Formal charge

1) Identify the formal charge on each atom in the following molecules:
   a) \( \text{SOCl}_2 \) (thionyl chloride)

\[
\begin{array}{c}
\text{O} \\
\text{Cl} - \text{S} - \text{Cl}
\end{array}
\]

b) \( \text{SCN}^- \) (thiocyanate ion)

\[
\left[ \text{S}=\text{C}=\text{N} \right]^- 
\]

c) \( \text{XeO}_2\text{F}_2 \) (xenon dioxodifluoride)

\[
\begin{array}{c}
\text{O} \\
\text{F} - \text{Xe} - \text{F} \\
\text{O}
\end{array}
\]

2) Assign formal charges and determine the preferred Lewis structure of \( \text{BrF}_3 \)

\[
\begin{array}{c}
\text{F} \\
\text{Br} - \text{F} \\
\text{F}
\end{array}
\]

\[
\begin{array}{c}
\text{F} \\
\text{Br} - \text{F} \\
\text{F}
\end{array}
\]

\[
\text{F} = \text{Br} = \text{F}
\]
3) Assign formal charges and determine the preferred Lewis structure of the cyanate ion:

\[
\begin{align*}
\overset{-}{\text{O}} &= \text{C} = \overset{-}{\text{N}} \\
\overset{-}{\text{O}} &= \overset{\cdot}{\text{C}} - \overset{-}{\text{N}} \\
\overset{-}{\text{O}} &= \overset{-}{\text{C}} = \overset{-}{\text{N}}
\end{align*}
\]
Answers:

1) 
   a) S: 0 Cl: 0 O: 0  
   b) S: 0 Cl: 0 N: -1  
   c) Xe: +2 F: 0 O: 0

2) 

The Lewis structure on the left is the preferred Lewis structure – the formal charges on each atom is zero.

3) 

Lewis structure C is the preferred Lewis structure. Even though Lewis structures A and C have the same overall formal charge (the same as the charge on the ion), structure C has the negative formal charge assigned to the most electronegative atom (O).