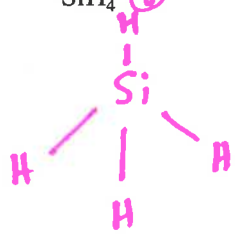
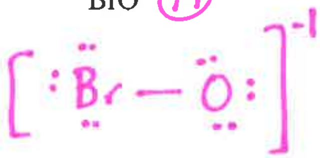
AP Chem WS 8.1 *Name:*______________________________________ *p.*_____ *#*______

1a. Draw the Lewis Dot Structure for each molecule or ion.
(If it has resonance, you can just draw one correct structure)

SiH_4 (8)



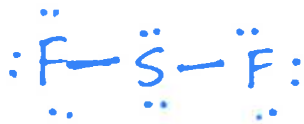
BrO^{-1} (14)



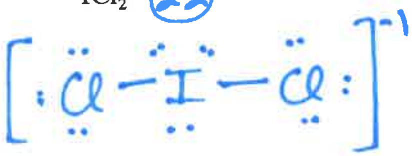
CO (10)

BrO^{+1} (12)

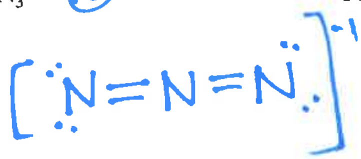
SF_2 (20)



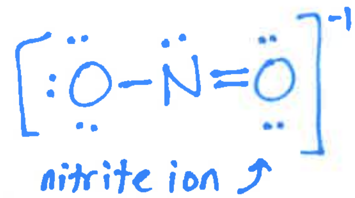
ICl_2^{-1} (22)



N_3^{-1} (16)

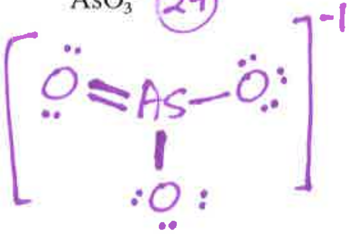


NO_2^{-1} (18)

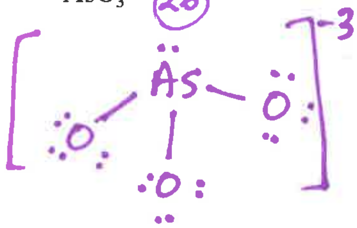


H_2O_2 (14)

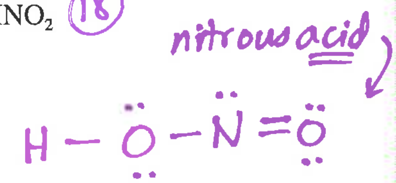
AsO_3^{-1} (24)



AsO_3^{-3} (26)

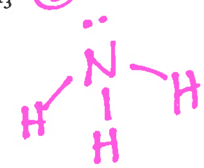


HNO_2 (18)

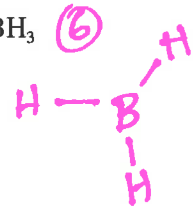


IF_3 (28)

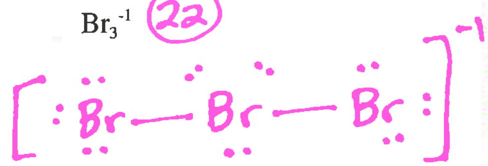
NH_3 (8)



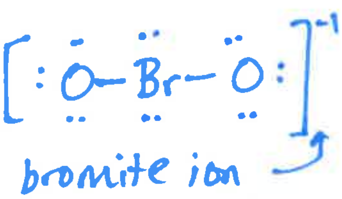
BH_3 (6)



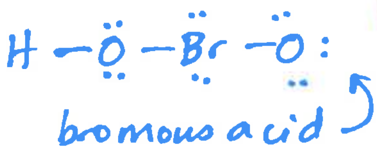
Br_3^{-1} (22)



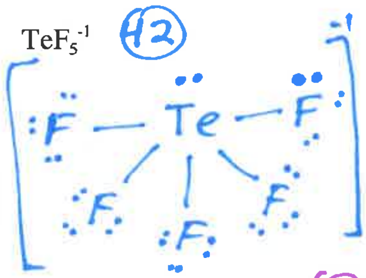
BrO_2^{-1} (20)



