DPP - Daily Practice Problems

Chapter-wise Sheets

Date : ☐ **Start Time :** ☐ **End Time :** ☐

CHEMISTRY (CC04)

SYLLABUS : Chemical bonding and Molecular Structure

Max. Marks : 180 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. The electronic configuration of metal M is $1s^2\,2s^2\,2p^6\,3s^1$. The formula of its oxide will be
(a) MO (b) M_2O
(c) SO_3 (d) All of these

2. Which of the following does not contain coordinate bond ?
(a) BH_4^{-} (b) NH_4^+
(c) CO_3^{2-} (d) H_3O^+

3. Which of the following statements is incorrect ?
(a) The formation of ionic compounds depend upon the ease of formation of the positive and negative ions from the respective neutral atoms.
(b) Formation of ionic compounds depend upon arrangement of the positive and negative ions in the solid.
(c) Formation of positive ion involves addition of electron(s) while that of negative ion involves removal of electron(s).
(d) None of these

4. Hybridisation of the underline atom changes in:
(a) $\underline{Al}H_3$ changes to AlH_4^-
(b) $H_2\underline{O}$ changes to H_3O^+
(c) $\underline{N}H_3$ changes to NH_4^+
(d) in all cases

5. The decreasing values of bond angles from NH_3 (106°) to SbH_3 (101°) down group-15 of the periodic table is due to
(a) decreasing lp-bp repulsion
(b) decreasing electronegativity
(c) increasing bp-bp repulsion
(d) increasing p-orbital character in sp^3

6. In PO_4^{3-}, the formal charge on each oxygen atom and the $P-O$ bond order respectively are
(a) –0.75, 0.6 (b) –0.75, 1.0
(c) –0.75, 1.25 (d) –3, 1.25

7. KF combines with HF to form KHF_2. The compound contains the species
(a) K^+, F^- and H^+ (b) K^+, F^- and HF
(c) K^+, and $[HF_2]^-$ (b) $[KHF]^+$ and F_2

RESPONSE GRID					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ			

Space for Rough Work

8. An ether is more volatile than an alcohol having the same molecular formula. This is due to
(a) dipolar character of ethers
(b) alcohols having resonance structures
(c) inter-molecular hydrogen bonding in ethers
(d) inter-molecular hydrogen bonding in alcohols

9. In which of the following ionization processes, the bond order has increased and the magnetic behaviour has changed?
(a) $N_2 \to N_2^+$ (b) $C_2 \to C_2^+$
(c) $NO \to NO^+$ (d) $O_2 \to O_2^+$.

10. The maximum number of 90° angles between bond pair-bond pair of electrons is observed in
(a) dsp^2 hybridization (b) sp^3d hybridization
(c) dsp^3 hybridization (d) sp^3d^2 hybridization

11. Two ice cubes are pressed over each other until they unite to form one block. Which one of the following forces dominate for holding them together?
(a) Dipole-dipole interaction
(b) Van der waals' forces
(c) Hydrogen bond formation
(d) Covalent attraction

12. In XeF_2, XeF_4 and XeF_6, the number of lone pairs on Xe are respectively
(a) 2, 3, 1 (b) 1, 2, 3
(c) 4, 1, 2 (d) 3, 2, 1

13. The hybridization of atomic orbitals of nitrogen in NO_2^+, NO_2^- and NH_4^+ are
(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

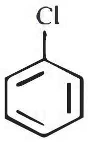
14. Match Column-I with Column-II and Column-III and choose the correct option from the given codes.

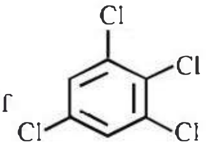
Column-I Molecule	**Column-II (No. of lone pairs and bond pairs)**	**Column-III (Shape of molecule)**
(A) NH_3	(i) 1, 2	(p) Bent
(B) SO_2	(ii) 1, 4	(q) Trigonal pyramidal
(C) SF_4	(iii) 2, 3	(r) T-shape
(D) ClF_3	(iv) 1, 3	(s) See-Saw

(a) A – (iv, q); B – (ii, p); C – (i, r); D – (iii, s)
(b) A – (iv, q); B – (i, p); C – (ii, s); D – (iii, r)
(c) A – (i, p); B – (iii, s); C – (iv, r); D – (ii, q)
(d) A – (iv, p); B – (i, r); C – (iii, q); D – (ii, s)

