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m1u1 = (kc11 m1 u1) / (dc11 + kcddeg11 + kretm11 + kretu11);
m1u2 = (kc12 m1 u2) / (dc12 + kcddeg12 + kretm12 + kretu12);
u2 = ku2 / (du2 + b m1);
u1 = ku1 / (du1 + a m1);
Solve[{(a b dm1) m1^3 + (dm1 du1 b + dm1 du2 a + b c ku1 + a d ku2 - km1 a b) m1^2 +
      (dm1 du1 du2 + c du2 ku1 + d ku2 du1 - km1 du1 b - km1 a du2) m1 - km1 du1 du2 == 0}, m1]

(*This expression is used in matlab for protein ss*)
{ {m1 -> - 
$$\frac{b \, dm1 \, du1 + a \, dm1 \, du2 - a \, b \, km1 + b \, c \, ku1 + a \, d \, ku2}{3 \, a \, b \, dm1} -$$


$$\left( 2^{1/3} \left( - (b \, dm1 \, du1 + a \, dm1 \, du2 - a \, b \, km1 + b \, c \, ku1 + a \, d \, ku2)^2 + \right. \right.$$


$$3 \, a \, b \, dm1 \, (dm1 \, du1 \, du2 - b \, du1 \, km1 - a \, du2 \, km1 + c \, du2 \, ku1 + d \, du1 \, ku2) \Big) \Big/$$


$$\left( 3 \, a \, b \, dm1 \left( -2 \, b^3 \, dm1^3 \, du1^3 + 3 \, a \, b^2 \, dm1^3 \, du1^2 \, du2 + 3 \, a^2 \, b \, dm1^3 \, du1 \, du2^2 - 2 \, a^3 \, dm1^3 \, du2^3 - \right. \right.$$


$$3 \, a \, b^3 \, dm1^2 \, du1^2 \, km1 + 12 \, a^2 \, b^2 \, dm1^2 \, du1 \, du2 \, km1 - 3 \, a^3 \, b \, dm1^2 \, du2^2 \, km1 +$$


$$3 \, a^2 \, b^3 \, dm1 \, du1 \, km1^2 + 3 \, a^3 \, b^2 \, dm1 \, du2 \, km1^2 + 2 \, a^3 \, b^3 \, km1^3 - 6 \, b^3 \, c \, dm1^2 \, du1^2 \, ku1 +$$


$$6 \, a \, b^2 \, c \, dm1^2 \, du1 \, du2 \, ku1 + 3 \, a^2 \, b \, c \, dm1^2 \, du2^2 \, ku1 + 3 \, a \, b^3 \, c \, dm1 \, du1 \, km1 \, ku1 -$$


$$6 \, a^2 \, b^2 \, c \, dm1 \, du2 \, km1 \, ku1 - 6 \, a^2 \, b^3 \, c \, km1^2 \, ku1 - 6 \, b^3 \, c^2 \, dm1 \, du1 \, ku1^2 +$$


$$3 \, a \, b^2 \, c^2 \, dm1 \, du2 \, ku1^2 + 6 \, a \, b^3 \, c^2 \, km1 \, ku1^2 - 2 \, b^3 \, c^3 \, ku1^3 + 3 \, a \, b^2 \, d \, dm1^2 \, du1^2 \, ku2 +$$


$$6 \, a^2 \, b \, d \, dm1^2 \, du1 \, du2 \, ku2 - 6 \, a^3 \, d \, dm1^2 \, du2^2 \, ku2 - 6 \, a^2 \, b^2 \, d \, dm1 \, du1 \, km1 \, ku2 +$$


$$3 \, a^3 \, b \, d \, dm1 \, du2 \, km1 \, ku2 - 6 \, a^3 \, b^2 \, d \, km1^2 \, ku2 - 3 \, a \, b^2 \, c \, d \, dm1 \, du1 \, ku1 \, ku2 -$$


$$3 \, a^2 \, b \, c \, d \, dm1 \, du2 \, ku1 \, ku2 + 12 \, a^2 \, b^2 \, c \, d \, km1 \, ku1 \, ku2 - 6 \, a \, b^2 \, c^2 \, d \, ku1^2 \, ku2 +$$


$$3 \, a^2 \, b \, d^2 \, dm1 \, du1 \, ku2^2 - 6 \, a^3 \, d^2 \, dm1 \, du2 \, ku2^2 + 6 \, a^3 \, b \, d^2 \, km1 \, ku2^2 - 6 \, a^2 \, b \, c \, d^2 \, ku1 \, ku2^2 -$$


$$2 \, a^3 \, d^3 \, ku2^3 + \sqrt{\left( -2 \, b^3 \, dm1^3 \, du1^3 + 3 \, a \, b^2 \, dm1^3 \, du1^2 \, du2 + 3 \, a^2 \, b \, dm1^3 \, du1 \, du2^2 - \right.}$$


$$2 \, a^3 \, dm1^3 \, du2^3 - 3 \, a \, b^3 \, dm1^2 \, du1^2 \, km1 + 12 \, a^2 \, b^2 \, dm1^2 \, du1 \, du2 \, km1 - 3 \, a^3 \, b \, dm1^2 \, du2^2 \, km1 +$$


$$3 \, a^2 \, b^3 \, dm1 \, du1 \, km1^2 + 3 \, a^3 \, b^2 \, dm1 \, du2 \, km1^2 + 2 \, a^3 \, b^3 \, km1^3 - 6 \, b^3 \, c \, dm1^2 \, du1^2 \, ku1 + 6 \, a \, b^2 \, c \, dm1^2 \, du1 \, du2 \, ku1 +$$


$$3 \, a^2 \, b \, c \, dm1^2 \, du2^2 \, ku1 + 3 \, a \, b^3 \, c \, dm1 \, du1 \, km1 \, ku1 - 6 \, a^2 \, b^2 \, c \, dm1 \, du2 \, km1 \, ku1 - 6 \, a^2 \, b^3 \, c \, km1^2 \, ku1 -$$


$$6 \, b^3 \, c^2 \, dm1 \, du1 \, ku1^2 + 3 \, a \, b^2 \, c^2 \, dm1 \, du2 \, ku1^2 + 6 \, a \, b^3 \, c^2 \, km1 \, ku1^2 -$$


$$2 \, b^3 \, c^3 \, ku1^3 + 3 \, a \, b^2 \, d \, dm1^2 \, du1^2 \, ku2 + 6 \, a^2 \, b \, d \, dm1^2 \, du1 \, du2 \, ku2 -$$


