy), as energy is released when an electron is added to a neutral oxygen atom.

The second electron affinity, associated with the formation of O²⁻, is endothermic (positive energy), because energy is required to add an electron to the negatively charged O⁻ ion (due to electron-electron repulsion). For O⁻: **-142 kJ/mol** (exothermic) For O²⁻: **+702 kJ/mol** (endothermic)

Hence, option (B) is correct.

HIMANCHAL PRADESH SET

1. Solution: (C)

All carbon atoms have six protons, and most have six neutrons as well. But some carbon atoms have seven or eight neutrons instead of the usual six. ... Different isotopes of an element generally have the same physical and chemical properties because they have the same numbers of protons and electrons.

Hence, option (C) is correct.

2. Solution: (D)

For 4d orbital,

Angular nodes = $l = 2$ for d-orbital

Radial node = $n - l - 1 = 4 - 2 - 1 = 1$

Hence, option (D) is correct.

JAMMU KASHMIR SET

1. Solution: (B)

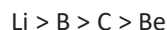
Know about the second ionization energy of the given atoms we are supposed to know the electronic configuration of the given atoms.

- The atomic number of lithium is 3 and the electronic configuration of the lithium is $1s^2 2s^1$
- The atomic number of beryllium is 4 and the electronic configuration of the beryllium is $1s^2 2s^2$
- The atomic number of boron is 5 and the electronic configuration of the boron is $1s^2 2s^1 2p^1$
- The atomic number of carbon is 6 and the electronic configuration of the carbon is $1s^2 2s^1 2p^2$

After removing one electron from the given elements the electronic configuration of the given elements will be as follows.

- Electronic configuration of the lithium (+1) is $1s^2 2s^0$.
- Electronic configuration of the beryllium (+1) is $1s^2 2s^1$.
- Electronic configuration of the boron (+1) is $1s^2 2s^2 2p^0$.
- Electronic configuration of the carbon (+1) is $1s^2 2s^2 2p^1$

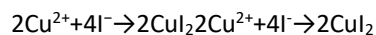
Hence the order will be:



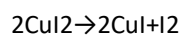
The second ionization energy for lithium is very high because the electronic configuration of Li (+1) resembles the electronic configuration of the stable noble gas. Boron also has filled 2s orbital after losing one electron. So, boron has high second ionization energy.

Hence, option (B) is correct.

2. Solution: (B)



The CuI_2 immediately decomposes to liberate I₂ and insoluble copper (I) iodide.



Hence, option (B) is correct.

3. Solution: (D)

In nth shell, the total number of orbitals are n^2 where each orbital can occupy a maximum of two electrons with opposite spin quantum number as $+1/2$ and $-1/2$. Hence max will be $2n^2$. Rest of the three quantum numbers in a given orbital will be same.

Thus it will follow Pauli's exclusion principle.

Hence, option (D) is correct.

4. Solution: (B)

The ionization energy is the energy required to remove an electron from the outermost shell of an isolated gaseous atom. When the first electron or the most loosely bound electron is removed, the amount of energy required is less than the energy required to remove the electron in the next successive shell. This ionisation energy goes on increasing with the number of electrons removed.

So the number of electrons removed from the successive no of shells and the energy involved is called successive ionization energy.

The second ionization energy is the energy required to remove an electron from a $1+$ cation in the gaseous state. Just like the first ionization energy, the second ionization energy is affected by size, effective nuclear charge, and electron configuration.

The order is $\text{Be} < \text{C} < \text{B} < \text{Li}$

Hence, option (B) is correct.

5. Solution: (B)

These are isoelectronic species. They have same number of electrons. S^{2-} has lowest protons 16, hence will be less effectively pulled by nucleus and hence the largest size.

Hence, option (B) is correct.

6. Solution: (B)

Li has the most negative E° value while E° values of other alkali metal become more and more negative as we, move down the group from Na to Rb.

Hence, option (B) is correct.

7. Solution: (C)

The correct order of electron gain enthalpy with negative sign of F, Cl, Br, and I is $\text{Cl} > \text{F} > \text{Br} > \text{I}$. Actually halogens have maximum electron gain enthalpy in the corresponding periods and it becomes less negative down the group. However, the negative electron gain enthalpy of fluorine is less than that of chlorine.

Hence, option (C) is correct.

8. Solution: (A)

Properties of elements are a periodic function of their atomic number. 'Let us recall that the atomic number gives us the number of protons in the nucleus of an atom and this number increases by one in going from one element to the next. Atomic no is given by the no of protons and electrons. Now in nucleus, protons are present so, the correct option is A

Hence, option (A) is correct.

9. Solution: (A)

Highest electron affinity will be of oxygen because as we move down the group, the size increases and hence the attraction of nucleus for electron also decreases.

Hence, option (A) is correct.

10. Solution: (A)

Electronegativity of atoms change less rapidly when crossing the d-block of elements than when crossing the p-block. This is due to the higher screening effect of penultimate d electrons. Hence, the increase in the

effective nuclear charge is more gradual for d block elements.

Hence, option (A) is correct.

11. Solution: (C)

Since Rb belongs to the first group of the periodic table and Ba belongs to the second period, hence the reaction between the two is not possible. The first metal has +1 valency while the period 2 metal while have +2 valency.

Hence, option (C) is correct.

12. Solution: (A)

Electronegativity increases across a period because of the number of charges on the nucleus increases. That attracts the bonding pair of electrons more strongly. It decreases along a group because the no of charges on nucleus is decreasing. Hence, be will have maximum electronegativity.

Hence, option (A) is correct.

13. Solution: (C)

The no of radial nodes = $n - l - 1$

$$3s = 3 - 0 - 1 = 2$$

Hence, option (C) is correct.

14. Solution: (B)

Generally, ionization energy increases with atomic number in a period as we move from left to right. But as P has the stability of half-filled 'p' orbital, it has greater ionization energy than S which has 4 electrons in 3p level and would readily lose the extra electron to acquire the stable half-filled 3p orbital.

Hence, option (B) is correct.

15. Solution: (C)

Orbital angular momentum is denoted by l which defined the type of orbital present. $L = 0 - s$

$$L = 1 - p$$

$$L = 2 - d$$

Magnetic quantum no is denoted by M quantum no

Spin quantum no is denoted by S

Total angular momentum is denoted by J

Hence, option (C) is correct.

16. Solution: (B)

While moving down the group, the electronegativity increases, with this increase the atoms try to keep their electrons to themselves and hence more ionization energy is required to remove the outermost electrons, hence an increase in I.E is observed.

Hence, option (B) is correct.

17. Solution: (C)

The radius of Fe^{3+} is lower than that of Fe^{2+} because the greater the charge, the greater would be the effective nuclear charge experienced and hence smaller radius.

Hence, option (C) is correct.

18. Solution: (B)

To achieve the stable half-filled d orbital configuration, only 1 electron is occupied by s orbital and 5 electrons are occupied by d-orbital.



Hence, option (B) is correct.

KARNATAKA SET

1. Solution: (D)

A) E.N.: $F > Cl > Br$ - Electronegativity decreases down the group and F is the most electronegative element.

B) E.A.: $Cl > Br < F$ - Electron affinity of fluorine is less than that of chlorine because of small size of F atom. As a result, there is strong interelectronic repulsion in the relatively small 2p orbitals of F and thus, the incoming electron does not experience much attraction.

Fluorine is stronger oxidising agent than chlorine because low bond dissociation energy of F-F bond and high hydration enthalpy of F^-

Bond energy $F_2 > Cl_2 > Br_2$ is wrong because low bond dissociation energy of F-F bond than Cl-Cl.

Hence, option (D) is correct.

2. Solution: (A)

Electronegativity depends on the number of electrons required to get octet configuration. It increases from left to right in a period, hence correct order is $F > O > N > C$.

Hence, option (A) is correct.

3. Solution: (C)

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

- Atomic size: On moving down the group, as additional shells are added, the atomic size increases.
- Shielding effect: As the number of inner electrons increases, the shielding effect on the outermost electrons increases.
- Nuclear charge: On moving from top to down in a group, the nuclear charge increases. The effect of increase in the atomic size and the shielding effect is much more significant than the nuclear charge. The electron becomes less tightly held to the nucleus on moving down the group.

Due to this, the ionization enthalpies gradually decrease on moving down the group. In non-transition elements. Hence, option (C) is correct.

4. Solution: (B)

Sodium and chlorine atoms come together to form sodium chloride (NaCl). NaCl is an ionic compound because of the strong electrostatic forces of attraction between positively charged Na metal cations and negatively charged Cl non-metal anions.

Carbon disulfide (CS₂) is made by the reaction of carbon and Sulphur. Since electronegativity of C and S is almost same so it is a covalent compound.

Sulphur reacts with oxygen to give Sulphur dioxide (SO₂). Sulfur dioxide bond is of covalent bonding since Sulphur and oxygen are both non-metals.

Calcium hydride (CaH₂) is an ionic compound that is formed when calcium metal reacts with hydrogen gas.

Hence, option (B) is correct.

5. Solution: (A)

Electronegativity varies in a predictable way across the periodic table. Electronegativity increases from bottom to top in groups, and increases from left to right across periods. Thus, fluorine is the most electronegative element, while francium is one of the least electronegative.

Hence, option (A) is correct.

6. Solution: (B)

7. Solution: (B)

Due to stable fully filled p-orbital the neon molecule does not want to lose electrons easily. Therefore, its first ionization potential is high. Also in sodium, the first ionization energy would be low as it would lead to stable inert gas configuration.

Hence, option (B) is correct.

8. Solution: (C)

In nitrogen, the first ionization energy would be very high as the electron is to be removed from stable half-filled p-orbital.

Hence, option (C) is correct.

9. Solution: (D)

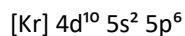
ZnS is soluble in acidic solution. Hence, it cannot be precipitated from acidic solution. However, it can be precipitated from alkaline solution and to some extent from neutral solution. CuS and PbS can be precipitated from acidic solution.

Thus, the treatment of hydrogen sulfide with a solution containing ions of copper, zinc and lead will precipitate CuS and PbS.

Hence, option (D) is correct.

10. Solution: (B)

The electronic configuration of xenon is-



In excited state, the two electrons in 5p are excited to higher energy 5d orbital.

Hence, option (B) is correct.

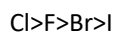
11. Solution: (D)

The distribution of electrons in these molecular orbitals by filling the orbitals in the same way that we fill atomic orbitals.

Hence, option (D) is correct.

MADHYA PRADESH SET

1. Solution: (B)



This means chlorine has the highest electron affinity, followed by fluorine, then bromine, and iodine has the lowest. The reason chlorine has a higher electron affinity than fluorine is due to fluorine's small atomic size, which leads to increased electron-electron repulsion when an extra electron is added.

Hence, option (B) is correct.

2. Solution: (A)

The lattice enthalpy of an ionic compound depends on two main factors:

1. Charges of the Ions: Higher charges result in stronger electrostatic attractions.
2. Sizes of the Ions: Smaller ions allow ions to get closer, strengthening the electrostatic forces.

MgO has the greatest lattice enthalpy because it has ions with higher charges and smaller sizes compared to the other options. MgO has the greatest lattice enthalpy because it involves highly charged small ions (Mg²⁺ and O²⁻).

Hence, option (A) is correct.

MAHARASHTRA SET

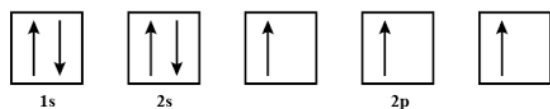
1. Solution: (C)

Total number of nodes for any orbital can be given by = $n - 1$ where n is the principal quantum number. For 3s orbital value of n is 3 so total number of orbitals is = $n - 1 = 2$

Hence, option (C) is correct.

2. Solution: (C)

The presence of three unpaired in Nitrogen can be explained by Hund's rule. According to this rule, *electron pairing in any orbital (s, p, d or f) cannot take place until each orbital of the same sublevel contains 1 electron*. The atomic number of nitrogen is 7, so its electronic configuration will be $1s^2 2s^2 2p^3$. 2p orbital has 3 sub-levels each of which will contain one electron. Pairing will occur only if the fourth electron is added. The distribution of electrons on the nitrogen is shown as follows:



Hence, option (C) is correct.

3. Solution: (D)

$H = \frac{1}{2} [V + M - C + A]$ where,

H = Number of orbitals involved in hybridization.

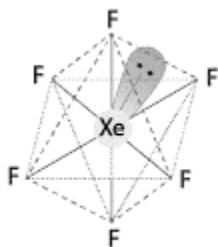
V = Valence electrons of a central atom.

M = Number of monovalent atoms linked to the central atom.

C = Charge of the cation.

A = Charge of the anion.

By applying the above formula, we get, the structure of XeF_6 is distorted one $[\text{sp}^3\text{d}^3]$. Others are perfect octahedral.

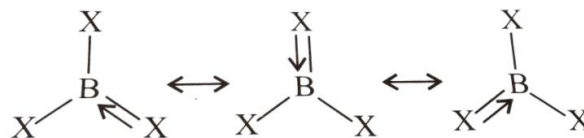


Hence, option (D) is correct.

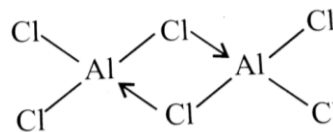
4. Solution: (B)

Boron atom being small in size is unable to accommodate four large-sized chlorine atoms around it. However, because of its large size, Al can easily accommodate four large-sized Cl atoms around it. Since in both BCl_3 and AlCl_3 , there are only six electrons

present in the valence shell of B and Al, both are electron deficient compound. BCl_3 compounds reduce their electron deficiency by accepting a pair of electrons from the filled np orbital of the halogen atom in the vacant 2p orbital of B, thus forming $\text{p}\pi\text{-p}\pi$ back bonding.



However, Al accepts a pair of electrons from 3p orbital of Cl (from another AlCl_3 molecule) in its vacant 3p orbital. As a result, AlCl_3 exist as a chlorine-bridged dimeric structure.



Hence, option (B) is correct.

5. Solution: (B)

A hydrogen bond is the electrostatic attraction between polar groups that occurs when a hydrogen (H) atom bound to a highly electronegative atom such as nitrogen (N), oxygen (O) or fluorine (F) experiences attraction to some other nearby highly electronegative atom. More electronegative the element, more is the hydrogen bonding.

Hence, the order is $\text{Cl} < \text{N} < \text{O} < \text{F}$

Hence, option (B) is correct.

6. Solution: (C)

The energy required to convert one Mg atom to Mg^{2+} ion is the sum of first and second ionization potentials = $7.646 + 15.035 = 22.681\text{eV} = 96.5 \times 22.681 = 2188.7\text{kJ/mol}$. The atomic mass of Mg is 24 g/mol and 12 mg of Mg corresponds to 0.5 millimoles.

The amount of energy required to convert 0.5 mmol of Mg atoms to Mg^{2+} ions = $0.5 \times 10^{-3} \times 2188.7 = 1.1\text{kJ}$

Hence, option (C) is correct.

7. Solution: (D)

As we go down group electropositive character increases because of increases in size and hence I.E. decreases. Ba is the most electropositive element in the group and Mg is least.

So, correct order is: $\text{Mg} > \text{Ca} > \text{Sr} > \text{Ba}$.

Hence, option (D) is correct.

8. Solution: (B)

There are certain rules that defines the acidity and the basicity of the oxides.

All metallic oxides are basic in nature hence, Na_2O is more basic in nature. Metal oxides which react with both acids as well as bases to produce salts and water are known as amphoteric oxides. Many metals (such as zinc, tin, lead, aluminum, and beryllium) form amphoteric oxides or hydroxides.

All nonmetallic oxides are acidic in nature hence, acidic oxides are NO_2 , CO_2 .

Deciding between CO_2 and NO_2 , we have carried out the hydrolysis reaction of both which produces H_2CO_3 [less acidic] and HNO_3 [more acidic] and hence correct order is $\text{CO}_2 < \text{NO}_2 < \text{Al}_2\text{O}_3 < \text{Na}_2\text{O}$

Hence, option (B) is correct.

9. Solution: (A)

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 10 d 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. Hence the order is, $\text{B} > \text{Tl} > \text{Ga} > \text{Al} > \text{In}$

Hence, option (A) is correct.

10. Solution: (A)

Valinomycin is a naturally occurring compound in living beings used in the transport of potassium. It is highly selective for potassium ions over sodium ions within the cell membrane. It functions as a potassium-specific transporter and facilitates the movement of potassium ions through lipid membranes down the electrochemical potential gradient.