15. Which of the following statements is/are not correct for combination of atomic orbitals?
(i) The combining atomic orbitals must have the same or nearly the same energy.
(ii) Greater the extent of overlap, the greater will be the electron density between the nuclei of a moleculer orbital.
(iii) $2p_z$ orbital of one atom can combine with either of $2p_x$, $2p_y$ or $2p_z$ orbital of other atom as these orbitals have same energy.
(a) (i) and (ii) (b) (iii) only
(c) (i) only (d) (ii) and (iii)

16. Which of the following is the correct increasing order of lone pair of electrons on the central atom?
(a) $IF_7 < IF_5 < ClF_3 < XeF_2$
(b) $IF_7 < XeF_2 < ClF_2 < IF_5$
(c) $IF_7 < ClF_3 < XeF_2 < IF_5$
(d) $IF_7 < XeF_2 < IF_5 < ClF_3$

17. The dipole moment of chlorobenzene  is 1.5 D.

The dipole moment of  is
(a) 2.86D (b) 2.25D
(c) 1.5D (d) 0D

18. In compounds of type ECl_3, where E = B, P, As or Bi, the angles Cl - E- Cl for different E are in the order.
(a) B > P = As = Bi (b) B > P > As > Bi
(c) B < P = As = Bi (d) B < P < As < Bi

19. Which of the following substances has the greatest ionic character ?
(a) Cl_2O (b) NCl_3
(c) $PbCl_2$ (d) $BaCl_2$

RESPONSE GRID					
	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ
	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ
	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ			

Space for Rough Work

20. If an organic compound contain 92.3% C and 7.7% H, then number of sp^3, sp^2 and sp hybridized carbon atoms in all possible structures of compound respectively are (molecular mass = 52 g/mol)

(a) 1,2,5 (b) 0,4,4
(c) 0,8,4 (d) None of these

21. Which of the following are isoelectronic and isostructural?
$NO_3^-, CO_3^{2-}, ClO_3^-, SO_3$

(a) NO_3^-, CO_3^{2-} (b) SO_3, NO_3^-
(c) ClO_3^-, CO_3^{2-} (d) CO_3^{2-}, SO_3

22. Consider the chemical species NO_3^-, NO_2^+ and NO_2^- and point out the correct statement given below

(a) The hybrid state of N in NO_2^+ is sp^2
(b) The hybrid state of N in all the species is the same
(c) The shape of both NO_2^+ and NO_2^- is bent while NO_3^- is planar
(d) The hybrid state of N in NO_3^- and NO_2^- is the same

23. Bond order normally gives idea of stability of a molecular species. All the molecules viz. H_2, Li_2 and B_2 have the same bond order yet they are not equally stable. Their stability order is

(a) $H_2 > B_2 > Li_2$ (b) $Li_2 > H_2 > B_2$
(c) $Li_2 > B_2 > H_2$ (d) $H_2 > Li_2 > B_2$

24. ${}_1H^2 + {}_1H^2 \longrightarrow {}_2He^3 + {}_0n^1$

The above nuclear reaction is called

(a) nuclear fission
(b) nuclear fusion
(c) artificial transmutation
(d) spontaneous disintegration

25. Hydrogen chloride molecule contains

(a) polar covalent bond (b) double bond
(c) co-ordinate bond (d) electrovalent bond

26. 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 $[HN_3, BF_3]$

27. In the anion $HCOO^-$ the two carbon - oxygen bonds are found to be of equal length. What is the reason for it ?

(a) Electronic orbitals of carbon atom are hybridised
(b) The C = O bond is weaker than the C – O bond
(c) The anion $HCOO^-$ has two resonating structures
(d) The anion is obtained by removal of a proton from the acid molecule

28. Which of the following is/are not essential condition(s) for hybridisation?

(i) The orbitals present in the valence shell of the atom are hybridised.
(ii) The orbitals undergoing hybridisation should have almost equal energy.
(iii) Promotion of electron is essential prior to hybridisation
(iv) Only half filled orbitals participate in hybridisation.