$$6 \, a^3 \, d \, dm1^2 \, du2^2 \, ku2 - 6 \, a^2 \, b^2 \, d \, dm1 \, du1 \, km1 \, ku2 + 3 \, a^3 \, b \, d \, dm1 \, du2 \, km1 \, ku2 -$$


$$6 \, a^3 \, b^2 \, d \, km1^2 \, ku2 - 3 \, a \, b^2 \, c \, d \, dm1 \, du1 \, ku1 \, ku2 - 3 \, a^2 \, b \, c \, d \, dm1 \, du2 \, ku1 \, ku2 +$$


$$12 \, a^2 \, b^2 \, c \, d \, km1 \, ku1 \, ku2 - 6 \, a \, b^2 \, c^2 \, d \, ku1^2 \, ku2 + 3 \, a^2 \, b \, d^2 \, dm1 \, du1 \, ku2^2 - 6 \, a^3 \, d^2 \, dm1 \, du2 \, ku2^2 +$$


$$6 \, a^3 \, b \, d^2 \, km1 \, ku2^2 - 6 \, a^2 \, b \, c \, d^2 \, ku1 \, ku2^2 - 2 \, a^3 \, d^3 \, ku2^3 \Big)^2 +$$


$$4 \left( - (b \, dm1 \, du1 + a \, dm1 \, du2 - a \, b \, km1 + b \, c \, ku1 + a \, d \, ku2)^2 + 3 \, a \, b \, dm1 \right.$$


$$\left. \left. (dm1 \, du1 \, du2 - b \, du1 \, km1 - a \, du2 \, km1 + c \, du2 \, ku1 + d \, du1 \, ku2) \right)^3 \right)^{1/3} \Big) +$$


$$\frac{1}{3 \times 2^{1/3} \, a \, b \, dm1} \left( -2 \, b^3 \, dm1^3 \, du1^3 + 3 \, a \, b^2 \, dm1^3 \, du1^2 \, du2 + 3 \, a^2 \, b \, dm1^3 \, du1 \, du2^2 - \right.$$


$$2 \, a^3 \, dm1^3 \, du2^3 - 3 \, a \, b^3 \, dm1^2 \, du1^2 \, km1 + 12 \, a^2 \, b^2 \, dm1^2 \, du1 \, du2 \, km1 -$$


$$3 \, a^3 \, b \, dm1^2 \, du2^2 \, km1 + 3 \, a^2 \, b^3 \, dm1 \, du1 \, km1^2 + 3 \, a^3 \, b^2 \, dm1 \, du2 \, km1^2 +$$


$$2 \, a^3 \, b^3 \, km1^3 - 6 \, b^3 \, c \, dm1^2 \, du1^2 \, ku1 + 6 \, a \, b^2 \, c \, dm1^2 \, du1 \, du2 \, ku1 +$$


$$3 \, a^2 \, b \, c \, dm1^2 \, du2^2 \, ku1 + 3 \, a \, b^3 \, c \, dm1 \, du1 \, km1 \, ku1 -$$


$$6 \, a^2 \, b^2 \, c \, dm1 \, du2 \, km1 \, ku1 - 6 \, a^2 \, b^3 \, c \, km1^2 \, ku1 - 6 \, b^3 \, c^2 \, dm1 \, du1 \, ku1^2 +$$


$$3 \, a \, b^2 \, c^2 \, dm1 \, du2 \, ku1^2 + 6 \, a \, b^3 \, c^2 \, km1 \, ku1^2 - 2 \, b^3 \, c^3 \, ku1^3 +$$


$$3 \, a \, b^2 \, d \, dm1^2 \, du1^2 \, ku2 + 6 \, a^2 \, b \, d \, dm1^2 \, du1 \, du2 \, ku2 - 6 \, a^3 \, d \, dm1^2 \, du2^2 \, ku2 -$$


$$6 \, a^2 \, b^2 \, d \, dm1 \, du1 \, km1 \, ku2 + 3 \, a^3 \, b \, d \, dm1 \, du2 \, km1 \, ku2 - 6 \, a^3 \, b^2 \, d \, km1^2 \, ku2 -$$


$$3 \, a \, b^2 \, c \, d \, dm1 \, du1 \, ku1 \, ku2 - 3 \, a^2 \, b \, c \, d \, dm1 \, du2 \, ku1 \, ku2 +$$


$$12 \, a^2 \, b^2 \, c \, d \, km1 \, ku1 \, ku2 - 6 \, a \, b^2 \, c^2 \, d \, ku1^2 \, ku2 + 3 \, a^2 \, b \, d^2 \, dm1 \, du1 \, ku2^2 -$$


$$6 \, a^3 \, d^2 \, dm1 \, du2 \, ku2^2 + 6 \, a^3 \, b \, d^2 \, km1 \, ku2^2 - 6 \, a^2 \, b \, c \, d^2 \, ku1 \, ku2^2 - 2 \, a^3 \, d^3 \, ku2^3 +$$


$$\sqrt{\left( -2 \, b^3 \, dm1^3 \, du1^3 + 3 \, a \, b^2 \, dm1^3 \, du1^2 \, du2 + 3 \, a^2 \, b \, dm1^3 \, du1 \, du2^2 - 2 \, a^3 \, dm1^3 \, du2^3 - \right.}$$


$$3 \, a \, b^3 \, dm1^2 \, du1^2 \, km1 + 12 \, a^2 \, b^2 \, dm1^2 \, du1 \, du2 \, km1 - 3 \, a^3 \, b \, dm1^2 \, du2^2 \, km1 +$$


$$3 \, a^2 \, b^3 \, dm1 \, du1 \, km1^2 + 3 \, a^3 \, b^2 \, dm1 \, du2 \, km1^2 + 2 \, a^3 \, b^3 \, km1^3 -$$


$$6 \, b^3 \, c \, dm1^2 \, du1^2 \, ku1 + 6 \, a \, b^2 \, c \, dm1^2 \, du1 \, du2 \, ku1 + 3 \, a^2 \, b \, c \, dm1^2 \, du2^2 \, ku1 +$$