Hence, option (A) is correct.

11. Solution: (A)

From left to right, Atomic size decreases due to increase in effective nuclear charge and from top to bottom, atomic size increases due to increase in principal quantum number. Hence the order is given as: $\text{Si} > \text{P} > \text{S} > \text{Cl}$

Hence, option (A) is correct.

12. Solution: (D)

A hydrogen bond is the electrostatic attraction between polar groups that occurs when a hydrogen (H) atom bound to a highly electronegative atom such as nitrogen (N), oxygen (O) or fluorine (F) experiences attraction to some other nearby highly electronegative atom. *More electronegative the element, more is the hydrogen bonding.* Also, the chlorine atom is too large. Despite its electronegativity, the size of the atom is such that its electron density is too low to form hydrogen bonds. This is why Chlorine does not display hydrogen bonding while nitrogen does. The correct order of the electronegativity is $\text{Cl} < \text{N} < \text{O}$ and hence, (i) > (iii) > (ii) Hence, option (D) is correct.

13. Solution: (C)

Hardness of the compound depends upon the size [atomic and ionic radius]. *Smaller is the radius, smaller is the size and harder is the base which shows higher HOMO-LUMO gap.* In the given question, size follows the order as, $\text{CH}_3^- > \text{NH}_2^- > \text{OH}^- > \text{F}^-$ and hence, the correct order of the hardness is $\text{CH}_3^- < \text{NH}_2^- < \text{OH}^- < \text{F}^-$ Hence, option (C) is correct.

RAJASTHAN SET

1. Solution: (C)

Mg has electronic configuration- $1s^2 2s^2 2p^6 3s^2$, since the electron is to be removed from fully filled 2s electronic configuration, hence will have highest ionization potential.

Hence, option (C) is correct.

2. Solution: (A)

The shielding effect can be defined as a reduction in the effective nuclear charge on the electron cloud, which is due to a difference in the attraction forces on the electrons in the atom. The s orbital has the greatest effect to reduce the force of attraction between the outermost electron and nucleus due to its effective charge density followed by $p > d > f$. According to orbital order, S orbital is closest to the nucleus followed by the P orbital, D orbital and finally the F orbital.

So, as per the screening effect, S orbital being close to the nucleus lacks screening from any other orbital as it is the first and the closest orbital.

Hence, option (A) is correct.

3. Solution: (D)

The inert pair effect decreases down a group, Bi will experience the maximum because the inert pair effect is the tendency of two Electrons in the outermost atomic orbital to remain unshared. The Electrons present in the intervening d-(and f-) orbitals do not effectively shield the s-electrons of the valence shell down the group. As a result, the inert pair of s Electrons remains more tightly held by the nucleus and hence participates less in bond formation.

Hence, option (D) is correct.

4. Solution: (C)

N will have the maximum ionization energy $1s^2 2s^2 2p^3$ because it will require maximum energy to remove an e from stable half-filled electronic configuration.

B will have the lowest ionization energy, $1s^2 2s^2 2p^1$ because on removing the e from p orbital, stable fully filled configuration will be achieved.

Hence, option (C) is correct.

5. Solution: (A)

Comparison of melting points of ionic compounds is generally done by considering the following two factors:

Charge of the cation/anion: More the charge of cation or anion, stronger will be the forces of attraction between the ions and higher will be the melting point.

Ionic radii: More the distance between ions, lesser will be the strength of the bond giving rise to lesser melting point.

Going by the above rules, the order should have been: $\text{LiCl} > \text{NaCl} > \text{KCl} > \text{RbCl}$

(Since charges of the ions are same for each molecule and cationic radius increases down the group.)

But LiCl, due to excessive polarization (Fajans' rules), exhibits high covalent character and is placed last in the order. Hence, the new order would be:

$\text{NaCl} > \text{KCl} > \text{RbCl} > \text{LiCl}$

Hence, option (A) is correct.

6. Solution: (D)

We know that the ionization energy decreases from top to bottom in a group. This is because as we move down the group, the atomic size increases and hence the force of attraction towards the valence electrons decreases.

In the above scenario, thallium has the least ionization energy compared to the other elements.

Hence, option (D) is correct.

7. Solution: (A)

Cr acquires

$4s^1 3d^5$ configuration so as to achieve half filled d-

configuration while Cu acquires

$4s^1 3d^{10}$ configuration so as to achieve fully filled d-configuration which is highly stable.

Hence, option (A) is correct.

WEST BENGAL SET**1. Solution: (B)**

If the electronegative difference is >1.7 then its nature is ionic and <1.7 then its nature is covalent and if its equal to 1.7 then nature of bond will be 50% ionic and 50% covalent.

Hence, option (B) is correct.

2. Solution: (D)

Among alkaline earth metal hydroxides, the anion being common, the cationic radius will influence the lattice enthalpy. Since lattice enthalpy decreases much more than the hydration enthalpy with increasing ionic size, the solubility increases down the group ($\downarrow$). The size of anions being much larger as compared to cations, the lattice enthalpy will remain almost constant within a particular group. Since the hydration enthalpy decreases down the group, solubility will decrease as found for alkaline earth metal carbonates and sulphates.

Hence, option (D) is correct.

3. Solution: (B)

As we move down the group, size increases. The smallest size Be will have maximum effective nuclear charge and hence the highest ionization enthalpy that is the energy required to remove an outermost electron.

Hence, option (B) is correct.

4. Solution: (C)

S-character is directly proportional to Bond angle i.e.

$S\text{-character} \propto \text{Bond Angle}$

Combination of S & P orbitals gives rise to Hybrid orbitals and more the s-character of a Hybrid molecule has, the greater the angle between their bond.

As F is more electronegative than O, so %S in C-F bond decreases hence $\angle \text{FCF}$ bond angle also decreases.

Hence, $\angle \text{FCO} > 120$ and $\angle \text{FCF} < 120$.

Hence, option (C) is correct.

5. Solution: (C)

The last shell will indicate the period while $n+1$ of the previous shell will indicate the group of the element in periodic table.

Hence, option (C) is correct.

6. Solution: (B)

Lattice Energy Factors:

Charge: All ions have the same charge (+2), so charge doesn't affect the order.

Ionic Size: Smaller ions have higher lattice energy because they attract the opposite ions more strongly.

Ionic Radii:

Ni^{2+} is the smallest ion.

Cr^{2+} is medium-sized.

Mn^{2+} is the largest ion.

Order of Lattice Energy:

$\text{Ni}^{2+} > \text{Cr}^{2+} > \text{Mn}^{2+}$

Smaller size (Ni^{2+}) leads to higher lattice energy.

Larger size (Mn^{2+}) leads to lower lattice energy.

Hence, option (B) is correct.

7. Solution: (B)

N_2 (Nitrogen Gas):

High Ionization Energy: Strong triple bond makes electrons tightly held, requiring more energy to remove an electron.

N (Nitrogen Atom): Moderate Ionization Energy: Single nitrogen atom has a lone electron, less tightly held than in N_2 , but more than in NO.

NO (Nitric Oxide): Lowest Ionization Energy: Contains an unpaired electron (radical), making it easier to remove an electron compared to N_2 and N.

The strong triple bond in N_2 results in the highest ionization energy. A single N atom has lower ionization energy than N_2 but higher than NO, which, being a radical, has the lowest ionization energy. Therefore, the order is:

$\text{N}_2 > \text{N} > \text{NO}$

Hence, option (B) is correct.

8. Solution: (B)

The ground-state electron configuration of boron (atomic number 5) is $1s^2 2s^2 2p^1$. The outermost electron in the ground state is in the $2p$ -orbital.

1. Principal Quantum Number (n): Since the outermost electron is in the second shell, $n = 2$.
2. Azimuthal Quantum Number (l): For a p -orbital, $l = 1$.
3. Magnetic Quantum Number (m): For $l = 1$, possible values of m are $-1, 0, +1$. The correct choice here is $m = -1$, which is specified in option B.
4. Spin Quantum Number (s): The electron can have $s = +\frac{1}{2}$ or $s = -\frac{1}{2}$. Here, $s = +\frac{1}{2}$ is specified.

Therefore, the correct set of quantum numbers for the outermost electron in boron is $n = 2, l = 1, m = -1, s = +\frac{1}{2}$.

Hence, option (B) is correct.

9. Solution: (D)

Chlorine (Cl) has the highest $-\Delta H_f$ because it is large enough to minimize electron repulsion compared to F , while still having a high nuclear charge that strongly attracts the added electron. This makes the formation of Cl^- release more energy (more negative ΔH_f) than O^- , O^{2-} , or F^- .

Hence, option (D) is correct.

10. Solution: (B)

To solve this, let's identify the atomic numbers of the elements based on their systematic names.

Unnilhexium (Unh):

The name "Unnilhexium" is derived from IUPAC's temporary naming system:

"Un" = 1, "Nil" = 0, "Hex" = 6

Atomic number = 106 (now known as Seaborgium (Sg)).

Ununennium (Uue):

Similarly, "Ununennium" translates to:

"Un" = 1, "Un" = 1, "En" = 9

Atomic number = 119 (a hypothetical element yet to be fully confirmed).

Hence, option (B) is correct.

5. Which of the following exhibits distinct acidic character?
- (A) B_2O_3 (B) Al_2O_3
(C) Ga_2O_3 (D) In_2O_3

(GJ-SET 2014)

6. Which of the given boron hydride is an arachno borane?

(A) $[B_5H_5]^{2-}$ (B) $[B_5H_8]^-$
(C) $[B_5H_9]$ (D) $[B_5H_{11}]$

(GJ-SET 2014)

7. In
- O_3^-
- , the O-O bond order is:

(A) 1.5 (B) 1
(C) 1.25 (D) 2

(GJ-SET 2014)

8. The oxidation number of nitrogen in
- N_3^-
- is:

(A) -1 (B) +1
(C) 0 (D) -1/3

(GJ-SET 2014)

9. Which one of the following elements in its native form is not expected to behave as ligand?

(A) P_4 (B) S_8
(C) N_2 (D) B_{12}

(GJ-SET 2014)

10. Which of the following does not have a bridging oxygen?

(A) Dichlorineheptoxide (B) Dichromate anion
(C) Orthosilicate (D) Pyrophosphoric acid

(GJ-SET 2014)

11. The gas most widely used in discharge tubes for advertisement is:

(A) He (B) Ne
(C) Kr (D) Xe

(GJ-SET 2016)

12. Amongst the following, which has a graphite like structure?

(A) Silicon carbide (B) Silica
(C) Boron nitride (D) Borazine

(GJ-SET 2017)

13. On hydrolysis, diborane produces:

(A) $H_3BO_2 + H_2O_2$ (B) $H_3BO_3 + H_2$
(C) $B_2O_3 + O_2$ (D) $H_3BO_3 + H_2O_2$

(GJ-SET 2017)

14. The reaction that yields
- $Li[AlH_4]$
- is:

(A) $HCl_{(excess)} + AlCl_3 + Li \rightarrow$ (B) $H_2 + Al + Li \rightarrow$
(C) $LiH_{(excess)} + AlCl_3 \rightarrow$ (D) $LiH_{(excess)} + Al \rightarrow$

(GJ-SET 2017)

15. Which of the following is not paramagnetic?

(A) NO_2 (B) O_2^-
(C) ClO_2 (D) Cl_2O_7

(GJ-SET 2017)

16. Of the following ions the one which is an ampholyte is:

(A) CO_3^{2-} (B) SO_4^{2-}
(C) HPO_4^{2-} (D) NO_3^-

(GJ-SET 2017)

17. Oxidation state of iodine in
- HIO_4
- ,
- H_3IO_5
- and
- H_5IO_6
- is respectively:

(A) +5, +2, +1 (B) +3, +2, +1
(C) +4, +5, +6 (D) +7, +7, +7

(GJ-SET 2018)

- 18.
- H_3BO_3
- is:

(A) Monobasic and strong Lewis's acid
(B) Monobasic and weak Bronsted base
(C) Tribasic and weak Bronsted acid
(D) Monobasic and weak Lewis's acid

(GJ-SET 2018)

19. Which of the following is colored?

(A) SnF_4 (B) $SnCl_4$
(C) $SnBr_4$ (D) SnI_4

(GJ-SET 2018)

20. To which type of the borane
- $[B_9C_2H_{11}]^{2-}$
- belongs:

(A) Closo (B) Nido
(C) Arachno (D) Hypo

(GJ-SET 2019)

21. The 'STYX' code for
- B_4H_{10}

(A) 4012 (B) 4120
(C) 4220 (D) 4024

(GJ-SET 2019)

22. Which of the following are arachno boranes?

(I) $B_6H_6^{2-}$ (II) B_4H_{10} (III) B_5H_9 (IV) B_6H_{12}
(A) (I) and (II) (B) (II) and (III)
(C) (I) and (IV) (D) (II) and (IV)

(GJ-SET 2019)

23. Which of the following on thermal decomposition yields a basic as well as an acidic oxide?

(A) $KClO_3$ (B) $CaCO_3$
(C) NH_4NO_3 (D) $NaNO_3$

(GJ-SET 2019)

24. Pick out the false statement from the following about ozone:

(A) Ozone is bent molecule with C_{2v} symmetry.
(B) The central oxygen atom is sp^2 hybridized with one lone pair.
(C) It oxidizes H_2S to SO_2
(D) It oxidizes dry iodine to I_4O_9 , a yellow powder.

(GJ-SET 2019)

25. Which of the following molecule is known as inorganic graphite?

(A) P_4S_3 (B) $N_3B_3H_{12}$
(C) S_4N_4 (D) B_3N_3

26. Find the correct arrangement of the following oxyacid with respect to decreasing acid strength.

(A) $HClO > HClO_2 > HClO_3 > HBrO > HIO$
 (B) $HClO_3 > HClO_2 > HClO > HBrO > HIO$
 (C) $HIO > HBrO > HClO > HClO_2 > HClO_3$
 (D) $HBrO > HClO > HClO_3 > HClO_2 > HIO$

(GJ-SET 2022)

27. The reaction between BH_3F^- and BF_3H^- leads to the formation of

(A) $BH_4^+ + BF_4^-$ (B) $BH_4^- + BF_4^-$
 (C) $BH_4^- + BF_4^+$ (D) $[BH_3F]^- [BF_3H]^+$

(GJ-SET 2022)

28. Polyphosphazene polymers consist of much lower electrical conductivity due to

(A) They are saturated polymers.
 (B) Sigma bonds are not delocalized
 (C) Pi-bonds are not delocalized
 (D) Phosphorous and nitrogen atoms are bad conductors of electricity.

(GJ-SET 2022)

29. When graphite is reacted with potassium metal at $300^\circ C$ to give an intercalation compound of composition C_6K . This compound on further heating turn to give 2nd, 3rd, 4th and 5th stage compounds, respectively. Identify the correct sequence of the following.

(A) $C_{16}K, C_{32}K, C_{48}K, C_{64}K$
 (B) $C_{24}K, C_{36}K, C_{48}K, C_{60}K$
 (C) $C_{24}K, C_{32}K, C_{44}K, C_{64}K$
 (D) $C_{16}K, C_{36}K, C_{48}K, C_{60}K$

(GJ-SET 2022)

30. Which among the following is incorrect?

(A) The oxides and hydroxides of Al and Ga are amphoteric in nature
 (B) The oxides and hydroxides of In and Tl are purely basic
 (C) $Al(OH)_3$ dissolves in excess of NH_4OH whereas $Zn(OH)_2$ does not
 (D) Tl_2O_3 and In_2O_3 are completely basic and form neither hydrates nor hydroxides

(GJ-SET 2022)

31. Identify which among the following pair has neither acidic nor basic properties?

(A) B_2O_3 and SiO_2 (B) N_2O_3 and SO_3
 (C) CuO and CO_2 (D) N_2O and CO

(GJ-SET 2022)

32. The reaction between $Zn(NH_3)_2$ and two equivalents of $NaNH_2$ in liquid NH_3 leads to the formation of

(A) $Na_2Zn(NH)_2 + 2NH_3$
 (B) $Zn(NH_3)_4 NH_2 + 2Na^+$
 (C) $Na_2Zn(NH_3)_2 + 2NH_3$
 (D) $Zn(NH)_2 + NaN_3 + Na^+$

(GJ-SET 2022)

33. Polyphosphonitrilic chloride when stored in the air makes the material brittle, this is due to formation of

(A) Chlorine bridges (B) Hydrogen bridges
 (C) Nitrogen bridges (D) Oxygen bridges

(GJ-SET 2022)

34. Tin (Sn) exists in three forms: grey, white and rhombic. For this element, which of the following statements does not hold good?

