1 Cognitive reasoning in the chemical sciences 5.10

1. Please assume the octet rule is obeyed for all the compounds below. Please draw traditional and modern Lewis structures for all the molecules below. Please add all lone pairs, resonance structures, and non-zero formal charges to all your Lewis structures.

   (a) I_3^-, the modern Lewis structure of this ion has two and only two surprising resonance forms.

   (b) SiF_6^{2-}, just draw a few of the resonance structures for this one.

   (c) PF_5

2. Please estimate the number of bonds the metal makes in the following compounds:

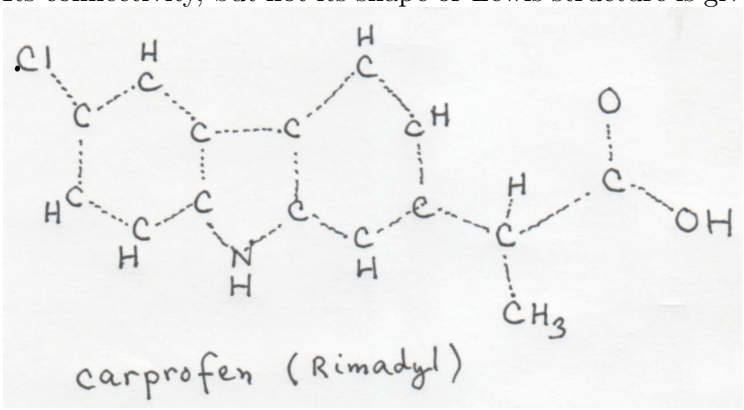
   (a) TiO_2

   (b) TiF_4

   (c) Fe_2O_3

3. Both the animals and people we care for are constantly being administered medicines. Most medicines consist of just one active compound, i.e., one specific molecule. The rules which you have learned about Lewis structures and molecular shape apply to these molecules.

   In this problem please consider the molecule carprofen, a powerful, and sometimes dangerous medicine which under the trade name Rimadyl is one of the leading medicines given to severely arthitic dogs. Its connectivity, but not its shape or Lewis structure is given on the next page.



   (a) Please draw two of the possible Lewis structures for this molecule. Use the resonance convention in writing down your answer.

   (b) Although you are not asked to draw all the most possible resonance structures, please determine how many of such resonance structures there are.

   (c) For those atoms with more than one bond, please identify all those which have a steric number of 4.

   (d) Both the nitrogen atom in this molecule and the carbon molecule at the right end of the molecule (that is the carbon molecule bonded to the two oxygen atoms) have three

atoms to which they are bonded. Which of these two atoms lies in the plane of the atoms to which they are bound?

(e) There are an enormous number of SN 3 atoms in carprofen. SN 3 corresponds to the trigonal planar environment and arrays of neighboring SN 3 atoms often lie all in the same plane. Please draw a Lewis structure of a carprofen molecule circling those atoms which all lie in the same plane as one another.

4. Based on the Mooser-Pearson diagram given in class, deduce which of the following compounds are on the ionic side and which are on the covalent side of the diagram: BN, SrSe, BeS, AlP, and KBr.

5. Please use the flow chart given in class to deduce the molecular shape of the following compounds. Please state whether the compound is a molecule or an extended solid. Please draw a picture following standard chemistry conventions of the molecular shape. In the case of extended solids, please include a large enough piece that the attentive reader can deduce the bonding environment of each of the elements in the structure.

   (a) brass, a mixture of copper and zinc atoms
   (b) CaO
   (c) TeF_6
   (d) MoF_6
   (e) MoF_2
   (f) $CaCO_3$
   (g) $HOSi(OC(CH_3)_3)$