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$$\begin{aligned}
& 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - \\
& 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3)^2 + \\
& 4 \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + 3 a b d m_1 \right. \\
& \quad \left. (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right)^3 \Big)^{1/3} \Big\}, \\
\{m_1 \rightarrow & - \frac{b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2}{3 a b d m_1} + \\
& \left(\left(1 + i \sqrt{3} \right) \right. \\
& \quad \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + \right. \\
& \quad \left. 3 a b d m_1 (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right) \Big) \Big/ \\
& \left(3 \times 2^{2/3} a b d m_1 \left(-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - \right. \right. \\
& \quad 2 a^3 d m_1^3 d u_2^3 - 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - \\
& \quad 3 a^3 b d m_1^2 d u_2^2 k m_1 + 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - \\
& \quad 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 + \\
& \quad \sqrt{\left(-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - 2 a^3 d m_1^3 d u_2^3 - \right. \\
& \quad 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - 3 a^3 b d m_1^2 d u_2^2 k m_1 + \\
& \quad 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - 6 a^3 \\
& \quad \left. d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 \right)^2 + \\
& \quad \left. 4 \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + 3 a b d m_1 \right. \right. \\
& \quad \left. \left. (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right)^3 \right) \Big)^{1/3} \Big) - \\
& \frac{1}{6 \times 2^{1/3} a b d m_1} \left(1 - i \sqrt{3} \right) \left(-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - \right. \\
& \quad 2 a^3 d m_1^3 d u_2^3 - 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - \\
& \quad 3 a^3 b d m_1^2 d u_2^2 k m_1 + 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - \\
& \quad \left. 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 \right) +
\end{aligned}$$

$$\begin{aligned}
& \sqrt{\left((-2b^3 dm1^3 du1^3 + 3ab^2 dm1^3 du1^2 du2 + 3a^2 b dm1^3 du1 du2^2 - 2a^3 dm1^3 du2^3 - \right. \\
& \quad 3ab^3 dm1^2 du1^2 km1 + 12a^2 b^2 dm1^2 du1 du2 km1 - 3a^3 b dm1^2 du2^2 km1 + \\
& \quad 3a^2 b^3 dm1 du1 km1^2 + 3a^3 b^2 dm1 du2 km1^2 + 2a^3 b^3 km1^3 - \\
& \quad 6b^3 c dm1^2 du1^2 ku1 + 6ab^2 c dm1^2 du1 du2 ku1 + 3a^2 b c dm1^2 du2^2 ku1 + \\
& \quad 3ab^3 c dm1 du1 km1 ku1 - 6a^2 b^2 c dm1 du2 km1 ku1 - 6a^2 b^3 c km1^2 ku1 - \\
& \quad 6b^3 c^2 dm1 du1 ku1^2 + 3ab^2 c^2 dm1 du2 ku1^2 + 6ab^3 c^2 km1 ku1^2 - \\
& \quad 2b^3 c^3 ku1^3 + 3ab^2 d dm1^2 du1^2 ku2 + 6a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6a^3 d dm1^2 du2^2 ku2 - 6a^2 b^2 d dm1 du1 km1 ku2 + 3a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6a^3 b^2 d km1^2 ku2 - 3ab^2 c d dm1 du1 ku1 ku2 - 3a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12a^2 b^2 c d km1 ku1 ku2 - 6ab^2 c^2 d ku1^2 ku2 + 3a^2 b d^2 dm1 du1 ku2^2 - \\
& \quad \left. 6a^3 d^2 dm1 du2 ku2^2 + 6a^3 b d^2 km1 ku2^2 - 6a^2 b c d^2 ku1 ku2^2 - 2a^3 d^3 ku2^3 \right)^2 + \\
& \quad 4 \left(-(b dm1 du1 + a dm1 du2 - ab km1 + bc ku1 + ad ku2)^2 + 3ab dm1 \right. \\
& \quad \left. (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2) \right)^3 \Big)^{1/3} \Big\}, \\
& \left\{ m1 \rightarrow - \frac{b dm1 du1 + a dm1 du2 - ab km1 + bc ku1 + ad ku2}{3ab dm1} + \right. \\
& \quad \left((1 - i \sqrt{3}) \right. \\
& \quad \left. \left(-(b dm1 du1 + a dm1 du2 - ab km1 + bc ku1 + ad ku2)^2 + \right. \right. \\
& \quad \left. \left. 3ab dm1 (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2) \right) \right) \Big/ \\
& \quad \left(3 \times 2^{2/3} ab dm1 \left(-2b^3 dm1^3 du1^3 + 3ab^2 dm1^3 du1^2 du2 + 3a^2 b dm1^3 du1 du2^2 - \right. \right. \\
& \quad 2a^3 dm1^3 du2^3 - 3ab^3 dm1^2 du1^2 km1 + 12a^2 b^2 dm1^2 du1 du2 km1 - \\
& \quad 3a^3 b dm1^2 du2^2 km1 + 3a^2 b^3 dm1 du1 km1^2 + 3a^3 b^2 dm1 du2 km1^2 + 2a^3 b^3 km1^3 - \\
& \quad 6b^3 c dm1^2 du1^2 ku1 + 6ab^2 c dm1^2 du1 du2 ku1 + 3a^2 b c dm1^2 du2^2 ku1 + \\
& \quad 3ab^3 c dm1 du1 km1 ku1 - 6a^2 b^2 c dm1 du2 km1 ku1 - 6a^2 b^3 c km1^2 ku1 - \\
& \quad 6b^3 c^2 dm1 du1 ku1^2 + 3ab^2 c^2 dm1 du2 ku1^2 + 6ab^3 c^2 km1 ku1^2 - \\
& \quad 2b^3 c^3 ku1^3 + 3ab^2 d dm1^2 du1^2 ku2 + 6a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6a^3 d dm1^2 du2^2 ku2 - 6a^2 b^2 d dm1 du1 km1 ku2 + 3a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6a^3 b^2 d km1^2 ku2 - 3ab^2 c d dm1 du1 ku1 ku2 - 3a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12a^2 b^2 c d km1 ku1 ku2 - 6ab^2 c^2 d ku1^2 ku2 + 3a^2 b d^2 dm1 du1 ku2^2 - \\
& \quad \left. 6a^3 d^2 dm1 du2 ku2^2 + 6a^3 b d^2 km1 ku2^2 - 6a^2 b c d^2 ku1 ku2^2 - 2a^3 d^3 ku2^3 + \right. \\
& \quad \sqrt{\left((-2b^3 dm1^3 du1^3 + 3ab^2 dm1^3 du1^2 du2 + 3a^2 b dm1^3 du1 du2^2 - 2a^3 dm1^3 du2^3 - \right. \\
& \quad 3ab^3 dm1^2 du1^2 km1 + 12a^2 b^2 dm1^2 du1 du2 km1 - 3a^3 b dm1^2 du2^2 km1 + \\
& \quad 3a^2 b^3 dm1 du1 km1^2 + 3a^3 b^2 dm1 du2 km1^2 + 2a^3 b^3 km1^3 - \\
& \quad 6b^3 c dm1^2 du1^2 ku1 + 6ab^2 c dm1^2 du1 du2 ku1 + 3a^2 b c dm1^2 du2^2 ku1 + \\
& \quad 3ab^3 c dm1 du1 km1 ku1 - 6a^2 b^2 c dm1 du2 km1 ku1 - 6a^2 b^3 c km1^2 ku1 - \\
& \quad 6b^3 c^2 dm1 du1 ku1^2 + 3ab^2 c^2 dm1 du2 ku1^2 + 6ab^3 c^2 km1 ku1^2 - \\
& \quad 2b^3 c^3 ku1^3 + 3ab^2 d dm1^2 du1^2 ku2 + 6a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6a^3 d dm1^2 du2^2 ku2 - 6a^2 b^2 d dm1 du1 km1 ku2 + 3a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6a^3 b^2 d km1^2 ku2 - 3ab^2 c d dm1 du1 ku1 ku2 - 3a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12a^2 b^2 c d km1 ku1 ku2 - 6ab^2 c^2 d ku1^2 ku2 + 3a^2 b d^2 dm1 du1 ku2^2 - \\
& \quad \left. 6a^3 d^2 dm1 du2 ku2^2 + 6a^3 b d^2 km1 ku2^2 - 6a^2 b c d^2 ku1 ku2^2 - 2a^3 d^3 ku2^3 \right)^2 + \\
& \quad \left. 4 \left(-(b dm1 du1 + a dm1 du2 - ab km1 + bc ku1 + ad ku2)^2 + 3ab dm1 \right. \right. \\
& \quad \left. \left. (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2) \right)^3 \right) \Big)^{1/3} \Big) - \\
& \quad \frac{1}{6 \times 2^{1/3} ab dm1} \left(1 + i \sqrt{3} \right) \left(-2b^3 dm1^3 du1^3 + 3ab^2 dm1^3 du1^2 du2 + 3a^2 b dm1^3 du1 du2^2 - \right. \\
& \quad 2a^3 dm1^3 du2^3 - 3ab^3 dm1^2 du1^2 km1 + 12a^2 b^2 dm1^2 du1 du2 km1 - \\
& \quad 3a^3 b dm1^2 du2^2 km1 + 3a^2 b^3 dm1 du1 km1^2 + 3a^3 b^2 dm1 du2 km1^2 + \\
& \quad 2a^3 b^3 km1^3 - 6b^3 c dm1^2 du1^2 ku1 + 6ab^2 c dm1^2 du1 du2 ku1 + \\
& \quad 3a^2 b c dm1^2 du2^2 ku1 + 3ab^3 c dm1 du1 km1 ku1 - 6a^2 b^2 c dm1 du2 km1 ku1 - \\
& \quad \left. 6a^2 b^3 c km1^2 ku1 - 6b^3 c^2 dm1 du1 ku1^2 + 3ab^2 c^2 dm1 du2 ku1^2 + 3a^2 b c^2 dm1 du2 ku1^2 + \right. \\
& \quad \left. 6ab^3 c^2 km1 ku1^2 + \right.
\end{aligned}$$

