Answer on Question #75973, Chemistry / Inorganic Chemistry

Explain the structure of XeO2F2 and XeOF2 on basis of VSEPR theory

Solution

The VSEPR model is based on the postulate that the geometry of the molecule is determined by the repulsions among the electron pairs in the valence shell of its central atom. Both bonding pairs and lone pairs have significant meaning in establishing the molecular geometry. The bond configuration around the central atom (Xe) is such that the electron pairs of the valence shell must be at maximum distances from each other.

A) XeO_2F_2

To determine molecular geometry we should determine the number of electron pairs around central atom:

Xe $[Kr]4d^{10}5s^25p^6$ - number of valence electrons – 8

O $[He]2s^22p^4$ – number of valence electrons – 6 (we have 2 atoms of O - 6·2 = 12)

F $[He]2s^22p^5$ – number of valence electrons – 7 (we have 2 atoms of F - 7·2 = 14)

Total number is 34.

We should start from Lewis structure:

```
       ..
      : F :
  ..    |  ..    . .
: O —— Xe —— O :
  . .   |       . .
      :  F :
       . .
```

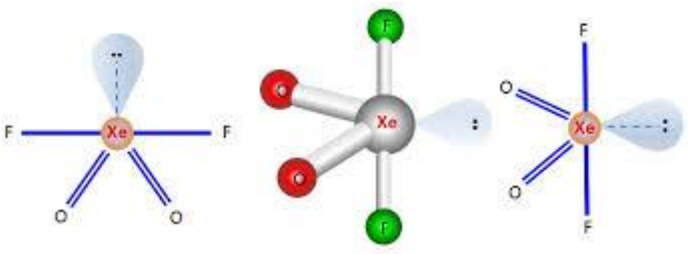
as we distributed electrons equally we can see that we have one electron pair left over (red colour).

Now we should draw structure of XeO_2F_2 using VSEPR theory:

```
   . .
 : F :    . .
   |   \\ O :
 : Xe       . .
   |          ..
 : F :      O :
   ..       . .
```

we have 5 electron groups: 4 bounding and 1 lone pair (red colour).

Molecular geometry: Trygonal Bipiramidal
Shape: See-saw



Geometri molekul XeO_2F_2 : Jungkat–jungkit (see–saw)

B) $XeOF_2$

To determine molecular geometry we should determine the number of electron pairs around central atom:

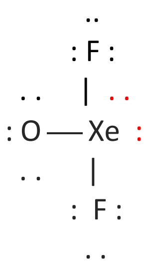
Xe $[Kr]4d^{10}5s^25p^6$ - number of valence electrons – 8

O $[He]2s^22p^4$ – number of valence electrons – 6

F $[He]2s^22p^5$ – number of valence electrons – 7 (as we have 2 atoms of F - 7·2 = 14)

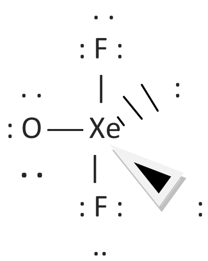
Total number is 28.

We should start from Lewis structure:



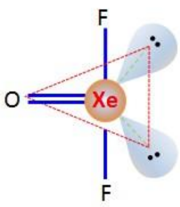
as we distributed electrons equally we can see that we have two electron pairs left over (red colour).

Now we should draw structure of $XeOF_2$ using VSEPR theory:

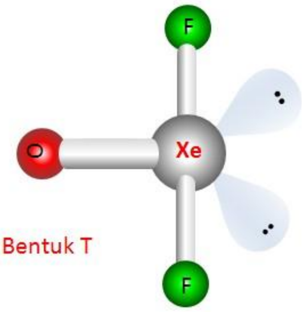


we have 5 electron groups: 3 bounding and 2 lone pairs (red colour).

Molecular geometry: T- shaped



Geometri molekul $XeOF_2$: Bentuk T



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