1. BH₃

**Energy Diagram:**

- Ground State: 1s
- Excited State: 2p

Promote to a higher energy state and hybridize with 2p to form 3σ B-H bonds.

- Bonded State: 1s

2. ICl₃

**Energy Diagram:**

- Ground State: 5s
- Excited State: 5p

Promote to a higher energy state and hybridize with 5p to form 5σ I-Cl bonds.

- Bonded State: 5s

*Note: Diagrams show the electron configurations and bond formations for BH₃ and ICl₃.*
3. \( \text{C}_2\text{Cl}_2 \)
   Energy Diagram:
   
   **Ground State**
   
   1s
   
   **Excited State**
   
   2s
   
   Energy Diagram:
   
   **Hybridize**
   
   2p
   
   **Bonded State**
   
   C in \( \text{C}_2\text{Cl}_2 \)

4. \( \text{AsI}_5 \)
   Energy Diagram:
   
   **Ground State**
   
   4s
   
   **Excited State**
   
   4p
   
   Energy Diagram:
   
   **Hybridize**
   
   4d
   
   As in \( \text{AsI}_5 \)

Trigonal Bipyramidal
5. $\text{PH}_3$

**Energy Diagram:**

\[
\begin{align*}
\text{3p} & \quad \text{hybridize} \\
\frac{1}{3} & \quad \frac{1}{3} & \quad \frac{1}{3} \\
\text{sp}^2
\end{align*}
\]

\[\text{P in PH}_3 \quad \text{Bonded state}\]

\[\text{P in PH}_3 \quad \text{Bonded state}\]

**Contour Diagram:**

Trigonal Pyramidal
6. S I₆

Energy Diagram:

- S Ground State
- Excited State
- \( \text{Octahedral} \)

Contour:

- \( \text{sp}^3\text{d}^2 \)
1. H₂Se

\[ : \text{Se} - \text{H} \]

Energy diagram

[Diagram showing hybridization and lone pair]

Se in H₂Se
Bonded state

< 109.5°
Bent
$\text{F - C} \equiv \text{C - F}$

Energy diagram:

- C: Ground state
- $\text{C}^*$: Excited state
- 2p: Electron configuration
- Hybridization: sp
- Bonding: 2π C-C bond
- Bonding: C-F bond

Linear molecule at 180°
Energy Diagram

Energy

3d

1s

Cl
Ground State

3p

+ Energy

3p

Cl
Excited State

Br

Bonded State

T-shaped
10. BrI₅

Energy diagram

4d

promote → 4d

4p

+Energy → 4p

Hybridize

Br

Ground state

Br

Excited state

< 90º

All Br orbitals are sp³d²

Square pyramidal

Br in BrI₅

Bonded state
Energy Diagram

\[ \begin{array}{c}
\text{Energy} \\
\text{Diagram} \\
\end{array} \]

C

Ground State

C

Excited State

C

Bonded State

\[ \begin{array}{c}
\text{promote} \\
+ \text{energy} \\
\text{hybridize} \\
\end{array} \]
1. $\text{Si}^-$

2. $\text{N}^-$

Energy diagram:

- Energy levels:
  1. $\text{Si}^-$: Ground state
  2. $\text{N}^-$: Ground state

3. Hybridization:
   - $\text{Si}^-$: $3s$ to $sp^3$ hybridization
   - $\text{N}^-$: $2s$ to $sp^3$ hybridization

4. Sigma and Pi bonds:
   - $\text{Si}^-$: $\sigma$ bond with $\text{N}^-$
   - $\text{N}^-$: $\sigma$ bond with $\text{Si}^-$

5. Lone pairs:
   - $\text{Si}^-$: 3 lone pairs
   - $\text{N}^-$: 1 lone pair

6. Geometric arrangement:
   - $\text{Si}^-$ and $\text{N}^-$ form a bond at an angle of $90^\circ$
13 NCl₃

1 1 1

2p

N Groundstate

Contour diagram

N in NCl₃ Bonded state

Trigonal pyramidal

$sp^3$
N Energy diagram

\[ \begin{array}{c}
2s \\
2p \\
\end{array} \]

hybridize

\[ \begin{array}{c}
1s \\
2s \\
2p \\
\end{array} \]

O Energy diagram

\[ \begin{array}{c}
1s \\
2s \\
2p \\
\end{array} \]

hybridize

\[ \begin{array}{c}
1s \\
2s \\
2p \\
\end{array} \]

120°

Trigonal Planar
N Energy Diagram

\[ \text{hybridize} \]

\[ \begin{array}{c}
\text{N} \\
2p \text{ hybridized to } sp^2 \\
\text{N in NO}_2^- \text{ bonded state}
\end{array} \]

O Energy Diagram

\[ \begin{array}{c}
\text{hybridize} \\
\text{O in NO}_2^- \text{ bonded state}
\end{array} \]

Note: This "extra e- is on the hybridized "O"
16. \( \text{CO}_3^{2-} \)

\[
\text{Energy Diagram} \\
\begin{array}{c}
\frac{1}{2s} \\
\frac{1}{2p} \\
\frac{1}{2p} \\
\end{array}
\]

\[\text{hybridize} \rightarrow \frac{1}{1k} \frac{1}{1k} \frac{1}{2s} \]

\[\text{C-O \sigma bond} \]

\[\text{C-O \pi bond} \]

\[\text{C in CO}_3^{2-} \]

\[\text{Bonded State} \]

\[\text{Ground State} \]

\[\text{Excited State} \]

\[\text{O Energy Diagram} \\
\begin{array}{c}
\frac{1}{2s} \\
\frac{1}{2p} \\
\frac{1}{2p} \\
\end{array}
\]

\[\text{hybridize} \rightarrow \frac{1}{1k} \frac{1}{1k} \frac{1}{2s} \]

\[\text{C-O \sigma bond} \]

\[\text{C-O \pi bond} \]

\[\text{C-\sigma bond} \]

\[\text{1 \sigma bond} \]

\[\text{2 \sigma bond} \]

\[\text{sp}^3 \]

\[\text{sp}^2 \]

\[\text{Contour} \]

\[120^\circ \]

\[90^\circ \]

\[180^\circ \]

\[\text{Trigonal Planar} \]