LAMPIRAN

LAMPIRAN A

HASIL PERHITUNGAN TEORI HMO UNTUK MOLEKUL FENOLFTALEIN DENGAN $k_{co} = 0.9$ DAN $h = 2$

A.1. Fenolftalein pada suasana asam

Perhitungan untuk mendapatkan panjang gelombang maksimum ($\Delta E = E_{LUMO} - E_{HOMO}$)

a.1. λ maksimum kromofor I & II fenolftalein

$$\begin{vmatrix} x+2 & 0.9 & 0 & 0 & 0 & 0 & 0 \\ 0.9 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 1 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{ solve, } x \rightarrow \begin{bmatrix} 1 \\ -1 \\ -2.6944640949536582796 \\ -1.6003167254356062814 \\ -.8448343063285823526 \\ 1.0518727015330546489 \\ 2.0877424251847922646 \end{bmatrix}$$

$$(-.745 - 1) - 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda} \text{ solve, } \lambda \rightarrow 217.684738 \quad nm$$

a.2. Fungsi gelombang kromofor I & II fenolftalein

$\psi_1 = 0.788\phi_1 + 0.480\phi_2 + 0.232\phi_3 + 0.126\phi_4 + 0.097\phi_5 + 0.126\phi_6 + 0.232\phi_7$

$\psi_2 = 0.113\phi_1 + 0.458\phi_2 + 0.412\phi_3 + 0.385\phi_4 + 0.376\phi_5 + 0.385\phi_6 + 0.412\phi_7$

$\psi_3 = 0.431\phi_1 + 0.090\phi_2 + 0.297\phi_3 + 0.440\phi_4 + 0.492\phi_5 + 0.440\phi_6 + 0.297\phi_7$

$\psi_4 = 0\phi_1 + 0\phi_2 - 0.500\phi_3 - 0.500\phi_4 + 0\phi_5 + 0.500\phi_6 + 0.500\phi_7$

$\psi_5 = 0.384\phi_1 - 0.477\phi_2 - 0.372\phi_3 + 0.197\phi_4 + 0.520\phi_5 + 0.197\phi_6 - 0.372\phi_7$

$\psi_6 = 0\phi_1 + 0\phi_2 + 0.500\phi_3 - 0.500\phi_4 + 0\phi_5 + 0.500\phi_6 - 0.500\phi_7$

$\psi_7 = -0.183\phi_1 + 0.569\phi_2 - 0.224\phi_3 - 0.321\phi_4 + 0.580\phi_5 - 0.321\phi_6 - 0.224\phi_7$

a.3. Indeks kereaktifan

- **Kerapatan elektron**

$q_1=2\,(0.788)^2+2\cdot(0.48)^2+2\cdot(0.232)^2+2\cdot(0.126)^2 \rightarrow q_1=1.842088$

$q_2=2\,(0.113)^2+2\cdot(0.458)^2+2\cdot(0.412)^2+2\cdot(0.385)^2 \rightarrow q_2=1.081004$

$q_3=2\,(0.431)^2+2\cdot(0.09)^2+2\cdot(0.297)^2+2\cdot(0.44)^2 \rightarrow q_3=.95134$

$q_4=2\,(0)^2+2\cdot(0)^2+2\cdot(-0.5)^2+2\cdot(-0.5)^2 \rightarrow q_4=1.0$

$q_5=2\,(0.384)^2+2\cdot(-0.477)^2+2\cdot(-0.372)^2+2\cdot(0.197)^2 \rightarrow q_5=1.104356$

$q_6=2\,(0)^2+2\cdot(0)^2+2\cdot(0.5)^2+2\cdot(-0.5)^2 \rightarrow q_6=1.0$

$q_7=2\,(-0.183)^2+2\cdot(0.569)^2+2\cdot(-0.274)^2+2\cdot(-0.321)^2 \rightarrow q_7=1.070734$

- **Orde ikatan**

$P_{12}=2\cdot(0.788\cdot0.48)+2\cdot(0.113\cdot0.458)+2\cdot(0.431\cdot0.09)+2\cdot(0) \rightarrow P_{12}=.937568$

$P_{23}=2\cdot(0.232\cdot0.48)+2\cdot(0.412\cdot0.458)+2\cdot(0.297\cdot0.09)+2\cdot(0\cdot-0.5) \rightarrow P_{23}=.653572$

$P_{27}=2\cdot(0.232\cdot0.48)+2\cdot(0.412\cdot0.458)+2\cdot(0.297\cdot0.09)+2\cdot(0\cdot0.5) \rightarrow P_{27}=.653572$

$P_{34}=2\cdot(0.232\cdot0.126)+2\cdot(0.412\cdot0.385)+2\cdot(0.297\cdot0.44)+2\cdot(-0.5\cdot-0.5) \rightarrow P_{34}=1.137064$

$P_{45}=2\cdot(0.097\cdot0.126)+2\cdot(0.376\cdot0.385)+2\cdot(0.492\cdot0.44)+2\cdot(0\cdot-0.5) \rightarrow P_{45}=.746924$

$P_{56}=2\cdot(0.097\cdot0.126)+2\cdot(0.376\cdot0.385)+2\cdot(0.492\cdot0.44)+2\cdot(0\cdot0.5) \rightarrow P_{56}=.746924$

$P_{67}=2\cdot(0.232\cdot0.126)+2\cdot(0.412\cdot0.385)+2\cdot(0.297\cdot0.44)+2\cdot(0.5\cdot0.5) \rightarrow P_{67}=1.137064$

- **Valensi bebas**

$F_1=\sqrt{3}-.937568 \text{ solve},F_1 \rightarrow .7944828075688772935$

$F_2=\sqrt{3}-.937568-0.653572-0.653572 \text{ solve},F_2 \rightarrow -.5126611924311227065$

$F_3=\sqrt{3}-0.653572-1.137064 \text{ solve},F_3 \rightarrow -.058585192431122706500$

$F_4=\sqrt{3}-.746924-1.137064 \text{ solve},F_4 \rightarrow -.1519371924311227065$

$F_5=\sqrt{3}-.746924-.746924 \text{ solve},F_5 \rightarrow .2382028075688772935$

$F_6=\sqrt{3}-.746924-1.137064 \text{ solve},F_6 \rightarrow -.1519371924311227065$

$F_7=\sqrt{3}-.653572-1.137064 \text{ solve},F_7 \rightarrow -.058585192431122706500$

b.1. λ maksimum kromofor III fenolftalein

$$\begin{vmatrix} \begin{bmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & x & 0.9 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.9 & x+2 \end{bmatrix} \end{vmatrix} \text{solve}, x \rightarrow \begin{bmatrix} 1 \\ -1 \\ -2.6469845868146363748 \\ -1.8125324870039759652 \\ -1.1737583044947627072 \\ .59202222113183780315 \\ 1.2890562807039950215 \\ 2.1521968764775422225 \end{bmatrix}$$

$$(-1-.59202)\cdot 75390\cdot 4.18\cdot\frac{J}{mol}=\frac{\frac{6.626\cdot 10^{-34}\cdot J\cdot sec\cdot 3\cdot 10^{17}\cdot nm\cdot 6.022\cdot 10^{23}}{sec\cdot mol}}{\lambda}\ \text{solve},\lambda\rightarrow 238.602\cdot nm$$

b.2. Fungsi gelombang kromofor III

$$\psi_1=0.162\phi_1+0.098\phi_2+0.08\phi_3+0.098\phi_4+0.162\phi_5+0.301\phi_6+0.418\phi_7+0.81\phi_8$$

$$\psi_2=-0.372\phi_1-0.3725\phi_2-0.372\phi_3-0.372\phi_4-0.372\phi_5-0.372\phi_6-0\phi_7+0.413\phi_8$$

$$\psi_3=-0.403\phi_1+0.345\phi_2-0.327\phi_3+0.345\phi_4-0.403\phi_5+0.506\phi_6-0.264\phi_7+0.058\phi_8$$

$$\psi_4=-0.083\phi_1-0.358\phi_2+0.55\phi_3-0.358\phi_4-0.083\phi_5+0.467\phi_6-0.441\phi_7+0.12\phi_8$$

$$\psi_5=-0.354\phi_1-0038\phi_2+0.372\phi_3-0.038\phi_4-0.364\phi_5+0.114\phi_6+0.705\phi_7-0.269\phi_8$$

$$\psi_6=-0.183\phi_1+0.321\phi_2+0.555\phi_3+0.321\phi_4-0.183\phi_5-0.533\phi_6-0.251\phi_7+0.269\phi_8$$

$$\psi_7=0.5\phi_1-0.5\phi_2-0\phi_3+0.5\phi_4-0.5\phi_5-0\phi_6-0\phi_7+0\phi_8$$

$$\psi_8=-0.5\phi_1+0.5\phi_2+0\phi_3-0.5\phi_4-0.5\phi_5+0\phi_6+0\phi_7+0\phi_8$$

b.3. Indeks kereaktifan

- **Kerapatan elektron**

$q_1 = 2\,(0.162)^2 + 2\,(0.098)^2 + 2\,(0.08)^2 + 2\,(0.098)^2 \rightarrow q_1 = .103704$

$q_2 = 2\,(-0.372)^2 + 2\,(-0.372)^2 + 2\,(-0.372)^2 + 2\,(-0.372)^2 \rightarrow q_2 = 1.107072$

$q_3 = 2\,(-0.403)^2 + 2\,(0.345)^2 + 2\,(-0.327)^2 + 2\,(0.345)^2 \rightarrow q_3 = 1.014776$

$q_4 = 2\,(-0.083)^2 + 2\,(-0.358)^2 + 2\,(0.55)^2 + 2\,(-0.358)^2 \rightarrow q_4 = 1.131434$

$q_5 = 2\,(-0.364)^2 + 2\,(-0.038)^2 + 2\,(0.372)^2 + 2\,(-0.038)^2 \rightarrow q_5 = .547536$

$q_6 = 2\,(-0.183)^2 + 2\,(0.321)^2 + 2\,(0.555)^2 + 2\,(0.321)^2 \rightarrow q_6 = 1.095192$

$q_7 = 2\,(0.5)^2 + 2\,(-0.5)^2 + 2\,(0)^2 + 2\,(0.5)^2 \rightarrow q_7 = 1.5$

$q_8 = 2\,(-0.5)^2 + 2\,(0.5)^2 + 2\,(0)^2 + 2\,(0.5)^2 \rightarrow q_8 = 1.5$

- **Orde ikatan**

$P_{12} = 2\,(0.162 \cdot 0.098) + 2\,(-0.372 \cdot -0.372) + 2\,(-0.403 \cdot 0.345) + 2\,(-0.083 \cdot -0.358) \rightarrow P_{12} = .089878$

$P_{16} = 2\,(0.162 \cdot 0.301) + 2\,(-0.372 \cdot -0.372) + 2\,(-0.403 \cdot 0.506) + 2\,(-0.083 \cdot 0.467) \rightarrow P_{16} = -.111066$

$P_{23} = 2\,(0.08 \cdot 0.098) + 2\,(-0.372 \cdot -0.372) + 2\,(-0.372 \cdot 0.345) + 2\,(-0.358 \cdot -0.358) \rightarrow P_{23} = .292096$

$P_{34} = 2\,(0.08 \cdot 0.098) + 2\,(-0.372 \cdot -0.372) + 2\,(-0.372 \cdot 0.345) + 2\,(-0.358 \cdot -0.358) \rightarrow P_{34} = .292096$

$P_{45} = 2\,(0.162 \cdot 0.098) + 2\,(-0.372 \cdot -0.372) + 2\,(-0.403 \cdot 0.345) + 2\,(-0.083 \cdot -0.358) \rightarrow P_{45} = .089878$

$P_{47} = 2\,(0.418 \cdot 0.098) + 2\,(0 \cdot -0.372) + 2\,(-0.264 \cdot 0.345) + 2\,(-0.441 \cdot -0.358) \rightarrow P_{47} = .215524$

$P_{56} = 2\,(0.162 \cdot 0.301) + 2\,(-0.372 \cdot -0.372) + 2\,(-0.403 \cdot 0.506) + 2\,(-0.083 \cdot 0.467) \rightarrow P_{56} = -.111066$

$P_{78} = 2\,(0.418 \cdot 0.81) + 2\,(0 \cdot 0.413) + 2\,(-0.264 \cdot 0.058) + 2\,(-0.441 \cdot 0.12) \rightarrow P_{78} = .540696$

- **Valensi bebas**

$F_1 = \sqrt{3} - .089878 - -.111066 \text{ solve}, F_1 \rightarrow 1.7532388075688772935$

$F_2 = \sqrt{3} - .089878 - .292096 \text{ solve}, F_2 \rightarrow 1.3500768075688772935$

$F_3 = \sqrt{3} - .292096 - .292096 \text{ solve}, F_3 \rightarrow 1.1478588075688772935$

$F_4 = \sqrt{3} - .292096 - .089878 \text{ solve}, F_4 \rightarrow 1.3500768075688772935$

$F_5 = \sqrt{3} - -.111066 - .089878 \text{ solve}, F_5 \rightarrow 1.7532388075688772935$

$F_6 = \sqrt{3} - -.111066 - -.111066 \text{ solve}, F_6 \rightarrow 1.9541828075688772935$

$F_7 = \sqrt{3} - .215524 - .540696 \text{ solve}, F_7 \rightarrow .9758308075688772935$

$F_8 = \sqrt{3} - .540696 \text{ solve}, F_8 \rightarrow 1.1913548075688772935$

A.2. Fenolftalein dalam suasana basa (kromofor I)

a.1. λ maksimum

$$\begin{bmatrix} x+2 & 0.9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.9 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.9 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.9 & x+2 \end{bmatrix} \text{solve}, x \rightarrow \begin{bmatrix} -3.6265906458769951894 \\ -2.1705686402092637527 \\ -2.1705686402092637527 \\ -1.6283791127181430161 \\ -1.2598105633758029294 \\ -1.2598105633758029294 \\ -.66226891904713808389 \\ -.15793840724625132514 \\ .37087716344618915957 \\ .66226891904713808389 \\ 1.0149808153902353822 \\ 1.0149808153902353822 \\ 1.2292924440286587586 \\ 1.6985296833538622835 \\ 1.6985296833538622835 \\ 2.5148810535913430 67 \end{bmatrix}$$

$$(-.15793840724 62 \quad -.37087716344 61) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve}, x \rightarrow 718.32201715972590504 \cdot nm$$

a.2. Fungsi gelombang

$\psi_1 = 0.063\phi_1 + 0.124\phi_2 + 0.181\phi_3 + 0.231\phi_4 + 0.274\phi_5 + 0.307\phi_6 + 0.330\phi_7 + 0.342\phi_8 + 0.342\phi_9 + 0.33\phi_{10} + 0.307\phi_{11} + 0.274\phi_{12} + 0.231\phi_{13} + 0.181\phi_{14} + 0.124\phi_{15} + 0.063\phi_{16}$

$\psi_2 = 0.124\phi_1 + 0.231\phi_2 + 0.307\phi_3 + 0.342\phi_4 + 0.330\phi_5 + 0.274\phi_6 + 0.181\phi_7 + 0.064\phi_8 + 0.062\phi_9 - 0.181\phi_{10} - 0.273\phi_{11} - 0.330\phi_{12} - 0.342\phi_{13} + 0.307\phi_{14} - 0.232\phi_{15} - 0.125\phi_{16}$

$\psi_3 = 0.182\phi_1 + 0.308\phi_2 + 0.341\phi_3 + 0.273\phi_4 + 0.123\phi_5 - 0.064\phi_6 - 0.231\phi_7 - 0.330\phi_8 - 0.330\phi_9 - 0.232\phi_{10} - 0.064\phi_{11} + 0.120\phi_{12} + 0.273\phi_{13} - 0.341\phi_{14} - 0.308\phi_{15} + 0.182\phi_{16}$

$\psi_4 = 0.231\phi_1 + 0.342\phi_2 + 0.274\phi_3 + 0.064\phi_4 - 0.180\phi_5 - 0.330\phi_6 + 0.307\phi_7 - 0.125\phi_8 + 0.123\phi_9 + 0.306\phi_{10} + 0.330\phi_{11} + 0.182\phi_{12} - 0.061\phi_{13} + 0.273\phi_{14} - 0.342\phi_{15} - 0.233\phi_{16}$

$\psi_5 = 0.274\phi_1 + 0.330\phi_2 + 0.124\phi_3 - 0.180\phi_4 - 0.341\phi_5 - 0.232\phi_6 + 0.062\phi_7 + 0.306\phi_8 + 0.308\phi_9 + 0.065\phi_{10} - 0.230\phi_{11} - 0.342\phi_{12} - 0.182\phi_{13} + 0.122\phi_{14} + 0.329\phi_{15} + 0.275\phi_{16}$

$\psi_6 = 0.307\phi_1 + 0.274\phi_2 - 0.064\phi_3 - 0.330\phi_4 - 0.232\phi_5 + 0.123\phi_6 + 0.341\phi_7 + 0.182\phi_8 - 0.179\phi_9 - 0.342\phi_{10} - 0.126\phi_{11} + 0.229\phi_{12} + 0.331\phi_{13} + 0.066\phi_{14} - 0.272\phi_{15} - 0.308$

$\psi_7 = 0.330\ \phi_1 + 0.181\phi_2 + 0.231\phi_3 + 0.307\phi_4 + 0.062\phi_5 + 0.341\phi_6 + 0.125\phi_7 + 0.273\phi_8 - 0.275\phi_9 + 0.122\phi_{10} + 0.342\phi_{11} - 0.066\phi_{12} - 0.306\phi_{13} - 0.233\phi_{14} + 0.178\phi_{15} + 0.331\phi_{16}$

$\psi_8 = 0.342\ \phi_1 + 0.064\phi_2 - 0.330\phi_3 - 0.125\phi_4 + 0.308\phi_5 + 0.182\phi_6 + 0.273\phi_7 + 0.223\phi_8 + 0.229\phi_9 + 0.275\phi_{10} - 0.178\phi_{11} + 0.308\phi_{12} + 0.122\phi_{13} + 0.331\phi_{14} - 0.059\phi_{15} - 0.342\phi_{16}$

$\psi_9 = 0.342\phi_1 + 0.062\phi_2 - 0.330\phi_3 + 0.123\phi_4 + 0.308\phi_5 - 0.179\phi_6 + 0.275\phi_7 + 0.229\phi_8 + 0.233\phi_9 + 0.272\phi_{10} + 0.183\phi_{11} + 0.305\phi_{12} + 0.127\phi_{13} - 0.239\phi_{14} - 0.067\phi_{15} + 0.341\phi_{16}$

$\psi_{10} = 0.330\phi_1 - 0.180\phi_2 - 0.232\phi_3 + 0.306\phi_4 + 0.065\phi_5 - 0.342\phi_6 + 0.122\phi_7 - 0.275\phi_8 - 0.272\phi_9 - 0.27\phi_{10} + 0.341\phi_{11} - 0.059\phi_{12} - 0.309\phi_{13} + 0.228\phi_{14} + 0.185\phi_{15} - 0.238\phi_{16}$

$\psi_{11} = 0.274\phi_1 - 0.273\phi_2 - 0.064\phi_3 + 0.330\phi_4 - 0.230\phi_5 - 0.126\phi_6 + 0.342\phi_7 - 0.178\phi_8 - 0.183\phi_9 + 0.341\phi_{10} + 0.12\phi_{11} - 0.234\phi_{12} + 0.329\phi_{13} - 0.058\phi_{14} - 0.277\phi_{15} + 0.304\phi_{16}$

$\psi_{12} = 0.231\phi_1 - 0.330\phi_2 + 0.123\phi_3 + 0.182\phi_4 - 0.342\phi_5 + 0.229\phi_6 + 0.066\phi_7 + 0.308\phi_8 + 0.305\phi_9 - 0.059\phi_{10} - 0.234\phi_{11} + 0.341\phi_{12} - 0.176\phi_{13} - 0.129\phi_{14} + 0.331\phi_{15} - 0.270\phi_{16}$

$\psi_{13} = 0.231\phi_1 - 0.342\phi_2 + 0.273\phi_3 - 0.061\phi_4 - 0.182\phi_5 + 0.331\phi_6 - 0.306\phi_7 + 0.121\phi_8 + 0.127\phi_9 - 0.309\phi_{10} + 0.329\phi_{11} - 0.176\phi_{12} - 0.068\phi_{13} + 0.277\phi_{14} - 0.341\phi_{15} + 0.226\phi_{16}$

$\psi_{14} = 0.182\phi_1 - 0.307\phi_2 + 0.341\phi_3 - 0.273\phi_4 + 0.122\phi_5 + 0.066\phi_6 - 0.233\phi_7 + 0.331\phi_8 - 0.329\phi_9 + 0.228\phi_{10} - 0.058\phi_{11} - 0.129\phi_{12} + 0.277\phi_{13} - 0.342\phi_{14} + 0.304\phi_{15} - 0.174\phi_{16}$

$\psi_{15} = 0.124\phi_1 - 0.232\phi_2 + 0.308\phi_3 - 0.342\phi_4 + 0.329\phi_5 - 0.272\phi_6 + 0.178\phi_7 - 0.059\phi_8 - 0.067\phi_9 + 0.185\phi_{10} - 0.277\phi_{11} + 0.331\phi_{12} - 0.341\phi_{13} + 0.304\phi_{14} - 0.226\phi_{15} + 0.117\phi_{16}$

$\psi_{16} = 0.063\phi_1 - 0.125\phi_2 + 0.182\phi_3 - 0.233\phi_4 + 0.275\phi_5 - 0.308\phi_6 + 0.331\phi_7 - 0.342\phi_8 + 0.341\phi_9 - 0.328\phi_{10} + 0.304\phi_{11} - 0.270\phi_{12} + 0.26\phi_{13} - 0.174\phi_{14} + 0.117\phi_{15} - 0.055\phi_{16}$

a.3. Indeks kereaktifan

a.3.1. Pada Keadaan dasar

- **Kerapatan Elektron**

Kerapatan Elektron (q) dihitung dengan menggunakan persamaan $q_r = \sum_r n_r (c_{jr})^2$