(a) (i) only (b) (iii) only
(c) (iv) only (d) (iii) and (iv)

29. The molecule XY_2 contains two σ and two π bonds and one lone pair of electrons in valence shell of X. The arrangement of lone pair and bond pairs is

(a) linear (b) trigonal planar
(c) square pyramidal (d) unpredictable

30. The molecules BF_3 and NF_3 are both covalent compounds, but BF_3 is non polar whereas NF_3 is polar. The reason for this is

(a) atomic size of boron is larger than nitrogen
(b) Boron is metal while nitrogen is gas
(c) B – F bonds are non-polar while N – F bonds are polar
(d) BF_3 is planar but NF_3 is pyramidal

31. 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) $MgCl_2$ and $BeCl_2$ (d) RbCl and $MgCl_2$

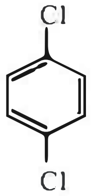
32. Which of the following is the wrong statement ?

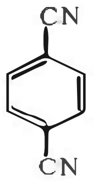
(a) ONCl and ONO^- are not isoelectronic.
(b) O_3 molecule is bent
(c) Ozone is violet-black in solid state
(d) Ozone is paramagnetic gas.

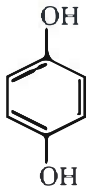
RESPONSE GRID	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ
	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ
	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ		

Space for Rough Work

33. For which of the following molecule significant $\mu \neq 0$?

(i) 

(ii) 

(iii) 

(iv) 

(a) Only(i) (b) (i) and (ii)
(c) Only(iii) (d) (iii) and (iv)

34. The bond dissociation energy of B – F in BF_3 is 646 kJ mol^{-1} whereas that of C – F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B – F bond dissociation energy as compared to that of C – F is

(a) stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4.
(b) significant $p\pi - p\pi$ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C and F in CF_4.
(c) lower degree of $p\pi - p\pi$ interaction between B and F in BF_3 than that between C and F in CF_4.
(d) smaller size of B– atom as compared to that of C– atom.

35. Dipole-induced dipole interactions are present in which of the following pairs :

(a) Cl_2 and CCl_4 (b) HCl and He atoms
(c) SiF_4 and He atoms (d) H_2O and alcohol

36. The number and type of bonds in C_2^{2-} ion in CaC_2 are:

(a) One σ bond and one π-bond
(b) One σ bond and two π-bond
(c) Two σ bond and two π-bond
(d) Two σ bond and one π-bond

37. Which of the following methods is used for measuring bond length ?

(a) X-ray diffraction
(b) Electron-diffraction
(c) Spectroscopic techniques
(d) All of these

38. Which of the following molecules have same bond order ?

$$\underset{I}{H_2},\ \underset{II}{Cl_2},\ \underset{III}{CO},\ \underset{IV}{Br_2},\ \underset{V}{N_2}$$

Choose the correct option.

(a) I, II and IV have same bond order
(b) III and V have same bond order
(c) Both (a) and (b) are correct
(d) None of the above

39. Which of the following is/are misconception(s) associated with resonance ?

(i) The molecule exists for a certain fraction of time in one cannonical form and for other fractions of time in other cannonical forms.
(ii) The cannonical forms have no real existence.
(iii) There is no such equilibrium between the cannonical forms.

(a) (i) only (b) (ii) and (iii)
(c) (i) and (iii) (d) (iii) only.

40. A neutral molecule XF_3 has a zero dipole moment. The element X is most likely

(a) chlorine (b) boron
(c) nitrogen (d) carbon

41. The species having pyramidal shape is :

(a) SO_3 (b) BrF_3 (c) SiO_3^{2-} (d) OSF_2

42. Bond order of 1.5 is shown by:

(a) O_2^+ (b) O_2^- (c) O_2^{2-} (d) O_2

43. Which one of the following properties is **not** shown by NO?

(a) It is diamagnetic in gaseous state
(b) It is neutral oxide
(c) It combines with oxygen to form nitrogen dioxide
(d) It's bond order is 2.5

44. 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, $K^+, Ca^{2+}, Mg^{2+}, Be^{2+}$?

(a) $Ca^{2+} < Mg^{2+} < Be^+ < K^+$
(b) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$
(c) $Be^{2+} < K^+ < Ca^{2+} < Mg^{2+}$
(d) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$.

45. In which of the following pairs of molecules/ions, both the species are not likely to exist ?

(a) H_2^+, He_2^{2-} (b) H_2^-, He_2^{2-}
(c) H_2^{2+}, He_2 (d) H_2^-, He_2^{2+}

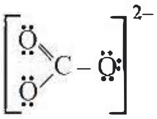
RESPONSE GRID

33.ⓐⓑⓒⓓ 34.ⓐⓑⓒⓓ 35.ⓐⓑⓒⓓ 36.ⓐⓑⓒⓓ 37. ⓐⓑⓒⓓ
38.ⓐⓑⓒⓓ 39.ⓐⓑⓒⓓ 40.ⓐⓑⓒⓓ 41.ⓐⓑⓒⓓ 42. ⓐⓑⓒⓓ
43.ⓐⓑⓒⓓ 44.ⓐⓑⓒⓓ 45.ⓐⓑⓒⓓ

Space for Rough Work

1. **(b)** Electronic configuration reveals it is monovalent (in fact Na) hence its oxide will be M_2O.

