Chemical Bonding

EXERCISE - 1 [A]

1. (b)
Lower the ionisation energy, cation is easily formed. Similarly higher the electron affinity, anion is easily formed.

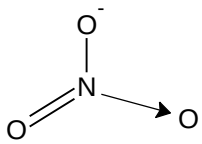
2. (c)
K^+I^-

3. (b)
H–Cl

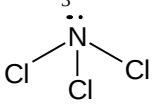
4. (b)
$$L.E. \propto \frac{q^{\oplus}q^{\Theta}}{r^{\oplus}+r^{\Theta}}$$
Charge ↑ L.E ↑
Size ↓ L.E. ↑

5. (b)
Covalent bond (directional)

6. (d)
In ClF_3, Cl has 10 valence electrons.

7. (d)


4 bond pair electrons & 0 lone pair electrons.

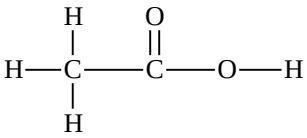
8. (d)
NCl_3


9. (c)
$AgNO_3 + CCl_4 \rightarrow$ No reaction

10. (c)
K^+CN^-
$^-C \equiv N$

11. (a)

CH_3COOH



16 Shared electrons
8 unshared electrons

12. (d)

ClF_3 7+3 = 10
IFi 7 + 7 = 14
PCl_5 5 + 5 =10

13. (d)

$p_x + p_x$	Sigma bond
$s + s$	Sigma bond
$s + p_z$	Sigma bond
$p_x + p_y$	No overlap

14. (d)

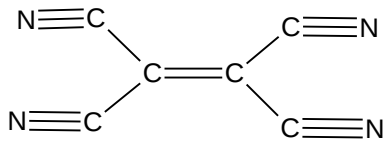
s – s σ bond
s – p σ bond
p – p π *and* σ bond

15. (a)

p – p axial σ
p – p lateral π

16. (c)

$(CN)_2C=C(CN)_2$

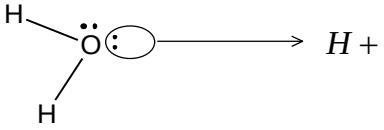


9σ bond
9π bond

17. (d)

S + Pz	no overlap
$P_x + P_y$	no overlap
$Pz + Pz$	σ
$Px + Px$	π

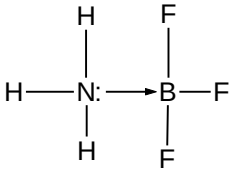
18. (c)



$H_2O \rightarrow H^+$

H_3O^+

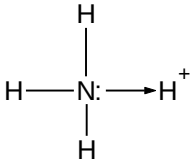
19. (c)



20. (b)

NH_4Cl

$NH_4^+Cl^-$



21. (d)

NH_4^+, CH_4 } tetrahedral

H_3O^+, NH_3 } trigonal pyramidal

I_3^-, XeF_2 } linear

PF_5 trigonal bipyramidal (sp^3d)

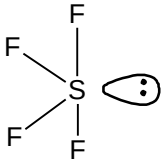
BrF_5 sp^3d^2 1 lone pair square pyramidal

22. (b)

SF_4

4σ bond

1 lone pair



sp^3d

G: trigonal bipyramidal

S : See – saw

23. (d)

I_3^-

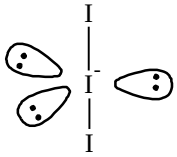
2σ bond

3 lone pair

sp^3d

G: triagonal bipyramidal

S : linear



24. (a)

PCl_6^- 6σ bond and 0 lone pair sp^3d^2 octahedral

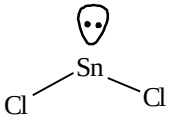
SF_4 sp^3d (see saw)

BO_3^{3-} sp^2 (trigonal planar)

BF_4^- sp^3 (tetrahedral)

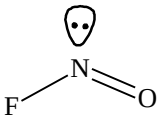
25. (b)

$SnCl_2$

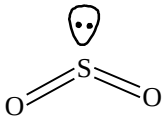


NO_2^+ $O = \overset{+}{N} = O$

FNO



SO_2



26. (c)

2σ *and* 2π bond 1 lone pair } sp^2 trigonal planar.

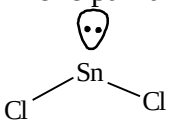
27. (b)

MCl_2

Atomic no. = 50 (Sn)

$SnCl_2$

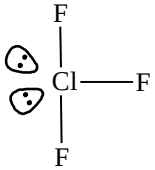
1 lone pair and 2 σ-bond



28. (c)

ClF_3

2 lone pair, 3σ *bond* } sp^3d



G : trigonal bipyramidal

S : T –shape

29. (d)

$\overset{1}{C}H_2 = \overset{2}{C}H - \overset{3}{C} \equiv \overset{4}{C}H$

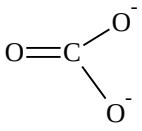
↑ ↑

sp^2 sp

30. (b)
Size $sp < sp^2 < sp^3$

31. (a)
CO_2
0 lone pair , 2σ bond, sp (linear) O = C = O

32. (c)
CO_3^{2-}



sp^2 trigonal planar

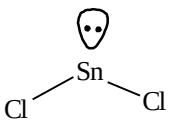
33. (b)
s and *p*
sp hybridisation angle $= 180^0$

34. (b)
BF_3
$O\,lone\,pair$, $3\sigma\,bond$ $\Big\}\, sp^2$
G and S trigonal planar

35. (a)
Iso electronic $\begin{Bmatrix} NO_3^- & sp^2 \\ CO_3^{2-} & sp^2 \end{Bmatrix}$ trigonal planar
SO_3 sp^2 trigonal planar
ClO_3^- sp^3 trigonal pyramidal

36. (c)
CO_2
O= C = O linear

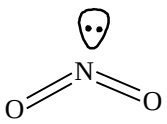
$SnCl_2$



NCO^-

$N \equiv C - O^-$
linear

NO_2



37. (b)
C_2H_2
$H - C \equiv C - H$
0 lone pair, 2σ bond, sp linear

38. (b)
In F_2, P_z & P_z orbitals overlap to form σ bond.

39. (b)

	sp^2 and	sp^3d
$\%s = \frac{1}{3}\times 100$		$\frac{1}{5}\times 100$
$= 33.33\%$		$= 20\%$

40. (b)

Electronegativity $sp > sp^2 > sp^3 > sp^3d$

41. (b)

SO_3 sp^2

PCl_5 sp^3d

SO_2 sp^2

PCl_3 sp^3

42. (c)

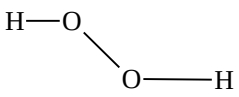
OF_2 $\left.\begin{matrix} 2\sigma\, bond \\ 2\, lone\ pair \end{matrix}\right\} sp^3$

43. (d)

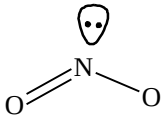
C_2H_2

$H-C\equiv C-H$ linear

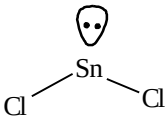
H_2O_2



NO_2



$SnCl_2$



CO_2

$O=C=O$

44. (b)

BF_3 sp^2 (trigonal planar)

NH_3 sp^3 (tetrahedral)

AlF_3 sp^2 (trigonal planar)

BeF_2 sp (linear)

H_2O sp^3 (tetrahedral)

BCl_3 sp^2 (trigonal planar)

PCl_3 sp^3 (tetrahedral)

45. (a)

PCl_3 sp^3 (trigonal pyramidal)

NH_3 sp^3 (trigonal pyramidal)

CF_4 sp^3 (tetrahedral)

SF_4 sp^3d (tetrahedral)

$PbCl_2$ sp^2 (V-bent)

CO_2 sp (Linear)

PF_5 sp^3d (trigonal bipyramidal)

IF_5 sp^3d^2 (square pyramidal)

46. (c)

BF_4^-

$\left.\begin{matrix} 0\,lone\ pair \\ 4\,\sigma\,bond \end{matrix}\right\} sp^3$

47. (a)

$POCl_3$

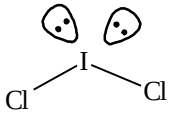
sp^3

PCl_3	SF_4	ClF_3	BCl_3
sp^3	sp^3d	sp^3d	sp^2

48. (d)

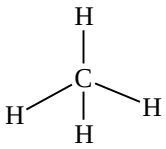
ICl_2^+

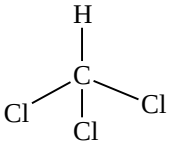
$\left.\begin{matrix} 2\sigma\,bond \\ 2\,lone\ pair \end{matrix}\right\} sp^3$

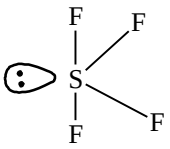


V bent

49. (c)







50. (c)

ML_X

sp^3d^2

G: octahedral

S: square planar

2 lone pair

4σ bond

$x = 4$

51. (b)

$$\text{Bond length} \propto \frac{1}{\text{bond strenght}}$$

C – H bond length is shortest

52. (d)

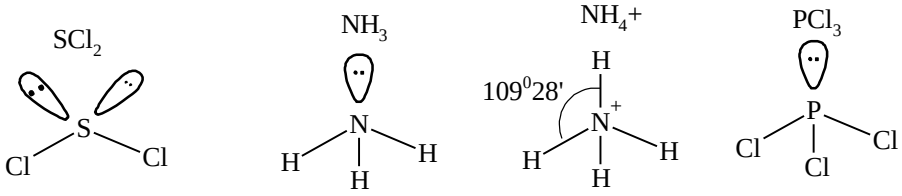
Solubility $MgF_2 < CaF_2 < SeF_2 < BaF_2$

53. (b)
Covalent correct
LiCl > RbCl
LiCl < $BeCl_2$
$BeCl_2$ > $MgCl_2$

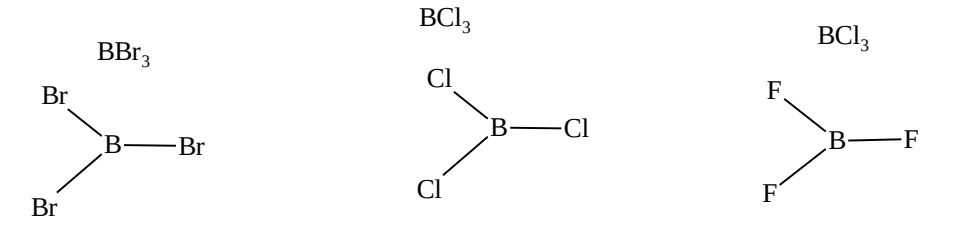
54. (b)
AgI
I^- Large anion
Greatest covalent character least soluble

55. (a)
AgCl
Greater covalent Ag^+ (less soluble)
PIGC (pseudo inert gas centi)

56. (b)



57. (d)



bond angle =120^0 bond angle =120^0 SP^2 bond angle =120^0

58. (d)

	CO	CO_3^{2-}	CO_2
B.O.	3	4/3	2

$b.\ell \propto \frac{1}{b.o}$

$b.\ell : CO_3^{2-} > CO_2 > CO$

59. (b)
Least covalent character highest melting point.

60. (c)
Covalent $LiCl > NaCl$
Solubility in water : LiCl < NaCl
Organic solvent : LiCl > NaCl

61. (c)

Covalent $BeCl_2 > MgCl_2 > CaCl_2 > SrCl_2 > BaCl_2$

62. (c)

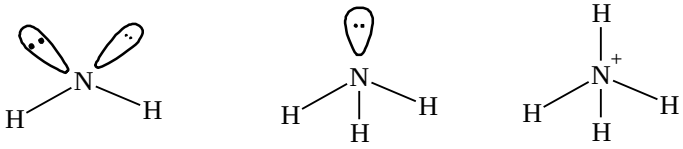
Charge ↑ Polarisation ↑ covalent characters ↑

Na_3N

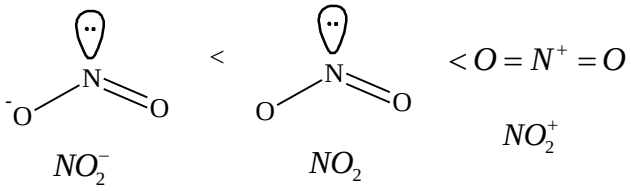
$F^- < O^{2-} < N^{3-}$

63 (b)

$NH_2^- < NH_3 < NH_4^+$



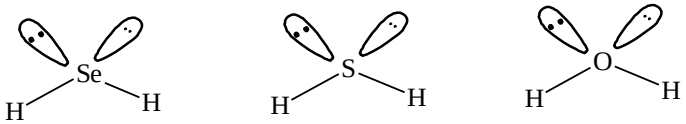
64. (d)



NO_2^- NO_2 $< O = N^+ = O$ NO_2^+

65. (c)

$H_2Se < H_2S < H_2O$



66. (d)

BF_3 BCl_3 BBr_3

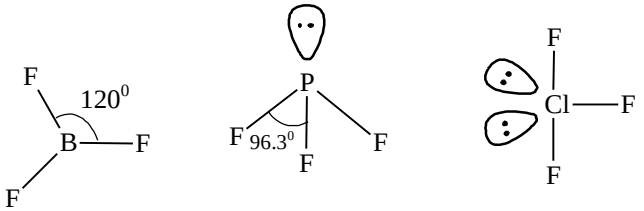
sp^2 sp^2 sp^2 trigonal planar bond angle = 120^0

67. (b)

NH_3	CH_4	H_2O	H_2S
107^0	$109^028'$	104.5^0	92^0

68. (c)

BF_3 PF_3 ClF_3



$ClF_3 < PF_3 < BF_3$

69. (b)

Covalent Character $KCl < CaCl_2 < AlCl_3 < SiCl_4$

70. (c)

IF_5

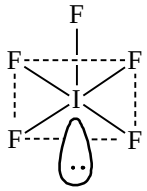
1 lone pair

5σ bond

sp^3d^2 octahedral

S: square pyramidal

90^0 *and* 180^0



71. (d)

Size $Na^+ > Mg^{2+}$

$S^{2-} > Cl^-$

Covalent MgS > NaCl

Solubility in water : $MgS < NaCl$

72. (d)

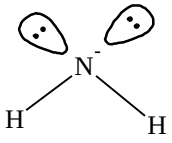
I^- largest anion (greater polarisation)

Covalent $AlI_3 > AlBr_3 > AlCl_3 > AlF_3$

73. (c)

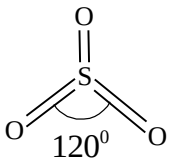
NH_2^-

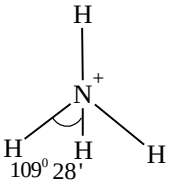
2σ bond , 2 lone pair }sp^3

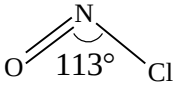


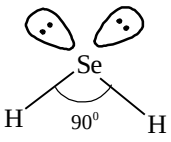
v-bent

74. (c)





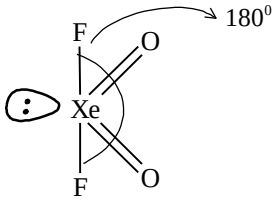




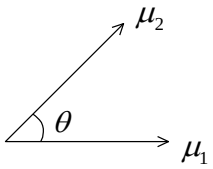
Bond $H_2Se < NH_4^+ < NOCl < SO_3$ angle

75. (c)

XeO_2F_2



76. (a)



$\mu_{net} = \sqrt{\mu_1^2 + \mu_2^2 + 2\mu_1\mu_2 \cos\theta}$

$0 < \theta < 90^0$ $\quad\quad$ $\theta \uparrow \mu_{net} \uparrow$

$90^0 < \theta < 180^0$ $\quad\quad$ $\theta \uparrow \mu_{net} \downarrow$

77. (c)

H_2O_2

$H - O - O - H$

$\uparrow$

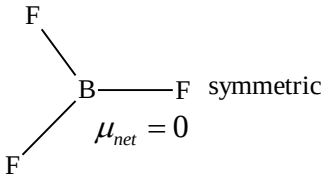
Non polar bond

78. (c)

C – F

$\Delta(E.N) \uparrow$ Polar character $\uparrow$

79. (b)

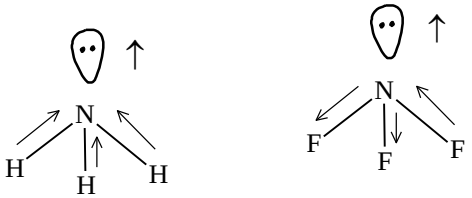


symmetric

$\mu_{net} = 0$

80. (d)

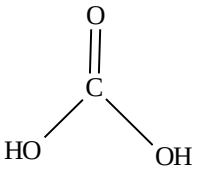
BF_3 $\mu_{net} = 0$



$NH_3 > NF_3 > BF_3$

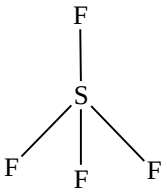
81. (a)

H_2CO_3



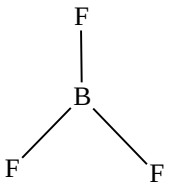
sp^2

Polar



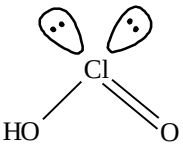
sp^3

Non polar



sp^2

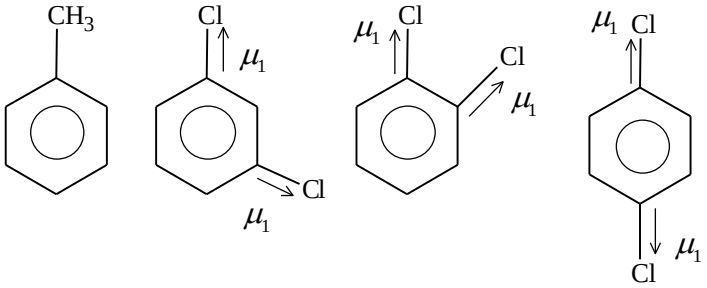
Non polar



sp^3

Polar

82. (b)



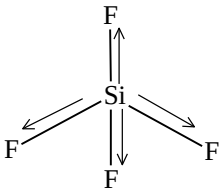
I II III IV

$\theta = 120^0$ $\theta = 60^0$ $\theta = 180^0$

$\mu_{net} = \mu_1$ $\mu_{net} = \sqrt{3}\mu_1$ $\mu_{net} = 0$

$IV < I < II < III$

83. (c)



$\mu_{net} = 0$

84. (a)

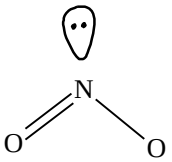
Dipole moment

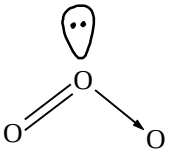
$CCl_4 < CHCl_3 < CH_3Cl_2 < CH_3Cl$

85. (b)

