Chemistry 217
Problem Set 1

Recommended Problems from the Book (1st ed. in parentheses): 1.1, 1.3-1.9, 1.36-1.42, 1.57-1.62 (1.1-1.8, 1.34-1.40, 1.54-1.58)


1. Draw the Lewis structure for each of the following molecules. Show all lone pairs. All molecules are neutral and all formal charges are zero.

(a) \( \text{CH}_2\text{Cl}_2 \)  (b) \( (\text{CH}_3)_2\text{COH} \)  (c) \( (\text{CH}_3)_2\text{O} \) (same as \( \text{CH}_3\text{OCH}_3 \))

(d) \( \text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_3 \)  (e) \( \text{CH}_3\text{CHO} \)  (f) \( \text{CH}_3\text{CH}(\text{CH}_2\text{CH}_3)\text{CH}_2\text{NHCH}_3 \)

2. Each of the following molecules is neutral. Determine the formal charge for each atom in the molecules (All lone pairs are shown).

(a) \( \text{H} \quad \text{H} \quad \text{C} \quad \text{H} \)

(b) \( \text{H} \quad \text{C} \quad \text{P} \quad \text{H} \quad \text{H} \quad \text{C} \quad \text{H}_3 \quad \text{C} \quad \text{H}_3 \quad \text{C} \quad \text{H}_3 \quad \text{P} \quad \text{C} \quad \text{H}_3 \)

(c) \( \text{H} \quad \text{C} \quad \text{P} \quad \text{H} \quad \text{H} \quad \text{C} \quad \text{H}_3 \quad \text{C} \quad \text{H}_3 \quad \text{C} \quad \text{H}_3 \quad \text{P} \quad \text{C} \quad \text{H}_3 \)

(d) \( \text{H}_3\text{N} \quad \text{H}_2\text{O} \quad \text{H}_2\text{N} \quad \text{H}_2\text{O} \)

(e) \( \text{H}_2\text{C} \quad \text{C} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{C} \quad \text{H}_3 \quad \text{C} \quad \text{H}_3 \quad \text{C} \quad \text{H}_3 \quad \text{P} \quad \text{C} \quad \text{H}_3 \)

3. Fill in the lone pairs on the following molecules. All non-zero formal charges are shown.

(a) \( \text{O}^+ \)  (b) \( \text{N} \)  (c) \( \text{N} \quad \text{H} \)

(d) \( \text{H}_3\text{C} \quad \text{Cl} \quad \text{H}_5\text{C} \quad \text{O} \quad \text{H}_3\text{C} \quad \text{H} \quad \text{H} \quad \text{H} \)
4. In class, we determined the rules of thumb in determining formal charge for carbon. This information is shown in the first rows of the table below. Fill in the remaining blank spaces for H, O, and N. Remember that you cannot violate the octet rule.

<table>
<thead>
<tr>
<th>Atom</th>
<th># of bonds</th>
<th># of lone pairs</th>
<th>charge</th>
</tr>
</thead>
<tbody>
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<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>+1</td>
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<tr>
<td></td>
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<td>1</td>
<td>-1</td>
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<tr>
<td></td>
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<tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td>+1</td>
</tr>
</tbody>
</table>

5. Fill in the lone pairs and formal charges on the atoms in the following molecules (all hydrogens are shown).

(a) \( \text{BF}_3 \)  
(b) \( \text{HOH} \)  
(c) \( \text{H}_2\text{O} \)  

(d) \( \text{H}_2\text{F} \)  
(e) \( \text{HF} \)  

(f) \( \text{H}_3\text{C-O-C-O-CH}_3 \)  

(g) \( \text{O} \)  
(h) \( \text{O} \)  

(i) \( \text{N=N=N} \)

6. Draw valid Lewis structures for the following. For each one, assign all non-zero formal charges and the overall charge on the molecule.

(a) \( \text{H}_3\text{NCH}_2\text{CHNH} \)  
(b) \( \text{CH}_3\text{CH}_2\text{CO}_2 \)  
(c) \( \text{CH}_2\text{CHCH}_2 \)
(7) Draw constitutional isomers which fulfill the following criteria:

(a) Pentane: C\textsubscript{5}H\textsubscript{12} (three different isomers)
(b) C\textsubscript{4}H\textsubscript{10}O
(c) C\textsubscript{5}H\textsubscript{10} (Draw at least four. Two should be cyclic molecules. Two should contain a carbon-carbon double bond.
(d) C\textsubscript{6}H\textsubscript{10} (Draw at least one isomer of compounds containing the following types of functionality: 1) a compound with two double bonds; 2) a compound with a ring and a double bond; 3) a compound with a triple bond; 4) a compound with two rings
(e) C\textsubscript{5}H\textsubscript{10}O\textsubscript{2} (Draw as many as you can.)

(8) Give the molecular formula of the following compounds:

(a) nicotine
(b) vitamin C
(c) cholesterol