CHEM1102 Worksheet 13 - Answers to Critical Thinking Questions

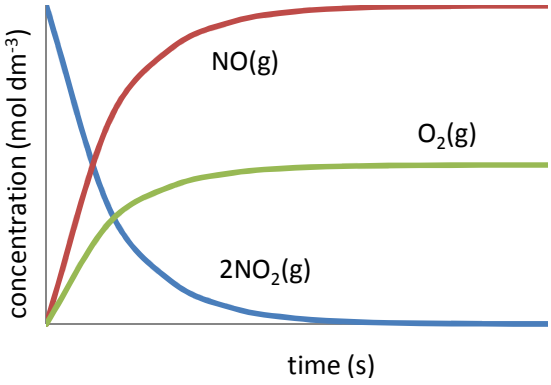
The worksheets and the associated group work form an integral part of the learning outcomes and experience for this unit.

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 [sucrose] decreases, [fructose] *increases* at the same rate.
3. Sucrose and H_3O^+ 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, [NO(g)] will increase at exactly the same rate as [NO_2(g)] decreases but [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) $[lactose]_0$ is doubled and $[H_3O^+]$ is unchanged. The rate doubles.
   (b) $[lactose]_0$ is unchanged and $[H_3O^+]$ 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 H_3O^+: $x = 1$ and $y = 1$.
   rate = $k[lactose]^1[H_3O^+]^1 = k[lactose][H_3O^+]$

(d) $[\text{lactose}]_0$ is decreased by a factor of 2. On its own, this change would half the rate.
$[H_3O^+]$ 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),

$$\text{rate} = k \times (0.01\ \text{M}) \times (0.001\ \text{M}) = 0.00116\ \text{M s}^{-1} \quad \text{so} \quad k = 116\ \text{M}^{-1}\ \text{s}^{-1}$$

Using experiment (2),

$$\text{rate} = k \times (0.02\ \text{M}) \times (0.001\ \text{M}) = 0.00232\ \text{M s}^{-1} \quad \text{so} \quad k = 116\ \text{M}^{-1}\ \text{s}^{-1}$$

Using experiment (3),

$$\text{rate} = k \times (0.01\ \text{M}) \times (0.004\ \text{M}) = 0.00464\ \text{M s}^{-1} \quad \text{so} \quad k = 116\ \text{M}^{-1}\ \text{s}^{-1}$$