SET 6

EXERCISE 1

1/ Write the Lewis electron structures of the following molecules and ions:

$BeCl_2$; HCN O_3 ; H_2O ; CO_2 ; NH_3 ; BH_3 ; PCl_3 SO_2 ; PCl_5 ; SO_3 ; SF_6 ; HNO_3 ; H_2SO_4 ; H_3PO_4 ; NO ; CO ; NH_4^+; SO_4^{2-}; PO_4^{3-} ; BrF_5 ; BrO_3^- ; BrO_4^- ; XeF_2 ; $HClO_4$; ClO_2 ; ClO^- ;.

2/ Which molecules do not obey the octet rule (only for the central atom)?

3/ Explain why **PCl_5 exists** while **NCl_5 does not exist.**

4/ **The molecule $POCl_3$ exists and is stable.** Using the electronic configurations of **P** and **O**, explain how the **P–O bond** is formed and specify **its nature.**

Given: $_8O$; $_7N$; $_4Be$; $_5B$; $_{11}Na$; $_6C$; $_{15}P$; $_{16}S$; $_9F$; $_{17}Cl$; $_{35}Br$; $_{33}As$; $_{54}Xe$.

EXERCISE 2

1/ Using **VSEPR** theory, give the **electron-pair arrangement** and the **molecular geometry** for each species in **Exercise 1.**

Also write the **AXE** formula for each species.

2/ Compare the bond angles in the following molecules and explain your answer.

a/ CO_2 and SO_2

b/ H_2O, NH_3, and CH_4.

c/ NH_3, PH_3, and AsH_3.

d/ NH_3 and NF_3.

3/ Assign to each molecule the bond angle that corresponds to it.

Given:

(180°, 119°)

(109.5° ; 104.5° ; 107.3°)

(93.3° ; 107.3° ; 91.8°)

(102.3° ; 107.3°)

EXERCISE 3

We consider the molecules and ions from Exercise 1.

Determine the hybridization of the central atom for each molecule and ion

EXERCISE 4

The experimental dipole moments and internuclear distances of the hydrogen halides are given below

	HF	HCl	HBr	HI
μ (Debye D)	1.94	1.08	0.80	0.40
D (Å)	0.93	1.28	1.42	1.61

1/ Determine the **partial charge "q"** carried by each atom.

2/ Calculate the **percentage ionic character** of each molecule.

3/ Was the trend predictable?

EXERCISE 5

The dipole moment of the **H_2S** molecule is **0.95 D**, and the dipole moment of the **S–H bond** is **0.67 D**.

1/ Calculate the value of the H–S–H bond angle.

2/ The bond length of **H–S** is **1.3 Å**.

3/ Calculate the partial charges carried by sulfur and hydrogen.

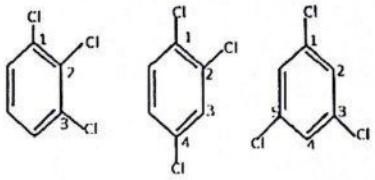
4/ Calculate the ionic percentage of the S–H bond.

EXERCISE 47

The dipole moment of the **C–Cl** bond is **1.7 D**.

Calculate the dipole moments of the three following molecules (the dipole moments of the **C–H** and **C–C** bonds are practically **zero**):

Form A – Form B – Form C (structures shown in the figure)



A B C