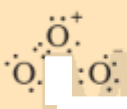
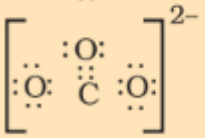
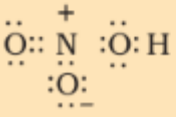
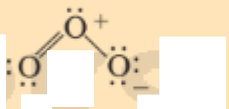
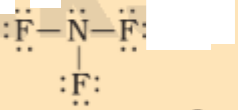
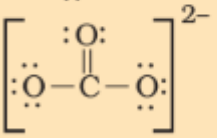
Set -1

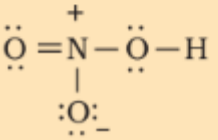
Table 4.1 The Lewis Representation of Some Molecules

Molecule/Ion	Lewis Representation
H_2	H : H*
O_2	:Ö::Ö:
O_3	
NF_3	
CO_3^{2-}	
HNO_3	









* Each H atom attains the configuration of helium (a duplet

Q1. Total no of lone pairs present in NF3?

A. 1
B. 6
C. 10
D. 16

Ans. (C)

Q2. Hybridisation of N in HNO3?

A. Sp
B. Sp^2
C. Sp^3
D. Sp^3d

Ans. (B)

Q3. No of lone pairs present in the central atom of O3?

A. 1
B. 2
C. 3
D. 0

Ans. (A)

Q4. Total no of bonded electrons in O2?

A. 8
B. 2
C. 6
D. 4

Ans. (D)

Set – 2

Table 4.2 Average Bond Lengths for Some Single, Double and Triple Bonds

Bond Type	Covalent Bond Length (pm)
O–H	96
C–H	107
N–O	136
C–O	143
C–N	143
C–C	154
C=O	121
N=O	122
C=C	133
C=N	138
C≡N	116
C≡C	120

Table 4.3 Bond Lengths in Some Common Molecules

Molecule	Bond Length (pm)
H_2 (H – H)	74
F_2 (F – F)	144
Cl_2 (Cl – Cl)	199
Br_2 (Br – Br)	228
I_2 (I – I)	267
N_2 (N ≡ N)	109
O_2 (O = O)	121
HF (H – F)	92
HCl (H – Cl)	127
HBr (H – Br)	141
HI (H – I)	160

Q1. Which of the following is incorrect about bond length?

A. C–H>O–H
B. C–O>N–O
C. C–C>C–N
D. C–O>C–N

Ans. (D)

Q2. Which of the following double bonds is largest?

A. C=O
B. N=O
C. C=N
D. C=C

Ans. (C)

Q3. Which of the following is correct order of bond lengths?

A. C=O
B. C=C
C. C=O
D. N=O

Ans. A

Q4. Which of the following options is correct about bond lengths?

A. C=C < C=N
B. C=C > C=N
C. C=C = C=N
D. None of the above

Ans. (D)

Q5. Which of the following is the correct order of bond lengths?

A. $N_2$22o
B. $H_2$22
C. $N_2$22
D. $O_2$22

Ans. (B)

Q6. Which of the following has the least Bond length?

A. HI
B. HBr
C. HCl
D. HF

Ans. (D)

Q7. Which of the following options is incorrect about bond length?

A. $F_2$2
B. $Cl_2$2
C. $Br_2$2
D. $F_2$2

Ans. (C)

Q8. Which of the following options is incorrect about bond length?

A. F_2
B. HCl2
C. HBr2
D. HI2

Ans. (A)

Set – 3

Table 4.5 Dipole Moments of Selected Molecules

Type of Molecule	Example	Dipole Moment, μ(D)	Geometry
Molecule (AB)	HF	1.78	linear
	HCl	1.07	linear
	HBr	0.79	linear
	HI	0.38	linear
	H_2	0	linear
Molecule (AB_2)	H_2O	1.85	bent
	H_2S	0.95	bent
	CO_2	0	linear
Molecule (AB_3)	NH_3	1.47	trigonal-pyramidal
	NF_3	0.23	trigonal-pyramidal
	BF_3	0	trigonal-planar
Molecule (AB_4)	CH_4	0	tetrahedral
	$CHCl_3$	1.04	tetrahedral
	CCl_4	0	tetrahedral

Q1. Which of the following is the correct dipole moment order of the given options?

A. HF
B. HCl
C. HI
D. HBr

Ans. (C)

Q2. Which of the following is not bent?

