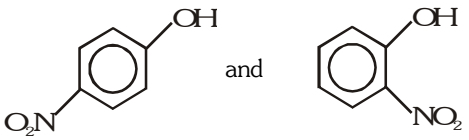
SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

1. Out of the two compounds shown below, the vapour pressure of B at a particular temperature is expected to be



(A) (B)

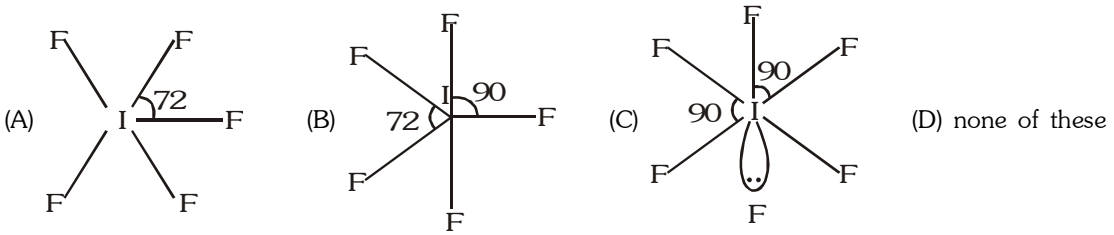
(A) higher than that of A

(B) lower than that of A

(C) same as that of A

(D) can be higher or lower depending upon the size of the vessel

2. The structure of IF_5 can be best described as :-



(D) none of these

3. The correct order of the bond angles is :-

(A) $NH_3 > H_2O > PH_3 > H_2S$ (B) $NH_3 > PH_3 > H_2O > H_2S$

(C) $NH_3 > H_2S > PH_3 > H_2O$ (D) $PH_3 > H_2S > NH_3 > H_2O$

4. The correct increasing bond angle among BF_3, PF_3 and ClF_3 follows the order :-

(A) $BF_3 < PF_3 < ClF_3$ (B) $PF_3 < BF_3 < ClF_3$ (C) $ClF_3 < PF_3 < BF_3$ (D) $BF_3 = PF_3 = ClF_3$

5. How many sigma and pi bonds are present in tetracyanoethylene ?

(A) nine σ and nine π (B) five π and nine σ (C) nine σ and seven π (D) eight σ and eight π

6. The types of bond present in N_2O_5 are :-

(A) only covalent (B) only ionic (C) ionic and covalent (D) covalent & coordinate

7. How many bonded electron pairs are present in IF_7 molecule :-

(A) 6 (B) 7 (C) 5 (D) 8

8. When 2s – 2s, 2p – 2p and 2p – 2s orbitals overlap, the bond strength decreases in the order :-

(A) p – p > s – s > p – s (B) p – p > p – s > s – s

(C) s – s > p – p > p – s (D) s – s > p – s > p – p

9. The volatility of HF is low as compare to other Hydra acid of Halogen because of :-

(A) its low polarizability

(B) the weak dispersion interaction between the molecules

(C) its small molecular mass

(D) its strong hydrogen bonding

10. The shapes of PCl_4^+, PCl_4^- and $AsCl_5$ are respectively :-

(A) square planar, tetrahedral and see-saw

(B) tetrahedral, see-saw and trigonal bipyramidal

(C) tetrahedral, square planar and pentagonal bipyramidal

(D) trigonal bipyramidal, tetrahedral and square pyramidal

11. The experimental value of the dipole moment of HCl is 1.03 D. The length of the H – Cl bond is 1.275 Å. The percentage of ionic character in HCl is :-

(A) 43 (B) 21 (C) 17 (D) 7

12. The shapes of IF_5 and IF_7 are respectively :-

(A) tetragonal pyramidal and pentagonal bipyramidal

(B) octahedral and pyramidal

(C) trigonal bipyramidal and square antiprismatic

(D) distorted square planar and distorted octahedral

13. Amongst LiCl, RbCl, $BeCl_2$ and $MgCl_2$, the compounds with the greatest and the least ionic character, respectively are :-

(A) LiCl and RbCl (B) RbCl and $BeCl_2$ (C) RbCl and $MgCl_2$ (D) $MgCl_2$ and $BeCl_2$

14. PCl_5, exists but NCl_5 does not because :-

(A) Nitrogen has no vacant 2d-orbitals (B) NCl_5 is unstable

(C) Nitrogen atom is much smaller than P (D) Nitrogen is highly inert

15. (C – Cl) bond in $CH_2 = CH - Cl$ (vinyl chloride) is stabilised in the same way as in :-

(A) benzyl chloride (B) ethyl chloride (C) chlorobenzene (D) allyl chloride

16. In $ICl_4^{\ominus}$, the shape is square planar. The number of bond pair-lone pair repulsion at 90 are :-

(A) 6 (B) 8 (C) 12 (D) 4

17. The structure of diborane (B_2H_6) contains :-

(A) four (2c – $2e^-$) bonds and two (2c – $3e^-$) bonds (B) two (2c – $2e^-$) bonds and two (3c – $2e^-$) bonds

(C) four (2c – $2e^-$) bonds and four (3c – $2e^-$) bonds (D) none

18. Among the following species, identify the isostructural pairs : NF_3, NO_3^-, BF_3, H_3O^+, HN_3 :-

(A) [NF_3, NO_3^-] and [BF_3, H_3O^+] (B) [NF_3, HN_3] and [NO_3^-, BF_3]

(C) [NF_3, H_3O^+] and [NO_3^-, BF_3] (D) [NF_3, H_3O^+] and [HN_3, BF_3]

19. Which of the following exhibit/s H-bonding ?

(A) CH_4 (B) H_2Se (C) N_2H_4 (D) H_2S

20. Valency expresses generally :

(A) total e^- in an atom (B) atomicity of an element

(C) oxidation number of an element (D) combining capacity of an element

21. Which element do not have valency equals to its group no. :

(A) sodium (B) aluminium (C) oxygen (D) carbon

22. Which condition favours the bond formation:-

(A) maximum attraction and maximum potential energy

(B) minimum attraction and minimum potential energy

(C) minimum potential energy and maximum attraction

(D) none of the above

23. Number of σ and π bonds present in :

$CH_3 - CH = CH - C \equiv CH$ are -

(A) 10 σ , 3 π (B) 10σ, 2π (C) 9σ, 2π (D) 8σ, 3π

24. Which is not characteristic of π-bond:-

(A) π - bond is formed when a sigma bond already formed

(B) π - bond are formed from hybrid orbitals

(C) π - bond may be formed by the overlapping of p-orbitals

(D) π-bond results from lateral overlap of atomic orbitals

25. When sodium and chlorine reacts then energy is :-

(A) released and ionic bond is formed (B) released and covalent bond is formed

(C) absorbed and ionic bond is formed (D) absorbed and covalent bond is formed

26. The electron pair which forms a bond between two similar non-metallic atoms will be :-

(A) dissimilar shared between the two (B) by complete transfer from one atom to other

(C) in a similar spin condition (D) equally shared in between the two

27. In N_2 molecule, the atoms are bonded by :-

(A) 1 σ and 2 π - bonds, 2 L.P. (B) 1 σ and 1 π - bonds, 1 L.P.

(C) 2 σ and 1 π - bonds, No L.P. (D) 1 σ, 2 π & No L.P.

28. An atom of element A has three electrons in its outer shell and B has six electrons in its outermost shell. The formula of the compound formed between these two will be :-

(A) A_6B_6 (B) A_2B_3 (C) A_3B_2 (D) A_2B

29. Two element X and Y have following electronic configuration :-

X $1s^2$; $2s^2$, $2p^6$; $3s^2$, $3p^6$; $4s^2$

Y $1s^2$; $2s^2$, $2p^6$; $3s^2$, $3p^5$

The expected compound formed by combination of X and Y will be expressed as :

(A) XY_2 (B) X_5Y_2 (C) X_2Y_5 (D) XY_5

30. Polarisibility of halide ions increases in the order :-

(A) F^-, I^-, Br^-, Cl^- (B) Cl^-, Br^-, I^-, F^- (C) I^-, Br^-, Cl^-, F^- (D) F^-, Cl^-, Br^-, I^-

31. The correct order of the O–O bond length in O_2, H_2O_2 and O_3 is :-

(A) $O_2 > O_3 > H_2O_2$ (B) $O_3 > H_2O_2 > O_2$ (C) $H_2O_2 > O_3 > O_2$ (D) $H_2O_2 > O_2 > O_3$

32. In which of the following the central atom does not use sp^3 hybrid orbitals in its bonding :-

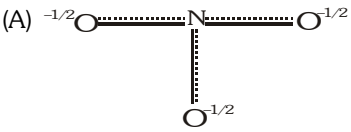
(A) BeF_3^- (B) OH_3^+ (C) NH_2^- (D) NF_3

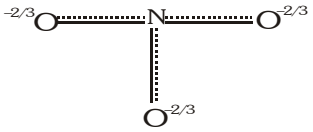
33. According to Fajjan's rule, covalent bond is favoured by :-

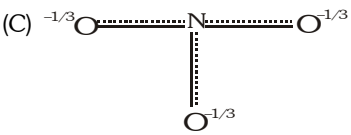
(A) large cation and small anion (B) large cation and large anion