$$\begin{aligned}
& 6 a b^3 c^2 k m_1 k u_1^2 - 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + \\
& 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + \\
& 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - \\
& 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + 12 a^2 b^2 c d k m_1 k u_1 k u_2 - \\
& 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - 6 a^3 d^2 d m_1 d u_2 k u_2^2 + \\
& 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 + \\
& \sqrt{\left(\left(-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - 2 a^3 d m_1^3 d u_2^3 - \right. \right. \\
& \quad 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - 3 a^3 b d m_1^2 d u_2^2 k m_1 + \\
& \quad 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - \\
& \quad \left. \left. 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 \right)^2 + \right. \\
& \quad \left. 4 \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + 3 a b d m_1 \right. \right. \\
& \quad \left. \left. (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right)^3 \right)^{1/3} \Big\}
\end{aligned}$$

(*Since there are three roots,

expression with the positive solution is chosen to find protein ss*)

m1u1 = (kc11 m1 u1) / (dc11 + kcodeg11 + kretm11 + kretu11);

m1u2 = (kc12 m1 u2) / (dc12 + kcodeg12 + kretm12 + kretu12);

u2 = ku2 / (du2 + b m1);

u1 = ku1 / (du1 + a m1);

m = -
$$\frac{b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2}{3 a b d m_1} -$$

$$\left(2^{1/3} \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + \right. \right.$$

$$\left. \left. 3 a b d m_1 (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right) \right)^{1/3} \Big/$$

$$\left(3 a b d m_1 \left(-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - 2 a^3 d m_1^3 d u_2^3 - \right. \right.$$

$$\begin{aligned}
& 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - 3 a^3 b d m_1^2 d u_2^2 k m_1 + \\
& 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - 6 b^3 c d m_1^2 d u_1^2 k u_1 + \\
& 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - \\
& 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - 6 b^3 c^2 d m_1 d u_1 k u_1^2 + \\
& 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + \\
& 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + \\
& 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - \\
& 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + \\
& 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - \\
& \left. \left. 2 a^3 d^3 k u_2^3 + \sqrt{\left(\left(-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - \right. \right. \right. \right. \\
& \quad 2 a^3 d m_1^3 d u_2^3 - 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - \\
& \quad 3 a^3 b d m_1^2 d u_2^2 k m_1 + 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - \\
& \quad \left. \left. 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 \right)^2 + \right. \\
& \quad \left. \left. 4 \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + 3 a b d m_1 \right. \right. \right. \\
& \quad \left. \left. (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right)^3 \right)^{1/3} \Big\}
\end{aligned}$$