μ_{net} of SiF_4 and $CO_2 = 0$

μ_{net} of NO_2 *and* $O_3 \neq 0$

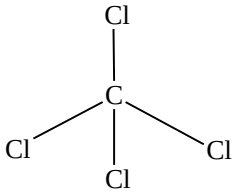




86. (c)

Covalent (directional)

87. (d)



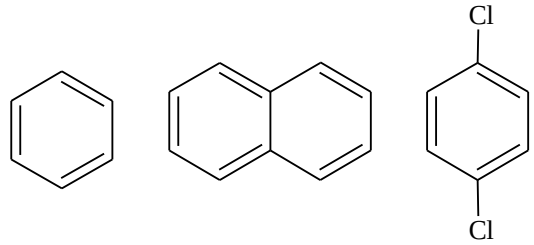
$\mu_{net} = 0$

88. (b)

C – H

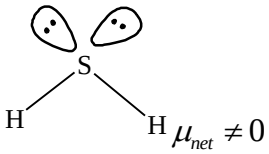
$\Delta(E.N)$ is very less

89. (d)



$\mu_{net} = 0$

90. (a)

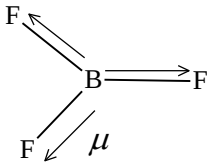


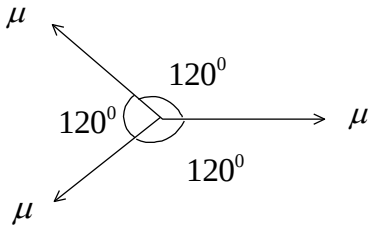
$\mu_{net} \neq 0$

Other $\mu_{net} = 0$

CO_2, BF_3, CCl_4)

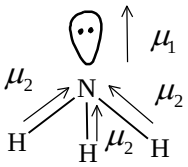
91. (d)





$\mu_{net} = 0$

92. (c)

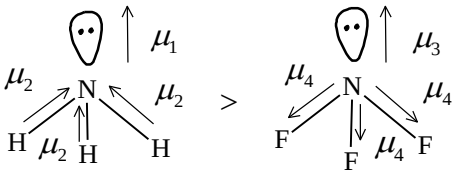


$\mu_{net} \neq 0$

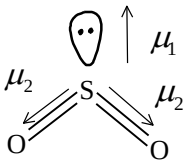
Others $\mu_{net} = 0$

93. (b)

μ_{net} of BF_3 *and* $B_2H_6 = 0$

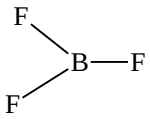


94. (c)



$\mu_{net} \neq 0$

95. (b)



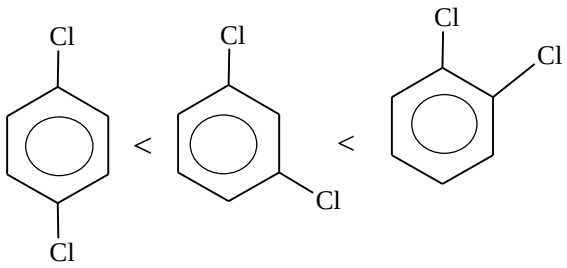
$\mu_{net} = 0$

96. (a)

$\mu_{net}(NF_3) < \mu_{net}(NH_3)$

μ_{net} of others =0

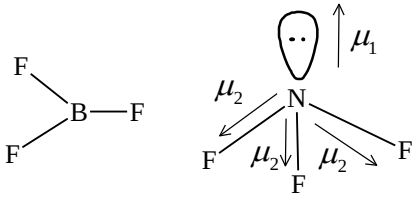
97. (d)



p m O

$\mu_{net} = 0$ $\mu_{net} = \mu$ $\mu_{net} = \sqrt{3}$

98. (c)



$\mu_{net} = 0$

$\mu_{net} \neq 0$

99. (a)

$\Delta(E.N) \uparrow$ ionic $\uparrow$

HI < HBr < HCl < HF

100. (c)

	O_2	$H_2O_2(O_2^{2-})$	O_3
B.O	2	1	1.5

$b.\ell: O_2 < O_3 < H_2O_2$

101. (a)

	N_2	N_2^+	O_2	O_2^+
B.O	$\frac{6-0}{2}=3$	$\frac{5-0}{2}=2.5$	$\frac{6-2}{2}=2$	$\frac{6-1}{2}=2.5$

$b.\ell: N_2 < N_2^+$

$O_2^+ < O_2$

102. (d)

	C_2	CN	N_2	O_2
B.O	$\frac{4-0}{2}=2$	$\frac{5-0}{2}=2.5$	$\frac{6-0}{2}=3$	$\frac{6-2}{2}=2$
B.O.	$\frac{3-0}{2}=1.5$	$\frac{4-0}{2}=2$	$\frac{5-0}{2}=2.5$	$\frac{6-1}{2}=2.5$

103. (c)

Energy $\sigma_{1s}^* < \sigma_{2s}$

n = 1 n = 2

104. (c)

Only same energy atomic orbitals combine to give molecular orbital.

105. (d)

O_2^{2-} $\quad B.O. = \frac{6-4}{2} = \frac{2}{2} = 1$

106. (a)

	O_2^+	N_2^-	CN^-	NO^+	CO
B.O	$\frac{6-1}{2}=2.5$	$\frac{6-1}{2}=2.5$	$\frac{6-0}{2}=3$	$\frac{6-0}{2}=3$	$\frac{6-0}{2}=3$

107. (d)

	H_2^+	H_2^-	H_2
B.O	$\frac{1-0}{2}=0.5$	$\frac{2-1}{2}=0.5$	$\frac{2-0}{2}=1$

$b.\ell.\ H_2 < H_2^+ < H_2^-$

108. (b)

	O_2	O_2^+	O_2^-	O_2^{2-}
B.O.	$\frac{6-2}{2}=2$	$\frac{6-1}{2}=2.5$	$\frac{6-3}{2}=1.5$	$\frac{6-4}{2}=1$

Bond strength $O_2^{2-} < O_2^- < O_2 < O_2^+$

109. (a)

	NO	NO^+	NO^-
B.O.	$\frac{6-1}{2}=2.5$	$\frac{6-0}{2}=3$	$\frac{6-2}{2}=2$

B.E. $NO^- < NO < NO^+$

110. (b)

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

111. (a)
O_2 has unpaired electrons in antibonding molecular orbitals.

112. (a)
O_2 is paramagnetic with 2 unpaired electrons.

113. (b)

	Unpaired electrons
B_2	2
O_2	2
NO	1

114. (b)

$$\text{B.O.} = \frac{2-0}{2} = 1$$

115. (a)
C_2

$$\sigma(1s) < \sigma^*(1s) < \sigma(2s) < \sigma^*(2s) < \pi(2p_x) = \pi(2p_y) < \sigma(2p_z) < \pi^*(2p_x) = \pi^*(2p_y) < \sigma^*(2p_z)$$

116. (c)

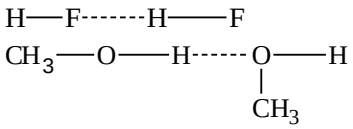
O_2	Paramagnetic
O_2^-	Paramagnetic
C_2	Diamagnetic
N_2^+	Paramagnetic

117. (c)
CaC_2 C_2^{2-}

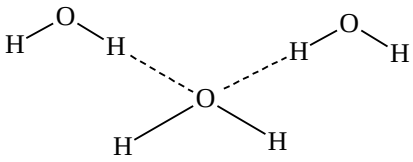
$$b.o. = \frac{6-0}{2} = 3$$

118. (b)
For antibonding molecular orbitals,
Energy increases on decreasing distance between atoms.

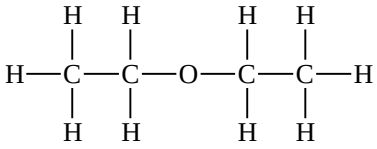
119. (c)



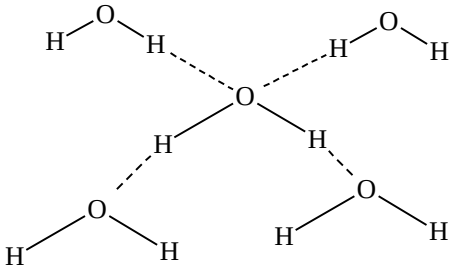
120. (b)



121. (d)



122. (d)



123. (b)
Volality ↑ if intermolecular hydrogen ↓ and
B.P.↓ bonding ↓
Molar mass ↑ B.P. ↑ voltality ↓
B.P. HCl < HBr < HI< HF
Voltality : HCl > HBr > HI > HF

124. (a)
B.P. $H_2S < H_2Se < H_2Te < H_2O$ ↑ due to intermolecular H-bonding

125. (d)
HCl (no H – bonding)

126. (a)
H-bonding Strength
H-----F > H ----O > H-----N

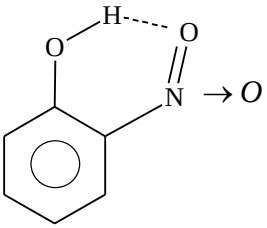
127. (b)
Bond length of H –bond >bond length of covalent bond

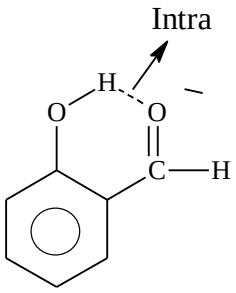
128. (b)

$CH_3OH < H_2O$ CH_3OCH_3

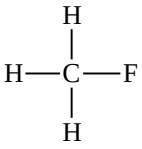
Greater strength of H-bonding in water No H –bonding

129. (d)





130. (d)



131. (d)

Hydrogen bond is weaker than other bonds

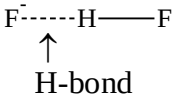
132. (d)

Molar mass $\uparrow$ $B.P.\uparrow$

$B.P: CH_4 < SiH_4 < GeH_4$

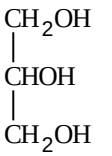
133. (c)

HF_2^-

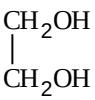


134. (a)

Inter molecular H-bonding $\uparrow$ viscosity $\uparrow$



Glycerol



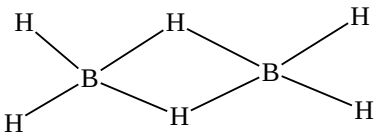
Glycol

135. (b)

Covalent bond is directional.

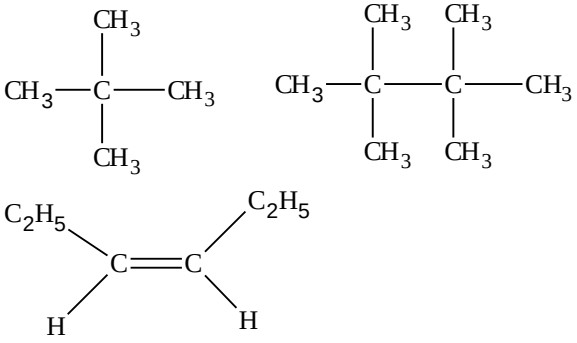
136. (d)

B_2H_6



(2c 2e bond or banana bond)

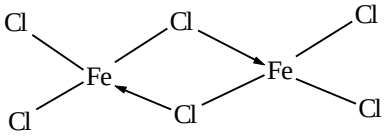
137. (c)



max. dipole moment

138. (a)

$FeCl_3$



139. (b)

B.P. HF > HBr > HCl

140. (c)

KO_2	AlO_2^-	BaO_2	NO_2^+
$K^+O_2^-$	$Al^{3+}O_2^{2-}$	$Ba^{2+}O_2^{2-}$	
Dia Para	Dia Dia	Dia Dia	Dia

141. (a)

% ionic character

$= 16\Delta(E.N) + 3.5\Delta(E.N)^2$

$= 16(2) + 3.5(2)^2$

$= 32 + 14$

= 46

142. (d)

Identical bonding is not necessary

143. (d)

Odd electrons molecules are paramagnetic ClO_2

144. (B)

Atomic no = 10 (Ne)

Monoatomic

B.O. of Ne_2 = 0

145. (c)

CO_2	H_2O	SiO_2	He
gas	*Liquid*	*Solid*	*gas*

146. (a)

	O_2	$Na_2O_2O_2^-$	KO_2	O_3
B.O	$\frac{6-2}{2}=2$	$\frac{6-4}{2}=1$	$\frac{6-3}{2}=1.5$	1.5

EXERCISE - 1 [B]

1. (b)

$Li^{2+}: 1s^1$

$Be^{2+}: 1s^2 = [He]$

$B^{2+}: 1s^2 2s^1$

$C^{2+}: 1s^2 2s^2$

2. (d)

$Cl^- = 1s^2 2s^2 2p^6 3s^2 3p^6$

$= [Ar]$

3. (d)

Ti^{4+} : [Ar]

Kr : [Ar] $3d^{10} 4s^2 4p^6$

Cl^- :[Ne] $3s^2 3p^6$

4. (a)

$Ca^+ : [Ar]4s^1$

5. (d)

$$\text{L.E.} \propto \frac{q^+ q^-}{r^+ + r^-}$$

6. (a)

$$AB(s) \longrightarrow A^+(g) + B^-(g)$$

$\Delta H = \text{L.E.}$

7. (d)

$$\text{L.E.} \propto \frac{q^+ q^-}{r^+ + r^-}$$

8. (d)

$[Kr]4d^{10}$ is ion of p-block elements or 11th or 12th group.

$Sn = [Kr]\,5s^2 4d^{10} 5p^2$

$Sn^{4+} = [Kr]\,5s^0 4d^{10}$

$Ag = [Kr]\,5s^1 4d^{10}$

$Ag^+ = [Kr]\,5s^0 4d^{10}$

9. (c)

$Fe = [Ar]\,4s^2 3d^6$

$Fe^{2+} = [Ar]\,4s^0\ 3d^6$

10. (c)
Bond formed between non-metals is covalent.

11. (b)
Bond order $\uparrow$, Bond length $\downarrow$

12. (b)
E.N. of Halogens is higher.

13. (a)
E.N. of Alkali metals is lower.

14. (d)
Left to right, E.N. $\uparrow$

15. (d)
Dipole moment : HF > HCl > HBr > HI

16. (b)
As ΔE.N. $\uparrow$ polarity $\uparrow$
It is least for *p* & *s*.

17. (b)
ΔE.N. $\uparrow$ polarity $\uparrow$
It is least for O & F & maximum for Mg & F.

18. (a)
$\Delta E.N.(O-F) = 4-3.5 = 0.5$
$\Delta E.N.(Cl-F) = 4-3 = 1$

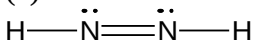
19. (b)
$\mu = \delta \times d$

$$\delta = \frac{\mu}{d} = \frac{0.44 \times 3.34 \times 10^{-30}}{1.61 \times 10^{-10}}$$

$$\frac{\delta}{e} = \frac{0.44 \times 3.34 \times 10^{-30}}{1.61 \times 10^{-10} \times 1.6 \times 10^{-19}}$$

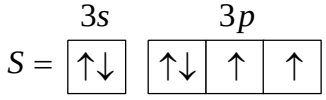
$$= 0.057$$

20. (c)



21. (d)
4 + 3 + 4 + 2 + 7= 20

22. (b)

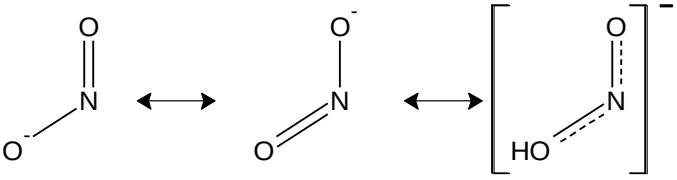


23. (a)

	CO	CO_2	CO_3^{2-}
Bond order :	3	2	1.33

Bond order ↑, Bond length ↑

24. (d)



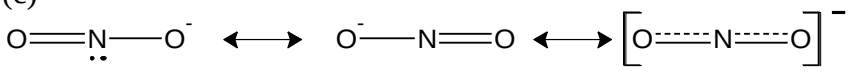
$$\text{B.O.} = \frac{3}{2} = 1.5$$

25. (a)
In resonance, delocalisation of electrons take place.

26. (c)
$x + 3(-1) = 0$
$x = +3$

27. (c)
In resonance, delocalisation of electrons take place.

28. (c)



29. (d)
In SO_4^{2-}, electrons are delocalised on 4 bond pair.

30. (b)
Due to resonance, bonds are identical in all.

31. (c)
O can not expand its octet.

32. (c)
CO has fully filled molecular orbitals of 2*p*.

33. (d)
$Sr = [Kr]\,5s^2$
$Sr = [Kr]\,5s^1$

34. (d)
SeF_4
6 + 4 = 10 valence electrons in Se.

35. (c)
CF_4
4 + 4 = 8
Valence Electrons.

36. (c)
BF_3
3 + 3 = 6
Valence Electrons.

37. (a)
ClF_3
7 + 3 = 10
Valence Electrons.
In SO_3, coordinate bond can be formed.

38. (c)
ICl_5
7 + 5 = 12
Valence Electrons.

39. (b)
BeH_2
2 + 2 = 4
Valence Electrons.

40. (a)

	O_2^{2+}	O_2^{+}	O_2^{-}	O_2^{2-}
Bond order	$\frac{6-0}{2}=3$	$\frac{6-1}{2}=2.5$	$\frac{6-3}{2}=1.5$	$\frac{6-4}{2}=1$

B. l $O_2^{2-} > O_2^{-} > O_2^{+} > O_2^{2+}$

41. (a)
Bond enthalpy is energy required to break 1 mole of covalent bond.

42. (c)

NO^+	C_2^{2-}	CN^-	N_2
14	14	14	14

isoelectronic

43. (d)
Bond order increasing.
Bond strength increasing.
Bond length decreasing.

44. (d)
Bond order increasing.
Bond strength increasing.
Bond length decreasing.

45. (d)
Bond order increasing.
Bond strength increasing.
Bond length decreasing.

46. (a)

Solid PCl_5 exists as

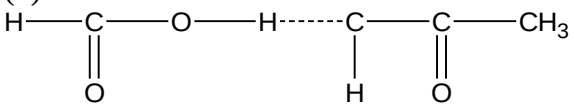
$[PCl_4]^+[PCl_6]^-$

sp^3 sp^3d

47. (b)

O_2^-	O_2^{2-}	O_2^+	O_2
Paramagnetic	Diamagnetic	Paramagnetic	Paramagnetic

48. (b)



49. (d)

PCl_5

$\underbrace{5\sigma \ \& \ 0\,\ell.p.}$

sp^3d

50. (d)

BBr_3	XeF_4	BCl_3	XeO_3
sp^2	sp^3d^2	sp^2	sp^3

51. (c)

I_3^-	CO_2	ClO_2^-
Linear	Linear	V-bent

52. (c)

$CuSO_4 \cdot 5H_2O$

$[Cu(H_2O)_4]SO_4 \cdot H_2O$

Covalent bond in H_2O & in SO_4

Ionic bond between $[Cu(H_2O)_4]^{2+}$ & SO_4^{2-},

Coordinate bond between Cu^{2+} & H_2O.