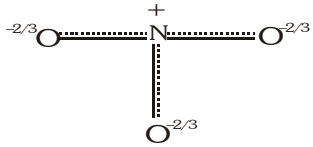
(C) Small cation and large anion (D) Small cation and small anion

34. Resonance hybrid of nitrate ion is :-

(A) 

(B) 

(C) 

(D) 

35. The correct order of bond angle (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is :-

(A) $H_2S < NH_3 < BF_3 < SiH_4$ (B) $NH_3 < H_2S < SiH_4 < BF_3$

(C) $H_2S < NH_3 < SiH_4 < BF_3$ (D) $H_2S < SiH_4 < NH_3 < BF_3$

CHECK YOUR GRASP					ANSWER KEY								EXERCISE -1							
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	A	C	A	C	A	D	B	B	D	B	C	A	B	A	C	B	D	C	C	D
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35					
Ans.	C	C	A	B	A	D	A	B	A	D	C	A	C	C	C					

SELECT THE CORRECT ALTERNATIVES (ONE OR MORE THEN ONE CORRECT ANSWERS)

1. Which of the following does not have same shape :-

(A) SO_4^{-2}, S_5^{-2} (B) $ICl_4^{\ominus}, I_5^{\ominus}$ (C) CO_2, SO_2 (D) $NO_2^{\oplus}, NO_2^{\ominus}$

2. $B_3N_3H_6$ + solution of hydrochloric acid $\longrightarrow$?

Select correct about above reaction :

(A) no reaction

(B) $B_3N_3H_6$ show substitution reaction & produce $B_3N_3Cl_6$

(C) $B_3N_3H_6$ show addition reaction and produce $B_3N_3H_9Cl_3$ in which Cl is bonded to boron

(D) $B_3N_3H_6$ show addition reaction and produce $B_3N_3H_9Cl_3$ in which Cl is bonded to nitrogen

3. Nodal planes of π bonds in benzene are located in :

(A) all are in molecular plane

(B) one in molecular plane and two in plane perpendicular to molecular plane which contain C – C σ bonds.

(C) two in molecular plane and one in plane perpendicular to molecular plane which contain C – C σ bond and C – H σ bond

(D) perpendicular to molecular plane which bisect benzene ring in two equal half

4. Which of the following has fractional bond order :-

(A) O_2^{2+} (B) O_2^{2-} (C) F_2^{2-} (D) H_2^-

5. Which is correct statement ?

As the s-character of a hybrid orbital decreases

(I) The bond angle decreases (II) The bond strength increases

(III) The bond length increases (IV) Size of orbitals increases

(A) (I), (III) and (IV) (B) (II), (III) and (IV) (C) (I) and (II) (D) all are correct

6. Which of the following compounds have the same no. of lone pairs with their central atom :-

(I) XeF_5^- (II) BrF_3 (III) XeF_2 (IV) Triple methylene

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

7. Select pair of compounds in which both have different hybridization but have same molecular geometry :-

(A) BF_3, BrF_3 (B) $ICl_2^{\ominus}$, $BeCl_2$ (C) $BeCl_3$, PCl_3 (D) PCl_3, NCl_3

8. The states of hybridization of boron and oxygen atoms in boric acid (H_3BO_3) are respectively.

(A) sp^3 and sp^2 (B) sp^2 and sp^3 (C) sp^2 and sp^2 (D) sp^3 and sp^3

9. Which of the following option w.r.t. increasing bond order is correct ?

(A) $NO < C_2 < O_2^- < He_2^+$ (B) $C_2 < NO < He_2^+ < O_2^-$

(C) $He_2^+ < O_2^- < NO < C_2$ (D) $He_2^+ < O_2^- < C_2 < NO$

10. Which is most ionic :

(A) P_2O_5 (B) MnO (C) CrO_3 (D) Mn_2O_7

11. The molecular orbital configuration of CN^+ is :-

(A) KK $\sigma (2s)^2$, $\sigma^* (2s)^2$, $\pi (2p_x)^2$, $\pi (2p_y)^2$ (B) KK $\sigma (2s)^2$, $\sigma^* (2s)^2$, $\sigma (2p_z)^2$, $\pi (2p_x)^1$, $\pi (2p_y)^1$

(C) KK $\sigma (2s)^2$, $\sigma^* (2s)^2$, $\sigma (2p_z)^2$, $\pi (2p_x)^2$, $\pi (2p_y)^1$ (D) KK $\sigma (2s)^2$, $\sigma^* (2s)^2$, $\sigma (2p_z)^2$, $\pi (2p_x)^2$, $\pi (2p_y)^2$

12. Among the following orbital bonds, the angle is minimum between :-

(A) sp^3 bonds (B) p_x and p_y orbitals

(C) H–O–H in water (D) sp bonds

13. Molecule having dipole moment is :-

(A) 2, 2-dimethylpropane (B) trans-2-pentene

(C) neopentane (D) 2,2.3,3-tetramethylbutane.

14. The AsF_5 molecule is trigonal bipyramidal. The hybrid orbitals used by the As atoms for bonding are :-

(A) $dx^2 - y^2$, dz^2, s, p_x, p_y (B) dxy, s, p_x, p_y, p_z

(C) s, p_x, p_y, p_z,dz^2 (D) $dx^2 - y^2$, s, p_x, p_y

15. Polarisation is the distortion of the shape of an anion by an adjacently placed cation. Which of the following statements is correct :-

(A) maximum polarisation is brought about by a cation of high charge

(B) minimum polarisation is brought about by a cation of low radius

(C) a large cation is likely to bring about a large degree of polarisation

(D) polarising power of a cation is less than that of anion

16. Amongest NO_3^-, AsO_3^{3-}, CO_3^{2-}, ClO_3^-, SO_3^{2-} and BO_3^{3-}, the non-planar species are :-

(A) CO_3^{2-}, SO_3^{2-} and BO_3^{3-} (B) AsO_3^{3-}, ClO_3^- and SO_3^{2-}

(C) NO_3^-, CO_3^{2-} and BO_3^{3-} (D) SO_3^{2-}, NO_3^- and BO_3^{3-}

17. The nature of π-bonds in perchlorate ion is :-

(A) O (d π) – Cl (p π) (B) O (p π) – Cl (d π) (C) O (d π) – Cl (d π) (D) O (p π) – Cl (p π)

18. CaO and NaCl have the same crystal structure and approximately the same ionic radii. If U is the lattice energy of NaCl, the approximate lattice energy of CaO is :-

(A) U/2 (B) U (C) 2 U (D) 4 U

19. The ease of hydrolysis of trichlorides of group 15 elements decreases in the order :-

(A) $NCl_3 > PCl_3 > AsCl_3 > SbCl_3 > BiCl_3$ (B) $PCl_3 > NCl_3 > AsCl_3 > SbCl_3 > BiCl_3$

(C) $AsCl_3 > NCl_3 > PCl_3 > SbCl_3 > BiCl_3$ (D) $SbCl_3 > BiCl_3 > PCl_3 > NCl_3 > AsCl_3$

20. Which of the following solid sold have highest value of K_p when heated in closed vessel :-

(A) Li_2CO_3 (s) (B) $BeCO_3$ (s) (C) Na_2CO_3 (s) (D) $BaCO_3$ (s)

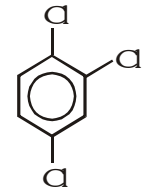
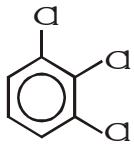
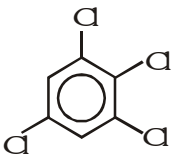
21. Type of bonds between calcium and carbon in CaC_2 are :-

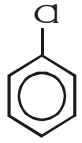
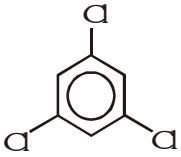
(A) σ, π (B) only σ (C) only π (D) ionic bond

22. Ethanol has a higher boiling point than dimethyl ether though they have the same molecular weight. This is due to :-

(A) resonance (B) coordinate bonding (C) hydrogen bonding (D) ionic bonding

23. Write order of dipole moment of following compounds :-

(i)  (ii)  (iii) 

(iv)  (v)  (vi) 

(A) (iii) > (ii) > (i) > (iv) > (v) > (vi) (B) (iii) > (i) > (ii) = (vi) > (iv) > (v)

(C) (ii) > (i) = (iii) = (iv) > (v) = (vi) (D) (iii) > (i) > (iv) > (v) > (ii) > (vi)

24. The correct order of increasing X – O – X bond angle is (X = H, F or Cl) :-

(A) $H_2O > Cl_2O > F_2O$ (B) $Cl_2O > H_2O > F_2O$

(C) $F_2O > Cl_2O > H_2O$ (D) $F_2O > H_2O > Cl_2O$

25. Out of given reaction which show change in hybridisation of central atom :-

(A) $H_2\underline{B}O_3$ dissolve in water (B) $H_2\underline{S}O_4$ dissolve in water

(C) $\underline{N}_2O_{5(g)} \longrightarrow N_2O_{5(s)}$ (D) $\underline{P}Br_{5(g)} \longrightarrow PBr_{5(s)}$

