During Class Invention

Name(s) with Lab section in Group

Lewis Structures

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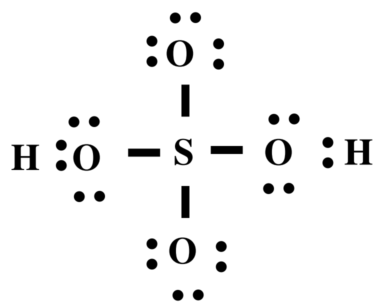
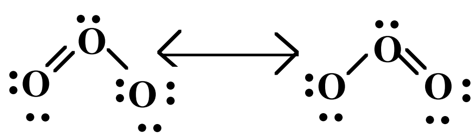
1. Draw the complete Lewis structure for

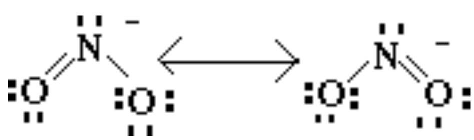


a) H_2SO_4

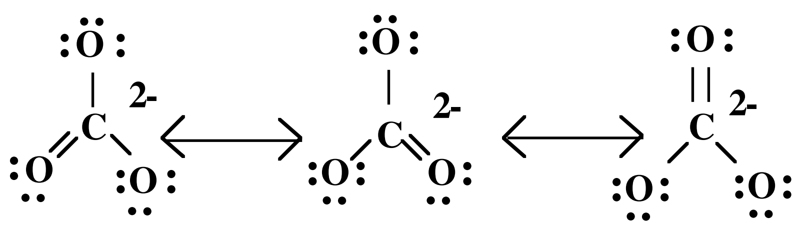
b) O_3



c) NO_2^-



d) CO_3^{2-}



2. Given the information in the table below;

Bond Lengths and Bond Energies

	Bond Length (nm)	Bond Energy (kJ/mol)
H–H	0.074	435
H–Cl	0.127	431
Cl–Cl	0.198	243
H–C	0.109	414
C–Cl	0.177	328
C–C	0.154	331
C=C	0.134	590
C≡C	0.120	812
C–O	0.143	326
C=O	0.120	803
C≡O	0.113	1075
N–N	0.145	159
N=N	0.125	473
N≡N	0.110	941
O_2	0.121	495

Explain the observed relationship between bond length and bond energy in the three examples of carbon-carbon bonds and in the three examples of carbon-oxygen bonds. Which is stronger and why?

The trend in bond energy for the carbon/carbon single, double and triple bonds demonstrates the increased strength of this of bonds. The same trend is observed in carbon/oxygen bonds and the nitrogen/nitrogen bonds.

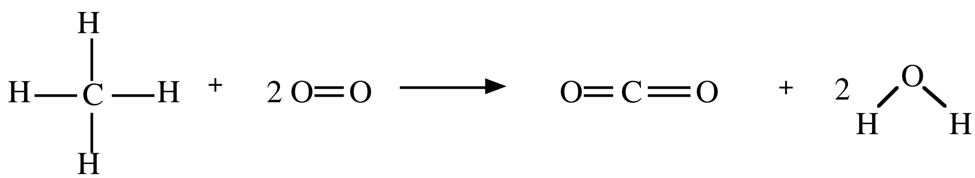
The trend also shows as the bond order increases the bond length decreases. More about that in a week.

Compare the bond strengths in a dihydrogen molecule and a chlorine molecule. Which is stronger and why?

Comparing the bond strength in H_2 and Cl_2 the chlorine/chlorine bond is weaker than the hydrogen/hydrogen bond. Because of the larger size of the chlorine atom, there are greater electron/electron repulsions.

It should also be pointed out there is no uniform relationship between bond distance and bond energy. When two bonds have similar bond distances, they may not be similar bond energies. For example, H–C and N≡N have similar bond distances, but significantly different bond energies.

3. Using bond energies, calculate ΔH° for the reaction



(See your text or other reference book for a more complete table of bond energies needed to solve this problem.)

$\mathbf{\Delta H_{reaction} = \Sigma\Delta H(bond\ breakage) - \Sigma\Delta H(bond\ formation)}$

$\mathbf{\Delta H_{reaction} = [4(C\text{-}H) + 2(O{=})] - [2(C{=}O) + 4(O\text{-}H)]}$

$\mathbf{= [4(414\ kJ\ mol^{-1}) + 2(495\ kJ\ mol^{-1})] - [2(799\ kJ\ mol^{-1}) + 4(463\ kJ\ mol^{-1})]}$

$\mathbf{\Delta H_{reaction} = -804\ kJ\ mol^{-1}}$