53. (c)

IF_7	SF_6	PCl_3	PCl_5
Non polar	Non polar	Polar	Non polar

54. (d)

H_2O	O_3	SO_2	CO_2
Non polar	Non polar	Polar	Non polar

55. (d)

$BeCl_2$	CS_2	CO_2	SO_3
Linear	Linear	Linear	Trigonal planer

56. (b)

Polarisation $\uparrow$ m.p. $\downarrow$

Polarisation $\propto$ size of anion

57. (d)

Polarisation $\propto$ charge

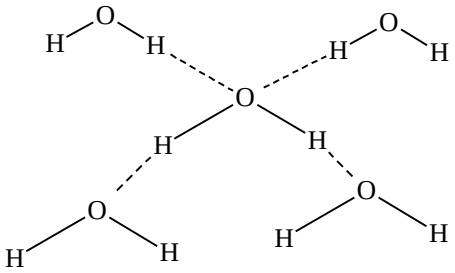
$\propto$ size of anion

$\propto \dfrac{1}{\text{size of cation}}$

58. (d)

O_2^-	O_2	O_2^{2-}
2 + 2 + 3	2 + 2 + 2	2 + 2 + 4
= 7	= 6	= 8

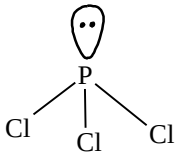
59. (d)



60. (c)

PCl_3

$\left.\begin{matrix} 3\sigma\, bond \\ 1 lone\ pair \end{matrix}\right] sp^3$



Trigonal pyramidal

61. (b)

Charge $\uparrow$ *and* size $\downarrow$ $AlCl_3$

62. (c)

S character $\uparrow$ electronegativity $\uparrow$

$sp > sp^2 > sp^3 > sp^3d > ...$

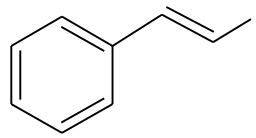
63. (a)

	N_2	O_2	F_2	Cl_2
B.O.	3	2	1	1

$b.o \uparrow b.\ell \downarrow$

Smallest $b.\ell$ N_2

64. (c)



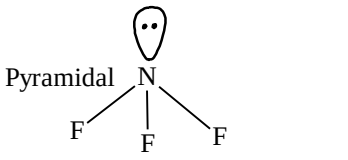
4π bond 9σ bond

65. (c)

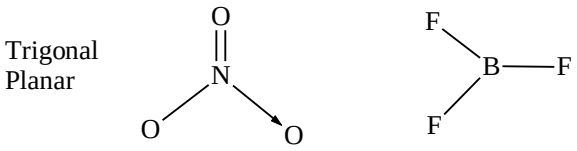
XeF_2	CO_2
2σ bond	2σ bond
$3\ell p$	0 lone pair
sp^3d	sp
G: trigonal bipyramidal	linear
S: linear	linear

66. (c)

NF_3 H_3O^+

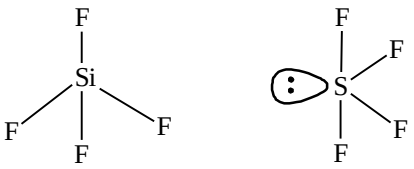


NO_3^- BF_3



67. (d)

SiF_4 SF_4



sp^3 sp^3d

Shape: tetrahedral see-saw

68. (c)

$H_2S < H_2O < NH_3 < SO_3$

90^0 120^0

69. (d)

B.P. $CH_3-O-CH_3 < C_2H_5OH$

Volatility $CH_3-O-CH_3 > C_2H_5OH$

Due to hydrogen bonding in C_2H_5OH

70. (b)

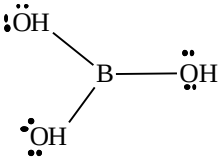
	NO	NO^+
b.o.	2.5	3

b.o. $\uparrow$ b. ℓ. $\downarrow$

$b.\ell.: NO > NO^+$

71. (b)

H_3BO_3



For B : 3σ bond ; 0 l.p (sp^2)

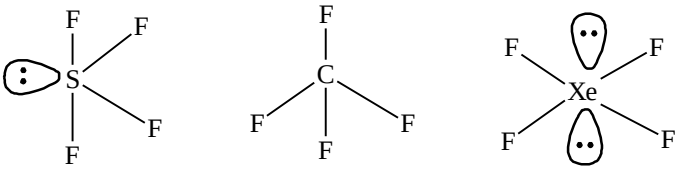
For O: 2σ ; $2\ell p$ (sp^3)

72. (b)

m.p. NaCl > KCl > RbCl > LiCl

73. (d)

SF_4 CF_4 XeF_4



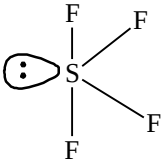
74. (a)

O_2^{2-} Diamagnetic

$$\sigma_{1s^2}\sigma^*_{1s^2}\sigma_{2s^2}\ \sigma^*_{2s^2}\ \sigma_{2p_{z^2}}\ \left\{\begin{matrix}\pi_{2p_{x^2}}\\ \pi_{2p_{y^2}}\end{matrix}\right\}\cdot\left[\begin{matrix}\pi^*_{2p_{x^2}}\\ \pi^*_{2p_{y^2}}\end{matrix}\right]$$

75. (a)

SF_4



$B.\ell(S-F)_{equ} \neq B.\ell.(S-F)_{axial}$

76. (b)

O_2^{2-}

Diamagnetic

77. (d)

$K^+ \; Ca^{2+} \; Mg^{2+} \; Be^{2+}$

Size of cation $\downarrow$

And

Charge $\uparrow$

Polarisation $\uparrow$

$K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

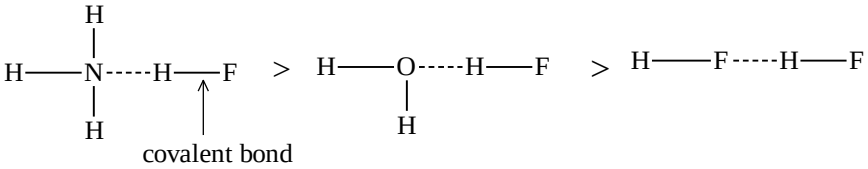
78. (c)

$O_2 \quad \rightarrow \quad O_2^+$

b.o. $\frac{6-2}{2} = 2 \qquad \frac{6-1}{2} = 2.5$

para Para

79. (c)



EXERCISE - 1 [C]

1. (1)
9σ and 9π bond are present.

2. (6)
$^4C_2 = \frac{4!}{2!2!} = 6$

3. (3)
SF_4, BF_2Cl, PF_3Cl_2

4. (5)
$I_3^+, XeF_4, H_2O, NH_2^-, H_2S$

5. (6)
$CH_4, CCl_4, CHCl_3, XeF_6, POCl_3, XeF_4$

6. (6)
Excited state

$SO_3 \rightarrow 2$	$CH_4 \rightarrow 1$
$OF_2 \rightarrow 0$	$SF_2 \rightarrow 0$
$XeF_4 \rightarrow 2$	$POCl_3 \rightarrow 1$

7. (8)
$[XeF_4]^{2+}, [ClF_4]^+, [SF_5]^+, [IF_2]^-, [SiF_5]^-$
XeF_2, $[SF_2]^{2-}$, $[PF_2]^{3-}$ have steric number = 5

8. (5)
$H_3PO_4, H_2SO_4, H_3PO_3, H_3PO_2, HClO_4$

9. (4)
BF_3, CCl_4, SF_6, SO_3

10. (3)
H_2O, XeF_5^-, ClF_3

11. (4)
(a) BF_3; (b) BCl_3; (c) CO_3^{2-}; (d) SO_3

12. (6)
$Cl_2O_6, Cl_2O_7, Cr_2O_7^{2-}, S_2O_7^{2-}, SO_2Cl_2, SOCl_2$

13. (4)
CCl_4, SO_3, SF_6, PCl_5

14. (4)
$BF_3, SF_6, B_3N_3H_6, PCl_3F_2$

15. (9)
$I_3^+, XeF_4, C_2F_4, BrF_4^-, SO_3, NOCl, ClF_3, F_2CO, XeF_5^-$

16. (6)
$O_2^{2+}, O_2^{2-}, B_2^{2-}, C_2^{2-}, C_2, N_2$

17. (3)
KO_2, NO_2, NO

18. (3)
B.L. : $N_2^- > N_2$; $NO > NO^+$; $H_2^+ < H_2^-$

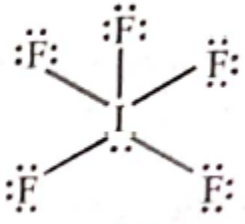
19. (2)
All axial bonds.

20. (1)

SECTION-I

1. (b)

The geometry of IF_5 is square pyramid with an unsymmetric charge distribution, therefore this molecule is polar.



2. (d)

Given $e = 1.60 \times 10^{-19}$ C

$d = 9.17 \times 10^{-11}$ m

From $\mu = e \times d$

$\mu = 1.60 \times 10^{-19} \times 9.17 \times 10^{-11} = 14.672 \times 10^{-30}$

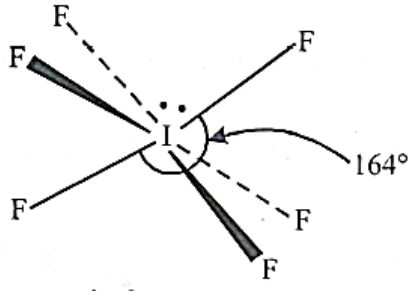
$$\% \text{ ionic character} = \frac{\text{Observed dipole moment}}{\text{Dipole moment for 100\% ionic bond}}$$

$$= \frac{6.104 \times 10^{-30}}{14.672 \times 10^{-30}} \times 100 = 41.5\%$$

3. (a)

The structure of IF_6^- is distorted octahedral.

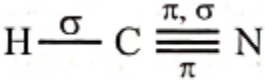
This is due to presence of a "weak" lone pair.



4. (b)

According to Fajans rules, small and highly charged cation has greatest covalent character while large cation with small charge has greatest ionic character.

5. (d)



Therefore, HCN has 2π and 2σ bonds.

6. (b)

Hydrogen bond is a type of strong electrostatic dipole-dipole interaction and dependent on the inverse cube of distance between the molecules.

7. (b)

Dipole moment $(\mu) = q \times d$

$\Rightarrow$ $1\text{D} \approx 10^{-18}$ esu cm

0.38×10^{-18} esu cm $= q \times (1.617 \times 10^{-8}\text{cm})$

$q = 2.35 \times 10^{-11}$ esu

So, fractional charge $= \dfrac{\text{Partial charge}}{\text{Total charge}} = \dfrac{q}{Q}$

$$= \frac{2.35 \times 10^{-11}\text{ esu}}{4.802 \times 10^{-10}\text{ esu}} = 0.049 \approx 0.05$$

8. (c)

Assertion is correct but reason is incorrect. Bonding MO shows constructive interference of the combining electron waves.

9. (c)

Hydridisation (H) = [No. of valence electrons of central atom + No. of monovalent atoms attached to it + (–ve charge if any) – (+ve charge in any)]

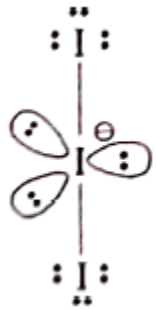
NO_2^+ sp hybridization

NO_2^- sp^2 hybridization

NO_3^- sp^2 hybridization

The Lewis structures of NO_2 shows a bent molecular geometry with trigonal planar electron pair geometry, hence the hybridization will be sp^2.

10. (c)



$\therefore$ Total number of lone pair of electrons is 9.

11. (c)

KCl is an ionic compound while others (PH_3, O_2, B_2H_6, and H_2SO_4) are covalent compounds.

12. (c)

Electronic configuration of O_2 is

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2$

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

When an electron is added in O_2 to form O_2^-, the incoming electron goes to π^*2p_x or π^*2p_y orbital.

13. (a)

Species	Hybridisation
ICl_2^-	sp^3d
ICl_4^-	sp^3d^2
BrF_2^-	sp^3d
IF_6^-	sp^3d^3

14. (b)

The molecules with no unpaired electrons are diamagnetic.

Molecule	Bond order
NO	1
CO	Zero
O_2	2
B_2	2

Since CO has no unpaired electron. Hence CO is diamagnetic.

15. (d)

$\mu_{CCl_4} = \mu_{CH_4} = 0$ due to symmetrical structure but $\mu_{CHCl_{13}} \neq 0$.

So dipole moment order is : $CHCl_3 > CH_4 = CCl_4$

16. (b)

Total number of electron in CN^- = 6 + 7 + 1 = 14

$\therefore$ Molecular orbital distribution

$$\sigma 1s^2\, \sigma^*1s^2 \sigma 2s^2 \sigma^*2s^2 \begin{bmatrix} \pi 2p_x^2 \\ \pi 2p_y^2 \end{bmatrix} \sigma 2p_z^2$$

$\therefore$ Bond order $= \dfrac{10-4}{2} = 3$

CN^- is diamagnetic because all electrons are paired.

17. (d)

(I) Ion-ion interaction energy $\propto \left(\dfrac{1}{r}\right)$.

(II) Dipole-dipole interaction energy $\propto \left(\dfrac{1}{r^3}\right)$.

(III) London dispersion $\propto \left(\dfrac{1}{r^6}\right)$.

18. (d)

Among given intermolecular forces, ionic interaction are strongest force.

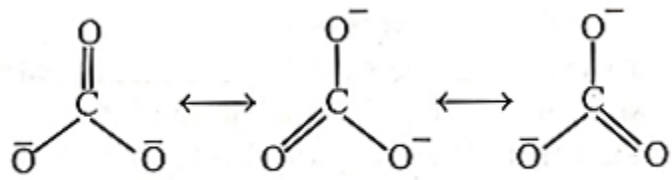
Thus, correct order is ion-ion > ion-dipole > dipole-dipole

19. (c)

For London dispersion forces,

$E \propto r^{-6}$; So, $x = -6$

20. (d)



3 Canonical structures

21. (b)

The chemical species having capability to donate electron pair is called lewis base. PCl_5 cannot function as a Lewis base as the central atom P does not have lone pair of electrons.

22. (c)

Species	Hybridisation	Bond length
XeF_4	sp^3d^2 (sq. planar)	All bond lengths equal
BF_4^-	sp^3 (Tetrahedral)	All bond lengths equal
SF_4	sp^3d (See-saw)	Axial B.L. > Equatorial B.L.
SiF_4	sp^3 (Tetrahedral)	All bond lengths equal

23. (a)

According to the electronic configuration of O_2^- ion is

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^2 = \pi^* 2p_y^1$

Bond order $= \frac{10-7}{2} = 1.5$

It also exhibit paramagnetic character due to the presence of unpaired electron.

24. (d)

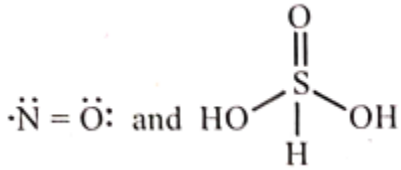
(A)-(III); (B)-(IV); (C)-(I); (D)-(II)

Molecule	Bond order
Ne_2	0
N_2	3
F_2	1
O_2	2

25. (b)

NO $\rightarrow$ Odd Electron molecule

$H_2SO_4 \rightarrow$ Expanded octet of S

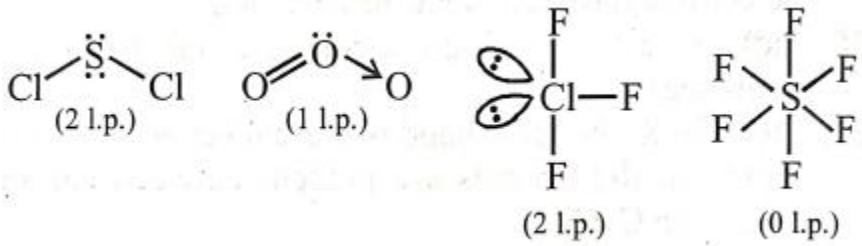


26. (b)
According to Fajan's rule, Covalent character $\propto$ size of Anion As the cation is same in all the option. Therefore covalent character will depend upon the size of anion. Covalent character : A < B < C < D; Size of anion : $F^- < Cl^- < Br^- < I^-$

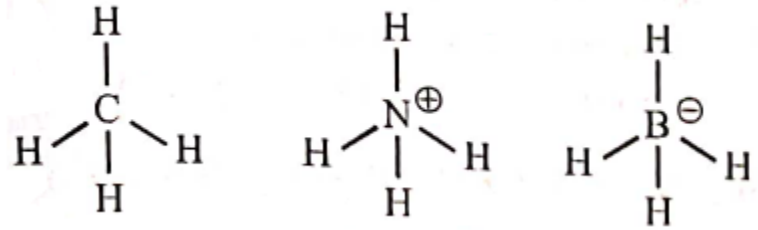
27. (c)
According to Fayan's rule, small size cation and larger size anion will have high covalent character. So the order is : LiCl > NaCl > KCl > CsCl

28. (c)
Electron deficient species have less than 8 electrons (or two electrons for H) in their valence (incomplete octet). B_2H_6, BCl_3 have incomplete octet.

29. (b)



30. (b)
Isoelectronic species have same number of electrons valence



All have steric number is 4 so
All are tetrahedral and each have 10 electrons.

31. (c)
As Fluorine is more electronegative it occupys the axial position and lone pairs occupy equatorial position

Steric no. = 5 (sp^3d), lone pair = 2
Bent T shape.

32. (c)
The sp^3d hybridization in PCl_5 is a combination of [sp^2 + pd] mixing.
sp^2 – hydrid orbital form equatorial bonds and pd hydrid orbital forms axial bonds.
Hence, axial bonds are longer and weaker than equatorial bonds.

33. (b)
PCl_5 forms five bonds by using the d-orbitals to "expand the octet". But NCl_5 does not exist because there are no d-orbitals in the valence shell (2^{nd} shell).
Therefore, there is no way to expand the octet.

34. (a)
In case of tetrahedral, rectangular planar and square planar geometries, there are only bond pair of electrons by four bonds.
Square pyramidal geometry is possible with four bond pairs and one lone pair of e^-. Hence, it will be polar due to dipole moment of these e^-.

35. (c)
The strength of H–bonding depends upon two factors:
(1) Electronegativity difference between the hydrogen and Halogen element.
(2) Number of H-bonding interaction.
So, the order of H-bonding is $CH_4 < HCN < NH_3$.