(A) Grey tin exists in powder form
 (B) Grey tin is a good conductor of electricity
 (C) White tin is soft and ductile in nature
 (D) Rhombic tin is stable above $161^\circ C$

(GJ-SET 2022)

35. Which of the following statements is incorrect about the two common forms of alumina (i.e. $\alpha - Al_2O_3$ and $\gamma - Al_2O_3$)?

(A) $\alpha - Al_2O_3$ and $\gamma - Al_2O_3$ are reflected as activated alumina and Corundum, respectively
 (B) $\alpha - Al_2O_3$ is stable at high temperature
 (C) $\gamma - Al_2O_3$ is used in column chromatography
 (D) $\alpha - Al_2O_3$ is used as an abrasive material

(GJ-SET 2022)

36. Consider the following statements:

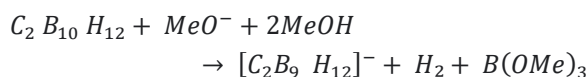
(1) Lead dissolves in organic acids.
 (2) Lead can be easily dissolved in dilute H_2SO_4 .
 (3) Lead reacts with F_2 in the cold forming PbF_2 .

The correct statements are

(A) 1 and 2 (B) 1 and 3
 (C) 2 and 3 (D) 1, 2 and 3

(GJ-2023: Set 2)

37. A strong base attacks on 1, 2-dicarba-closo-dodecaborane to yield,



The resulting anion, $[C_2B_9H_{12}]^-$ is a

(A) Conjugate acid of a strong base
 (B) Conjugate base of a strong acid
 (C) Conjugate acid of a weak base
 (D) Conjugate base of a weak acid

(GJ-2023: Set 2)

38. There are two reactions undergoing wherein, Diborane reacts separately with ammonia and with phosphine, resulting its _____ and _____ cleavages, respectively.

(A) Symmetric; unsymmetric
(B) Unsymmetric; symmetric
(C) Both symmetric
(D) Both unsymmetric

(GJ-2023: Set 2)

39. Of the following, which one is a natural zeolite?

(A) Benitoite (B) Cristobalite
(C) Phlogopite (D) Natrolite

(GJ-2023: Set 2)

40. Choose the correct statement(s) about white phosphorus:

(1) Pure form is a translucent liquid.
(2) When exposed to air, it undergoes oxidation.
(3) During oxidation, it gives a smell like that of garlic. and if the
(4) It vapours, if continuously inhaled, cause necrosis of the bones.
(A) 1 only (B) 1, 3 and 4 only
(C) 1 and 4 only (D) 2, 3 and 4 only

HIMACHAL PRADESH SET

(HP-SET 2017)

1. Assertion: Noble gas element exist as mono-atoms in molecules.

Reason: Noble gas element have stable outer electronic configuration.

(A) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.
(B) Both Assertion and Reason are correct but Reason is not the correct explanation for Assertion.
(C) Assertion is true but reason is incorrect
(D) Both Assertion and Reason are incorrect

(HP-SET 2017)

2. Which of the following halogens has the highest bond energy?

(A) F_2 (B) Cl_2
(C) Br_2 (D) I_2

(HP-SET 2017)

3. Which of the following light is effective in the formation of chlorophyll?

(A) Sodium lamp (B) Neon lamp
(C) Mercury lamp (D) Argon lamp

(HP-SET 2017)

4. Which reaction is not feasible?

(A) $2KI + Br_2 \rightarrow 2KBr + I_2$
(B) $2KBr + I_2 \rightarrow 2KI + Br_2$
(C) $2KBr + Cl_2 \rightarrow 2KCl + Br_2$
(D) $2H_2O + 2F_2 \rightarrow 2HF + O_2$

(HP-SET 2019)

5. Perxenate ion is:

(A) XeO_4^- (B) $HXeO_4^-$
(C) XeO_6^{4-} (D) XeO_4^{2-}

(HP-SET 2019)

6. The HOMO present in the borane cluster $[B_6H_6]^{2-}$ is:

(A) t_{2g} (B) t_{2u}
(C) a_{2g} (D) a_{1g}

JAMMU & KASHMIR SET

(J&K-SET 2011)

1. The paramagnetic oxides of nitrogen are:
(A) dinitrogen monoxide and nitrogen monoxide
(B) nitrogen monoxide and nitrogen dioxide
(C) nitrogen dioxide and dinitrogen trioxide
(D) dinitrogen trioxide and dinitrogen tetroxide

(J&K-SET 2011)

2. The oxyacid of sulphur that contains a lone pair of electrons on sulphur is:

(A) Sulphurous acid
(B) Sulphuric acid
(C) Peroxodisulphuric acid
(D) Pyrosulphuric acid

(J&K-SET 2012)

3. Boron is unable to form BF_6^{3-} because of:

(A) high electronegativity of boron
(B) high electronegativity of fluorine
(C) lack of d-orbitals in boron
(D) less difference in electronegativity between B and F

(J&K-SET 2012)

4. The gaseous molecule NO is:

(A) Paramagnetic
(B) Diamagnetic
(C) Ferromagnetic
(D) An even electron molecule

(J&K-SET 2012)

5. The correct order of bond energy is:

(A) $Cl_2 > Br_2 > F_2 > I_2$
(B) $Cl_2 > F_2 > Br_2 > I_2$
(C) $I_2 > Br_2 > Cl_2 > F_2$
(D) $I_2 > Br_2 > F_2 > Cl_2$

(J&K-SET 2016)

6. What is incorrect for Borazine?
 (A) Borazine is isoelectronic with benzene
 (B) Borazine has similar physical and chemical properties as benzene
 (C) Borazine is isostructural with benzene
 (D) Borazine has electron rich Nitrogen and electrophilic Boron atoms in ring structure

(J&K-SET 2016)

7. To which group of the qualitative analysis scheme Cu^+ and Sn^{2+} ions would belong?
 (A) Group I and II (B) Group II
 (C) Group II and III (D) Group III

(J&K-SET 2016)

8. Correct sequence for the following borane types is $\text{B}_7\text{H}_7^{2-}$, B_6H_{10} , B_5H_{11}
 (A) Closo, Nido, Arachno (B) Nido, Closo, Arachno
 (C) Arachno, Nido, Closo (D) Closo, Arachno, Nido

(J&K-SET 2016)

9. What is correct for Sulfur Nitrogen compounds?
 (A) S_2N_2 has 6π and S_3N_3^- has 12π delocalization respectively
 (B) S_4N_4 structure has a cradle conformation
 (C) S_4N_4 has a six membered planar conformation
 (D) Polythiazyl $(\text{SN})_x$ has three unpaired electrons on each S atom which leads to a one dimensional conductor/metal characteristics along the direction of $(\text{SN})_x$

(J&K-SET 2018)

10. Number of B - B bonds present in tetraborane, B_4H_{10} is
 (A) 1 (B) 2
 (C) 3 (D) 4

(J&K-SET 2018)

11. Which among the following are wide spread sources of acid rain?
 (A) Nitrogen oxides (B) Carbon dioxide
 (C) Water vapour (D) Carbon monoxide

KARNATAKA SET

(KA-SET 2013)

1. Total number of 3C-2e bonds present in pentaborane-9 is:
 (A) 3 (B) 4
 (C) 5 (D) 2

(KA-SET 2013)

2. Inorganic benzene is:
 (A) $\text{B}_3\text{N}_3\text{H}_9$ (B) $\text{B}_3\text{N}_3\text{H}_6$
 (C) $\text{B}_3\text{N}_3\text{H}_{12}$ (D) $\text{P}_3\text{N}_3\text{Cl}_6$

(KA-SET 2013)

3. Reduction of tetrasulfur tetranitride with metallic potassium yields
 (A) S_3N_3^- (B) S_2N_2
 (C) $(\text{SN})_x$ (D) S_4N_4

(KA-SET 2013)

4. Molten iodine conducts electricity because of the formation of
 (A) I_3^- (B) I_3^+
 (C) $\text{I}_3 + \text{I}_2$ (D) $\text{I}_3^+ + \text{I}_3^-$

(KA-SET 2014)

5. Identify the non-aromatic species among the following
 (A) S_4N_4 (B) S_2N_2
 (C) S_3N_3^- (D) $\text{S}_4\text{N}_4^{2-}$

(KA-SET 2014)

6. The STYX numbers of B_5H_9 are:
 (A) 4012 (B) 4120
 (C) 4210 (D) 2410

(KA-SET 2015)

7. B_5H_{11} belongs to:
 (A) closo series (B) nido series
 (C) arachno series (D) hypho series

(KA-SET 2015)

8. The increase in Bronsted acidity of B_5H_9 , B_4H_{10} , B_6H_{10} and $\text{B}_{10}\text{H}_{14}$ follows the order
 (A) $\text{B}_4\text{H}_{10} < \text{B}_5\text{H}_9 < \text{B}_6\text{H}_{10} < \text{B}_{10}\text{H}_{14}$
 (B) $\text{B}_{10}\text{H}_{14} < \text{B}_6\text{H}_{10} < \text{B}_5\text{H}_9 < \text{B}_4\text{H}_{10}$
 (C) $\text{B}_{10}\text{H}_{14} < \text{B}_5\text{H}_9 < \text{B}_6\text{H}_{10} < \text{B}_4\text{H}_{10}$
 (D) $\text{B}_4\text{H}_{10} < \text{B}_6\text{H}_{10} < \text{B}_5\text{H}_9 < \text{B}_{10}\text{H}_{14}$

(KA-SET 2015)

9. STYX code of B_5H_{11} is
 (A) 3 2 0 3 (B) 3 2 1 3
 (C) 3 2 2 1 (D) 4 2 3 1

(KA-SET 2015)

10. Which among the following is the best conductor?
 (A) S_2N_2 (B) S_4N_4
 (C) S_4N_2 (D) $(\text{SN})_x$

(KA-SET 2015)

11. What happens when nitric acid is mixed with acetic acid?
 (A) Decomposition reaction (B) Hydrolysis reaction
 (C) Electron transfer reaction (D) Explosive reaction

(KA-SET 2015)

12. Which of the following species is amphoteric?
 (A) H_2CO_3 (B) H_2SO_4
 (C) HCl (D) H_2O

(KA-SET 2015)

13. Select the correct statements for thiazyl trifluoride (NSF_3):
- (i) S–N bond length is 141.5 pm, probably the shortest one between S and N.
 - (ii) The three highly electronegative fluorine substituents contract the 3d-orbitals of sulphur sufficiently to affect the strong π -bonding with the half-filled p-orbitals of nitrogen.
 - (iii) The bond angle F–S–F = 94° indicates the involvement of almost pure p-orbitals of S in binding the fluorine atoms.
 - (iv) The very strong bonding (due to multiple bond formation) between N and S demands the participation of s-character enriched orbitals of sulphur.
- (A) i, ii, iv only (B) i, iii & iv only
(C) i & iii only (D) All of the above

(KA-SET 2016)

14. The most symmetrical isomer/isomers of closo- $\text{B}_{10}\text{C}_2\text{H}_{12}$ is/are
- (A) 1, 2-isomer (B) 1, 7-isomer
(C) 1, 12-isomer (D) 1, 2- and 1, 12 isomers

(KA-SET 2016)

15. The number of (3C–2e) B–H–B bonds and (2c–2e) B–H bonds in B_4H_{10} are, respectively
- (A) 6 and 4 (B) 4 and 6
(C) 8 and 2 (D) 4 and 4

(KA-SET 2016)

16. Silicon doped with group 13 and group 15 member elements are called:
- (A) p-type and n-type respectively
(B) n-type and p-type respectively
(C) n-type and n-type respectively
(D) p-type and p-type respectively

(KA-SET 2016)

17. In a regular B_{12} icosahedron, the number of edges and the number of boron atoms equidistant from a given boron atom are, respectively.
- (A) 30 and 5 (B) 30 and 12
(C) 20 and 11 (D) 20 and 12

(KA-SET 2017)

18. The close structure of $[\text{B}_6\text{H}_6]^{2-}$ anion is anticipated by:
- (A) Huckel rule (B) Wade's rule
(C) EAN rule (D) Octet rule

(KA-SET 2017)

19. Number of pentagons and hexagons in C_{60} are:
- (A) 12 and 20 (B) 20 and 30
(C) 10 and 20 (D) 18 and 30

(KA-SET 2017)

20. The oxidation number of sulphur in S_8 , S_2F_2 and H_2S respectively are
- (A) 0, +1 and -2 (B) +2, +1 and -2
(C) 0, +1 and +2 (D) -2, +1 and -2

(KA-SET 2017)

21. The oxidation state of S in sulphurous acid is
- (A) 2 (B) 3
(C) 4 (D) 6

(KA-SET 2020)

22. The sulphide ion, S^{2-} isoelectronic with
- (A) O^{2-} (B) Al^{3+}
(C) Na^+ (D) K^+

(KA-SET 2020)

23. Lithium nitride on complete hydrolysis yields:
- (A) Lithium hydroxide and ammonia
(B) Lithium nitrate and water
(C) Lithium oxide and dinitrogen
(D) Lithium and hydrazoic acid

(KA-SET 2020)

24. The reaction of sodium amide with liquid ammonia (anhydrous) gives:
- (A) Sodium amide and hydrogen
(B) Sodium hydroxide and hydrazine
(C) Sodium nitride and hydrogen
(D) Sodium nitride and hydrazoic acid

(KA-SET 2020)

25. X–P–X bond angles for POX_3 (X = F, Cl, Br) molecules follow the order
- (A) Br (104.1°), Cl (103.3°) and F (101.3°)
(B) Br (101.3°), Cl (103.3°) and F (104.1°)
(C) F (103.3°), Br (104.1°) and Cl (101.3°)
(D) Cl (104.1°), Br (101.3°) and F (104.1°)

(KA-SET 2020)

26. Mendeleev proposed the existence of an unknown element and he named it as eka-aluminum. This element is
- (A) Boron (B) Indium
(C) Gallium (D) Silicon

(KA-SET 2020)

27. Which of the following is most acidic in nature?
- (A) BeO (B) MgO
(C) SrO (D) CaO

(KA-SET 2020)

28. According to Wades rules, the structure type of B_5H_9 is
- (A) Nido (B) Arachno
(C) Closo (D) Hypo

(KA-SET 2020)

29. Reaction between tetrachlorosilane and lithium aluminum hydride results in
 (A) LiCl, AlH₃ and SiH₄ (B) LiCl, AlCl₃ and SiH₄
 (C) LiH, AlCl₃ and SiCl₂ (D) LiH, AlH₃ and SiH₄
30. The main contributors of acid rain are
 (A) sulphur oxides and carbon oxides
 (B) nitrogen oxides and sulphur dioxides
 (C) carbon dioxide and carbon monoxide
 (D) nitrogen oxides and carbon oxides

MAHARASHTRA SET

(MH-SET 2011)

1. Both NF₃ and NCl₃ are covalent but they do not undergo hydrolysis similarly because:
 (A) NF₃ is more stable than NCl₃
 (B) Dipole moment of NF₃ is more than NCl₃
 (C) Electronegativity of F is greater than Cl
 (D) Cl can expand its octet by using d-orbitals
2. Haber's process for preparation of ammonia is exothermic. It is carried out at a high temperature so as to ensure:
 (A) Faster rate of production of ammonia
 (B) Vaporization of reactants/products
 (C) Declogging of the surface of the catalyst
 (D) Greater yield

(MH-SET 2013)

3. Match the following class of boranes with their examples:
 (a) Closo (i) B₈H₁₄
 (b) Nido (ii) (B₁₀H₁₀)²⁻
 (c) Arachno (iii) B₉H₁₃
 (A) (a)–(iii), (b)–(i), (c)–(ii)
 (B) (a)–(i), (b)–(iii), (c)–(ii)
 (C) (a)–(ii), (b)–(i), (c)–(iii)
 (D) (a)–(ii), (b)–(iii), (c)–(i)

(MH-SET 2013)

4. Among the following statements:
 (a) Sheet silicates have general formula $[Si_2O_5]^{2n-}_n$
 (b) ZrSiO₄ is an example for Orthosilicate
 (c) Si₂O₇⁶⁻ is a Cyclosilicate
 (d) BaTiSi₃O₉ is a Pyrosilicate
 (A) Only (a) is correct (B) (a), (c) are correct
 (C) (a), (b) are correct (D) (b), (c) are correct