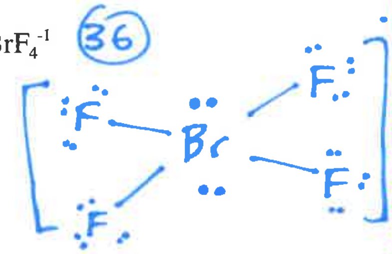
$HBrO_2$ (20)



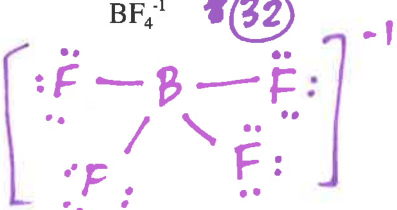
TeF_5^{-1} (42)



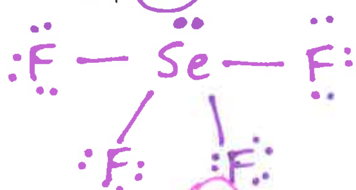
BrF_4^{-1} (36)



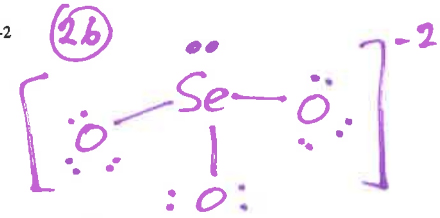
BF_4^{-1} (32)



SeF_4 (34)

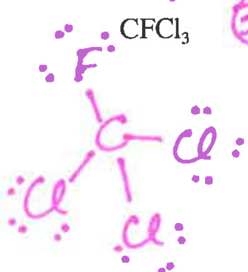


SeO_3^{-2} (26)

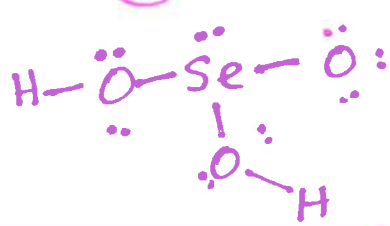


SeO_3 (24)

$CFCl_3$ (32)



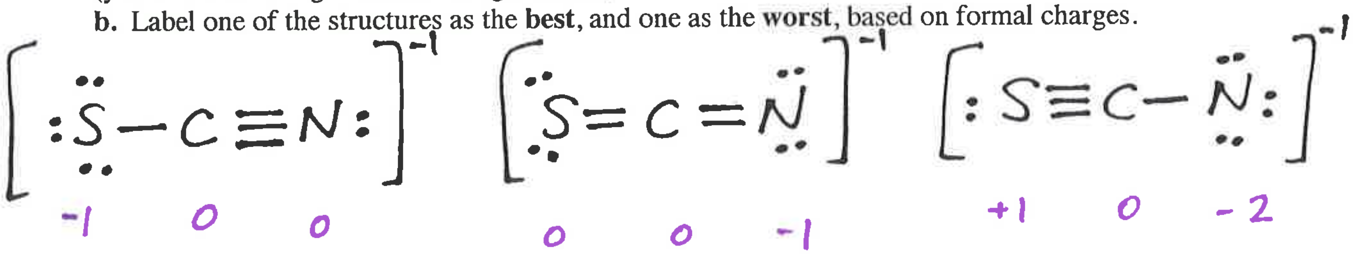
H_2SeO_3 (26)



4. Three possible dot structures for the thiocyanate ion, SCN^{-1}, are shown below.

a. Determine the formal charge for each atom in each structure, and write the formal charge next to each atom (you will be finding 9 formal charges in all).

b. Label one of the structures as the **best**, and one as the **worst**, based on formal charges.



BEST! ↑ N is more electronegative than Sulfur, so give N the negative F.C.

WORST! ↑ Since has the biggest F.C. values

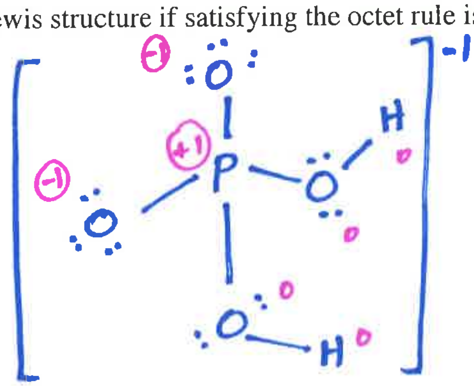
5. (I stole this from Chapter 6 #68)

Some chemists believe that satisfaction of the octet rule should be the top criterion for choosing the dominant Lewis structure of a molecule or ion. Other chemists believe that achieving the best formal charges should be the top criterion.