36. (a)

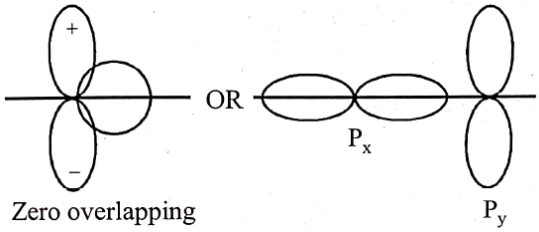
ion / molecule	Number of e^- in BMO	Number of e^- in ABMO	Bond order
O_2^+	10	5	2.5
O_2	10	6	2
O_2^-	10	7	1.5
O_2^{2-}	10	8	1

Bond order: $O_2^{2-} < O_2^- < O_2 < O_2^+$

37. (c)
Bond strength $\propto$ Bond order
Removal of electron from antibonding MO increases B.O.
NO and O_2 have valence e^- in π^* orbital.

38. (a)
$$2PCl_5(g) \longrightarrow \underset{\text{Tetrahedral}}{[PCl_4]^+}\ \underset{\text{Octahedral}}{[PCl_6]^-}(s)$$

39. (a)
Zero overlapping is occur due to improper orientation or orbitals and it is an out of phase overlapping.



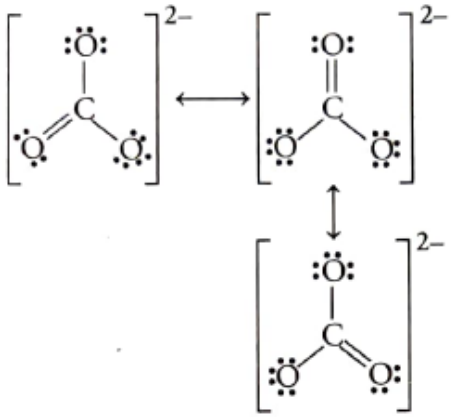
Zero overlapping

40. (c)
Statement I: O_2, Cu^{2+} and Fe^{3+} all are paramagnetic species. Hence, they will be attracted by magnetic field and will be magnetized in the same direction as magnetic field.
Statement II: Due to no unpaired e^- in Na^+, Cl^-, H^+ and O^{2-}, they will not be magnetized in a magnetic field.

41. (d)

CO_3^{2-} has a single structure i.e., resonance hybrid of CO_3^{2-} gives three canonical structures.

The given structures are resonating structures of carbonate ion.



42. (d)

Greater the difference of electronegativity between the cation and anion, greater will be the ionic character and lesser will be the covalent character.

Hence, correct order is KI > KF; LiF > KF; CuCl > NaCl

Smaller the size of the cation, higher will be its polarising power. Since, Sn^{4+} is smaller in size than Sn^{2+} hence it will have more covalent character in its compounds. So, $SnCl_4 > SnCl_2$.

43. (c)

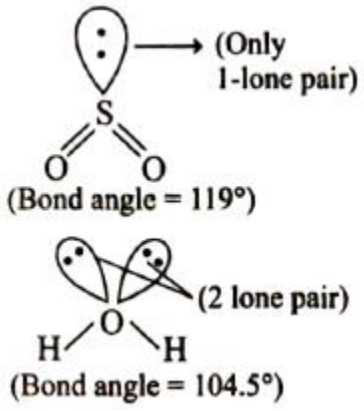
Assertion (A) is correct but Reason (R) is incorrect.

Dipole moment is a vector quantity i.e., it has magnitude as well as definite directions.

In chemistry, the dipole moment is represented by cross arrow on the positive center and arrowhead on the negative center. This arrow symbolises the shift of electron density in the molecules.

44. (b)

Shape of SO_2 and H_2O are given as



Hence, both has V-shape, but bond angle in SO_2 is greater than H_2O, due to respulsion between lone pairs at oxygen.

So, statement I is correct but statement II is incorrect.

45. (a)

The correct match is A-II, B-I, C-IV, D-III.

46. (d)

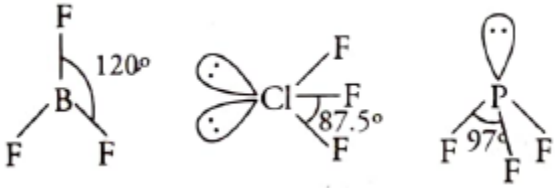
The bond order of acetylide ion C_2^{2+} $(^{-}C \equiv C^{-})$ is 3 and is diamagnetic in nature.

- Bond order of $O_2^- = \frac{10-7}{2} = 1.5$ and paramagnetic
- Bond order of $N_2^- = \frac{10-5}{2} = 2.5$ and paramagnetic
- Bond order of $NO^+ = \frac{10-4}{2} = 3$ and paramagnetic
- Bond order of $O_2^+ = \frac{10-5}{2} = 2.5$ and paramagnetic

Thus, bond order and magnetic property of acetylide ion are same as that of NO^+.

47. (b)

The structure of given compounds are as follows.



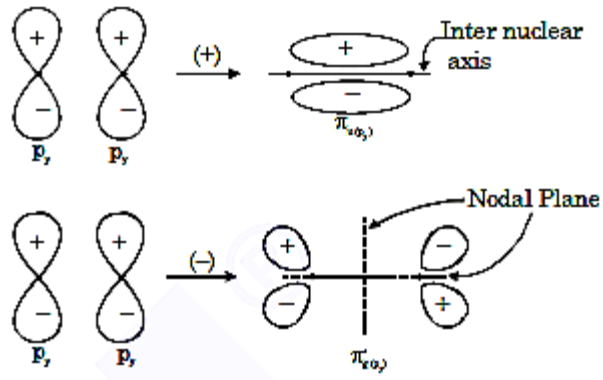
So, the correct order of bond angle is $ClF_3 < PF_3 < BF_3$.

48. (b)

Among the given molecules CH_4 and PF_5 are non-polar. Hence they have net zero dipole momentum while among NH_3 and NF_3, the dipole moment of NH_3 is greater than NF_3. It is because in NH_3 vector addition of bond momentum and lone pair takes place while in NF_3 vector subtraction of bond moment and lone pair takes place.

49. (c)

A π bonding molecular orbital has higher electron density above and below inter nuclear axis



50. (a)

The ionic character in a molecule depend upon electronegativity difference between the constituting atoms.

Greater the electronegativity difference, greater will be the ionic character of molecules.

Therefore, the correct sequence of increasing order of ionic character.

$N_2 < SO_2 < ClF_3 < K_2O < LiF$

Hence, option (a) is correct.

51. (c)

According to Fajan's rule, Ag and Cl bond will be covalent in nature not ionic.

The ionic character of the given compounds is in the order,

$AgCl < CoCl_2 < BaCl_2 < KCl$

Hence, AgCl is least ionic.

52. (d)

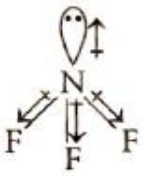
Polar molecules are those molecules in which there exists an electronegativity difference between the bonded atom. They have non-zero dipole moment. Hence, $CHCl_3$ is a polar molecule. Non-polar molecules are those molecules in which electrons are shared equally. They have zero dipole moment, $CH_2 = CH_2$, CCl_4, CO_2 are non-polar molecules.

Hence, option (d) is correct.

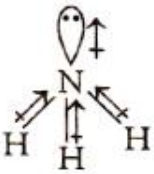
53. (a)

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

The bond structure of NF_3 and NH_3 with dipole moment direction are;



Resultant dipole moment $= 0.80 \times 10^{-30} Cm$

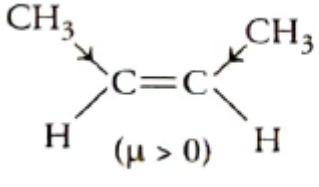


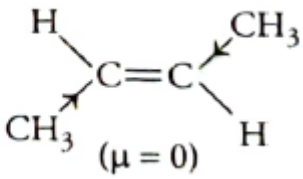
Resultant dipole moment $= 4.9 \times 10^{-30}$ Cm

54. (a)

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

Dipole moment is a vector quantity and for compound net dipole moment is the vector sum of all dipoles. Hence dipole moment of *cis*-form is greater than *trans*-form.





55. (c)

The hybridisation of central atom of given species in different options are

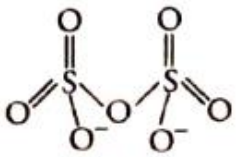
$BF_3, NO_2^-, NO_2 \Rightarrow sp^2$-hybridisation

H_2O and $NH_2^- \Rightarrow sp^3$-hybridisation

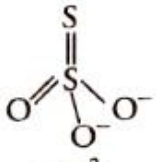
So, the pair of central atoms that exhibit sp^2-hybridisation is BF_3 and NO_2^-.

56. (c)

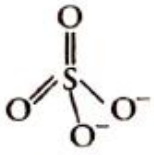
The geometry of the given species are as follows



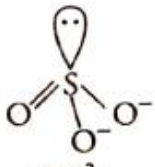
$S_2O_7^{2-}$
Tetrahedral



$S_2O_3^{2-}$
Tetrahedral



SO_4^{2-}
Tetrahedral



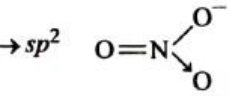
SO_3^{2-}
Pyramidal

Thus, among the given species only SO_3^{2-} has pyramidal geometry.

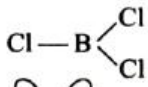
57. (b)

The hybridisation of central atom in the given molecules/ ions are as follows

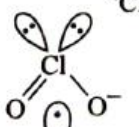
$NO_3^- \rightarrow sp^2$



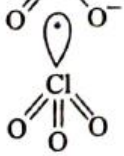
$BCl_3 \rightarrow sp^2$



$ClO_2^- \rightarrow sp^3$



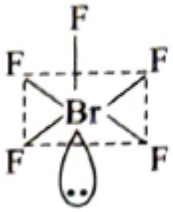
$ClO_3 \rightarrow sp^3$



Thus, two molecules / ions i.e. ClO_2^- and ClO_3 has sp^3 hybridisation.

58. (a)

Among the given options, BrF_5 has square pyramidal shape.



sp^3d^2
hybridisation

59. (b)

Among the given options, only $\left[Co(NH_3)_6\right]^{3+}$ shows d^2sp^3 hybridisation.

Hybridisation of rest of the members are as follows

$BrF_5 = sp^3d^2$

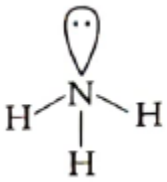
$SF_6 = sp^3d^2$

$\left[PtCl_4\right]^{2-} = dsp^2$

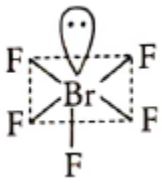
60. (c)

The correct match is A-II, B-I, C-IV, D-II

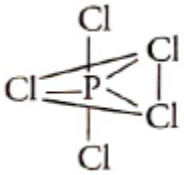
NH_3 =Trigonal pyramidal



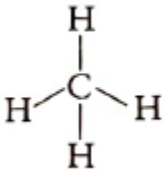
BrF_5 = Square pyramidal



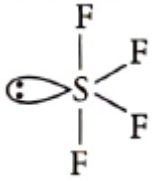
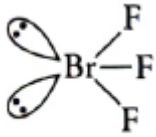
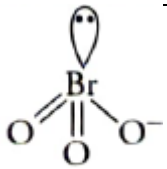
PCl_5 = Trigonal bipyramidal

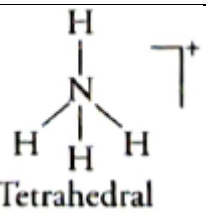


CH_4 = Tetrahedral



61. (a)

Molecules	**Hybridisation**	**Shape/geometry**
SF_4	sp^3d	 *see-saw*
BrF_3	sp^3d	 Bent T-shape
BrO_3^-	sp^3	 Pyramidal

NH_4^+	sp^3	 Tetrahedral

Hence, correct match is A-III, B-IV, C-II, D-I.

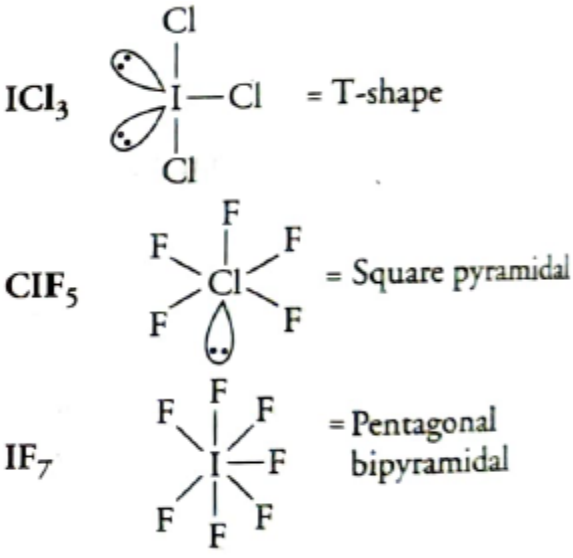
62. (c)
The correct match is A-III, B-I, C-II, D-IV.

- SO_2Cl_2 has sp^3-hybridisation and has tetrahedral geometry.
- NO is paramagnetic in nature.
- NO_2^- is diamagnetic in nature.
- I_3^- has sp^3d-hybridisation and has linear geometry.

63. (c)
The correct match is A-III, B-IV, C-I, D-II.

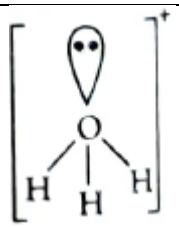
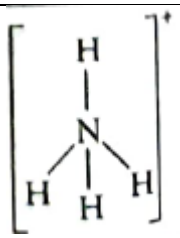
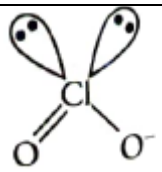
Hybridisation	Orientation
$sp^3 \rightarrow$	Tetrahedral
$dsp^2 \rightarrow$	Square planar
$sp^3d \rightarrow$	Trigonal bipyramidal
$sp^3d^2 \rightarrow$	Octahedral

64. (a)
The correct match is A-IV, B-I, C-II, D-III.
ICl = Linear



65. (d)

The correct match is A-III, B-II, C-I, D-IV.

Molecules	Hybridisation	Shape	Structure
A. H_3O^+	sp^3	Pyramidal (III)	
B. Acetylide anion	sp	Linear (II)	
C. NH_4^+	sp^3	Tetrahedral (I)	
D. ClO_2^-	sp^3	Bent (IV)	

66. (a)

Antibonding molecular orbital (ABMO) are formed by destructive interference of wave function.

(AMBO)$\sigma^* = \Psi_A - \Psi_B$

67. (a)

Statements given in A, D and E are correct while Statement given in B and C are incorrect. Their correct form are as follows

- Intramolecular hydrogen bonding is present in *o*-nitrophenol.
- Intermolecular hydrogen bonding is present in HF.

SECTION-II

1. (0)

Molecular orbital configuration of O_2^{2-} is :

$$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2$$

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

Total unpaired electron in O_2^{2-} is zero.

2. (0)

Bond order of CO = 3;

Due to isoelectronic species, bond order of NO^+ = 3

Difference $= 0 = \frac{x}{2} \Rightarrow x = 0$

3. (15)

Bond order $= \frac{\text{No. of } e^- \text{s in BMO} - \text{No. of } e^- \text{s in ABMO}}{2} = 2.5$

$\Rightarrow$ No. of e^-s in BMO – No. of e^-s in AMBO = 5

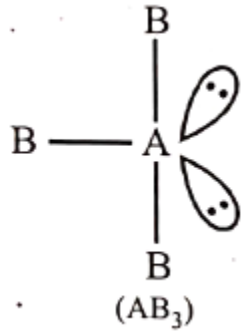
As AX is diatomic molecule (neutral), the only possible case is NO.

Total number of electrons = 15

Note : Total number of electrons equal to 13 will also have the 2.5 bond order. But in this case neutral diatomic molecule will not be possible.

4. (2)

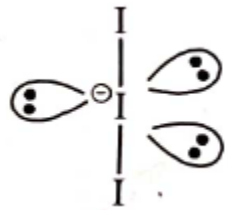
T-shaped molecule means central atom has 3 sigma bond and 2 lone pairs of electron.



(AB_3)

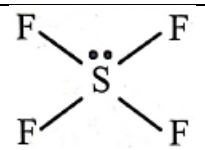
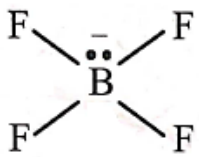
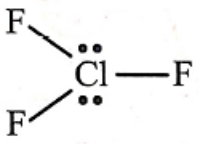
5. (3)

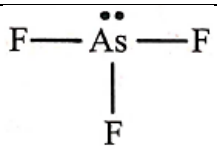
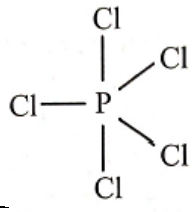
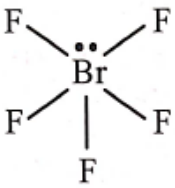
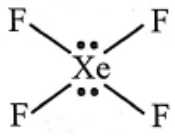
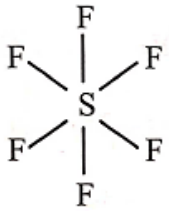
I_3^- : It is sp^3d hybridised.



The number of lone pairs of electron on the central atom is 3.

6. (2)

Species	Structure	Lone Pair
SF_4		1
BF_4^-		0
ClF_3		2

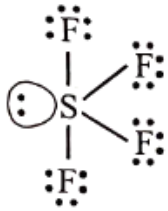
AsF_3		1
PCl_5		0
BrF_5		1
XeF_4		2
SF_6		0

7. (1)
S.N. = [5 B.P. + 0 L.P.)
$PF_5 \Rightarrow sp^3d$ hybridization

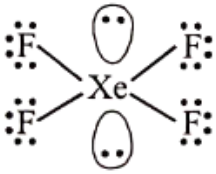
8. (4)
The molecular orbital configuration of B_2 is : $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x)^1 (\pi 2p_y)^1$
The molecular orbital configuration of C_2^+ is : $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\sigma 2p_z)^1$
The molecular orbital configuration O_2^+ is :
$(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\pi^* 2p_x)^1$
The molecular orbital configuration of He_2^+ is : $(\sigma 1s)^2 (\sigma^* 1s)^1$
Hence, B_2, C_2^-, O_2^+ and He_2^+ are paramagnetic species.

9. (3)
CN^-, NO^+ and O_2^{2+} all have bond order 3.

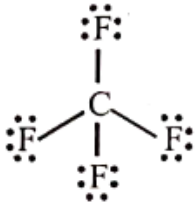
10. (1)
The electron pairs which do not take part in bonding and resides on atom are resides on atom are called lone pair.