(MH-SET 2013)

5. The type of hybridization of carbon atoms in graphene sheets is:
 (A) only sp² (B) sp² and sp³
 (C) only sp³ (D) sp and sp²
6. Which of the following statements is correct regarding fullerene C₆₀?
 (A) 12,500 Resonating structures are possible for C₆₀
 (B) Fullerene C₆₀ is a super aromatic compound
 (C) Unsubstituted fullerene C₆₀ can be acylated using Friedal-Crafts acylation
 (D) Fullerene C₆₀ is susceptible to attack by nucleophilic reagents

(MH-SET 2013)

7. Reducing ability of the oxyanions of sulphur change as:
 (A) S₂O₃²⁻ > SO₃²⁻ > S₂O₈²⁻ (B) SO₃²⁻ > S₂O₈²⁻ > S₂O₃²⁻
 (C) SO₃²⁻ > S₂O₃²⁻ > S₂O₈²⁻ (D) S₂O₈²⁻ > SO₃²⁻ > S₂O₃²⁻
8. The H-B-H bond angle in BH₄⁻ is:
 (A) 180° (B) 90°
 (C) 120° (D) 109°

(MH-SET 2014)

9. Beryl is a:
 (A) Beryllium containing group like BeH₃, named in analogy with silyl, alkyl etc.
 (B) Precious stone with diamond like structure
 (C) Cyclic silicate
 (D) Beryllium oxide

(MH-SET 2014)

10. Catena means
 (A) Special type dimeric structure
 (B) A chain structure
 (C) A tetrameric structure
 (D) A trimeric structure

(MH-SET 2014)

11. Identify the following boranes with their class of boranes:
 (a) Closo (i) B₆H₁₂
 (b) Nido (ii) (B₆H₆)²⁻
 (c) Arachno (iii) B₆H₁₀
 (A) (a)-(iii), (b)-(i), (c)-(ii) (B) (a)-(i), (b)-(iii), (c)-(ii)
 (C) (a)-(ii), (b)-(i), (c)-(iii) (D) (a)-(ii), (b)-(iii), (c)-(i)

(MH-SET 2014)

12. Among the following statements:
 (a) Orthosilicates have general formula (SiO₄)⁴⁻
 (b) BaTiSi₃O₉ is an example for Cyclosilicate
 (c) Si₂O₇⁶⁻ is an Orthosilicate

- (d) ZrSiO_4 is a Pyrosilicate
 (A) (a), (b) are correct (B) (a), (c) are correct
 (C) only (a) is correct (D) (c), (d) are correct
(MH-SET 2014)
13. The type of hybridization of carbon in carbon nanotube is:
 (A) sp and sp^2 (B) sp^2
 (C) sp and sp^3 (D) sp , sp^2 and sp^3
(MH-SET 2014)
14. The oxidation states of chlorine in Cl_2O , Cl_2 , $(\text{ClO}_3)^-$ are respectively:
 (A) +5, 0, +1 (B) +1, -1, +5
 (C) -1, 0, +5 (D) +1, 0, +5
(MH-SET 2014)
15. Which of the following will not form clathrates?
 (A) Ar (B) He
 (C) Kr (D) Xe
(MH-SET 2014)
16. The isotope used for treatment hyperthyroiditis is:
 (A) ^{125}I (B) ^{127}I
 (C) ^{131}I (D) ^{128}I
(MH-SET 2014)
17. The correct order of the thermal stability of hydrogen halides ($\text{H}-\text{X}$) is
 (A) $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$ (B) $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$
 (C) $\text{HCl} < \text{HF} < \text{HBr} < \text{HI}$ (D) $\text{HI} > \text{HCl} < \text{HF} < \text{HBr}$
(MH-SET 2015)
18. The commercially important ore of lead is:
 (A) Bauxite (B) Galena
 (C) Haematite (D) Cinnabar
(MH-SET 2015)
19. Aluminothemic reaction is:
 (A) Oxidation reaction (B) Reduction reaction
 (C) Redox reaction (D) Neutralization reaction
(MH-SET 2015)
20. The hybrid state of carbon C-60 is
 (A) sp (B) sp^2
 (C) sp^3 (D) dsp^2
(MH-SET 2015)
21. Which one of the following compounds has the smallest (Halogen-S-Halogen) bond angle?
 (A) SOF_2 (B) SOCl_2
 (C) SOBr_2 (D) SOI_2
(MH-SET 2015)
22. What is the oxidation state of sulfur atom when thiosulphate acts as a reducing agent forming tetrathionate ($\text{Na}_2\text{S}_4\text{O}_6$) is
 (A) +1 (B) +2.5
 (C) +4 (D) +5
23. According to IUPAC nomenclature the ligand O^{2-} , O_2^{2-} and Cl^- are named respectively as:
 (A) Peroxido, oxido, chlorido
 (B) Oxido, peroxido, chlorido
 (C) Oxido, peroxide, chloride
 (D) Oxido, superoxo, chloro
(MH-SET 2016)
24. In which of the following pair of molecules the oxidation number of nitrogen is the same?
 (A) HNO_2 and HNO_3 (B) NO_2 and N_2O
 (C) N_2O_5 and HNO_3 (D) HNO_3 and N_2O
(MH-SET 2016)
25. The correct STYX number for B_5H_9 (nido-pentaborane) is:
 (A) 2002 (B) 4120
 (C) 3003 (D) 4012
(MH-SET 2017)
26. Which byproduct is obtained during the extraction of Pb from Galena in smelters?
 (A) SO_3 (B) SO_4
 (C) SO_2 (D) S_3
(MH-SET 2017)
27. The order of ionic radius for M^{3+} cations of group 13 is:
 (A) $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$ (B) $\text{Al} < \text{Ga} < \text{Tl} < \text{In}$
 (C) $\text{Al} < \text{In} < \text{Tl} < \text{Ga}$ (D) $\text{Al} < \text{Tl} < \text{In} < \text{Ga}$
(MH-SET 2017)
28. The noble gas which does not form clathrate compound is:
 (A) Ne (B) Ar
 (C) Kr (D) Xe
(MH-SET 2018)
29. The $F-N-F$ bond angle in NF_3 is:
 (A) $109^\circ 28'$ (B) $107^\circ 48'$
 (C) $102^\circ 30'$ (D) $104^\circ 27'$
(MH-SET 2019)
30. The molecules P_4 and CH_4 exhibit the same:
 (A) Color (B) Geometry
 (C) Boiling point (D) Physical state at 300 K
(MH-SET 2020)
31. The bond length of the tetrachlorides for the following Group IV elements follows the order:
 (A) $\text{SiCl}_4 > \text{CCl}_4 > \text{GeCl}_4$ (B) $\text{SiCl}_4 > \text{GeCl}_4 > \text{CCl}_4$
 (C) $\text{GeCl}_4 > \text{SiCl}_4 > \text{CCl}_4$ (D) $\text{GeCl}_4 > \text{CCl}_4 > \text{SiCl}_4$
(MH-SET 2021)
32. According to Wade's rules, the structure of $\text{B}_{10}\text{C}_2\text{H}_{12}$ and $\text{B}_{10}\text{H}_{12}(\text{SEt}_2)_2$ are respectively
 (A) nido and closo (B) closo and nido
 (C) closo and arachano (D) nido and arachano

(MH-SET 2021)

33. The oxidising tendency of chlorine oxyanions ClO_4^- , ClO_3^- , ClO_2^- , ClO^- , follows the order
 (A) $ClO_4^- = ClO_3^- < ClO_2^- < ClO^-$
 (B) $ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$
 (C) $ClO_4^- < ClO_3^- < ClO_2^- \cong CO^-$
 (D) $ClO_4^- < ClO_3^- \cong ClO_2^- < ClO^-$

(MH-SET 2021)

34. The only metal which forms nitride N_3 among group 1 element is
 (A) K (B) Na
 (C) Li (D) Rb

(MH-SET 2023)

35. The Wade's rules can be applied to the naked clusters of *p*-block elements. According to Wade's rules, the number of skeletal electrons in Pb_5^{72-} cluster is:
 (A) 18 (B) 22
 (C) 8 (D) 12

(MH-SET 2023)

36. Based on Pauling's electronegativity scale hydrogen can oxidize:
 (A) Boron (B) Carbon
 (C) Nitrogen (D) Oxygen

(MH-SET 2023)

37. Historically, oxygen was prepared by the decomposition of metal oxides. The correct set of oxides that give dioxygen on heating is:
 (A) HgO , CaO , BaO (B) KO_2 , BaO_2 , Na_2O
 (C) Na_2O , CaO , BaO (D) HgO , KO_2 , BaO_2

(MH-SET 2023)

38. The set of compounds that show autoionization is:
 (A) Cl_2O_6 , $POCl_3$, HF (B) IF_3 , HF , $POCl_3$
 (C) HF , IF_3 , Cl_2O_6 (D) $POCl_3$, IF_3 , Cl_2O_6

(MH-SET 2024)

39. The increasing order of acidity of pentafluorides (SbF_5 , NbF_5 , PF_5 , AsF_5 and TaF_5) in fluorosulphonic acid is:

- (A) $SbF_5 > AsF_5 > PF_5 > TaF_5 = NbF_5$
 (B) $SbF_5 > AsF_5 > TaF_5 \cong NbF_5 > PF_5$
 (C) $PF_5 > NbF_5 > TaF_5 > AsF_5 > SbF_5$
 (D) $SbF_5 > AsF_5 > TaF_5 > NbF_5 > PF_5$

(MH-SET 2024)

40. The incorrect statement about XeF_6 is :
 (A) It has 14 electrons around central xenon atom
 (B) In condensed phase, it exists as an equilibrium mixture of $4XeF_6 \rightleftharpoons [XeF_5^+F^-]_4$

- (C) It can be synthesized by reacting SbF_5 with XeF_5^+ wherein XeF_5^+ acts as a fluoride ion acceptor
 (D) It undergoes double-displacement reaction with SiO_2 to give xenon trioxide

(MH-SET 2024)

41. The reactivities of halogen oxyanions and oxyacids are well understood by studying Latimer diagram. The Latimer diagram for bromine species in acidic medium is given below:



Identify the correct statement(s) from the following:

- (i) BrO_3^- is unstable with respect to disproportionation.
 (ii) $HBrO$ is more electrophilic.
 (iii) Reactions of BrO_4^- are more rapid than BrO_3^- .
 (A) Statements (i) and (iii) are correct
 (B) Statements (ii) and (iii) are correct
 (C) Statements (i) and (ii) are correct
 (D) Only statement (ii) is correct

(MH-SET 2024)

42. The point group of diborane is:

- (A) D_{2h} (B) C_{2h}
 (C) $D_{\infty h}$ (D) D_{4h}

(MH-SET 2024)

43. In the ^1H NMR spectrum of diborane number of resonance peaks obtained due to bridging hydrogens are:

(11 B; I = 3/2)

- (A) 21 (B) 7
 (C) 3 (D) 35

(MH-SET 2024)

44. The pair of compounds that are isoelectronic and isostructural is:

- (i) $C_2 B_{10} H_{12}$ (ii) $C_2 B_9 H_{12}^-$
 (iii) $C_2 B_8 NH_{11}$ (iv) $C_3 B_7 SH_{11}^{2+}$
 (A) (i), (ii) and (iii) (B) (ii), (iii) and (iv)
 (C) (i), (iii) and (iv) (D) (i), (ii) and (iv)

MADHYA PRADESH SET

(MP-SET 2018)

1. The correct statement for molecule, CsI_3 is
 (A) It is a covalent molecule
 (B) It contains Cs^+ and I_3^- ions
 (C) it contains Cs^{3+} and I^- ions
 (D) None of these

(MP-SET 2018)

2. Which species among the following has pyramidal shape
 (A) SO_3^{2-} (B) SO_4^{2-}
 (3) $InCl_4^-$ (D) PCl_6^-

(MP-SET 2018)

3. Among Al_2O_3 , SiO_2 , P_2O_3 and SO_2 the correct order of acid strength is-
- (A) $\text{SO}_2 < \text{P}_2\text{O}_3 < \text{SiO}_2 < \text{Al}_2\text{O}_3$
 (B) $\text{SiO}_2 < \text{SO}_2 < \text{Al}_2\text{O}_3 < \text{P}_2\text{O}_3$
 (C) $\text{Al}_2\text{O}_3 < \text{SiO}_2 < \text{SO}_2 < \text{P}_2\text{O}_3$
 (D) $\text{Al}_2\text{O}_3 < \text{SiO}_2 < \text{P}_2\text{O}_3 < \text{SO}_2$

RAJASTHAN SET

(RAJ-SET 2012)

1. In B_2H_6 , each Boron atom is hybridized:
- (A) sp (B) sp^2
 (C) sp^3 (D) dsp^2

(RAJ-SET 2012)

2. Which of the following carbide does not release any hydrocarbon on reaction with water?
- (A) CaC_2 (B) Mg_2C_3
 (C) SiC (D) Be_2C

(RAJ-SET 2012)

3. The basic structural unit of silicate minerals is:
- (A) Si (B) SiO_2
 (C) SiO_3^{--} (D) SiO_4^{4-}

(RAJ-SET 2012)

4. Borazole is
- (A) B_2H_6 (B) B_6H_{10}
 (C) $\text{B}_3\text{N}_3\text{H}_6$ (D) BH_3O_3

(RAJ-SET 2012)

5. Which catalyst is used in the manufacturing of Ammonia by Haber's process?
- (A) Fe/Mo (B) Ni
 (C) Pt (D) V_2O_3

(RAJ-SET 2013)

6. Oxidation number of carbon in carbon suboxide $[\text{C}_3\text{O}_2]$ is:
- (A) +4/3 (B) +2/3
 (C) 0 (D) +2 and 0

(RAJ-SET 2013)

7. Which of the following boranes is classified as a 'closo' species?
- (A) $\text{B}_{11}\text{H}_{15}$ (B) B_5H_8^-
 (C) $\text{B}_7\text{H}_7^{2-}$ (D) $\text{B}_{10}\text{H}_{18}$

(RAJ-SET 2013)

8. Which of the following elements exhibits allotropism?
- (A) Zn (B) Mg
 (C) Cs (D) Sn

(RAJ-SET 2013)

9. Which of the following reacts with dinitrogen to form a nitride?
- (A) Li (B) Na
 (C) K (D) Rb

WEST BENGAL SET

(WB-SET 2015)

1. The number of pairs of framework electrons in the closo borane $[\text{B}_n\text{H}_n]^{2-}$
- (A) n+1 (B) n+2
 (C) n+3 (D) n+4

(WB-SET 2021: 2Mark)

2. Which of the following species doesn't exist?
- (A) PbI_4 (B) PbCl_4
 (C) PbI_2 (D) PbCl_2

(WB-Set 2021: 2Mark)

3. The *styx* codes of B_2H_6 and B_4H_{10} , respectively are:
- (A) 2002 and 4012 (B) 3103 and 2102
 (C) 4120 and 2012 (D) 4012 and 2002

(WB-Set 2021: 2Mark)

4. The compound, among the following, having P – P single bond is:
- (A) P_4O_6 (B) P_4O_{10}
 (C) $\text{H}_4\text{P}_2\text{O}_7$ (D) $\text{H}_4\text{P}_2\text{O}_6$

(WB-Set 2021: 2Mark)

5. B_2H_6 reacts with NH_3 forming a compound $\text{B}_2\text{H}_6 \cdot 2\text{NH}_3$. The resulting compound:
- (A) is ionic and exists as $[\text{BH}_2(\text{NH}_3)_2]^+$ and BH_4^- ions.
 (B) is converted into inorganic benzene on heating.
 (C) Statement (A) is correct but (B) is incorrect.
 (D) Both (A) and (B) are correct.