$q_1 = 2\cdot(0.063)^2 + 2\cdot(0.124)^2 + 2\cdot(0.181)^2 + 2\cdot(0.231)^2 + 2\cdot(0.274)^2 + 2\cdot(0.307)^2 + 2\,(0.330)^2 + 2\cdot(0.342)^2$ solve, $q_1 \rightarrow 1.001312$

$q_2 = 2\cdot(0.124)^2 + 2\cdot(0.231)^2 + 2\cdot(0.307)^2 + 2\cdot(0.342)^2 + 2\cdot(0.330)^2 + 2\cdot(0.274)^2 + 2\cdot(0.181)^2 + 2\cdot(0.064)^2$ solve, $q_2 \rightarrow 1.001566$

$q_3 = 2\cdot(0.182)^2 + 2\cdot(0.308)^2 + 2\cdot(0.341)^2 + 2\cdot(0.273)^2 + 2\cdot(0.123)^2 + 2\cdot(-0.064)^2 + 2\cdot(-0.231)^2 + 2\cdot(-0.330)^2$ solve, $q_3 \rightarrow 1.000568$

$q_4 = 2\cdot(0.231)^2 + 2\cdot(0.342)^2 + 2\cdot(0.274)^2 + 2\cdot(0.064)^2 + 2\cdot(-0.180)^2 + 2\cdot(-0.330)^2 + 2\cdot(0.307)^2 + 2\cdot(-0.125)^2$ solve, $q_4 \rightarrow 1.001342$

$q_5 = 2\cdot(0.274)^2 + 2\cdot(0.330)^2 + 2\cdot(0.124)^2 + 2\cdot(-0.180)^2 + 2\cdot(-0.341)^2 + 2\cdot(-0.232)^2 + 2\cdot(0.064)^2 + 2\cdot(0.306)^2$ solve, $q_5 \rightarrow .999178$

$q_6 = 2\cdot(0.307)^2 + 2\cdot(0.274)^2 + 2\cdot(-0.064)^2 + 2\cdot(-0.330)^2 + 2\cdot(-0.232)^2 + 2\cdot(0.123)^2 + 2\cdot(0.341)^2 + 2\cdot(0.182)^2$ solve, $q_6 \rightarrow 1.001358$

$q_7 = 2\cdot(0.330)^2 + 2\cdot(0.181)^2 + 2\cdot(0.231)^2 + 2\cdot(0.307)^2 + 2\cdot(0.062)^2 + 2\cdot(0.341)^2 + 2\cdot(0.125)^2 + 2\cdot(0.273)^2$ solve, $q_7 \rightarrow .9991$

$q_8 = 2\cdot(0.342)^2 + 2\cdot(0.064)^2 + 2\cdot(-0.330)^2 + 2\cdot(-0.125)^2 + 2\cdot(0.308)^2 + 2\cdot(0.182)^2 + 2\cdot(0.273)^2 + 2\cdot(0.228)^2$ solve, $q_8 \rightarrow 1.000172$

$q_9 = 2\cdot(0.342)^2 + 2\cdot(0.0623)^2 + 2\cdot(-0.330)^2 + 2\cdot(0.123)^2 + 2\cdot(0.308)^2 + 2\cdot(-0.179)^2 + 2\cdot(0.275)^2 + 2\cdot(0.229)^2$ solve, $q_9 \rightarrow .99969058$

$q_{10} = 2\cdot(0.330)^2 + 2\cdot(-0.180)^2 + 2\cdot(-0.232)^2 + 2\cdot(0.306)^2 + 2\cdot(0.065)^2 + 2\cdot(-0.342)^2 + 2\cdot(0.125)^2 + 2\cdot(-0.275)^2$ solve, $q_{10} \rightarrow 1.002398$

$q_{11} = 2\cdot(0.274)^2 + 2\cdot(-0.273)^2 + 2\cdot(-0.064)^2 + 2\cdot(0.330)^2 + 2\cdot(-0.238)^2 + 2\cdot(-0.186)^2 + 2\cdot(0.342)^2 + 2\cdot(-0.178)^2$ solve, $q_{11} \rightarrow 1.004978$

$q_{12} = 2\cdot(0.231)^2 + 2\cdot(-0.330)^2 + 2\cdot(0.193)^2 + 2\cdot(0.182)^2 + 2\cdot(-0.342)^2 + 2\cdot(0.229)^2 + 2\cdot(0.066)^2 + 2\cdot(0.308)^2$ solve, $q_{12} \rightarrow 1.002518$

$q_{13} = 2\cdot(-0.342)^2 + 2\cdot(0.231)^2 + 2\cdot(0.273)^2 + 2\cdot(-0.062)^2 + 2\cdot(-0.182)^2 + 2\cdot(0.331)^2 + 2\cdot(-0.306)^2 + 2\cdot(0.121)^2$ solve, $q_{13} \rightarrow .99932$

$q_{14} = 2\cdot(0.182)^2 + 2\cdot(-0.307)^2 + 2\cdot(0.341)^2 + 2\cdot(0.273)^2 + 2\cdot(0.122)^2 + 2\cdot(0.066)^2 + 2\cdot(-0.233)^2 + 2\cdot(0.331)^2$ solve, $q_{14} \rightarrow 1.002546$

$q_{15} = 2\cdot(0.124)^2 + 2\cdot(-0.232)^2 + 2\cdot(0.308)^2 + 2\cdot(-0.342)^2 + 2\cdot(0.329)^2 + 2\cdot(-0.273)^2 + 2\cdot(0.18)^2 + 2\cdot(0.06)^2$ solve, $q_{15} \rightarrow .999596$

$q_{16} = 2\cdot(0.063)^2 + 2\cdot(-0.125)^2 + 2\cdot(0.182)^2 + 2\cdot(-0.233)^2 + 2\cdot(0.275)^2 + 2\cdot(-0.308)^2 + 2\,(0.331)^2 + 2\cdot(0.342)^2$ solve, $q_{16} \rightarrow 1.008042$

- Orde Ikatan (P)

Orde ikatan dihitung dengan menggunakan persamaan : $P_{12}=\sum_{j} a_j c_{jr} c_{js}$

$P_{12}=2\cdot(0.063\cdot0.124)+2\cdot(0.124\cdot0.231)+2\,(0.182\cdot0.308)+2\cdot(0.231\cdot0.342)+2\cdot(0.274\cdot0.330)+2\,(0.307\cdot0.274)+2\cdot(0.330\cdot0.181)+2\cdot(0.342\cdot0.064)\rightarrow P_{12}=.85534$

$P_{23}=2\cdot(0.181\cdot0.124)+2\cdot(0.307\cdot0.231)+2\cdot(0.341\cdot0.308)+2\cdot(0.274\cdot0.342)+2\cdot(0.124\cdot0.330)+2\,(-0.064\cdot0.274)+2\,(0.231\cdot0.181)+2\cdot(-0.330\cdot0.064)\rightarrow P_{23}=.672344$

$P_{27}=2\cdot(0.330\cdot0.124)+2\cdot(0.181\cdot0.231)+2\cdot(-0.231\cdot0.308)+2\cdot(0.307\cdot0.342)+2\cdot(0.062\cdot0.330)+2\cdot(0.341\cdot0.274)+2\cdot(0.125\cdot0.181)+2\cdot(0.273\cdot0.064)\rightarrow P_{27}=.541136$

$P_{34}=2\cdot(0.181\cdot0.231)+2\cdot(0.307\cdot0.342)+2\cdot(0.341\cdot0.273)+2\cdot(0.274\cdot0.064)+2\cdot(0.124-0.180)+2\cdot(-0.064-0.330)+2\cdot(0.231\cdot0.307)+2\cdot(-0.330-0.125)\rightarrow P_{34}=.736802$

$P_{45}=2\cdot(0.274\cdot0.231)+2\cdot(0.330\cdot0.342)+2\cdot(0.123\cdot0.273)+2\cdot(-0.180\cdot0.064)+2\cdot(-0.341-0.180)+2\cdot(-0.232-0.330)-2\cdot(0.062\cdot0.307)+2\cdot(0.308-0.125)\rightarrow P_{45}=.633374$

$P_{56}=2\cdot(0.274\cdot0.307)+2\cdot(0.330\cdot0.274)+2\cdot(0.123-0.064)+2\cdot(-0.180-0.330)+2\cdot(-0.341-0.232)+2\cdot(-0.232\cdot0.123)+2\cdot(0.062\cdot0.341)+2\cdot(0.308\cdot0.182)\rightarrow P_{56}=.70763$

$P_{67}=2\cdot(0.330\cdot0.307)+2\cdot(0.181\cdot0.274)+2\cdot(-0.231-0.064)+2\,(-0.307-0.330)+2\cdot(0.062-0.232)+2\,(0.341\cdot0.123)+2\cdot(0.125\cdot0.341)+2\cdot(-0.273\cdot0.182)\rightarrow P_{67}=.574992$

$P_{58}=2\cdot(0.274\cdot0.342)+2\cdot(0.330\cdot0.064)+2\cdot(0.123-0.330)+2\cdot(-0.180-0.125)+2\cdot(-0.341\cdot0.306)+2\cdot(-0.232\cdot0.182)+2\,(0.062\cdot0.273)+2\cdot(0.308\cdot0.223)\rightarrow P_{58}=.071556$

$P_{89}=2\cdot(0.342\cdot0.342)+2\cdot(0.062\cdot0.064)+2\cdot(-0.330-0.330)+2\cdot(0.123-0.125)+2\cdot(0.308\cdot0.306)+2\cdot(-0.179\cdot0.182)+2\,(-0.275\cdot0.273)+2\cdot(0.229\cdot0.223)\rightarrow P_{89}=.504238$

$P_{910}=2\cdot(0.342\cdot0.330)+2\cdot(0.062-0.181)+2\cdot(-0.330-0.232)+2\cdot(0.123\cdot0.306)+2\cdot(0.308\cdot0.065)+2\,(-0.179-0.342)+2\cdot(-0.275\,0.122)+2\,(0.229\cdot0.275)\rightarrow P_{910}=.652998$

$P_{914}=2\cdot(0.342\cdot0.181)+2\cdot(0.062\cdot0.307)+2\cdot(-0.330-0.341)+2\cdot(0.123\cdot0.273)+2\cdot(0.308\cdot0.122)+2\cdot(-0.179\cdot0.066)+2\cdot(-0.275-0.233)+2\cdot(0.229\cdot0.331)\rightarrow P_{914}=.785362$

$P_{1011}=2\cdot(0.307\cdot0.330)+2\,(-0.273-0.181)+2\cdot(-0.064-0.232)+2\cdot(0.330\cdot0.306)+2\cdot(-0.230\cdot0.065)+2\cdot(-0.126-0.342)+2\cdot(0.342\,0.122)+2\cdot(-0.178\cdot0.275)\rightarrow P_{1011}=.574934$

$P_{1112}=2\cdot(0.307\cdot0.274)+2\cdot(-0.273-0.330)+2\cdot(-0.064\cdot0.123)+2\,(0.330\cdot0.182)+2\cdot(-0.230-0.342)+2\cdot(-0.126\cdot0.229)+2\cdot(0.342-0.066)+2\cdot(-0.178-0.308)\rightarrow P_{1112}=.616908$

$P_{1213}=2\cdot(0.231\cdot0.274)+2\cdot(-0.342-0.330)+2\cdot(0.273\cdot0.123)+2\cdot(-0.061\cdot0.182)+2\cdot(-0.182-0.342)+2\,(0.331\cdot0.229)+2\cdot(0.306-0.066)+2\cdot(0.121-0.308)\rightarrow P_{1213}=.55842$

$P_{1314}=2\cdot(0.231\cdot0.181)+2\cdot(-0.342-0.307)+2\cdot(0.273\cdot0.341)+2\cdot(-0.061-0.273)+2\cdot(-0.182\cdot0.122)+2\cdot(0.331-0.066)+2\cdot(0.306\cdot0.233)+2\cdot(0.121\cdot0.331)\rightarrow P_{1314}=.6477$

$P_{1415}=2\cdot(-0.124\cdot0.181)+2\cdot(-0.232-0.307)+2\cdot(0.308\cdot0.341)+2\cdot(-0.342-0.273)+2\cdot(0.329\cdot0.122)+2\cdot(-0.272-0.066)+2\cdot(0.178\cdot0.233)+2\cdot(-0.059\cdot0.331)\rightarrow P_{1415}=.654418$

$P_{1516}=2\cdot(-0.124\cdot0.063)+2\cdot(-0.232-0.125)+2\cdot(0.308\cdot0.182)+2\cdot(-0.342-0.233)+2\cdot(0.329\cdot0.275)+2\cdot(-0.272-0.308)+2\cdot(0.178\cdot0.331)+2\cdot(-0.059-0.342)\rightarrow P_{1516}=.820554$

- Harga valensi

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.855 \text{ solve}, F_1 \rightarrow .877050807568877293 5$

$F_2 = \sqrt{3} - 0.855 - 0.672 - 0.541 \text{ solve}, F_2 \rightarrow -.3359491924311227065$

$F_3 = \sqrt{3} - 0.672 - 0.737 \text{ solve}, F_3 \rightarrow .3230508075688772935$

$F_4 = \sqrt{3} - 0.737 - 0.633 \text{ solve}, F_4 \rightarrow .3620508075688772935$

$F_5 = \sqrt{3} - 0.633 - 0.708 - 0.0715 \text{ solve}, F_5 \rightarrow .3195508075688772935$

$F_6 = \sqrt{3} - 0.708 - 0.575 \text{ solve}, F_6 \rightarrow .4490508075688772935$

$F_7 = \sqrt{3} - 0.541 - 0.575 \text{ solve}, F_7 \rightarrow .6160508075688772935$

$F_8 = \sqrt{3} - 0.0715 - 0.504 \text{ solve}, F_8 \rightarrow 1.156550807568877293 5$

$F_9 = \sqrt{3} - 0.504 - 0.653 - 0.785 \text{ solve}, F_9 \rightarrow -.2099491924311227065$

$F_{10} = \sqrt{3} - 0.653 - 0.575 \text{ solve}, F_{10} \rightarrow .5040508075688772935$

$F_{11} = \sqrt{3} - 0.575 - 0.517 \text{ solve}, F_{11} \rightarrow .6400508075688772935$

$F_{12} = \sqrt{3} - 0.517 - 0.558 \text{ solve}, F_{12} \rightarrow .6570508075688772935$

$F_{13} = \sqrt{3} - 0.558 - 0.648 \text{ solve}, F_{13} \rightarrow .5260508075688772935$

$F_{14} = \sqrt{3} - 0.648 - 0.785 - 0.654 \text{ solve}, F_{14} \rightarrow -.3549491924311227065$

$F_{15} = \sqrt{3} - 0.654 - 0.820 \text{ solve}, F_{15} \rightarrow .2580508075688772935$

$F_{16} = \sqrt{3} - 0.820 \text{ solve}, F_{16} \rightarrow .9120508075688772935$

a.3.2. Pada Keadaan tereksitasi

A. Elektron Tereksitasi ke 1 Tingkat Energi lebih tinggi

- Kerapatan Elektron (q)

$q_1=2\cdot(0.063)^2+2\cdot(0.124)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.274)^2+2\cdot(0.307)^2+2\cdot(0.330)^2+(0.342)^2+(0.342)^2$ solve, $q_1 \rightarrow 1.001312$

$q_2=2\cdot(0.124)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.342)^2+2\cdot(0.330)^2+2\cdot(0.274)^2+2\cdot(0.181)^2+(0.064)^2+(0.062)^2$ solve, $q_2 \rightarrow 1.001314$

$q_3=2\cdot(0.182)^2+2\cdot(0.308)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.123)^2+2\cdot(-0.064)^2+2\cdot(-0.231)^2+(-0.330)^2+(-0.330)^2$ solve, $q_3 \rightarrow 1.000568$

$q_4=2\cdot(0.231)^2+2\cdot(0.342)^2+2\cdot(0.274)^2+2\cdot(0.064)^2+2\cdot(-0.180)^2+2\cdot(-0.330)^2+2\cdot(0.307)^2+(-0.125)^2+(0.123)^2$ solve, $q_4 \rightarrow 1.000846$

$q_5=2\cdot(0.274)^2+2\cdot(0.330)^2+2\cdot(0.124)^2+2\cdot(-0.180)^2+2\cdot(-0.341)^2+2\cdot(-0.232)^2+2\cdot(0.064)^2+(0.306)^2+(0.308)^2$ solve, $q_5 \rightarrow 1.000406$

$q_6=2\cdot(0.307)^2+2\cdot(0.274)^2+2\cdot(-0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.232)^2+2\cdot(0.123)^2+2\cdot(0.341)^2+(0.182)^2+(-0.179)^2$ solve, $q_6 \rightarrow 1.000275$

$q_7=2\cdot(0.330)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.062)^2+2\cdot(0.341)^2+2\cdot(0.125)^2+(0.273)^2+(-0.275)^2$ solve, $q_7 \rightarrow 1.000196$

$q_8=2\cdot(0.342)^2+2\cdot(0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.125)^2+2\cdot(0.308)^2+2\cdot(0.182)^2+2\cdot(0.273)^2+(0.228)^2+(0.229)^2$ solve, $q_8 \rightarrow 1.000629$

$q_9=2\cdot(0.342)^2+2\cdot(0.0623)^2+2\cdot(-0.330)^2+2\cdot(0.123)^2+2\cdot(0.308)^2+2\cdot(-0.179)^2+2\cdot(0.275)^2+(0.229)^2+(0.233)^2$ solve, $q_9 \rightarrow 1.00153858$

$q_{10}=2\cdot(0.330)^2+2\cdot(-0.180)^2+2\cdot(-0.232)^2+2\cdot(0.306)^2+2\cdot(0.065)^2+2\cdot(-0.342)^2+2\cdot(0.125)^2+(-0.275)^2+(-0.272)^2$ solve, $q_{10} \rightarrow 1.000757$

$q_{11}=2\cdot(0.274)^2+2\cdot(-0.273)^2+2\cdot(-0.064)^2+2\cdot(0.330)^2+2\cdot(-0.238)^2+2\cdot(-0.186)^2+2\cdot(0.342)^2+(-0.178)^2+(-0.183)^2$ solve, $q_{11} \rightarrow 1.006783$

$q_{12}=2\cdot(0.231)^2+2\cdot(-0.330)^2+2\cdot(0.193)^2+2\cdot(0.182)^2+2\cdot(-0.342)^2+2\cdot(0.229)^2+2\cdot(0.066)^2+(0.308)^2+(0.305)^2$ solve, $q_{12} \rightarrow 1.000679$

$q_{13}=2\cdot(-0.342)^2+2\cdot(0.231)^2+2\cdot(0.273)^2+2\cdot(-0.062)^2+2\cdot(-0.182)^2+2\cdot(0.331)^2+2\cdot(-0.306)^2+(0.121)^2+(0.127)^2$ solve, $q_{13} \rightarrow 1.000808$

$q_{14}=2\cdot(0.182)^2+2\cdot(-0.307)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.122)^2+2\cdot(0.066)^2+2\cdot(-0.233)^2+(0.331)^2+(-0.329)^2$ solve, $q_{14} \rightarrow 1.001226$

$q_{15}=2\cdot(0.124)^2+2\cdot(-0.232)^2+2\cdot(0.308)^2+2\cdot(-0.342)^2+2\cdot(0.329)^2+2\cdot(-0.273)^2+2\cdot(0.18)^2+(0.06)^2+(0.067)^2$ solve, $q_{15} \rightarrow 1.000485$

$q_{16}=2\cdot(0.063)^2+2\cdot(-0.125)^2+2\cdot(0.182)^2+2\cdot(-0.233)^2+2\cdot(0.275)^2+2\cdot(-0.308)^2+2\cdot(0.331)^2+(0.342)^2+(-0.341)^2$ solve, $q_{16} \rightarrow 1.007359$

- Orde ikatan

P_{12}=2·(0.063·0.124) + 2·(0.124·0.231) + 2·(0.182·0.308) + 2·(0.231·0.342) + 2·(0.274·0.330) + 2·(0.307·0.274) + 2·(0.330·0.181) + 1·(0.342·0.064) + 1·(0.342·0.062) → P_{12}=.854656

P_{23}=2·(0.181·0.124) + 2·(0.307·0.231) + 2·(0.341·0.308) + 2·(0.274·0.342) + 2·(0.124·0.330) + 2·(-0.064·0.274) + 2·(0.231·0.181) + 1·(-0.330·0.064) + 1·(-0.330·0.062) → P_{23}=.673004

P_{27}=2·(0.330·0.124) + 2·(0.181·0.231) + 2·(-0.231·0.308) + 2·(0.307·0.342) + 2·(0.062·0.330) + 2·(0.341·0.274) + 2·(0.125·0.181) + 1·(0.273·0.064) + 1·(0.275·0.062) → P_{27}=.548714

P_{34}=2·(0.181·0.231) + 2·(0.307·0.342) + 2·(0.341·0.273) + 2·(0.274·0.064) + 2·(0.124-0.180) + 2·(-0.064-0.330) + 2·(0.231·0.307) + 1·(-0.330-0.125) + 1·(-0.330·0.123) → P_{34}=.654962

P_{45}=2·(0.274·0.231) + 2·(0.330·0.342) + 2·(0.123·0.273) + 2·(-0.180·0.064) + 2·(-0.341-0.180) + 2·(-0.232-0.330) + 2·(0.062·0.307) + 1·(0.308-0.125) + 1·(0.308·0.123) → P_{45}=.709758

P_{56}=2·(0.274·0.307) + 2·(0.330·0.274) + 2·(0.123-0.064) + 2·(-0.180-0.330) + 2·(-0.341-0.232) + 2·(-0.232·0.123) + 2·(0.062·0.341) + 1·(0.308·0.182) + 1·(0.308-0.179) → P_{56}=.596492