$$\begin{aligned}
& km1\ ku1 - 6\ a^2\ b^3\ c\ km1^2\ ku1 - 6\ b^3\ c^2\ dm1\ du1\ ku1^2 + 3\ a\ b^2\ c^2\ dm1 \\
& du2\ ku1^2 + 6\ a\ b^3\ c^2\ km1\ ku1^2 - 2\ b^3\ c^3\ ku1^3 + 3\ a\ b^2\ d\ dm1^2\ du1^2\ ku2 + \\
& 6\ a^2\ b\ d\ dm1^2\ du1\ du2\ ku2 - 6\ a^3\ d\ dm1^2\ du2^2\ ku2 - 6\ a^2\ b^2\ d\ dm1\ du1 \\
& km1\ ku2 + 3\ a^3\ b\ d\ dm1\ du2\ km1\ ku2 - 6\ a^3\ b^2\ d\ km1^2\ ku2 - 3\ a\ b^2\ c\ d\ dm1 \\
& du1\ ku1\ ku2 - 3\ a^2\ b\ c\ d\ dm1\ du2\ ku1\ ku2 + 12\ a^2\ b^2\ c\ d\ km1\ ku1\ ku2 - \\
& 6\ a\ b^2\ c^2\ d\ ku1^2\ ku2 + 3\ a^2\ b\ d^2\ dm1\ du1\ ku2^2 - 6\ a^3\ d^2\ dm1\ du2\ ku2^2 + \\
& 6\ a^3\ b\ d^2\ km1\ ku2^2 - 6\ a^2\ b\ c\ d^2\ ku1\ ku2^2 - 2\ a^3\ d^3\ ku2^3)^2 + \\
& 4\left(- (b\ dm1\ du1 + a\ dm1\ du2 - a\ b\ km1 + b\ c\ ku1 + a\ d\ ku2)^2 + \right. \\
& \quad \left. 3\ a\ b\ dm1\ (dm1\ du1\ du2 - b\ du1\ km1 - a\ du2\ km1 + \right. \\
& \quad \left. c\ du2\ ku1 + d\ du1\ ku2)^3\right)^{1/3} + \\
& \frac{1}{3 \times 2^{1/3} a\ b\ dm1} \left(-2\ b^3\ dm1^3\ du1^3 + 3\ a\ b^2\ dm1^3\ du1^2\ du2 + 3\ a^2\ b\ dm1^3\ du1 \right. \\
& \quad du2^2 - 2\ a^3\ dm1^3\ du2^3 - 3\ a\ b^3\ dm1^2\ du1^2\ km1 + 12\ a^2\ b^2\ dm1^2\ du1\ du2 \\
& \quad km1 - 3\ a^3\ b\ dm1^2\ du2^2\ km1 + 3\ a^2\ b^3\ dm1\ du1\ km1^2 + 3\ a^3\ b^2\ dm1\ du2 \\
& \quad km1^2 + 2\ a^3\ b^3\ km1^3 - 6\ b^3\ c\ dm1^2\ du1^2\ ku1 + 6\ a\ b^2\ c\ dm1^2\ du1\ du2 \\
& \quad ku1 + 3\ a^2\ b\ c\ dm1^2\ du2^2\ ku1 + 3\ a\ b^3\ c\ dm1\ du1\ km1\ ku1 - 6\ a^2\ b^2\ c\ dm1 \\
& \quad du2\ km1\ ku1 - 6\ a^2\ b^3\ c\ km1^2\ ku1 - 6\ b^3\ c^2\ dm1\ du1\ ku1^2 + 3\ a\ b^2\ c^2 \\
& \quad dm1\ du2\ ku1^2 + 6\ a\ b^3\ c^2\ km1\ ku1^2 - 2\ b^3\ c^3\ ku1^3 + 3\ a\ b^2\ d\ dm1^2\ du1^2 \\
& \quad ku2 + 6\ a^2\ b\ d\ dm1^2\ du1\ du2\ ku2 - 6\ a^3\ d\ dm1^2\ du2^2\ ku2 - 6\ a^2\ b^2\ d\ dm1 \\
& \quad du1\ km1\ ku2 + 3\ a^3\ b\ d\ dm1\ du2\ km1\ ku2 - 6\ a^3\ b^2\ d\ km1^2\ ku2 - 3\ a\ b^2 \\
& \quad c\ d\ dm1\ du1\ ku1\ ku2 - 3\ a^2\ b\ c\ d\ dm1\ du2\ ku1\ ku2 + 12\ a^2\ b^2\ c\ d\ km1 \\
& \quad ku1\ ku2 - 6\ a\ b^2\ c^2\ d\ ku1^2\ ku2 + 3\ a^2\ b\ d^2\ dm1\ du1\ ku2^2 - 6\ a^3\ d^2\ dm1 \\
& \quad du2\ ku2^2 + 6\ a^3\ b\ d^2\ km1\ ku2^2 - 6\ a^2\ b\ c\ d^2\ ku1\ ku2^2 - 2\ a^3\ d^3\ ku2^3 + \\
& \quad \sqrt{\left((-2\ b^3\ dm1^3\ du1^3 + 3\ a\ b^2\ dm1^3\ du1^2\ du2 + 3\ a^2\ b\ dm1^3\ du1\ du2^2 - 2\ a^3\ dm1^3\ du2^3 - \right. \\
& \quad \left. 3\ a\ b^3\ dm1^2\ du1^2\ km1 + 12\ a^2\ b^2\ dm1^2\ du1\ du2\ km1 - 3\ a^3\ b\ dm1^2\ du2^2\ km1 + \right. \\
& \quad \left. 3\ a^2\ b^3\ dm1\ du1\ km1^2 + 3\ a^3\ b^2\ dm1\ du2\ km1^2 + 2\ a^3\ b^3\ km1^3 - 6\ b^3\ c\ dm1^2\ du1^2\ ku1 + 6\ a\ b^2\ c\ dm1^2\ du1\ du2\ ku1 + 3\ a^2\ b\ c\ dm1^2\ du2^2\ ku1 + 3\ a\ b^3\ c\ dm1\ du1\ km1\ ku1 - 6\ a^2\ b^2\ c\ dm1\ du2\ km1\ ku1 - 6\ a^2\ b^3\ c\ km1^2\ ku1 - 6\ b^3\ c^2\ dm1\ du1\ ku1^2 + 3\ a\ b^2\ c^2\ dm1\ du2\ ku1^2 + 6\ a\ b^3\ c^2\ km1\ ku1^2 - 2\ b^3\ c^3\ ku1^3 + 3\ a\ b^2\ d\ dm1^2\ du1^2\ ku2 + 6\ a^2\ b\ d\ dm1^2\ du1\ du2\ ku2 - 6\ a^3\ d\ dm1^2\ du2^2\ ku2 - 6\ a^2\ b^2\ d\ dm1\ du1\ km1\ ku2 + 3\ a^3\ b\ d\ dm1\ du2\ km1\ ku2 - 6\ a^3\ b^2\ d\ km1^2\ ku2 - 3\ a\ b^2\ c\ d\ dm1\ du1\ ku1\ ku2 - 3\ a^2\ b\ c\ d\ dm1\ du2\ ku1\ ku2 + 12\ a^2\ b^2\ c\ d\ km1\ ku1\ ku2 - 6\ a\ b^2\ c^2\ d\ ku1^2\ ku2 + 3\ a^2\ b\ d^2\ dm1\ du1\ ku2^2 - 6\ a^3\ d^2\ dm1\ du2\ ku2^2 + 6\ a^3\ b\ d^2\ km1\ ku2^2 - 6\ a^2\ b\ c\ d^2\ ku1\ ku2^2 - 2\ a^3\ d^3\ ku2^3\right)^2 + \\
& \quad \left. 4\left(- (b\ dm1\ du1 + a\ dm1\ du2 - a\ b\ km1 + b\ c\ ku1 + a\ d\ ku2)^2 + \right. \right. \\
& \quad \left. \left. 3\ a\ b\ dm1\ (dm1\ du1\ du2 - b\ du1\ km1 - a\ du2\ km1 + c\ du2\ ku1 + \right. \right. \\
& \quad \left. \left. d\ du1\ ku2)^3\right)^{1/3}\right) - ktrans11\ mu1 - ktrans12\ mu2\left.\right\}\left.\right\} \\
& (*calculating sensitivity of protein*) \\
& p = -\frac{1}{dp1} \left(-kp1 \left(-\frac{b\ dm1\ du1 + a\ dm1\ du2 - a\ b\ km1 + b\ c\ ku1 + a\ d\ ku2}{3\ a\ b\ dm1} - \right. \right. \\
& \quad \left. \left. (2^{1/3} (- (b\ dm1\ du1 + a\ dm1\ du2 - a\ b\ km1 + b\ c\ ku1 + a\ d\ ku2)^2 + \right. \right. \\
& \quad \left. \left. 3\ a\ b\ dm1\ (dm1\ du1\ du2 - b\ du1\ km1 - a\ du2\ km1 + c\ du2\ ku1 + d\ du1\ ku2)^3\right)^{1/3} \right) \right) / \\
& \left(3\ a\ b\ dm1 \left(-2\ b^3\ dm1^3\ du1^3 + 3\ a\ b^2\ dm1^3\ du1^2\ du2 + 3\ a^2\ b\ dm1^3\ du1\ du2^2 - 2\ a^3\ dm1^3\ du2^3 - \right. \right. \\
& \quad du2^3 - 3\ a\ b^3\ dm1^2\ du1^2\ km1 + 12\ a^2\ b^2\ dm1^2\ du1\ du2\ km1 - 3\ a^3\ b\ dm1^2\ du2^2\ km1 + 3\ a^2\ b^3\ dm1\ du1\ km1^2 + 3\ a^3\ b^2\ dm1\ du2\ km1^2 + 2\ a^3\ b^3\ km1^3 - 6\ b^3\ c\ dm1^2\ du1^2\ ku1 + 6\ a\ b^2\ c\ dm1^2\ du1\ du2\ ku1 + 3\ a^2\ b\ c\ dm1^2\ du2^2\ ku1 + 3\ a\ b^3\ c\ dm1\ du1\ km1\ ku1 - 6\ a^2\ b^2\ c\ dm1\ du2\ km1\ ku1 - 6\ a^2\ b^3\ c\ km1^2\ ku1 - 6\ b^3\ c^2\ dm1\ du1\ ku1^2 + 3\ a\ b^2\ c^2\ dm1\ du2\ ku1^2 + 6\ a\ b^3\ c^2\ km1\ ku1^2 - 2\ b^3\ c^3\ ku1^3 + 3\ a\ b^2\ d\ dm1^2\ du1^2\ ku2 + 6\ a^2\ b\ d\ dm1^2\ du1\ du2\ ku2 - 6\ a^3\ d\ dm1^2\ du2^2\ ku2 - 6\ a^2\ b^2\ d\ dm1\ du1\ km1\ ku2 + 3\ a^3\ b\ d\ dm1\ du2\ km1\ ku2 - 6\ a^3\ b^2\ d\ km1^2\ ku2 - 3\ a\ b^2\ c\ d\ dm1\ du1\ ku1\ ku2 - 3\ a^2\ b\ c\ d\ dm1\ du2\ ku1\ ku2 + 12\ a^2\ b^2\ c\ d\ km1\ ku1\ ku2 - 6\ a\ b^2\ c^2\ d\ ku1^2\ ku2 + 3\ a^2\ b\ d^2\ dm1\ du1\ ku2^2 - 6\ a^3\ d^2\ dm1\ du2\ ku2^2 + 6\ a^3\ b\ d^2\ km1\ ku2^2 - 6\ a^2\ b\ c\ d^2\ ku1\ ku2^2 - 2\ a^3\ d^3\ ku2^3\left.\right)^2 + \\
& \quad \left. 4\left(- (b\ dm1\ du1 + a\ dm1\ du2 - a\ b\ km1 + b\ c\ ku1 + a\ d\ ku2)^2 + \right. \right. \\
& \quad \left. \left. 3\ a\ b\ dm1\ (dm1\ du1\ du2 - b\ du1\ km1 - a\ du2\ km1 + c\ du2\ ku1 + d\ du1\ ku2)^3\right)^{1/3} \right) - ktrans11\ mu1 - ktrans12\ mu2\left.\right\}\left.\right)
\end{aligned}$$