(WB-Set 2021: 2Mark)

6. Kaolin is an example of:
- (A) pyrosilicates (B) chain silicates
 (C) sheet silicates (D) cyclic silicates

(WB-Set 2021: 2Mark)

7. The correct set of statements amongst the following on the ^{19}F NMR study of PF_5 molecule is:
- (i) one broad peak at room temperature.
 (ii) two peaks at -80°C .
 (iii) two peaks at room temperature.
 (iv) one broad peak at -80°C .
- (A) (i) and (ii) (B) (ii) and (iii)
 (C) (iii) and (iv) (D) (ii) and (iv)

[WB-Set 2021: 2 Mark]

8. Identify the correct set of statements from the following on ferrimagnetism, observed in the magnetite which exhibits:
- (i) Fe(II) and Fe(III) in the octahedral structure
 - (ii) Fe(II) and Fe(III) in the tetrahedral structure
 - (iii) Fe(II) in the tetrahedral structure
 - (iv) Fe(III) in the tetrahedral structure
- (A) (i) and (iii) (B) (i) and (iv)
(C) (i) and (ii) (D) (ii) and (iii)

(WB-SET 2022: 2 Mark)

9. Which of the following is NOT an example of covalent hydride?
- (A) SiH₄ (B) BaH₂
(C) H₂Te (D) PH₃

(WB-SET 2022: 2 Mark)

10. The volatile nature of XeF₂, XeF₄ and XeF₆ decreases as
- (A) XeF₂ > XeF₄ > XeF₆
(B) XeF₆ > XeF₂ > XeF₄
(C) XeF₆ > XeF₄ > XeF₂
(D) XeF₄ > XeF₂ > XeF₆

(WB-SET 2022: 2 Mark)

11. Correct name of Sn₂(CH₃)₆ is
- (A) Hexamethyl distanane
(B) Hexamethyl distinnane
(C) Ditin hexamethyl
(D) Distanane hexamethyl

(WB-SET 2022: 2 Mark)

12. Beryllium oxide has structure similar to
- (A) Fluorite (B) Wurtzite
(C) Antifluorite (D) Sodium chloride

(WB-SET 2022: 2 Mark)

13. ³¹P resonance in H₃PO₃ and H₃PO₂ consists of
- (A) doublet, doublet (B) triplet, triplet
(C) doublet, triplet (D) triplet, doublet

(WB-SET 2022: 2 Mark)

14. The solubility of the sulphates decreases in the order:
- (A) BeSO₄ > MgSO₄ > BaSO₄ > CaSO₄
(B) CaSO₄ > BaSO₄ > MgSO₄ > BeSO₄
(C) BaSO₄ > CaSO₄ > MgSO₄ > BeSO₄
(D) BeSO₄ > MgSO₄ > CaSO₄ > BaSO₄

(WB-SET 2022: 2 Mark)

15. Which one of the following species DOES NOT have S – S bond?
- (A) S₂O₃²⁻ (B) S₂O₅²⁻
(C) S₂O₈²⁻ (D) S₂O₄²⁻

(WB-SET 2022: 2 Mark)

16. The borax-bead is a mixture of
- (A) NaBO₃ + B₂O₃ (B) Na₂B₄O₇ + B₂O₃
(C) Na₂BO₂ + B₂O₃ (D) NaBO₂ + B₂O₃

(WB-SET 2022: 2 Mark)

17. Stability order of +1 oxidation state compared to that of +3 oxidation state of the following Gr. 13 elements is
- (A) Tl > Ga > In (B) Ga > In > Tl
(C) In > Tl > Ga (D) Tl > In > Ga

(WB-SET 2022: 2 Mark)

18. The term symbol of the ground state of carbon is
- (A) ³P₀ (B) ³P₂
(C) ³P₁ (D) ³F₂

(WB-SET 2022: 2 Mark)

19. The first ionization energy of the following Gr. 13 elements follows the order:
- (A) B > In > Tl (B) B > Tl > In
(C) Tl > In > B (D) In > Tl > B

(WB-SET 2022: 2 Mark)

20. A Fe-compound shows two lines in the Mossbauer spectra and the separation between these two lines is temperature dependent. The compound is
- (A) High spin Fe (II)
(B) Low spin Fe (II)
(C) High spin Fe (III)
(D) The data are not adequate for any such prediction.

(WB- SET 2023: 2 Mark)

21. Styx-number of the most symmetric topological structure of B₄H₁₀ is
- (A) 3013 (B) 4012
(C) 4120 (D) 3103

(WB- SET 2023: 2 Mark)

22. Identify the correct statement in relation to HN₃ and N₃⁻
- (A) In both the species, the terminal N-N and middle N – N bond lengths are equal
(B) Both in HN₃ and N₃⁻ the terminal N-N bond lengths are shorter than the middle NN bond length.
(C) In HN₃ the terminal N - N bond length is shorter than the middle N - N bond length but reverse is true for N₃⁻
(D) In HN₃, the terminal N-N bond is longer than the middle N - N bond but both the bond lengths are same in N₃⁻.

(WB- SET 2023: 2 Mark)

23. Which of the following is the correct order of increasing lattice energy?

(i) $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$

(ii) $\text{LiF} < \text{NaF} < \text{KF} < \text{CsF}$

(iii) $\text{CsCl} < \text{KCl} < \text{NaCl} < \text{LiCl}$

(A) (i) only

(B) (ii) only

(C) (iii) only

(D) (i) and (ii)

(WB- SET 2023: 2 Mark)

24. Match the correct sequence of dimensions (P) against each of the Carbon allotrope (Q).

P	Q
(a) Zero	(i) Graphene
(b) One	(ii) Nano diamond
(c) Two	(iii) Fullerene
(d) Three	(iv) Carbon nanotubes

The correct option is

(a)	(b)	(c)	(d)
(A) (i)	(ii)	(iii)	(iv)
(B) (ii)	(i)	(iv)	(iii)
(C) (iii)	(iv)	(i)	(ii)
(D) (iv)	(iii)	(ii)	(i)

(WB- SET 2023: 2 Mark)

25. Which of the following compounds does not produce CO_2 on heating?

(A) Na_2CO_3

(B) Li_2CO_3

(C) MgCO_3

(D) BaCO_3

ANSWER KEY									
ANDHRA PRADESH SET									
1	2	3	4	5	6	7			
A	A	C	A	A	D	A			
CHHATTISGARH SET									
1									
A									
GUJARAT SET									
1	2	3	4	5	6	7	8	9	10
C	A	A	C	A	D	C	D	D	C
11	12	13	14	15	16	17	18	19	20
B	C	B	C	D	C	D	D	D	B
21	22	23	24	25	26	27	28	29	30
A	D	B	C	D	B	C	C	B	C
31	32	33	34	35	36	37	38	39	40
D	A	D	B	B	B	B	B	D	D

HIMACHAL PRADESH SET									
1	2	3	4	5	6				
A	B	C	B	C	A				
JAMMU & KASHMIR SET									
1	2	3	4	5	6	7	8	9	10
B	A	C	A	A	B	B	A	B	A
11									
A									
KARNATAKA SET									
1	2	3	4	5	6	7	8	9	10
B	B	A	D	A	B	C	A	A	D
11	12	13	14	15	16	17	18	19	20
D	D	D	C	B	A	A	B	A	A
21	22	23	24	25	26	27	28	29	30
C	D	A	A	A	C	A	A	B	B
MAHARASHTRA SET									
1	2	3	4	5	6	7	8	9	10
A	A	D	C	A	A	D	D	C	B
11	12	13	14	15	16	17	18	19	20
D	A	B	D	B	C	B	B	B	B
21	22	23	24	25	26	27	28	29	30
A	B	B	C	B	C	A	A	C	B
31	32	33	34	35	36	37	38	39	40
C	B	C	C	D	A	D	B	D	C
41	42	43	44						
B	A	B	B						
MADHYA PRADESH SET									
1	2	3							
B	A	D							
RAJASTHAN SET									
1	2	3	4	5	6	7	8	9	
C	C	D	C	A	A	C	D	A	
WEST BENGAL SET									
1	2	3	4	5	6	7	8	9	10
A	A	A	D	D	C	A	B	B	C
11	12	13	14	15	16	17	18	19	20
A	B	C	D	C	D	D	A	B	A
21	22	23	24	25					
B	D	C	C	A					

SOLUTIONS

ANDHRA PRADESH SET

1. Solution: (A)

Assertion (A): Cluster formation by a metal is inversely proportional to its effective nuclear charge.

Reason (R): Nuclear charge contracts the metal orbitals meant for overlap.

Cluster formation by a metal is inversely proportional to its effective nuclear charge. Because, nuclear charge contracts the metal orbitals meant for overlap.

Both A and R are true and R is the correct explanation of A.

Hence, option (A) is correct.

2. Solution: (A)

1. Closo

Given unit $B_{10}C_2H_{12} = B_{10}(BH)_2H_{12} = B_{12}H_{14}$ is same as $(B_nH_n)^{2-}$ unit which is Closo.

So, $B_{10}C_2H_{12}$ is closo.

2. Nido

Given unit $(B_9C_2H_{11})^{2-} = [B_9(BH)_2H_{11}]^{-2} = [B_{11}H_{13}]^{-2} = [B_{11}H_{11}]^{-4}$ is same as $(B_nH_n)^{4-}$ unit which is Nido.

So, $(B_9C_2H_{11})^{2-}$ is nido.

Hence, option (A) is correct.

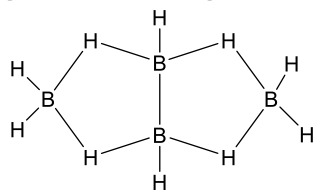
3. Solution: (C)

Pyro silicates two tetrahedral units of silicates combined by sharing an Oxygen atom with two units. Or we can say that the tetrahedral silicate unit joins by the removal of an O atom and the units are combined at the corner of the O atom. So the formulae becomes $Si_2O_7^{6-}$

Hence, option (C) is correct.

4. Solution: (A)

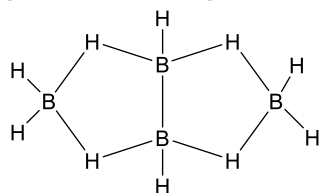
Four B–H–B bridges, no closed or bridging B–B–B unit, one B–B bond and two terminal BH₂ groups are present [STYX code is 4012].



Hence, option (A) is correct.

5. Solution: (A)

Four B–H–B bridges, no closed or bridging B–B–B unit, one B–B bond and two terminal BH₂ groups are present [STYX code is 4012].



Hence, option (A) is correct.

6. Solution: (D)

Talc is a hydrated sheet silicate mineral composed of magnesium, silicon, oxygen, and hydrogen with a chemical formula of $Mg_3Si_4O_{10}(OH)_2$.

Hence, option (D) is correct.

7. Solution: (A)

The stability of dihalides increases steadily as we move down the group from C to Ge.

So, the correct order of stability of difluorides:



Hence, option (A) is correct.

CHHATTISGARH SET

1. Solution: (A)

(a) Diamond is an insulator.

This statement is correct. Diamond has a very wide band gap (about 5.5 eV), which makes it an excellent electrical insulator. It does not conduct electricity under normal conditions.

(b) Ge is doped with a small amount of As. The resultant material is an intrinsic semiconductor.

This statement is incorrect. When germanium (Ge) is doped with arsenic (As), which is a group V element, the resultant material becomes an n-type semiconductor, not an intrinsic semiconductor. The addition of As introduces extra electrons, increasing the conductivity.

(c) Ge is doped with a small amount of In. The band level of In is close to the valence band of Ge.

This statement is correct. Indium (In) is a group III element, and when doped into germanium, it acts as a p-type dopant. The energy level of In is indeed close to the valence band of Ge, allowing it to accept electrons and create holes.

Hence, option (A) is correct.

GUJARAT SET

1. Solution: (C)

Eka silicon is known as Germanium.

In large part, the success of the Mendeleev's analysis can be attributed to the gaps which he predicted would contain undiscovered elements with predictable properties. Mendeleev named these unknown elements using the terms eka, dvi & tri.

Eka-boron (scandium)

Eka-aluminium (gallium)

Eka-manganese (technetium)

Eka-silicon (germanium).

Hence Eka silicon is called germanium.

One of these elements was the element now called Germanium; Mendeleev called it "eka-silicon," meaning "beyond silicon" on his table.

Hence, option (C) is correct.

2. Solution: (A)

Boron always forms covalent bond because boron required very high energy to form B^{3+} and again B^{3+} due to its very small size having high polarising power thus cause greater polarization and eventually significant covalent characteristics (Fajan's rule).

Boron forms electron deficient compounds because of small size and high charge density of boron. Boron has very small atomic radius. Boron forms covalent compounds. It has 3 valence electrons which it prefers to share rather than donate as B^{3+} ions is very small and unstable, so it forms sextet rather than octet. Due to incomplete octet of boron, it forms electron deficient compounds.

Hence, option (A) is correct.

3. Solution: (A)

Boron always forms covalent bonds due to: high charge/size ratio.

According to Fajans rule small cations having high charge density always have tendency to form covalent bond.

Hence, option (A) is correct.

4. Solution: (C)

Due to sp^2 the geometry of H_3BO_3 is trigonal planar. Boron is attached to three oxygen atoms and each oxygen is bonded to one hydrogen. Each such unit is H_3BO_3 . These units are bonded together through hydrogen bonds to give a two-dimensional layered structure of boric acid.

Hence, option (C) is correct.

5. Solution: (A)

On moving down the group, the basicity of the oxide increases along with increase in metallic character of the element. Thus B_2O_3 is acidic, Al_2O_3 and Ga_2O_3 amphoteric while In_2O_3 and Tl_2O_3 are basic.

Hence, option (A) is correct.

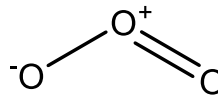
6. Solution: (D)

Given unit $B_5H_{11} = (B_5H_5)^{6-}$ is same as $(B_nH_n)^{6-}$ unit which is Arachno

So, B_5H_{11} is Arachno. Hence, option (D) is correct.

7. Solution: (C)

The Lewis structures in Figure 1 indicate that the ozone molecule has two equivalent resonance structures, which means the electrons are delocalized. From the Lewis structure, we see that the bond order for O_2 is 2 (a double bond), whereas the bond order for O_3^- is 1.5 (one and a half bonds).



Hence, option (C) is correct.

8. Solution: (D)

The oxidation number of nitrogen in N_3^- is

$$3x = -1$$

$$x = -1/3$$

Hence, option (D) is correct.

9. Solution: (D)

Hence, option (D) is correct.

10. Solution: (C)

Orthosilicates or Island Silicates: No tetrahedral O shared with other tetrahedral.

Hence, option (C) is correct.

11. Solution: (B)

Neon because neon lights are of visible from large distances and even during fog or mist.

Coloured lighting in discharge tubes are usually filled with neon.

Mixing with other gases results in different coloured lights.

Hence, option (B) is correct.

12. Solution: (C)

The structure of boron nitride BN is similar to the structure of graphite. It consists of flat planes of hexagons. Each hexagon having alternate B and N atoms. In graphite, each corner of the hexagon has C atom.

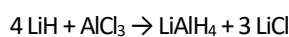
Hence, option (C) is correct.

13. Solution: (B)

Diborane readily hydrolyzes in water to give hydrogen gas and boric acid.

Hence, option (B) is correct.

14. Solution: (C)



by reacting LiH in the presence of dry ether with $AlCl_3$.

Hence, option (C) is correct.

15. Solution: (D)

Cl_2O_7 has no unpaired electron in it, so it is diamagnetic in nature.

Hence, option (D) is correct.

16. Solution: (C)

Ampholytes are amphoteric molecules that contain both acidic and basic groups and will exist mostly as zwitterions in a certain range of pH. The pH at which the average charge is zero is known as the molecule's isoelectric point. Ampholytes are used to establish a stable pH gradient for use in isoelectric focusing.

Amphiprotic species is HPO_4^{2-} as they can behave as acid as well as base.

Hence, option (C) is correct.

17. Solution: (D)

An oxidation state is a number that is assigned to an element in a chemical combination. This number represents the number of electrons that an atom can gain, lose, or share when chemically bonding with an atom of another element.

The total sum of the oxidation state of all atoms in any given species is equal to the net charge on that species. In neutral species, the total sum of the oxidation state of all atoms is 0. The oxidation state of H is +1 in a compound. The oxidation state of O is -2 in a compound. Calculating the oxidation states of I, we get

$$\text{H}_5\text{IO}_6; 5+x-12=0 \text{ or } x=+7$$

$$\text{H}_3\text{IO}_5; 3+x-10=0 \text{ or } x=+7$$

$$\text{HIO}_4; 1x-8=0 \text{ or } x=+7$$

Hence, option (D) is correct.

18. Solution: (D)

Orthoboric acid H_3BO_3 is a monobasic and Lewis acid.

It is a very weak acid and ionises mainly as a monobasic acid and that too to a very limited extent. It is not a proton donor but behaves as a Lewis acid. It can accept a lone pair of electrons from an OH^- ion.

Hence, option (D) is correct.