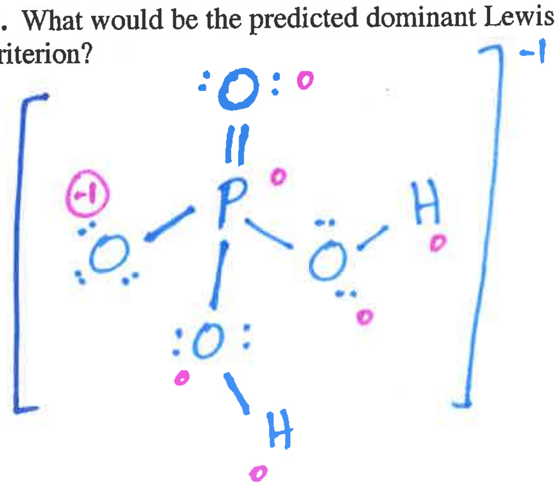
Consider the dihydrogen phosphate ion, $H_2PO_4^{-1}$, in which the H atoms are bonded to O atoms.

a. What would be the predicted dominant Lewis structure if satisfying the octet rule is the top criterion?

$2(1) + 5 + 4(6) + 1 = 32$ v.e.

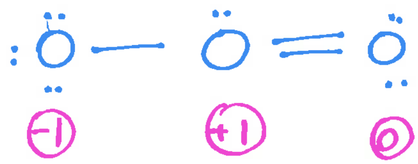


b. What would be the predicted dominant Lewis structure if achieving the best formal charges is the top criterion?



Something will have to have a nonzero F.C. since its an ion. It'll have 1 double bond (not 2) since doing 2 double bonds would give the Phosphorus the -1 FC instead of the oxygen. Since Oxygen is more electronegative than P, Oxygen should have the Negative F.C. (no explanation needed for HW)

2. a. Draw the Lewis Dot Structure for Ozone (O_3) in the space below part (b).
b. Determine the formal charge of each atom in the molecule and label each atom with its formal charge. (Don't worry about resonance for this problem)

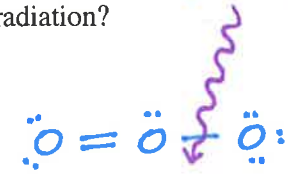


(OR, with correct geometry:

)

Up in the stratosphere, ozone shields us from a type of ionizing radiation.
c. What type of radiation does it shield us from? (what part of the EM spectrum?) ultraviolet (uv)
d. What is happening within the O_3 molecule when it absorbs this radiation?

It absorbs the uv and uses the energy to break a bond.



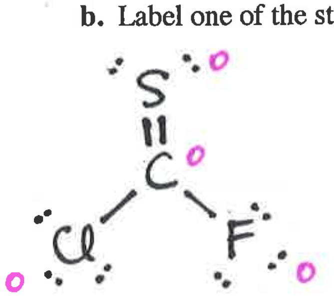
$uv + O_3 \rightarrow O_2 + O$

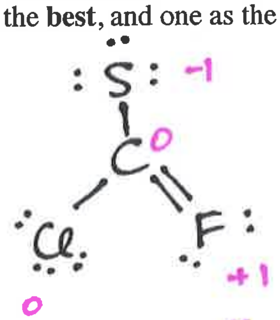
Ka Pow! the Bond breaks.

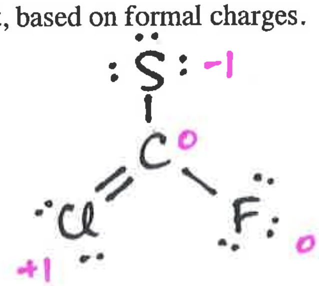
In the troposphere (the part of the atmosphere we breathe), ozone is a component of "photochemical smog" and is classified as a pollutant. According to EPA.gov, ozone can cause shortness of breath, coughing, inflamed and damaged airways, increased incidence of asthma attacks, increased susceptibility to lung infection, and chronic obstructive pulmonary disease (COPD).
e. Explain, based on your answers to (b), why ozone is so reactive!

Oxygen is the second most electronegative element (after F). So it will be very reactive if it has to have a positive formal charge. (The middle "O" has a +1 F.C.)