$$\begin{aligned}
& ku2 + 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - 6 \\
& a^3 d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3 + \\
& \sqrt{\left((-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - 2 a^3 dm1^3 du2^3 - \right. \\
& 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - 3 a^3 b dm1^2 du2^2 km1 + \\
& 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - 6 b^3 c dm1^2 \\
& du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + 3 a b^3 c \\
& dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - 6 b^3 c^2 \\
& dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - 2 b^3 c^3 ku1^3 + \\
& 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - 6 a^3 d dm1^2 du2^2 ku2 - \\
& 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - 6 a^3 b^2 d km1^2 ku2 - \\
& 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + 12 a^2 b^2 c d km1 \\
& ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - 6 a^3 d^2 dm1 \\
& du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3 \Big)^2 + \\
& 4 \left(- (b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2)^2 + 3 a b dm1 (dm1 \right. \\
& du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2) \Big)^3 \Big)^{1/3} \Big) + \\
& \frac{1}{3 \times 2^{1/3} a b dm1} \left(-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - \right. \\
& 2 a^3 dm1^3 du2^3 - 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - \\
& 3 a^3 b dm1^2 du2^2 km1 + 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - \\
& 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + \\
& 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - \\
& 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - \\
& 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - \\
& 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - \\
& 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + \\
& 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - \\
& 6 a^3 d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3 + \\
& \sqrt{\left((-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - 2 a^3 dm1^3 du2^3 - \right. \\
& 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - 3 a^3 b dm1^2 du2^2 km1 + \\
& 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - \\
& 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + \\
& 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - \\
& 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - \\
& 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - \\
& 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - \\
& 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + \\
& 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - 6 a^3 \\
& d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3 \Big)^2 + \\
& 4 \left(- (b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2)^2 + \right. \\
& 3 a b dm1 (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + \\
& d du1 ku2) \Big)^3 \Big)^{1/3} \Big) - ktrans11 mu1 - ktrans12 mu2 \Big);
\end{aligned}$$