2. **(c)** CO_3^{2-} Its structure is



3. **(c)** Formation of positive ion involves removal of electron(s) from neutral atom and that of the negative ion involves addition of electron(s) to the neutral atom.

4. **(a)** $$\text{Hybridisation} = \frac{1}{2}\left[\begin{pmatrix}\text{No. of electrons}\\ \text{in valence}\\ \text{shell of atom}\end{pmatrix} + \begin{pmatrix}\text{No.of monovalent}\\ \text{atoms around it}\end{pmatrix} - \begin{pmatrix}\text{charge on}\\ \text{cation}\end{pmatrix} + \begin{pmatrix}\text{charge on}\\ \text{anion}\end{pmatrix}\right]$$

(a) For AlH_3,

Hybridisation of Al atom $= \frac{1}{2}[3+3-0+0] = 3 = sp^2$

For AlH_4^-,

Hybridisation of Al atom$= \frac{1}{2}[3+4-0+1] = 4 = sp^3$

(b) For H_2O,

Hybridisation of O atom$= \frac{1}{2}[6+2-0+0] = 4 = sp^3$

For H_3O^+, Hybridisation of O atom $= \frac{1}{2}[6+3-1+0]$
$= 4 = sp^3$

(c) For NH_3

Hybridisation of N atom $= \frac{1}{2}[5+3-0+0] = 4 = sp^3$

For NH_4^+, Hybridisation of N atom$= \frac{1}{2}[5+4-1+0]$
$= 4 = sp^3$

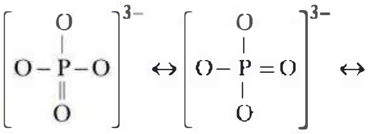
Thus hybridisation changes only in option (a).

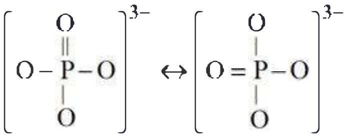
5. **(b)** The bond angle decreases on moving down the group due to decrease in bond pair-bond pair repulsion.

NH_3	PH_3	AsH_3	SbH_3	BiH_3
107°	93.5°	91.8°	91.3°	90°

NOTE : This can also be explained by the fact that as the size of central atom increases sp^3 hybrid orbital becomes more distinct with increasing size of central atom i.e. pure p- orbitals are utilized in M–H bonding

6. **(c)**





$$\left[O-\underset{\underset{O}{\|}}{\overset{\overset{O}{|}}{P}}-O\right]^{3-} \leftrightarrow \left[O-\underset{\underset{O}{|}}{\overset{\overset{O}{|}}{P}}=O\right]^{3-} \leftrightarrow \left[O-\underset{\underset{O}{|}}{\overset{\overset{O}{\|}}{P}}-O\right]^{3-} \leftrightarrow \left[O=\underset{\underset{O}{|}}{\overset{\overset{O}{|}}{P}}-O\right]^{3-}$$

Bond order

$$= \frac{\text{Number of bonds}}{\text{Number of Resonating structures}} = \frac{5}{4} = 1.25$$

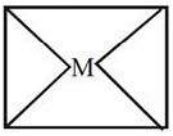
Three unit negative charge is being shared by four O atoms.
Formal charge = –3/4

7. **(c)** Since F form H-bond $[HF_2]^-$ exists. Therefore KHF_2 gives $K^+ + HF_2^-$

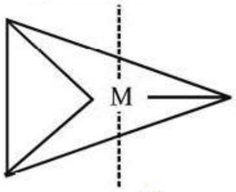
8. **(d)** In alcohol intermolecular H-bonding is possible whereas in ether it is not possible.