(E) $C_2H_6 \xrightarrow[\text{bond cleavage of C–C bond}]{\text{Homolytic}}$

26. In the cyclo-S_8 molecule of rhombic sulphur, all the S–S bond lengths and all the S–S–S bond angles are respectively (give approximate values) :-

(A) 204 pm and 105 (B) 102 pm and 120

(C) 204 pm and 180 (D) 102 pm and 60

27. The structure of the SO_3 molecule in the gaseous phase contains :-

(A) only σ-bonds between sulphur and oxygen

(B) σ-bonds and a (pπ-pπ) bonds between sulphur and oxygen

(C) σ-bonds and a (dπ-pπ) bonds between sulphur and oxygen

(D) σ-bonds, and a (pπ-pπ) and a (pπ-dπ) bonds between sulphur and oxygen

28. Which of the following allotropic forms of sulphur is the most stable thermodynamically :-

(A) Orthorhombic (B) β-monoclinic

(C) γ-monoclinic (D) Plastic sulphur

29. Which of the following acids is not a peroxo acid :-

(A) CF_3CO_3H (B) $H_2S_2O_8$ (C) $H_2S_2O_7$ (D) $H_2N_2O_2$

30. The hydrolysis of 1 mol of peroxodisulphuric acid produces :-

(A) 2 mol of sulphuric acid

(B) 2 mol of peroxomonosulphuric acid

(C) 1 mol each of sulphuric acid and peroxomonosulphuric acid

(D) 1 mol each of sulphuric acid, peroxomonosulphuric acid and hydrogen peroxide

31. Which of the following statements is correct :-

(A) SF_6 does not react with water (B) OF_6 is d^2Sp^3-hybridized

(C) $S_2O_3^{2-}$ is a linear ion (D) There is no π-bonding in SO_4^{2-}

32. In H_2O, the bond angle H–O–H is 104 28' but in H_2S, H_2Se and H_2Te the bond angles are pretty close to 90 . This suggests that :-

(A) oxygen uses sp^2-hybrid orbitals while S, Se and Te use sp^3-hybrid orbitals for bonding with the hydrogen atoms

(B) oxygen uses sp^3-hybrid orbitals to bond with the two hydrogen atoms while S, Se and Te use almost pure p orbitals

(C) oxygen uses sp^3-hybrid orbitals while S, Se and Te utilize d orbitals for bonding with the hydrogen atoms

(D) all the atoms use pure p orbitals to bond with the hydrogen atoms

33. Which of the following statements are correct for the SO_4^{2-} ion ?

(A) it is tetrahedral

(B) all the S–O bond length are equal, and shorter than expected

(C) it contains four σ-bonds between the S and the O atoms, two π-bonds delocalized over the S and the four O atoms, and all the S–O bonds have a bond order of 1.5

(D) Oxidation state of sulphur is +6 and all oxygen in –2

34. The colour of halogens progressively deepens from fluorine to iodine because :-

(A) halogens of higher atomic number absorb light of longer wavelength since the difference in energy between the ground state and excited state decreases as the atomic number increases.

(B) fluorescence and phosphorescence become more intense as the atomic numbers of halogen increases

(C) the standard electrode potential increases from I_2 to F_2

(D) halogens of higher atomic number absorb light of shorter wavelength since the difference in energy between the ground state and excited state increases as the atomic number increases.

35. Which of the following pairs of halogens have approximately identical bond energy ?

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

36. Which of the following is arranged in order of increasing ionic character :-

(A) $PbCl_2 < SnCl_4 < KCl < MgCl_2$ (B) $SnCl_4 < PbCl_2 < KCl < MgCl_2$

(C) $SnCl_4 < PbCl_2 < MgCl_2 < KCl$ (D) $PbCl_2 < SnCl_4 < MgCl_2 < KCl$

37. $XeOF_4$ contains :-

(A) six electron pairs forming an octahedron with two positions occupied by lone pairs

(B) two π-bonds and the remaining six electron pairs, forming an octahedron

(C) three π-bonds and the remaining four electron pairs forming an tetrahedron

(D) one π-bonds and the remaining six electron pairs forming an octahedron with one position occupied by a lone pair

38. The azide ion has :-

(A) 20 outer electrons and is isoelectronic with Br_2O (B) 18 outer electrons and is isoelectronic with NO_2^-

(C) 16 outer electrons and is isoelectronic with CO_2 (D) 14 outer electrons and is isoelectronic with H_2O_2

39. Which of the following pairs of ions do not represent cyclic and chain silicates ?

(A) $Si_2O_7^{2-}$ and $(SiO_3)_n^{2n-}$ (B) $Si_3O_9^{6-}$ and $(Si_4O_{11})_n^{6n-}$

(C) $Si_2O_7^{2-}$ and $(Si_2O_5)_n^{2n-}$ (D) $Si_2O_7^{7-}$ and $(SiO_3)_n^{2n-}$

40. Which of the following statements is/are incorrect ?

(A) B_2H_6 is not an electron-deficient molecule.

(B) the dipole moment of BF_3 is zero

(C) $B(OH)_3$ partially reacts with water to form H_3O^+ and $[B(OH)_4]^-$, and behaves like a weak acid.

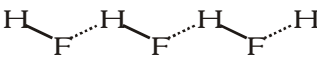
(D) BF_3 and BrF_3 molecules have different shapes.

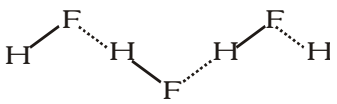
41. Rotation around the bond (between the underlined atoms) is restricted in :

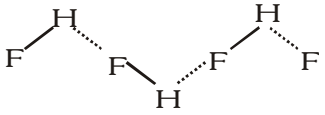
(A) $\underline{C}_2H_4$ (B) $H_2\underline{O}_2$ (C) $\underline{C}_2H_2$ (D) $\underline{C}_2H_6$

42. The H bond in solid HF can be best represented as :

(A) H – F ...H – F ...H – F

(B) 

(C) 

(D) 

43. Which of the following statements is/are correct ?

(A) NH_2^+ shows sp^2 – hybridisation whereas NH_2^- shows sp^3 – hybridisation

(B) $Al(OH)_4^-$ has a regular tetrahedral geometry

(C) sp^2–hybridized orbitals have equal s-and p-character

(D) usually hybridized orbitals form σ-bonds

44. Which of the following statements is/are true for BaO and MgO ?

(A) BaO is more ionic than MgO (B) MgO is more ionic than BaO

(C) BaO has a higher melting point than MgO (D) MgO has a higher melting point than BaO

45. Select the correct statement (s) about the compound $NO[BF_4]$:

(A) it has 5σ and 2π bond

(B) nitrogen - oxygen bond length is higher than nitric oxide (NO)

(C) it is a diamagnetic species

(D) B–F bond length in this compound is lower than in BF_3

46. Silane is more reactive than CH_4 due to :

(A) larger size of Si compared to C which facilitate the attack by nucleophile

(B) polarity of Si–H bond is opposite to that of C – H bond

(C) availability of vacant 3d orbitals in case of Si to form the reaction intermediate easily

(D) Si-H bond energy is lower than that of C–H bond

47. Select correct statement (s) :

(A) acidic strength of HBr > HCl but reverse is true for their reducing property

(B) basic strength of PH_3 > AsH_3 but reverse is true for their bond angle

(C) dipole moment of CH_3Cl > CH_3F but reverse is true for their $H\tilde{C}H$ bond angle

(D) K_{a_1} of fumaric acid is higher than maleic acid but reverse is true for their K_{a_2}

48. Nodal planes of π-bonds (s) in $CH_2 = C = C = CH_2$ are located in :

(A) all are in molecular plane

(B) two in molecular plane and one in a plane perpendicular to molecular plane which contains C – C σ-bond

(C) one in molecular plane and two in a plane perpendicular to molecular plane which contains C – C σ-bonds

(D) two in molecular plane and one in a plane perpendicular to molecular plane which bisects C – C σ-bonds at right angle

49. BF_3 and NF_3 both molecules are covalent, but BF_3 is non-polar and NF_3 is polar. Its reason is :

(A) in uncombined state boron is metal and nitrogen is gas

(B) B–F bond has no dipole moment whereas N–F bond has dipole moment

(C) the size of boron atom is smaller than nitrogen

(D) BF_3 is planar whereas NF_3 is pyramidal

50. Which of the following has been arranged in order of decreasing bond length :-

(A) P – O > Cl – O > S – O (B) P – O > S – O > Cl – O

(C) S – O > Cl – O > P – O (D) Cl – O > S – O > P – O

51. Which of the following models best describes the bonding with in a layer of the graphite structure ?

(A) metallic bonding (B) ionic bonding

(C) non - metallic covalent bonding (D) vander Waals forces

52. Which of the following is tetrabasic acid ?

(A) orthophosphoric acid (B) hypophosphorus acid

(C) metaphosphoric acid (D) pyrophosphoric acid

BRAIN TEASERS				ANSWER KEY							EXERCISE -2			
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
A,B,C,D	C	A	D	A	C	B	C	D	B	A	B	B	C	A
16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	B	D	A	B	D	C	C	B	A,C,D, E	A	D	A	C,D	C
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
A	B	A,B,C,D	A	B	C	D	C	A,C,D	A	A,B,C	C	A,B,D	A,D	A,C
46	**47**	**48**	**49**	**50**	**51**	**52**								
A,B,C,D	C	B	D	B	C	D								