D[
p,
ku2]

$$\begin{aligned}
& \frac{1}{dp1} kp1 \left(-\frac{d}{3 b dm1} + \left(2^{1/3} \left(- (b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2)^2 + \right. \right. \right. \\
& 3 a b dm1 (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2) \Big) \\
& \left(3 a b^2 d dm1^2 du1^2 + 6 a^2 b d dm1^2 du1 du2 - 6 a^3 d dm1^2 du2^2 - 6 a^2 b^2 d dm1 du1 km1 + \right. \\
& 3 a^3 b d dm1 du2 km1 - 6 a^3 b^2 d km1^2 - 3 a b^2 c d dm1 du1 ku1 - 3 a^2 b c d dm1 du2 ku1 + \\
& 12 a^2 b^2 c d km1 ku1 - 6 a b^2 c^2 d ku1^2 + 6 a^2 b d^2 dm1 du1 ku2 -
\end{aligned}$$

$$\begin{aligned}
& 12 a^3 d^2 dm1 du2 ku2 + 12 a^3 b d^2 km1 ku2 - 12 a^2 b c d^2 ku1 ku2 - 6 a^3 d^3 ku2^2 + \\
& (2 (3 a b^2 d dm1^2 du1^2 + 6 a^2 b d dm1^2 du1 du2 - 6 a^3 d dm1^2 du2^2 - 6 a^2 b^2 d dm1 du1 km1 + 3 \\
& \quad a^3 b d dm1 du2 km1 - 6 a^3 b^2 d km1^2 - 3 a b^2 c d dm1 du1 ku1 - 3 a^2 b c d dm1 \\
& \quad du2 ku1 + 12 a^2 b^2 c d km1 ku1 - 6 a b^2 c^2 d ku1^2 + 6 a^2 b d^2 dm1 du1 ku2 - 12 \\
& \quad a^3 d^2 dm1 du2 ku2 + 12 a^3 b d^2 km1 ku2 - 12 a^2 b c d^2 ku1 ku2 - 6 a^3 d^3 ku2^2) \\
& (-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - 2 a^3 dm1^3 \\
& \quad du2^3 - 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - 3 a^3 b dm1^2 du2^2 km1 + 3 \\
& \quad a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - 6 b^3 c dm1^2 du1^2 ku1 + 6 \\
& \quad a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 \\
& \quad b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 \\
& \quad du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 \\
& \quad du1 du2 ku2 - 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 \\
& \quad km1 ku2 - 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 \\
& \quad ku2 + 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - 6 \\
& \quad a^3 d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3) + \\
& 12 (3 a b d dm1 du1 - 2 a d (b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2)) \\
& (- (b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2)^2 + \\
& \quad 3 a b dm1 (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2))^2) / \\
& (2 \sqrt{((-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - \\
& \quad 2 a^3 dm1^3 du2^3 - 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - \\
& \quad 3 a^3 b dm1^2 du2^2 km1 + 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + \\
& \quad 2 a^3 b^3 km1^3 - 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + \\
& \quad 3 a^2 b c dm1^2 du2^2 ku1 + 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - \\
& \quad 6 a^2 b^3 c km1^2 ku1 - 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 \\
& \quad km1 ku1^2 - 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - 6 a^3 \\
& \quad d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3)^2 + \\
& \quad 4 (- (b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2)^2 + 3 a b dm1 \\
& \quad (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2))^3)) / \\
& (9 a b dm1 (-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - \\
& \quad 2 a^3 dm1^3 du2^3 - 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - \\
& \quad 3 a^3 b dm1^2 du2^2 km1 + 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + \\
& \quad 2 a^3 b^3 km1^3 - 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + \\
& \quad 3 a^2 b c dm1^2 du2^2 ku1 + 3 a b^3 c dm1 du1 km1 ku1 - \\
& \quad 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - 6 b^3 c^2 dm1 du1 ku1^2 + \\
& \quad 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - 2 b^3 c^3 ku1^3 + \\
& \quad 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - 6 a^3 d dm1^2 du2^2 ku2 - \\
& \quad 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - 6 a^3 b^2 d km1^2 ku2 - \\
& \quad 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - \\
& \quad 6 a^3 d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3 + \\
& \quad \sqrt{((-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - 2 a^3 dm1^3 du2^3 - \\
& \quad 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - 3 a^3 b dm1^2 du2^2 km1 + \\
& \quad 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - \\
& \quad 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + \\
& \quad 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - \\
& \quad 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - \\
& \quad 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - 6 a^3
\end{aligned}$$

$$\begin{aligned}
& d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3)^2 + \\
& 4 \left(- (b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2)^2 + 3 a b dm1 \right. \\
& \quad \left. (dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2) \right)^3 \Big)^{4/3} \Big) + \\
& \left(3 a b^2 d dm1^2 du1^2 + 6 a^2 b d dm1^2 du1 du2 - 6 a^3 d dm1^2 du2^2 - \right. \\
& \quad 6 \\
& \quad a^2 \\
& \quad b^2 \\
& \quad d \\
& \quad dm1 \\
& \quad du1 \\
& \quad km1 + 3 \\
& \quad a^3 \\
& \quad b \\
& \quad d \\
& \quad dm1 \\
& \quad du2 \\
& \quad km1 - 6 \\
& \quad a^3 \\
& \quad b^2 \\
& \quad d \\
& \quad km1^2 - 3 \\
& \quad a \\
& \quad b^2 \\
& \quad c \\
& \quad d \\
& \quad dm1 \\
& \quad du1 \\
& \quad ku1 - 3 \\
& \quad a^2 \\
& \quad b \\
& \quad c \\
& \quad d \\
& \quad dm1 \\
& \quad du2 \\
& \quad ku1 + 12 \\
& \quad a^2 \\
& \quad b^2 \\
& \quad c \\
& \quad d \\
& \quad km1 \\
& \quad ku1 - 6 \\
& \quad a \\
& \quad b^2 \\
& \quad c^2 \\
& \quad d \\
& \quad ku1^2 + 6 \\
& \quad a^2 \\
& \quad b \\
& \quad d^2 \\
& \quad dm1 \\
& \quad du1 \\
& \quad ku2 - 12 \\
& \quad a^3 \\
& \quad d^2 \\
& \quad dm1 \\
& \quad du2 \\
& \quad ku2 + 12
\end{aligned}$$

