CHEM 202 Accelerated General Chemistry I Week 12 – Chemical Bonding and IMFs II MERIT WS 12.2 TA: Alex Wang November 11, 2021 Section AQG



Remember to continue learning your VSEPR shapes and geometries!

Oxidation of the cyanide ion produces the stable cyanate ion (OCN⁻). The fulminate ion (CNO⁻), on the other hand, is very unstable. Fulminate salts explode when struck; Hg(CNO)₂ is used in blasting caps. Write the Lewis structures and assign formal charges for the cyanate and fulminate ions. Why is the fulminate ion so unstable? (Hint: C is the central atom in OCN⁻ and N is the central atom in CNO⁻).

2. Consider Remdesivir, an antiviral used to treat COVID-19. It can insert itself into the growing RNA of COVID-19 during replication and stops RNA Polymerase and other replication machinery from working. Looking at the circled spots in the molecule, label the shape. What are possible places where hydrogen bonding would occur? Where do you think the drug incorporates into the RNA? (Remember anytime you see a wedge, it is a carbon!)



- 3. Predict the molecular structure (shape and geometry) and the bond angles for each of the following.
 - a. $XeCl_2$
 - b. ICl₃
 - $c. \quad \mathsf{TeF}_4$
 - $d. \ PCI_5$
 - e. ICI_5
 - f. XeCl₄
 - $g. \ SeCl_2$

4. A toxic cloud covered Bhopal, India, in December 1984 when water leaked into a tank of methyl isocyanate and the product escaped into the atmosphere. Methyl isocyanate is used in the production of many pesticides. Draw the Lewis structure for methyl isocyanate, CH₃NCO, including resonance forms.

5. Give two requirements that should be met for a molecule to be polar. Explain why CF₄ and XeF₄ are nonpolar compounds, whereas SF₄ is polar. Is CO₂ polar? What about COS? Explain. (*Hint ... draw them out!*)

6. In the Van der Waals equation, why is a term added to the observed pressure and why is a term subtracted from the container volume to correct for nonideal gas behavior?

7. Without looking at tables of values, which of the following gases would you expect to have the largest value of the Van der Waals constant b: hydrogen gas, nitrogen gas, methane, ethane, or propane?

- 8. Define the following:
 - a. Intermolecular Force:
 - i. Hydrogen Bonding:
 - ii. Dipole-Dipole:
 - iii. Van der Waals Forces:
 - b. Intramolecular Force:
 - i. Ionic Bonding:
 - ii. Covalent Bonding:

- 9. In each of the following groups of substances, pick the one that has the given property. Justify each answer.
 - a. Highest boiling point: carbon tetrachloride, carbon tetrafluoride, carbon tetrabromide
 - b. Lowest freezing point: LiF, F₂, HCl
 - c. Lowest vapor pressure at 25°C: CH₃OCH₃, CH₃CH₂OH, CH₃CH₂CH₃
 - d. Greatest Viscosity: H_2S , HF, or H_2O_2
 - e. Greatest Heat of Vaporization: H₂CO, CH₃CH₃, CH₄
 - f. Smallest Enthalpy of Fusion: I₂, CsBr, or CaO

- 10. Rationalize the difference in boiling points for each of the following pairs of substances:
 - a. *n*-pentane (straight chain of carbon atoms): 36.2°C and neopentane (C(CH₃)₄): 9.4°C
 - b. HF: 20°C and HCl: -85°C
 - c. HCl: -85°C and LiCl: 1360°C
 - d. *n*-pentane: 36.2°C and *n*-hexane (straight chain of 6 carbon atoms): 69°C

11. Given the following data:

Lattice energy: $CaCl_{2(s)} = -2247 \text{ kJ/mol}$. $Cal_{2(s)} = -2059 \text{ kJ/mol}$

 ΔH_{soln} : CaCl_{2(s)} = -46 kJ/mol. Cal_{2(s)} = -104 kJ/mol

- a. Use the above data to calculate the enthalpy of hydration for calcium chloride and calcium iodide.
- b. Based on your answer to part a, which ion is more strongly attracted to water?

12. Although aluminum hydroxide is insoluble in water, sodium hydroxide is very soluble. Explain this difference in terms of lattice energies.

- 13. Which solvent, water or carbon tetrachloride, would you choose to dissolve each of the following?
 - a. KrF_2
 - b. SF_2
 - c. SO₂
 - d. CO_2
 - e. MgF₂
 - $f. \quad CH_2O$
 - g. $CH_2=CH_2$

- 14. A promising new material with great potential as a fuel in solid rocket motors is ammonium dinitramide $[NH_4N(NO_2)_2]$.
 - a. Draw a Lewis structures (including resonance forms) for the dinitramide ion $[N(NO_2)_2]$.
 - b. Predict the bond angles around each nitrogen in the dinitramide ion.
 - c. Ammonium dinitramide can decompose explosively to nitrogen, water, and oxygen. Write a balanced equation for this reaction and use bond energies to estimate ΔH for the explosive decomposition of this compound.
 - d. To estimate ΔH from the bond energies, you made several assumptions. What are some of your assumptions?

15. Given the two isomers with the formula C_2H_6O and respective boiling point data explain their differences in boiling point.



Boiling Point of Ethyl Alcohol: 79°C Boiling Point of Dimethyl Ether: -24°C

16. Peptide Synthesis

The figure below describes the generalized mechanism for peptide formation. You will discuss the mechanism in much more depth within your organic chemistry courses. However, we can use our CHEM 202 knowledge to begin to assign some properties to the peptide bond.

My challenge for you is to identify whether the peptide bond has single bond character, double bond character, or a mixture of both. Explain using pictures and words. Additionally, how do you think the bond character affects protein structures (remember amino acids make up complex proteins)? Make an educated guess.