9. **(c)** (a) N_2 : bond order 3, paramagnetic
N_2^- : bond order, 2.5, paramagnetic
(b) C_2 : bond order 2, diamagnetic
C_2^+ : bond order 1.5, paramagnetic
(c) NO: bond order 2.5, paramagnetic
NO^+ : bond order 3, diamagnetic
(d) O_2 : bond order 2, paramagnetic
O_2^+ : bond order 2.5, paramagnetic

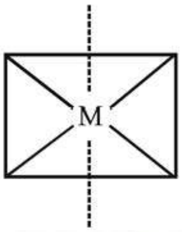
10. **(d)**



dsp^2 hybridisation
Number of 90° angle between bonds = 4



sp^3d or dsp^3 hybridisation
Number of 90° angle between bonds = 6



sp^3d^2 hybridisation
Number of 90° angle between bonds= 12

11. **(c)** It is due to H - bonding.

12. **(d)** In XeF_2 Total number of valence electrons of Xe = 8, two electrons shared with 2F atoms, 6 electrons left hence 3 lone pairs, in XeF_4 4 shared with 4 F atoms 4 left hence 2 lone pairs; in XeF_6 6 shared with 6 F atoms 2 left hence 1 lone pair.

13. **(b)** $NO_2^+ = \frac{1}{2}[5+0+0-1] = 2$ sp; $NO_2^- = \frac{1}{2}[5+0+1-0]$

$= 3$ sp^2; $NH_4^+ = \frac{1}{2}[5+4+0-1] = 4$ sp^3

14. **(b)** $NH_3 \rightarrow$ 1l.p, 3b.p $\rightarrow$ Trigonal pyramidal
$SO_2 \rightarrow$ 1l.p, 2b.p $\rightarrow$ Bent
$SF_4 \rightarrow$ 1l.p, 4b.p $\rightarrow$ See-saw
$ClF_3 \rightarrow$ 2l.p, 3b.p $\rightarrow$ T-shape

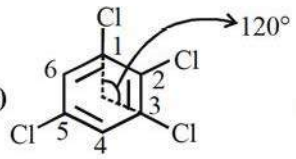
15. **(b)** Atomic orbitals having same or nearly same energy will not combine if they do not have the same symmetry. $2p_z$ Orbital of one atom cannot combine with $2p_x$ or $2p_y$ orbital of other atom because of their different symmetries.

16. **(a)** The number of lone pairs of electrons on central atom in various given species are

Species	Number of lone pairs on central atom
IF_7	nil
IF_5	1
ClF_3	2
XeF_2	3

Thus the correct increasing order is
$IF_7 < IF_5 < ClF_3 < XeF_2$
0 1 2 3

17. **(c)**



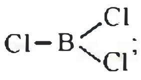
Dipole moments of 2Cl and 5 Cl are vectorically cancelled (opposite in direction).

and now for 1 Cl and 3 Cl, $\mu^2 = \mu_1^2 + \mu_2^2 + 2\mu_1\mu_2 \cos\theta$

$= (1.5)^2 + (1.5)^2 + 2 \times 1.5 \times 1.5 \cos 120$

$\therefore \mu = 1.5D$

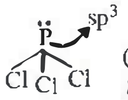
18. **(b)** BCl_3:



; sp^2 - Hybridisation

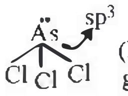
(Trigonal geometry);
Bond angle= 120°

In PCl_3



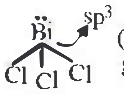
(Pyramidal geometry)

In $AsCl_3$–



(Pyramidal geometry)

In $BiCl_3$–



(Pyramidal geometry)

Bond angle = below 109° 28' and decreases from PCl_3 to $BiCl_3$

In these, order of bond angle : $BCl_3 > PCl_3 > AsCl_3 > BiCl_3$

19. **(d)** According to Fajan's rule :

$$\text{Covalent character} \propto \frac{1}{\text{size of cation}}$$

$$\propto \text{size of anion}$$

Among the given species order of size of cations
$N^{3+} < O^{2+} < Pb^{2+} < Ba^{2+}$
order of size of anions $O^{2-} < Cl^-$.
Hence the order of covalent character is
$NCl_3 > Cl_2O > PbCl_2 > BaCl_2$
$BaCl_2$ is most ionic in nature.