19. Solution: (D)

The orange colour of SnI_4 is caused by the absorption of blue light. The reflected light thus containing a higher proportion of red and orange. The energy absorbed in this way causes the transfer of an electron from I to Sn. Since transferring an electron to another atom is transferring a charge, such spectra are called charge transfer spectra.

Hence, option (D) is correct.

20. Solution: (B)

Nido

$$\text{Given unit } [\text{B}_9\text{C}_2\text{H}_{11}]^{2-} = [\text{B}_9(\text{BH})_2\text{H}_{11}]^{2-} = (\text{B}_{11}\text{H}_{13})^{2-} = (\text{B}_{11}\text{H}_{11})^{4-} \text{ is same as } (\text{B}_n\text{H}_n)^{4-} \text{ unit which is Nido}$$

So, $[\text{B}_9\text{C}_2\text{H}_{11}]^{2-}$ is nido.

Hence, option (B) is correct.

21. Solution: (A)

STYX formula = 4 0 1 2

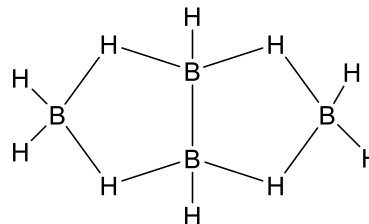
Molecule of B_4H_{10} contains -

4 B-H-B bonds

0 B-B-B bond

1 B-B bond

2 BH_2 groups.



Hence, option (A) is correct.

22. Solution: (D)

1. Arachno

Given unit $\text{B}_4\text{H}_{10} = (\text{B}_4\text{H}_4)^{6-}$ is same as $(\text{B}_n\text{H}_n)^{6-}$ unit which is Arachno

So, B_4H_{10} is arachno.

2. Arachno

Given unit $\text{B}_6\text{H}_{12} = (\text{B}_6\text{H}_6)^{6-}$ is same as $(\text{B}_n\text{H}_n)^{6-}$ unit which is Arachno

So, B_6H_{12} is arachno.

Hence, option (D) is correct.

23. Solution: (B)

When calcium carbonate is heated, it breaks down to form calcium oxide and carbon dioxide.

Thermal decomposition is the process in which heat is required.

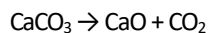
It is also known as thermolysis.

It is processed in which a compound breaks into two or more products when the heat is supplied.

This reaction is used for the production of oxygen.

This reaction is also used for production of acidic as well as basic oxides.

CaCO_3 on thermal decomposition gives:



Hence, option (B) is correct.

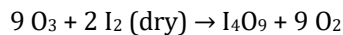
24. Solution: (C)

(A) Ozone is bent molecule with C_{2v} symmetry.

(B) The central oxygen atom is sp^2 hybridized with one lone pair.

(C) It oxidizes H_2S to SO_2 (false) (slow reaction)

(D) It oxidizes dry iodine to I_4O_9 , a yellow powder.



So, I_4O_9 is produced when ozone reacts with dry iodine along with oxygen gas.

Hence, option (C) is correct.

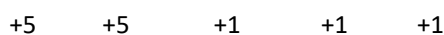
25. Solution: (D)

Boron Nitride is also called as Inorganic graphite,

Hence, option (D) is correct.

26. Solution: (B)

As Oxidation state increase Acidic strength also increases



As Electronegativity increases acidity also increases.

Hence, option (B) is correct.

27. Solution: (C)

Reaction between BH_3F^- and BF_3H^- leads to the formation of BH_4^- and BF_4^-

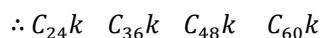
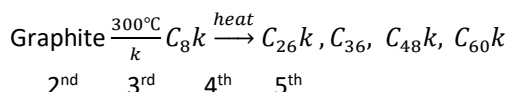
Hence, option (C) is correct.

28. Solution: (C)

Polyphosphazene polymers consist of much lower electrical conductivity due to π bonds are not delocalized

Hence, option (C) is correct.

29. Solution: (B)



Hence, option (B) is correct.

30. Solution: (C)

$\text{Al}(\text{OH})_3$ is amphoteric and dissolves in both acids and bases, but it does not dissolve in excess of ammonium hydroxide (NH_4OH). Instead, $\text{Zn}(\text{OH})_2$ is also amphoteric and can dissolve in NH_4OH due to the formation of complex ions.

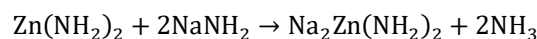
Hence, option (C) is correct.

31. Solution: (D)

Both **nitrous oxide (N_2O)** and **carbon monoxide (CO)** are neutral oxides, meaning they do not exhibit either acidic or basic properties. Unlike other oxides that can react with acids or bases, these two do not react with water to form acids or bases and are considered chemically neutral

Hence, option (D) is correct.

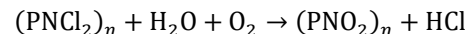
32. Solution: (A)



Hence, option (A) is correct.

33. Solution: (D)

The reaction of polyphosphonitrilic chloride (PNCI_2) with air, specifically moisture and oxygen, leads to the formation of oxygen bridges. The general reaction can be represented as:



In this process:

1. The PNCI_2 reacts with water and oxygen in the air.
2. The chlorine atoms are replaced by oxygen, forming P – O – P linkages (oxygen bridges) in the polymer chain.
3. This cross-linking, due to oxygen bridges, makes the polymer more rigid and brittle over time.

This degradation reaction leads to the brittleness of polyphosphonitrilic chloride when stored in air.

Hence, option (D) is correct.

34. Solution: (B)

Grey tin is not a good conductor of electricity; it has a diamond cubic crystal structure, similar to non-metals like silicon and germanium, which makes it a poor conductor.

Grey tin is a non-metallic form of tin, which is brittle and does not conduct electricity well.

White tin is the metallic form of tin, which is soft, ductile, and conducts electricity.

Rhombic tin (another allotrope) is stable above 161°C , where the transformation between grey and white tin takes place. Hence, option (B) is correct.

- 35. Solution: (B)** $\alpha - \text{Al}_2\text{O}_3$ (alpha-alumina) is indeed stable at high temperatures and is used as an abrasive material, commonly known as Corundum.

$\gamma - \text{Al}_2\text{O}_3$ (gamma-alumina) is used as activated alumina and is commonly employed in column chromatography due to its high surface area and adsorption properties.

Therefore, the mismatch in option (A) is that $\alpha - \text{Al}_2\text{O}_3$ is actually Corundum, not activated alumina, and $\gamma - \text{Al}_2\text{O}_3$ is referred to as activated alumina, not Corundum. Hence, (B) is incorrect.

36. Solution: (B)

Statement 1 is correct: Lead does dissolve in organic acids, such as acetic acid, forming lead salts.

Statement 2 is incorrect: Lead is resistant to dilute H_2SO_4 due to the formation of an insoluble protective sulfate layer. It dissolves in concentrated sulfuric acid but not easily in dilute acid.

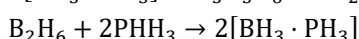
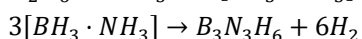
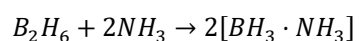
Statement 3 is correct: Lead reacts with fluorine (F_2) in cold conditions to form lead fluoride (PbF_2), which is STABLE. Hence, option (B) is correct.

37. Solution: (B)

In the reaction, the compound 1,2-dicarba-closo-dodecaborane ($C_{10}H_{12}$) is treated with a strong base (MeO^-), leading to the removal of a proton and the formation of the anion $[C_{10}H_{11}]^-$ along with the evolution of hydrogen gas and the formation of $B(OMe)_3$. The anion $[C_{10}H_{11}]^-$ is the conjugate base of the original neutral species, $C_{10}H_{12}$.

Since 1,2-dicarba-closo-dodecaborane ($C_{10}H_{12}$) is a strong acid (due to its ability to readily lose a proton when treated with a strong base), the resulting anion $[C_{10}H_{11}]^-$ is classified as the conjugate base of a strong acid.

Hence, option (B) is correct.

38. Solution: (B)

Diborane + Ammonia: Results in unsymmetric cleavage, forming $[BH_3 \cdot NH_3]$ or borazine. Diborane + Phosphine: Results in symmetric cleavage, forming $[BH_3 \cdot PH_3]$.

Hence, option (B) is correct.

39. Solution: (D)

Natrolite is a natural zeolite, which is a group of minerals commonly used for ion exchange and as molecular sieves due to their porous structure. Zeolites, including natrolite, are hydrated aluminosilicate minerals that have various industrial applications.

Hence, option (D) is correct.

40. Solution: (D)

Pure form is a translucent liquid: This statement is **incorrect**. White phosphorus is typically a waxy, white or yellowish solid at room temperature, not a liquid.

When exposed to air, it undergoes oxidation: This statement is **correct**. White phosphorus readily oxidizes when exposed to air, which can lead to combustion.

During oxidation, it gives a smell like that of garlic: This statement is **correct**. White phosphorus oxidation is associated with a distinctive garlic-like smell.

Its vapors, if continuously inhaled, cause necrosis of the bones: This statement is **correct**. Prolonged exposure to white phosphorus vapors can cause a condition known as "phossy jaw," leading to necrosis of the jawbone.

Hence, option (D) is correct.

HIMACHAL PRADESH SET**1. Solution: (A)**

Assertion: Noble gas element exist as mono-atoms in molecules.

Reason: Noble gas element have stable outer electronic configuration.

Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

Explanation-

Inert gases have stable outer electronic configuration, thus they exist in monoatomic state. Example: Helium $[1s^2]$, Neon $[1s^2 2s^2 2p^6]$.

Hence, option (A) is correct.

2. Solution: (B)

The bond energy will decrease down the group because, as we move down the group, the bond length increases. However, chlorine has greater energy than fluorine because of its extremely small size. The F-F bond length is so short that the lone pairs of electrons on the fluorine atoms repels the other and weakens the F-F bond.

Hence, option (B) is correct.

3. Solution: (C)

When, during the lag phase of chlorophyll formation in the dark, the algal cells were pre-illuminated with different coloured lights described earlier, blue light was the most effective followed by yellow, green and red lights, in decreasing order, in enhancing the dark formation of chlorophyll.

Neon lights were named for neon, a noble gas which gives off a popular orange light, but other gases and chemicals are used to produce other colors, such as hydrogen (red), helium (yellow), carbon dioxide (white), and mercury (blue).

Hence, option (C) is correct.

4. Solution: (B)

The reactions are based on the reactivity order of Halogens – $F > O > Cl > Br > I$ and is the single displacement reaction. Reaction C is not feasible since Iodide cannot displace Br due to its less reactivity.

Hence, option (B) is correct.

5. Solution: (C)

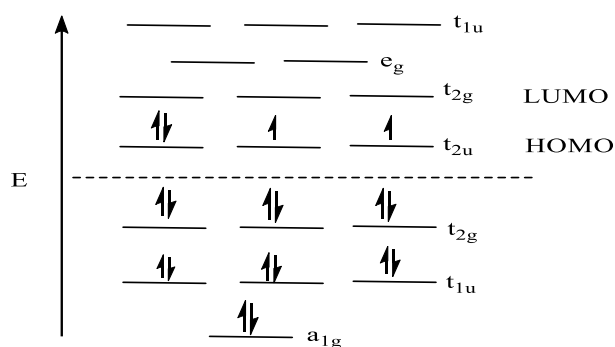
In chemistry, perxenates are salts of the yellow xenon-containing anion XeO_6^{4-} . This anion has octahedral molecular geometry, as determined by Raman spectroscopy, having O-Xe-O bond angles varying

between 87° and 93° . The Xe–O bond length was determined by X-ray crystallography to be 1.875 Å.

Hence, option (C) is correct.

6. Solution: (A)

When the six B–H units come together, a total of 18 (6×3) atomic orbitals combine to form 18 molecular orbitals. There are seven orbitals with net bonding character delocalized over the skeleton. All of the bonding orbitals are filled ($n + 1$ framework bonding pairs), so seven pairs of electrons are used to hold the cluster together. The bonding cannot be interpreted using a localized electron model. There is a considerable energy gap between the bonding MOs and the remaining largely antibonding MOs, contributing to the stability of the cluster.



Hence, option (A) is correct.

JAMMU & KASHMIR SET

1. Solution: (B)

Odd electron molecules like NO, NO_2 are generally paramagnetic as they contain one unpaired electron each. Nitrogen has many oxides. Among all NO and NO_2 are paramagnetic.

Hence, option (B) is correct.

2. Solution: (A)

The oxyacid of sulphur that contains a lone pair of electrons on sulfur is sulfurous acid H_2SO_3 in which only 4 of its valence electrons are involved in bonding remaining 2 electrons are remained as a lone pair on sulfur (Sulfur has six valence electrons).

Hence, option (A) is correct.

3. Solution: (C)

Boron does not have d orbitals. Because of this, it is not possible for the element to expand on its octet. This causes the maximum covalence of boron to be restricted to 4. Beyond this value, boron will become unstable and thus, cannot form BF_6^{3-} ions.

Hence, option (C) is correct.

4. Solution: (A)

NO has an odd number of electrons (11 valence electrons) and hence is paramagnetic in the gaseous state. But in liquid and solid states, it exists as a symmetrical or asymmetrical dimer and hence is diamagnetic in these states.

Hence, option (A) is correct.

5. Solution: (A)

The bond energies of F_2 , Cl_2 , Br_2 and I_2 are 37, 58, 46 and 36 kJ.

The size of a fluorine atom is very small as compared to a chlorine atom. ... Hence, it requires less energy to break up the fluorine molecule, making its bond dissociation energy lesser than that of chlorine molecule.

Bond energy of Cl_2 is highest among all halogen molecules. On moving down the group of halogens, the bond energy decreases from chlorine to bromine and to iodine.

Order of bond energy: $\text{Cl}_2 > \text{Br}_2 > \text{F}_2 > \text{I}_2$

Hence, option (A) is correct.

6. Solution: (B)

The key difference between borazine and benzene is that the borazine contains three boron atoms and three nitrogen atoms in the ring structure whereas the benzene contains six carbon atoms in the ring structure.

Both borazine and benzene have similar structures with a six-membered ring, and these two compounds are isoelectronic. That means, both borazine and benzene have the same numbers of electrons or the same electronic structure. However, they have completely different chemical and physical properties because the rings of these compounds consist of different atoms.

Hence, option (B) is correct.

7. Solution: (B)

Group II (Cu^{2+} , Bi^{3+} , Cd^{2+} , Hg^{2+} , As^{3+} , Sb^{3+} , Sn^{4+}) cations produce very insoluble sulfides (K_{sp} values less than 10^{-30}) so they can be precipitated by low amounts of sulfide ion; this can be achieved by adding an acidic solution of H_2S .

Hence, option (B) is correct.

8. Solution: (A)

(a) closo

Given unit $\text{B}_7\text{H}_7^{2-}$ is same as $(\text{B}_n\text{H}_n)^{2-}$ unit which is Closo. So, $\text{B}_7\text{H}_7^{2-}$ is closo.

(b) nido

Given unit $\text{B}_6\text{H}_{10} = (\text{B}_6\text{H}_6)^{4-}$ is same as $(\text{B}_n\text{H}_n)^{4-}$ unit which is nido

So, B_6H_{10} is nido.

(c) arachno

Given unit $B_5H_{11} = (B_5H_5)^{-6}$ is same as $(B_nH_n)^{6-}$ unit which is arachno.

So, B_5H_{11} is arachno.

Hence, option (A) is correct.

9. Solution: (B)

(A) S_2N_2 has 6π and $S_3N_3^-$ has 12π delocalization respectively (Incorrect statement). S_3N_3 would have 10π electrons. S_4N_4 would have 12π electrons.

(B) S_4N_4 structure has a cradle conformation (Correct statement)

(C) S_4N_4 has a six membered planar conformation (Incorrect statement)

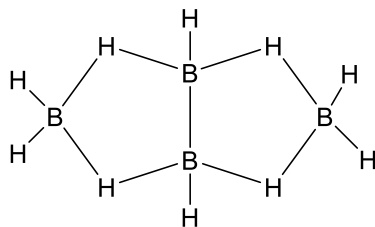
(D) Polythiazyl $(SN)_x$ has three unpaired electrons on each S atom which leads to a one dimensional conductor/metal characteristics along the direction of $(SN)_x$ (Incorrect statement)

Polythiazyl shows an anisotropic electrical conductivity. Along the fibres or SN chains, the bond is electrically conductive, perpendicular to it acts as an insulator. The one-dimensional conductivity is based on the bonding conditions in the S-N chain, where each sulfur atom provides two p electrons and each nitrogen atom provides one p electron to form two-center 3p electron bonding units.