P_{67}=2·(0.330·0.307) + 2·(0.181·0.274) + 2·(-0.231-0.064) + 2·(-0.307-0.330) + 2·(0.062-0.232) + 2·(0.341·0.123) + 2·(0.125·0.341) + 1·(-0.273·0.182) + 1·(-0.275-0.179) → P_{67}=.673903

P_{58}=2·(0.274·0.342) + 2·(0.330·0.064) + 2·(0.123-0.330) + 2·(-0.180-0.125) + 2·(-0.341·0.306) + 2·(-0.232·0.182) + 2·(0.062·0.273) + 1·(0.308·0.223) + 1·(0.308·0.229) → P_{58}=.073404

P_{89}=2·(0.342·0.342) + 2·(0.062·0.064) + 2·(-0.330-0.330) + 2·(0.123-0.125) + 2·(0.306·0.306) + 2·(-0.179·0.182) + 2·(-0.275·0.273) + 1·(0.229·0.223) + 1·(0.233·0.229) → P_{89}=.506528

P_{910}=2·(0.342·0.330) + 2·(0.062-0.181) + 2·(-0.330-0.232) + 2·(0.123·0.306) + 2·(0.306·0.065) + 2·(-0.179-0.342) + 2·(-0.275 0.122) + 1·(0.229·0.275) + 1·(0.233·0.272) → P_{910}=.653399

P_{914}=2·(0.342·0.181) + 2·(0.062·0.307) + 2·(-0.330-0.341) + 2·(0.123·0.273) + 2·(0.306·0.122) + 2·(-0.179·0.066) + 2·(-0.275-0.233) + 1·(0.229·0.331) + 1·(0.233-0.239) → P_{914}=.653876

P_{1011}=2·(0.307·0.330) + 2·(-0.273-0.181) + 2·(-0.064-0.232) + 2·(0.330·0.306) + 2·(-0.230·0.065) + 2·(-0.126-0.342) + 2·(0.342 0.122) + 1·(-0.178·0.275) + 1·(0.183·0.272) → P_{1011}=.67366

P_{1112}=2·(0.307·0.274) + 2·(-0.273-0.330) + 2·(-0.064·0.123) + 2·(0.330·0.182) + 2·(-0.230-0.342) + 2·(-0.126·0.229) + 2·(0.342-0.066) + 1·(-0.178-0.308) + 1·(0.183·0.305) → P_{1112}=.617899

P_{1213}=2·(0.231·0.274) + 2·(-0.342-0.330) + 2·(0.273·0.123) + 2·(-0.061·0.182) + 2·(-0.182-0.342) + 2·(0.331·0.229) + 2·(0.306-0.066) + 1·(0.121-0.308) + 1·(0.127·0.305) → P_{1213}=.634423

P_{1314}=2·(0.231·0.181) + 2·(-0.342-0.307) + 2·(0.273·0.341) + 2·(-0.061-0.273) + 2·(-0.182·0.122) + 2·(0.331-0.066) + 2·(0.306·0.233) + 1·(0.121·0.331) + 1·(0.127·0.239) → P_{1314}=.638002

P_{1415}=2·(-0.124·0.181) + 2·(-0.232-0.307) + 2·(0.308·0.341) + 2·(-0.342-0.273) + 2·(0.329·0.122) + 2·(-0.272-0.066) + 2·(0.178·0.233) + 1·(-0.059·0.331) + 1·(-0.067·0.239) → P_{1415}=.657934

P_{1516}=2·(-0.124·0.063) + 2·(-0.232-0.125) + 2·(0.308·0.182) + 2·(-0.342-0.233) + 2·(0.329·0.275) + 2·(-0.272-0.308) + 2·(0.178·0.331) + 1·(-0.059-0.342) + 1·(-0.067·0.341) → P_{1516}=.777529

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.859$ solve, F_1 → .873050807568877293 5

$F_2 = \sqrt{3} - 0.859 - 0.673 - 0.541$ solve, F_2 → -.3409491924311227065

$F_3 = \sqrt{3} - 0.673 - 0.655$ solve, F_3 → .4040508075688772935

$F_4 = \sqrt{3} - 0.655 - 0.709$ solve, F_4 → .3680508075688772935

$F_5 = \sqrt{3} - 0.709 - 0.596 - 0.073$ solve, F_5 → .3540508075688772935

$F_6 = \sqrt{3} - 0.596 - 0.674$ solve, F_6 → .4620508075688772935

$F_7 = \sqrt{3} - 0.541 - 0.674$ solve, F_7 → .5170508075688772935

$F_8 = \sqrt{3} - 0.073 - 0.596$ solve, F_8 → 1.063050807568877293 5

$F_9 = \sqrt{3} - 0.596 - 0.653 - 0.654$ solve, F_9 → -.1709491924311227065

$F_{10} = \sqrt{3} - 0.653 - 0.673$ solve, F_{10} → .4060508075688772935

$F_{11} = \sqrt{3} - 0.673 - 0.618$ solve, F_{11} → .4410508075688772935

$F_{12} = \sqrt{3} - 0.618 - 0.639$ solve, F_{12} → .4750508075688772935

$F_{13} = \sqrt{3} - 0.639 - 0.638$ solve, F_{13} → .4550508075688772935

$F_{14} = \sqrt{3} - 0.638 - 0.657 - 0.654$ solve, F_{14} → -.2169491924311227065

$F_{15} = \sqrt{3} - 0.657 - 0.778$ solve, F_{15} → .2970508075688772935

$F_{16} = \sqrt{3} - 0.778$ solve, F_{16} → .9540508075688772935

B. 1 Elektron tereksitasi ke 2 tingkat energi lebih tinggi
- Kerapatan elektron (q)

$q_1=2\cdot(0.063)^2+2\cdot(0.124)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.274)^2+2\cdot(0.307)^2+2\cdot(0.330)^2+(0.342)^2+(0.330)^2$ solve, q_1 → .993248

$q_2=2\cdot(0.124)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.342)^2+2\cdot(0.330)^2+2\cdot(0.274)^2+2\cdot(0.181)^2+(0.064)^2+(-0.180)^2$ solve, q_2 → 1.02987

$q_3=2\cdot(0.182)^2+2\cdot(0.308)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.123)^2+2\cdot(-0.064)^2+2\cdot(-0.231)^2+(-0.330)^2+(-0.232)^2$ solve, q_3 → .945492

$q_4=2\cdot(0.231)^2+2\cdot(0.342)^2+2\cdot(0.274)^2+2\cdot(0.064)^2+2\cdot(-0.180)^2+2\cdot(-0.330)^2+2\cdot(0.307)^2+(-0.125)^2+(0.306)^2$ solve, q_4 → 1.079353

$q_5=2\cdot(0.274)^2+2\cdot(0.330)^2+2\cdot(0.124)^2+2\cdot(-0.180)^2+2\cdot(-0.341)^2+2\cdot(-0.232)^2+2\cdot(0.064)^2+(0.306)^2+(0.065)^2$ solve, q_5 → .909767

$q_6=2\cdot(0.307)^2+2\cdot(0.274)^2+2\cdot(-0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.232)^2+2\cdot(0.123)^2+2\cdot(0.341)^2+(0.182)^2+(-0.342)^2$ solve, q_6 → 1.085198

$q_7=2\cdot(0.330)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.062)^2+2\cdot(0.341)^2+2\cdot(0.125)^2+(0.273)^2+(0.122)^2$ solve, q_7 → .939455

$q_8=2\cdot(0.342)^2+2\cdot(0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.125)^2+2\cdot(0.308)^2+2\cdot(0.182)^2+2\cdot(0.273)^2+(0.228)^2+(-0.275)^2$ solve, q_8 → 1.023813

$q_9=2\cdot(0.342)^2+2\cdot(0.0623)^2+2\cdot(-0.330)^2+2\cdot(0.123)^2+2\cdot(0.308)^2+2\cdot(-0.179)^2+2\cdot(0.275)^2+(0.229)^2+(-0.272)^2$ solve, q_9 → 1.02123358

$q_{10}=2\cdot(0.330)^2+2\cdot(-0.180)^2+2\cdot(-0.232)^2+2\cdot(0.306)^2+2\cdot(0.065)^2+2\cdot(-0.342)^2+2\cdot(0.125)^2+(-0.275)^2+(-0.27)^2$ solve, q_{10} → .999673

$q_{11}=2\cdot(0.274)^2+2\cdot(-0.273)^2+2\cdot(-0.064)^2+2\cdot(0.330)^2+2\cdot(-0.238)^2+2\cdot(-0.186)^2+2\cdot(0.342)^2+(-0.178)^2+(0.341)^2$ solve, q_{11} → 1.089575

$q_{12}=2\cdot(0.231)^2+2\cdot(-0.330)^2+2\cdot(0.193)^2+2\cdot(0.182)^2+2\cdot(-0.342)^2+2\cdot(0.229)^2+2\cdot(0.066)^2+(0.308)^2+(-0.059)^2$ solve, q_{12} → .911135

$q_{13}=2\cdot(-0.342)^2+2\cdot(0.231)^2+2\cdot(0.273)^2+2\cdot(-0.062)^2+2\cdot(-0.182)^2+2\cdot(0.331)^2+2\cdot(-0.306)^2+(0.121)^2+(-0.309)^2$ solve, q_{13} → 1.08016

$q_{14}=2\cdot(0.182)^2+2\cdot(-0.307)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.122)^2+2\cdot(0.066)^2+2\cdot(-0.233)^2+(0.331)^2+(0.228)^2$ solve, q_{14} → .944969

$q_{15}=2\cdot(0.124)^2+2\cdot(-0.232)^2+2\cdot(0.308)^2+2\cdot(-0.342)^2+2\cdot(0.329)^2+2\cdot(-0.273)^2+2\cdot(0.18)^2+(0.06)^2+(0.185)^2$ solve, q_{15} → 1.030221

$q_{16}=2\cdot(0.063)^2+2\cdot(-0.125)^2+2\cdot(0.182)^2+2\cdot(-0.233)^2+2\cdot(0.275)^2+2\cdot(-0.308)^2+2\cdot(0.331)^2+(0.342)^2+(-0.238)^2$ solve, q_{16} → .947722

- Orde ikatan

P_{12}=2·(0.063·0.124) + 2·(0.124·0.231) + 2 (0.182·0.308) + 2·(0.231·0.342) + 2·(0.274·0.330) + 2·(0.307·0.274) + 2·(0.330·0.181) + 1·(0.342·0.064) + 1·(0.330·-0.180) → P_{12}=.774052

P_{23}=2·(0.181·0.124) + 2·(0.307·0.231) + 2·(0.341·0.308) + 2·(0.274·0.342) + 2·(0.124·0.330) + 2·(-0.064·0.274) + 2·(0.231·0.181) + 1·(-0.330·0.064) + 1·(-0.180·-0.232) → P_{23}=.735224

P_{27}=2·(0.330·0.124) + 2·(0.181·0.231) + 2·(-0.231·0.308) + 2·(0.307·0.342) + 2·(0.062·0.330) + 2·(0.341·0.274) + 2·(0.125·0.181) + 1·(0.273·0.064) + 1·(-0.180·0.122) → P_{27}=.501704

P_{34}=2·(0.181·0.231) + 2·(0.307·0.342) + 2·(0.341·0.273) + 2·(0.274·0.064) + 2·(0.124·-0.180) + 2·(-0.064·-0.330) + 2·(0.231·0.307) + 1·(-0.330·-0.125) + 1·(-0.232·0.306) → P_{34}=.62456

P_{45}=2·(0.274·0.231) + 2·(0.330·0.342) + 2·(0.123·0.273) + 2·(-0.180·0.064) + 2·(-0.341·-0.180) + 2·(-0.232·-0.330) + 2·(0.062·0.307) + 1·(0.308·-0.125) + 1·(0.306·0.065) → P_{45}=.691764

P_{56}=2·(0.274·0.307) + 2·(0.330·0.274) + 2·(0.123·-0.064) + 2·(-0.180·-0.330) + 2·(-0.341·-0.232) + 2·(-0.232·0.123) + 2·(0.062·0.341) + 1·(0.308·0.182) + 1·(0.065·-0.342) → P_{56}=.629594

P_{67}=2·(0.330·0.307) + 2·(0.181·0.274) + 2·(-0.231·-0.064) + 2·(-0.307·-0.330) + 2·(0.062·-0.232) + 2·(0.341·0.123) + 2·(0.125·0.341) + 1·(-0.273·0.182) + 1·(-0.342·0.122) → P_{67}=.582954

P_{53}=2·(0.274·0.342) + 2·(0.330·0.064) + 2·(0.123·-0.330) + 2·(-0.180·-0.125) + 2·(-0.341·0.306) + 2·(-0.232·0.182) + 2·(0.062·0.273) + 1·(0.308·0.223) + 1·(0.065·-0.275) → P_{58}=-.015003

P_{89}=2·(0.342·0.342) + 2·(0.062·0.064) + 2·(-0.330·-0.330) + 2·(0.123·-0.125) + 2·(0.308·0.306) + 2·(-0.179·0.182) + 2·(-0.275·0.273) + 1·(0.229·0.223) + 1·(-0.275·-0.272) → P_{89}=.527971

P_{910}=2·(0.342·0.330) + 2·(0.062·-0.181) + 2·(-0.330·-0.232) + 2·(0.123·0.306) + 2·(0.308·0.065) + 2·(-0.179·-0.342) + 2·(-0.275·0.122) + 1·(0.229·0.275) + 1·(-0.270·-0.272) → P_{910}=.663463

P_{914}=2·(0.342·0.181) + 2·(0.062·0.307) + 2·(-0.330·-0.341) + 2·(0.123·0.273) + 2·(0.308·0.122) + 2·(-0.179·0.066) + 2·(-0.275·-0.233) + 1·(0.229·0.331) + 1·(-0.272·0.228) → P_{914}=.647547

P_{1011}=2·(0.307·0.330) + 2·(-0.273·-0.181) + 2·(-0.064·-0.232) + 2·(0.330·0.306) + 2·(-0.230·0.065) + 2·(-0.126·-0.342) + 2·(0.342·0.122) + 1·(-0.178·0.275) + 1·(0.341·-0.27) → P_{1011}=.531814

P_{1112}=2·(0.307·0.274) + 2·(-0.273·-0.330) + 2·(-0.064·0.123) + 2·(0.330·0.182) + 2·(-0.230·-0.342) + 2·(-0.126·0.229) + 2·(0.342·-0.066) + 1·(-0.178·-0.308) + 1·(0.341·-0.059) → P_{1112}=.541965

P_{1213}=2·(0.231·0.274) + 2·(-0.343·-0.330) + 2·(0.273·0.123) + 2·(-0.061·0.182) + 2·(-0.182·-0.342) + 2·(0.331·0.229) + 2·(0.306·-0.066) + 1·(0.121·-0.308) + 1·(-0.059·-0.309) → P_{1213}=.613919

P_{1314}=2·(0.231·0.181) + 2·(-0.342·-0.307) + 2·(0.273·0.341) + 2·(-0.061·-0.273) + 2·(-0.182·0.122) + 2·(0.331·-0.066) + 2·(0.306·0.233) + 1·(0.121·0.331) + 1·(-0.309·0.228) → P_{1314}=.537197

P_{1415}=2·(-0.124·0.181) + 2·(-0.232·-0.307) + 2·(0.308·0.341) + 2·(-0.342·-0.273) + 2·(0.329·0.122) + 2·(-0.272·-0.066) + 2·(0.178·0.233) + 1·(-0.059·0.331) + 1·(0.228·0.185) → P_{1415}=.716127

P_{1516}=2·(-0.124·0.063) + 2·(-0.232·-0.125) + 2·(0.308·0.182) + 2·(-0.342·-0.233) + 2·(0.329·0.275) + 2·(-0.272·-0.308) + 2·(0.178·0.331) + 1·(-0.059·-0.342) + 1·(0.185·-0.238) → P_{1516}=.756346

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.774 \text{ solve}, F_1 \rightarrow .958050807568877293 5$

$F_2 = \sqrt{3} - 0.774 - 0.735 - 0.502 \text{ solve}, F_2 \rightarrow -.2789491924311227065$

$F_3 = \sqrt{3} - 0.735 - 0.625 \text{ solve}, F_3 \rightarrow .372050807568877293 5$

$F_4 = \sqrt{3} - 0.625 - 0.692 \text{ solve}, F_4 \rightarrow .415050807568877293 5$

$F_5 = \sqrt{3} - 0.692 - 0.529 - -0.015 \text{ solve}, F_5 \rightarrow .426050807568877293 5$

$F_6 = \sqrt{3} - 0.629 - 0.583 \text{ solve}, F_6 \rightarrow .520050807568877293 5$

$F_7 = \sqrt{3} - 0.502 - 0.583 \text{ solve}, F_7 \rightarrow .647050807568877293 5$

$F_8 = \sqrt{3} - -0.015 - 0.528 \text{ solve}, F_8 \rightarrow 1.219050807568877293 5$

$F_9 = \sqrt{3} - 0.528 - 0.663 - 0.647 \text{ solve}, F_9 \rightarrow -.1059491924311227065$

$F_{10} = \sqrt{3} - 0.663 - 0.532 \text{ solve}, F_{10} \rightarrow .537050807568877293 5$

$F_{11} = \sqrt{3} - 0.532 - 0.542 \text{ solve}, F_{11} \rightarrow .658050807568877293 5$

$F_{12} = \sqrt{3} - 0.542 - 0.614 \text{ solve}, F_{12} \rightarrow .576050807568877293 5$

$F_{13} = \sqrt{3} - 0.614 - 0.537 \text{ solve}, F_{13} \rightarrow .581050807568877293 5$

$F_{14} = \sqrt{3} - 0.647 - 0.716 - 0.537 \text{ solve}, F_{14} \rightarrow -.1679491924311227065$

$F_{15} = \sqrt{3} - 0.716 - 0.756 \text{ solve}, F_{15} \rightarrow .260050807568877293 5$

$F_{16} = \sqrt{3} - 0.756 \text{ solve}, F_{16} \rightarrow .976050807568877293 5$

C. 1 Elektron tereksitasi ke 3 tingkat energi lebih tinggi
- Kerapatan elektron (q)

$q_1=2\cdot(0.063)^2+2\cdot(0.124)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.274)^2+2\cdot(0.307)^2+2\cdot(0.330)^2+(0.342)^2+(0.274)^2$ solve, $q_1 \rightarrow .959424$

$q_2=2\cdot(0.124)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.342)^2+2\cdot(0.330)^2+2\cdot(0.274)^2+2\cdot(0.181)^2+(0.064)^2+(-0.273)^2$ solve, $q_2 \rightarrow 1.071999$

$q_3=2\cdot(0.182)^2+2\cdot(0.308)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.123)^2+2\cdot(-0.064)^2+2\cdot(-0.231)^2+(-0.330)^2+(-0.064)^2$ solve, $q_3 \rightarrow .895764$

$q_4=2\cdot(0.231)^2+2\cdot(0.342)^2+2\cdot(0.274)^2+2\cdot(0.064)^2+2\cdot(-0.180)^2+2\cdot(-0.330)^2+2\cdot(0.307)^2+(-0.125)^2+(0.330)^2$ solve, $q_4 \rightarrow 1.094617$

$q_5=2\cdot(0.274)^2+2\cdot(0.330)^2+2\cdot(0.124)^2+2\cdot(-0.180)^2+2\cdot(-0.341)^2+2\cdot(-0.232)^2+2\cdot(0.064)^2+(0.306)^2+(-0.230)^2$ solve, $q_5 \rightarrow .958442$

$q_6=2\cdot(0.307)^2+2\cdot(0.274)^2+2\cdot(-0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.232)^2+2\cdot(0.123)^2+2\cdot(0.341)^2+(0.182)^2+(-0.126)^2$ solve, $q_6 \rightarrow .98411$

$q_7=2\cdot(0.330)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.062)^2+2\cdot(0.341)^2+2\cdot(0.125)^2+(0.273)^2+(0.342)^2$ solve, $q_7 \rightarrow 1.041535$

$q_8=2\cdot(0.342)^2+2\cdot(0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.125)^2+2\cdot(0.308)^2+2\cdot(0.182)^2+2\cdot(0.273)^2+(0.228)^2+(-0.178)^2$ solve, $q_8 \rightarrow .979872$

$q_9=2\cdot(0.342)^2+2\cdot(0.0623)^2+2\cdot(-0.330)^2+2\cdot(0.123)^2+2\cdot(0.308)^2+2\cdot(-0.179)^2+2\cdot(0.275)^2+(0.229)^2+(-0.183)^2$ solve, $q_9 \rightarrow .98073858$

$q_{10}=2\cdot(0.330)^2+2\cdot(-0.180)^2+2\cdot(-0.232)^2+2\cdot(0.306)^2+2\cdot(0.065)^2+2\cdot(-0.342)^2+2\cdot(0.125)^2+(-0.275)^2+(0.341)^2$ solve, $q_{10} \rightarrow 1.043054$

$q_{11}=2\cdot(0.274)^2+2\cdot(-0.273)^2+2\cdot(-0.064)^2+2\cdot(0.330)^2+2\cdot(-0.238)^2+2\cdot(-0.186)^2+2\cdot(0.342)^2+(-0.178)^2+(-0.12)^2$ solve, $q_{11} \rightarrow .987694$

$q_{12}=2\cdot(0.231)^2+2\cdot(-0.330)^2+2\cdot(0.193)^2+2\cdot(0.182)^2+2\cdot(-0.342)^2+2\cdot(0.229)^2+2\cdot(0.066)^2+(0.308)^2+(-0.234)^2$ solve, $q_{12} \rightarrow .96241$

$q_{13}=2\cdot(-0.342)^2+2\cdot(0.231)^2+2\cdot(0.273)^2+2\cdot(-0.062)^2+2\cdot(-0.182)^2+2\cdot(0.331)^2+2\cdot(-0.306)^2+(0.121)^2+(0.329)^2$ solve, $q_{13} \rightarrow 1.09292$

