Dougherty Valley HS Chemistry - AP
Bonding – FRQs

Worksheet #7

Name: **Period:** **Seat#:**

2006 D

7. Answer the following questions about the structures of ions that contain only sulfur and fluorine.

(a) The compounds SF_4 and BF_3 react to form an ionic compound according to the following equation.

$$SF_4 + BF_3 \rightarrow SF_3BF_4$$

(i) Draw a complete Lewis structure for the SF_3^+ cation in SF_3BF_4.

(ii) Identify the type of hybridization exhibited by sulfur in the SF_3^+ cation.

(iii) Identify the geometry of the SF_3^+ cation that is consistent with the Lewis structure drawn in part (a)(i).

(iv) Predict whether the F—S—F bond angle in the SF_3^+ cation is larger than, equal to, or smaller than 109.50˚. Justify your answer.

(b) The compounds SF_4 and CsF react to form an ionic compound according to the following equation.

$$SF_4 + CsF \rightarrow CsSF_5$$

(i) Draw a complete Lewis structure for the SF_5^- anion in $CsSF_5$.

(ii) Identify the type of hybridization exhibited by sulfur in the SF_5^- anion.

(iii) Identify the geometry of the SF_5^- anion that is consistent with the Lewis structure drawn in part (b)(i).

(iv) Identify the oxidation number of sulfur in the compound $CsSF_5$.

2006 D

6. Answer each of the following in terms of principles of molecular behavior and chemical concepts.

(a) The structures for glucose, $C_6H_{12}O_6$, and cyclohexane, C_6H_{12}, are shown below. *(to the right for spacing)*

Identify the type(s) of intermolecular attractive forces in

(i) pure glucose

(ii) pure cyclohexane

(b) Glucose is soluble in water but cyclohexane is not soluble in water. Explain.

(c) Consider the two processes represented below.

Process 1: $H_2O(l) \rightarrow H_2O(g)$ $\quad \Delta H^\circ = +44.0$ kJ mol^{-1}

Process 2: $H_2O(l) \rightarrow H_2(g) + \frac{1}{2} O_2(g)$ $\quad \Delta H^\circ = +286$ kJ mol^{-1}

(i) For each of the two processes, identify the type(s) of intermolecular or intramolecular attractive forces that must be overcome for the process to occur.

(ii) Indicate whether you agree or disagree with the statement in the box below. Support your answer with a short explanation.

When water boils, H_2O molecules break apart to form hydrogen molecules and oxygen molecules.

(d) Consider the four reaction-energy profile diagrams shown below.

(i) Identify the two diagrams that could represent a catalyzed and an uncatalyzed reaction pathway for the same reaction. Indicate which of the two diagrams represents the catalyzed reaction pathway for the reaction.

(ii) Indicate whether you agree or disagree with the statement in italics. Support your answer with a short explanation. *"Adding a Catalyst to a reaction mixture adds energy that causes the reaction to proceed more quickly."*

2005 D

7. Use principles of atomic structure, bonding and/or intermolecular forces to respond to each of the following. Your responses must include specific information about all substances referred to in each question.

(a) At a pressure of 1 atm, the boiling point of NH_3*(l)* is 240 K, whereas the boiling point of NF_3*(l)* is 144 K.
  (i) Identify the intermolecular forces(s) in each substance.
  (ii) Account for the difference in the boiling points of the substances.

(b) The melting point of KCl*(s)* is 776˚C, whereas the melting point of NaCl*(s)* is 801˚C.
  (i) Identify the type of bonding in each substance.
  (ii) Account for the difference in the melting points of the substances.

(c) As shown in the table below, the first ionization energies of Si, P, and Cl show a trend.

Element	First Ionization Energy (kJ mol^{-1})
Si	786
P	1012
Cl	1251

  (i) For each of the three elements, identify the quantum level (e.g., n =1, n = 2, etc.) of the valence electrons in the atom.
  (ii) Explain the reasons for the trend in the first ionization energy.

(d) A certain element has two stable isotopes. The mass of one of the isotopes is 62.93 amu and the mass of the other isotope is 64.93 amu.
  (i) Identify the element. Justify your answer.
  (ii) Which isotope is more abundant? Justify your answer.

2005 D

6. Answer the following questions that relate to chemical bonding

(a) In the boxes provided, draw the complete Lewis structure (electron-dot diagram) for each of the three molecules represented below.

CF_4	PF_5	SF_4

(b) On the basis of the Lewis structures drawn above, answer the following questions about the particular molecule indicated.

(i) What is the F-C-F bond angle in CF_4?
(ii) What is the hybridization of the valence orbitals of P in PF_5?
(iii) What is the geometric shape formed by the atoms in SF_4?

(c) Two Lewis structures can be drawn for the OPF_3 molecule, as shown. Structure 1 Structure 2
  (i) How many sigma bonds and how many pi bonds are in structure 1?
  (ii) Which one of the two structures best represents a molecule of OPF_3? Justify your answer in terms of formal charge.

2004

7. Use appropriate chemical principles to account for each of the following observations. In each part, your response must include specific information about both substances.

(a) At 25˚ C and 1 atm, F_2 is a gas whereas I_2 is a solid.

(b) The melting point of NaF is 993˚ C, whereas the melting point of CsCl is 645˚.

(c) The shape of ICl_4^- ion is square planar, whereas the shape of BF_4^- ion is tetrahedral.

(d) Ammonia, NH_3, is very soluble in water, whereas phosphine, PH_3, is only moderately soluble in water.