Total lone pairs = 13



Total lone pairs = 14



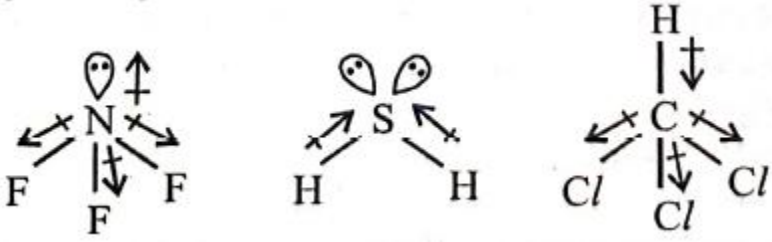
Total lone pairs = 12

Total lone pairs = 2

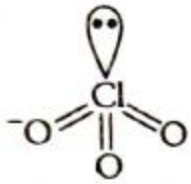
11. (3)

Symmetrical molecules have zero dipole moment like BF_3, BeF_2, SiF_4, CCl_4 and PF_5.

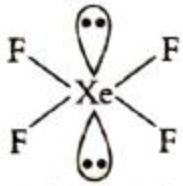
Unsymmetrical molecules have net dipole moment like NF_3, $CHCl_3$ and H_2S



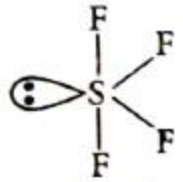
12. (3)



(1 lone pair)



(2 lone pairs)



(1 lone pair)

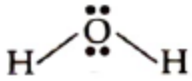
(3 lone pairs)

Among the given species I_3^- contains maximum number of unpaired electrons on its central atom i.e. 3.

13. (4)

In water (H_2O) molecule, oxygen is bonded to two hydrogen atoms. Total number of valence electrons present in oxygen atom is 6. It shares one electron with each hydrogen atom to form two single bonds.

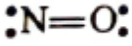
Since, four valence electrons do not participate in any bond formation, there are two lone pairs in water molecule.



In CO, each carbon and oxygen atom contains one lone pair of electrons.

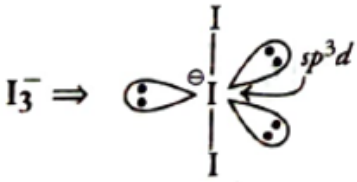
The nitrogen atoms are bonded with triple bonds. So, each of them have a lone pair of electron. Hence, total number of lone pair is 2.

In nitric oxide (NO). Total number of lone pair is 2.

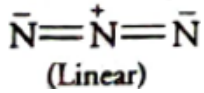


14. (3)

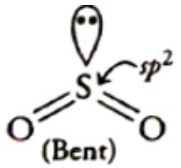
N_3^- and I_3^- are linear whereas NO_2^-, O_3 and SO_2 are bent



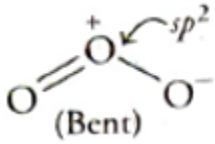
Also, N_3^- structure is linear and has *sp*-hybidisation.



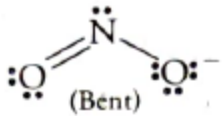
SO_2 is bent in shape.



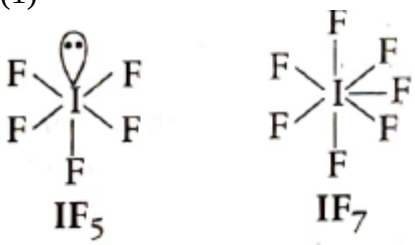
O_3 is bent in shape.



NO_2^-, that is nitrite ion, the N-atom have sp^2-hybridisation, thus it adopts bent geometry.



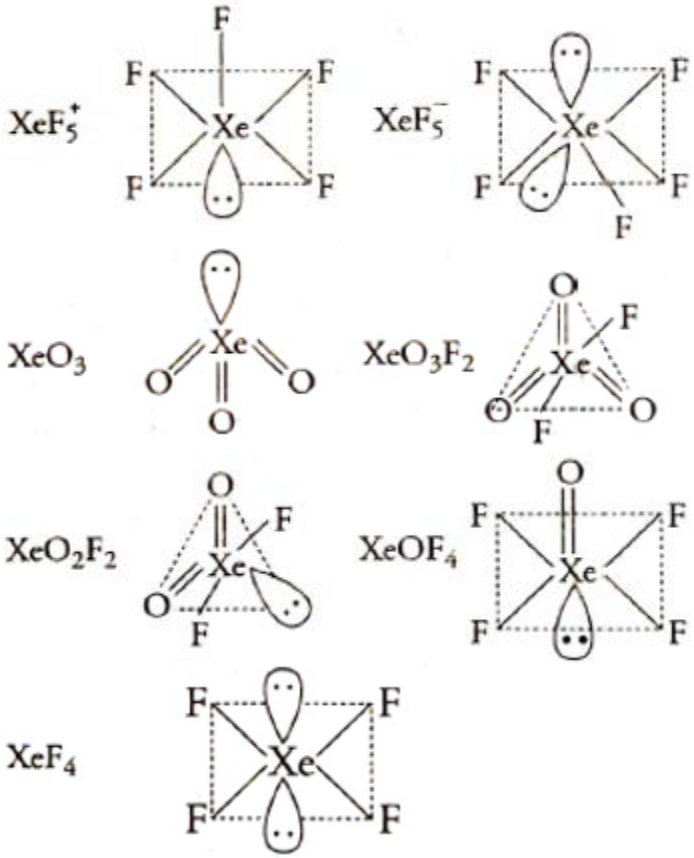
15. (1)



Lone pairs present on the central atom of interhalogen, IF_5 is one and IF_7 is zero.

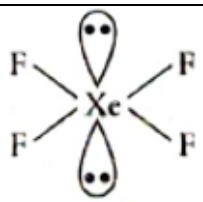
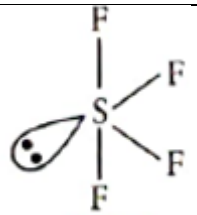
So, sum of lone pairs present on the central atom of the interhalogen IF_5 and IF_7 is (1 + 0) equal to one.

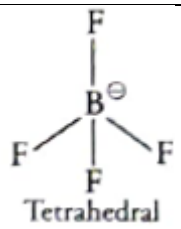
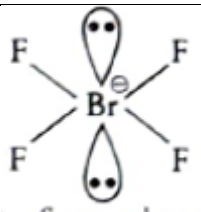
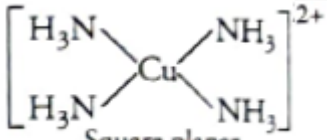
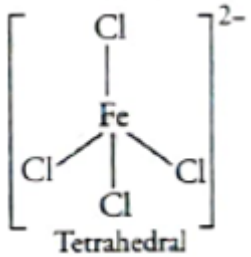
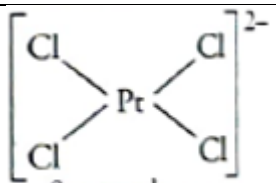
16. (4)



Thus, XeF_5^+, XeO_3, XeO_2F_2 and $XeOF_4$ have single lone pair on central atom.

17. (4)

Species	Hybridisation	Structure
XeF_4	sp^3d^2	 Square planar
SF_4	sp^3d	 *see-saw*
SiF_4	sp^3	 Tetrahedral

BF_4^-	sp^3	 Tetrahedral
BrF_4^-	dsp^2	 Square planar
$\left[Cu(NH_3)_4\right]^{2+}$	dsp^2	 Square planar
$\left[FeCl_4\right]^{2-}$	sp^3	 Tetrahedral
$\left[PtCl_4\right]^{2-}$	dsp^2	 Square planar

So, total 4 species have square planar shape.

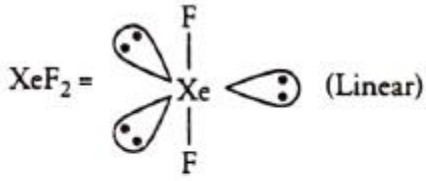
18. (3)

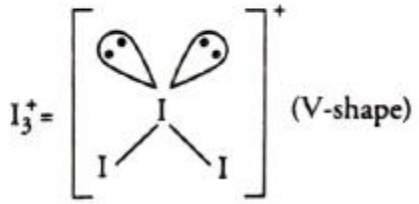
PF_5	sp^3d	Trigonal pyramidal
BrF_4^-	sp^3d^2	Square planar
IF_5	sp^3d^2	Square pyramidal
BrF_5	sp^3d^2	Square pyramidal
$XeOF_4$	sp^3d^2	Square pyramidal
ICl_4^-	sp^3d^2	Square planar

In above molecules, 3 molecules (IF_5, BrF_5, $XeOF_4$) have square pyramidal structure.

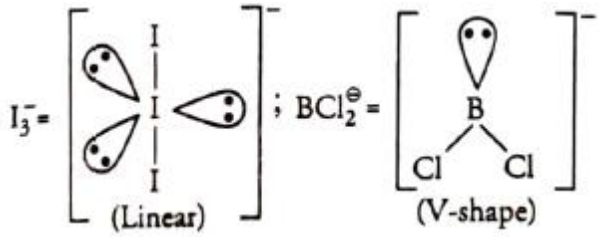
19. (5)

Among the given molecule only five i.e. $XeF_2, C_3O_2, I_3^-, CO_2, BeCl_2$ have linear structure.





$C_3O_2 \Rightarrow O = C = C = C = O$ (Linear)

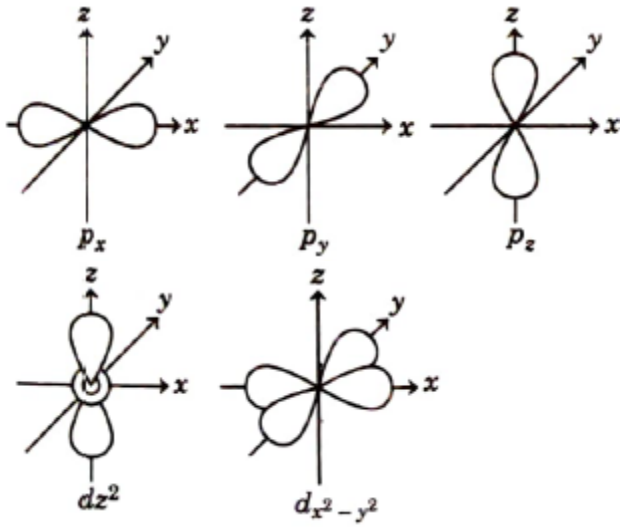


$CO_2 \Rightarrow O = C = O$ (Linear)

$BeCl_2 = Cl - Be - Cl$ (Linear)

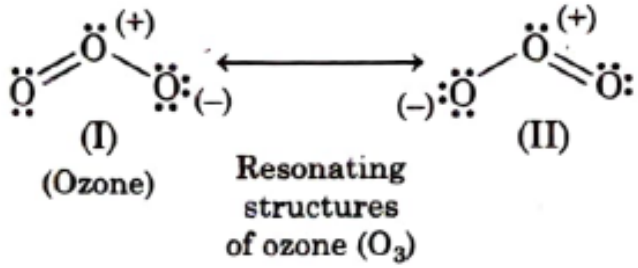
20. (5)

p_x, p_y, p_z, p_{z^2} and $d_{x^2-y^2}$ orbitals have electron density along the axes.



d_{xy} and d_{yz} have electron density between the axes (on the plane).

21. (6)



Ozone has 6 lone pair of electrons.

22. (6)

NO_2, H_2SO_4, BF_3, ClO_2, PCl_5, BeF_2. These are exception of octet rule.

Hence, among the given molecules total 6 molecule are exception of octet rule.

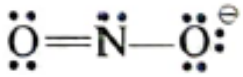
23. (6)

Among the given, H_2, CO_2, BF_3, CH_4, SiF_4, BeF_2 are symmetrical molecules.

Hence, total 6 molecules will show zero dipole moment.

24. (8)

The Lewis dot structure of NO_2^- is



Number of valence e^- around N-atom = 8.

25. (5)

Polar molecules have non-zero dipole moments while non-polar molecules have zero dipole moments. Thus, among the given species/compounds NF_3, H_2O, H_2S, HBr and HCl will have non-zero dipole moment.

26. (3)

Molecule with net zero dipole moment are CO_2, CH_4 and BF_3 i.e. 3

Remaining all molecules have non-zero dipole moment.

27. (4)

The number of non-polar molecules are 4. These are CO_2, H_2, CH_4 and BF_3.

Remaining all compound are polar molecules.

HF, H_2O, SO_2, NH_3, $CHCl_3$, HCl.

28. (6)

Among the given species, total 6 species have sp^2 hybrid orbital for bonding with central atoms.

These are SO_2, C_2H_4, BCl_3, HCHO, C_6H_6, BF_3

29. (3)

Molecules / Ions	**Shapes**
PF_5, PCl_5, $Fe(CO)_5$	Trigonal bipyramidal
BrF_5	Square pyramidal

$[PrCl_4]^{2-}$	Square planar
BF_3	Trigonal planar

Hence, total 3 molecules have trigonal bipyramidal shape.

30. (4)

The number of species that uses sp^3 hybrid orbitals in bonding are 4 i.e., H_2O, NH_3, SiO_2, CH_4.

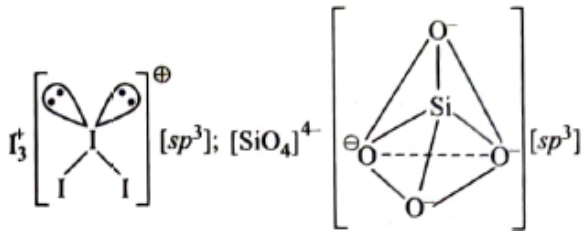
While other species uses sp^2 and *sp*-hybrid orbitals which are as follows.

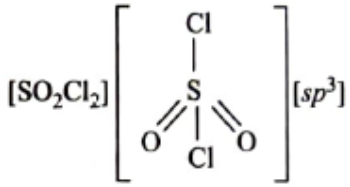
$sp^2 - SO_2, BCl_3$

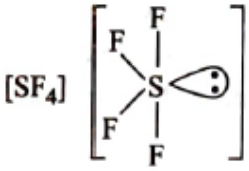
$sp - BeCl_2, CO_2$

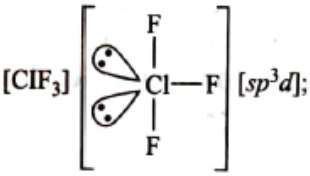
31. (5)

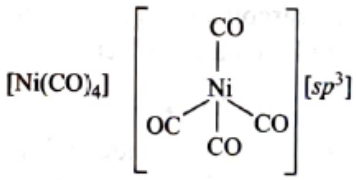
The structures of given species among with their hybridisation is given below

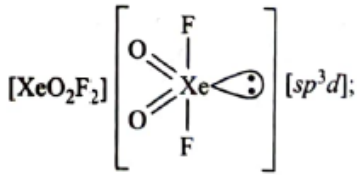


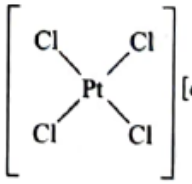




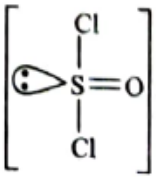






$[PtCl_4]^{2-}$  $[dsp^2]$

$[XeF_4]$  $[sp^3d^2]$;

$[SOCl_2]$  $[sp^3]$

Thus, $I_3^+, [SiO_4]^{4-}$, SO_2Cl_2, $Ni(CO)_4$ and $SOCl_2$ have sp^3-hybridised central atom.

32. (6)

The electronic configuration of $O_2(16e^-)$ is

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2$

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

So, number of e^- in π^* of $O_2 = 2$

Number of e^- in π^* of $O_2^+ = 1$

Number of e^- in π^* of $O_2^- = 3$

So, total number of e^- in $\pi^* = 2+1+3 = 6$

33. (4)

Species	Unpaired electrons
N_2	0
O_2	2
C_2^-	1
O_2^-	1
O_2^{2-}	0
H_2^+	1
CN^-	0
He_2^+	1

So, one unpaired electron is present in C_2^-, O_2^-, H_2^+ and He_2^+.

34. (2)

Formula for Bond order (B.O) $= \frac{N_B - N_A}{2}$

Where, N_B = Number of electron in bonding orbital.

N_A = Number of electron in antibonding orbital.

For C_2

$$B.O. = \frac{8-4}{2} = 2$$

For O_2

$$B.O, = \frac{10-6}{2} = 2$$

For Be_2

$$B.O. = \frac{4-4}{2} = 0$$

For Li_2

$$B.O. = \frac{4-2}{2} = 1$$

For Ne_2

$$B.O. = \frac{4-2}{2} = 1$$

For N_2

$$B.O. = \frac{10-4}{2} = 3$$

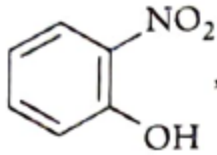
For He_2

$$B.O. = \frac{2-2}{2} = 0$$

Hence, total 2 molecules have bond order of 2.

35. (5)

Among the given compounds, the given below compounds exhibit hydrogen bonding,

CH_3OH, H_2O, 

, HF, NH_3

Hence, total 5 compounds are there.

36. (2)

According to molecular orbital theory, number of unpaired electrons in the given molecules / species as follows

O_2 = Number of unpaired electrons is 2

O_2^{-1} = Number of unpaired electron is 1

NO = Number of unpaired electron is 1

CN^{-1} = Number of unpaired electron is zero

O_2^{2-} = Number of unpaired electron is zero

37. (8)

Molecular orbital formed by 2*s* atomic orbital $= 2(\sigma 2s \text{ and } \sigma^* 2s)$

Molecular orbital formed by 2*p* atomic orbital

$= 6(\sigma 2p_z \text{ and } \sigma^* 2p_z, \pi 2p_x \; \pi 2p_y \text{ and } \pi^* 2p_x, \pi^* 2p_y)$

So, total molecular orbitals = 2 + 6 = 8

38. (4)

Antibonding molecular orbital from 2*s* = 1

Antibonding molecular orbital from 2*p* = 3

Therefore, total number of antibonding molecular orbitals are = 1 + 3 = 4

39. (1)

Ion/molecule	**Magnetic behaviour**	**Bond order**
H_2	Diamagnetic	1
He_2^+	Paramagnetic	0.5
N_2^{2-}	Paramagnetic	2
O_2^{2-}	Diamagnetic	1
O_2^+	Paramagnetic	2.5
F_2	Diamagnetic	1
Ne_2^+	Paramagnetic	0.5
B_2	Paramagnetic	1

Only B_2 has paramagnetic magnetic behaviour and bond order of 1.

40. (6)

NO^+ and CO both are isoelectronic species and each of them is having bond order 3.

$\therefore$ Sum of bond order of NO^+ and CO = Bond order (NO^+) + Bond order (CO) = 3 + 3 = 6

EXERCISE - 2 [A]

1. (b)
4 B.P and Zero L.P is SiF_4.