3. Three possible dot structures for a compound are shown below.
a. Determine the formal charge for each atom in each structure, and write the formal charge next to each atom (you will be finding 12 formal charges in all).
b. Label one of the structures as the **best**, and one as the **worst**, based on formal charges.







C: 4-4-0 = 0
S: 6-2-4 = 0
Cl: 7-1-6 = 0
F: 7-1-6 = 0

Best!
all F.C. = ∅

C: 4-4-0 = 0
S: 6-1-7 = -1
Cl: 7-1-6 = 0
F: 7-2-4 = +1

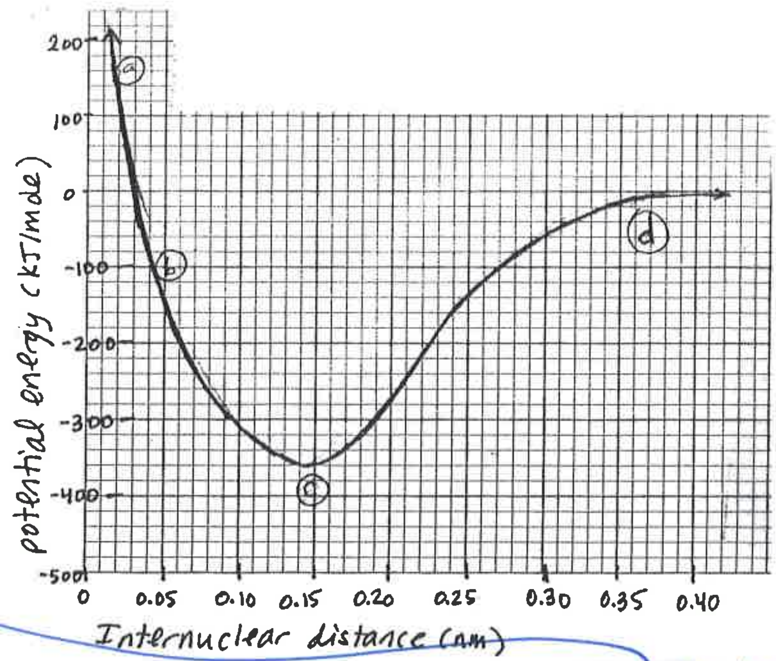
Worst! F and Cl are both very electronegative, but F is more electronegative, so F shouldn't have a positive F.C.

(you don't have to show work for F.C.)

Question E.

The graph to the right shows potential energy vs. internuclear distance for a C-O single bond.

(360 kJ are required to break one mole of C–O bonds)



1. Use the graph to determine the bond energy for the C-O bond. Include units! 360 kJ/mole (Book value is 358kJ)

2. Use the graph to determine the bond length for the C-O bond. Include units! ≈ 0.14 nm (Book value is 0.143nm)

3. The potential energy graph is most affected by forces between the electrons and the nuclei, and by forces between the two nuclei.

a. Is the force between the nuclei attractive or repulsive? repulsive
Explain your answer:

Both nuclei are positive due to the protons; same charge repels.

b. Is the force between the electrons and the nuclei attractive or repulsive? attractive
Explain your answer:

electrons are negative and the nucleus is positive; Opposite charges attract.

