Chemistry 202: Quiz #8

1. Which of the following bonds is the **most** polar?

   a) N—O
   b) P—O
   c) S—O
   d) Cl—O
   e) F—O

2. Hydrocarbons, as the name implies, consist only of carbon and hydrogen. For so-called *saturated* hydrocarbons (with the maximum number of hydrogen atoms per molecule), the general formula is C_nH_{2n+2}. When hydrocarbons combust with oxygen gas, the products are carbon dioxide and water vapor. Estimate the **magnitude** of the difference between $\Delta H°$ values for these reactions for two hydrocarbons, one with x carbon atoms per molecule and the other with $(x + 1)$ carbon atoms per molecule, in units of kJ/mol of hydrocarbon.

   a) 400 kJ/mol b) 600 kJ/mol c) 800 kJ/mol d) 1000 kJ/mol e) 1200 kJ/mol

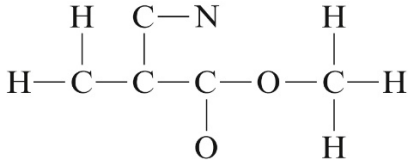
3. For ozone gas (O_3), the value of $\Delta H°_f$ is 143 kJ/mol. Which of the following is the best estimate for the average bond energy in the ozone molecule?

   a) 72.0 kJ/mol b) 150 kJ/mol c) 300 kJ/mol d) 400 kJ/mol e) 500 kJ/mol

4. Consider the following gases, all at 500K: Ne, C_3H_8, H_2O, He, C_2H_6. Arrange them from most ideal to least ideal behavior as gases. Which gas is in the middle of the order?

   a) Ne b) C_3H_8 c) H_2O d) He e) C_2H_6

5. The skeletal structure of methyl cyanoacrylate (the main ingredient of Super Glue) is



   Draw the complete Lewis structure for methyl cyanoacrylate by minimizing formal charge and determine the C—C—N bond angle.

   a) 90° b) 109° c) 120° d) 180°

6. You are your friends are playing this really cool game where you have found small molecules with the general formula XY_2 and written their formulas on separate pieces of paper. You make enough so that there is one example of every geometry-shape combination for a molecule with the formula XY_2. You then randomly take a piece of paper and determine the shape. What are the odds that the shape will be *bent*?

   a) 10% b) 20% c) 33% d) 40% e) 60%

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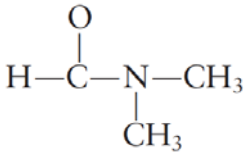
7. The skeletal structure for N,N-dimethylformamide (a common organic solvent, commonly abbreviated as DMF) is



How many possible resonance structures exist for DMF?

a) 0 b) 1 c) 2 d) 3 e) 4

8. Each of the four groups below has two molecules with the same general formula:

- CO_2 and SO_2
- BF_3 and NF_3
- CF_4 and SF_4
- PF_5 and IF_5

How many groups include one nonpolar and one polar molecule?

a) 0 b) 1 c) 2 d) 3 e) 4

9. We discussed Lewis structures as models – their significance and limitations. In this question we will examine these.

   a. When drawing a Lewis structure of ozone (O_3), we need to include resonance structures. When drawing a Lewis structure of carbon dioxide, we do not need to use resonance structures. **Explain** why this is true, discussing **why we use resonance structures** and **why they show there is a flaw** in the Lewis structure model.
   b. Consider the reaction of ozone to oxygen gas [$2O_3(g) \rightarrow 3O_2(g)$]. Use Lewis structures, bond energies (Table 13.6), and your understanding of thermodynamics, to decide if the reaction as written is: always spontaneous, never spontaneous, or spontaneous only at a certain temperature range (if you choose this one, specify if it spontaneous at relatively high or relatively low temperatures). If you believe that more information is needed to answer this, explain why, what is needed, and how it would help you to decide. Whichever you chose, make sure to **defend your answer**.
   c. Use bond energies to estimate $\Delta H°_f$ for ozone, $O_3(g)$, and $\Delta H°_f$ for atomic oxygen, $O(g)$. **Show all work**. Which value, if either, is expected to be more accurate? **Defend your answer** by addressing in general why bond energies can be used to accurately determine $\Delta H°_f$ values, and why sometimes using bond energies is not as accurate.

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KEY:

MC: 1. b, 2. b, 3. c, 4. e, 5. d, 6. d, 7. c, 8. e

9. See videos, lectures, and the textbook.