2. (d)
ICl_2^+ has 2 B.P and 2 L.P.
sp^3 hybridization and bent shape.

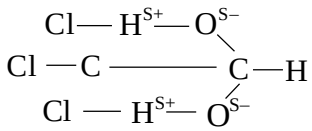
3. (c)
sp^2 hybridization and trigonal planar geometry.

4. (d)
$I_3^- : 3,\ XeF_4 : 2,\ SF_4 : 1, ClO_3^- : 1$

5. (c)
ClO_4^- : 4 B.P + Zero L.P Sp^3 hybridization.

6. (d)
n of $\sigma_{2s} > n$ of σ_{1s}^*

7. (a)



8. (b)
Bond order of $O_2^{2-} = 1$; $O_2 = 2$
$O_2^- = 1.5$; $O_2^+ = 2.5$
Hence, Stability $O_2^+ > O_2 > O_2^- > O_2^{2-}$

9. (b)
CH_3 free radical is formed which is sp^2 hybridized.

10. (b)
Both BN & O_2^{2-} are diamagnetic

11. (c)

	N_2	N_2^+	O_2	O_2^+	NO	NO^+
B.O.	3	2.5	2	2.5	2.5	3

Bond dissociation energy : $N_2 > N_2^+$
$O_2^+ > O_2$
Bond length : $N_2^+ > N_2$
$NO > NO^+$

12. (c)

$KHF_2 = K^+[HF_2]^-$

13. (d)

$PO_4^{3-} : sp^3$

$ICl_4^- : sp^3d^2$

$SO_3 : sp^2$

$NO_3^- : sp^2$

$SO_4^{2-} : sp^3$

14. (d)

As O.N. $\uparrow$ acidic strength increases.

15. (b)

$CO_2 : sp$

$SO_2 : sp^2$

$N_2O : sp$

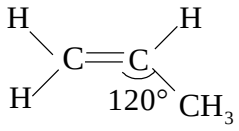
16. (a)

	CN^-	O_2^-	NO^+	CN^+
B.O.	3	1.5	3	2

17. (b)

$NO_2^+ \Rightarrow sp$; $NO_3^- \Rightarrow sp^2$; $NH_4^+ \Rightarrow sp^3$

18. (c)

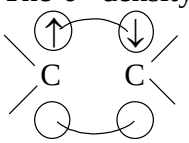


19. (a)

All are 14 e^- with B.O = 3.

20. (a)

The e^- density lies above and below the inter-nuclear / molecular axis.



21. (b)

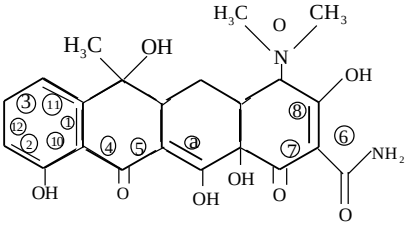
$CH_3C \equiv CCH_3$ is non polar.

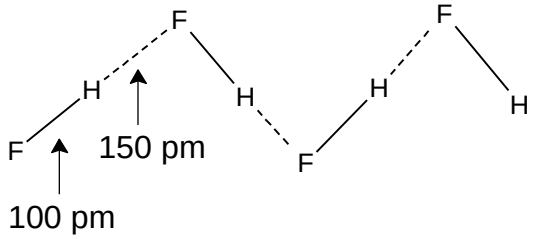
22. (c)

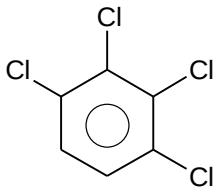
$O_2^- : \sigma_{1s^2}\sigma^*_{1s^2}\sigma_{2s^2}\sigma^*_{2s^2}\sigma_{2p_z^2}\left\{\pi_{2p_x^2} = \pi_{2p_y^2}\right\}\left\{\pi^*_{2p_x^2} = \pi^*_{2p_y^1}\right\}$

23. (b)
More the number of H – atoms, more is the H – Bonding hence, Due to higher intermolecular forces of attraction, higher is the melting point.

24. (a)
Lead Oxide PbO_2.

25. (d)


26. (c)
It is Zig Zag structure.


27. (c)

Dipole Moment of

$= \sqrt{3} \times 1.5\ \text{D} \quad \left(\sqrt{p_1^2 + p_2^2 + 2p_1p_2\cos 60^0}\right)$

$= 2.6\ \text{D.} \qquad P_1 = P_2.$

28. (d)
O – H bond is more polar than N – H bond. & SO + on H is more in O – H bond.
Also N is better donor than O .

29. (c)
MX_3
$\mu_{net} = 0$
Trigonal planar
sp^2

30. (a)
CO CN^-
$14e^-$ $14e^-$

31. (a)

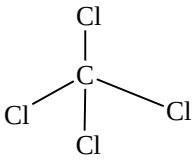
CO_2

O = C = O (linear sp)

32. (b)

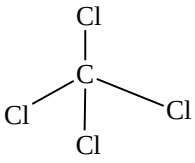
CCl_4

$\mu_{net} = 0$



33. (b)

$\mu_{net} = 0$



34. (d)

H – Cl

In F, N, O, H-bond are formed.

35. (a)

NO : $\sigma_{1s^2}\sigma^*_{1s^2}\sigma_{2s^2}\ \sigma^*_{2s^2}$

$\sigma_{2p_z^2}\left\{\begin{matrix}\pi_{2p_{x^2}}\\ \pi_{2p_{y^2}}\end{matrix}\right\}\cdot\left[\begin{matrix}\pi^*_{2p_{x^1}}\\ \pi^*_{2p_{y^0}}\end{matrix}\right]$

36. (c)

For strongest H-bond, H should be attached to F with covalent bond.

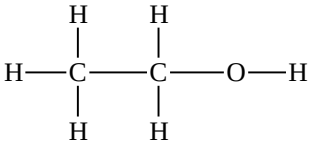
37. (c)

SO_2

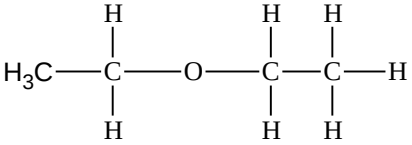
$\left.\begin{matrix}1\ell.\text{p}\\ 2\sigma\text{ bond}\end{matrix}\right\}\text{sp}^2$

38. (a)

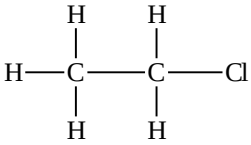
C_2H_5OH



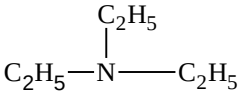
$C_2H_5OC_2H_5$



C_2H_5Cl



$(C_2H_5)_3N$



39. (c)

CH_3^+

$\left.\begin{matrix} 3\sigma \text{ bond} \\ 0\ \ell\ P \end{matrix}\right] sp^2$

40. (a)

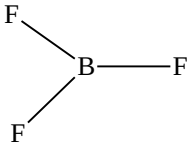
CO_2

O = C = O

sp

41. (b)

BF_3

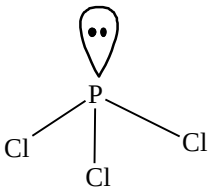


$\mu_{net} = 0$

42. (a)

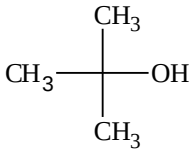
PCl_3

$\left.\begin{matrix} 1\ell.p \\ 3\sigma \text{ bond} \end{matrix}\right\} sp^3$



43. (c)

$(CH_3)_3COH$



4σ bond

$0\ \ell.p$

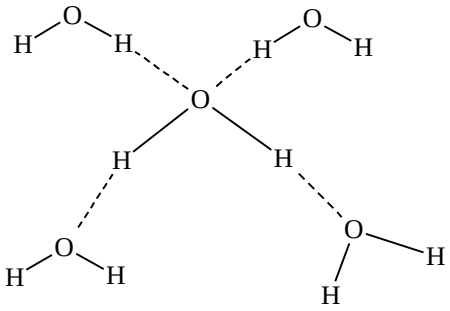
sp^3

44. (a)

ClO_2^-

$\left.\begin{matrix}2\sigma \text{ bond}\\ 2\ell.p\end{matrix}\right\} sp^3$

45. (b)



4 hydrogen bond per molecule

46. (c)

P_2O_5

Oxide of non-metal (covalent)

Ionic $MnO > Mn_2O_7$

+2 +7

47. (d)

$O_2^- : \sigma_{1s^2}\sigma^*_{1s^2}\sigma_{2s^2}\sigma^*_{2s^2}\sigma_{2p_z^2}\left\{\pi_{2p_x^2}=\pi_{2p_y^2}\right\}\left\{\pi^*_{2p_x^1}=\pi^*_{2p_y^1}\right\}$

No. of paired O = 14

48. (c)

$\underbrace{NF_3 \quad H_3O^+}_{sp^3}$ $\underbrace{NO_3^- \quad BF_3}_{sp^2}$

S: trigonal pyramidal S: trigonal planar

49. (b)

CaC_2

$Ca^{2+}\ C_2^{2-}$

B.O. = 3

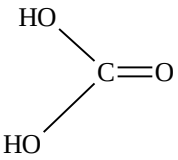
$^-C \equiv C^-$ and 1σ and 2π

50. (c)

KO_2	AlO_2^-	BaO_2	NO_2^+
$K^+O_2^-$	$Al^{3+}O_2^{4-}$	$Ba^{2+}\ O_2^{2-}$	Dia
Dia para	Dia dia	Dia Dia	
Para	Dia	dia	

51. (a)

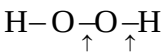
H_2CO_3



sp^2

$\mu_{net} \neq 0$

52. (c)



Non polar

Polar

53. (d)

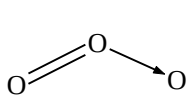
O_2	H_2O
Non-polar	polar

54. (b)

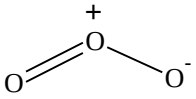
SO_2

1 lone pair
2σ bond
sp^2

55. (a)



Or



56. (c)

LiCl

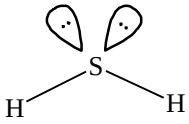
Li^+ small size polarisation $\uparrow$ Covalent character $\uparrow$

57. (d)

	CO	CO_3^{2-}	CO_2
Bond order	3	$\frac{4}{3}=1.33$	2

Bond length $CO_2^{3-} > CO_2 > CO$

58. (a)



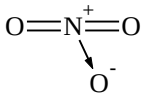
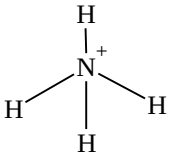
$\mu_{net} \neq 0$

Polar

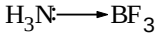
59. (d)

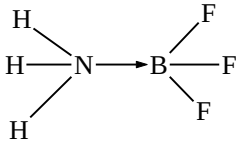
SF_4	CF_4	XeF_4
4σ	4σ	4σ
$1\ell.p$	$0\ell.p$	$2\ell.p$
sp^3d	sp^3	sp^3d^2
see-saw	tetrahedral	octahedral

60. (b)

NO_2^+	NO_3^-	NH_4^+
		
$O = N^+ = O$		
sp	sp^2	sp^3

61. (a)





4σ	4σ
$0\ \ell.p$	$0\ \ell.p$
sp^3	sp^3

Tetrahedral

62. (c)

$$O_2^- : \sigma_{1s^2}\sigma^*_{1s^2}\sigma_{2s^2}\sigma^*_{2s^2}\sigma_{2p_z^2}\left\{\pi_{2p_x^2} = \pi_{2p_y^2}\right\}\left\{\pi^*_{2p_x^2} = \pi^*_{2p_y^1}\right\}$$

63. (b)

$$O_2^+ : \sigma_{1s^2}\sigma^*_{1s^2}\sigma_{2s^2}\sigma^*_{2s^2}\sigma_{2p_z^2}\left\{\pi_{2p_x^2} = \pi_{2p_y^2}\right\}\left\{\pi^*_{2p_x^1} = \pi^*_{2p_y^0}\right\}$$

Bond order $= \dfrac{6-1}{2} = 2.5$

Paramagnetic.

EXERCISE - 2 [B]

One or More Than One Option Correct

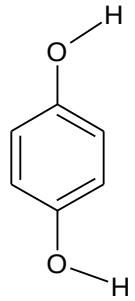
1. (a, b, c)

O_2^{2-} (Na_2O_2)	:	Diamagnetic
O_3	:	Diamagnetic
N_2O	:	Diamagnetic
O_2^- (KO_2)	:	Paramagnetic

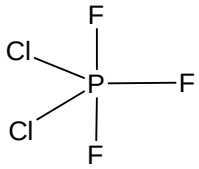
2. (b, c, d)

	CO	NO^-	NO^+	CN^-	N_2
B.O.	3	2	3	3	3

3. (a, c)

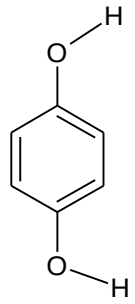


Polar

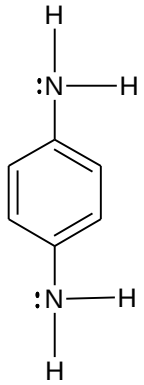


Polar

4. (b, c)



Polar

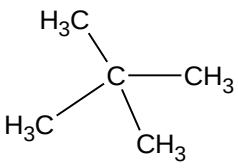


Polar

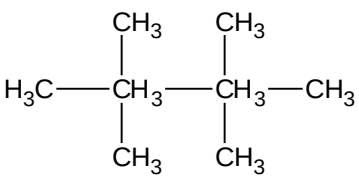
5. (a, b, c)

ICl_2^-	ClF_3	XeO_2F_2	XeF_4
sp^3d	sp^3d	sp^3d	sp^3d^2

6. (b, c)



Non-Polar



Non-Polar

7. (b, c)

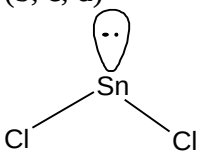
	N_2	N_2^+	N_2^-	N_2^{2-}
Bond order :	3	2.5	2.5	2

8. (a, b)

O_2	N_2^{2-}	N_2	O_2^{2-}
Paramagnetic	Paramagnetic	Diamagnetic	Diamagnetic

9. (a, b, c, d)
All have lone pair of electrons. Therefore geometry is distorted.

10. (b, c, d)



sp^2

NCO^-	NO_2^+	CS_2
sp	*sp*	*sp*

11. (a, d)
sp^3 tetrahedral
sp^3d trigonal bipyramidal

12. (a, c)
Bond strength : $\sigma > \pi$
$\equiv \; > \; =$

13. (a, c, d)

$HgCl_2$	ClF_3	ICl_4^-
Linear	T-shaped	square planar

14. (a, b)

PCl_5	PCl_4^+	PCl_6^-
sp^3d	sp^3	sp^3d^2

AlH_3	$Li^+[AlH_4]^-$
sp^2	sp^3

NH_3	NH_4^+
sp^3	sp^3

H_3PO_2	H_3PO_3	PH_3
sp^3	sp^3	sp^3

15. (a, c)
Cl – Hg – Cl ; H – C ≡ C – H

16. (b, c, d)
S = C = S ; $O = \overset{+}{N} = O$

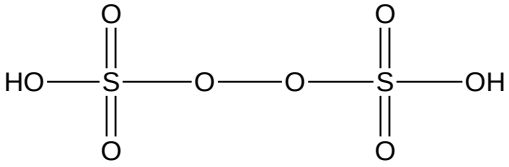
17. (a, c)
CN^- and NO^+ has B.O = 3.

18. (a, c, d)
B_2H_6 & $Al_2(CH_3)_6$ have 3 carbon & 2 electron bond.
Al_2Cl_6 has 3 carbon & 4 electron bond
Acidic strength : $BCl_3 > AlCl_3$

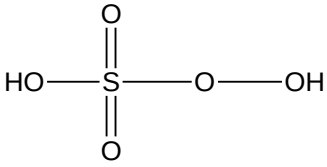
19. (b, d)
H_3O^+, NH_3 and $CH_3^{\odot}$ have Sp^3 hybridization.

20. (b)
BF_3
sp^2 (trigonal planar)

21. (a, c)



$H_2S_2O_8$



H_2SO_5

22. (b, d)

CN^-	NO	O_2^{2-}	O_2
Diamagnetic	Paramagnetic	Diamagnetic	Paramagnetic

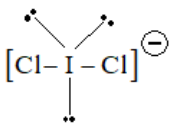
23. (a, b, c, d)
More electronegative element in each case, i.e. O and F occupy axial position in I & II respectively.

24. (b, c, d)
Ionic bonds are non directional bonds.
Ionic compounds have high melting point. They have high solubility in polar solvent.

25. (a, b, d)
NH_4^+ has one coordinate bond.
Bond strength : $\sigma > H$
Polarity : HF > HCl

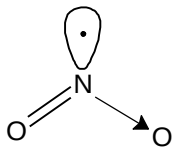
26. (a, b, c)
HF and H_2O have abnormally high B.pt due to H – Bonds

27. (a, c, d)

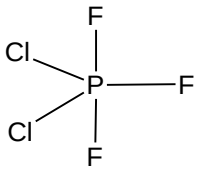


$Cl - Hg - Cl$; ; S = C = S

28. (b, d)



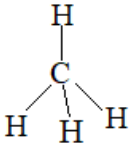
Polar



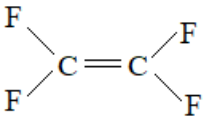
Polar

29. (d)
Hydrogen can form 1 bond with itself or with other elements to give 1 σ bond.

30. (a, b, c)



; $F-C \equiv C-F$;



31. (a, b, c, d)
In all intermolecular hydrogen bonding take place.

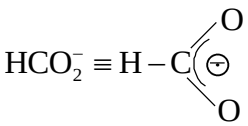
32. (b, c)
$SF_4 \Rightarrow$ 4 B.P + 1 L.P

$PF_5 \Rightarrow 5$ B.P + Zero L.P .

33. (a, c)
SF_6 is octahedral in shape.
It has 12 electrons in valence shell of S but Ar has 8 electrons.

34. (a, c, d)
Only O_2 and B_2 are paramagnetic.
Bond length : $NO > NO^+$
Bond length : $CO > CO^+$

35. (c, d)

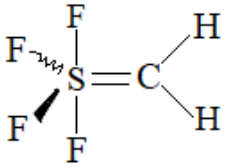


B.O of $HCO_2^- (1.5) >$ B.O of $CO_3^{2-} (1.33)$

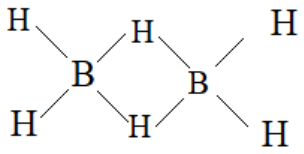
[formate ion] [Carbonate ion]

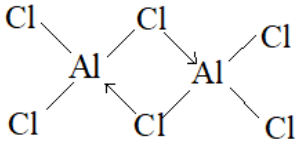
$\therefore$ Bond length of $HCO_2^- <$ Bond length of CO_3^{2-}

36. (a, c)



37. (a, b)





Comprehension Type

Passage-I

1. (d)
Both F – atoms are present in axial positions.

