Derivation of Rate law

The rate law for the suggested plan can be elucidated in the following manner:

$$\text{Rate of Reaction} = -\frac{\mathrm{d}\,[\mathrm{DPC}]}{\mathrm{dt}} = \mathrm{k}\,[\mathrm{Complex}][\mathrm{Cu(H_2O)_2\ (H_2IO_6)}] \quad (1)$$

Equations 7, 8, and 9 were used to produce,

$$\text{Rate of Reaction} = -\frac{\mathrm{d}\,[\mathrm{DPC}]}{\mathrm{dt}} = \frac{\mathrm{kK_1K_2K_3[L-leucine]_F[Ru(III)]_F[DPC]_F[OH^-]_F}}{[\mathrm{H_3IO_6^{2-}}]} \quad (2)$$

The entirety of the [DPC] can be represented as follows,

$$[\mathrm{DPC}]_\mathrm{T} = [\mathrm{DPC}]_\mathrm{F} + [\mathrm{Cu(H_2O)_2\ (H_2IO_6)}] + [\mathrm{Cu\ (H_2IO_6)(H_3IO_6)^{2-}}]$$

$$[\mathrm{DPC}]_\mathrm{T} = [\mathrm{DPC}]_\mathrm{F} + \mathrm{K_1}[\mathrm{DPC}]_\mathrm{F}[\mathrm{OH^-}] + \frac{\mathrm{K_1K_2}[\mathrm{DPC}]_\mathrm{F}[\mathrm{OH^-}]}{[\mathrm{H_3IO_6^{2-}}]}$$

$$[\mathrm{DPC}]_\mathrm{F} = \frac{[\mathrm{DPC}]_\mathrm{T}\,[\mathrm{H_3IO_6^{2-}}]}{[\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1}[\mathrm{OH^-}][\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1K_2}[\mathrm{OH^-}]} \quad (3)$$

In a comparable manner, the overall [Ru(III)] can be expressed as,

$$[\mathrm{Ru(III)}]_\mathrm{T} = [\mathrm{Ru(III)}]_\mathrm{F} + [\mathrm{Ru(III)\ in\ Complex}]$$

$$[\mathrm{Ru(III)}]_\mathrm{T} = [\mathrm{Ru(III)}]_\mathrm{F} + \mathrm{K_3}\,[\mathrm{L-leucine}]\,[\mathrm{Ru(III)}]_\mathrm{F}$$

$$[\mathrm{Ru(III)}]_\mathrm{F} = \frac{[\mathrm{Ru(III)}]_\mathrm{T}}{1 + \mathrm{K_3}[\mathrm{L-leucine}]} \quad (4)$$

Given the low concentrations of DPC and $H_3IO_6^{2-}$, it is reasonable to consider,

$[\mathrm{L-leucine}]_\mathrm{T} = [\mathrm{L-leucine}]_\mathrm{F}$, and $[\mathrm{OH^-}]_\mathrm{T} = [\mathrm{OH^-}]_\mathrm{F}$

In light of the aforementioned condition and by employing Equations 3 and 4, Equation 2 is reformulated into Equation 5,

$$\text{Rate} = \frac{\mathrm{kK_1K_2K_3\,[L-leucine]\,[Ru(III)]\,[DPC]\,[OH^-]}}{[\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1}[\mathrm{OH^-}][\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1K_2}[\mathrm{OH^-}] + \mathrm{K_3}[\mathrm{L-leucine}][\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1K_3}[\mathrm{L-leucine}][\mathrm{OH^-}][\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1K_2K_3}[\mathrm{L-leucine}][\mathrm{OH^-}]} \quad (5)$$

Considering the low concentrations of periodate and L-leucine employed in this work, we can disregard K_3[L-leucine][$H_3IO_6^{2-}$], and K_1K_3[L-leucine][OH^-][$H_3IO_6^{2-}$]; thus, the rate law will be,

$$\text{Rate} = \frac{\mathrm{kK_1K_2K_3\,[L-leucine]\,[Ru(III)]\,[DPC]\,[OH^-]}}{[\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1}[\mathrm{OH^-}][\mathrm{H_3IO_6^{2-}}] + \mathrm{K_1K_2}[\mathrm{OH^-}] + \mathrm{K_1K_2K_3}[\mathrm{L-leucine}][\mathrm{OH^-}]} \quad (6)$$

The mentioned rate law delineates the entirety of the recorded kinetic order concerning various reaction parameters.