CHE1031 Module 7 lecture examples: Chemical bonding

7.1: Ionic bonding ***[sidebar = optional]***

1. Combine aluminum and oxygen to create an ionic compound.

2. Write the electron configurations of the Cr^{+3} and Zn^{+2} cations.

3. Write the electron configurations of the K and Mg cations.

4. Write the electron configurations of the Se and I anions.

5. Write the electron configurations of the P atom and anion.

7.2: Covalent bonding

6. Determine the types of bonds between these atoms and label their polarities.

C – H

S – H

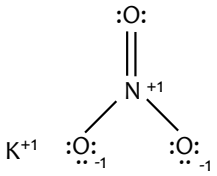
C – N

N – H

C – O

O – H

7. Determine the types of bonds in potassium nitrate and show polarity arrows.



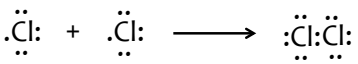
7.3: Lewis symbols & structures

8. Use Lewis symbols and arrows to diagram out the formation of aluminum fluoride from aluminum and fluoride atoms.

9. Lewis structures are used to show the structure and bonding patterns of covalent molecules.

- A pair of shared e- = : = ---
- Remember to show the unbonded electron pairs

H. + H. ⟶ H:H



10. Draw Lewis structures for these:

CHO_2^{-1}
NO^{+1}
OF_2

11. NASA's Cassini-Huygens mission detected a cloud of toxic hydrogen cyanide (HCN) on Titan, one of Saturn's moons. Titan's atmosphere also includes ethane (H_3CCH_3), acetylene (HCCH) and ammonia (NH_3). Draw their Lewis structures!

12. Both carbon monoxide and carbon dioxide are produced by combustion of fossil fuels. Draw their Lewis structures.

13. Draw the Lewis structure of nitric oxide (NO). It's an exception to the octet rule!

14. Draw the Lewis structure of beryllium dihydride (BeH_2). It's an exception to the octet rule!

15. Draw the Lewis structure of boron trifluoride (BF_3). It's an exception to the octet rule!

16. Draw the Lewis structure of phosphorus pentachloride (PCl_5). It's an exception to the octet rule!

17. Draw the Lewis structure of sulfur hexafluoride (SF_6). It's an exception to the octet rule!

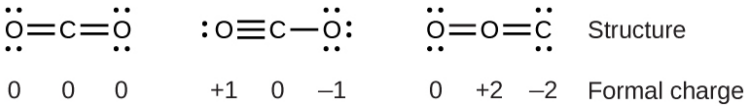
18. Write the Lewis structures for XeF_2, XeF_4, XeF_6 and identify any exceptions to the octet rule.

7.4: Formal charges & resonance

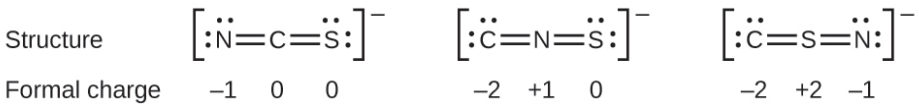
19. Calculate formal charges in ICl_4^{-1}. *Where is the -1 charge?*

20. Calculate formal charges in carbon monoxide.

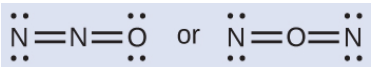
21. Which is the 'best' structure for carbon dioxide?



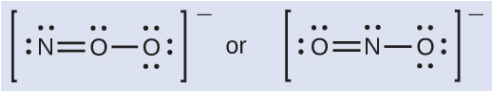
22. Which is the 'best' structure for the thiocyanate ion (-1)?



23. Nitrous oxide, N_2O, is commonly known as laughing gas. Which is the optimal structure for nitrous oxide?



24. Which is the 'best' structure for the nitrite ion (NO_2^{-1})?



25. The carbonate ion has resonance.
(a) Draw one Lewis structure of the carbonate ion, CO_3^{-2}.
(b) Draw all other resonance structures.
(c) What determines the number of resonance structures?
(d) Draw the resonance hybrid.

7.5: Strength of ionic & covalent bonding

26. Calculate the enthalpy change (ΔH) of this reaction:
$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$

27. Ethyl alcohol (ethanol) was one of the first chemicals made by man. Calculate the overall enthalpy change for the reaction shown here
$H_2CCH_2 + H_2O \rightarrow CH_3CH_2OH$

28. Explain why these lattice energies differ: *[sidebar = optional]*

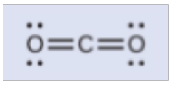
MgF_2	2957 kJ/mol
MgI_2	2327 kJ/mol

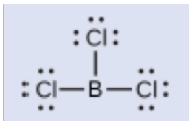
29. Which has higher lattice energy? *[sidebar = optional]*
Al_2O_3
Al_2Se_3

30. Which has higher lattice energy? *[sidebar = optional]*
ZnO
NaCl

7.6: Molecular structures and geometries

31. Using the Lewis dot structures for CO_2 and BCl_3 shown here, use the VSEPR to determine bond angles, electron pair and molecular geometries.





32. Use VSEPR to determine the electron pair and molecular geometries of:
(a) H_2O
(b) SF_4

33. Use VSEPR to determine the electron pair and molecular geometries of each 'center' of the amino acid glycine.