Hence, option (B) is correct.

10. Solution: (A)

Four B-H-B bridges, no closed or bridging B-B-B unit, one B-B bond and two terminal BH_2 groups are present [STYX code is 4012].



Hence, option (A) is correct.

11. Solution: (A)

Sources of Acid Rain - Acid rain is caused by a chemical reaction that begins when compounds like sulfur dioxide and nitrogen oxides are released into the air. These substances can rise very high into the atmosphere, where they mix and react with water, oxygen, and other chemicals to form more acidic pollutants, known as acid rain. Sulfur dioxide and nitrogen oxides dissolve very easily in water and can be carried very far by the wind. As

a result, the two compounds can travel long distances where they become part of the rain, sleet, snow, and fog that we experience on certain days.

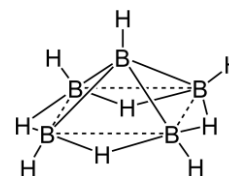
Human activities are the main cause of acid rain. Over the past few decades, humans have released so many different chemicals into the air that they have changed the mix of gases in the atmosphere. Power plants release the majority of sulfur dioxide and much of the nitrogen oxides when they burn fossil fuels, such as coal, to produce electricity. In addition, the exhaust from cars, trucks, and buses releases nitrogen oxides and sulfur dioxide into the air. These pollutants cause acid rain.

Hence, option (A) is correct.

KARNATAKA SET

1. Solution: (B)

Pentaborane-9



4 electrons are used up in four B-H-B bridge bonds

Hence, option (B) is correct.

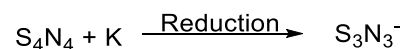
2. Solution: (B)

Borazine, also known as borazole, is a polar inorganic compound with the chemical formula $B_3H_6N_3$. In this cyclic compound, the three BH units and three NH units alternate. The compound is isoelectronic and isostructural with benzene. For this reason borazine is sometimes referred to as "inorganic benzene".

Hence, option (B) is correct.

3. Solution: (A)

Reduction of tetrasulfur tetranitride with metallic potassium yields $S_3N_3^-$.



Hence, option (A) is correct.

4. Solution: (D)

Molten iodine conducts electricity because of the formation of $I_3^+ + I_3^-$:

Because ionic compounds are formed by alternating positive and negative ions, and because they are all held together with these strong electrostatic forces, the oppositely charged ions pack tightly with each other and form a crystal lattice structure that is extremely hard to break.

Hence, option (D) is correct.

5. Solution: (A)

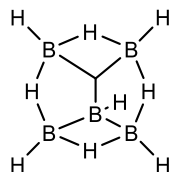
If a cyclic, planar molecule has $4n+2$ π electrons, it is considered aromatic.

S_4N_4 not follows Huckel rule so it is non aromatic compound.

Hence, option (A) is correct.

6. Solution: (B)

It can be clearly seen that there are four B-H-B bridges, one closed or triply bridged B-B-B unit, two B-B bond and no terminal BH_2 groups. Hence, the overall STYX code B_5H_9 molecule is 4120.



Hence, option (B) is correct.

7. Solution: (C)

Arachno

Given unit $B_5H_{11} = (B_5H_5)^{6-}$ is same as $(B_nH_n)^{6-}$ unit which is Arachno

So, B_5H_{11} is arachno.

Hence, option (C) is correct.

8. Solution: (A)

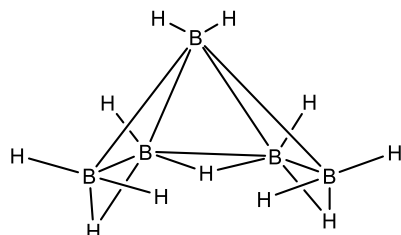
$B_4H_{10} < B_5H_9 < B_6H_{10} < B_{10}H_{14}$

Acidity of boron hydride depends on the size of borane greater the sizes higher will be the acidity. This is because the negative charge, formed upon deprotonation, can be better delocalized over a large anion with many boron atoms than over a small one.

Hence, option (A) is correct.

9. Solution: (A)

It can be clearly seen that there are 3 B-H-B bridges, 2 closed or triply bridged B-B-B unit, 0 B-B bond and 3 terminal BH_2 groups. Hence, the overall STYX code B_5H_9 molecule is 3203.



Hence, option (A) is correct.

10. Solution: (D)

Polythiazyl (polymeric sulfur nitride), $(SN)_x$, is an electrically conductive, gold- or bronze-colored polymer with metallic luster. It was the first conductive inorganic polymer discovered and was also found to be a

superconductor at very low temperatures (below 0.26 K). It is a fibrous solid, described as "lustrous golden on the faces and dark blue-black", depending on the orientation of the sample. It is air stable and insoluble in all solvents. Hence, option (D) is correct.

11. Solution: (D)

Nitric acid is used in an aqueous solution. Fuming nitric acid is concentrated nitric acid that contains dissolved nitrogen dioxide. It also reacts very violently with organic chemicals (acetone, acetic acid, acetic anhydride), causing fire and explosion hazards.

Hence, option (D) is correct.

12. Solution: (D)

An amphoteric molecule (or ion) can either donate or accept a proton, thus acting either as an acid or a base. Water, amino acids, hydrogen carbonate ion (or bicarbonate ion) HCO_3^- , dihydrogen phosphate ion $H_2PO_4^-$, and hydrogen sulfate ion (or bisulfate ion) HSO_4^- are common examples of amphoteric species. Since they can donate a proton, all amphoteric substances contain a hydrogen atom. Hence, option (D) is correct.

13. Solution: (D)

Thiazyl trifluoride (NSF_3):

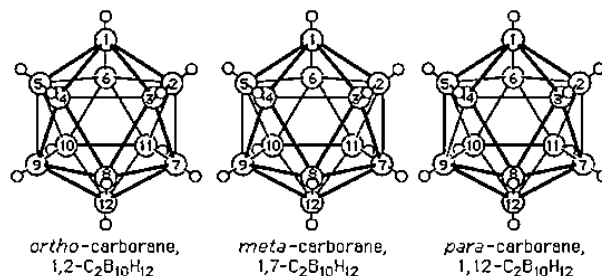
- S-N bond length is 141.5 pm, probably the shortest one between S and N.
- The three highly electronegative fluorine substituents contract the 3d-orbitals of sulphur sufficiently to affect the strong π -bonding with the half-filled p-orbitals of nitrogen.
- The bond angle $F-S-F = 94^\circ$ indicates the involvement of almost pure p-orbitals of S in binding the fluorine atoms.
- The very strong bonding (due to multiple bond formation) between N and S demands the participation of s-character enriched orbitals of sulphur.

All the four statements are correct.

Hence, option (D) is correct.

14. Solution: (C)

The most symmetrical isomer/isomers of closo- $B_{10}C_2H_{12}$ is 1, 12-isomer.



Hence, option (C) is correct.

15. Solution (B)

STYX formula = 4 0 1 2

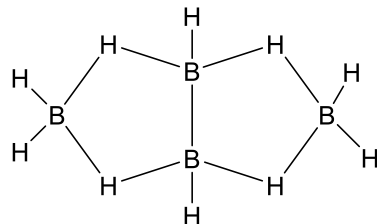
Molecule of B_4H_{10} contains -

4 B-H-B bonds

0 B-B-B bond

1 B-B bond

2 BH_2 groups.



Hence, option (B) is correct.

16. Solution: (A)

The addition of small amount of foreign impurity in the host crystal is called as doping. It results in an increase in the electrical conductivity of the crystal. Doping of group 14 elements (such as Si, Ge etc.) with elements of group 15 (such as As) produces an excess of electrons in the crystals. Thus, it gives n-type semiconductors. Doping of groups 14 elements with group 13 elements (such as Indium) produces holes (electron deficiency) in the crystals. Thus, p-type semiconductors are produced. The symbol 'p' indicates flow of positive charge.

Hence, option (A) is correct.

17. Solution: (A)

In a regular B_{12} icosahedron, Five boron atoms are equidistant from a given boron atom and There are 30 edges, i.e. 5 from the top B-atom, 5 around the upper pentagon, 10 from the upper pentagon to the low, 5 around the lower pentagon and 5 to the bottom boron atom.

Hence, option (A) is correct.

18. Solution: (B)

The general methodology to be followed when applying Wade's rules is as follows: Determine the total number of valence electrons from the chemical formula, i.e., 3 electrons per B, and 1 electron per H. A cluster with n vertices (i.e., n boron atoms) and $n+1$ Skeleton Electron Pair (SEP) for bonding has a closo structure.

Given $(B_nH_n)^{6-}$ unit which is Closo

Hence, option (B) is correct.

19. Solution: (A)

C_{60} is a molecule that consists of 60 carbon atoms, arranged as 12 pentagons and 20 hexagons.

Hence, option (A) is correct.

20. Solution: (A)

The oxidation number of sulphur in given compounds.

(i) S_8 :- As we can see that S_8 contains only one type of atom that is of sulphur. So, as per rule, its oxidation state will be zero because the bond contains the same two atoms, hence there is no electronegativity difference. So, we can finalize that in this compound, the oxidation state of sulphur is zero.

(ii) S_2F_2 :- Now, we will find the oxidation state of sulphur in S_2F_2 . Note that the oxidation number of the halogen family is -1. So, this fluorine atom also has -1 oxidation state. The overall charge on this compound is zero. So, the calculation will be as follows:

$$\text{Overall charge on } S_2F_2 = 2(\text{Oxidation number of S}) + 2(\text{Oxidation number of F})$$

$$0 = 2(\text{Oxidation number of S}) + 2(-1)$$

$$0 = 2(\text{Oxidation number of S}) - 2$$

$$\text{So, } 2 = 2(\text{Oxidation number of S})$$

$$\text{Oxidation number of S} = 2/2 = +1$$

So, from the above calculation, the oxidation state of sulphur in S_2F_2 is +1.

(iii) H_2S :- Now, we will calculate the oxidation state of sulphur in H_2S . Here, we should note that the oxidation state of hydrogen is +1 because it is less electronegative. Overall charge on H_2S is zero. So, we can use the formula of finding oxidation number here as:

$$\text{Overall charge on } H_2S = 2(\text{Oxidation number of H}) + \text{Oxidation number of S}$$

$$0 = 2(+1) + \text{Oxidation number of S}$$

$$0 = 2 + \text{Oxidation number of S}$$

$$\text{Oxidation number of S} = -2$$

So, from above calculation oxidation state of sulphur in H_2S is -2.

Hence, option (A) is correct.

21. Solution: (C)

H_2SO_3 Let, Oxidation state of S is x

$$\text{So, } x + 3 \times (-2) + 2 \times (+1) = 0$$

$$\Rightarrow x = +4$$

Hence, option (C) is correct.

22. Solution: (D)

Sulphur has 16 electrons. S^{2-} has 18 electrons.

Potassium has an atomic number of 19 which means it has 19 electrons when neutral. When it becomes a potassium ion, K^+ , the charge 1+ implies that it has lost 1 electron and thus, the total number of electrons of potassium ion is 18.

Hence, option (D) is correct.

23. Solution: (A)

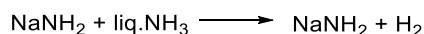
On hydrolysis of lithium nitride, 1 mole of ammonia is produced for each mole of lithium nitride. Combining the two, there will be a total of 3 moles of ammonia that will be produced in the given reaction.



Hence, option (A) is correct.

24. Solution: (A)

The reaction of sodium amide with liquid ammonia (anhydrous) gives Sodium amide and hydrogen.



Hence, option (A) is correct.

25. Solution: (A)

Fluorine is the most electronegative halogen, so it will draw electron density in the P-F bond away from P atom; repulsion of the P-F bonding pairs will be less than the repulsion of P-Cl and P-Br bonding pairs, so the F-P-F bond angle will be the smallest.

Hence, option (A) is correct.

26. Solution: (C)

Mendeleev predicted the properties of some of the elements during the classification which were not yet discovered. He named one of the element as eka-aluminium which was later discovered as Gallium.

Hence, option (C) is correct.

27. Solution: (A)

In metals moving down the group metallic character increases, so basic nature increases hence most acidic will be BeO as Be is least metallic in group 2 elements.

BeO is most acidic in nature as the acidity of oxides decreases with increases in the electropositive character of the central atom.

Hence, option (A) is correct.

28. Solution: (A)

nido

Given unit $\text{B}_5\text{H}_9 = (\text{B}_5\text{H}_5)^{4-}$ is same as $(\text{B}_n\text{H}_n)^{4-}$ unit which is nido

So, B_5H_9 is nido.

Hence, option (A) is correct.

29. Solution: (B)

Lithium aluminium hydride reacts with silicon tetrachloride to form LiCl (lithium chloride),

AlCl_3 (aluminum trichloride) and SiH_4 (silicon hydride).



Hence, option (B) is correct.

30. Solution: (B)

Major contributors to acid rain are SO_2 and NO_2 .

Acid rain- Acid rain is said to be the precipitation of acid in the form of rain in the simplest manner. When atmospheric pollutants like oxides of nitrogen and sulphur react with rainwater and come down with the rain, then this results in Acid Rain.

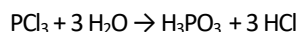
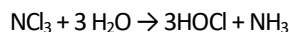
Hence, option (B) is correct.

MAHARASHTRA SET**1. Solution: (A)**

NF_3 is more stable than NCl_3 and hydrolysis product of NF_3 does not exist.

In contrast to NF_3 , NCl_3 and NBr_3 are highly unstable.

Expect NF_3 and PF_3 , trihalides are hydrolysed by water and the ease of hydrolysis decreases down the group, i.e., NCl_3 is easily hydrolysed and SbCl_3 and BiCl_3 are partly hydrolysed.



Hence, option (A) is correct.

2. Solution: (A)

The manufacture of ammonia by Haber's process is an exothermic reaction. According to Le Chatelier's principle maximum yield of an exothermic reaction can be obtained at low temperatures. There are 4 molecules on reactant side and 2 on product side. According to Le Chatelier's principle if you increase the pressure the system will respond by favouring the reaction which produces fewer molecules. So the maximum yield of ammonia will be obtained at high pressure and low temperature

Hence, option (A) is correct.

3. Solution: (D)

(a) Closo

Given unit $(\text{B}_{10}\text{H}_{10})^{2-}$ is same as $(\text{B}_n\text{H}_n)^{2-}$ unit which is closo.

So, $(\text{B}_{10}\text{H}_{10})^{2-}$ is closo.

(b) Nido

Given unit $\text{B}_9\text{H}_{13} = (\text{B}_9\text{H}_9)^{4-}$ is same as $(\text{B}_n\text{H}_n)^{4-}$ unit which is nido

So, B_9H_{13} is nido.

(c) Arachno

Given unit $\text{B}_8\text{H}_{14} = (\text{B}_8\text{H}_8)^{6-}$ is same as $(\text{B}_n\text{H}_n)^{6-}$ unit which is arachno

So, B_8H_{14} is arachno.

Hence, option (D) is correct.

4. Solution: (C)

(a) The general formula of Sheet or Phyllo or two dimensional (2-D) silicates is $(\text{Si}_2\text{O}_5)_n^{2n-}$. Each

SiO_4 tetrahedron shares three oxygen atoms with others and thus by forming two-dimensional sheets. These silicates can be cleaved easily just like graphite. The layers are held together by weak van der Waal's forces. Sheet silicates have general formula $[\text{Si}_2\text{O}_5]_n^{2n-}$ (so this statement is correct)

- (b) Ortho silicates (or Neso or Island silicates) are the simplest silicates which contain discrete SiO_4^{4-} tetrahedral units. The ortho silicate ion is the strong conjugate base of weak orthosilicic acid as well as it will not persist in aqueous solutions. Hence in nature, ortho silicate minerals are rare and only found with cations which form highly insoluble salts.

Examples of Ortho silicates:

- (1) Phenacite (also known as phenakite) - Be_2SiO_4
 (2) Willemite - Zn_2SiO_4 - A minor silicate ore of zinc. Highly fluorescent (green) under shortwave UV.
 Note: The Be^{2+} and Zn^{2+} ions are tetrahedrally surrounded by the oxygen atoms of silicate.