A. CO_2
B. H_2O
C. H_2S
D. H_2Se

Ans. (A)

Q3. Which of the following compounds has dipole moment non-zero?

A. CCl_4
B. $CHCl_3$
C. CO_2
D. BF_3

Ans. (B)

Q4. Geometry of BF3is:

A. Trigonal-pyramidal
B. Tetrahedral
C. Trigonal-planar
D. Bent

Ans. (C)

Q5. Geometry of NH3is:

A. etrahedral
B. Trigonal-pyramidal
C. Bent
D. Linear

Ans. (B)

Q6. Geometry of CH4is:

A. Tetrahedral
B. Trigonal-planar
C. Trigonal-pyramidal
D. Linear

Ans. (A)

Set – 4

Shape of molecules/ ions	Hybridisation type	Atomic orbitals	Examples
Square planar	dsp^2	$d+s+p(2)$	$[Ni(CN)_4]^{2-}$, $[Pt(Cl)_4]^{2-}$
Trigonal bipyramidal	sp^3d	$s+p(3)+d$	PF_5, PCl_5
Square pyramidal	sp^3d^2	$s+p(3)+d(2)$	BrF_5
Octahedral	sp^3d^2 d^2sp^3	$s+p(3)+d(2)$ $d(2)+s+p(3)$	SF_6, $[CrF_6]^{3-}$ $[Co(NH_3)_6]^{3+}$

Q1. Which of the following hybridisation represent square planar molecules?

A. Sp^3d
B. Sp^3d^2

C. d^2sp^3
D. dsp^2

Ans. (D)

Q2. Which geometry is represented by Sp3d hybridisation?

A. Square planar
B. Trigonal bipyramidal
C. Square pyramidal
D. octahedral

Ans. (B)

Q3. No. of atomic orbitals present in BrF5is:

A. 2
B. 4
C. 6
D. 5

Ans. (C)

Q4. Shape of SF6is:

A. octahedral
B. Square pyramidal
C. Trigonal bipyramidal
D. Square planar

Ans. (A)

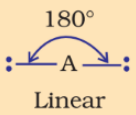
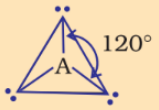
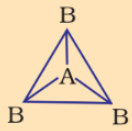
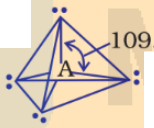
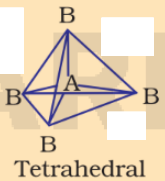
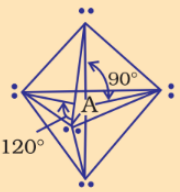
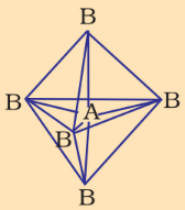
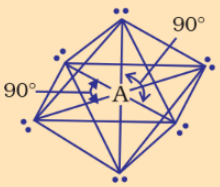
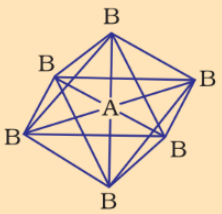
Q5. Which of the following represents correct no. of atomic orbitals present and hybridisation of PF5?

A. 4,Sp^3d
B. 4,dsp^2
C. 5,Sp^3d
D. 5,Sp^3d^2

Ans. (C)

Set – 5

Table 4.6 Geometry of Molecules in which the Central Atom has No Lone Pair of Electrons

Number of electron pairs	Arrangement of electron pairs	Molecular geometry	Examples
2	 Linear	B—A—B Linear	$BeCl_2$, $HgCl_2$
3	 Trigonal planar	 Trigonal planar	BF_3
4	 Tetrahedral	 Tetrahedral	CH_4, NH_4^+
5	 Trigonal bipyramidal	 Trigonal bipyramidal	PCl_5
6	 Octahedral	 Octahedral	SF_6

Q1. Geometry of HgCl2is:

A. Linear
B. Trigonal planar
C. Bent
D. tetrahedral

Ans. (A)

Q2. The B–A–B angle in trigonal planar geometry is:

A. 90
B. 180
C. 120
D. 109.5

Ans. (C)

Q3. 109.5 is the B–A–B angle of which of the following shapes?

A. Trigonal planar
B. Tetrahedral
C. Trigonal bipyramidal
D. Octahedral

Ans. (B)

Q4. Which of the following is the correct option about axial B–A–B angle and equatorial B–A–B angle of trigonal bipyramidal geometry?