20. **(c)** Let amount of compound = 100 g

No. of moles of C $= \frac{92.3}{12} = 7.69 = 7.7$

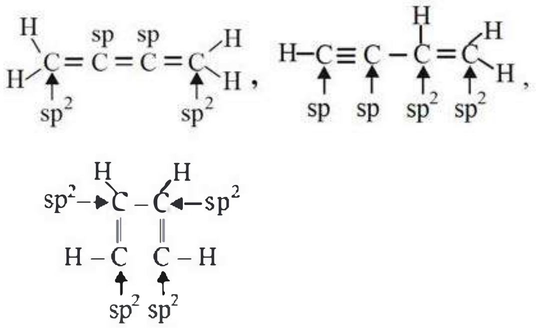
No. of moles of H $= \frac{7.7}{1} = 7.7$

Empirical formula = CH
Empirical formula mass = 12 + 1 = 13 g/mol
Molecular mass = 52 g/mol

$n = \frac{52}{13} = 4$

$\therefore$ Molecular foumula = Empirical formula × 4
$= C_4H_4$

Possible structures



21. **(a)** NO_3^- and CO_3^{2-} both have same number of electrons (equal to 32) and central atom in each being sp^2 hybridised, are isostructural too.

22. **(d)** The hybrid state of N in NO_3^- and NO_2^- is the same and it is sp^2 while in NO_2^+ it is sp

23. **(d)** The molecular orbital configuration of the given molecules is
$H_2 = \sigma 1s^2$ (no electron anti-bonding)
$Li_2 = \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2$ (two anti-bonding electrons)

$B_2 = \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2 \left\{\pi 2p_y^1 = \pi 2p_z^1\right\}$

(4 anti-bonding electrons)
Though the bond order of all the species are same (B.O = 1) but stability is different. This is due to difference in the presence of no. of anti-bonding

electron.

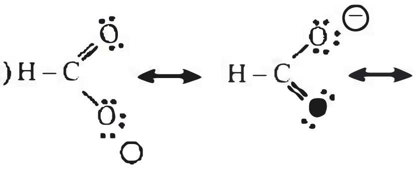
Higher the no. of anti-bonding electron lower is the stability hence the correct order is $H_2 > Li_2 > B_2$

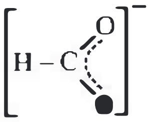
24. (b) The formation of a heavy nucleus from those of lighter elements is known as nuclear fusion. The mass of the heavier nucleus is always less than the sum of masses of lighter nuclei which is converted into energy according to Einstein equation $E = mc^2$.

25. (a) A gaseous HCl molecule has hydrogen and chlorine linked by a covalent bond. Here electronegativity of chlorine is greater than that of hydrogen. Due to this the shared pair of electron is more attracted towards chlorine. Thus, chlorine end of molecule has higher electron density and becomes slightly negative and the hydrogen and slightly positive. Hence the covalent bond in HCl has a polar character as shown below

$$\overset{\delta^+}{H}\longrightarrow\overset{\delta^-}{Cl}$$

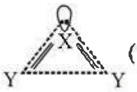
26. (c) Hybridisation in NF_3 and H_3O^+ is sp^3 and they have pyramidal shape. Hybridisation in NO_3^- and BF_3 is sp^2 and they have triangular planar shape.

27. (c)  or Resonance

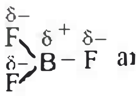
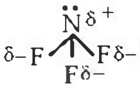
hybrid  due to resonance C – O bond length is the same.

28. (d) Promotion of electron is not an essential condition prior to hybridisation. It is not necessary that only half filled orbitals participate in hybridisation. In some cases, even filled orbitals of valence shell take part in hybridisation.

29. (b) Since XY_2 forms 2σ, 2π bonds and has 1 lone pair of electrons. It must have the structure $Y = \ddot{X} = Y$. Hence Y is divalent. The hybridisation of X is $sp^2\left(\frac{1}{2}(6+0+0-0)=3\right)$. So XY_2 is trigonal planar



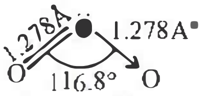
(like SO_2).

30. (d) The shape of BF_3 is trigonal planar  and $\mu = 0$ hence it is non polar. The shape of NF_3 is pyramidal  and $\mu \neq 0$ hence it is polar.

31. (b) According to Fajan's rules smaller, highly charged cation has greatest covalent character while large cation with smaller charge has greatest ionic character.

32. (d)

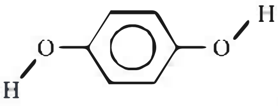
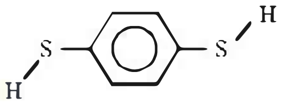
(a) $ONCl = 8+7+17 = 32e^-$
$ONO^- = 8+7+8+1 = 24e^-$ } not isoelectronic

(b) 

The central atom is sp^2 hybridized with one lone pair.