TRUE OR FALSE :

1. The polarising power of a cation is directly proportional to its size.
2. The polarisability of an anion is directly proportional to its charge.
3. For a given cation, greater the polarisability of the anion, more the covalent character.
4. An element with low ionization potential is most likely to form a covalent bond with an other element having a high electron affinity.
5. Ionic interactions are stronger than covalent bonds.
6. Two non-metal atoms are likely to form covalent bonds on combination.
7. Ionic interactions are directional.
8. All molecules having polar bonds are polar.
9. The CH_2Cl_2 molecule may be polar or nonpolar depending on its geometry.
10. Two isomers of $C_2H_2Cl_2$ are polar.
11. The net dipole in the water molecules is the resultant of its bond dipoles.
12. SO_2 is polar whereas CO_2 is non-polar.
13. If all bonds in a molecule are polar, the molecule as a whole must be polar.
14. The bond angle around B in BCl_3 and BF_3 is same.
15. NH_3 molecule involve sp^3 hybridisation of N-atom.
16. The bond length decreases with increase in multiplicity of bonds between two atoms.
17. The geometry of NH_3 and BH_3 is same.
18. Dipole moment of NF_3 is less than that of NH_3.
19. A non-polar molecule can have a polar bond in it.
20. In ionic bond formation octet is completed.
21. π -bond is formed by the colateral overlapping of atomic orbitals.
22. Normally the covalent bond is non-directional.
23. He_2 having no existence because its bond order is zero.
24. O_2, O_2^- and O_2^+ all are paramagnetic.
25. When bond order increases, bond length decreases.
26. Bond order is the measurement of bond strength.
27. In hybridisation, only orbitals are involved not electrons.
28. SF_6 molecule is octahedral.
29. Ethyne is a linear molecule.
30. CO_2 is a polar molecule but not have polar bond.
31. C–C sigma bond in ethyne is sp^2 –sp^2.
32. XeF_4 molecule is square planar in shape.
33. Hybridised orbitals have identical shape.
34. The bond angle in Cl_2O is equal to that of OF_2.
35. The density of water is more than ice.
36. HCl is a gas while HF is high boiling point liquid because H–F bond is stronger.
37. Liquid NH_3 does not contain H–bond.

38. Dipole moment is completely based on ionic nature of bond.

39. BeF_2 containing dipole moment while H_2O having zero dipole moment.

40. In CO_2 molecule, C–O bond is polar but CO_2 molecule is non-polar because the vector sum of two C—O bond is zero.

41. Odd electron molecule is paramagnetic.

42. The reason for resonance, is delocalisation of π -electrons.

43. During the formation of covalent bond both shared electron having opposite spin.

44. The bond Hg–Cl is more ionic in $HgCl_2$ than Hg_2Cl_2.

45. The solubility of ionic solids decreases when hydration energy of ions increases.

46. Between layers of graphite, bond will be covalent.

47. The polarising power of Zn^{2+} is greater than Ca^{2+} ions.

48. The colour of PbI_2 is yellow. The reason for this is large size of Pb^{+2} ion.

49. The H – N – H bond angle in NH_3 is greater than H – As – H bond angle in AsH_3.

50. Linear overlap of atomic p-orbitals leads to a sigma bond.

51. The dipole moment of CH_3F is greater than that of CH_3Cl.

52. sp^2 hybrid orbitals have equal s- and p-character.

53. All the Al – Cl bonds in Al_2Cl_6 are not equivalent.

FILL IN THE BLANKS :

1. Hydrogen bond energy is around ..... .

2. The valence atomic orbitals on carbon in silver acetylide are ..... hybridised.

3. The hybridisation state of oxygen in water molecule is ..... .

4. When N_2 goes to N_2^+, then N–N bond distance ..... and when O_2 goes to O_2^+, then O–O bond distance ..... .

5. Among N_2O, SO_2, I_3^+ and I_3^-, the linear species are ..... and ..... .

MATCH THE COLUMN :

1.

	Column-I		Column-II
(A)	O_3	(p)	covalent bond
(B)	$H_2O_{(\ell)}$	(q)	Co-ordinate bond
(C)	$CuSO_4 \cdot 5H_2O$	(r)	Hydrogen bond
(D)	$(NH_4)_2SO_4$	(s)	Ionic bond

2.

	Column-I		Column-II
(A)	$B_3N_3H_6$	(p)	planar geometry
(B)	H_2O_2	(q)	non planar geometry
(C)	B_2H_6	(r)	no lone pair
(D)	I_2Cl_6	(s)	non polar molecule

3.

	Column-I		Column-II
(A)	$\underline{B}_2H_6 + 2NaH \longrightarrow$	(p)	no change in hybridisation of under line atom
(B)	$H_3\underline{B}O_3$ + water $\longrightarrow$	(q)	$sp^2 \longrightarrow sp^3$ (change in hybridisation)
(C)	$\underline{Be}H_2 \longrightarrow (BeH_2)_{(s)}$	(r)	breaking of 3C – $2e^-$ bond
(D)	$\underline{B}F_3 + NaF \longrightarrow$	(s)	formation of 3C – $2e^-$ bond

4.

	Column-I		Column-II
(A)	N_2^+ is stable than N_2^-	(p)	due to one have higher electrons in antibonding than other
(B)	NO can easily loss its electron than N_2	(q)	one have B.O. 3 and other have 2.5
(C)	NO have large bond length than NO^+	(r)	both are paramagnetic with same bond order
(D)	He_2^+ exist but less stable than H_2^+	(s)	one paramagnetic and other diamagnetic

ASSERTION & REASON QUESTION :

These questions contains, Statement-I (assertion) and Statement-II (reason).

(A) Statement-I is True, Statement-II is True ; Statement-II is a correct explanation for Statement-I

(B) Statement-I is True, Statement-II is True ; Statement-II is NOT a correct explanation for Statement-I

(C) Statement-I is True, Statement-II is False.

(D) Statement-I is False, Statement-II is True.

1. **Statement-I :** FeI_3 cannot exist in an aqueous solution.
Because
Statement-II : Fe^{3+} oxidizes I^- to I_2 easily.

2. **Statement-I :** SF_6 exists but SH_6 does not.
Because
Statement-II : $d\pi$-$p\pi$ bonding cannot take place in SH_6

3. **Statement-I :** The stability of peroxides and superoxides increases in passing from Li to Cs.
Because
Statement-II : The electropositive character of the elements in the periodic table increases on moving down a group.

4. **Statement-I :** Borazole is aromatic in nature.
Because
Statement-II : Nitrogen contributes π-electrons to the system.

5. **Statement-I :** The first ionization energy of Be is greater than that of B.
Because
Statement-II : The 2p orbital is lower in energy than the 2s.

6. **Statement-I :** Bond order of O_2 and BN is same.
Because
Statement-II : O_2 and BN are isoelectronic

7. **Statement-I :** CO_2 is non polar while SO_2 is polar molecule.
Because
Statement-II : S-O bonds are polar while C-O non polar.

8. **Statement-I :** CO_2 and SiO_2 has same physical state at room temp.

Because

Statement-II : Carbon has more electronegativity than silicon atom.

9. **Statement-I :** In NF_3 molecule lone pair resides in sp^3 hybrid orbital.

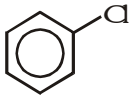
Because

Statement-II : NF_3 has pyramidal shape.

10. **Statement-I :** N_2O, CO_2 & I_3^- are isostructral.

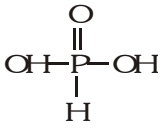
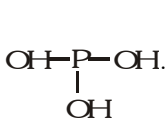
Because

Statement-II : All three have same hybridise central atom.

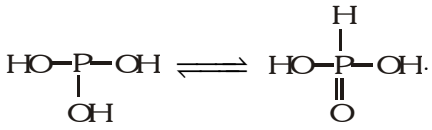
11. **Statement-I :** Dipole moment of  is similar as bromo benzene.

Because

Statement-II : Dipole moment of Cl - C bond is greater than Br- C bond.

12. **Statement-I :** PCl_3 on hydrolysis gives  and  .

Because

Statement-II : H_3PO_3 exists in two tautomeric forms : 

13. **Statement-I :** Super oxide ion is paramagnetic whereas peroxide ion is diamagnetic.

Because

Statement-II : Super oxide ion has one unpaired electron whereas per oxide ion has no unpaired electron.

14. **Statement-I :** Although PF_5, PCl_5 and PBr_5 are known, the penta halide of nitrogen have not been observed.

Because

Statement-II : Phosphorus has lower electronegativity than nitrogen.

15. **Statement-I :** Among alkali metal cations, Li^+(aq.) has highest electrical conductance.

Because

Statement-II : Li^+(aq.) is largest alkali metal cation because of greater degree of hydration.

16. **Statement-I :** HNO_3 is a stronger acid than HNO_2.

