**1. Basic molecular geometries**: Insert pictures of molecules CO2, BCl3, SO2, CH4, NH3, H2O, PCl5, SF4, ClF3, SF6, BrF5, XeF4 in the table.

|  |  |  |  |
| --- | --- | --- | --- |
| steric number (hybridization and bond angle) | lone pairs | | |
| 0 | 1 | 2 |
| 2  (sp180°) | *D*∞h  (linear) |  |  |
| 3  (sp2 120°) | *D*3h  (trigonal planar) | *C*2v  (bent) |  |
| 4  (sp3 ~109.5°) | *T*d  (tetrahedral) | *C*3v  (trigonal pyramidal) | *C*2v  (bent) |
| 5  (dsp3 90°/120°) | *D*3h  (trigonal bipyramidal) | *C*2v  (seesaw) | *C*2v  (t-shaped) |
| 6  (d2sp3 90°) | *O*h  (octahedral) | *C*4v  (square pyramidal) | *D*4h  (square planar) |

VSEPR stands for Valence Shell Electron Pair Repulsion.

* VSEPR predicts the trend lp-lp > lp-bp > bp-bp for repulsions where lp=lone pair/bp=bond pair.
* For steric number > 4, dorbitals are involved so the number of electrons can exceed the octet rule in hypervalent molecules.

**2. Atomic orbitals:** Insert pictures of atomic orbitals of an H atom for the orbitals in the table.

|  |  |  |
| --- | --- | --- |
| s (sharp) | p (principle) | d (diffuse)    (circle ) |

3. **Molecular orbitals:** Insert pictures of molecular orbitals in the table. (HOMO for base, LUMO for acid and both for the product)

|  |  |  |
| --- | --- | --- |
| Lewis base is NH3. | Product is BNH6 | Lewis acid is BH3. |
| HOMO stands for  highest occupied molecular orbital |  | LUMO stands for  lowest unoccupied molecular orbital |

* For more information see the link https://www.youtube.com/watch?v=l3Oq0rAejiU&t=590s

**4. Matching 3D structures with skeletal structures:** Give one letter alphabet that corresponds to the structures in the table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Wedge-and-dash projection** | | | **Fischer projection** | **Newman projection** | **Haworth projection** |
|  |  |  |  |  |  |
| **H** | **C** | **M** | **M** | **R** | **F** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bond-line structures** | | | | | |
|  |  |  |  |  |  |
| **I** | **V** | **S** | **N** | **O** | **Y** |

**BONUS: Write the name and properties of the compounds below.**

|  |  |
| --- | --- |
| (*R*)-(−)-carvone  MW:150.22 g/mol bp: 231 °C  density: 0.96 g/mL at 25 °C  sweetish minty smell,  like spearmint leaves | (*S*)-(+)-carvone  MW:150.22 g/mol bp: 231 °C  density: 0.96 g/mL at 25 °C  spicy aroma with notes of rye,  like caraway seeds. |
| (*S*)-thalidomide  MW: 258.23 g/mol  The (*S*) is a teratogen. In in 46 countries, more than 10,000 children were born with deformities between late 1950s and early 1960s due to this compound. | (*R*)-thalidomide  MW: 258.23 g/mol  The (*R*)-enantiomer has the desired sedative effect for morning sickness. However, it can be converted to (*S*)-isomer in human body. |

Refs: https://en.wikipedia.org/wiki/Carvone https://en.wikipedia.org/wiki/Thalidomide

Enantiomers are pairs of compounds with the same connectivity; one enantiomer cannot be superimposed on the other and are mirror images of each other.