PAULING ELECTRONEGATIVITY SCALE

The Pauling electronegativity scale is based on the difference in bond energies in nonpolar molecules versus the bond energies in polar molecules. To understand the Pauling model, let's consider the molecule HF. The relative electronegativities of the H and F atoms are determined by comparing the measured H-F bond energy and the "expected" H-F bond energy (i.e. if the H-F bond were nonpolar), which is an average of the H-H and F-F bond energies:

$$\text{"Expected" H-F bond energy} = \frac{\text{H-H bond energy} + \text{F-F bond energy}}{2}$$

The difference (Δ) between the actual(experimental) and expected bond energies is:

$$\Delta = (\text{H-F})_{act} - (\text{H-F})_{expected}$$

The Pauling electronegativity scale is based on these bond energy differences according to the following relationship with the element F given the base value of $\chi_F = 4.0$

$$\chi_F - \chi_H = 0.104\ \Delta^{\frac{1}{2}}$$

For the above example the H-H bond energy is 436 kJ/mol, the F-F bond energy is 157 kJ/mol and the H-F bond energy is 569 kJ/mol. Therefore the "expected" H-F bond energy is 296.5 kJ/mol while the actual H-F bond energy is 569 kJ/mol. This gives a $\Delta = 272.5$ and $\chi_F - \chi_H = 1.72$. Since the electronegativity value for F is arbitrarily set at 4.0 the electronegativity value of H in this case would be $\chi_H = 2.28$.

Problem: Calculate the electronegativity difference between H and Br given the following bond energies. The H-H bond energy is 436 kJ/mol, the Br-Br bond energy is 193 kJ/mol and the H-Br bond energy is 368 kJ/mol.