Because

Statement-II : In HNO_3, there are two N–O linkage whereas in HNO_2 there is only one.

17. **Statement-I :** $Al(OH)_3$ is amphoteric in nature.

Because

Statement-II : Al–O and O–H bonds can be broken with equal case in $Al(OH)_3$.

18. **Statement-I :** H_2SO_4 in more viscous than water.

Because

Statement-II : In H_2SO_4, S has highest oxidation state.

19. **Statement-I :** F_3^- ion is known, which has same geometry as X_3^- (X = Cl, Br, I)

Because

Statement-II : F is most electronegative element.

20. **Statement-I :** The p-isomer of dichlorobenzene has higher melting point than o-and m-isomer.

Because

Statement-II : p-isomer is symmetrical and thus shows more closely packed structure.

21. **Statement-I :** Boron does not show univalent nature but unipositive nature of thallium is quite stable.

Because

Statement-II : Inert pair effect predominates in thallium.

22. **Statement-I :** H_3BO_3 is monobasic acid in water.

Because

Statement-II : In water ionise as $H_3BO_3 \rightleftharpoons H_2BO_3^- + H^+$.

COMPREHENSION BASED QUESTIONS :

Comprehension # 1

In order to explain the shape and geometry of molecules. The valence bond theory was supplemented by the concept of Hybridization. This is a Hypothetical concept and has been introduced by Pauling and Slater. According to this concept any number of atomic orbitals of an atom which differ in energy slightly may mix with each other to form new orbitals called hybrid orbitals. The process of mixing or amalgamation of atomic orbitals of nearly same energy to produced a set of entirely new orbitals of equivalent energy is known as Hybridization.

1. The hybridization of carbon atoms in C – C single bond of H – C ≡ C – CH = CH_2 is :

(A) $sp^3 - sp^3$ (B) $sp^2 - sp^3$ (C) $sp - sp^2$ (D) $sp^3 - sp$

2. In XeF_2, XeF_4 and XeF_6 the number of lone pairs on Xe is respectively :

(A) 2, 3, 1 (B) 1, 2, 3 (C) 4, 1, 2 (D) 3, 2, 1

3. Which of the following is the correct set :

(A) H_2O ; sp^3, angular (B) H_2O ; sp^2, linear

(C) NH_3 ; sp^2, pyramidal (D) BF_3 ; sp^3, trigonal planar

4. In NO_3^- ion, number of bond pair and lone pairs of electrons on nitrogen atom are :

(A) 2, 2 (B) 3, 1 (C) 1, 3 (D) 4, 0

5. T-shape is exhibited by molecule :

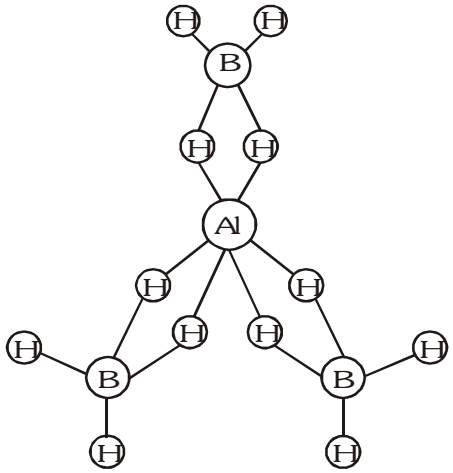
(A) ClF_3 (B) $CHCl_3$ (C) CCl_4 (D) PCl_5

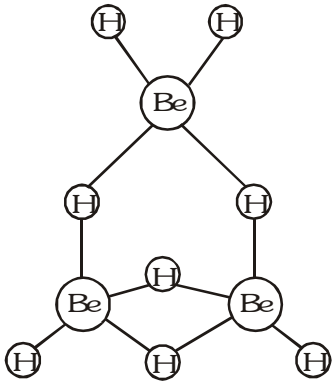
Comprehension # 2

$Na[BH_4]$ is ionic compound contain $BH_4^\ominus$ tetrahydrido borate ion and in solid state $NaBH_4$ has sodium chloride structure. Not all tetrahydridoborates are ionic. The beryllium, aluminium and transition metal borohydrides become increasingly covalent and volatile. In these type of tetrahydrido borate, the $BH_4^\ominus$ form covalent bond with metal ion. One or more H atoms in a $BH_4^\ominus$ act as a bridging and bond to metal, forming a three centre bond with two electrons shared by three atoms.

The $BH_4^\ominus$ is usually in that it may form one two or three such three centre bonds to the metal ion when forms covalent bond.

$Be(BH_4)_2$ and $Al(BH_4)_3$ are covalent and structures are given below.





1. $Li[AlH_4]$ is used as a reducing agent in many reaction & it is prepared by excess LiH and $AlCl_3$. Select incorrect statement about $Li[AlH_4]$.

(A) hybridisation of Al is same as B in $Na[BH_4]$ (B) geometry of around Al is same as $AlCl_4^{\ominus}$

(C) $AlH_4^{\ominus}$, $BH_4^{\ominus}$, $AlCl_4^{\ominus}$ are iso-structral (D) $AlH_4^{\ominus}$, $AlCl_4^{\ominus}$, $BH_4^{\ominus}$ are iso electronic.

2. Select correct about $Al(BH_4)_3$:

(A) all three tetrahydride borate form two hydrogen bridges

(B) two $BH_4^{\ominus}$ form 2 hydrogen bridges and one form one hydrogen bridge.

(C) one $BH_4^{\ominus}$ form 2 hydrogen bridge and two form one hydrogen bridge

(D) B form only $2c-2e^-$ bond

3. Total no. of $2c-2e^-$ bond and $3c-2e^-$ bond in $Al(BH_4)_3$ are respectively :

(A) 6 , 12 (B) 6 , 6 (C) 12 , 12 (D) 12 , 6

4. Total 2c–2e and 3c–2e bonds in $Be(BH_4)_2$ are respectively :

(A) 8, 4 (B) 4, 8 (C) 4, 4 (D) 8, 8

Comprehension # 3

The molecular orbital with the lowest energy is filled first. Thus σ (1s) is filled first where as σ^* (2p) is filled in the last, also the maximum number of electron in bonding and antibonding molecular orbtitals are according to Pauli and Hund's rule. As an electron in an antibonding molecular orbital cancels out the stability introduced by the electron in a bonding molecular orbital, it means that in order for bonding of atoms to occur there should be an excess of bonding electrons over antibonding electrons. In case where the number of bonding and antibonding electrons are equal, no bond will be formed between the atoms. With the help of above discussion, we can define easily bond order, relative bond length, relative stability and magnetic properties for a molecule.

Read the above paragraph carefully and give the answer of following questions :

1. In an antibonding molecular orbital, there is a point between the two probability contours of hydrogen atoms. This is called.

(A) antinode

(B) node

(C) a plane where electron charge density is maximum

(D) A and C both are correct

2. According to MOT which statement is correct about Boron molecule ?

(A) it is diamagnetic in nature

(B) it is paramagnetic in nature having magnetic moment 2.8 B.M. by using spin only formula

(C) it is paramagnetic but having magnetic moment 1.7 B.M.

(D) its bond order is 2

3. Which of the following are paramagnetic in nature ?

(A) B_2, N_2 and C_2 (B) O_2, B_2, N_2^- and O_2^-

(C) $O_2^{-\,-}$, N_2^+ and CO (D) B_2, C_2 and F_2

MISCELLANEOUS TYPE QUESTION — ANSWER KEY — EXERCISE -5

- ***True / False***

1. F	2. T	3. T	4. F	5. F	6. T	7. F
8. F	9. F	10. T	11. F	12. T	13. F	14. T
15. T	16. T	17. F	18. T	19. T	20. T	21. T
22. F	23. T	24. T	25. T	26. T	27. T	28. T
29. T	30. F	31. F	32. T	33. T	34. F	35. T
36. F	37. F	38. F	39. F	40. T	41. T	42. T
43. T	44. F	45. F	46. F	47. T	48. F	49. T
50. T	51. F	52. F	53. T			

- ***Fill in the Blanks***

1. 4.2 – 8.4 kJ mol^{-1} 2. sp 3. sp^3

4. increases, decreases 5. N_2O, I_3^-

- ***Match the Column***

1. A - (p, q), B - (p, r), C - (p, q, r, s), D - (p, q, s) 2. A - (p, r, s), B - (q), C - (q, r, s), D - (p, s)

3. A - (p, r), B - (q), C - (s), D - (q) 4. A - (p, r), B - (p, q, s), C - (p, q, s), D - (p, r)

- ***Assertion - Reason Questions***

1. A	2. B	3. A	4. B	5. C	6. C	7. C
8. D	9. A	10. C	11. D	12. A	13. A	14. B
15. D	16. C	17. C	18. B	19. D	20. A	21. A
22. C						

- ***Comprehension Based Questions***

Comprehension #1 : 1. (C) 2. (D) 3. (A) 4. (D) 5. (A)

Comprehension #2 : 1. (D) 2. (A) 3. (B) 4. (C)

Comprehension #3 : 1. (B) 2. (B) 3. (B)

SUBJECTIVE QUESTIONS :

