

These are not the bonds you're looking for: Introduction to  
Resonance Structures Version 2.0 January 18, 2018

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[All Actors enter with speeder stage left]

Storm Trooper #1: Have long have you had these molecules?

**Luke Skywalker:** Two or three seasons.

Storm Trooper #2:

Looks like you are transporting molecules with chemical bonds.

Storm Trooper #1: We are looking for  
molecules with Single bonds and or Double bonds. These types of  
molecules will be detained for questioning.

Storm Trooper #2: These molecules sure look like they have single  
or double bonds.

**Ben Obi-Wan Kenobi:** [*with a small wave of his hand*]

You should measure the bond lengths and the bond energies in ozone.

Storm Troopers #1 and #2 [together]: We should measure the bond  
lengths and bond energies in Ozone.

Storm Trooper #1: [uses a yard stick and measures the bond lengths  
of the oxygen-oxygen bonds in ozone.]

Storm Trooper #1 [looks at Trooper #2]: These oxygen-oxygen bonds  
all have the same bond length. pause Single bonds are longer  
than double bonds. These can't be single or double bonds. You  
better measure the bond energies.

Storm Trooper #2 [uses a phone with the i-phone, sound app with  
waves space music, to measure the bond energies]: [looks at Trooper  
#1] These oxygen-oxygen bonds all have the same bond energy.  
[pause] Double bonds have a larger bond energy compared to single  
bonds. These can't be single or double bonds.

**Ben Obi-Wan Kenobi:** [*with a small wave of his hand*] The Ozone molecule  
turns over its Lewis Structure Placard

Yes You are correct. Look again. You see the oxygen bonds  
in ozone all have the same bond length and bond energy!

**Ben Obi-Wan Kenobi:** [*with a small wave of his hand*] These bonds do not  
have a bond order of one or a bond order of 2. Do you see the bond  
order?

Storm Trooper #1 and #2: [shake their heads] No.

**Luke Skywalker:** All of the bonds in this ozone molecule have the same bond length and bond strength they can't be single bonds or double bonds.

**Ben Obi-Wan Kenobi:** If you take the double bond and single bond and add them together  $2 + 1 = ?$

StormTroopers (together): 3

**Ben Obi-Wan Kenobi:** Since there are two bonds. Take the 3 and divide by 2 regions of electron density. 3 divided by 2 is ?

StormTroopers (together): one and a half

**Luke Skywalker:** Now you see it. The bond order in each bond is 1.5

Storm Trooper #1: That's weird. How can that be?

**Ben Obi-Wan Kenobi:** These bonds are resonance stabilized. The electrons are delocalized. The ozone molecule is especially stable and this molecule is of no concern to you.

Storm Trooper #2: OK. but what about that carbonate ion over there? It has two single bonds and one double bond.

**Ben Obi-Wan Kenobi:** [*with a small wave of his hand*]

You should measure the bond lengths and the bond energies in the carbonate ion.

StormTroopers #1 and #2 [together]: We should measure the bond lengths and bond energies in the carbonate ion.

StormTrooper #1: [*uses a yard stick and measures the bond length.*]

Storm Trooper #1 [*looks at Trooper #2*]: These carbon-oxygen bonds all have the same bond length. They can't be single or double bonds. [*pause*] You better measure the bond energies.

Storm Trooper #2 [*uses a phone with the flashlight app on to measure the bond energies*]: [*looks at Trooper #1*] These carbon-oxygen bonds all have the same bond energy. [*pause*] Double bonds have a larger bond energies compared to single bonds. These can't be single or double bonds.

**Ben Obi-Wan Kenobi:** [*with a small wave of his hand*] The carbonate ion turns over its Lewis Structure Placard

yes You are correct. Look again. You see the bonds in the carbonate ion all have the same bond length and bond energy!

**Ben Obi-Wan Kenobi:** [*with a small wave of his hand*] These bonds do not

have a bond order of one or a bond order of 2. Do you see the bond order?

StormTroopers #1 and #2: Shake their heads.

**Luke Skywalker:** All of the carbon-oxygen bonds in this carbonate ion have the same bond length and bond strength they can't be single bonds or double bonds.

**Ben Obi-Wan Kenobi:** There are two single bonds and one double bond, add them together  $1 + 1 + 2 = ?$

Storm Troopers: [together] 4

**Ben Obi-Wan Kenobi:** 4 divided by 3 regions of electron density is ?

StormTroopers [use slide rule, then together: 1 and one third

StormTrooper #2: That's weird. How can that be?

**Luke Skywalker:** These carbon oxygen bonds in the carbonate ion are resonance stabilized. The electrons are delocalized. All three carbon-oxygen bonds have a bond order of one and a third. They are especially stable and they are of no concern to you.

**Ben Obi-Wan Kenobi** [to both of the storm troopers] [*with a small wave of his hand*]: "These are not the bonds you're looking for."

**Stormtrooper #1 and #2 [together]:** These are not the bonds we're looking for.

**Ben Obi-Wan Kenobi** [to StormTrooper #1]: He can go about his business.

**StormTrooper #1:** You can go about your business.

**Ben Obi-Wan Kenobi** [to StormTrooper #2]: Move along.

**StormTrooper #2:** Move along... move along. [StormTroopers back away off stage] [Luke and Ben and the molecules take one or two steps forward and stop]

**Luke Skywalker:** I can't understand how we got past those troops?

**Ben Obi-Wan Kenobi:** The resonance force can have a strong influence on the weak-minded.