Learning Centre



Hybrid Orbitals

NUMBER OF	Electron Domain
ORBITALS	GEOMETRY
2	linear
3	trigonal planar
4	tetrahedral
4	square planar
5	trigonal bipyramidal
6	octahedral
	NUMBER OF ORBITALS 2 3 4 4 5 5 6

EXERCISES

A. Consider the molecule BeH₂.

1) Show the electronic structure of beryllium's valence shell. Use arrows to represent the electrons contained in each orbital.

Be _____ ___ ___ ___ ____

2) How many covalent bonds does the Be atom form with the H atoms?

3) Therefore, the beryllium atom should provide ______ half-filled orbitals.

4) This is accomplished by creating a pair of _____ hybrids and placing _____ electron(s) in each of them. Show this in the following diagram, using up arrows (\uparrow) to represent beryllium's electrons. Label the orbitals:

Be* _____ ____ ____

5) Show the orbital diagram for the beryllium atom in the BeH₂ molecule, using down arrows (\downarrow) to represent electrons from hydrogen:

Be* _____ ____

6) What electron domain (ED) geometry does this molecule have?

B. Consider the molecule CH₄.

1) Show the electronic structure of carbon's valence shell. Use arrows to represent the electrons contained in each orbital.

C _____ ___ ___ ____ ____ ____



2) How many covalent bonds does the C atom form with the H atoms?

3) Therefore, the carbon atom should provide _____ half-filled orbitals.

4) This is accomplished by creating four _____ hybrids and placing _____ electron(s) in each of them. Show this in the following diagram, using up arrows to represent carbon's electrons. Label the orbitals:

C* _____ ____

5) Show the orbital diagram for the carbon atom in the CH₄ molecule, using down arrows to represent electrons from hydrogen:

C* _____ ____

6) What electron domain (ED) geometry does this molecule have?

C. Consider the molecule SF₆.

1) Show the electronic structure of sulphur's valence shell. Use arrows to represent the electrons contained in each orbital.

S _____ 3s ____ 3p ____ ___ 3d ____

2) How many covalent bonds does the S atom form with the F atoms?

3) Therefore, the sulphur atom should provide $\underline{}_{how many ?}$ half-filled orbitals.

4) This is accomplished by creating six _____ hybrids and placing _____ electron(s) in each of them. Show this in the following diagram, using up arrows to represent sulphur's electrons. Label the orbitals:

S* _____ ____ ____ ____

5) Show the orbital diagram for the sulphur atom in the SF_6 molecule, using down arrows to represent electrons from fluorine:

S* _____ ____ ____ ____ ____ ____

6) What electron domain (ED) geometry does this molecule have?

D. Consider the molecule SeF₄.

1) Show the electronic structure of selenium's valence shell, ignoring the 3d orbitals, which are not involved in bonding in this molecule. Use arrows to represent the electrons contained in each orbital.



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2) How many covalent bonds does the Se atom form with the F atoms?

3) Therefore, the selenium atom should provide _____ half-filled orbitals.

4) This is accomplished by creating _____ hybrids, placing _____ electron(s) in four of them, and leaving _____ lone pair(s) of electrons. Show this in the following diagram, using arrows to represent selenium's electrons. Label the orbitals:

Se* _____ ____ ____ ____ ____ ____ ____

5) Show the orbital diagram for the selenium atom in the SeF₄ molecule, using darker arrows (or arrows in another colour) to represent electrons from fluorine:

Se* _____ ____ ____ ____ ____ ____ ____

6) What electron domain (ED) geometry does this molecule have?

7) What is molecular geometry of this molecule?



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