1. Give reasons for the following :
   (a) KHF_2 is known whereas $KHCl_2$ is unknown.
   (b) $(CH_3)_3N$ is pyramidal but $(SiH_3)_3N$ is trigonal planar.
   (c) CO_2 is a gas but SiO_2 is a solid.
2. (a) The structures of N_2O_3 and P_2O_3 are different. Explain.
   (b) Among H–I, H–Br and H–Cl bonds which is weakest?
3. Suppose that the stability of carbonates when heated depends on the ability of the metal cation to polarize the carbonate ion and remove an oxide ion from it, so releasing CO_2.
   (a) Predict the order of thermal stability of the group 1 and 2 metal carbonates ?
   (b) Comment on the likely stability of aluminium carbonate ?
4. (a) BF_3 has less lewis acidic property than BBr_3. Why ?
   (b) $(CH_3)_3C–OH$ is less acid than $(CH_3)_3Si–OH$. Why ?
   (c) Why in the presence of ethyne HF exhibit more acidic character.
   (d) Why SF_4 can be hydrolysed easily but SF_6 can not ?
5. In what hybridization state is the beryllium atom in $BeCl_2$ molecule? How will the type of hybridization change when $BeCl_2$ transform to the solid state.
6. Give a suitable reason for the high mobility of H^+ ions through the ice than through liquid water.
7. (a) Example the following :
   (i) Boron trichloride has triangular planar geometry whereas aluminium trichloride has tetrahedral dimeric structure.
   (ii) Barium sulphate is sparingly soluble in water whereas beryllium sulphate is freely soluble.
   (iii) Dioxygen (O_2) molecule is stable whereas disulphur (S_2) is unstable at the room temperature.
8. Assuming Z-axis as molecular axis, lable the molecular orbitals formed by the following combination of atomic orbitals :
   (i) $1s + 1s$
   (ii) $2p_y - 2p_y$
   (iii) $2p_z + 2p_z$
   (iv) $2s + 2s$
   (v) $2p_x + 2p_x$
9. When a magnet is dipped in a jar of liquid O_2, some O_2 clings to it. Why ?
10. (a) What type of bonding holds the layer in graphite ?
    Why will graphite conduct electricity well in a direction parallel to the planes of hexagons, but not at all well in a direction perpendicular to the planes ?
    (b) PCl_5 exists as solid in the form of $[PCl_4]^+ [PCl_6]^-$, yet it is a non conductor of electricity. Why?
11. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is 0.1 Å, what fraction of an electron charge, e exist on each atom?
12. Through the electronegativities of nitrogen and chlorine are same, NH_3 exists as liquid whereas HCl as gas. Why?

13. The percent ionic character in HCl is 18.08. The observed dipole moment is 1.08 D. Find the internuclear distance in HCl.

14. HBr has dipole moment 2.6 10^{-30} CM. If the ionic character of the bond is 11.5 %, calculate the interatomic spacing.

15. Dipole moment of LiF was experimentally determined and was found to be 6.32 D. Calculate percentage ionic character in LiF molecule Li – F bond length is 0.156 nm.

16. Based upon M.O. theory state reason for the paramagnetic characater of CN, the diamagnetic character of CN^-, the stability of CN^- and calculate their respective bond orders.

17. Draw the structure of following compound

(i) S_8

(ii) N_2H_4

(iii) P_4H_{10}

(iv) $POCl_3$

(v) $XeOF_4$

(vi) C_3O_2

(vii) BrF_5

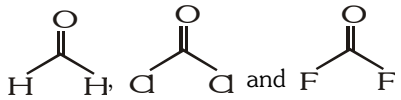
CONCEPTUAL SUBJECTIVE EXERCISE **ANSWER KEY** EXERCISE -4(A)

14. 1.4 Å **15.** 84.35 % **16.** $2\frac{1}{2}$, 3

SUBJECTIVE QUESTIONS :

1. Draw the structure of following compound
   (i) $Na[B_3O_3(OH)_4]$
   (ii) $Na[B_4O_5(OH)_4].8H_2O$
   (iii) $Na_6P_6O_{18}$
   (iv) $S_3O_6^{-2}$
   (v) S_3O_9
   (vi) $(CN)_2$

2. What is the increasing order of the bond angle for the following compounds ?



3. How many S – S linkage present in $H_2S_nO_6$

4. Draw the geometry of following three molecules and explain with proper reasoning :
   (i) $N(CH_3)_3$
   (ii) $N(SiH_3)_3$
   (iii) $P(SiH_3)_3$

5. The dipole moment of LiH is 1.964 10^{-29} CM and the intermolecular distance between Li and H in this molecule is 1.596 Å. What is percent ionic character in molecule ?

6. The dipole moment of KCl is 3.336 10^{-29} coulomb metre which indicates that it is a highly polar molecule. The interatomic distance between K^+ and Cl^- in this molecule is 2.6 10^{-10} m. Calculate the dipole moment of KCl molecule, if these were opposite charges of one fundamental unit located at each nucleus. Calculate percentage ionic charcter of KCl.

7. Assuming covalent radii to be additive property ; calculate the iodine - iodine distance in o–, m–, p– di-iodobenzene. The benzene ring is regular hexagon and each C – I bond lies on a line passing through the centre of hexagon. The C – C bond length C_6H_6 are 1.40 Å and covalent radius of iodine and carbon atom are 1.33 Å and 0.77 Å. Also neglect different overlapping effect.

8. Assuming that all the four valency of carbon atom in propane pointing towards the corners of a regular tetrahedron. Calculate the distance between the terminal carbon atoms in propane. Given, C – C single bond length is 1.54 Å.

CONCEPTUAL SUBJECTIVE EXERCISE	ANSWER KEY	EXERCISE -4(B)

5. 76.82%
6. 4.165 10^{-29} coulomb metre.
7. 3.50 Å, 6.06 Å, 7.0 Å
8. 2.514 Å

1. In which of the following species is the underlined carbon having sp^3 - hybridisation ? **[AIEEE 2002]**

(1) $CH_3–\underline{C}OOH$ (2) $CH_3\underline{C}H_2OH$ (3) $CH_3\underline{C}OCH_3$ (4) $CH_2=\underline{C}H–CH_3$

2. Which of the following statements is true ? **[AIEEE 2002]**

(1) HF is less polar than HBr

(2) Water does not contain any ions

(3) Chemical bond formation takes place when forces of attraction overcome the forces of repulsion

(4) In covalent bond, transfer of electrons takes place

3. A square planar complex is formed by hybridisation of which atomic orbital ? **[AIEEE 2002]**

(1) s, p_x, p_y, d_{yz} (2) $s, p_x, p_y, d_{x^2-y^2}$ (3) s, p_x, p_y, d_{z^2} (4) s, p_x p_y, d_{xy}

4. The reason for double helical structure of DNA is operation of : **[AIEEE 03]**

(1) dipole-dipole interaction (2) hydrogen bonding

(3) electrostatic attractions (4) vander Walls' forces

5. Which one of the following pairs of molecules will have permanent dipole moments for both members **[AIEEE 03]**

(1) NO_2 and CO_2 (2) NO_2 and O_3 (3) SiF_4 and CO_2 (4) SiF_4 and NO_2

6. The pair of species having identical shapes for molecules of both species is **[AIEEE 03]**

(1) XeF_2, CO_2 (2) BF_3, PCl_3 (3) PF_5, IF_5 (4) CF_4, SF_4

7. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is :– **[AIEEE–2004]**

(1) $H_2S < NH_3 < SiH_4 < BF_3$ (2) $NH_3 < H_2S < SiH_4 < BF_3$

(3) $H_2S < SiH_4 < NH_3 < BF_3$ (4) $H_2S < NH_3 < BF_3 < SiH_4$

8. The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species ? **[AIEEE–2004]**

(1) Bond length in NO^+ is equal to that in NO (2) Bond length in NO is greater than in NO^+

(3) Bond length in NO^+ is greater than in NO (4) Bond length is unpredictable

9. The states of hybridization of boron and oxygen atoms in boric acid (H_3BO_3) are respectively **[AIEEE–2004]**

(1) sp^3 and sp^2 (2) sp^2 and sp^3 (3) sp^2 and sp^2 (4) sp^3 and sp^3

10. Which one of the following has the regular tetrahedral structure ? **[AIEEE–2004]**

(1) BF_4^- (2) SF_4 (3) XeF_4 (4) $[Ni(CN)_4]^{2-}$

(Atomic nos.: B = 5, S = 16, Ni = 28, Xe = 54)

11. The maximum number of 90 angles between bond pair-bond pair of electrons is observed in :- **[AIEEE–2004]**

(1) dsp^2 hybridization (2) sp^3d hybridization (3) dsp^3 hybridization (4) sp^3d^2 hybridization

12. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in

(1) Forming covalent halides (2) Forming polymeric hydrides **[AIEEE–2004]**

(3) Exhibiting maximum covalency in compounds (4) Exhibiting amphoteric nature in their oxides

13. Which one of the following species is diamagnetic in nature ? **[AIEEE-2005]**

(1) He_2^+ (2) H_2 (3) H_2^+ (4) H_2^-

14. lattice energy of an ionic compound depends upon **[AIEEE-2005]**

(1) charge on the ion only (2) size of the ion only

(3) packing of the ion only (4) charge and size of the ion

15. The molecular shapes of SF_4, CF_4 and XeF_4 are

(1) the same with 2, 0 and 1 lone pair of electrons on the central atom, respecitvely **[AIEEE-2005]**

