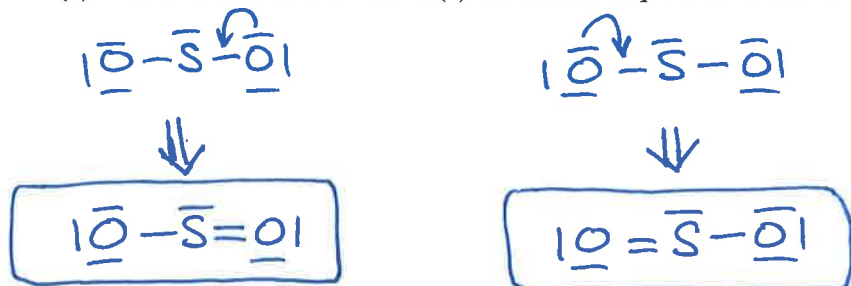


### Resonance Structures Practice

1. Sulfur dioxide is a gas that is associated with the formation of acid rain.

(a) Draw the Lewis structure(s) for  $\text{SO}_2$  that provide a stable octet for each atom.

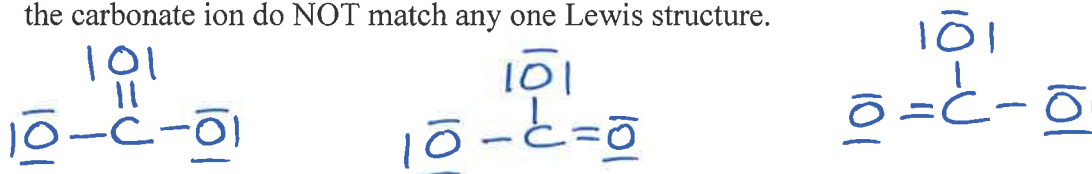


(b) The two sulfur – oxygen bonds in the actual  $\text{SO}_2$  molecule are equal in length. Explain this surprising observation.

TWO LEWIS STRUCTURES ABOVE WOULD SUGGEST ONE SHORT  $\text{S}=\text{O}$  DOUBLE BOND + ONE LONGER SINGLE  $\text{S}-\text{O}$  BOND.

$\text{O} \cdots \text{S} \cdots \text{O}$  IN REALITY, WE OBSERVE A " $1\frac{1}{2}$  BOND" BETWEEN EACH  $\text{S}-\text{O}$

2. Write Lewis structure(s) for the carbonate ion,  $\text{CO}_3^{2-}$ . Explain how the experimental observations of the carbonate ion do NOT match any one Lewis structure.



2 Longer  $\text{C}-\text{O}$  bonds, 1 shorter  $\text{C}=\text{O}$  bond predicted

REALITY: ALL BONDS ARE EQUAL IN LENGTH + STRENGTH  
" $1\frac{1}{3}$  bonds"

3. Compare the lengths of the carbon – oxygen bonds in  $\text{CO}$  and  $\text{CO}_2$ .

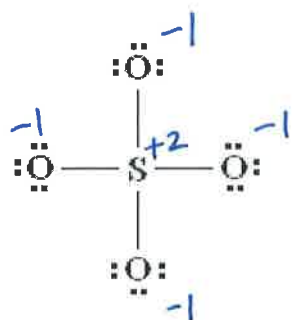


↑  
shorter  
because triple  
bonds are so  
short

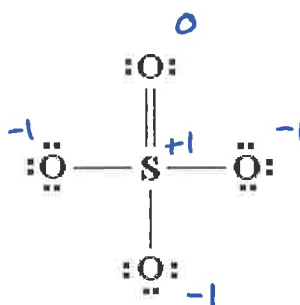


↑ ↑  
equal in length and longer  
than  $\text{C}=\text{O}$  would be.

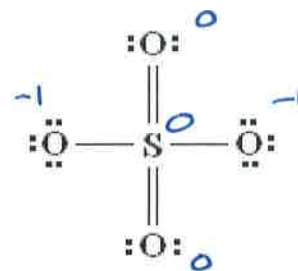
4. There are three different types of resonance structures that can be drawn for the sulfate ion. One type has nothing but single bonds, one has one double bond, and the third has two double bonds.



All single bonds



One double bond

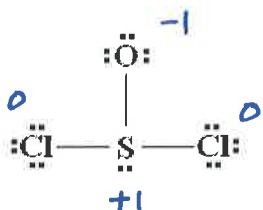


Two double bonds

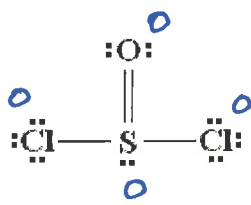
Which of the 3 types of resonance structures is the best? Explain your reasoning.

RESONANCE STRUCTURE ON FAR RIGHT IS THE BEST BECAUSE IT MINIMIZES FORMAL CHARGES AND HAS THE -1 FORMAL CHARGES PLACED ON THE ATOMS THAT HAVE THE HIGHER ELECTRONEGATIVITY.

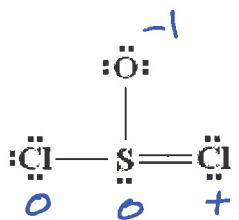
5. Compare the following resonance structures for thionyl chloride,  $\text{SOCl}_2$ .



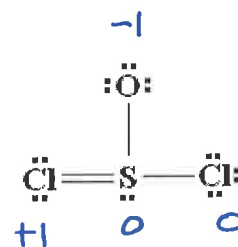
A



B



C



D

Rank these from best (most accurate) to worst (least accurate). Explain your reasoning.

B IS THE BEST BECAUSE ALL FORMAL CHARGES = 0

A IS SECOND-BEST WITH NEGATIVE FORMAL CHARGE PLACED ON OXYGEN WHICH HAS HIGH ELECTRONEGATIVITY.

C, D ARE TERRIBLE BECAUSE WE HAVE A +1 FORMAL CHARGE ON HIGH ELECTRONEGATIVITY ATOM LIKE CHLORINE