CHEM1102 Worksheet 13 - Answers to Critical Thinking Questions

The worksheets and the associated group work form an integral part of the learning outcomes and experience for this unit.

Model 1: Naming Coordination Compounds

1. (a) pentaamminechloridocobalt(III)
   (b) trichloridohydroxidoaurate(III)
   (c) tetraaquadichloridochromium(III)
   (d) pentaammineaquaruthenium(III)

2. (a) pentaamminechloridocobalt(III) chloride
   (b) potassium trichloridohydroxidoaurate(III)
   (c) tetraaquadichloridochromium(III) chloride
   (d) pentaammineaquaruthenium(III) bromide
   (e) tris(ethylenediamine)nickel(II) iodide

Model 2: Rate of Reaction

1. Rate is defined as the change in concentration with time: M s$^{-1}$.
2. As $[\text{sucrose}]$ decreases, $[\text{fructose}]$ increases at the same rate.
3. Sucrose and $\text{H}_3\text{O}^+$ are both reactants and so their concentrations decrease with time, Fructose and glucose are both products and so their concentrations increase with time.
4. From the chemical equation, $[\text{NO(g)}]$ will increase at exactly the same rate as $[\text{NO}_2(g)]$ decreases but $[\text{O}_2(g)]$ is produced at half the rate.

Model 3: The Rate Law

1. (a) The rate increases by a factor of 4 (i.e. it quadruples).
   (b) The rate increases by a factor of 2 (i.e. it doubles)
   (c) The rate is unchanged.

2. (a) The rate doubles.
   (b) The rate doubles.
   (c) The rate quadruples (i.e. it increases by a factor of 4).

3. (a) $[\text{lactose}]_0$ is doubled and $[\text{H}_3\text{O}^+]$ is unchanged. The rate doubles.
   (b) $[\text{lactose}]_0$ is unchanged and $[\text{H}_3\text{O}^+]$ is increased by a factor of 4. The rate increases by a factor of 4.
   (c) The reaction is first order with respect to both lactose and $\text{H}_3\text{O}^+$: $x = 1$ and $y = 1$.
   \[
   \text{rate} = k[\text{lactose}]^1[\text{H}_3\text{O}^+]^1 = k[\text{lactose}][\text{H}_3\text{O}^+] \]
(d) [lactose]₀ is decreased by a factor of 2. On its own, this change would half the rate. [H₃O⁺] is increased by a factor of 4. On its own, this change would reduce the rate by 4. When both changes are made together, the rate therefore doubles.

(e) Using experiment (1),
\[
\text{rate} = k \times (0.01 \text{ M}) \times (0.001 \text{ M}) = 0.00116 \text{ M s}^{-1} \text{ so } k = 116 \text{ M}^{-1} \text{ s}^{-1}
\]
Using experiment (2),
\[
\text{rate} = k \times (0.02 \text{ M}) \times (0.001 \text{ M}) = 0.00232 \text{ M s}^{-1} \text{ so } k = 116 \text{ M}^{-1} \text{ s}^{-1}
\]
Using experiment (3),
\[
\text{rate} = k \times (0.01 \text{ M}) \times (0.004 \text{ M}) = 0.00464 \text{ M s}^{-1} \text{ so } k = 116 \text{ M}^{-1} \text{ s}^{-1}
\]