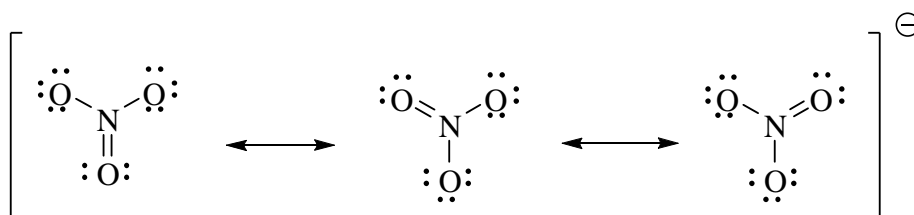


Marks  
2

- What is the bond order of the nitrogen-oxygen bonds in the nitrate ion,  $\text{NO}_3^-$ ? Explain your answer.

Three equivalent Lewis structures can be drawn for the nitrate ion:



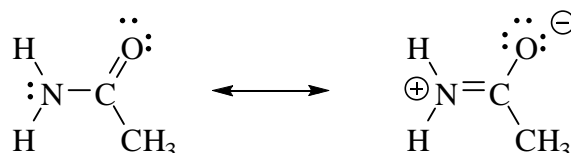
These *resonance* structures contribute equally and the real electron distribution is an average of them. The N-O bond order is an average of its bond order in the resonance structures:

$$\text{bond order} = \frac{1}{3} (1 + 1 + 2) = \frac{4}{3}$$

- The observed geometry of the atoms attached to the N atom in  $\text{H}_2\text{NCOCH}_3$  is trigonal planar. Explain this observation.

2

The molecule has two major resonance contributors as shown below:



Although the form on the left is more important, the contribution of the form on the right means that the C-N bond has partial double bond character.

This causes the peptide bond to be planar with restricted rotation. It also means that the amide nitrogen atom has low basicity and that the C-N bond is strong.