6. A key player in stratospheric ozone depletion is chlorine nitrate, ClONO₂. Its connectivity (that is, the location of its sigma bonds) is known to be the following:

\[
\begin{align*}
\text{Cl} & \equiv \text{O}_a \equiv \text{N} \\
\ & \equiv \text{O}_b \equiv \text{O}_c
\end{align*}
\]

(a) (6 points) Draw the two best resonance structures for ClONO₂. (They will be equivalent.) Be sure to show all valence electrons, and label all non-zero formal charges. Keep the oxygens labeled as Oₐ, Oₐ, and O_c for the purpose of further discussion.

(b) (3 points) Write down the hybridization for the following atoms in chlorine nitrate. You need not justify your answers beyond what you have drawn for part (a).

\[
\text{Cl} \overset{3p^3}{\text{Cl}} \quad \text{O}_a \overset{3p^3}{\text{O}_a} \quad \text{N} \overset{2p^2}{\text{N}}
\]

(c) (4 points) Experimentally, one of the ClONO₂ bond angles is known to be 133°. Which angle would you predict it to be? (Circle your choice.)

(i) \(\theta(\text{Cl}-\text{O}_a-\text{N})\)  
(ii) \(\theta(\text{O}_a-\text{N}-\text{O}_b)\)  
(iii) \(\theta(\text{O}_a-\text{N}-\text{O}_c)\)  
(iv) \(\theta(\text{O}_b-\text{N}-\text{O}_c)\)

(d) (6 points) Justify your answer to part (c) by using the concepts of VSEPR theory. Be sure to discuss both what is expected ideally, and deviations from that ideal.

Since the N is \(\overset{2p^2}{\text{sp}^2}\)-hybridized, we'd expect the 3 angles about it to be \(\approx 120^\circ\). (This is unlike the \(\text{Cl}-\text{O}_a-\text{N}\) angle, which should be \(\approx 109.5^\circ\).)

Given that the 2 resonance structures are equivalent, we can assign a bond order of 1.5 to both N-Oₐ and N-O_c. These partial double bonds will repel each other the most, which will lead to a Oₐ-N-O_c angle of \(> 120^\circ\).