- (3) Olivine - $(\text{Fe/Mg})_2\text{SiO}_4$: Typically green in color. The cations are octahedrally coordinated to the oxygen atoms of the silicate.
 (4) Zircon - ZrSiO_4 : The oldest mineral on Earth. The coordination number of Zr^{4+} is 8.
 ZrSiO_4 is an example for orthosilicate (so this statement is correct)

- (c) In cyclosilicates, the tetrahedra form rings of 3, 4, or 6 tetrahedra. However, most cyclosilicates are formed from a framework of six tetrahedra, giving them the formula $(\text{Si}_6\text{O}_{18})^{12-}$, and examples of this type of mineral includes the gemstones beryl (including the varieties emerald and aquamarine, and tourmaline).

$\text{Si}_2\text{O}_7^{6-}$ is a cyclosilicate (so this statement is wrong)

- (d) Pyro silicate (or Soro silicate or disilicate) contain $\text{Si}_2\text{O}_7^{6-}$ ions which are formed by joining two tetrahedral SiO_4^{4-} which share one oxygen atom at one corner (one oxygen is removed while joining).

The pyrosilicate ion is less basic than orthosilicate ion. There only one mineral in nature containing pyrosilicate ion.

E.g. 1) Thortveitite - $\text{Sc}_2\text{Si}_2\text{O}_7$, $\text{BaTiSi}_3\text{O}_9$ is a Pyrosilicate (so this statement is wrong)

Hence, option (C) is correct.

5. Solution: (A)

Graphene is a nanomaterial arranged in a two-dimensional layer of carbon atoms with sp^2

hybridization that are connected in a hexagonal lattice structure.

The sp^2 hybridized carbon gives rise to a trigonal structure of graphite. The single layer of graphite named as graphene; is single atom thick layer which has got wide importance due to its high strength, high electrical and thermal conductivity. It is a two dimensional structure of hexagonal rings where carbon atoms are connected with each other by covalent bonds.

Hence, option (A) is correct.

6. Solution: (A)

C-60 has 12,500 resonance structures involving its 60 pi-electrons we may profitably consider the pi-electrons to be particles delocalized over a sphere.

Hence, option (A) is correct.

7. Solution: (D)

$$\text{SO}_3^{2-} \rightarrow x + (-6) = -2 \Rightarrow x = +4$$

$$\text{S}_2\text{O}_3^{2-} \rightarrow 2x + (-6) = -2 \Rightarrow x = +2$$

$$\text{S}_2\text{O}_8^{2-} \rightarrow 2x + (-16) = -2 \Rightarrow x = +7$$

Reducing ability of the oxyanions of sulphur change as : $\text{S}_2\text{O}_8^{2-} > \text{SO}_3^{2-} > \text{S}_2\text{O}_3^{2-}$

Hence, option (D) is correct.

8. Solution: (D)

H-B-H bond angle in BH_4^- is 109° because it forms the tetrahedral geometry.

Hence, option (D) is correct.

9. Solution: (C)

Beryl is a cyclic silicate.

Cyclic silicates contain $(\text{SiO}_3)_n^{2n-}$ ions which are formed by linking three or more tetrahedral SiO_4^{4-} units cyclically....

- (1) Benitoite - $\text{BaTi}(\text{SiO}_3)_3$: containing three tetrahedra arranged cyclically $[\text{Si}_3\text{O}_9]^{6-}$.
 (2) Beryl - $\text{Be}_3\text{Al}_2(\text{SiO}_3)_6$: containing six-silicate rings $[\text{Si}_6\text{O}_{18}]^{12-}$. It is an aluminosilicate.

Hence, option (C) is correct.

10. Solution: (B)

Catena: Any compound having two or more rings interconnected like the links of a chain, without a covalent bond.

Catena means chain structure.

Hence, option (B) is correct.

11. Solution: (D)

- (a) closo

Given unit $(\text{B}_6\text{H}_6)^{2-}$ is same as $(\text{B}_n\text{H}_n)^{2-}$ unit which is closo.

So, $(\text{B}_6\text{H}_6)^{2-}$ is closo.

(b) nido

Given unit $B_6H_{10} = (B_6H_6)^{4-}$ is same as $(B_nH_n)^{4-}$ unit which is nido

So, B_6H_{10} is nido.

(c) arachno

Given unit $B_6H_{12} = (B_6H_6)^{6-}$ is same as $(B_nH_n)^{6-}$ unit which is arachno

So, B_6H_{12} is arachno.

Hence, option (D) is correct.

12. Solution: (A)

(a) Orthosilicates have general formula $(SiO_4)^{4-}$

Ortho silicates (or Neso or Island silicates) are the simplest silicates which contain discrete SiO_4^{4-} tetrahedral units. The ortho silicate ion is the strong conjugate base of weak orthosilicic acid as well as it will not persist in aqueous solutions. Hence in nature, ortho silicate minerals are rare and only found with cations which form highly insoluble salts.

Examples of Ortho silicates:

(1) Phenacite (also known as phenakite) - Be_2SiO_4

(2) Willemite - Zn_2SiO_4 - A minor silicate ore of zinc. Highly fluorescent (green) under shortwave UV.

Note: The Be^{2+} and Zn^{2+} ions are tetrahedrally surrounded by the oxygen atoms of silicate.

(3) Olivine - $(Fe/Mg)_2SiO_4$: Typically green in color. The cations are octahedrally coordinated to the oxygen atoms of the silicate.

(4) Zircon - $ZrSiO_4$: The oldest mineral on Earth. The coordination number of Zr^{4+} is 8.

(b) $BaTiSi_3O_9$ is an example for cyclosilicate

Beryl is a cyclic silicate.

Cyclic silicates contain $(SiO_3)_n^{2n-}$ ions which are formed by linking three or more tetrahedral SiO_4^{4-} units cyclically. ...

(1) Benitoite - $BaTi(SiO_3)_3$: containing three tetrahedra arranged cyclically $[Si_3O_9]^{6-}$. 2) Beryl - $Be_3Al_2(SiO_3)_6$: containing six-silicate rings $[Si_6O_{18}]^{12-}$. It is an aluminosilicate.

(c) $Si_2O_7^{6-}$ is an orthosilicate (wrong)

$Si_2O_7^{6-}$ is an Pyrosilicate

(d) $ZrSiO_4$ is a Pyrosilicate (wrong)

$ZrSiO_4$ is a Orthosilicate

Hence, option (A) is correct.

13. Solution: (B)

The chemical bonding of nanotubes is composed entirely of **sp² hybridized** bonds, similar to those of graphene. These bonds, which are stronger than the sp³ bonds found in diamond, provide nanotubes with their unique

strength, and the associated π bonds are the reason for their electrical properties.

Hence, option (B) is correct.

14. Solution: (D)

1. Cl_2O : Let X be the oxidation number of chlorine in Cl_2O .

$$2X - 2 = 0 \Rightarrow X = +1$$

2. Cl_2 : The oxidation number of chlorine is +1, +3, +5, +7 and -1. However for Chlorine gas, the oxidation number (Cl_2) is zero.

3. $(ClO_3)^-$: Let x be the oxidation number of chlorine in ClO_3^-

The oxidation number of oxygen is -2.

The sum of the oxidation numbers of chlorine and oxygen is -1, which is equal to the charge on ion.

$$\text{Hence, } x + 3(-2) = -1 \text{ or, } x = +5.$$

Hence, option (D) is correct.

15. Solution: (B)

However, the smaller noble gases He and Ne do not form clathrate compounds because the noble gas atoms are small enough to escape from the cavities.

Clathrates are the compounds formed by inert gases (Argon, Krypton, and Xenon). In which the gas molecules penetrate the cavities of the crystal structure composed of H_2O molecules.

Hence, option (B) is correct.

16. Solution: (C)

Radioactive Iodine (I-131) Therapy. Radioiodine therapy is a nuclear medicine treatment for an overactive thyroid, a condition called hyperthyroidism, and also may be used to treat thyroid cancer.

Hence, option (C) is correct.

17. Solution: (B)

As we move down the group in hydrogen halides the thermal stability decreases due to decrease in bond strength. So the correct order of thermal stability is $HF > HCl > HBr > HI$

Hence, option (B) is correct.

18. Solution: (B)

Ores. Of the more than 60 known lead-containing minerals, by far the most important primary ore of the metal is the lead sulfide galena (PbS). Other commercially significant lead-containing minerals are cerussite (lead carbonate) and anglesite (lead sulfate).

Hence, option (B) is correct.

19. Solution: (B)

During aluminothermic reduction, the ferro-alloys are produced from their oxide ores by reduction with aluminium using the exothermic heat of the reaction.

Aluminothermic reactions are exothermic chemical reactions using aluminium as the reducing agent at high

temperature. The process is industrially useful for production of alloys of iron. ... For the production of iron, a cheaper reducing agent, coke, is used instead via the carbothermic reaction.

Hence, option (B) is correct.

20. Solution: (B)

C₆₀ is the fullerene and in fullerene, the hybrid state of carbon atoms is sp² similar to graphite. Fullerenes are stable, but not totally unreactive. The sp²-hybridized carbon atoms, which are at their energy minimum in planar graphite, must be bent to form the closed sphere or tube, which produces angle strain.

Hence, option (B) is correct.

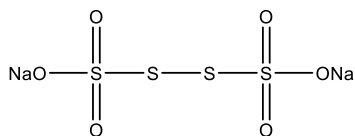
21. Solution: (A)

SOF₂ has the smallest bond (X–S–X) in the given molecules. Fluorine is the most electronegative element on the earth.

It attracts the electrons of S–F bonds towards itself due to which the repulsion between the bond pair electrons decreases. Hence, the SOF₂ bond angle is minimum.

Hence, option (A) is correct.

22. Solution: (B)



From the above structure, we can say that the oxidation numbers of the first sulphur atom are six, the second sulphur atom is two, third sulphur is two, the fourth sulphur atom is six. The sum of the oxidation numbers is zero for an electrically neutral compound and equals the overall charge for anionic species.

Let's take the oxidation number of sulphur as x , sodium is +1 and oxygen is -2, then

The equation to find the unknown oxidation number according to the structure is

$$2(+1) + 4x + 6(-2) = 0$$

$$2 + 4x - 12 = 0$$

$$4x = 10$$

$$x = 10/4$$

$$x = 2.5$$

So the oxidation number of S in Na₂S₄O₆ is +2.5.

Hence, option (B) is correct.

23. Solution: (B)

For anionic ligands end in "-o";

For anions that end in "-ide" (e.g. chloride), "-ate" (e.g. sulfate, nitrate), and "-ite" (e.g. nitrite),

Change the endings as follows: -ide → -o; -ate → -ato; -ite → -ito.

The ligand O²⁻, O₂²⁻ and Cl⁻ are named respectively as: Oxido, peroxido, chlorido

Hence, option (B) is correct.

24. Solution: (C)

$$\text{HNO}_3 \Rightarrow 1 + x + 3(-2) = 0$$

$$\Rightarrow x = +5$$

$$\text{N}_2\text{O}_5 \Rightarrow 2x + 5(-2) = 0$$

$$= 2x - 10$$

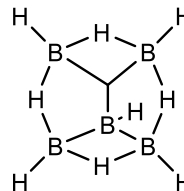
$$x = 10/2$$

$$x = +5$$

Hence, option (C) is correct.

25. Solution: (B)

It can be clearly seen that there are four B–H–B bridges, one closed or triply bridged B–B–B unit, two B–B bond and no terminal BH₂ groups. Hence, the overall STYX code B₅H₉ molecule is 4120.



Hence, option (B) is correct.

26. Solution: (C)

Galena, the most common mineral of lead, is primarily lead sulfide (PbS). The sulfide is oxidized to a sulfite (PbSO₃) which thermally decomposes into lead oxide and sulfur dioxide gas. (PbO and SO₂) The sulfur dioxide is expelled, and the lead oxide is reduced.

Hence, option (C) is correct.

27. Solution: (A)

The size of atom is defined as distance between nucleus and outermost electron. It depends upon the number of shells and screening effect of orbitals. Generally, down the group the atomic size increases because new shells add at each step and effectively nuclear charge decreases.

Order of ionic radius for M³⁺ cations: Al < Ga < In < Tl

Hence, option (A) is correct.

28. Solution: (A)

However, the smaller noble gases He and Ne do not form clathrate compounds because the noble gas atoms are small enough to escape from the cavities.

Clathrates are the compounds formed by inert gases (Argon, Krypton, Xenon). In which the gas molecules penetrate the cavities of the crystal structure composed of H₂O molecules.

Hence, option (A) is correct.

29. Solution: (C)

The bond angle in NF_3 (102.3°) is, smaller than NH_3 (107.2°). This is because of. large size of F compared to H. large size of N compared to F.

Hence, option (C) is correct.

30. Solution: (B)

White phosphorus, yellow phosphorus or simply tetraphosphorus (P_4) exists as molecules made up of four atoms in a tetrahedral structure. Methane has 4 regions of electron density around the central carbon atom (4 bonds, no lone pairs). The resulting shape is a regular tetrahedron with H-C-H angles of 109.5° .

Hence, option (B) is correct.

31. Solution: (C)

bond length or bond distance is defined as the average distance between nuclei of two (chemical bond|bonded) atoms in a molecule. It is a transferable property of a bond between atoms of fixed types, relatively independent of the rest of the molecule.

CCl_4 175pm

SiCl_4 190pm

GeCl_4 305 pm

Bond length of the tetrachlorides order:

$\text{GeCl}_4 > \text{SiCl}_4 > \text{CCl}_4$

Hence, option (C) is correct.

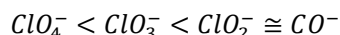
32. Solutions: (B)

$B_{10}C_2H_{12} = B_{10}(BH)_2H_{12} = B_{12}H_{14} = B_{12}H_{12}^{2-} = \text{Closo}$

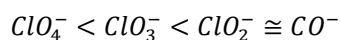
$B_{10}H_{12}(SEt_2)_2 = B_{10}H_{12}(SEt_2)_2 = B_{10}H_{12}H_2 =$

$B_{10}H_{10}^{4-} = \text{Nido}$

Hence, option (B) is correct.

33. Solutions: (C)

The oxidation of many molecules and ions by halogen oxyanions becomes progressively faster as the oxidation no. of the halogen decreases. Thus the rates observed are often in these order.



Hence, option (C) is correct.

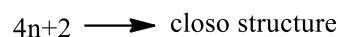
34. Solutions: (C)

unlike the other elements of group 1, Li reacts directly with nitrogen to form lithium nitride. This is because Li^+ is very small in size and so its size is the most compatible with the N^{3-} ion

Hence, option (C) is correct.

35. Solution: (D)

$$\text{VEC} = 4 \times 5 + 2 = 22 \text{ electron}$$



$$n = \text{no. of atom}$$

$$\begin{aligned} \text{closo } 4n+2 \quad n+1 \text{ electron pair} \\ 5+1 = 6 \text{ electron pair} \\ 6 \times 2 = 12 \text{ electron} \end{aligned}$$

Hence, option (D) is correct.

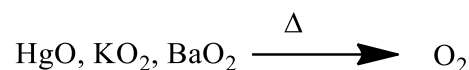
36. Solution: (A)

B is less electronegative from other so, H can oxidize B easily.

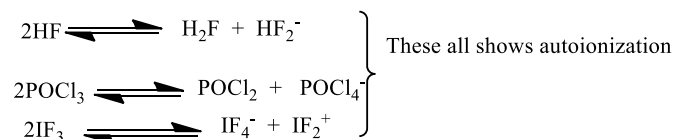
Hence, option (A) is correct.

37. Solution: (D)

Generally metal oxides are stable even at 1000°C . but many oxides decomposes on heating. Peroxides generally decomposes on heating.



Hence, option (D) is correct.

38. Solution: (B)

Hence, option (B) is correct.

39. Solution: (D)

SbF_5 : Largest size and highest coordination ability, strongest Lewis acid.

AsF_5 : Smaller than Sb, slightly less acidic.

$\text{TaF}_5 \cong \text{NbF}_5$: Transition metals with similar sizes and acidity.

PF_5 : Smallest size, poor fluoride ion acceptance, weakest acid.



Hence, option (D) is correct.

40. Solution: (C)

XeF_6 can be synthesized by reacting SbF_5 with XeF_5^+ , where XeF_5^+ acts as a fluoride ion acceptor.

This is incorrect because XeF_5^+ is actually a fluoride ion donor, not an acceptor.

In reality, XeF_6 reacts with SbF_5 , and SbF_5 (the Lewis acid) accepts a fluoride ion from XeF_6 , forming XeF_5^+ and SbF_6^- : $\text{XeF}_6 + \text{SbF}_5 \rightarrow [\text{XeF}_5]^+ [\text{SbF}_6]^-$