A. 120, 90
B. 90, 90
C. 109.5,109.5
D. 90,120

Ans. (D)

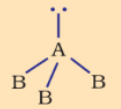
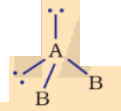
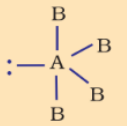
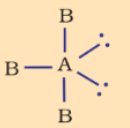
Q5. Which of the following is the correct relation about axial B–A–B angle and equatorial B–A–B angle of Octahedral geometry?

A. axial B–A–B angle < equatorial B–A–B angle
B. axial B–A–B angle > equatorial B–A–B angle
C. axial B–A–B angle = equatorial B–A–B angle
D. None of these

Ans. (C)

Set – 6

Table 4.7 Shape (geometry) of Some Simple Molecules/Ions with Central Ions having One or More Lone Pairs of Electrons(E).

Molecule type	No. of bonding pairs	No. of lone pairs	Arrangement of electron pairs	Shape	Examples
AB_2E	2	1	 Trigonal planer	Bent	SO^2O_3
AB_3E	3	1	 Tetrahedral	Trigonal pyramidal	NH_3
AB_2E_2	2	2	 Tetrahedral	Bent	H_2O
AB_4E	4	1	 Trigonal bi-pyramidal	See saw	SF_4
AB_3E_2	3	2	 Trigonal bi-pyramidal	T-shape	ClF_3

Q1. Which of the following is not bent?

A. SO_2

B. O_3

C. NH_3

D. H_2O:

Ans. (C)

Q2. Shape of SF4molecule is:

A. Bent
B. See-Saw
C. T-Shape
D. Square pyramid

Ans. (B)

Q3. Which of the following represents the correct shape of ClF3molecules?

A. Square pyramid
B. Square planar
C. See-Saw
D. T-Shape

Ans. (D)

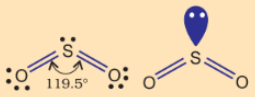
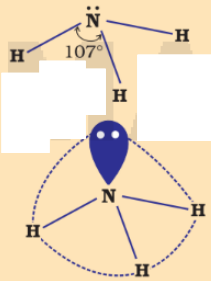
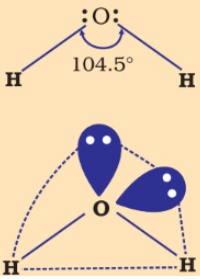
Q4. No, of bond pairs and no. of lone pairs present in BrF5 molecule is:

A. 5 and 1
B. 4 and 1
C. 4 and 2
D. 5 and 2

Ans. (A)

Set – 7

Table 4.8 Shapes of Molecules containing Bond Pair and Lone Pair

Molecule type	No. of bonding pairs	No. of lone pairs	Arrangement of electrons	Shape	Reason for the shape acquired
AB_2E	4	1		Bent	Theoretically the shape should have been triangular planar but actually it is found to be bent or v-shaped. The reason being the lone pair-bond pair repulsion is much more as compared to the bond pair-bond pair repulsion. So the angle is reduced to 119.5° from 120°.
AB_3E	3	1		Trigonal pyramidal	Had there been a bp in place of lp the shape would have been tetrahedral but one lone pair is present and due to the repulsion between lp-bp (which is more than bp-bp repulsion) the angle between bond pairs is reduced to 107° from 109.5°.
AB_2E_2	2	2		Bent	The shape should have been tetrahedral if there were all bp but two lp are present so the shape is distorted tetrahedral or angular. The reason is lp-lp repulsion is more than lp-bp repulsion which is more than bp-bp repulsion. Thus, the angle is reduced to 104.5° from 109.5°.

Q1. No. of bonding pairs and no. of lone pairs present in ClF3molecule is:

A. 3 and 2
B. 2 and 2
C. 2 and 3
D. 3 and 3

Ans. (A)

Q2. No. of bonding pairs and no. of lone pairs present in SO2molecule is:

A. 3 and 2
B. 4 and 1

C. 1 and 4
D. 2 and 3

Ans. (B)

Q3. The B–A–B angle of SO2molecule is:

A. 109.5
B. 107
C. 104.5
D. 119.5

Ans. (D)

Q4. Which of the following molecule has B–A–B angle of 107:

A. CH_4
B. SO_2
C. NH_3
D. ClF_3

Ans. (C)

Q5. The B–A–B angle of H2O molecule is:

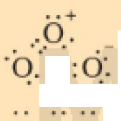
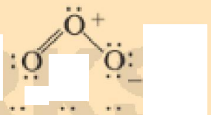
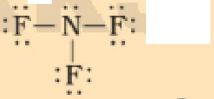
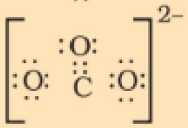
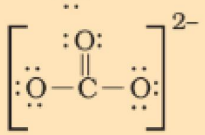
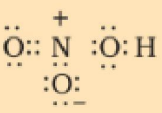
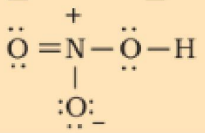
A. 109.5
B. 104.5
C. 119.5
D.107

Ans. (B)

Chemical Bonding and Molecular Structure

Set -1

Table 4.1 The Lewis Representation of Some Molecules

Molecule/Ion	Lewis Representation	
H_2	H : H*	H – H
O_2	:Ö::Ö:	:Ö=Ö:
O_3		
NF_3		
CO_3^{2-}		
HNO_3		

* Each H atom attains the configuration of helium (a duplet

Q1. Total no of lone pairs present in NF3?

A. 1
B. 6
C. 10
D. 16

Ans. (C)

Q2. Hybridisation of N in HNO3?

A. Sp
B. Sp^2
C. Sp^3
D. Sp^3d

Ans. (B)

Q3. No of lone pairs present in the central atom of O3?

A. 1
B. 2
C. 3
D. 0

Ans. (A)

Q4. Total no of bonded electrons in O2?

A. 8
B. 2
C. 6
D. 4

Ans. (D)

Set – 2

Table 4.2 Average Bond Lengths for Some Single, Double and Triple Bonds

Bond Type	Covalent Bond Length (pm)
O–H	96
C–H	107
N–O	136
C–O	143
C–N	143
C–C	154
C=O	121
N=O	122
C=C	133
C=N	138
C≡N	116
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Table 4.3 Bond Lengths in Some Common Molecules

Molecule	Bond Length (pm)
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Br_2 (Br – Br)	228
I_2 (I – I)	267
N_2 (N ≡ N)	109
O_2 (O = O)	121
HF (H – F)	92
HCl (H – Cl)	127
HBr (H – Br)	141
HI (H – I)	160

Q1. Which of the following is incorrect about bond length?

A. C–H>O–H
B. C–O>N–O
C. C–C>C–N
D. C–O>C–N

Ans. (D)

Q2. Which of the following double bonds is largest?

A. C=O
B. N=O
C. C=N
D. C=C

Ans. (C)

Q3. Which of the following is correct order of bond lengths?

A. C=O
B. C=C
C. C=O
D. N=O

Ans. A

Q4. Which of the following options is correct about bond lengths?

A. C=C < C=N
B. C=C > C=N
C. C=C = C=N
D. None of the above

Ans. (D)

Q5. Which of the following is the correct order of bond lengths?

A. $N_2$22o
B. $H_2$22
C. $N_2$22
D. $O_2$22

Ans. (B)

Q6. Which of the following has the least Bond length?

A. HI
B. HBr
C. HCl
D. HF

Ans. (D)

Q7. Which of the following options is incorrect about bond length?

A. $F_2$2
B. $Cl_2$2
C. $Br_2$2
D. $F_2$2

Ans. (C)

Q8. Which of the following options is incorrect about bond length?

A. F_2
B. HCl2
C. HBr2
D. HI2

Ans. (A)

Set – 3

Table 4.5 Dipole Moments of Selected Molecules

Type of Molecule	Example	Dipole Moment, μ(D)	Geometry
Molecule (AB)	HF	1.78	linear
	HCl	1.07	linear
	HBr	0.79	linear
	HI	0.38	linear
	H_2	0	linear
Molecule (AB_2)	H_2O	1.85	bent
	H_2S	0.95	bent
	CO_2	0	linear
Molecule (AB_3)	NH_3	1.47	trigonal-pyramidal
	NF_3	0.23	trigonal-pyramidal
	BF_3	0	trigonal-planar
Molecule (AB_4)	CH_4	0	tetrahedral
	$CHCl_3$	1.04	tetrahedral
	CCl_4	0	tetrahedral

Q1. Which of the following is the correct dipole moment order of the given options?

A. HF
B. HCl
C. HI
D. HBr

Ans. (C)

Q2. Which of the following is not bent?

