

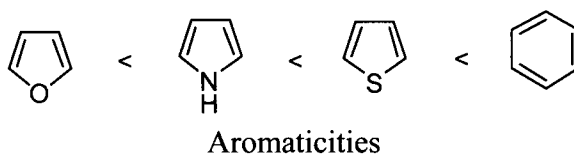
Chapter 2 Pyrroles

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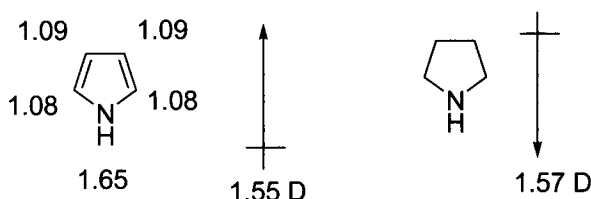
2.1 Introduction

The parent compound pyrrole is a colorless, flammable liquid with a boiling point of 131 °C. It turns to a light-amber color upon exposure to air and/or light. Pyrrole has a mild aniline-like odor.

Pyrrole, with 6 π -electrons, is an electron-*excessive* (also known as electron-*rich*) aromatic heterocycle because the electron density on each ring atom is greater than one. Its lone pair electrons take part in the delocalization thus essential to pyrrole's aromaticity. Pyrrole's aromaticity is between furan and thiophene, which is in accordance with Pauling's electronegativity for O (3.5), N (3.0), and S (2.5):



The reason why pyrrole is an electron-*excessive* aromatic heterocycle is because the electron density on each ring atom is greater than one. Pyrrole has a dipole moment of 1.55 D, similar to that of pyrrolidine in number although with *opposite direction*. (Here, the direction of the dipole moment vector is represented by an arrow and is properly defined so that the arrow is directed from the positive fractional charge to the negative fractional charge).



Electron Densities of the Atoms on the Pyrrole Ring and Dipole Moments

Although the direction of pyrrolidine's dipole moment is easily rationale by the nitrogen atom's inductive effect, that of pyrrole's is more nuanced. As shown in the following resonance structures: