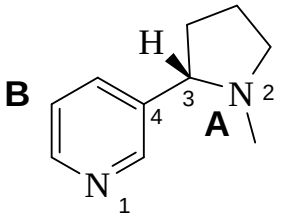
Marks 8

- The molecular structure of nicotine, the addictive component of tobacco, is shown below.



List the types of intermolecular interactions that each of the following sites on nicotine would be involved in when it is dissolved in water.

A – H bonding and dipole-dipole interactions

B – dispersion forces and dipole-induced dipole

Provide the requested information for each of the indicated atoms in nicotine.

Atom	Geometric arrangement of the electron pairs around the atom	Hybridisation of the atom	Geometry around the atom
N-1	**trigonal planar**	***sp*^{2}**	**bent (~120°)**
N-2	**tetrahedral**	***sp*^{3}**	**trigonal pyramidal**
C-3	**tetrahedral**	***sp*^{3}**	**tetrahedral**
C-4	**trigonal planar**	***sp*^{2}**	**trigonal planar**

The pK_b of N-1 is 10.88 and the pK_b of N-2 is 5.98. Draw the structure of the predominant form of nicotine that exists in the human body at pH 7.4.

For N-1, the pK_a of the protonated form (the conjugate acid) is (14.00 – 10.88) = 3.12. As the pH is *higher* than the pK_a, the conjugate acid is deprotonated: *very* little protonation occurs.

For N=2, the pK_a of the protonated form is (14.00 – 5.98) = 8.02. As the pH is *lower* than the pK_a, the conjugate acid form dominates: protonation occurs.