4. Why is the potential energy higher at point (d) than at point (c)? Explain.

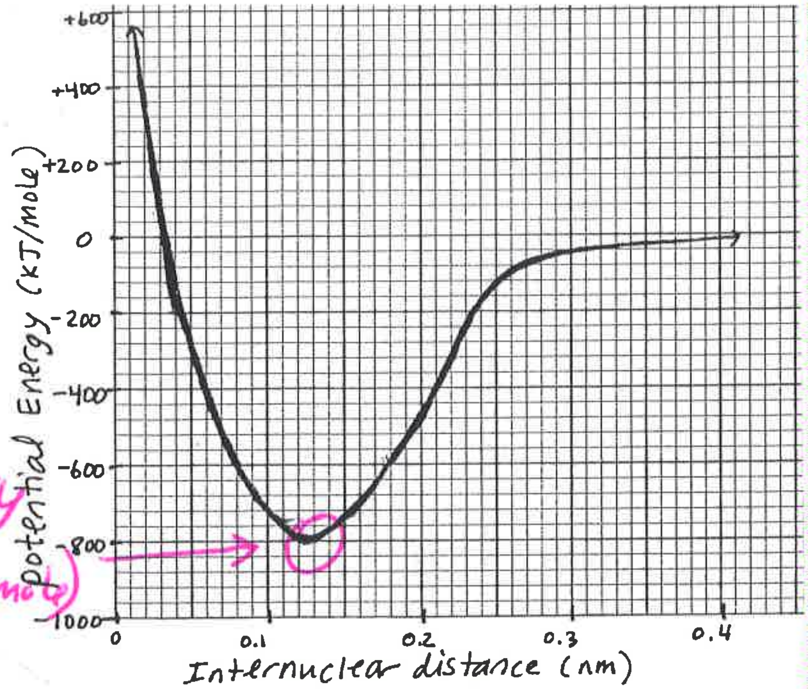
The atoms are further apart at (d) than they are at (c). The e- in each atom are attracted to each nucleus, so potential energy must increase as the e- increase their distance to the other atom's nucleus.

5. Why is the potential energy higher at point (a) than at point (c)? Explain.

The atoms are closer together at (a) than they are at (c). Since the nuclei repel each other, potential energy increases when the nuclei become closer.

This next graph is for a C=O double bond:

(Question E, contd)



Minimum potential energy is at (0.125 nm, -800 kJ/mole) acc to graph

6. Use the graph to determine the bond energy for the C=O bond. ≈ 800 kJ/mole (Book value is 799 kJ/mole)

7. Use the graph to determine the bond length for the C=O bond. ≈ 0.125 nm (Book value is 0.123 nm)

8. How do double bonds compare to single bonds in terms of bond energy? Double bonds have higher bond energies (Double bonds require more energy to break)

9. How do double bonds compare to single bonds in terms of length? Double bonds are shorter than single bonds.

10. Consider the CO triple bond. Based on your previous answers, which of these would make sense for bond energy and bond length, of the CO triple bond? Explain your choice.

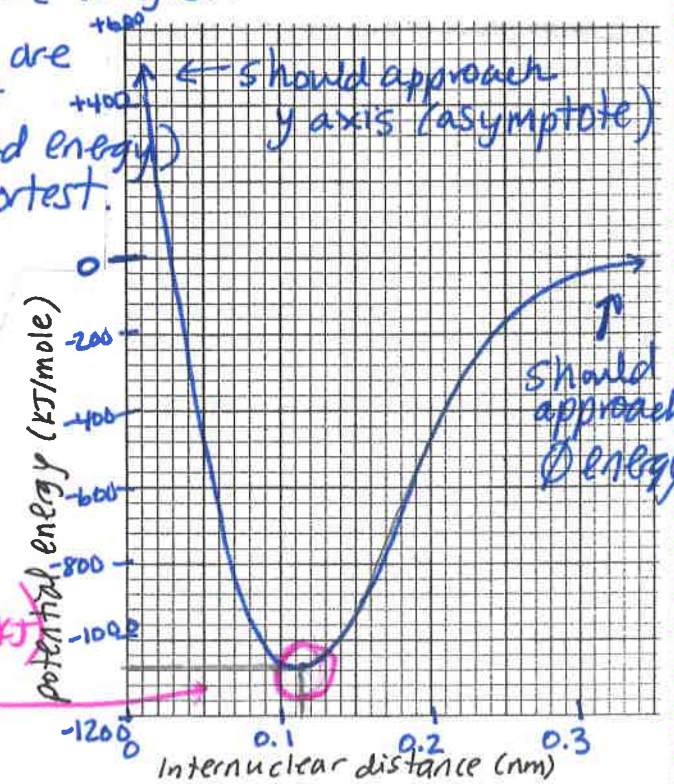
a. 650 kJ/mole and 0.113 nm
b. 1072 kJ/mole and 0.132 nm
c. 650 kJ/mole and 0.132 nm
(d.) 1072 kJ/mole and 0.113 nm

Single bonds are weakest (lowest bond energy) and are the longest. triple bonds are the strongest (highest bond energy) and the shortest.

1072 kJ > 800 kJ

0.113 nm < 0.125 nm

11. Use your answer to #10 to complete this graph for a CO triple bond.
(Label the scales on the axes and sketch the curve).



should reach minimum energy at (0.113 nm, -1072 kJ)