A. CO_2
B. H_2O
C. H_2S
D. H_2Se

Ans. (A)

Q3. Which of the following compounds has dipole moment non-zero?

A. CCl_4
B. $CHCl_3$
C. CO_2
D. BF_3

Ans. (B)

Q4. Geometry of BF3is:

A. Trigonal-pyramidal
B. Tetrahedral
C. Trigonal-planar
D. Bent

Ans. (C)

Q5. Geometry of NH3is:

A. etrahedral
B. Trigonal-pyramidal
C. Bent
D. Linear

Ans. (B)

Q6. Geometry of CH4is:

A. Tetrahedral
B. Trigonal-planar
C. Trigonal-pyramidal
D. Linear

Ans. (A)

Set – 4

Shape of molecules/ ions	Hybridisation type	Atomic orbitals	Examples
Square planar	dsp^2	$d+s+p(2)$	$[Ni(CN)_4]^{2-}$, $[Pt(Cl)_4]^{2-}$
Trigonal bipyramidal	sp^3d	$s+p(3)+d$	PF_5, PCl_5
Square pyramidal	sp^3d^2	$s+p(3)+d(2)$	BrF_5
Octahedral	sp^3d^2 d^2sp^3	$s+p(3)+d(2)$ $d(2)+s+p(3)$	SF_6, $[CrF_6]^{3-}$ $[Co(NH_3)_6]^{3+}$

Q1. Which of the following hybridisation represent square planar molecules?

A. Sp^3d
B. Sp^3d^2

C. d^2sp^3
D. dsp^2

Ans. (D)

Q2. Which geometry is represented by Sp3d hybridisation?

A. Square planar
B. Trigonal bipyramidal
C. Square pyramidal
D. octahedral

Ans. (B)

Q3. No. of atomic orbitals present in BrF5is:

A. 2
B. 4
C. 6
D. 5

Ans. (C)

Q4. Shape of SF6is:

A. octahedral
B. Square pyramidal
C. Trigonal bipyramidal
D. Square planar

Ans. (A)

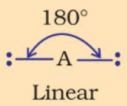
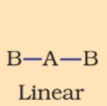
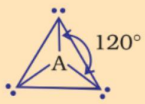
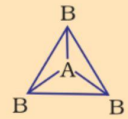
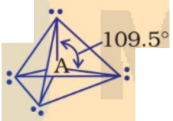
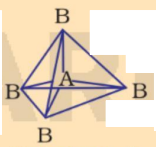
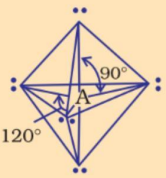
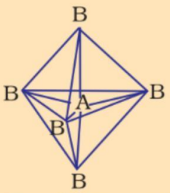
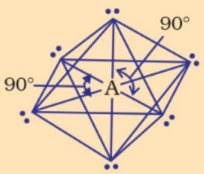
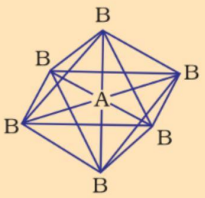
Q5. Which of the following represents correct no. of atomic orbitals present and hybridisation of PF5?

A. 4,Sp^3d
B. 4,dsp^2
C. 5,Sp^3d
D. 5,Sp^3d^2

Ans. (C)

Set – 5

Table 4.6 Geometry of Molecules in which the Central Atom has No Lone Pair of Electrons

Number of electron pairs	Arrangement of electron pairs	Molecular geometry	Examples
2	 Linear	 Linear	$BeCl_2$, $HgCl_2$
3	 Trigonal planar	 Trigonal planar	BF_3
4	 Tetrahedral	 Tetrahedral	CH_4, NH_4^+
5	 Trigonal bipyramidal	 Trigonal bipyramidal	PCl_5
6	 Octahedral	 Octahedral	SF_6

Q1. Geometry of HgCl2is:

A. Linear
B. Trigonal planar
C. Bent
D. tetrahedral

Ans. (A)

Q2. The B–A–B angle in trigonal planar geometry is:

A. 90
B. 180
C. 120
D. 109.5

Ans. (C)

Q3. 109.5 is the B–A–B angle of which of the following shapes?

A. Trigonal planar
B. Tetrahedral
C. Trigonal bipyramidal
D. Octahedral

Ans. (B)

Q4. Which of the following is the correct option about axial B–A–B angle and equatorial B–A–B angle of trigonal bipyramidal geometry?

