Quiz (Shape of Molecules)

1. The shapes of H_2S, NF_3 and SiH_4 are found to be similar to that of H_2O, NH_3 and CH_4 respectively.
   (a) Draw the electron diagrams of H_2S, NF_3 and SiH_4 respectively, showing electrons in the outermost shells only.

   (b) State the shapes of H_2S, NF_3 and SiH_4 molecules respectively and draw the three-dimensional structures of each of these molecules.

   (c) Explain why each of the following pairs of molecules has similar shape:
      (i) H_2S and H_2O;
      (ii) NF_3 and NH_3;
      (iii) SiH_4 and CH_4.

2. Predicting shapes of molecules with central atom obeying octet rule and with multiple bonds.
   For each of the following molecules:
      (i) carbon dioxide (CO_2)
      (ii) methanal (HCHO)

   (a) Draw the electron diagram of the molecule, showing electrons in the outermost shells only.

   (b) Predict the shape and draw the three-dimensional structure of the molecule.

3. CCl_4 is a carbon compound. The shape of a CCl_4 molecule is similar to that of a CH_4 molecule.
   (a) Draw an electron diagram of CCl_4, showing electrons in the outermost shells only. (Use '•' for electrons of the central atom and '×' for electrons of other atoms.)

   (b) State the shape of a CCl_4 molecule.

   (c) Explain why the shape of a CCl_4 molecule is similar to that of a CH_4 molecule.

   (d) Draw the three-dimensional structure of a CCl_4 molecule.

4. Consider a sulphur trioxide molecule, SO_3.
   (a) Draw an electron diagram for the molecule, showing electrons in the outermost shells only.

   (b) Predict and draw the three-dimensional structure of the molecule.

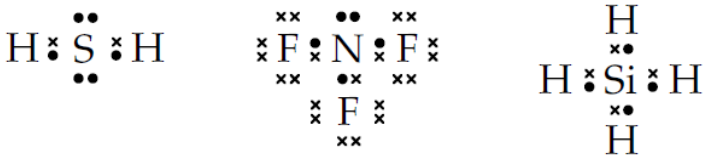
5. For each of the following molecules,
   (a) HCN
   (b) PCl_3
   (c) SCl_6

   (i) Draw an electron diagram of the molecule, showing electrons in the outermost shells only.

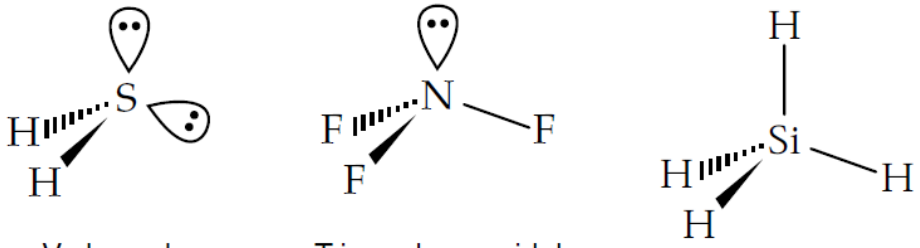
   (ii) Predict the shape and draw the three-dimensional structure of the molecule.

Suggested Answer

1. (a)



(b) H_2S is V-shaped, NF_3 is trigonal pyramidal and SiH_4 is tetrahedral in shape.



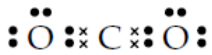
V-shaped Trigonal pyramidal Tetrahedral

(c) (i) Both the sulphur atom in H_2S and the oxygen atom in H_2O have two lone pairs and two bond pairs around them. The repulsion between these electron pairs causes both H_2S and H_2O to adopt a V-shape.

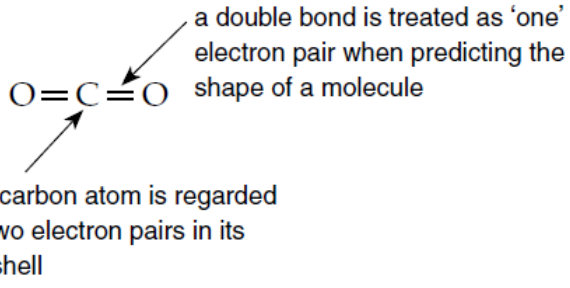
(ii) Both the nitrogen atoms in NF_3 and NH_3 have one lone pair and three bond pairs around them. The repulsion between these electron pairs causes both NF_3 and NH_3 to adopt a trigonal pyramidal shape.