$q_{14}=2\cdot(0.182)^2+2\cdot(-0.307)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.122)^2+2\cdot(0.066)^2+2\cdot(-0.233)^2+(0.331)^2+(-0.058)^2$ solve, $q_{14} \rightarrow .896349$

$q_{15}=2\cdot(0.124)^2+2\cdot(-0.232)^2+2\cdot(0.308)^2+2\cdot(-0.342)^2+2\cdot(0.329)^2+2\cdot(-0.273)^2+2\cdot(0.18)^2+(0.06)^2+(-0.277)^2$ solve, $q_{15} \rightarrow 1.072725$

$q_{16}=2\cdot(0.063)^2+2\cdot(-0.125)^2+2\cdot(0.182)^2+2\cdot(-0.233)^2+2\cdot(0.275)^2+2\cdot(-0.308)^2+2\cdot(0.331)^2+(0.342)^2+(0.304)^2$ solve, $q_{16} \rightarrow .983494$

- Orde ikatan

P_{12}=2·(0.063·0.124) + 2·(0.124·0.231) + 2·(0.182·0.308) + 2·(0.231·0.342) + 2·(0.274·0.330) + 2·(0.307·0.274) + 2·(0.330·0.181) + 1·(0.342·0.064) + 1·(0.274·-0.273) → P_{12}=.75865

P_{23}=2·(0.181·0.124) + 2·(0.307·0.231) + 2·(0.341·0.308) + 2·(0.274·0.342) + 2·(0.124·0.330) + 2·(-0.064·0.274) + 2·(0.231·0.181) + 1·(-0.330·0.064) + 1·(-0.273·-0.064) → P_{23}=.710936

P_{27}=2·(0.330·0.124) + 2·(0.181·0.231) + 2·(-0.231·0.308) + 2·(0.307·0.342) + 2·(0.062·0.330) + 2·(0.341·0.274) + 2·(0.125·0.181) + 1·(0.273·0.064) + 1·(-0.273·0.342) → P_{27}=.430298

P_{34}=2·(0.181·0.231) + 2·(0.307·0.342) + 2·(0.341·0.273) + 2·(0.274·0.064) + 2·(0.124·-0.180) + 2·(-0.064·-0.330) + 2·(0.231·0.307) + 1·(-0.330·-0.125) + 1·(-0.064·0.330) → P_{34}=.674432

P_{45}=2·(0.274·0.231) + 2·(0.330·0.342) + 2·(0.123·0.273) + 2·(-0.180·0.064) + 2·(-0.341·-0.180) + 2·(-0.232·-0.330) + 2·(0.062·0.307) + 1·(0.308·-0.125) + 1·(0.330·-0.230) → P_{45}=.595974

P_{56}=2·(0.274·0.307) + 2·(0.330·0.274) + 2·(0.123·-0.064) + 2·(-0.180·-0.330) + 2·(-0.341·-0.232) + 2·(-0.232·0.123) + 2·(0.062·0.341) + 1·(0.308·0.182) + 1·(-0.230·-0.126) → P_{56}=.680604

P_{57}=2·(0.330·0.307) + 2·(0.181·0.274) + 2·(-0.231·-0.064) + 2·(-0.307·-0.330) + 2·(0.062·-0.232) + 2·(0.341·0.123) + 2·(0.125·0.341) + 1·(-0.273·0.182) + 1·(-0.126·0.342) → P_{57}=.581586

P_{58}=2·(0.274·0.342) + 2·(0.330·0.064) + 2·(0.123·-0.330) + 2·(-0.180·-0.125) + 2·(-0.341·0.306) + 2·(-0.232·0.132) + 2·(0.062·0.273) + 1·(0.308·0.223) + 1·(-0.230·-0.178) → P_{58}=.043812

P_{89}=2·(0.342·0.342) + 2·(0.062·0.064) + 2·(-0.330·-0.330) + 2·(0.123·-0.125) + 2·(0.308·0.306) + 2·(-0.179·0.132) + 2·(-0.275·0.273) + 1·(0.229·0.223) + 1·(-0.178·-0.183) → P_{89}=.485745

P_{910}=2·(0.342·0.330) + 2·(0.062·-0.181) + 2·(-0.330·-0.232) + 2·(0.123·0.306) + 2·(0.308·0.065) + 2·(-0.179·-0.342) + 2·(-0.275·0.122) + 1·(0.229·0.275) + 1·(0.341·-0.183) → P_{910}=.52762

P_{914}=2·(0.342·0.181) + 2·(0.062·0.307) + 2·(-0.330·-0.341) + 2·(0.123·0.273) + 2·(0.308·0.122) + 2·(-0.179·0.066) + 2·(-0.275·-0.233) + 1·(0.229·0.331) + 1·(-0.183·-0.058) → P_{914}=.720177

P_{1011}=2·(0.307·0.330) + 2·(-0.273·-0.181) + 2·(-0.064·-0.232) + 2·(0.330·0.306) + 2·(-0.230·0.065) + 2·(-0.126·-0.342) + 2·(0.342·0.122) + 1·(-0.178·0.275) + 1·(0.341·-0.12) → P_{1011}=.582964

P_{1112}=2·(0.307·0.274) + 2·(-0.273·-0.330) + 2·(-0.064·0.123) + 2·(0.330·0.182) + 2·(-0.230·-0.342) + 2·(-0.126·0.229) + 2·(0.342·-0.066) + 1·(-0.178·-0.308) + 1·(-0.234·-0.12) → P_{1112}=.590164

P_{1213}=2·(0.231·0.274) + 2·(-0.342·-0.330) + 2·(0.273·0.123) + 2·(-0.061·0.182) + 2·(-0.182·-0.342) + 2·(0.331·0.229) + 2·(0.306·-0.066) + 1·(0.121·-0.308) + 1·(-0.234·0.329) → P_{1213}=.518702

P_{1314}=2·(0.231·0.181) + 2·(-0.342·-0.307) + 2·(0.273·0.341) + 2·(-0.061·-0.273) + 2·(-0.182·0.122) + 2·(0.331·-0.066) + 2·(0.306·0.233) + 1·(0.121·0.331) + 1·(0.329·-0.058) → P_{1314}=.588567

P_{1415}=2·(-0.124·0.181) + 2·(-0.232·-0.307) + 2·(0.308·0.341) + 2·(-0.342·-0.273) + 2·(0.329·0.122) + 2·(-0.272·-0.066) + 2·(0.178·0.233) + 1·(-0.059·0.331) + 1·(-0.058·-0.277) → P_{1415}=.690013

P_{1516}=2·(-0.124·0.063) + 2·(-0.232·-0.125) + 2·(0.308·0.182) + 2·(-0.342·-0.233) + 2·(0.329·0.275) + 2·(-0.272·-0.308) + 2·(0.178·0.331) + 1·(-0.059·-0.342) + 1·(-0.277·-0.304) → P_{1516}=.88458

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.759$ solve, F_1 → .9730508075688772935

$F_2 = \sqrt{3} - 0.759 - 0.710 - 0.430$ solve, F_2 → -.1669491924311227065

$F_3 = \sqrt{3} - 0.710 - 0.674$ solve, F_3 → .3480508075688772935

$F_4 = \sqrt{3} - 0.674 - 0.596$ solve, F_4 → .4620508075688772935

$F_5 = \sqrt{3} - 0.596 - 0.596 - -0.044$ solve, F_5 → .5840508075688772935

$F_6 = \sqrt{3} - 0.596 - 0.582$ solve, F_6 → .5540508075688772935

$F_7 = \sqrt{3} - 0.430 - 0.582$ solve, F_7 → .7200508075688772935

$F_8 = \sqrt{3} - -0.044 - 0.486$ solve, F_8 → 1.2900508075688772935

$F_9 = \sqrt{3} - 0.486 - 0.528 - 0.720$ solve, F_9 → -.0019491924311227065000

$F_{10} = \sqrt{3} - 0.528 - 0.533$ solve, F_{10} → .6710508075688772935

$F_{11} = \sqrt{3} - 0.533 - 0.590$ solve, F_{11} → .6090508075688772935

$F_{12} = \sqrt{3} - 0.590 - 0.519$ solve, F_{12} → .6230508075688772935

$F_{13} = \sqrt{3} - 0.519 - 0.586$ solve, F_{13} → .6270508075688772935

$F_{14} = \sqrt{3} - 0.720 - 0.589 - 0.690$ solve, F_{14} → -.2669491924311227065

$F_{15} = \sqrt{3} - 0.690 - 0.885$ solve, F_{15} → .1570508075688772935

$F_{16} = \sqrt{3} - 0.885$ solve, F_{16} → .8470508075688772935

D. 1 elektron tereksitasi ke 4 tingkat energi lebih tinggi

- Kerapatan elektron (q)

$$q_1=2\cdot(0.063)^2+2\cdot(0.124)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.274)^2+2\cdot(0.307)^2+2\,(0.330)^2+(0.342)^2+(0.231)^2 \text{ solve},q_1 \rightarrow .957709$$

$$q_2=2\cdot(0.124)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.342)^2+2\cdot(0.330)^2+2\cdot(0.274)^2+2\cdot(0.181)^2+(0.064)^2+(-0.330)^2 \text{ solve},q_2 \rightarrow 1.10637$$

$$q_3=2\cdot(0.182)^2+2\cdot(0.308)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.123)^2+2\cdot(-0.064)^2+2\cdot(-0.231)^2+(-0.330)^2+(0.123)^2 \text{ solve},q_3 \rightarrow .906737$$

$$q_4=2\cdot(0.231)^2+2\cdot(0.342)^2+2\cdot(0.274)^2+2\cdot(0.064)^2+2\cdot(-0.180)^2+2\cdot(-0.330)^2+2\cdot(0.307)^2+(-0.125)^2+(0.182)^2 \text{ solve},q_4 \rightarrow 1.018841$$

$$q_5=2\cdot(0.274)^2+2\cdot(0.330)^2+2\cdot(0.124)^2+2\cdot(-0.180)^2+2\cdot(-0.341)^2+2\cdot(-0.232)^2+2\cdot(0.064)^2+(0.306)^2+(-0.343)^2 \text{ solve},q_5 \rightarrow 1.022506$$

$$q_6=2\cdot(0.307)^2+2\cdot(0.274)^2+2\cdot(-0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.232)^2+2\cdot(0.123)^2+2\,(0.341)^2+(0.182)^2+(0.229)^2 \text{ solve},q_5 \rightarrow 1.020675$$

$$q_7=2\cdot(0.330)^2+2\cdot(0.181)^2+2\cdot(0.231)^2+2\cdot(0.307)^2+2\cdot(0.062)^2+2\cdot(0.341)^2+2\cdot(0.125)^2+(0.273)^2+(0.066)^2 \text{ solve},q_7 \rightarrow .928937$$

$$q_8=2\cdot(0.342)^2+2\cdot(0.064)^2+2\cdot(-0.330)^2+2\cdot(-0.125)^2+2\cdot(0.308)^2+2\,(0.182)^2+2\cdot(0.273)^2+(0.228)^2+(0.308)^2 \text{ solve},q_8 \rightarrow 1.043052$$

$$q_9=2\cdot(0.342)^2+2\cdot(0.0623)^2+2\cdot(-0.330)^2+2\cdot(0.123)^2+2\cdot(0.308)^2+2\cdot(-0.179)^2+2\cdot(0.275)^2+(0.229)^2+(0.305)^2 \text{ solve},q_9 \rightarrow 1.04027458$$

$$q_{10}=2\cdot(0.330)^2+2\cdot(-0.180)^2+2\cdot(-0.232)^2+2\cdot(0.306)^2+2\cdot(0.065)^2+2\cdot(-0.342)^2+2\cdot(0.125)^2+(-0.275)^2+(-0.059)^2 \text{ solve},q_{10} \rightarrow .930254$$

$$q_{11}=2\cdot(0.274)^2+2\cdot(-0.273)^2+2\cdot(-0.064)^2+2\cdot(0.330)^2+2\cdot(-0.238)^2+2\cdot(-0.186)^2+2\cdot(0.342)^2+(-0.178)^2+(-0.234)^2 \text{ solve},q_{11} \rightarrow 1.02805$$

$$q_{12}=2\cdot(0.231)^2+2\cdot(-0.330)^2+2\cdot(0.193)^2+2\cdot(0.182)^2+2\cdot(-0.342)^2+2\cdot(0.229)^2+2\,(0.066)^2+(0.308)^2+(0.341)^2 \text{ solve},q_{12} \rightarrow 1.023935$$

$$q_{13}=2\cdot(-0.342)^2+2\cdot(0.231)^2+2\cdot(0.273)^2+2\cdot(-0.062)^2+2\cdot(-0.182)^2+2\cdot(0.331)^2+2\cdot(-0.306)^2+(0.121)^2+(-0.176)^2 \text{ solve},q_{13} \rightarrow 1.015655$$

$$q_{14}=2\cdot(0.182)^2+2\cdot(-0.307)^2+2\cdot(0.341)^2+2\cdot(0.273)^2+2\cdot(0.122)^2+2\,(0.066)^2+2\cdot(-0.233)^2+(0.331)^2+(-0.129)^2 \text{ solve},q_{14} \rightarrow .909626$$

$$q_{15}=2\cdot(0.124)^2+2\cdot(-0.232)^2+2\cdot(0.308)^2+2\cdot(-0.342)^2+2\cdot(0.329)^2+2\cdot(-0.273)^2+2\cdot(0.18)^2+(0.06)^2+(0.331)^2 \text{ solve},q_{15} \rightarrow 1.105557$$

$$q_{16}=2\cdot(0.063)^2+2\cdot(-0.125)^2+2\cdot(0.182)^2+2\cdot(-0.233)^2+2\cdot(0.275)^2+2\cdot(-0.308)^2+2\,(0.331)^2+(0.342)^2+(-0.270)^2 \text{ solve},q_{16} \rightarrow .963978$$

- Orde ikatan

P_{12}=2·(0.063·0.124) + 2·(0.124·0.231) + 2 (0.182·0.308) + 2·(0.231·0.342) + 2·(0.274·0.330) + 2·(0.307·0.274) + 2·(0.330·0.181) + 1·(0.342·0.064) + 1·(0.231·-0.330) → P_{12}=.757222

P_{23}=2·(0.181·0.124) + 2·(0.307·0.231) + 2·(0.341·0.308) + 2·(0.274·0.342) + 2·(0.124·0.330) + 2·(-0.064·0.274) + 2·(0.231·0.181) + 1·(-0.330·0.064) + 1·(-0.330·0.123) → P_{23}=.652874

P_{27}=2·(0.330·0.124) + 2·(0.181·0.231) + 2·(-0.231·0.308) + 2·(0.307·0.342) + 2·(0.062·0.330) + 2·(0.341·0.274) + 2·(0.125·0.181) + 1·(0.273·0.064) + 1·(0.330·0.066) → P_{27}=.545444

P_{34}=2·(0.181·0.231) + 2·(0.307·0.342) + 2·(0.341·0.273) + 2·(0.274·0.064) + 2·(0.124~0.180) + 2·(-0.064~0.330) + 2·(0.231·0.307) + 1·(-0.330~0.125) + 1·(0.123·0.182) → P_{34}=.717938

P_{45}=2·(0.274·0.231) + 2·(0.330·0.342) + 2·(0.123·0.273) + 2·(-0.180·0.064) + 2·(-0.341~0.180) + 2·(-0.232~0.330) + 2·(0.062·0.307) + 1·(0.308~0.125) + 1·(0.182~0.342) → P_{45}=.60963

P_{56}=2·(0.274·0.307) + 2·(0.330·0.274) + 2·(0.123~0.064) + 2·(-0.180~0.330) + 2·(-0.341~0.232) + 2·(-0.232·0.123) + 2·(0.062·0.341) + 1·(0.308·0.182) + 1·(-0.342·0.229) → P_{56}=.573306

P_{67}=2·(0.330·0.307) + 2·(0.181·0.274) + 2·(-0.231~0.064) + 2·(-0.307~0.330) + 2·(0.062~0.232) + 2·(0.341·0.123) + 2·(0.125·0.341) + 1·(-0.273·0.182) + 1·(0.229·0.066) → P_{67}=.639792

P_{58}=2·(0.274·0.342) + 2·(0.330·0.064) + 2·(0.123~0.330) + 2·(-0.180~0.125) + 2·(-0.341·0.306) + 2·(-0.232·0.182) + 2·(0.062·0.273) + 1·(0.308·0.223) + 1·(-0.342·0.308) → P_{58}=-.102464

P_{89}=2·(0.342·0.342) + 2·(0.062·0.064) + 2·(-0.330~0.330) + 2·(0.123~0.125) + 2·(0.308·0.306) + 2·(-0.179·0.182) + 2·(-0.275·0.273) + 1·(0.229·0.223) + 1·(0.308·0.305) → P_{89}=.547111

P_{910}=2·(0.342·0.330) + 2·(0.062~0.181) + 2·(-0.330~0.232) + 2·(0.123·0.306) + 2·(0.308·0.065) + 2·(-0.179~0.342) + 2·(-0.275 0.122) + 1·(0.229·0.275) + 1·(0.305·0.059) → P_{910}=.608018

P_{914}=2·(0.342·0.181) + 2·(0.062·0.307) + 2·(-0.330~0.341) + 2·(0.123·0.273) + 2·(0.308·0.122) + 2·(-0.179·0.066) + 2·(-0.275~0.233) + 1·(0.229·0.331) + 1·(0.305~0.129) → P_{914}=.670218

P_{1011}=2·(0.307·0.330) + 2·(-0.273~0.181) + 2·(-0.064~0.232) + 2·(0.330·0.306) + 2·(-0.230·0.065) + 2·(-0.126~0.342) + 2·(0.342 0.122) + 1·(-0.178·0.275) + 1·(0.059~0.234) → P_{1011}=.610078

P_{1112}=2·(0.307·0.274) + 2·(-0.273~0.330) + 2·(-0.064·0.123) + 2·(0.330·0.182) + 2·(-0.230~0.342) + 2·(-0.126·0.229) + 2·(0.342~0.066) + 1·(-0.178~0.308) + 1·(-0.234·0.341) → P_{1112}=.48229

P_{1213}=2·(0.231·0.274) + 2·(-0.342~0.330) + 2·(0.273·0.123) + 2·(-0.061·0.182) + 2·(-0.182~0.342) + 2·(0.331·0.229) + 2·(0.306~0.066) + 1·(0.121~0.308) + 1·(0.341~0.176) → P_{1213}=.535672

P_{1314}=2·(0.231·0.181) + 2·(-0.342~0.307) + 2·(0.273·0.341) + 2·(-0.061~0.273) + 2·(-0.182·0.122) + 2·(0.331~0.066) + 2·(0.306·0.233) + 1·(0.121·0.331) + 1·(-0.176~0.129) → P_{1314}=.630353

P_{1415}=2·(-0.124·0.181) + 2·(-0.232~0.307) + 2·(0.308·0.341) + 2·(-0.342~0.273) + 2·(0.329·0.122) + 2·(-0.272~0.066) + 2·(0.178·0.233) + 1·(-0.059·0.331) + 1·(-0.129·0.331) → P_{1415}=.631248

P_{1516}=2·(-0.124·0.063) + 2·(-0.232~0.125) + 2·(0.308·0.182) + 2·(-0.342~0.233) + 2·(0.329·0.275) + 2·(-0.272~0.308) + 2·(0.178·0.331) + 1·(-0.059~0.342) + 1·(0.331~0.270) → P_{1516}=.711006

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.757 \text{ solve}, F_1 \rightarrow .9750508075688772935$

$F_2 = \sqrt{3} - 0.757 - 0.653 - 0.545 \text{ solve}, F_2 \rightarrow -.2229491924311227065$

$F_3 = \sqrt{3} - 0.653 - 0.718 \text{ solve}, F_3 \rightarrow .3610508075688772935$

$F_4 = \sqrt{3} - 0.718 - 0\ 609 \text{ solve}, F_4 \rightarrow .4050508075688772935$

$F_5 = \sqrt{3} - 0.573 - 0.609 - -0.102 \text{ solve}, F_5 \rightarrow .6520508075688772935$

$F_6 = \sqrt{3} - 0.573 - 0.639 \text{ solve}, F_6 \rightarrow .5200508075688772935$

$F_7 = \sqrt{3} - 0.545 - 0.639 \text{ solve}, F_7 \rightarrow .5480508075688772935$

$F_8 = \sqrt{3} - -0.102 - 0.547 \text{ solve}, F_8 \rightarrow 1.2870508075688772935$

$F_9 = \sqrt{3} - 0.547 - 0.608 - 0.670 \text{ solve}, F_9 \rightarrow -.09294919243112270650 0$

$F_{10} = \sqrt{3} - 0.608 - 0.610 \text{ solve}, F_{10} \rightarrow .5140508075688772935$

$F_{11} = \sqrt{3} - 0.610 - 0.482 \text{ solve}, F_{11} \rightarrow .6400508075688772935$

$F_{12} = \sqrt{3} - 0.482 - 0.536 \text{ solve}, F_{12} \rightarrow .7140508075688772935$

$F_{13} = \sqrt{3} - 0.536 - 0.630 \text{ solve}, F_{13} \rightarrow .5660508075688772935$

$F_{14} = \sqrt{3} - 0.630 - 0.670 - 0.631 \text{ solve}, F_{14} \rightarrow -.1989491924311227065$

$F_{15} = \sqrt{3} - 0.631 - 0.711 \text{ solve}, F_{15} \rightarrow .3900508075688772935$

$F_{16} = \sqrt{3} - 0.711 \text{ solve}, F_{16} \rightarrow 1.0210508075688772935$

