The O-H bond in water is very polar due to the difference in EN between $\delta^-$ O and $\delta^+$ H. The bond is therefore neither completely covalent — because electrons are not evenly shared — nor completely ionic — because sharing does occur.

Should the bond be considered covalent or ionic when counting electrons? Yes — meaning both.

**Formal charge** — An electron counting system in which all bonds are treated as completely covalent, break bonds $H\cdot 1-1=O\cdot 0-0\cdot 6-6=0$

- $\text{C} = \# \text{ of standard valence electrons} - \# \text{ of } e^- \text{ present}$
  (for unreacted element)

  Lewis dot structures are based on a covalent bonding model, so formal charge is used in drawing Lewis dot structures.

  Sum of individual formal charges must equal the overall charge of the molecule.

  $FC = \# \text{ of valence } e^- - (\# \text{ of lone } e^- + \frac{1}{2} \# \text{ of bonding } e^-)$

  $= \# \text{ of valence } e^- - \# \text{ of lone } e^- - \# \text{ of bonds}$

  $\text{O} = 6 - 6 - 1 = -1$

  $\text{N} = 5 - 2 - 3 = 0$

  $FC = 6 - 4 - 2 = 0$
Oxidation state - An electron counting system in which all bonds are treated as completely ionic (unless the bond is composed of two of the same atom).

* The electrons in each bond are given to the more EN element in that bond.

\[ \text{OS} = \# \text{ of standard valence electrons} - \# \text{ of } e^- \text{ present} \]

* Sum of individual oxidation states must equal the overall charge of the molecule.

**OS Rules**

- \( \text{H}^+ : +1 \), except in metal hydride \(-1\)
- \( \text{H} \) is usually less EN than most elements; it forms bonds with, except metals.
- For monatomic ions, \( F, C = 0.5 \), because there are not bonds.
- \( \text{O}^- : -2 \), except in peroxides.

\[ +1 + 4 = 2 \]
\[ \text{H}_2 \text{O}_3 \]

\[ \text{O} = 2(\text{H}) + 1(\text{S}) + 3(\text{O}) = 2(\text{H}) + 5 + 3(-2) \]

\[ \text{O} = 2 + 5 - 6 \quad \text{S} = 4 \]

[Diagram of heterolysis]

\[ \text{Cr}_2\text{O}_7^{2-} \]

\[ -2 = 2(\text{Cr}) + 7(\text{O}) \]

\[ -2 = 2 \text{Cr} + 7(-2) \]

\[ 12 + 6 = 2 \text{ Cr} \]

\[ 6 = \text{Cr} \]