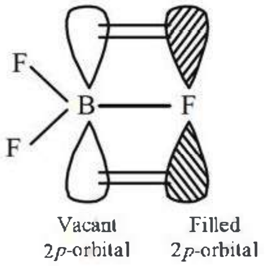
(c) It is a pale blue gas. At – 249.7°, it forms violet black crystals.

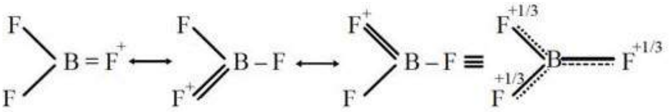
(d) It is diamagnetic in nature due to absence of unpaired electrons.

33. (d)  

In both the molecules the bond moments are not cancelling with each other and hence the molecules has a resultant dipole and hence the molecule is polar.

34. (b) The delocalised $p\pi - p\pi$ bonding between filled *p*-orbital of F and vacant *p*-orbital of B leads to shortening of B–F bond length which results in higher bond dissociation energy of the B–F bond.





35. (b) This type of attractive force operates between the polar molecules having permanent dipole and the molecules lacking permanent dipole.

HCl is polar ($\mu \neq 0$) and He is non polar ($r \neq 0$), thus gives dipole-induced dipole interaction.

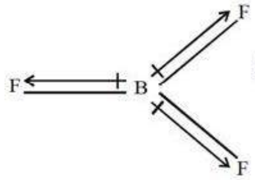
36. (d) The structure of CaC_2 is $Ca^{2+}[:C \equiv C:]^{2-}$ i.e, one π and two σ bonds

37. (d) Bond lengths are measured by spectroscopic, X-ray diffraction and electron diffraction techniques.

38. (c) In CO (three shared electron pairs between C and O) the bond order is 3. For N_2 bond order is 3 H_2, Cl_2, Br_2 have identical Bond order, Bond order 1.

39. (a) The molecule does not exist for a certain fraction of time in one cannonical form and for other fractions of time in other cannonical forms.

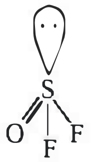
40. **(b)** BF_3 has planar and symmetrical structure thus as a result the resultant of two bond moments, being equal and opposite to the third, cancels out and hence molecule possess zero dipole moment.



; $\mu = 0$

41. **(d)** OSF_2 : $H = \frac{6+2}{2} = 4$. sp^3 hybridization.

It has 1 lone pair and 3-bond pair.



(Shape is trigonal pyramidal)

The shapes of SO_3, BrF_3 and SiO_3^{2-} are triangular planar respectively.

42. **(b)** $(O_2) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$

$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi * 2P_y^1$$

$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{10-6}{2} = \frac{4}{2} = 2$$

$\left(O_2^+ \text{ ion}\right) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$

$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1$$

$$\text{Bondorder } \frac{N_b - N_a}{2} = \frac{10-5}{2} = \frac{5}{2} = 2\frac{1}{2}$$

$\left(\bullet_2^-\right) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2P_z^2,$

$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^1$$

$$\text{Bond order } = \frac{(N_b - N_a)}{2} = \frac{10-7}{2} = \frac{3}{2} = 1\frac{1}{2}$$

$\left(O_2^{2-}\right) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$

$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$$

$$\text{Bond order } \frac{N_b - N_a}{2} = \frac{10-8}{2} = \frac{2}{2} = 1$$

43. **(a)** Nitric oxide is paramagnetic in the gaseous state because of the presence of one unpaired electron in its outermost shell.
The electronic configuration of NO is

$$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \sigma_{2p_z}^2 \pi_{2p_x}^2 = \pi_{2p_y}^2 \pi_{2p_x}^{*1}$$

44. **(d)** Smaller the size and higher the charge more will be polarising power of cation. Since the order of the size of cation is $K^+ > Ca^{2+} > Mg^{2+} > Be^{2+}$. So the correct order of polarising power is
$K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

45. **(c)** $H_2^{2+} = \sigma 1s^{\bullet} \sigma^* 1s^0$

bond order for $H_2^{2+} = \frac{1}{2}(0-0) = 0$

$He_2 = \sigma 1s^2 \sigma^* 1s^2$

bond order for $He_2 = \frac{1}{2}(2-2) = 0$

so both H_2^{2+} and He_2 do not exist