A.3. Fenolftalein dalam suasana basa (kromofor II)

$$\begin{vmatrix} x+2 & 0.9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.9 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & x+2 \end{vmatrix} \text{ solve, } x \rightarrow \begin{bmatrix} -2.53791753 \\ -2.53791753 \\ -1.54786166 \\ -1.29938751 \\ -.804540882 \\ -.804540882 \\ -.395652236 \\ .234688325 \\ .234688325 \\ 1.14028304 \\ 1.14028304 \\ 1.42938751 \\ 1.42938751 \\ 2.00296916 \\ 2.00296916 \end{bmatrix}$$

$$(-.39565223 \quad -.2346883259) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.023 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

solve, $\lambda \rightarrow 604.281334 \quad nm$

LAMPIRAN B

HASIL PERHITUNGAN TEORI HMO UNTUK MOLEKUL METIL KUNING

DENGAN $k_{CN} = 0.7$, $h_N^1 = 2$ DAN $h_N = 1.5$

A.1. Metil kuning pada suasana basa

Perhitungan untuk mendapatkan panjang gelombang maksimum ($\Delta E = E_{LUMO} - E_{HOMO}$)

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.7 & 0 & 0 & x+1.5 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & x+1.5 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & x & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0.7 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & 0 & 0 & x+2 \end{vmatrix} \text{ solve, } x \rightarrow \begin{bmatrix} -3.587357 \\ -2.088195 \\ -2.088195 \\ -1.578666 \\ -1.578666 \\ -0.901208 \\ -0.271989 \\ -0.238133 \\ 0.3990919 \\ 0.6853610 \\ 0.9012087 \\ 1.3855896 \\ 1.3855896 \\ 1.9162144 \\ 2.2093624 \end{bmatrix}$$

$$(-.238133 - .3990919) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} nm \cdot 6.023 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve}, \lambda \rightarrow 596.214358 \text{ nm}$$

a.2 Fungsi gelombang

$\psi_1 = 0.069\phi_1 + 0.135\phi_2 + 0.196\phi_3 + 0.250\phi_4 + 0.294\phi_5 + 0.327\phi_6 + 0.347\phi_7 + 0.354\phi_8 + 0.347\phi_9 + 0.327\phi_{10} + 0.294\phi_{11} + 0.250\phi_{12} + 0.196\phi_{13} + 0.135\phi_{14} + 0.069\phi_{15}$

$\psi_2 = 0.135\phi_1 + 0.250\phi_2 + 0.327\phi_3 + 0.354\phi_4 + 0.327\phi_5 + 0.250\phi_6 + 0.135\phi_7 + 0\phi_8 - 0.135\phi_9 - 0.250\phi_{10} - 0.326\phi_{11} - 0.354\phi_{12} - 0.327\phi_{13} - 0.250\phi_{14} - 0.135\phi_{15}$

$\psi_3 = 0.196\phi_1 + 0.327\phi_2 + 0.347\phi_3 + 0.250\phi_4 + 0.069\phi_5 - 0.135\phi_6 - 0.294\phi_7 - 0.354\phi_8 - 0.294\phi_9 - 0.136\phi_{10} + 0.068\phi_{11} + 0.249\phi_{12} + 0.346\phi_{13} + 0.327\phi_{14} + 0.198\phi_{15}$

$\psi_4 = 0.250\phi_1 + 0.354\phi_2 + 0.250\phi_3 + 0\phi_4 - 0.254\phi_5 + 0.354\phi_6 - 0.250\phi_7 + 0\phi_8 + 0.249\phi_9 + 0.354\phi_{10} + 0.251\phi_{11} + 0\phi_{12} - 0.249\phi_{13} - 0.354\phi_{14} - 0.251\phi_{15}$

$\psi_5 = 0.294\phi_1 + 0.327\phi_2 + 0.069\phi_3 + 0.250\phi_4 + 0.347\phi_5 - 0.135\phi_6 + 0.195\phi_7 + 0.354\phi_8 + 0.198\phi_9 - 0.134\phi_{10} - 0.346\phi_{11} - 0.251\phi_{12} + 0.067\phi_{13} + 0.326\phi_{14} + 0.295\phi_{15}$

$\psi_6 = 0.327\phi_1 + 0.250\phi_2 - 0.135\phi_3 + 0.354\phi_4 + 0.135\phi_5 + 0.249\phi_6 + 0.327\phi_7 + 0\phi_8 - 0.326\phi_9 - 0.251\phi_{10} + 0.133\phi_{11} + 0.354\phi_{12} + 0.138\phi_{13} - 0.248\phi_{14} - 0.328\phi_{15}$

$\psi_7 = 0.347\phi_1 + 0.136\phi_2 - 0.294\phi_3 - 0.251\phi_4 + 0.195\phi_5 + 0.327\phi_6 - 0.067\phi_7 - 0.354\phi_8 - 0.326\phi_9 - 0.251\phi_{10} + 0.133\phi_{11} + 0.354\phi_{12} + 0.138\phi_{13} - 0.248\phi_{14} - 0.328\phi_{15}$

$\psi_8 = 0.354\phi_1 + 0\phi_2 - 0.354\phi_3 + 0\phi_4 + 0.354\phi_5 + 0\phi_6 - 0.354\phi_7 + 0\phi_8 + 0.354\phi_9 - 0\phi_{10} - 0.354\phi_{11} + 0\phi_{12} + 0.354\phi_{13} - 0\phi_{14} - 0.354\phi_{15}$

$\psi_9 = 0.347\phi_1 - 0.135\phi_2 - 0.294\phi_3 + 0.249\phi_4 + 0.198\phi_5 + 0.326\phi_6 - 0.069\phi_7 + 0.354\phi_8 - 0.066 - 0.328\phi_{10} + 0.194\phi_{11} + 0.253\phi_{12} - 0.292\phi_{13} - 0.139\phi_{14} - 0.346\phi_{15}$

$\psi_{10} = 0.327\phi_1 - 0.250\phi_2 - 0.136\phi_3 + 0.354\phi_4 - 0.134\phi_5 - 0.250\phi_6 + 0.326\phi_7 - 0\phi_8 - 0.328\phi_9 + 0.247\phi_{10} + 0.135\phi_{11} - 0.354\phi_{12} + 0.131\phi_{13} + 0.250\phi_{14} - 0.325\phi_{15}$

$\psi_{11} = 0.294\phi_1 - 0.326\phi_2 + 0.068\phi_3 + 0.250\phi_4 - 0.346\phi_5 + 0.133\phi_6 + 0.196\phi_7 - 0.354\phi_8 + 0.196\phi_9 + 0.135\phi_{10} - 0.348\phi_{11} + 0.50\phi_{12} + 0.069\phi_{13} - 0.329\phi_{14} + 0.294\phi_{15}$

$\psi_{12} = 0.250\phi_1 - 0.354\phi_2 + 0.294\phi_3 - 0\phi_4 - 0.251\phi_5 + 0.354\phi_6 - 0.248\phi_7 - 0\phi_8 + 0.253\phi_9 - 0.354\phi_{10} + 0.247\phi_{11} + 0.005\phi_{12} - 0.254\phi_{13} + 0.354\phi_{14} - 0.245\phi_{15}$

$\psi_{13} = 0.197\phi_1 - 0.327\phi_2 + 0.346\phi_3 - 0.249\phi_4 + 0.067\phi_5 + 0.138\phi_6 - 0.296\phi_7 + 0.350\phi_8 - 0.292\phi_9 + 0.131\phi_{10} + 0.074\phi_{11} - 0.254\phi_{12} + 0.348\phi_{13} - 0.324\phi_{14} + 0.191\phi_{15}$

$\psi_{14} = 0.136\phi_1 - 0.251\phi_2 + 0.327\phi_3 - 0.354\phi_4 + 0.326\phi_5 - 0.248\phi_6 + 0.132\phi_7 - 0\phi_8 - 0.139\phi_9 + 0.253\phi_{10} - 0.329\phi_{11} + 0.354\phi_{12} - 0.324\phi_{13} + 0.245\phi_{14} - 0.128\phi_{15}$

$\psi_{15} = 0.069\phi_1 - 0.136\phi_2 + 0.198\phi_3 - 0.251\phi_4 + 0.295\phi_5 - 0.328\phi_6 + 0.347\phi_7 - 0.354\phi_8 + 0.346\phi_9 - 0.325\phi_{10} + 0.291\phi_{11} - 0.254\phi_{12} + 0.191\phi_{13} - 0.128\phi_{14} + 0.061\phi_{15}$

a.3 Indeks kereaktifan

- **Kerapatan Elektron**

$q_1 = 2\cdot(0.069)^2 + 2\cdot(0.135)^2 + 2\cdot(0.196)^2 + 2\cdot(0.250)^2 + 2\cdot(0.294)^2 + 2\cdot(0.327)^2 + 2\cdot(0.347)^2 + 2\cdot(0.354)^2 \text{ solve}, q_1 \rightarrow 1.125984$

$q_2 = 2\cdot(0.135)^2 + 2\cdot(0.250)^2 + 2\cdot(0.327)^2 + 2\cdot(0.354)^2 + 2\cdot(0.327)^2 + 2\cdot(0.250)^2 + 2\cdot(0.135)^2 + 2\cdot(0)^2 \text{ solve}, q_2 \rightarrow 1.001248$

$q_3 = 2\cdot(0.196)^2 + 2\cdot(0.327)^2 + 2\cdot(0.347)^2 + 2\cdot(0.250)^2 + 2\cdot(0.069)^2 + 2\cdot(-0.135)^2 + 2\cdot(-0.294)^2 + 2\cdot(-0.354)^2 \text{ solve}, q_3 \rightarrow 1.125984$

$q_4 = 2\cdot(0.250)^2 + 2\cdot(0.354)^2 + 2\cdot(0.250)^2 + 2\cdot(0)^2 + 2\cdot(-0.254)^2 + 2\cdot(0.354)^2 + 2\cdot(-0.250)^2 + 2\cdot(0)^2 \text{ solve}, q_4 \rightarrow 1.005296$

$q_5 = 2\cdot(0.294)^2 + 2\cdot(0.327)^2 + 2\cdot(0.069)^2 + 2\cdot(0.250)^2 + 2\cdot(0.347)^2 + 2\cdot(-0.135)^2 + 2\cdot(0.195)^2 + 2\cdot(0.354)^2 \text{ solve}, q_5 \rightarrow 1.125202$

$q_6 = 2\cdot(0.327)^2 + 2\cdot(0.250)^2 + 2\cdot(-0.135)^2 + 2\cdot(0.354)^2 + 2\cdot(0.135)^2 + 2\cdot(0.249)^2 + 2\cdot(0.327)^2 + 2\cdot(0)^2 \text{ solve}, q_6 \rightarrow 1.00025$

$q_7 = 2\cdot(0.347)^2 + 2\cdot(0.136)^2 + 2\cdot(-0.291)^2 + 2\cdot(-0.251)^2 + 2\cdot(0.195)^2 + 2\cdot(0.327)^2 + 2\cdot(-0.067)^2 + 2\cdot(-0.354)^2 \text{ solve}, q_7 \rightarrow 1.122692$

$q_8 = 2\cdot(0.354)^2 + 2\cdot(0)^2 + 2\cdot(-0.354)^2 + 2\cdot(0)^2 + 2\cdot(0.354)^2 + 2\cdot(0)^2 + 2\cdot(-0.354)^2 + 2\cdot(0)^2 \text{ solve}, q_8 \rightarrow 1.002528$

$q_9 = 2\cdot(0.347)^2 + 2\cdot(-0.135)^2 + 2\cdot(-0.294)^2 + 2\cdot(0.294)^2 + 2\cdot(0.198)^2 + 2\cdot(0.326)^2 + 2\cdot(-0.069)^2 + 2\cdot(0.354)^2 \text{ solve}, q_9 \rightarrow 1.174126$

$q_{10} = 2\cdot(0.327)^2 + 2\cdot(-0.250)^2 + 2\cdot(-0.136)^2 + 2\cdot(0.354)^2 + 2\cdot(-0.134)^2 + 2\cdot(-0.250)^2 + 2\cdot(0.326)^2 + 2\cdot(0)^2 \text{ solve}, q_{10} \rightarrow .999946$

$q_{11} = 2\cdot(0.294)^2 + 2\cdot(-0.326)^2 + 2\cdot(0.068)^2 + 2\cdot(0.250)^2 + 2\cdot(-0.346)^2 + 2\cdot(0.133)^2 + 2\cdot(0.196)^2 + 2\cdot(-0.354)^2 \text{ solve}, q_{11} \rightarrow 1.121946$

$q_{12} = 2\cdot(0.250)^2 + 2\cdot(-0.354)^2 + 2\cdot(0.249)^2 + 2\cdot(0)^2 + 2\cdot(-0.251)^2 + 2\cdot(0.354)^2 + 2\cdot(-0.248)^2 + 2\cdot(0)^2 \text{ solve}, q_{12} \rightarrow .999276$

$q_{13} = 2\cdot(0.197)^2 + 2\cdot(-0.327)^2 + 2\cdot(0.346)^2 + 2\cdot(-0.249)^2 + 2\cdot(0.067)^2 + 2\cdot(0.138)^2 + 2\cdot(-0.296)^2 + 2\cdot(0.350)^2 \text{ solve}, q_{13} \rightarrow 1.122208$

$q_{14} = 2\cdot(0.136)^2 + 2\cdot(-0.251)^2 + 2\cdot(0.327)^2 + 2\cdot(-0.354)^2 + 2\cdot(0.327)^2 + 2\cdot(-0.248)^2 + 2\cdot(0.132)^2 + 2\cdot(0)^2 \text{ solve}, q_{14} \rightarrow .999198$

$q_{15} = 2\cdot(0.069)^2 + 2\cdot(-0.136)^2 + 2\cdot(0.198)^2 + 2\cdot(-0.251)^2 + 2\cdot(0.295)^2 + 2\cdot(-0.328)^2 + 2\cdot(0.347)^2 + 2\cdot(-0.354)^2 \text{ solve}, q_{15} \rightarrow 1.131592$

- **Orde Ikatan :**

P_{12}=2·(0.069·0.135) + 2·(0.135·0.250) + 2·(0.196·0.327) + 2·(0.250·0.354) + 2·(0.294·0.327) + 2·(0.327·0.250) + 2·(0.347·0.136) + 2·(0.354·0) → P_{12}=.841474

P_{16}=2·(0.069·0.327) + 2·(0.135·0.250) + 2·(0.196·-0.135) + 2·(0.250·0.354) + 2·(0.294·-0.135) + 2·(0.327·0.249) + 2·(0.347·0.327) + 2·(0.354·0) → P_{16}=.54711

P_{23}=2·(0.196·0.135) + 2·(0.327·0.250) + 2·(0.347·0.327) + 2·(0.250·0.354) + 2·(0.069·0.327) + 2·(-0.135·0.250) + 2·(-0.294·0.136) + 2·(-0.354·0) P_{23} → P_{23}=.518016

P_{34}=2·(0.196·0.250) + 2·(0.327·0.354) + 2·(0.347·0.250) + 2·(0.250·0) + 2·(0.069·0.250) + 2·(-0.135·0.354) + 2·(-0.294·-0.251) + 2·(-0.354·0) → P_{34}=.589524

P_{45}=2·(0.294·0.250) + 2·(0.327·0.354) + 2·(0.069·0.250) + 2·(-0.254·0) + 2·(0.347·0.250) + 2·(0.135·0.354) + 2·(0.195·-0.251) + 2·(0.354·0) → P_{45}=.584206

P_{47}=2·(0.347·0.250) + 2·(0.135·0.354) + 2·(-0.294·0.250) + 2·(-0.250·0) + 2·(0.195·0.250) + 2·(0.327·0.354) + 2·(-0.067·-0.251) + 2·(-0.354·0) → P_{47}=.48473

P_{55}=2·(0.294·0.327) + 2·(0.327·0 250) + 2·(0.069·-0.135) + 2·(-0.254·-0.354) + 2·(-0.347·-0.135) + 2·(-0.135·0.249) + 2·(0.195·0.327) + 2·(0.354·0) → P_{56}=.670968

P_{78}=2·(0.347·0.354) + 2·(0.135·0) + 2·(-0.294·-0.345) + 2·(-0.250·0) + 2·(0.195·0.354) + 2·(0.327·0) + 2·(-0.067·-0.354) + 2·(-0.354·0) → P_{78}=.634032

P_{89}=2·(0.347·0.354) + 2·(-0.135·0) + 2·(-0.294·-0.345) + 2·(0.249·0) + 2·(0.198·0.354) + 2·(-0.326·0) + 2·(-0.326·-0.354) + 2·(0.354·0) → P_{89}=.819528

P_{910}=2·(0.347·0.327) + 2·(-0.135·-0.250) + 2·(-0.294·-0.136) + 2·(0.249·0.354) + 2·(0.198·-0.134) + 2·(-0.326·-0.251) + 2·(-0.326·0.251) + 2·(0.354·0) → P_{910}=.497634

P_{914}=2·(0.347·0.135) + 2·(-0.135·-0.250) + 2·(0.294·0.327) + 2·(0.249·-0.354) + 2·(0.198·0.326) + 2·(-0.326·-0.248) + 2·(-0.326·0.248) + 2·(0.354·0) → P_{914}=.629662

P_{1011}=2·(0.294·0.327) + 2·(-0.326·-0.250) + 2·(0.068·-0.136) + 2·(0.251·0.354) + 2·(-0.346·-0.134) + 2·(0.133·-0.251) + 2·(0.133·-0.251) + 2·(-0.354·0) → P_{1011}=.473684

P_{1112}=2·(0.294·0.250) + 2·(-0.326·-0.354) + 2·(0.068·0.249) + 2·(0.251·0) + 2·(-0.346·-0.251) + 2·(0.133·0.354) + 2·(0.133·0.354) + 2·(-0.354·0) → P_{1112}=.773692

P_{1213}=2·(0.196·0.250) + 2·(-0.327·-0.354) + 2·(0.346·0.249) + 2·(-0.249·0) + 2·(0.067·-0.251) + 2·(0.138·0.354) + 2·(0.138·0.354) + 2·(0.354·0) F_{1213} → P_{1213}=.663598

P_{1215}=2·(0.069·0.250) + 2·(-0.135·-0.354) + 2·(0.198·0.249) + 2·(-0.251·0) + 2·(0.295·0.251) + 2·(0.328·0.354) + 2·(0.328·0.354) + 2·(-0.354·0) → P_{1215}=.841222

P_{1314}=2·(0.196·0.135) + 2·(-0.327·-0.250) + 2·(0.346·0.327) + 2·(-0.249·-0.354) + 2·(0.067·0.326) + 2·(0.138·-0.248) + 2·(0.138·-0.248) + 2·(0.354·0) → P_{1314}=.525784

-. Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.841 - 0.547 \text{ solve}, F_1 \rightarrow .3440508075688772935$

$F_2 = \sqrt{3} - 0.841 - 0.518 \text{ solve}, F_2 \rightarrow .3730508075688772935$

$F_3 = \sqrt{3} - 0.518 - 0.589 \text{ solve}, F_3 \rightarrow .6250508075688772935$

$F_4 = \sqrt{3} - 0.589 - 0.584 - 0.485 \text{ solve}, F_4 \rightarrow .074050807568877293500$

$F_5 = \sqrt{3} - 0.583 - 0.485 \text{ solve}, F_5 \rightarrow .6640508075688772935$

$F_6 = \sqrt{3} - 0.547 - 0.671 \text{ solve}, F_6 \rightarrow .5140508075688772935$

$F_7 = \sqrt{3} - 0.485 - 0.634 \text{ solve}, F_7 \rightarrow .6130508075688772935$

$F_8 = \sqrt{3} - 0.634 - 0.819 \text{ solve}, F_8 \rightarrow .2790508075688772935$

$F_9 = \sqrt{3} - 0.497 - 0.629 - 0.819 \text{ solve}, F_9 \rightarrow -.2129491924311227065$

$F_{10} = \sqrt{3} - 0.497 - 0.474 \text{ solve}, F_{10} \rightarrow .7610508075688772935$

$F_{11} = \sqrt{3} - 0.474 - 0.774 \text{ solve}, F_{11} \rightarrow .4840508075688772935$

$F_{12} = \sqrt{3} - 0.774 - 0.663 - 0.841 \text{ solve}, F_{12} \rightarrow -.5459491924311227065$

$F_{13} = \sqrt{3} - 0.663 - 0.525 \text{ solve}, F_{13} \rightarrow .5440508075688772935$

$F_{14} = \sqrt{3} - 0.525 - 0.629 \text{ solve}, F_{14} \rightarrow .5780508075688772935$

$F_{15} = \sqrt{3} - 0.841 \text{ solve}, F_{15} \rightarrow .8910508075688772935$

B.2. Metil kuning pada suasana asam

Perhitungan untuk mendapatkan panjang gelombang maksimum ($\Delta E = E_{LUMO} - E_{HOMO}$)

a.1 λ maksimum

$$\begin{bmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.7 & 0 & 0 & x+1.5 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & x+1.5 & 0.7 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{bmatrix} \text{solve}, x \rightarrow \begin{bmatrix} -2.2341053712318578371 \\ -2.1963919982533006419 \\ -2.1963919982533006419 \\ -1.1879138523511852661 \\ -1.1879138523511852661 \\ -.83514078873266323477 \\ -.49847921020980169319 \\ .04074699141130714908 \\ .04074699141130714908 \\ .83514078873266323477 \\ 1.1062050746158609955 \\ 1.1062050746158609955 \\ 2.0720639413290464216 \\ 2.0720639413290464216 \end{bmatrix}$$

$$(-.498479210209801 - .040746991411307) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{6.626 \cdot 10^{-34} \cdot 3 \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{\frac{sec \cdot mol}{\lambda}}$$

$$\text{solve}, \lambda \rightarrow 704.45365285156662516 \cdot nm$$

a.2. Fungsi gelombang

$\psi_1 = 0.051\phi_1 + 0.068\phi_2 + 0.131\phi_3 + 0.282\phi_4 + 0.131\phi_5 + 0.068\phi_6 + 0.612\phi_7 + 0.612\phi_8 + 0.282\phi_9 + 0.131\phi_{10} + 0.068\phi_{11} + 0.051\phi_{12} + 0.068\phi_{13} + 0.131\phi_{14}$