A. 120, 90
B. 90, 90
C. 109.5,109.5
D. 90,120

Ans. (D)

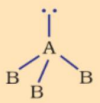
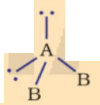
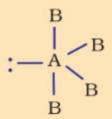
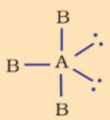
Q5. Which of the following is the correct relation about axial B–A–B angle and equatorial B–A–B angle of Octahedral geometry?

A. axial B–A–B angle < equatorial B–A–B angle
B. axial B–A–B angle > equatorial B–A–B angle
C. axial B–A–B angle = equatorial B–A–B angle
D. None of these

Ans. (C)

Set – 6

Table 4.7 Shape (geometry) of Some Simple Molecules/Ions with Central Ions having One or More Lone Pairs of Electrons(E).

Molecule type	No. of bonding pairs	No. of lone pairs	Arrangement of electron pairs	Shape	Examples
AB_2E	2	1	 Trigonal planer	Bent	SO^2O_3
AB_3E	3	1	 Tetrahedral	Trigonal pyramidal	NH_3
AB_3E_2	2	2	 Tetrahedral	Bent	H_2O
AB_4E	4	1	 Trigonal bi-pyramidal	See saw	SF_4
AB_3E_2	3	2	 Trigonal bi-pyramidal	T-shape	ClF_3

Q1. Which of the following is not bent?

A. SO_2

B. O_3

C. NH_3

D. H_2O:

Ans. (C)

Q2. Shape of SF4molecule is:

A. Bent
B. See-Saw
C. T-Shape
D. Square pyramid

Ans. (B)

Q3. Which of the following represents the correct shape of ClF3molecules?

A. Square pyramid
B. Square planar
C. See-Saw
D. T-Shape

Ans. (D)

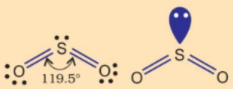
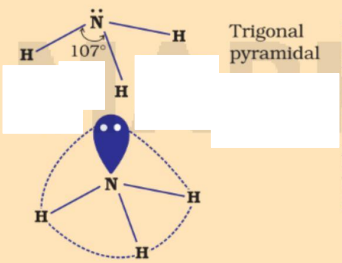
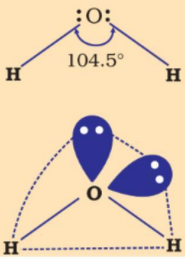
Q4. No, of bond pairs and no. of lone pairs present in BrF5 molecule is:

A. 5 and 1
B. 4 and 1
C. 4 and 2
D. 5 and 2

Ans. (A)

Set – 7

Table 4.8 Shapes of Molecules containing Bond Pair and Lone Pair

Molecule type	No. of bonding pairs	No. of lone pairs	Arrangement of electrons	Shape	Reason for the shape acquired
AB_2E	4	1		Bent	Theoretically the shape should have been triangular planar but actually it is found to be bent or v-shaped. The reason being the lone pair-bond pair repulsion is much more as compared to the bond pair-bond pair repulsion. So the angle is reduced to 119.5° from 120°.
AB_3E	3	1		Trigonal pyramidal	Had there been a bp in place of lp the shape would have been tetrahedral but one lone pair is present and due to the repulsion between lp-bp (which is more than bp-bp repulsion) the angle between bond pairs is reduced to 107° from 109.5°.
AB_2E_2	2	2		Bent	The shape should have been tetrahedral if there were all bp but two lp are present so the shape is distorted tetrahedral or angular. The reason is lp-lp repulsion is more than lp-bp repulsion which is more than bp-bp repulsion. Thus, the angle is reduced to 104.5° from 109.5°.

Q1. No. of bonding pairs and no. of lone pairs present in ClF3molecule is:

A. 3 and 2
B. 2 and 2
C. 2 and 3
D. 3 and 3

Ans. (A)

Q2. No. of bonding pairs and no. of lone pairs present in SO2molecule is:

A. 3 and 2
B. 4 and 1

C. 1 and 4
D. 2 and 3

Ans. (B)

Q3. The B–A–B angle of SO2molecule is:

A. 109.5
B. 107
C. 104.5
D. 119.5

Ans. (D)

Q4. Which of the following molecule has B–A–B angle of 107:

A. CH_4
B. SO_2
C. NH_3
D. ClF_3

Ans. (C)

Q5. The B–A–B angle of H2O molecule is:

A. 109.5
B. 104.5
C. 119.5
D.107

Ans. (B)