2. (a)
ClF_3 has Sp^3d hybridization ; 3 B. P + 2 L.P

3. (d)
PI_5 and $\left[PBr_6\right]^e$ do not exist due to steric factors. In PH_5, Because of its low electronegative H-atom cannot effect the contraction of dz^2 orbital to form Sp^3 hybridized P-atom.

4. (b)
$\left[PBr_6\right]^-$ does not exist since P cannot accommodate 6 Br – atoms around it due to steric hindrance.

5. (d)
$^{30}P\left(^{35}Cl\right)_5 + {}^{30}P\left(^{37}Cl\right)_5 + {}^{31}P\left(^{35}Cl\right)_5 + {}^{31}P\left(^{37}Cl\right)_5 = 4$

(i) $^{31}P\left(^{35}Cl\right)_1\left(^{37}Cl\right)_4$ $\begin{cases} {}^{31}P\left(^{35}Cl\right)_{ax}\left(^{37}Cl\right)_{ax}\left(^{37}Cl_3\right)_{(eq)} \\ {}^{31}P\left(^{37}Cl_2\right)_{eq}\ {}^{35}Cl_{eq}\left(^{37}Cl_2\right)_{ax} \end{cases}$

= 2 forms

(ii) $^{31}P\left(^{35}Cl\right)_2\left(^{37}Cl\right)_3$ $\begin{cases} {}^{31}P_{ax}\left(^{35}Cl_2\right)_{ax}\left(^{37}Cl_3\right)_{eq} \\ {}^{31}P\left(^{35}Cl^{37}Cl\right)_{ax}\left(^{35}Cl^{37}Cl_2\right)_{eq} \\ {}^{31}P\left(^{37}Cl_2\right)_{ax}\left(^{35}Cl_2{}^{37}Cl\right)_{eq} \end{cases}$

= 3 forms

(iii) $^{31}P\left(^{35}Cl\right)_3\left(^{37}Cl\right)_2 = 3$ forms ; same as (ii)

(iv) $^{31}P\left(^{35}Cl\right)_4\left(^{37}Cl\right) = 2$ forms ; same as (ii)

Similarly with ^{30}P – atom as central Atom, 10 forms will be there. Total = 24.

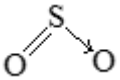
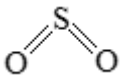
6. (c)
SF_4 has 4 G.P + 1 L. P ; Hence (C).

7. (c)
$IF_2^-\left(sp^3d\right)$ has 2B.P + 3 L.P

8. (c)
In Sp^3d hybridized, dz^2 orbital is utilized.

Passage-II

1. (a)
i) $I_3^+ : 2B.P + 2L.P; Sp^3$ hybridization

ii) SO_2 can be represented as  and  . It is considered that S being in 3rd period can utilized its d – orbitals to form pπ – dπ bonds with O atoms.

iii) XeF_2 : 3 L.P and 2 B.P $\Rightarrow Sp^3d$ hybridization.

CO_2 : Sp hybridization $\Rightarrow 2\ B.P$

iv) SF_4 : Sp^3d hybridization $\Rightarrow$ 4 B.P + 1 L.P
ICl_3 : Sp^3d hybridization $\Rightarrow$ 3 B.P + 2 L.P

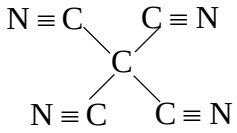
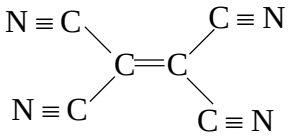
2. (c)
$I_3^- : L.P = 3;$ $B.P = 2$ Ratio $\Rightarrow 1.5$
XeF_4 : L.P = 2 ; B.P = 4 Ratio $\Rightarrow 0.5$

3. (a)
$NO_2^+ \Rightarrow linear \Rightarrow 180^0$
$NO_2 (odd\ e^-\ system) \Rightarrow bent \Rightarrow 134^0$
NO_2 (1 L.P) $\Rightarrow$ bent $\Rightarrow 115^0$

4. (c)
Bond angle $PF_3 < PCl_3 < PBr_3 < PI_3$.
Due to dπ – pπ bonds in PF_3, double bond character develops increase in B.P – B.P repulsions lead to increase is Bond Angle.

5. (d)
B.O of $O_2^+ = 2.5; O_2^- = 1.5; O_2 = 2, O_2^{+2} = 3; O_2^{2-} = 1$
Bond length $O_2^{2-} > O_2^- > O_2 > O_2^+ > O_2^{+2}$

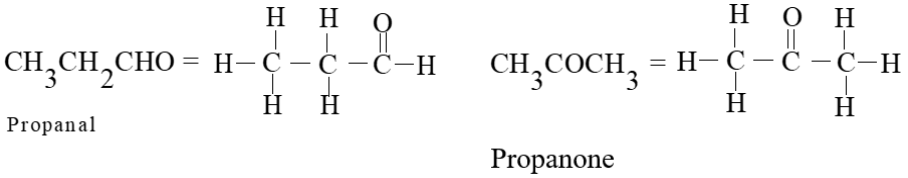
6. (d)
B.O of $N_2^+ = 2.5$
B.O of $N_2^- = 2.5;$ e^-s occupy non – bonding Molecular orbital's.
$\therefore$ bond strength of $N_2 <$ Bond strength of N_2^+

7. (c)
i)  

σ bonds = 8 σ bonds = 9

π bonds = 8 π bonds = 9

ii)



iii) XeF_4 is square planar in shape.
SF_4 has See – saw Shape.

iv) Due to smaller orbital size, effective overlapping take place in Cl – Cl bond.

Passage-III

1. (d)
Hydrogen bond is very weak compared to covalent bond.

2. (a)
In HF_2^- H bonding exists between HF and F^-.

3. (b)
H attached to more E.N. element with covalent bond forms stronger H-bond.

Passage-IV

1. (a)
$BeCl_2$ has maximum covalent character because of smallest size of cation $\left(Be^{+2}\right)$

2. (d)
I^- is the largest Anion.
It has maximum polar ability.

3. (c)
Highest positive change and smallest size of cation (Al^{+3}), hence maximum polarization and covalent character.

4. (b)
LiCl has maximum covalent character, hence it will be most soluble in non – polar solvent ether.

5. (d)
CaI_2 has maximum covalent character hence least M.pt…

Passage-V

1. (a, b)
These are planar molecules. XeF_4 has square planar shape.
XeF_4 has trigonal planar shape.

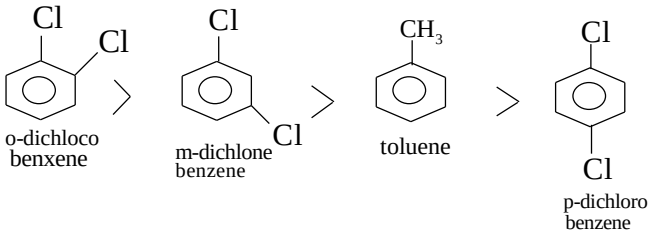
2. (c)
$p = q \times l$

$$q = \frac{p}{l} = \frac{1.2\times10^{-18}\text{ esu cm}}{10^{-8}\text{ cm}}$$

$$q = 1.2\times10^{-10}\text{ esu.}$$

Fraction of charge $= \frac{1.2\times10^{-10}}{4.8\times10^{-10}} = \frac{1}{4} = 0.25$.

3. (c)



4. (d)

5. (b)

% Ionic character $= \frac{1.5\times10^{-29}\text{ C.m}}{1.6\times10^{-19}\text{C}\times150\times10^{-12}\text{m}}\times100 = 62.5\%$

Passage-VI

1. (b)

Bond order $= \frac{6}{4} = 1.5$

2. (a)

	O_2	O_2^-	O_2^{2-}	O_3
Bond order :	2	1.5	1	1.5

Bond strength : $O_2 > O = O_3 > O_2^{2-}$

3. (a)

	$CH_3 - CH_3$	Benzene
Bond order :	1	1.5

Bond length of C–C : $CH_3 - CH_3$ > benzene

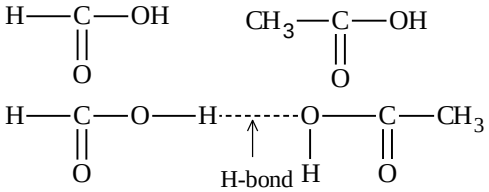
Fill in the Blanks

1. CO_2

Bond angle

CO_2	>	CH_4	>	H_2O
180^0		$109^0 28'$		104.5^0

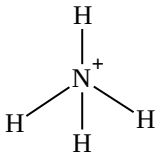
2. HCOOH and CH_3COOH



3. 2

$N \equiv N$ 1σ *and* 2π bond

4. sp^3



4σ and 0 $\ell.p$

sp^3

5. planar

CH_3^+

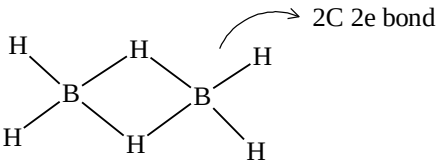
$$\left.\begin{matrix}0 \text{ lone pair} \\ 3\ \sigma \text{ bond}\end{matrix}\right] 3 \text{hybrid orbitals}$$

sp^2

G and S : trigonal planar

6. three centred two electrons bond or banana bond

B_2H_6



banana bond (3c 2e bond)

7. Increases, decreases

	N_2	N_2^+	O_2	O_2^+
Bond order	$\frac{6-0}{2}=3$	$\frac{5-0}{2}=2.5$	$\frac{6-2}{2}=2$	$\frac{6-1}{2}=2.5$

B.l. $N_2^+ > N_2$ and $O_2 > O_2^+$

8. N_2O, I_3^-

N_2O SO_2 I_3^+ I_3^-

$N \equiv N \rightarrow O$

2σ bond $2\ell.p$ $3\ell.p.$

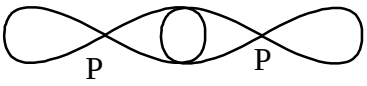
0 *l.p.* 1 *l.p* 2σ bond 2σ bond

sp sp^2 sp^3 sp^3d

linear V. bent linear

True / False

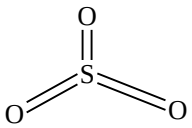
1. True



σ bond

2. False

CO_2 and SO_3



$O = C = O$ $\mu_{net} = 0$

$\mu_{net} = 0$

3. True

$SnCl_2$

$2\ \sigma$ bond, $1\ \ell.p$ $\}$ sp^2

S : v- bent

4. False

C_6H_6

sp^2

5. False

sp^3

% s character = $\frac{1}{4} \times 100 = 25$

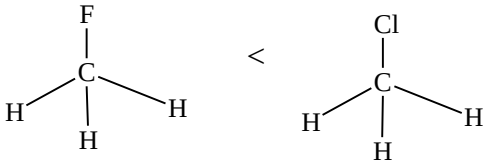
% p character = $\frac{3}{4} \times 100 = 75$

6. False

CO_2 and SO_3

$\mu_{net} = 0$ $\mu_{net} = 0$

7. False



$\mu = q \times d$

Matrix Match

1. A → q, r ; B → q, s; C → p, r; D → q, r

	B_2^{2-}	C_2^{2-}	O_2	N_2^{2+}
Bond order :	2	3	2	2
	Diamagnetic	Diamagnetic	Paramagnetic	Diamagnetic

2. A → s; B → q; C → p, s; D → p, r, s

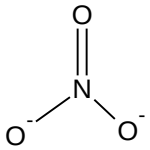
XeF_2	BH_4^-	$XeOF_4$	PF_3Cl_2
180°	109°28'	90° & 180°	90°, 120°, 180°

3. A → p, r; B → q, s; C → q, r; D → p, s

XeO_2F_2	$XeOF_4$	XeF_4	PCl_5
sp^3d	sp^3d^2	sp^3d^2	sp^3d
$(4\sigma \& 1\ell.p.)$	$(5\sigma \& 1\ell.p.)$	$(4\sigma \& 2\ell.p.)$	$(5\sigma \& 0\ell.p.)$

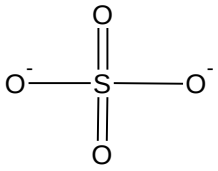
4. A → r; B → p, q, s; C → q, s; D → p, q, s

CO_3^{2-}



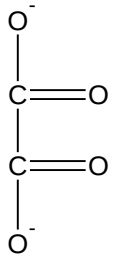
3σ & 1π

SO_4^{2-}



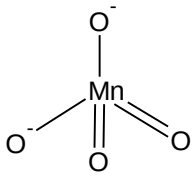
4σ & 2π

$C_2O_4^{2-}$



2π & 5σ

MnO_4^{2-}

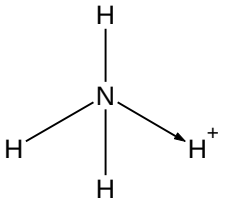


4σ & 2π

5. A → p, q, r, s; B → p, r, s; C → q; D → p

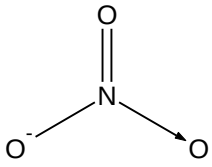
CS_2	XeF_2	C_2H_2	NCO^-
Linear	Linear	Linear	Linear
sp	sp^3d	sp	sp

6. A → p, q; B → p, q, s; C → p, r, s; D → r



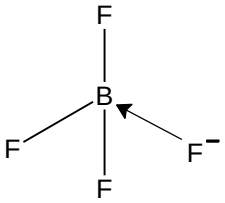
sp^3

tetrahedral



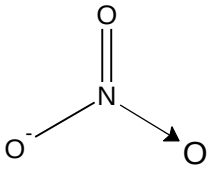
sp^2

planar



sp^3

tetrahedral



sp^2

planar

7. A → p, r, t; B → s, t; C → p, q; D → p, q, s

	B_2	N_2	O_2^-	O_2
Bond order :	1	3	1.5	2
	Paramagnetic	Diamagnetic	Paramagnetic	Paramagnetic

In B_2 & N_2, mixing of *s* & *p* orbitals take place.

$B_2 + e^- \rightarrow B_2^-$ Reduction

B.O. 1 1.5

$O_2^- \rightarrow O_2 + e^-$ Oxidation

B.O. 1.5 2

$O_2 \rightarrow O_2^+ + e^-$ Oxidation

B.O. 2 2.5

As bond order ↑ stability ↑

8. A → p, q; B → p, q, r; C → p, q, r, s; D → p, q, r, s;

A	B	C	D
PCl_3F_2	PCl_2F_3	$\underline{BF_3 \quad BCl_3}$	
sp^3d	sp^3d	sp^2	
trigonal bipyramidal	trigonal bipyramidal	trigonal planar	
non-polar	polar	non-polar	

$\underline{CO_2 \quad CN_2^{2-}}$	$\underline{C_6H_6 \quad B_3N_3H_6}$
sp	sp^2
Linear	ring & planar
Non-polar	non-polar
Isoelectronic	isoelectronic

9. A - r - w; B - q - u, C - p - v

sp^3d : d_{z^2} & trigonal bipyramidal

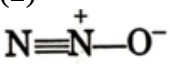
sp^3d^2 : $d_{x^2-y^2}, d_{z^2}$ & octahedral

sp^3d^3 : $d_{xy}, d_{x^2-y^2}, d_{z^2}$ & pentagonal bipyramidal

EXERCISE - 2 [C]

1. (4)

2. (2)



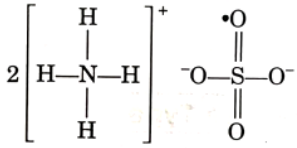
3. (8)

$SO_4^{2-} \to 2;\ NO_3^- \to 0;\ (SO_3)_3 \to 6$

4. (6)

$NH_3, PH_3, NH_2^-, PF_3, H_2O, H_2S$

5. (2)



$p\pi$-$d\pi = 2$

6. (5)

$XeF_6 \to sp^3d^2; SOF_4 \to sp^3d; NO_3^- \to sp^2; ClO_3^- \to sp^3; BrF_3 \to sp^3d; IF_4^- \to sp^3d^2;$
$COCl_2 \to sp^2; PCl_6^- \to sp^3d^2$

7. (4)

$\sigma \to 4\times4;\ \pi \to 1\times4$

8. (3)

$H_3PO_2, H_3PO_3, H_4P_2O_5$

9. (0)

None have two $p\pi$-$p\pi$ bonds.

10. (5)

$Na_2S_2O_3, Na_2S_4O_6, N_2O_4, N_2O_3$ (unsymm.), $H_2S_2O_5$

11. (2)

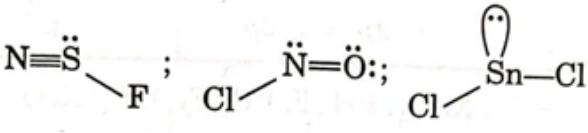
s-*p* mixing is not possible in : O_2^{2+}, O_2^+

12. (2)

PCl_5, SF_4

13. (9)

$:CF_2, :SiCl_2, SnCl_2$, NOCl, NO_2^-, O_3, SO_2, NSF, OF_2.



14. (9)

$NO_3^-, CO_3^{2-}, F_2, Cl_2, Br_2, O_2^{2-}, Li_2^+, He_2^+, O_2^-$ have B.O. < 2

15. (3524)

3	5	2	4
P	Q	R	S

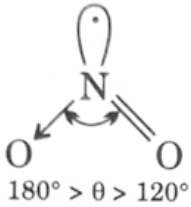
16. (3)

B_2, N_2, C_2

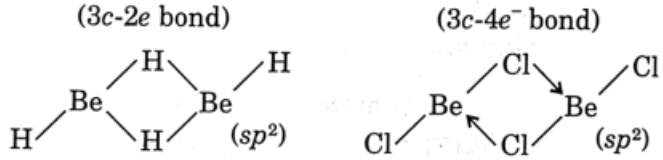
17. (8)

K = 5, 3, 0 (possible values under given condition)

18. (134)



19. (3)



20. (3)

H_2S, H_2Se, PH_3

21. (1)

BF_3 only

22. (1)

BF_3 only

23. (1)

$N(SiH_3)_3$ only

24. (4)

$Si_2H_6, C_2H_6, Si_2Cl_6, Al_2Cl_6$

Only One Option Correct

1. (a)
Molecular electronic configuration of
$CO: \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_y^2 = \pi 2p_z^2, \sigma 2p_x^2$
Therefore, bond order $= \frac{N_b - N_a}{2} = \frac{10-4}{2} = 3$
$NO^- : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_y^2 = \pi 2p_x^2, \left\{\pi^*2p_y^1 = \pi^*2p_x^1\right\}$
Bond order = $\frac{10-6}{2} = 2$
$\therefore$ NO^- has different bond order from that in CO.