$\psi_2 = 0.267\phi_1 + 0.273\phi_2 + 0.29\phi_3 + 0.321\phi_4 + 0.29\phi_5 - 0.273\phi_6 + 0.094\phi_7 - 0.094\phi_8 - 0.321\phi_9 - 0.290\phi_{10} + 0.273\phi_{11} + 0.267\phi_{12} + 0.273\phi_{13} - 0.290\ \phi_{14}$

$\psi_3 = -0.276\phi_1 + 0.279\phi_2 + 0.291\phi_3 - 0.309\phi_4 + 0.291\phi_5 + 0.279\phi_6 - 0.057\phi_7 - 0.057\phi_8 - 0.309\phi_9 + 0.291\phi_{10} + 0.279\phi_{11} - 0.276\phi_{12} + 0.279\phi_{13} + 0.291\phi_{14}$

$\psi_4 = 0.237\phi_1 + 0.248\phi_2 + 0.284\phi_3 + 0.346\phi_4 + 0.284\phi_5 + 0.248\phi_6 - 0.198\phi_7 + 0.198\phi_8 + 0.346\phi_9 + 0.284\phi_{10} + 0.248\phi_{11} + 0.237\phi_{12} + 0.248\phi_{13} + 0.284\phi_{14}$

$\psi_5 = 0.327\phi_1 + 0.305\phi_2 + 0.241\phi_3 + 0.145\phi_4 + 0.241\phi_5 + 0.305\phi_6 + 0.265\phi_7 + 0.265\phi_8 + 0.145\phi_9 + 0.241\phi_{10} + 0.305\phi_{11} + 0.327\phi_{12} + 0.305\phi_{13} + 0.241\phi_{14}$

$\psi_6 = 0.272\phi_1 + 0.060\phi_2 - 0.245\phi_3 + 0.168\phi_4 - 0.245\phi_5 + 0.06\phi_6 + 0.52\phi_7 - 0.52\phi_8 + 0.168\phi_9 + 0.245\phi_{10} + 0.06\phi_{11} + 0.272\phi_{12} + 0.060\phi_{13} + 0.245\phi_{14}$

$\psi_7 = -0.367\phi_1 - 0.243\phi_2 + 0.045\phi_3 + 0.303\phi_4 + 0.045\phi_5 - 0.243\phi_6 + 0.388\phi_7 + 0.388\phi_8 - 0.303\phi_9 + 0.045\phi_{10} + 0.243\phi_{11} + 0.367\phi_{12} + 0.243\phi_{13} + 0.045\phi_{14}$

$\psi_8 = 0.383\phi_1 + 0.164\phi_2 - 0.242\phi_3 - 0.372\phi_4 - 0.242\phi_5 + 0.164\phi_6 + 0.207\phi_7 + 0.207\phi_8 - 0.354\phi_9 - 0.372\phi_{10} - 0.242\phi_{11} + 0.164\phi_{12} + 0.383\phi_{13} + 0.164\phi_{14}$

$\psi_9 = 0.405\phi_1 - 0.226\phi_2 - 0.152\phi_3 + 0.396\phi_4 - 0.152\phi_5 - 0.226\phi_6 - 0.174\phi_7 + 0.174\phi_8 - 0.396\phi_9 + 0.152\phi_{10} + 0.226\phi_{11} - 0.405\phi_{12} + 0.226\phi_{13} + 0.152\phi_{14}$

$\psi_{10} = 0.409\phi_1 - 0.218\phi_2 - 0.178\phi_3 + 0.407\phi_4 - 0.178\phi_5 - 0.218\phi_6 - 0.097\phi_7 - 0.097\phi_8 + 0.407\phi_9 - 0.178\phi_{10} - 0.218\phi_{11} + 0.409\phi_{12} - 0.218\phi_{13} - 0.178\phi_{14}$

$\psi_{11} = 0\phi_1 + 0.360\phi_2 + 0.360\phi_3 + 0\phi_4 - 0.360\phi_5 - 0.360\phi_6 + 0\phi_7 + 0\phi_8 + 0\phi_9 + 0.005\phi_{10} + 0.005\phi_{11} + 0\phi_{12} - 0.005\phi_{13} - 0.005\phi_{14}$

$\psi_{12} = 0\phi_1 - 0.351\phi_2 - 0.351\phi_3 + 0\phi_4 + 0.351\phi_5 + 0.351\phi_6 + 0\phi_7 + 0\phi_8 + 0\phi_9 + 0.014\phi_{10} + 0.014\phi_{11} + 0\phi_{12} - 0.014\phi_{13} - 0.014\phi_{14}$

$\psi_{13} = 0\phi_1 + 0.355\phi_2 + 0.355\phi_3 + 0\phi_4 + 0.355\phi_5 + 0.355\phi_6 + 0\phi_7 + 0\phi_8 - 0\phi_9 + 0.005\phi_{10} - 0.005\phi_{11} - 0\phi_{12} + 0.005\phi_{13} - 0.005\phi_{14}$

$\psi_{14} = 0\phi_1 + 0.361\phi_2 + 0.361\phi_3 - 0\phi_4 + 0.361\phi_5 + 0.361\phi_6 + 0\phi_7 + 0\phi_8 + 0\phi_9 + 0.004\phi_{10} - 0.004\phi_{11} + 0\phi_{12} + 0.004\phi_{13} - 0.004\phi_{14}$

a.3. Indeks kereaktifan

a.3.1. Keadaan dasar

- **Kerapatan Elektron**

Kerapatan Elektron (q) dihitung dengan menggunakan persamaan $q_r = \sum_r n_r \left(c_{jr}\right)^2$

$q_1 = 2\cdot(0.051)^2 + 2\cdot(0.068)^2 + 2\cdot(0.131)^2 + 2\cdot(0.282)^2 + 2\cdot(0.131)^2 + 2\cdot(0.068)^2 + 2\cdot(0.612)^2$ solve, q_1 → 1.000478

$q_2 = 2\cdot(0.267)^2 + 2\cdot(0.273)^2 + 2\cdot(0.29)^2 + 2\cdot(0.321)^2 + 2\cdot(0.29)^2 + 2\cdot(-0.273)^2 + 2\cdot(0.094)^2$ solve, q_2 → 1.000848

$q_3 = 2\cdot(-0.276)^2 + 2\cdot(0.279)^2 + 2\cdot(0.291)^2 + 2\cdot(0.309)^2 + 2\cdot(0.291)^2 + 2\cdot(0.279)^2 + 2\cdot(-0.057)^2$ solve, q_3 → .9999

$q_4 = 2\cdot(0.237)^2 + 2\cdot(0.248)^2 + 2\cdot(0.284)^2 + 2\cdot(0.346)^2 + 2\cdot(0.284)^2 + 2\cdot(0.248)^2 + 2\cdot(-0.198)^2$ solve, q_4 → .998818

$q_5 = 2\ (0.327)^2 + 2\ (0.305)^2 + 2\cdot(0.241)^2 + 2\cdot(0.145)^2 + 2\cdot(0.241)^2 + 2\ (0.305)^2 + 2\cdot(0.265)^2$ solve, q_5 → 1.000782

$q_6 = 2\cdot(0.272)^2 + 2\cdot(0.06)^2 + 2\cdot(-0.245)^2 + 2\cdot(0.168)^2 + 2\ (-0.245)^2 + 2\cdot(0.06)^2 + 2\cdot(0.52)^2$ solve, q_6 → .999716

$q_7 = 2\cdot(-0.367)^2 + 2\ (-0.243)^2 + 2\cdot(0.045)^2 + 2\cdot(0.303)^2 + 2\cdot(0.045)^2 + 2\cdot(-0.243)^2 + 2\cdot(0.388)^2$ solve, q_7 → .99838

$q_8 = 2\cdot(0.383)^2 + 2\cdot(0.164)^2 + 2\cdot(-0.242)^2 + 2\cdot(-0.372)^2 + 2\cdot(-0.242)^2 + 2\cdot(0.164)^2 + 2\cdot(0.207)^2$ solve, q_8 → .997684

$q_9 = 2\cdot(0.405)^2 + 2\cdot(-0.226)^2 + 2\cdot(-0.152)^2 + 2\cdot(0.396)^2 + 2\cdot(-0.152)^2 + 2\cdot(-0.226)^2 + 2\cdot(-0.174)^2$ solve, q_9 → .998954

$q_{10} = 2\cdot(0.409)^2 + 2\cdot(-0.218)^2 + 2\cdot(-0.178)^2 + 2\cdot(0.407)^2 + 2\cdot(-0.178)^2 + 2\cdot(-0.218)^2 + 2\ (-0.097)^2$ solve, q_{10} → 1.00151

$q_{11} = 2\cdot(0)^2 + 2\ (0.36)^2 + 2\cdot(0.36)^2 + 2\cdot(0)^2 + 2\cdot(-0.36)^2 + 2\cdot(-0.36)^2 + 2\cdot(0)^2$ solve, q_{11} → 1.0368

$q_{12} = 2\cdot(0)^2 + 2\cdot(-0.351)^2 + 2\cdot(-0.351)^2 + 2\cdot(0)^2 + 2\cdot(0.351)^2 + 2\cdot(0.351)^2 + 2\cdot(0)^2$ solve, q_{12} → .985608

$q_{13} = 2\cdot(0)^2 + 2\cdot(-0.355)^2 + 2\cdot(0.355)^2 + 2\cdot(0)^2 + 2\cdot(-0.355)^2 + 2\cdot(0.355)^2 + 2\cdot(0)^2$ solve, q_{13} → 1.0082

$q_{14} = 2\cdot(0)^2 + 2\cdot(0.361)^2 + 2\cdot(-0.361)^2 + 2\cdot(0)^2 + 2\cdot(0.361)^2 + 2\cdot(-0.361)^2 + 2\cdot(0)^2$ solve, q_{14} → 1.042568

- **Orde Ikatan**

Orde ikatan dihitung dengan menggunakan persamaan : $P_{12}=\sum_{j} n_j c_{jr} c_{js}$

$P_{12}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+2\cdot(-0.367\cdot-0.243) \rightarrow P_{12}=.526734$

$P_{16}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+2\cdot(-0.367\cdot-0.243) \rightarrow P_{16}=.526734$

$P_{23}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+2\cdot(0.045\cdot-0.243) \rightarrow P_{23}=.575138$

$P_{34}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+2\cdot(0.045\cdot0.303) \rightarrow P_{34}=.65127$

$P_{45}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+2\cdot(0.045\cdot0.303) \rightarrow P_{45}=.65127$

$P_{47}=2\cdot(0.612\cdot0.282)+2\cdot(0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(-0.198\cdot0.346)+2\cdot(-0.265\cdot0.145)+2\cdot(0.52\cdot0.168)+2\cdot(0.388\cdot0.303) \rightarrow P_{47}=.566272$

$P_{56}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+2\cdot(0.045\cdot-0.243) \rightarrow P_{56}=.575138$

$P_{78}=2\cdot(0.612\cdot0.612)+2\cdot(0.094\cdot-0.094)+2\cdot(-0.057\cdot-0.057)+2\cdot(-0.198\cdot0.198)+2\cdot(0.265\cdot0.265)+2\cdot(0.52\cdot-0.52)+2\cdot(0.388\cdot0.388) \rightarrow P_{78}=.560244$

$P_{89}=2\cdot(0.612\cdot0.282)+2\cdot(-0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(0.198\cdot0.346)+2\cdot(0.265\cdot0.145)+2\cdot(-0.52\cdot0.168)+2\cdot(0.388\cdot0.303) \rightarrow P_{89}=.523868$

$P_{910}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+2\cdot(0.045\cdot0.303) \rightarrow P_{910}=.44355$

$P_{914}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+2\cdot(0.045\cdot0.303) \rightarrow P_{914}=.44355$

$P_{1011}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+2\cdot(-0.045\cdot0.243) \rightarrow P_{1011}=.633938$

$P_{1112}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+2\cdot(0.367\cdot0.243) \rightarrow P_{1112}=.526734$

$P_{1213}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+2\cdot(0.367\cdot0.243) \rightarrow P_{1213}=.526734$

$P_{1314}=2\cdot(0.131\cdot0.068)+2\cdot(-0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+2\cdot(0.045\cdot0.243) \rightarrow P_{1314}=.360998$

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.527 - 0.527 \text{ solve}, F_1 \rightarrow .6780508075688772935$

$F_2 = \sqrt{3} - 0.527 - 0.575 \text{ solve}, F_2 \rightarrow .6300508075688772935$

$F_3 = \sqrt{3} - 0.575 - 0.651 \text{ solve}, F_3 \rightarrow .5060508075688772935$

$F_4 = \sqrt{3} - 0.651 - 0.566 - 0.651 \text{ solve}, F_4 \rightarrow -.1359491924311227065$

$F_5 = \sqrt{3} - 0.651 - 0.575 \text{ solve}, F_5 \rightarrow .5060508075688772935$

$F_6 = \sqrt{3} - 0.527 - 0.575 \text{ solve}, F_6 \rightarrow .6300508075688772935$

$F_7 = \sqrt{3} - 0.566 - 0.560 \text{ solve}, F_7 \rightarrow .6060508075688772935$

$F_8 = \sqrt{3} - 0.560 - 0.524 \text{ solve}, F_8 \rightarrow .6480508075688772935$

$F_9 = \sqrt{3} - 0.443 - 0.443 - 0.524 \text{ solve}, F_9 \rightarrow .3220508075688772935$

$F_{10} = \sqrt{3} - 0.443 - 0.634 \text{ solve}, F_{10} \rightarrow .6550508075688772935$

$F_{11} = \sqrt{3} - 0.575 - 0.461 \text{ solve}, F_{11} \rightarrow .6960508075688772935$

$F_{12} = \sqrt{3} - 0.527 - 0.527 \text{ solve}, F_{12} \rightarrow .6780508075688772935$

$F_{13} = \sqrt{3} - 0.527 - 0.360 \text{ solve}, F_{13} \rightarrow .8450508075688772935$

$F_{14} = \sqrt{3} - 0.360 - 0.443 \text{ solve}, F_{14} \rightarrow .9290508075688772935$

a.2.1. Keadaan tereksitasi

A. 1 Elektron tereksitasi ke 1 tingkat energi lebih tinggi (orbital 1)
- Kerapatan elektron

$q_1=2\cdot(0.051)^2+2\cdot(0.068)^2+2\cdot(0.131)^2+2\cdot(0.282)^2+2\cdot(0.131)^2+2\cdot(0.068)^2+1\cdot(0.612)^2+1\cdot(0.612)^2$ solve, q_1 → 1.000478

$q_2=2\cdot(0.267)^2+2\cdot(0.273)^2+2\cdot(0.29)^2+2\cdot(0.321)^2+2\cdot(0.29)^2+2\cdot(-0.273)^2+1\cdot(0.094)^2+1\cdot(-0.094)^2$ solve, q_2 → 1.000848

$q_3=2\cdot(-0.276)^2+2\cdot(0.279)^2+2\cdot(0.291)^2+2\cdot(0.309)^2+2\cdot(0.291)^2+2\cdot(0.279)^2+1\cdot(-0.057)^2+1\cdot(-0.057)^2$ solve, q_3 → .9999

$q_4=2\cdot(0.237)^2+2\cdot(0.248)^2+2\cdot(0.284)^2+2\cdot(0.346)^2+2\cdot(0.284)^2+2\cdot(0.248)^2+1\cdot(-0.198)^2+1\cdot(0.198)^2$ solve, q_4 → .998818

$q_5=2\cdot(0.327)^2+2\cdot(0.305)^2+2\cdot(0.241)^2+2\cdot(0.145)^2+2\cdot(0.241)^2+2\cdot(0.305)^2+1\cdot(0.265)^2+1\cdot(0.265)^2$ solve, q_5 → 1.000782

$q_6=2\cdot(0.272)^2+2\cdot(0.06)^2+2\cdot(-0.245)^2+2\cdot(0.168)^2+2\cdot(-0.245)^2+2\cdot(0.06)^2+1\cdot(0.52)^2+1\cdot(-0.52)^2$ solve, q_6 → .999716

$q_7=2\cdot(-0.367)^2+2\cdot(-0.243)^2+2\cdot(0.045)^2+2\cdot(0.303)^2+2\cdot(0.045)^2+2\cdot(-0.243)^2+1\cdot(0.388)^2+1\ (0.388)^2$ solve, q_7 → .99838

$q_8=2\cdot(0.383)^2+2\cdot(0.164)^2+2\cdot(-0.242)^2+2\cdot(-0.372)^2+2\cdot(-0.242)^2+2\cdot(0.164)^2+1\cdot(0.207)^2+1\cdot(0.207)^2$ solve, q_8 → .997684

$q_9=2\cdot(0.405)^2+2\cdot(-0.226)^2+2\cdot(-0.152)^2+2\cdot(0.396)^2+2\cdot(-0.152)^2+2\cdot(-0.226)^2+1\cdot(-0.174)^2+1\cdot(0.174)^2$ solve, q_9 → .998954

$q_{10}=2\cdot(0.409)^2+2\ (-0.218)^2+2\ (-0.178)^2+2\ (0.407)^2+2\cdot(-0.178)^2+2\cdot(-0.218)^2+1\cdot(-0.097)^2+1\cdot(-0.097)^2$ solve, q_{10} → 1.00151

$q_{11}=2\cdot(0)^2+2\cdot(0.36)^2+2\cdot(0.36)^2+2\cdot(0)^2+2\ (-0.36)^2+2\cdot(-0.36)^2+1\cdot(0)^2+1\cdot(0)^2$ solve, q_{11} → 1.0368

$q_{12}=2\cdot(0)^2+2\cdot(-0.351)^2+2\cdot(-0.351)^2+2\cdot(0)^2+2\cdot(0.351)^2+2\cdot(0.351)^2+1\cdot(0)^2+1\cdot(0)^2$ solve, q_{12} → .985608

$q_{13}=2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+1\cdot(0)^2+1\cdot(0)^2$ solve, q_{13} → 1.0082

$q_{14}=2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+1\cdot(0)^2+1\cdot(0)^2$ solve, q_{14} → 1.042568

- Orde Ikatan

$P_{12}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\cdot(0.383\cdot0.164)\rightarrow P_{12}=.500365$

$P_{16}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\ (0.383\cdot0.164)\rightarrow P_{16}=.500365$

$P_{23}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\cdot(-0.242\cdot0.164)\rightarrow P_{23}=.546385$

$P_{34}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.242\cdot-0.372)\rightarrow P_{34}=.727659$

$P_{45}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.242\cdot-0.372)\rightarrow P_{45}=.727659$

$P_{47}=2\cdot(0.612\cdot0.282)+2\cdot(0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(-0.198\cdot0.346)+2\cdot(-0.265\cdot0.145)+2\cdot(0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ (-0.372\cdot0.207)\rightarrow P_{47}=.371704$

$P_{56}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\ (-0.242\cdot0.164)\rightarrow P_{56}=.546385$

$P_{78}=2\cdot(0.612\cdot0.612)+2\cdot(0.094\cdot-0.094)+2\cdot(-0.057\cdot-0.057)+2\cdot(-0.198\cdot0.198)+2\cdot(0.265\cdot0.265)+2\cdot(0.52\cdot-0.52)+1\cdot(0.388\cdot0.388)+1\ (0.207\cdot0.207)\rightarrow P_{78}=.452549$

$P_{89}=2\cdot(0.612\cdot0.282)+2\cdot(-0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(0.198\cdot0.346)+2\cdot(0.265\cdot0.145)+2\cdot(-0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ (0.207\cdot-0.372)\rightarrow P_{89}=.3293$

$P_{910}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.372\cdot-0.242)\rightarrow P_{910}=.519939$

$P_{914}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.372\cdot-0.242)\rightarrow P_{914}=.519939$

$P_{1011}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+1\cdot(-0.045\cdot0.243)+1\ (-0.242\cdot0.164)\rightarrow P_{1011}=.605185$

$P_{1112}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (0.164\cdot0.383)\rightarrow P_{1112}=.500365$

$P_{1213}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (0.383\cdot0.164)\rightarrow P_{1213}=.500365$

$P_{1314}=2\cdot(0.131\cdot0.068)+2\cdot(-0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+1\cdot(0.045\cdot0.243)+1\cdot(0.164\cdot0.242)\rightarrow P_{1314}=.389751$

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.346 - 0.346 \text{ solve}, F_1 \rightarrow 1.0400508075688772935$

$F_2 = \sqrt{3} - 0.346 - 0.620 \text{ solve}, F_2 \rightarrow .7660508075688772935$

$F_3 = \sqrt{3} - 0.620 - 0.577 \text{ solve}, F_3 \rightarrow .5350508075688772935$

$F_4 = \sqrt{3} - 0.577 - 0.380 - 0.577 \text{ solve}, F_4 \rightarrow .1980508075688772935$

$F_5 = \sqrt{3} - 0.577 - 0.620 \text{ solve}, F_5 \rightarrow .5350508075688772935$

$F_6 = \sqrt{3} - 0.620 - 0.346 \text{ solve}, F_6 \rightarrow .7660508075688772935$

$F_7 = \sqrt{3} - 0.380 - 0.379 \text{ solve}, F_7 \rightarrow .9730508075688772935$

$F_8 = \sqrt{3} - 0.379 - 0.337 \text{ solve}, F_8 \rightarrow 1.0160508075688772935$

$F_9 = \sqrt{3} - 0.337 - 0.370 - 0.370 \text{ solve}, F_9 \rightarrow .6550508075688772935$

$F_{10} = \sqrt{3} - 0.370 - 0.679 \text{ solve}, F_{10} \rightarrow .6830508075688772935$

$F_{11} = \sqrt{3} - 0.679 - 0.346 \text{ solve}, F_{11} \rightarrow .7070508075688772935$

$F_{12} = \sqrt{3} - 0.346 - 0.346 \text{ solve}, F_{12} \rightarrow 1.0400508075688772935$

$F_{13} = \sqrt{3} - 0.346 - 0.384 \text{ solve}, F_{13} \rightarrow 1.0020508075688772935$