(iii) Both the silicon atom in SiH_4 and the carbon atom in CH_4 have four bond pairs around them. The repulsion between these electron pairs causes both SiH_4 and CH_4 to adopt a tetrahedral shape.

2. (a)

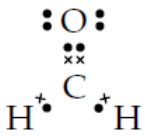
(i) 

(ii) Linear

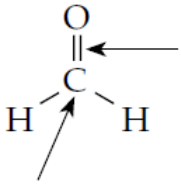


(b)

(i)



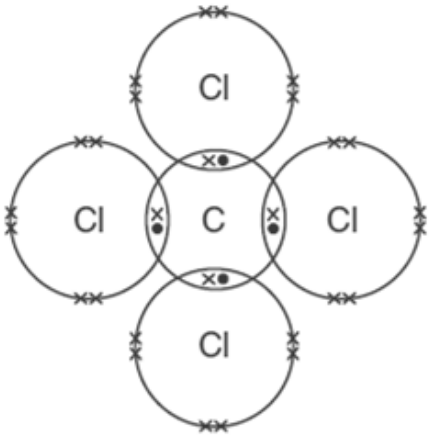
(ii) Trigonal planar



a double bond is treated as 'one' electron pair when predicting the shape of a molecule

this central carbon atom is regarded as having three electron pairs in its outermost shell

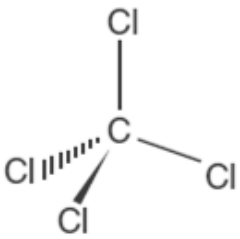
3. (a)



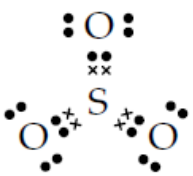
(b) Tetrahedral

(c) Both the carbon atoms in CCl_4 and in CH_4 have four bond pairs around them. The repulsion between these electron pairs causes both CCl_4 and CH_4 to adopt a tetrahedral shape.

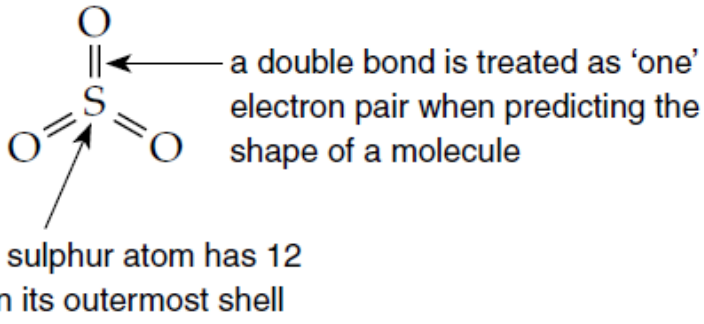
(d)



4. (a)

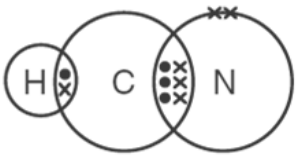


(b) Trigonal planar



5. (a)

(i)

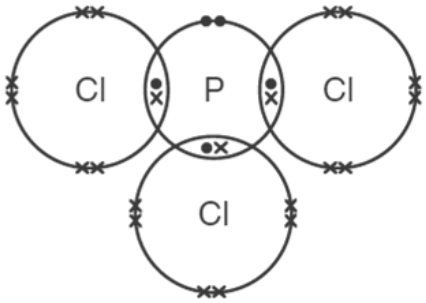


(ii) Linear;

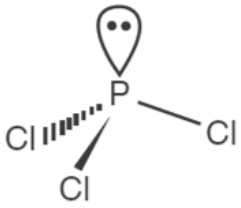
H — C ≡ N

(b)

(i)

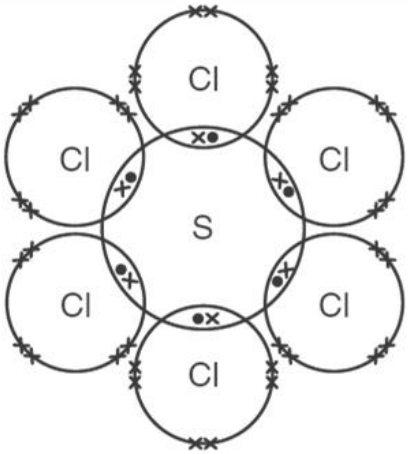


(ii) Trigonal pyramidal;



(c)

(i)



(ii) Octahedral;