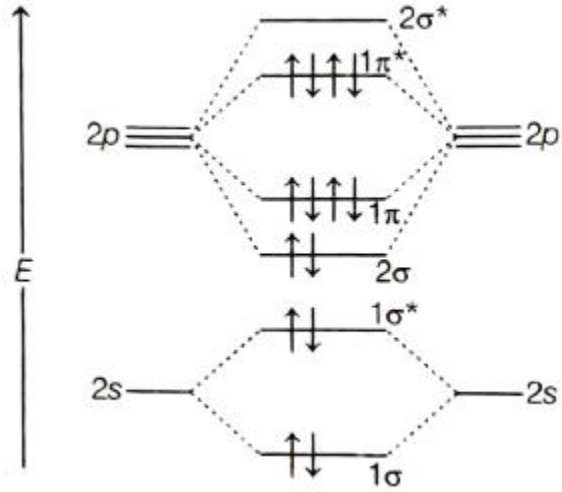
2. (d)
(a) In Na_2O_2, we have O_2^{2-} ion. Number of valence electrons of the two oxygen in O_2^{2-} ion $= 8\times 2 + 2 = 18$
Which are present as follows :
$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_y^2 = \pi 2p_x^2, \pi^*2p_y^2 = \pi^*2p_x^2$
$\therefore$ Number of unpaired electrons = 0, hence, O_2^{2-} is diamagnetic.
(b) No. of valence electrons of all atoms in $O_3 = 6\times 3 = 18$.
Thus, it also does not have any unpaired electron,
Hence, it is diatomic.
(c) No. of valence electron of all atom in N_2O = $2\times 5 + 6 = 16$.
Hence, here also all electrons are paired.
So, it is diatomic.
(d) In KO_2, were O_2^- no. of valence electron of all atoms in $O_2^- = 2\times 6 + 1 = 13$,
It has one unpaired electron, hence it is paramagnetic.

3. (a)
If Hund's rule is violated then pairing of e^- in the same molecular orbital (of same energy) can take place. Complying with Hund's rule: M.O. configuration: $\sigma 1s^2$, $\sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^1, \pi 2p_y^1$
Molecular orbital configuration of B_2 (10) violating Hund's rule: $\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_y^2$
Bond order of $B_2 = \frac{6-4}{2} = 1$, B_2 will be diamagnetic.

4. (c)
$C_2 = \sigma 1s^2 \sigma^*1s^2 \sigma 2s^2 \sigma^*2s^2 \sigma 2p_z^2\, \pi 2p_x^1\, \pi 2p_y^1$
When there is no mixing of 2*s* and 2*p* atomic orbitals, the energy of $\sigma 2p_z$ molecular orbital will be low. Thus, only C_2 will be paramagnetic.

5. (c)
Molecular orbital electronic configuration of F_2 molecule is given by
$(\sigma 1s)^2(\sigma 1s^*)^2(\sigma 2s)^2(\sigma 2s^*)^2(\sigma 2p_z)^2(\pi 2p_x)^2 = (\pi 2p_y)^2(\pi 2p_x^*)^2 = (\pi 2p_y^*)^2$

It molecular orbital diagram is given below



One or More than One Option Correct

1. (a, c)

(a) The molecular orbital energy configuration of C_2^{2-} is $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \pi_{2p_x}^2 = \pi_{2p_y}^2, \sigma_{2p_z}^2$

In the MO of C_2^{2-}, there is no unpaired electron hence, it is diamagnetic.

(b) Bond order of O_2^{2+} is 3 and O_2 is 2 therefore bond length of O_2 is greater than O_2^{2+}.

(c) The molecular orbital energy configuration of N_2^+ is $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \pi_{2p_x}^2 = \pi_{2p_y}^2, \sigma_{2p_z}^1$

Bond order of $N_2^+ = \frac{1}{2}(9-4) = 2.5$

The molecular orbital energy configuration of N_2^- is $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \pi_{2p_x}^2 = \pi_{2p_y}^2, \sigma_{2p_z}^2, \pi_{2p_x}^{*1}$

Bond order of $N_2^- = \frac{1}{2}(10-5) = 2.5$

(d) He_2^+ has less energy in comparison to two isolated He atoms because some energy is released during the formation of He_2^+ from 2 He atoms.

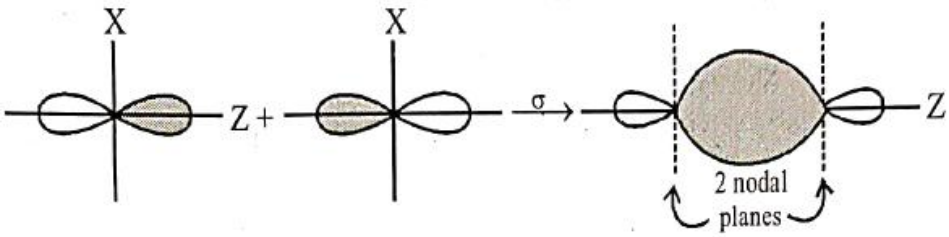
2. (b, c)

Dipole moment (μ) value of BF_3, SF_6, $BeCl_2$, CO_2, BCl_3 is zero.

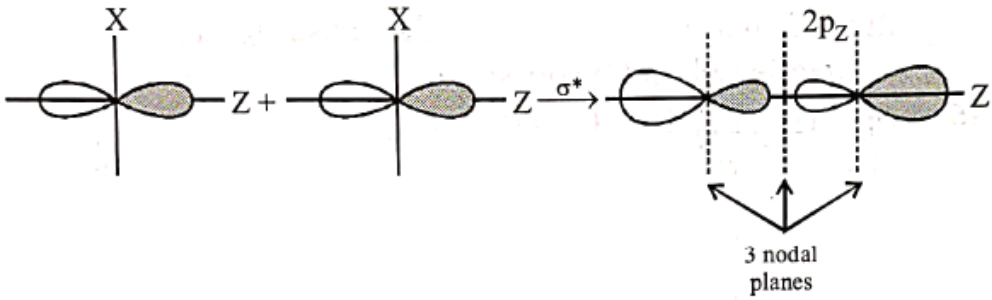
3. (a, d)

Overlap of two $2p_z$ orbitals.

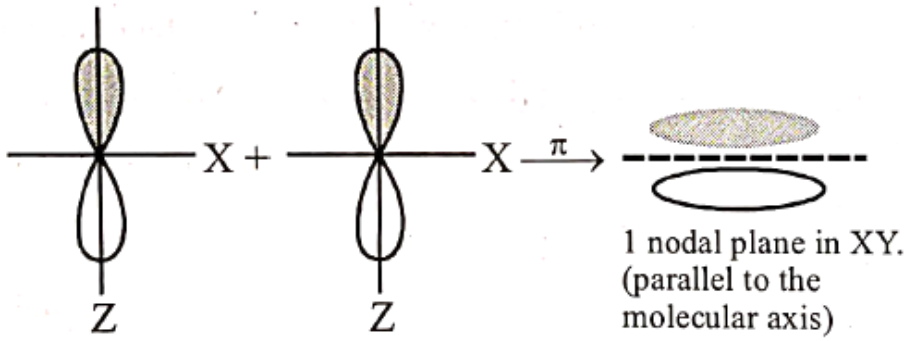
(a)



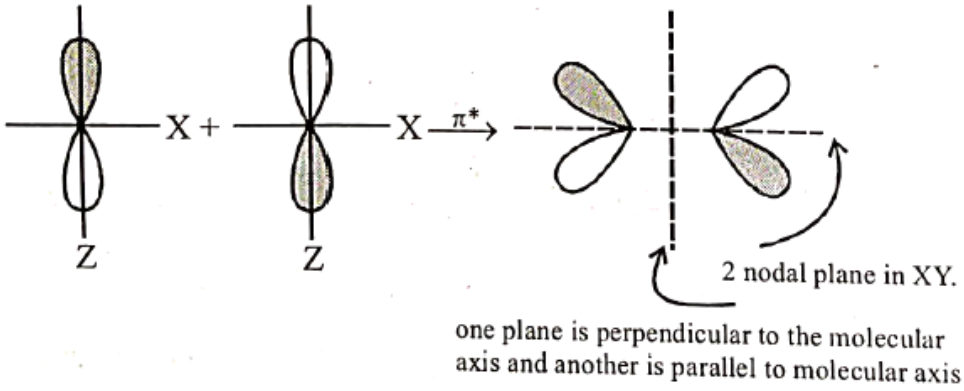
(b)



(c)



(d)



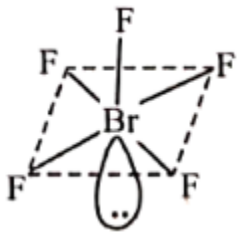
4. (a, d)

Among the given molecules only CO_2, C_2H_4, HCl and O_3 follows octet rule while NO, NO_2, BCl_3, H_2SO_4 do not follows octet rule. Thus, option with at three molecule that follow octet rule are A and D.

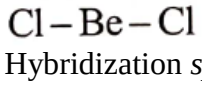
Integer Value Answer

1. (4)

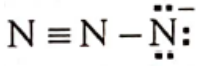
According to VSEPR theory, number of electron pairs around central atom (Br) are 6.
Five are bond pairs and one is lone pair.
Its geometry is octahedral but due to lone pair-bond pair repulsion, the four fluorine atoms at equatorial positions are forced towards the axial fluorine, atoms, thus reducing F–Br–F angle from 90° to 84.8°.
The $F_{eq} - Br - F_{eq}$ angle will remain 90°.



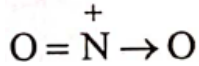
2. (4)



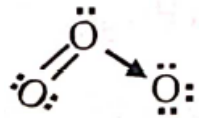
Hybridization *sp*
Structure linear



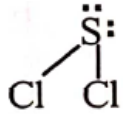
Hybridistion *sp*
Structure linear



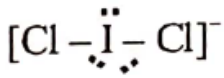
Hybridistion *sp*
Structure linear



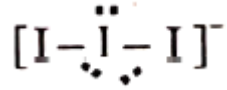
Hybridisation sp^2
Structure Trigonal planar



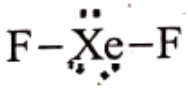
Hybridisation sp^3
Structure Angular



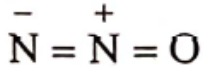
Hybridisation sp^3d
Structure Linear



Hybridisation sp^3d
Structure Linear



Hybridisation sp^3d
Structure Linear



Hybridisation *sp*
Structure Linear

Only $BeCl_2$, N_3^-, N_2O and NO_2^+ are linear with *sp*-hybridisation.

3. (6)

(H_2, Li_2, Be_2, C_2, N_2, F_2)

H_2 : $\sigma 1s^2$ (Diamagnetic)

He_2^+ : $\sigma 1s^2, \sigma^* 1s^1$ (Paramagnetic)

Li_2 : $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2$ (Diamagnetic)

Be_2 : $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$ (Diamagnetic)

B_2 : $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_y^1$ (Paramagnetic)

C_2 : $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2$ (Diamagnetic)

N_2 : $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$ (Diamagnetic)

O_2^- : $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^1$ (Paramagnetic)

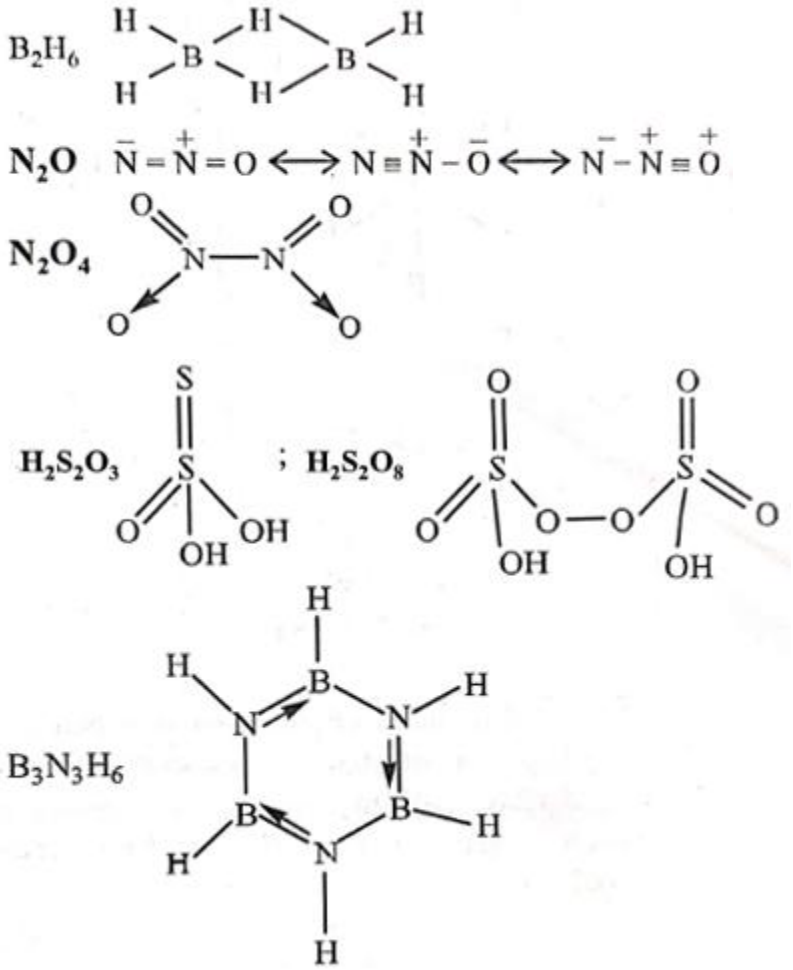
F_2 : $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$ (Diamagnetic

4. (6)

Species	**No. of valence e^- with central atom**	**No. of σ-bonds**	**No. of lone pairs**
$[TeBr_6]^{2-}$	8	6	1
$[BrF_2]^+$	6	2	2
SNF_3	6	4	0
$[XeF_3]^-$	8 + 1	3	3

Sum of number of lone pairs = 1 + 2 + 0 + 3 = 6

5. (4)



Total no. of molecules containing covalent bond between two atoms of the same kind are 4.

6. (6)

Polar molecules will be attracted/deflected near charged comb.

Polar molecules : HF, H_2O, NH_3, H_2O_2, $CHCl_3$, C_6H_5Cl (6-polar molecules)

Nonpolar molecules : O_2, CCl_4, C_6H_6

7. (6)

$2AgNO_3(s) \xrightarrow{\Delta} 2Ag(s) + 2NO_2(g) + O_2(g)$

NO_2 has one unpaired e^- and O_2 has two unpaired e^-.

Molecular orbital configuration of O_2 : $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 \pi 2p_y^2 \pi 2^* p_x^1 2^* p_y^1$

Total number of e^- present in antibonding molecular orbital = 6.

8. (5)

The geometry of the given species are as follows

$\left[Co(CN)_4\right]^{4-} \rightarrow$ Tetrahedral

$\left[Co(CO)_3(NO)\right] \rightarrow$ Tetrahedral

$\left[XeF_4\right] \rightarrow$ Square planar

$\left[PCl_4\right]^+ \rightarrow$ Tetrahedral

$[PdCl_4]^{2-} \rightarrow$ Square planar

$[ICl_4]^{-} \rightarrow$ Square planar

$[Cu(CN)_4]^{3-} \rightarrow$ Tetrahedral

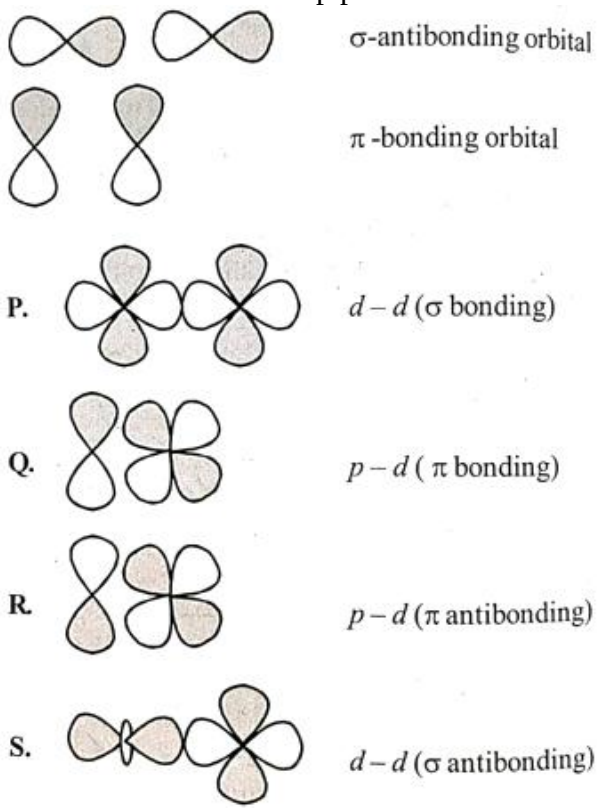
$P_4 \rightarrow$ Tetrahedral

Thus, among the given species only 5 species have tetrahedral geometry.

Matrix-Match

1. (c)

When two same phase overlap, it forms bonding molecular orbital otherwise antibonding molecular orbital. Also axial overlap produces σ-bond and sideways overlap produces π-bond. For example :



2. (A) – P, R, T ; (B) – S, T ; (C) – P, Q ; (D) – P, Q, S

(A) $B_2 : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1, \pi 2p_y^1$

Addition of e^- will increase the B.O., hence it will undergo reduction.

(B) $N_2 : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2, \pi 2p_y^2, \sigma 2p_z^2, \pi^* 2p_x^o, \pi^* 2p_y^o$

Addition or removal of e^- will decrease the B.O., hence it will not undergo oxidation or reduction.

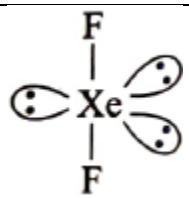
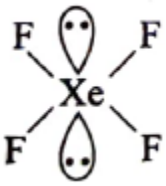
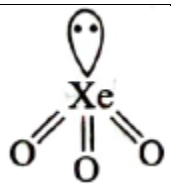
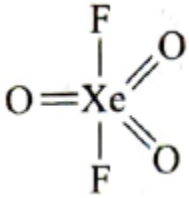
(D) $O_2 : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2, \pi 2p_y^2, \pi^* 2p_x^1, \pi^* 2p_y^1$

Removal of e^- will increase the B.O., hence it will undergo oxidation easily.

(C) Similarly, removal of e^- will increase the B.O. for O_2^- also. Hence it will undergo oxidation easily.

3. (b)

The correct match is P–5, Q–3, R–2, S–4

XeF_2	 Trigonal bipyramidal and 3 lone pair of electrons
XeF_4	 Octahedral and 2 lone pair of electrons
XeO_3	 Tetrahedral and 1 lone pair of electrons
XeO_3F_2	 Trigonal bipyramidal and no lone pair of electrons