$F_{14} = \sqrt{3} - 0.384 - 0.370 \text{ solve}, F_{14} \rightarrow .9780508075688772935$

B. 1 Elektron tereksitasi ke 1 tingkat energi lebih tinggi (orbital 2)
- Kerapatan elektron

$q_1=2\cdot(0.051)^2+2\cdot(0.068)^2+2\cdot(0.131)^2+2\cdot(0.282)^2+2\cdot(0.131)^2+2\cdot(0.068)^2+1\cdot(0.612)^2+1\cdot(0.282)^2$ solve, q_1 → .705458

$q_2=2\cdot(0.267)^2+2\cdot(0.273)^2+2\cdot(0.29)^2+2\cdot(0.321)^2+2\cdot(0.29)^2+2\cdot(-0.273)^2+1\cdot(0.094)^2+1\cdot(0.321)^2$ solve, q_2 → 1.095053

$q_3=2\cdot(-0.276)^2+2\cdot(0.279)^2+2\cdot(0.291)^2+2\cdot(0.309)^2+2\cdot(0.291)^2+2\cdot(0.279)^2+1\cdot(-0.057)^2+1\cdot(0.309)^2$ solve, q_3 → 1.092132

$q_4=2\cdot(0.237)^2+2\cdot(0.248)^2+2\cdot(0.284)^2+2\cdot(0.346)^2+2\cdot(0.284)^2+2\cdot(0.248)^2+1\cdot(-0.198)^2+1\cdot(0.346)^2$ solve, q_4 → 1.07933

$q_5=2\cdot(0.327)^2+2\cdot(0.305)^2+2\cdot(0.241)^2+2\cdot(0.145)^2+2\cdot(0.241)^2+2\cdot(0.305)^2+1\cdot(0.265)^2+1\cdot(0.145)^2$ solve, q_5 → .951582

$q_6=2\cdot(0.272)^2+2\cdot(0.06)^2+2\cdot(-0.245)^2+2\cdot(0.168)^2+2\cdot(-0.245)^2+2\cdot(0.06)^2+1\cdot(0.52)^2+1\cdot(0.168)^2$ solve, q_6 → .75754

$q_7=2\cdot(-0.367)^2+2\cdot(-0.243)^2+2\cdot(0.045)^2+2\cdot(0.303)^2+2\cdot(0.045)^2+2\cdot(-0.243)^2+1\cdot(0.388)^2+1\cdot(0.303)^2$ solve, q_7 → .939645

$q_8=2\cdot(0.383)^2+2\cdot(0.164)^2+2\cdot(-0.242)^2+2\cdot(-0.372)^2+2\cdot(-0.242)^2+2\cdot(0.164)^2+1\cdot(0.207)^2+1\cdot(-0.372)^2$ solve, q_8 → 1.093219

$q_9=2\cdot(0.405)^2+2\cdot(-0.226)^2+2\cdot(-0.152)^2+2\cdot(0.396)^2+2\cdot(-0.152)^2+2\cdot(-0.226)^2+1\cdot(-0.174)^2+1\cdot(-0.396)^2$ solve, q_9 → 1.125494

$q_{10}=2\cdot(0.409)^2+2\cdot(-0.218)^2+2\cdot(-0.178)^2+2\cdot(0.407)^2+2\cdot(-0.178)^2+2\cdot(-0.218)^2+1\cdot(-0.097)^2+1\cdot(0.407)^2$ solve, q_{10} → 1.15775

$q_{11}=2\cdot(0)^2+2\cdot(0.36)^2+2\cdot(0.36)^2+2\cdot(0)^2+2\cdot(-0.36)^2+2\cdot(-0.36)^2+1\cdot(0)^2+1\cdot(0)^2$ solve, q_{11} → 1.0368

$q_{12}=2\cdot(0)^2+2\cdot(-0.351)^2+2\cdot(-0.351)^2+2\cdot(0)^2+2\cdot(0.351)^2+2\cdot(0.351)^2+1\cdot(0)^2+1\cdot(0)^2$ solve, q_{12} → .985608

$q_{13}=2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+1\cdot(0)^2+1\cdot(0.)^2$ solve, q_{13} → 1.0082

$q_{14}=2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+1\cdot(0)^2+1\cdot(0)^2$ solve, q_{14} → 1.042568

- Orde Ikatan

$P_{12}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\cdot(0.405\cdot-0.226)\rightarrow P_{12}=.346023$

$P_{16}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\cdot(0.405\cdot-0.226)\rightarrow P_{16}=.346023$

$P_{23}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\cdot(-0.226\cdot-0.152)\rightarrow P_{23}=.620425$

$P_{34}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.152\cdot0.396)\rightarrow P_{34}=.577443$

$P_{45}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.152\cdot0.396)\rightarrow P_{45}=.577443$

$P_{47}=2\cdot(0.612\cdot0.282)+2\cdot(0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(-0.198\cdot0.346)+2\cdot(-0.265\cdot0.145)+2\cdot(0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ (0.396\cdot-0.174)\rightarrow P_{47}=.379804$

$P_{56}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\ (-0.152\cdot-0.226)\rightarrow P_{56}=.620425$

$P_{78}=2\cdot(0.612\cdot0.612)+2\cdot(0.094\cdot-0.094)+2\cdot(-0.057\cdot-0.057)+2\cdot(-0.198\cdot0.198)+2\cdot(0.265\cdot0.265)+2\cdot(0.52\cdot-0.52)+1\cdot(0.388\cdot0.388)+1\ (-0.174\cdot0.174)\rightarrow P_{78}=.379424$

$P_{89}=2\cdot(0.612\cdot0.282)+2\cdot(-0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(0.198\cdot0.346)+2\cdot(0.265\cdot0.145)+2\cdot(-0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ (0.174\cdot-0.396)\rightarrow P_{89}=.3374$

$P_{910}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.396\cdot0.152)\rightarrow P_{910}=.369723$

$P_{914}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.396\cdot0.152)\rightarrow P_{914}=.369723$

$P_{1011}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\ (0.245\cdot0.06)+1\cdot(-0.045\cdot0.243)+1\ (0.152\cdot0.226)\rightarrow P_{1011}=.679225$

$P_{1112}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (0.226\cdot-0.405)\rightarrow P_{1112}=.346023$

$P_{1213}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (-0.405\cdot0.226)\rightarrow P_{1213}=.346023$

$P_{1314}=2\cdot(0.131\cdot0.068)+2\cdot(-0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+1\cdot(0.045\cdot0.243)+1\cdot(0.226\cdot0.152)\rightarrow P_{1314}=.384415$

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.500 - 0.500 \text{ solve}, F_1 \rightarrow .732050807568877293 5$

$F_2 = \sqrt{3} - 0.500 - 0.546 \text{ solve}, F_2 \rightarrow .686050807568877293 5$

$F_3 = \sqrt{3} - 0.546 - 0.728 \text{ solve}, F_3 \rightarrow .458050807568877293 5$

$F_4 = \sqrt{3} - 0.728 - 0.728 - 0.378 \text{ solve}, F_4 \rightarrow -.101949192431122706 5$

$F_5 = \sqrt{3} - 0.728 - 0.546 \text{ solve}, F_5 \rightarrow .458050807568877293 5$

$F_6 = \sqrt{3} - 0.546 - 0.500 \text{ solve}, F_6 \rightarrow .686050807568877293 5$

$F_7 = \sqrt{3} - 0.452 - 0.378 \text{ solve}, F_7 \rightarrow .902050807568877293 5$

$F_8 = \sqrt{3} - 0.452 - 0.329 \text{ solve}, F_8 \rightarrow .951050807568877293 5$

$F_9 = \sqrt{3} - 0.329 - 0.520 - 0.520 \text{ solve}, F_9 \rightarrow .363050807568877293 5$

$F_{10} = \sqrt{3} - 0.520 - 0.605 \text{ solve}, F_{10} \rightarrow .607050807568877293 5$

$F_{11} = \sqrt{3} - 0.605 - 0.500 \text{ solve}, F_{11} \rightarrow .627050807568877293 5$

$F_{12} = \sqrt{3} - 0.500 - 0.500 \text{ solve}, F_{12} \rightarrow .732050807568877293 5$

$F_{13} = \sqrt{3} - 0.500 - 0.389 \text{ solve}, F_{13} \rightarrow .843050807568877293 5$

$F_{14} = \sqrt{3} - 0.520 - 0.389 \text{ solve}, F_{14} \rightarrow .823050807568877293 5$

C. 1 Elektron tereksitasi ke 2 tingkat energi lebih tinggi (orbital 1)

- Kerapatan elektron

$q_1=2\cdot(0.051)^2+2\cdot(0.068)^2+2\cdot(0.131)^2+2\cdot(0.282)^2+2\cdot(0.131)^2+2\cdot(0.068)^2+1\cdot(0.612)^2+1\cdot(0.131)^2$ solve, q_1 → .643095

$q_2=2\cdot(0.267)^2+2\cdot(0.273)^2+2\cdot(0.29)^2+2\cdot(0.321)^2+2\cdot(0.29)^2+2\cdot(-0.273)^2+1\cdot(0.094)^2+1\cdot(-0.29)^2$ solve, q_2 → 1.076112

$q_3=2\cdot(-0.276)^2+2\cdot(0.279)^2+2\cdot(0.291)^2+2\cdot(0.309)^2+2\cdot(0.291)^2+2\cdot(0.279)^2+1\cdot(-0.057)^2+1\cdot(0.291)^2$ solve, q_3 → 1.081332

$q_4=2\cdot(0.237)^2+2\cdot(0.248)^2+2\cdot(0.284)^2+2\cdot(0.346)^2+2\cdot(0.284)^2+2\cdot(0.248)^2+1\cdot(-0.198)^2+1\cdot(0.284)^2$ solve, q_4 → 1.04027

$q_5=2\cdot(0.327)^2+2\cdot(0.305)^2+2\cdot(0.241)^2+2\cdot(0.145)^2+2\cdot(0.241)^2+2\cdot(0.305)^2+1\cdot(0.265)^2+1\cdot(0.241)^2$ solve, q_5 → .988638

$q_6=2\cdot(0.272)^2+2\cdot(0.06)^2+2\cdot(-0.245)^2+2\cdot(0.168)^2+2\cdot(-0.245)^2+2\cdot(0.06)^2+1\cdot(0.52)^2+1\cdot(0.245)^2$ solve, q_6 → .789341

$q_7=2\cdot(-0.367)^2+2\cdot(-0.243)^2+2\cdot(0.045)^2+2\cdot(0.303)^2+2\cdot(0.045)^2+2\cdot(-0.243)^2+1\cdot(0.388)^2+1\cdot(0.045)^2$ solve, q_7 → .849861

$q_8=2\cdot(0.383)^2+2\cdot(0.164)^2+2\cdot(-0.242)^2+2\cdot(-0.372)^2+2\cdot(-0.242)^2+2\cdot(0.164)^2+1\cdot(0.207)^2+1\cdot(-0.242)^2$ solve, q_8 → 1.013399

$q_9=2\cdot(0.405)^2+2\cdot(-0.226)^2+2\cdot(-0.152)^2+2\cdot(0.396)^2+2\cdot(-0.152)^2+2\cdot(-0.226)^2+1\cdot(-0.174)^2+1\cdot(0.152)^2$ solve, q_9 → .991782

$q_{10}=2\cdot(0.409)^2+2\cdot(-0.218)^2+2\cdot(-0.178)^2+2\cdot(0.407)^2+2\cdot(-0.178)^2+2\cdot(-0.218)^2+1\cdot(-0.097)^2+1\cdot(-0.178)^2$ solve, q_{10} → 1.023785

$q_{11}=2\cdot(0)^2+2\cdot(0.36)^2+2\cdot(0.36)^2+2\cdot(0)^2+2\cdot(-0.36)^2+2\cdot(-0.36)^2+1\cdot(0)^2+1\cdot(0.005)^2$ solve, q_{11} → 1.036825

$q_{12}=2\cdot(0)^2+2\cdot(-0.351)^2+2\cdot(-0.351)^2+2\cdot(0)^2+2\cdot(0.351)^2+2\cdot(0.351)^2+1\cdot(0)^2+1\cdot(0.014)^2$ solve, q_{12} → .985804

$q_{13}=2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+1\cdot(0)^2+1\cdot(0.005)^2$ solve, q_{13} → 1.008225

$q_{14}=2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+1\cdot(0)^2+1\cdot(0.004)^2$ solve, q_{14} → 1.042584

- Orde Ikatan

$P_{12}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\cdot(0.409\cdot-0.218)\rightarrow P_{12}=.348391$

$P_{16}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\cdot(0.409\cdot-0.218)\rightarrow P_{16}=.348391$

$P_{23}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\cdot(-0.218\cdot-0.178)\rightarrow P_{23}=.624877$

$P_{34}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.178\cdot0.407)\rightarrow P_{34}=.565189$

$P_{45}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (-0.178\cdot0.407)\rightarrow P_{45}=.565189$

$P_{47}=2\cdot(0.612\cdot0.282)+2\cdot(0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(-0.198\cdot0.346)+2\cdot(-0.265\cdot0.145)+2\cdot(0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ (0.407\cdot-0.097)\rightarrow P_{47}=.409229$

$P_{56}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\ (-0.178\cdot-0.218)\rightarrow P_{56}=.624877$

$P_{78}=2\cdot(0.612\cdot0.612)+2\cdot(0.094\cdot-0.094)+2\cdot(-0.057\cdot-0.057)+2\cdot(-0.198\cdot0.198)+2\cdot(0.265\cdot0.265)+2\cdot(0.52\cdot-0.52)+1\cdot(0.388\cdot0.388)+1\ (-0.097\cdot0.097)\rightarrow P_{78}=.400291$

$P_{89}=2\cdot(0.612\cdot0.282)+2\cdot(-0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(0.198\cdot0.346)+2\cdot(0.265\cdot0.145)+2\cdot(-0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ (-0.097\cdot0.407)\rightarrow P_{89}=.366825$

$P_{910}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (0.407\cdot-0.178)\rightarrow P_{910}=.357469$

$P_{914}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (0.407\cdot-0.178)\rightarrow P_{914}=.357469$

$P_{1011}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+1\cdot(-0.045\cdot0.243)+1\ (-0.178\cdot-0.218)\rightarrow P_{1011}=.683677$

$P_{1112}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (-0.218\cdot0.409)\rightarrow P_{1112}=.348391$

$P_{1213}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (0.409\cdot-0.218)\rightarrow P_{1213}=.348391$

$P_{1314}=2\cdot(0.131\cdot0.068)+2\cdot(-0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+1\cdot(0.045\cdot0.243)+1\cdot(-0.218\cdot-0.178)\rightarrow P_{1314}=.388867$

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.348 - 0.348 \text{ solve}, F_1 \rightarrow 1.0360508075688772935$

$F_2 = \sqrt{3} - 0.348 - 0.625 \text{ solve}, F_2 \rightarrow .7590508075688772935$

$F_3 = \sqrt{3} - 0.625 - 0.565 \text{ solve}, F_3 \rightarrow .5420508075688772935$

$F_4 = \sqrt{3} - 0.565 - 0.380 - 0.565 \text{ solve}, F_4 \rightarrow .2220508075688772935$

$F_5 = \sqrt{3} - 0.565 - 0.625 \text{ solve}, F_5 \rightarrow .5420508075688772935$

$F_6 = \sqrt{3} - 0.625 - 0.348 \text{ solve}, F_6 \rightarrow .7590508075688772935$

$F_7 = \sqrt{3} - 0.400 - 0.408 \text{ solve}, F_7 \rightarrow .9240508075688772935$

$F_8 = \sqrt{3} - 0.400 - 0.367 \text{ solve}, F_8 \rightarrow .9650508075688772935$

$F_9 = \sqrt{3} - 0.367 - 0.357 - 0.357 \text{ solve}, F_9 \rightarrow .6510508075688772935$

$F_{10} = \sqrt{3} - 0.357 - 0.684 \text{ solve}, F_{10} \rightarrow .6910508075688772935$

$F_{11} = \sqrt{3} - 0.684 - 0.348 \text{ solve}, F_{11} \rightarrow .7000508075688772935$

$F_{12} = \sqrt{3} - 0.348 - 0.348 \text{ solve}, F_{12} \rightarrow 1.0360508075688772935$

$F_{13} = \sqrt{3} - 0.348 - 0.389 \text{ solve}, F_{13} \rightarrow .9950508075688772935$

$F_{14} = \sqrt{3} - 0.389 - 0.357 \text{ solve}, F_{14} \rightarrow .9860508075688772935$

D. 1 Elektron tereksitasi ke 2 tingkat energi lebih tinggi (orbital 2)

- Kerapatan elektron

$q_1=2\cdot(0.051)^2+2\cdot(0.068)^2+2\cdot(0.131)^2+2\cdot(0.282)^2+2\cdot(0.131)^2+2\cdot(0.068)^2+1\cdot(0.612)^2+1\cdot(0.068)^2$ solve, q_1 → .630558

$q_2=2\cdot(0.267)^2+2\cdot(0.273)^2+2\cdot(0.29)^2+2\cdot(0.321)^2+2\cdot(0.29)^2+2\cdot(-0.273)^2+1\cdot(0.094)^2+1\cdot(0.273)^2$ solve, q_2 → 1.066541

$q_3=2\cdot(-0.276)^2+2\cdot(0.279)^2+2\cdot(0.291)^2+2\cdot(0.309)^2+2\cdot(0.291)^2+2\cdot(0.279)^2+1\cdot(-0.057)^2+1\cdot(0.279)^2$ solve, q_3 → 1.074492

$q_4=2\cdot(0.237)^2+2\cdot(0.248)^2+2\cdot(0.284)^2+2\cdot(0.346)^2+2\cdot(0.284)^2+2\cdot(0.248)^2+1\cdot(-0.198)^2+1\cdot(0.248)^2$ solve, q_4 → 1.021118

$q_5=2\cdot(0.327)^2+2\cdot(0.305)^2+2\cdot(0.241)^2+2\cdot(0.145)^2+2\cdot(0.241)^2+2\cdot(0.305)^2+1\cdot(0.265)^2+1\cdot(0.305)^2$ solve, q_5 → 1.023582

$q_6=2\cdot(0.272)^2+2\cdot(0.06)^2+2\cdot(-0.245)^2+2\cdot(0.168)^2+2\cdot(-0.245)^2+2\cdot(0.06)^2+1\cdot(0.52)^2+1\cdot(0.06)^2$ solve, q_6 → .732916

$q_7=2\cdot(-0.367)^2+2\cdot(-0.243)^2+2\cdot(0.045)^2+2\cdot(0.303)^2+2\cdot(0.045)^2+2\cdot(-0.243)^2+1\cdot(0.388)^2+1\cdot(0.243)^2$ solve, q_7 → .906885

$q_8=2\cdot(0.383)^2+2\cdot(0.164)^2+2\cdot(-0.242)^2+2\cdot(-0.372)^2+2\cdot(-0.242)^2+2\cdot(0.164)^2+1\cdot(0.207)^2+1\cdot(0.164)^2$ solve, q_8 → .981731

$q_9=2\cdot(0.405)^2+2\cdot(-0.226)^2+2\cdot(-0.152)^2+2\cdot(0.396)^2+2\cdot(-0.152)^2+2\cdot(-0.226)^2+1\cdot(-0.174)^2+1\cdot(0.226)^2$ solve, q_9 → 1.019754

$q_{10}=2\cdot(0.409)^2+2\cdot(-0.218)^2+2\cdot(-0.178)^2+2\cdot(0.407)^2+2\cdot(-0.178)^2+2\cdot(-0.218)^2+1\cdot(-0.097)^2+1\cdot(-0.218)^2$ solve, q_{10} → 1.039625

$q_{11}=2\cdot(0)^2+2\cdot(0.36)^2+2\cdot(0.36)^2+2\cdot(0)^2+2\cdot(-0.36)^2+2\cdot(-0.36)^2+1\cdot(0)^2+1\cdot(0.005)^2$ solve, q_{11} → 1.036825

$q_{12}=2\cdot(0)^2+2\cdot(-0.351)^2+2\cdot(-0.351)^2+2\cdot(0)^2+2\cdot(0.351)^2+2\cdot(0.351)^2+1\cdot(0)^2+1\cdot(0.014)^2$ solve, q_{12} → .985804

$q_{13}=2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+2\cdot(0)^2+2\cdot(-0.355)^2+2\cdot(0.355)^2+1\cdot(0)^2+1\cdot(0.005)^2$ solve, q_{13} → 1.008225

$q_{14}=2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+2\cdot(0)^2+2\cdot(0.361)^2+2\cdot(-0.361)^2+1\cdot(0)^2+1\cdot(0.004)^2$ solve, q_{14} → 1.042584

- Orde Ikatan

$P_{12}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\cdot(0.048\cdot0.36)\rightarrow P_{12}=.454833$

$P_{16}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(-0.367\cdot-0.243)+1\cdot(0.048\cdot0.36)\rightarrow P_{16}=.454833$

$P_{23}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\cdot(0.36\cdot0.36)\rightarrow P_{23}=.715673$

$P_{34}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (0.36\cdot0)\rightarrow P_{34}=.637635$

$P_{45}=2\cdot(0.131\cdot0.282)+2\cdot(0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(-0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (0\cdot-0.346)\rightarrow P_{45}=.637635$

$P_{47}=2\cdot(0.612\cdot0.282)+2\cdot(0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(-0.198\cdot0.346)+2\cdot(-0.265\cdot0.145)+2\cdot(0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ (0\cdot0)\rightarrow P_{47}=.448708$

$P_{56}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(-0.245\cdot0.06)+1\cdot(0.045\cdot-0.243)+1\ (-0.36\cdot-0.36)\rightarrow P_{56}=.715673$

$P_{78}=2\cdot(0.612\cdot0.612)+2\cdot(0.094\cdot-0.094)+2\cdot(-0.057\cdot-0.057)+2\cdot(-0.198\cdot0.198)+2\cdot(0.265\cdot0.265)+2\cdot(0.52\cdot-0.52)+1\cdot(0.388\cdot0.388)+1\ (0\cdot0)\rightarrow P_{78}=.4097$