(2) the same with 1, 1 and 1 lone pair of electrons on the central atoms, respectively

(3) different with 0, 1 and 2 lone pair of electrons on the central atoms, respectively

(4) different with 1, 0 and 2 lone pair of electrons on the central atoms, respectively

16. Of the following sets which one does not contain isoelectronic species ? **[AIEEE-2005]**

(1) PO_4^{3-}, SO_4^{2-}, ClO_4^- (2) CN^-, N_2, C_2^{2-}

(3) SO_3^{2-}, CO_3^{2-}, NO_3^- (4) BO_3^{3-}, CO_3^{2-}, NO_3^-

17. Which of the following molecules\ions does not contain unpaired electrons? **[AIEEE-2006]**

(1) N_2^+ (2) O_2 (3) O_2^{2-} (4) B_2

18. Among the following mixtures, dipole-dipole as the major interaction, is present in **[AIEEE-2006]**

(1) KCl and water (2) benzene and carbon tetrachloride

(3) benzene and ethanol (4) acetonitrile and acetone

19. A metal, M forms chlorides in its +2 and +4 oxidation states. Which of the following statements about these chlorides is correct? **[AIEEE-2006]**

(1) MCl_2 is more ionic than MCl_4 (2) MCl_2 is more easily hydrolysed than MCl_4

(3) MCl_2 is more volatile than MCl_4 (4) MCl_2 is more soluble in anhydrous ethanol than MCl_4

20. In which of the following molecules/ions are all the bonds **not** equal? **[AIEEE-2006]**

(1) XeF_4 (2) BF_4^- (3) SF_4 (4) SiF_4

21. The decreasing values of bond angles from NH_3 (106) to SbH_3 (91) down group-15 of the periodic table is due to **[AIEEE-2006]**

(1) decreasing lp – bp repulsion (2) increasing electronegativity

(3) increasing bp – bp repulsion (4) increasing p-orbital character in sp^3

22. In which of the following ionizion processes, the bond order has increased and the magnetic behaviour has changed **[AIEEE-2007]**

(1) $NO \rightarrow NO^+$ (2) $O_2 \rightarrow O_2^+$ (3) $N_2 \rightarrow N_2^+$ (4) $C_2 \rightarrow C_2^+$

23. Which of the following hydrogen bonds is the strongest **[AIEEE-2007]**

(1) F–H.....F (2) O–H.....O (3) O–H.....F (4) O–H.....N

24. Which of the following species exhibits the diamagnetic behaviour **[AIEEE-2007]**

(1) O_2^+ (2) O_2 (3) NO (4) O_2^{2-}

25. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+, Ca^{+2}, Mg^{+2}, Be^{+2} **[AIEEE-2007]**

(1) $Be^{+2} < K^+ < Ca^{+2} < Mg^{+2}$ (2) $K^+ < Ca^{+2} < Mg^{+2} < Be^{+2}$

(3) $Ca^{+2} < Mg^{+2} < Be^{+2} < K^+$ (4) $Mg^{+2} < Be^{+2} < K^+ < Ca^{+2}$

26. Using MO theory predict which of the following species has the shortest bond length? **[AIEEE-2009]**

(1) O_2^- (2) O_2^{2-} (3) O_2^{2+} (4) O_2^+

27. The hybridisation of orbitals of N atom in NO_3^-, NO_2^+ and NH_4^+ are respectively:- **[AIEEE-2011]**

(1) sp, sp^3, sp^2 (2) sp^2, sp^3, sp (3) sp, sp^2, sp^3 (4) sp^2, sp, sp^3

28. The structure of IF_7 is :- **[AIEEE-2011]**

(1) octahedral (2) pentagonal bipyramid

(3) square pyramid (4) trigonal bipyramid

29. Among the following the maximum covalent character is shown by the compound :- **[AIEEE-2011]**

(1) $AlCl_3$ (2) $MgCl_2$ (3) $FeCl_2$ (4) $SnCl_2$

30. Which of the following has maximum number of lone pairs associated with Xe ? **[AIEEE-2011]**

(1) XeO_3 (2) XeF_4 (3) XeF_6 (4) XeF_2

31. The number of types of bonds between two carbon atoms in calcium carbide is :- **[AIEEE-2005, 2011]**

(1) One sigma, two pi (2) One sigma, one pi (3) Two sigma, one pi (4) Two sigma, two pi

32. Ortho-Nitrophenol is less soluble in water than p– and m– Nitrophenols because :- **[AIEEE-2005, 2012]**

(1) Melting point of o–Nitrophenol is lower than those of m– and p– isomers

(2) o–Nitrophenol is more volatile in steam than those of m– and p– isomers

(3) o–Nitrophenol shows Intramolecular H–bonding

(4) o–Nitrophenol shows Intermolecular H–bonding

33. Iron exhibits +2 and +3 oxidation states. Which of the following statements about iron is **incorrect** ? **[AIEEE-2012]**

(1) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds.

(2) Ferrous oxide is more basic in nature than the ferric oxide.

(3) Ferrous compounds are relatively more ionic than the corresponding ferric compounds.

(4) Ferrous compounds are less volatile than the corresponding ferric compounds.

34. The molecule having smallest bond angle is :- **[AIEEE-2012]**

(1) PCl_3 (2) NCl_3 (3) $AsCl_3$ (4) $SbCl_3$

35. In which of the following pairs the two species are not isostructural ? **[AIEEE-2012]**

(1) AlF_6^{3-} and SF_6 (2) CO_3^{2-} and NO_3^- (3) PCl_4^+ and $SiCl_4$ (4) PF_5 and BrF_5

PREVIOUS YEAR QUESTIONS						CHEMICAL BONDING						EXERCISE-05(A)				
Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A.	2	3	2	2	2	1	1	2	3	1	4	3	2	4	4	3	3
Q.	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
A.	4	1	3	4	1	1	4	2	3	4	2	1	4	1	3	1	4
Q.	35																
A.	4																

Choose the correct alter-native (only one correct answer).

1. The geometry & the type of hybrid orbitals present about the central atom in BF_3 is : **[JEE '98]**

(A) linear, sp (B) trigonal planar, sp^2 (C) tetrahedral, sp^3 (D) pyramidal, sp^3

2. The correct order of increasing C–O bond length of, CO, CO_3^{2-}, CO_2 is **[JEE '99]**

(A) $CO_3^{2-} < CO_2 < CO$ (B) $CO_2 < CO_3^{2-} < CO$ (C) $CO < CO_3^{2-} < CO_2$ (D) $CO < CO_2 < CO_3^{2-}$

3. In the dichromate anion **[JEE '99]**

(A) 4Cr – O bonds are equivalent

(B) 6Cr – O bonds are equivalent

(C) all Cr – O bonds are equivalent

(D) all Cr – O bonds are non equivalent

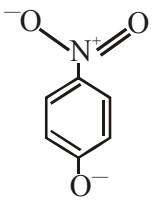
4. The geometry of H_2S and its dipole moment are **[JEE '99]**

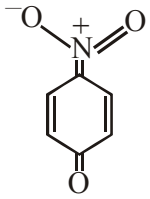
(A) angular & non zero (B) angular & zero (C) linear & non zero (D) linear & zero

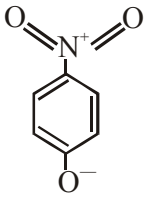
5. In compounds type ECl_3, where E = B, P, As or Bi, the angles Cl – E – CI for different E are in the order **[JEE '99]**

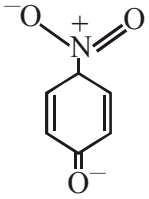
(A) B > P = As = Bi (B) B > P > As > Bi (C) B < P = As = Bi (D) B < P < As < Bi

6. The most likely representation of resonance structure of p-nitrophenoxide is: **[JEE '99]**

(A) 

(B) 

(C) 

(D) 

7. Amongst H_2O, H_2S , H_2Se and H_2Te, the one with the highest boiling point is **[JEE 2000]**

(A) H_2O because of hydrogen bonding (B) H_2Te because of higher molecular weight

(C) H_2S because of hydrogen bonding (D) H_2Se because of lower molecular weight

8. The hybridization of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ are **[JEE 2000]**

(A) sp^2, sp^3 and sp^2 respectively (B) sp, sp^2 and sp^3 respectively

(C) sp^2, sp, and sp^3 respectively (D) sp^2, sp^3 and sp respectively

9. The correct order of hybridization of the central atom in the following species NH_3, $PtCl_4^{-2}$, PCl_5 and BCl_3 is **[JEE 2001]**

(A) dsp^2, sp^3d, sp^2 and sp^3 (B) sp^3, dsp^2, sp^3d, sp^2

(C) dsp^2, sp^2, sp^3, sp^3d (D) dsp^2, sp^3, sp^2, sp^3d

10. The common features among the species CN^-, CO and NO^+ are **[JEE 2001]**

(A) Bond order three and isoelectronic

(B) Bond other three and weak field ligands

(C) Bond order two and π–acceptors

(D) Isoelectronic and weak field ligands

11. Specify hybridization of N and B atoms in a 1 : 1 complex of BF_3 and NH_3 **[JEE 2002]**

(A) N : tetrahedral, sp^3; B : tetrahedral, sp^3 (B) N : pyramidal, sp^3; B : pyramidal, sp^3

(C) N : pyramidal, sp^3; B : planar, sp^2 (D) N : pyramidal, sp^3; B : tetrahedral, sp^3

12. The nodal plane in the π-bond of ethene is located in **[JEE 2002]**

(A) the molecular plane

(B) a plane parallel to the molecular plane

(C) a plane perpendicular to the molecular plane which bisects, the carbon-carbon a bond at right angle.

