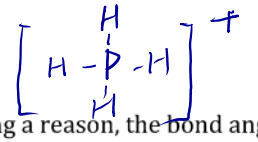
1.

(i) Deduce the Lewis structure of PH_4^+ .



(ii) Predict, giving a reason, the bond angle around the phosphorus atom in PH_4^+ .

The bond angle is 109.5° because there are 4 electron domain and all of them are bonding pairs, so the shape is tetrahedral

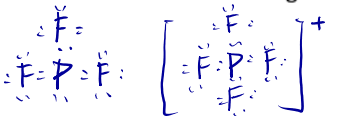
(iii) Predict whether or not the P–H bond is polar, giving a reason for your choice.

P-H bond is nonpolar, because P and H have nearly the same electronegativity.

2.

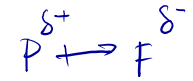
Lewis (electron dot) structures are useful models.

Draw the Lewis (electron dot) structures of PF_3 and PF_4^+ and use the VSEPR theory to deduce the molecular geometry of each species.



	Electron Domain	bonding pair	molecular geometry
PF_3	4	3	trigonal pyramidal
PF_4^+	4	4	tetrahedral

Predict with a reason, whether the molecule PF_3 is polar or non-polar.

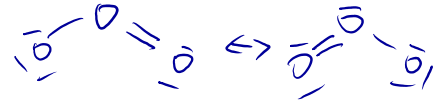


PF_3 is polar, because the shape of PF_3 is trigonal paramydal and is not symmetric. so the dipoles cannot cancel out

3.

a. Draw the Lewis structures of oxygen, O_2, and ozone, O_3.

b. State the different bond lengths and strengths between the oxygen atoms in O_2 and O_3 in the ozone layer affect radiation reaching the Earth's surface.

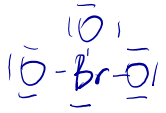
The resonance structure of O_3 is 

the bond length in O_3 is between single bond and double bond, longer than that of O_2, so the bond strength in O_3 is smaller than that of O_2

4.

78 18 26/2 = 13

a. Draw the Lewis (electron dot) structure for BrO_3^- that obeys the octet rule.



b. Predict, using the VSEPR theory, the geometry of the BrO_3^- ion and the O–Br– O bond angles.

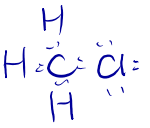
Geometry: trigonal pyramidal

Reason: 4 electron domain, 3 bonding pairs

O-Br-O angle: 107°

5.

a. Draw the Lewis (electron dot) structure of chloromethane CH3Cl.



b. Predict the shape of the chloromethane molecule and the H–C–H bond angle.

Shape: tetrahedral

Bond angle: 109.5°

c. Explain why chloromethane is a polar molecule.

Because the dipoles in C-H and C-Cl bonds are different, the dipoles cannot be canceled, thus CH_3Cl is a polar molecule.

6.

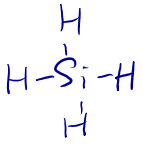
(a) Sketch and state the names of the shapes of the following molecules.

(i) SiH_4

(ii) PH_3 (4)

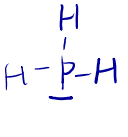
(b) State the bond angle in SiH_4 and explain why it is greater than that in PH_3. (2)

(a) (i)

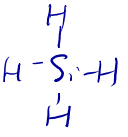


tetrahedral

(ii)



trigonal pyramidal



	SiH_4	PH_3
Electron Domain	4	4
bonding pair	4	3
bond angle	109.5°	107

(b) Bond angle of SiH_4 is bigger than PH_3 because

7.

Predict the shape and bond angles of the following molecules:

(a) H_2S **(b)** CF_4 **(c)** HCN **(d)** NF_3
(e) BCl_3 **(f)** NH_2Cl **(g)** OF_2

5+7×3/2 = 13 7×2+6/2 = 10.

(a) H–S–H linear 180°

(b) tetrahedral 109.5°

(c) H–C≡N linear 180°

(d) trigonal pyramidal 107°

(e) trigonal pyramidal 107°

(f) trigonal pyramidal 107°

(g) V-shape 104.5°

8.

Predict the shape and bond angles of the following ions:

(a) CO_3^{2-} **(b)** NO_3^- **(c)** NO_2^+ **(d)** NO_2^-
(e) ClF_2^+ **(f)** $SnCl_3^-$

4+2+6×3 = 12 5+1+6×3 5+12−1 = 16/2 = 8 18/2 = 9

7+7×2−1 = 20, 14 4+2+1×3 = 26/13

(a) trigonal planar 120°

(b) trigonal planar 120°

(c) linear 180°

(d) V-shape 119°

(e) V-shape 104.5°

(f) trigonal pyramidal 107°

9.

Put the following species in order of increasing carbon–oxygen bond length:

CO CO_2 CO_3^{2-} CH_3OH

3 2 4/3 1

$CH_3OH > CO_3^{2-} > CO_2 > CO$