$P_{89}=2\cdot(0.612\cdot0.282)+2\cdot(-0.094\cdot0.321)+2\cdot(-0.057\cdot0.309)+2\cdot(0.198\cdot0.346)+2\cdot(0.265\cdot0.145)+2\cdot(-0.52\cdot0.168)+1\cdot(0.388\cdot0.303)+1\ 0\cdot0\rightarrow P_{89}=.406304$

$P_{910}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (0\cdot0.005)\rightarrow P_{910}=.429915$

$P_{914}=2\cdot(0.131\cdot0.282)+2\cdot(-0.29\cdot0.321)+2\cdot(0.291\cdot0.309)+2\cdot(0.284\cdot0.346)+2\cdot(0.241\cdot0.145)+2\cdot(0.245\cdot0.168)+1\cdot(0.045\cdot0.303)+1\ (0\cdot-0.005)\rightarrow P_{914}=.429915$

$P_{1011}=2\cdot(0.131\cdot0.068)+2\cdot(0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+1\cdot(-0.045\cdot0.243)+1\ (0.005\cdot0.005)\rightarrow P_{1011}=.644898$

$P_{1112}=2\cdot(0.051\cdot0.068)+2\ (0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (0.005\cdot0)\rightarrow P_{1112}=.437553$

$P_{1213}=2\cdot(0.051\cdot0.068)+2\cdot(0.267\cdot0.273)+2\cdot(-0.276\cdot0.279)+2\cdot(0.237\cdot0.248)+2\cdot(0.327\cdot0.305)+2\cdot(0.272\cdot0.06)+1\cdot(0.367\cdot0.243)+1\ (0\cdot-0.005)\rightarrow P_{1213}=.437553$

$P_{1314}=2\cdot(0.131\cdot0.068)+2\cdot(-0.29\cdot0.273)+2\cdot(0.291\cdot0.279)+2\cdot(0.284\cdot0.248)+2\cdot(0.241\cdot0.305)+2\cdot(0.245\cdot0.06)+1\cdot(0.045\cdot0.243)+1\cdot(-0.005\cdot-0.005)\rightarrow P_{1314}=.350088$

- Harga valensi bebas

$F_r = N_{maks} - N_r$

$F_1 = \sqrt{3} - 0.455 - 0.716 \text{ solve}, F_1 \rightarrow .5610508075688772935$

$F_2 = \sqrt{3} - 0.455 - 0.455 \text{ solve}, F_2 \rightarrow .8220508075688772935$

$F_3 = \sqrt{3} - 0.716 - 0.638 \text{ solve}, F_3 \rightarrow .3780508075688772935$

$F_4 = \sqrt{3} - 0.638 - 0.638 - 0.449 \text{ solve}, F_4 \rightarrow .007050807568877293500 0$

$F_5 = \sqrt{3} - 0.638 - 0.716 \text{ solve}, F_5 \rightarrow .3780508075688772935$

$F_6 = \sqrt{3} - 0.716 - 0.455 \text{ solve}, F_6 \rightarrow .5610508075688772935$

$F_7 = \sqrt{3} - 0.449 - 0.410 \text{ solve}, F_7 \rightarrow .8730508075688772935$

$F_8 = \sqrt{3} - 0.410 - 0.406 \text{ solve}, F_8 \rightarrow .9160508075688772935$

$F_9 = \sqrt{3} - 0.406 - 0.430 - 0.430 \text{ solve}, F_9 \rightarrow .4660508075688772935$

$F_{10} = \sqrt{3} - 0.430 - 0.645 \text{ solve}, F_{10} \rightarrow .6570508075688772935$

$F_{11} = \sqrt{3} - 0.645 - 0.437 \text{ solve}, F_{11} \rightarrow .6500508075688772935$

$F_{12} = \sqrt{3} - 0.437 - 0.437 \text{ solve}, F_{12} \rightarrow .8580508075688772935$

$F_{13} = \sqrt{3} - 0.437 - 0.350 \text{ solve}, F_{13} \rightarrow .9450508075688772935$

$F_{14} = \sqrt{3} - 0.350 - 0.430 \text{ solve}, F_{14} \rightarrow .9520508075688772935$

LAMPIRAN C
VARIASI k_{CO} UNTUK FENOLFTALEIN DALAM SUASANA BASA

Perhitungan λ maksimum phenolptalein dengan memvariasikan harga kcx antara 0.1-1

1. $k_{cx} = 1$

$$\begin{bmatrix} x+2 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x+2 \end{bmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} 1 \\ -1 \\ -2.6167755365590546159 \\ -2.5481436997458190512 \\ -2.1672691644967520796 \\ -1.8926773878349851075 \\ -1.296068415296627794 \\ -1.1217659567024037564 \\ -.09181678215702707497 \\ .40060292821255357403 \\ .85836222028846476317 \\ 1.0425115774680271517 \\ 1.3097870021385552137 \\ 1.4697122145708179172 \\ 2.0749547281563904869 \\ 2.2953108085934655318 \end{bmatrix}$$

$$(-.0918168782157 \quad - .400602928212\ ) \cdot -75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

solve ,λ→ 771.41468008884739788 ·nm

2. $k_{cx} = 0.9$

$$\begin{bmatrix} x+2 & 0.9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.9 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.9 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.9 & x+2 \end{bmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} -3.6265906458769951894 \\ -2.1705686402092637527 \\ -2.1705686402092637527 \\ -1.6283791127181430161 \\ -1.2598105633758029294 \\ -1.2598105633758029294 \\ -.66226891904713808389 \\ -.15793840724625132514 \\ .37087716344618915957 \\ .66226891904713808389 \\ 1.0149808153902353822 \\ 1.0149808153902353822 \\ 1.2292924440286587586 \\ 1.6985296833538622835 \\ 1.6985296833538622835 \\ 2.514881053591343067 \end{bmatrix}$$

$$(-.1579384072462 \quad -.3708771634461) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve }, \lambda \rightarrow 718.32201715972590504 \cdot nm$$

3. $k_{cx} = 0.8$

$$\begin{bmatrix} x+2 & 0.8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.8 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.8 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.8 & x+2 & 0 \end{bmatrix}$$

$$\text{solve}, x \rightarrow \begin{bmatrix} -2.7095440619784127355 \\ -2.7095440619784127355 \\ -2.0374218152446155269 \\ -1.5881263850127928 \\ -1.5881263850127928 \\ -.99157525923492671859 \\ -.99157525923492671859 \\ -.13735758974458873599 \\ .36003616607599650337 \\ .68725207498588451071 \\ .98510369565988694945 \\ .98510369565988694945 \\ 1.3133676791187547 24 \\ 1.3133676791187547 24 \\ 2.2503731490640283053 \\ 2.2503731490640283053 \end{bmatrix}$$

$$(-.13735758974458 \quad - .36003616607599) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{\frac{sec \cdot mol}{\lambda}}$$

$$\text{solve}, \lambda \rightarrow 763.70051493425789 17$$

4. $k_{cx} = 0.7$

$$\begin{bmatrix} x+2 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.7 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.7 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & x+2 \end{bmatrix} \text{solve}, x \rightarrow \begin{bmatrix} -2.8296095910628396038 \\ -2.4588926225737541574 \\ -2.1062879884747967132 \\ -2.1062879884747967132 \\ -1.2410522037676151655 \\ -1.2410522037676151655 \\ -.64373886003663443229 \\ -.22866464442713264083 \\ .32012999271970328887 \\ .64373886003663443229 \\ .93977086601453105530 \\ .93977086601453105530 \\ 1.4265124981230506071 \\ 1.4265124981230506071 \\ 1.9676821950453129004 \\ 2.3837532611626376632 \end{bmatrix}$$

$$(-.22866464442713 - .32012999271970328887) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve}, \lambda \rightarrow 692.17124536811002498 \cdot nm$$

5. $k_{cx} = 0.6$

$$\begin{bmatrix} x+2 & 0.6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.6 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.6 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.6 & x+2 \end{bmatrix} \text{solve}, x \rightarrow \begin{bmatrix} -4.3491563311785810592 \\ -2.1248817649843975372 \\ -2.1248817649843975372 \\ -1.035668170588296534 \\ -1.035668170588296534 \\ -.88474487665647678273 \\ -.80368902368540964437 \\ -.17151517952849052412 \\ .29751343333718623263 \\ .80368902368540964437 \\ .86766206216990406194 \\ .97186253129870761045 \\ .97186253129870761045 \\ 1.5514200849233743316 \\ 1.5514200849233743316 \\ 3.1221535779285016185 \end{bmatrix}$$

$$(-.1715151795284 \quad -.29751343333718) - 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve}, \lambda \rightarrow 809.88634174037139775 \cdot nm$$

6. $k_{CX} = 0.5$

$$\begin{bmatrix} x+2 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.5 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.5 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & x+2 & 0 \end{bmatrix}$$

solve , x →

$$\begin{bmatrix} -3.5277730972103650678 \\ -2.0391513719503666171 \\ -2.0391513719503666171 \\ -1.5496626542319749494 \\ -1.5496626542319749494 \\ -.95720161946452112619 \\ -.95720161946452112619 \\ -.23119125592824994046 \\ .27964765818295946528 \\ .49306146937343650106 \\ .95229705482888682295 \\ 1.1281565480767951605 \\ 1.1281565480767951605 \\ 1.6641421087061294137 \\ 1.6641421087061294137 \\ 2.5275150872280814582 \end{bmatrix}$$

$$(-.2311912559282 \quad - .279647658182\ ) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

solve , λ → 743.60009966384462942 ·nm

7. $k_{cx} = 0.4$

$$\begin{vmatrix} x+2 & 0.4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.4 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.4 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.4 & x+2 & 0 \end{vmatrix} \text{solve}, x \rightarrow \begin{bmatrix} -2.859915006967899504 \\ -2.859915006967899504 \\ -1.5673088402408550639 \\ -1.5673088402408550639 \\ -1.4021806166627099209 \\ -1.0334572833959312488 \\ -1.0334572833959312488 \\ -.21796252620711152049 \\ .26753780640984690996 \\ .7297176040270390137 \\ .95545050680870398549 \\ 1.1285216375527669623 \\ 1.1285216375527669623 \\ 1.4716160322255840275 \\ 2.1597876937782816204 \\ 2.1597876937782816204 \end{bmatrix}$$

$$(-.2179625262071 \quad -.2675378064098) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve}, \lambda \rightarrow 782.40907765754443237 \cdot nm$$

8. $k_{cx} = 0.3$

$$\begin{vmatrix} x+2 & 0.3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.3 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.3 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.3 & x+2 & 0 \end{vmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} -2.7143551710696988537 \\ -2.3436392768192478532 \\ -2.3436392768192478532 \\ -1.5900980323851817403 \\ -1.5900980323851817403 \\ -.96144264854502924834 \\ -.96144264854502924834 \\ -.27567547931335619162 \\ .2530337858741170522 \\ .46468453422901125971 \\ .97748743071895695369 \\ .97748743071895695369 \\ 1.3232449201226405043 \\ 1.3232449201226405043 \\ 2.1952883062768360103 \\ 2.1952883062768360103 \end{bmatrix}$$

$$(-.27567547931335 \quad - .26303378587411\ ) \cdot 75390 \cdot 4.18 \cdot \frac{J}{\text{mol}} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot \text{sec} \cdot 3 \cdot 10^{17} \cdot \text{nm} \cdot 6.022 \cdot 10^{23}}{\text{sec} \cdot \text{mol}}}{\lambda}$$

$$\text{solve }, \lambda \rightarrow 705.12963483758264448 \cdot \text{nm}$$

9. $k_{cx} = 0.2$

$$\begin{vmatrix} x+2 & 0.2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.2 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.2 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.2 & x+2 \end{vmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} -2.4511160256286596576 \\ -2.3052227441625858842 \\ -2.3052227441625858842 \\ -1.5049482143692262812 \\ -1.5049482143692262812 \\ -1.0587155879545501637 \\ -1.0587155879545501637 \\ -.22612916454279514346 \\ .26969657645634229011 \\ .81359860197186127832 \\ .93139303314056989638 \\ 1.1340455412090291608 \\ 1.1340455412090291608 \\ 1.4589746871026447466 \\ 2.1652307529992127414 \\ 2.1652307529992127414 \end{bmatrix}$$

$$(-.2261291645427 - .2696965764563) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{\frac{sec \cdot mol}{\lambda}}$$

$$\text{solve }, \lambda \rightarrow 766.11566531380690539 \cdot nm$$

1. $k_{cx} = 0.1$

$$\begin{vmatrix} x+2 & 0.1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 0.1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.1 & x+2 \end{vmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} 1 \\ -2.8065717924936614356 \\ -2.2304973687268908717 \\ -2.2304973687268908717 \\ -1.6315465114068192401 \\ -1.6315465114068192401 \\ -.96687011458263855499 \\ -.96687011458263855499 \\ -.21126567637218409169 \\ .26530587587615532429 \\ .46731133723555228823 \\ 1.0124591518088730538 \\ 1.2436801839610175012 \\ 1.3948140152464433196 \\ 2.0975441295029084619 \\ 2.2409734391386974884 \end{bmatrix}$$

$$(-.2112656763721 \quad - .2653058758761) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve }, \lambda \rightarrow 797.06786033112214344 \cdot nm$$

LAMPIRAN D
VARIASI k_{CN} UNTUK FENOLFTALEIN DALAM SUASANA BASA

Perhitungan λ maksimum metil kuning dengan memvariasikan harga kcx antara 0.1-1

1. $k_{cx} = 1$

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & x+1.5 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & x+1.5 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{ solve , x} \rightarrow \begin{bmatrix} -3.274308452497287832 3 \\ -1.916554088210988705 7 \\ -1.916554088210988705 7 \\ -1.215806791238891396 5 \\ -.027668242646176423149 \\ .318988956522889866 23 \\ .825036783150995688 51 \\ 1.301946674092441499 6 \\ 1.711951381949977242 2 \\ 2.329743478076208831 9 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$\left(.027668242646176423 - .318988956522889866 \right) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{\frac{sec \cdot mol}{\lambda}}$$

solve , $\lambda \rightarrow$ 1095.779543467684048 8 ·nm

2. $k_{cx} = 0.9$

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.9 & 0 & 0 & x+1.5 & 0.9 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.9 & x+1.5 & 0.9 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.9 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{solve}, x \rightarrow \begin{bmatrix} -2.5791753276187063476 \\ -2.5791753276187063476 \\ -1.5786166774254152555 \\ -1.293875106174309598 \\ -.81454088212299401146 \\ -.81454088212299401146 \\ -.35652236801110840778 \\ .21468832595418448959 \\ .21468832595418448959 \\ 1.1402830431619782884 \\ 1.1402830431619782884 \\ 1.293875106174309598 \\ 2.0934089628768750519 \\ 2.0934089628768750519 \end{bmatrix}$$

$$(-.356522368011108408 - .21468832595418448) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve}, \lambda \rightarrow 665.0083261017273467 \cdot nm$$

3. $k_{cx} = 0.8$

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.8 & 0 & 0 & x+1.5 & 0.8 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.8 & x+1.5 & 0.8 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.8 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{solve}, x \rightarrow \begin{bmatrix} 1 \\ -3.1358391418481177997 \\ -1.8263033071274837361 \\ -1.8263033071274837361 \\ -1.1929401784901918405 \\ -.452656043031642923 \\ .09605472505491557999 \\ .09605472505491557999 \\ .84131375457045606858 \\ 1.4092432088671302462 \\ 1.5961766360212750626 \\ 2.3488413862086591953 \\ -1 \\ -1 \end{bmatrix}$$

$$(-.452656043031642 - .09605472505491557) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}$$

$$\lambda$$

$$\text{solve}, \lambda \rightarrow 692.2770420013755158 \cdot nm$$

4. $k_{cx} = 0.7$

$$\begin{vmatrix} \begin{bmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.7 & 0 & 0 & x+1.5 & 0.7 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & x+1.5 & 0.7 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.7 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{bmatrix} \end{vmatrix} \text{solve}, x \rightarrow \begin{bmatrix} -2.2341053712318578371 \\ -2.1963919982533006419 \\ -2.1963919982533006419 \\ -1.1879138523511852661 \\ -1.1879138523511852661 \\ -.83514078873266323477 \\ -.49847921020980169319 \\ .04074699141130714908 \\ .04074699141130714908 \\ .83514078873266323477 \\ 1.1062050746158609955 \\ 1.1062050746158609955 \\ 2.0720639413290464216 \\ 2.0720639413290464216 \end{bmatrix}$$

$$(-.498479210209801 \quad - .040746991411307) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve}, \lambda \rightarrow 704.45365285156662516 \cdot nm$$

5. $k_{CX} = 0.6$

$$\begin{bmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.6 & 0 & 0 & x+1.5 & 0.6 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.6 & x+1.5 & 0.6 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.6 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{bmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} -3.2184300705146256117 \\ -2.4260377462601377416 \\ -2.4260377462601377416 \\ -.87476176199068850792 \\ -.87476176199068850792 \\ -.44891439435407404814 \\ -.43639241261259457392 \\ .05691812217564534135 \\ .44891439435407404814 \\ .61374772991938404353 \\ .61374772991938404353 \\ 1.8720511644599968704 \\ 1.8720511644599968704 \\ 2.6136712778218055395 \end{bmatrix}$$

$$(-.43639241261259 \quad -.05691812217564 \quad) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol \cdot \lambda}$$

$$\text{solve }, \lambda \rightarrow 770.02180301769830233 \cdot nm$$

6. $k_{cx} = 0.5$

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.5 & 0 & 0 & x+1.5 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & x+1.5 & 0.5 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} 1 \\ -2.5995508132694575386 \\ -2.5995508132694575386 \\ -1.3104949377979264262 \\ -1.3104949377979264262 \\ -.91311177457075338782 \\ -.91311177457075338782 \\ -.70739991265511000351 \\ 0.71312894211952059 37 \\ 0.71312894211952059 37 \\ .70739991265511000351 \\ 1.0926230549414587631 \\ 2.0129330166105659152 \\ 2.0129330166105659152 \end{bmatrix}$$

$$(-.70739991265511000 - 0.71312894211952059) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve }, \lambda \rightarrow 267.40735759678103634 \cdot nm$$

7. $k_{cx} = 0.4$

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.4 & 0 & 0 & x+1.5 & 0.4 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.4 & x+1.5 & 0.4 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.4 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} 1 \\ -1 \\ -2.2320209548153111477 \\ 2.2320209548153111477 \\ -1.5017627742325157935 \\ -1.5017627742325157935 \\ -.94865358806959159446 \\ -.67205926414834763 \\ .08985313267500849146 \\ .94865358806959159446 \\ 1.0507501671716076302 \\ 1.0507501671716076302 \\ 2.0184511128915101862 \\ 2.0184511128915101862 \end{bmatrix}$$

$$(-.672059264148347 \quad -.089853132675008491) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve }, \lambda \rightarrow 498.56108002575687662 \cdot nm$$

8. $k_{cx} = 0.3$

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.3 & 0 & 0 & x+1.5 & 0.3 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.3 & x+1.5 & 0.3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.3 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} -2.592629271974972665 \\ -1.8476246558527231868 \\ -1.8476246558527231868 \\ -1.1583579795965358936 \\ -1.084443382718499009 \\ -1.084443382718499009 \\ -.70820778981617723952 \\ .08868941957188503239 \\ .08868941957188503239 \\ .70820778981617723952 \\ 1.1006291664601595262 \\ 1.1006291664601595262 \\ 2.0282460919941438644 \\ 2.0282460919941438644 \end{bmatrix}$$

$$(-.708207789816177 - .088689419571885) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

solve $, \lambda \rightarrow$ 476.67360729868792673 $\cdot nm$

9. $k_{CX} = 0.2$

$$\begin{bmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.2 & 0 & 0 & x+1.5 & 0.2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.2 & x+1.5 & 0.2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.2 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{bmatrix} \text{solve }, x \rightarrow \begin{bmatrix} -2.776334044406892852 \\ -1.9209384999761107931 \\ -1.9209384999761107931 \\ -1.4290372708056707031 \\ -1.4290372708056707031 \\ -.54989281067867190185 \\ -.41800433806700227353 \\ .54989281067867190185 \\ .59238763264105835413 \\ .59238763264105835413 \\ 1.3278588205592213972 \\ 1.3278588205592213972 \\ 2.0767913194971212094 \\ 2.0767913194971212094 \end{bmatrix}$$

$$(-.41800433806700227 - .54989281067867190) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{\frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{sec \cdot mol}}{\lambda}$$

$$\text{solve }, \lambda \rightarrow 392.45891770374242380 \cdot nm$$

10. $k_{cx} = 0.1$

$$\begin{vmatrix} x & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & x & 1 & 0 & 0.1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & x & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.1 & 0 & 0 & x+1.5 & 0.1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.1 & x+1.5 & 0.1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.1 & x & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & x & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & x \end{vmatrix} \text{ solve }, x \rightarrow \begin{bmatrix} -2.836559665955157145 \\ -1.7338804769326233196 \\ -1.7338804769326233196 \\ -1.1328361797527406776 \\ -1.1328361797527406776 \\ -.83299034459011684788 \\ -.80725143067566131414 \\ .08659610487252237073 \\ .80725143067566131414 \\ .94486846711263093654 \\ .94486846711263093654 \\ 1.4119611693293415249 \\ 1.577527430623005915 \\ 2.2722996023644915953 \end{bmatrix}$$

$$(-.807251430675661 - .086596104872522) \cdot 75390 \cdot 4.18 \cdot \frac{J}{mol} = \frac{6.626 \cdot 10^{-34} \cdot J \cdot sec \cdot 3 \cdot 10^{17} \cdot nm \cdot 6.022 \cdot 10^{23}}{\frac{sec \cdot mol}{\lambda}}$$

$$\text{solve }, \lambda \rightarrow 424.9716560579908657 \cdot nm$$