(D) a plane perpendicular to the molecular plane which contains, the carbon-carbon bond.

13. Identify the least stable ion amongst the following : **[JEE 2002]**

(A) Li^- (B) Be^- (C) B^- (D) C^-

14. Which of the following molecular species has unpaired electron(s) ? **[JEE 2002]**

(A) N_2 (B) F_2 (C) O_2^- (D) O_2^{2-}

15. Which of the following are isoelectronic and isostructural ? **[JEE 2003]**

NO_3^- . CO_3^{2-}, ClO_3^-, SO_3

(A) NO_3^-, CO_3^{2-} (B) SO_3, NO_3^- (C) ClO_3^-, CO_3^{2-} (D) CO_3^{2-}, SO_3

16. According to molecular orbital theory which of the following statement about the magnetic character and bond order is correct regarding O_2^+ **[JEE 2004]**

(A) Paramagnetic and Bond order < O_2 (B) Paramagnetic and Bond order > O_2

(C) Diamagnetic and Bond order < O_2 (D) Diamagnetic and Bond order > O_2

17. Which species has the maximum number of lone pair of electrons on the central atom?

(A) ClO_3^- (B) XeF_4 (C) SF_4 (D) I_3^- **[JEE 2005]**

18. The percentage of p-character in the orbitals forming P–P bonds in P_4 is

(A) 25 (B) 33 (C) 50 (D) 75

19. Among the following, the paramagnetic compound is **[JEE 2007]**

(A) Na_2O_2 (B) O_3 (C) N_2O (D) KO_2

20. The species having bond order different from that in CO is **[JEE 2007]**

(A) NO^- (B) NO^+ (C) CN^- (D) N_2

21. The structure of XeO_3 is **[JEE 2007]**

(A) linear (B) planar (C) pyramidal (D) T-shaped

22. **Statement-1 :** p-Hydroxybenzoic acid has a lower boiling point than o-hydroxybenzoic acid.

and **[JEE 2007]**

Statement-2 : o-Hydroxybenzoic acid has intramolecular hydrogen bonding.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

23. **Statement-1 :** In water, orthoboric acid behaves as a weak monobasic acid. **[JEE 2007]**

and

Statement-2 : In water, orthoboric, acid acts as a proton donor.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

24. **Statement-1 :** Pb^{+4} compounds are stronger oxidizing agents than Sn^{4+} compounds **[JEE 2008]**

and

Statement-2 : The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect' .

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

25. Match each of the diatomic molecules in Column I with its property / properties in Column II. **[JEE 2009]**

	Column I		Column II
(A)	B_2	(P)	Paramagnetic
(B)	N_2	(Q)	undergoes oxidation
(C)	O_2^-	(R)	Undergoes reduction
(D)	O_2	(S)	Bond order ≥ 2
		(T)	Mixing of 's' and `p' orbitals

26. The nitrogen oxide(s) that contain(s) N–N bond(s) is (are) **[JEE 2009]**

(A) N_2O (B) N_2O_3 (C) N_2O_4 (D) N_2O_5

27. In the reaction **[JEE 2009]**

$$2X + B_2H_6 \longrightarrow [BH_2(X)_2]^+ [BH_4]^-$$

the amine(s) X is (are)

(A) NH_3 (B) CH_3NH_2 (C) $(CH_3)_2NH$ (D) $(CH_3)_3N$

28. The species having pyramidal shape is **[JEE 2010]**

(A) SO_3 (B) BrF_3 (C) SiO_3^{2-} (D) OSF_2

29. Assuming that Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is **[JEE 2010]**

(A) 1 and diamagnetic (B) 0 and diamagnetic

(C) 1 and paramagnetic (D) 0 and paramagnetic

30 In allene (C_3H_4), the type(s) of hybridisation of the carbon atoms is (are) **[JEE 2012]**

(A) sp and sp^3 (B) sp and sp^2

(C) only sp^2 (D) sp^2 and sp^3

31 Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen-

(A) HNO_3, NO, NH_4Cl, N_2 (B) HNO_3, NO, N_2, NH_4Cl **[JEE 2012]**

(C) HNO_3, NH_4Cl, NO, N_2 (D) NO, HNO_3, NH_4Cl, N_2

32 The shape of XeO_2F_2 molecule is : **[JEE 2012]**

(A) Trigonal bipyramidal (B) Square planar (C) tetrahedral (D) see-saw

Explain the following.

1. Give reason carbon oxygen bond lengths in formic acid are 1.23Å & 1.36 Å and both the carbon oxygen bonds in sodium formate have the same value i.e. 1.27Å. **[JEE '88]**

2. Explain the first I.E. of carbon atom is greater than that of boron atom whereas the reverse is true for the second I.E. **[JEE '89]**

3. The experimentally determined N–F bond length in NF_3 is greater than the sum of single bond covalent radii of N & F. Explain. **[JEE '95]**

4. Explain the difference in the nature of bonding in LiF & LiI. **[JEE '96]**

5. Give reasons for the following in one or two sentences only. **[JEE '99]**

(a) $BeC1_2$ can be easily hydrolyed (b) CrO_3 is an acid anhydride

Arrange as directed.

1. N_2, O_2, F_2, Cl_2 in increasing order of bond dissociation energy. **[JEE '88]**

2. CO_2, N_2O_5 SiO_2 , SO_3 is the increasing order of acidic character. **[JEE '88]**

3. HOCl, $HOClO_2$, $HOClO_3$, HOClO in increasing order of thermal stability. **[JEE '88]**

4. The decreasing order of acid strength of ClOH, BrOH, IOH. **[JEE '97]**

5. Arrange in order of increasing radii , Li^+, Mg^{2+}, K^+, Al^{3+} **[JEE '97]**

6. Arrange $BeSO_4$, $MgSO_4$, $CaSO_4$, $SrSO_4$ in order of decreasing thermal stability. **[JEE '97]**

7. Decreasing order of the O-O bond length present in them **[JEE 2004]**

O_2, KO_2 and O_2 $[AsF_4]$

Subjective

1. The number of water molecule(s) directly bonded to the metal centre in $CuSO_4.5H_2O$ is **[JEE 2009]**

2. Based on VSEPR theory, the number of 90 degree F–Br–F angles in BrF_5 is **[JEE 2010]**

3. The value of n in the molecular formula $Be_nAl_2Si_6O_{18}$ is **[JEE 2010]**

4. The total number of diprotic acids among the following is **[JEE 2010]**

H_3PO_4 H_2SO_4 H_3PO_3 H_2CO_3 $H_2S_2O_7$

H_3BO_3 H_3PO_2 H $_2CrO_4$ H_2SO_3

5. Among the following, the number of elements showing only one non-zero oxidation state is **[JEE 2010]**

O, Cl, F, N, P, Sn, Tl, Na, Ti

6. The difference in the oxidation numbers of the two types of sulphur atoms in $Na_2S_4O_6$ is. **[JEE 2011]**

PREVIOUS YEARS QUESTIONS — ANSWER KEY — EXERCISE-5 [B]

1. (B)	**2.** (D)	**3.** (B)	**4.** (A)	**5.** (B)	**6.** (A)	**7.** (A)
8. (B)	**9.** (B)	**10.** (A)	**11.** (A)	**12.** (A)	**13.** (B)	**14.** (C)
15. (A)	**16.** (B)	**17.** (D)	**18.** (D)	**19.** (D)	**20.** (A)	**21.** (C)
22. (D)	**23.** (C)	**24.** (C)				

25. (A) $\rightarrow$ P,Q,R,T ; B $\rightarrow$ Q,R,S,T ; (C) $\rightarrow$ P,Q,R ; (D) $\rightarrow$ P,Q,R,S

26. A,B,C	**27.** B,C	**28.** (D)	**29.** (A)	**30.** (B)	**31.** (B)	**32.** (D)

● ***Arrange as directed :***

1. $F_2 < Cl_2 < O_2 < N_2$ **2.** $SiO_2 < CO_2 < N_2O_5 < SO_3$

3. $HOCl < HClO_2 < HClO_3 < HClO_4$ **4.** HOCl > HOBr > HOI

5. $Al^{3+} < Mg^{2+} < Li^+ < K^+$ **6.** $SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$

7. $KO_2 > O_2 > O_2$ $[AsF_4]$

● ***Subjective Questions***

1. 4	**2.** 0	**3.** 3	**4.** 6	**5.** 2	6. 5