CHEM1102 Worksheet 12 – Answers to Critical Thinking Questions

The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

Model 1: The oxidation number and electronic configuration of transition metal cations in coordination compounds
1 – 2. See table below.

Model 2: To minimize repulsion, electrons occupy orbitals singly before they pair up
1 – 2. See table below.

<table>
<thead>
<tr>
<th>Coordination Compound or Complex</th>
<th>Oxidation Number</th>
<th>d Configuration</th>
<th>Electron Arrangement</th>
<th>Paramagnetic?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na[MnO₄]⁻</td>
<td>+7</td>
<td>d⁰</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>(NH₄)₂[CoCl₄]</td>
<td>+2</td>
<td>d⁷</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>[Cr(NH₃)₅(H₂O)]Cl₃</td>
<td>+3</td>
<td>d³</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>[Zn(en)₂Cl₂]</td>
<td>+2</td>
<td>d¹⁰</td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

Model 3: Iron in Biology (1): Transferrin
1. Five unpaired electrons.
2. Coordination number is 6 and coordination geometry is approximately octahedral. CO₃²⁻ is bidentate.
3. CO₃²⁻ is a weak base and will become protonated at low pH. This will lead to it detaching from the iron.

Model 4: Iron in Biology (2): Ferredoxins
1. Coordination number is 4 and coordination geometry is approximately tetrahedral.
3. Although there are 5 unpaired electrons on each Fe(III) atom, the electrons on one Fe(III) have opposite spins to those on the other Fe(III) atom. Overall, there are no net unpaired electrons.
4. Fe(III) will have 5 unpaired electrons and Fe(II) will have 4 unpaired electrons. If these point in opposite directions, there will be 1 net unpaired electron.