$$\begin{aligned}
& a^3 \\
& b \\
& d^2 \\
& km1 \\
& ku2 - 12 \\
& a^2 \\
& b \\
& c \\
& d^2 \\
& ku1 \\
& ku2 - 6 \\
& a^3 \\
& d^3 \\
& ku2^2 + \\
& \left(2 \left(3 a b^2 d dm1^2 du1^2 + 6 a^2 b d dm1^2 du1 du2 - 6 a^3 d dm1^2 du2^2 - 6 a^2 b^2 d dm1 du1 km1 + \right. \right. \\
& \quad 3 a^3 b d dm1 du2 km1 - 6 a^3 b^2 d km1^2 - 3 a b^2 c d dm1 du1 ku1 - 3 a^2 b c d dm1 du2 ku1 + \\
& \quad 12 a^2 b^2 c d km1 ku1 - 6 a b^2 c^2 d ku1^2 + 6 a^2 b d^2 dm1 du1 ku2 - \\
& \quad 12 a^3 d^2 dm1 du2 ku2 + 12 a^3 b d^2 km1 ku2 - 12 a^2 b c d^2 ku1 ku2 - 6 a^3 d^3 ku2^2 \Big) \\
& \quad \left(-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - 2 a^3 dm1^3 du2^3 - \right. \\
& \quad 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - 3 a^3 b dm1^2 du2^2 km1 + \\
& \quad 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - \\
& \quad 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + \\
& \quad 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - \\
& \quad 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - \\
& \quad 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - \\
& \quad 6 a^3 d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3 \Big) + \\
& \quad 12 \left(3 a b d dm1 du1 - 2 a d \left(b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2 \right) \right) \\
& \quad \left(- \left(b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2 \right)^2 + 3 a b dm1 \right. \\
& \quad \left. \left(dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2 \right) \right)^2 \Big) \Big) / \\
& \left(2 \sqrt{\left(\left(-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - 2 a^3 dm1^3 du2^3 - \right. \right. \right. \\
& \quad 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - 3 a^3 b dm1^2 du2^2 km1 + \\
& \quad 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - \\
& \quad 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + \\
& \quad 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - \\
& \quad 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - \\
& \quad 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 + \\
& \quad 12 a^2 b^2 c d km1 ku1 ku2 - 6 a b^2 c^2 d ku1^2 ku2 + 3 a^2 b d^2 dm1 du1 ku2^2 - \\
& \quad 6 a^3 d^2 dm1 du2 ku2^2 + 6 a^3 b d^2 km1 ku2^2 - 6 a^2 b c d^2 ku1 ku2^2 - 2 a^3 d^3 ku2^3 \Big)^2 + \\
& \quad 4 \left(- \left(b dm1 du1 + a dm1 du2 - a b km1 + b c ku1 + a d ku2 \right)^2 + 3 a b dm1 \right. \\
& \quad \left. \left(dm1 du1 du2 - b du1 km1 - a du2 km1 + c du2 ku1 + d du1 ku2 \right) \right)^3 \Big) \Big) / \\
& \left(9 \times 2^{1/3} a b dm1 \left(-2 b^3 dm1^3 du1^3 + 3 a b^2 dm1^3 du1^2 du2 + 3 a^2 b dm1^3 du1 du2^2 - \right. \right. \\
& \quad 2 a^3 dm1^3 du2^3 - 3 a b^3 dm1^2 du1^2 km1 + 12 a^2 b^2 dm1^2 du1 du2 km1 - \\
& \quad 3 a^3 b dm1^2 du2^2 km1 + 3 a^2 b^3 dm1 du1 km1^2 + 3 a^3 b^2 dm1 du2 km1^2 + 2 a^3 b^3 km1^3 - \\
& \quad 6 b^3 c dm1^2 du1^2 ku1 + 6 a b^2 c dm1^2 du1 du2 ku1 + 3 a^2 b c dm1^2 du2^2 ku1 + \\
& \quad 3 a b^3 c dm1 du1 km1 ku1 - 6 a^2 b^2 c dm1 du2 km1 ku1 - 6 a^2 b^3 c km1^2 ku1 - \\
& \quad 6 b^3 c^2 dm1 du1 ku1^2 + 3 a b^2 c^2 dm1 du2 ku1^2 + 6 a b^3 c^2 km1 ku1^2 - \\
& \quad 2 b^3 c^3 ku1^3 + 3 a b^2 d dm1^2 du1^2 ku2 + 6 a^2 b d dm1^2 du1 du2 ku2 - \\
& \quad 6 a^3 d dm1^2 du2^2 ku2 - 6 a^2 b^2 d dm1 du1 km1 ku2 + 3 a^3 b d dm1 du2 km1 ku2 - \\
& \quad 6 a^3 b^2 d km1^2 ku2 - 3 a b^2 c d dm1 du1 ku1 ku2 - 3 a^2 b c d dm1 du2 ku1 ku2 +
\end{aligned}$$

$$\begin{aligned}
& 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - \\
& 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 + \\
& \sqrt{\left((-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - 2 a^3 d m_1^3 d u_2^3 - \right. \\
& \quad 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - 3 a^3 b d m_1^2 d u_2^2 k m_1 + \\
& \quad 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - 6 a^3 \\
& \quad \left. d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 \right)^2 + \\
& \quad 4 \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + 3 a b d m_1 \right. \\
& \quad \left. (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right)^3 \Big)^{2/3} \Big) - \\
& \left(2^{1/3} (3 a b d d m_1 d u_1 - 2 a d (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)) \right) / \\
& \left(3 \right. \\
& \quad a \\
& \quad b \\
& \quad d m_1 \\
& \quad \left(-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - 2 a^3 d m_1^3 d u_2^3 - \right. \\
& \quad 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - 3 a^3 b d m_1^2 d u_2^2 k m_1 + \\
& \quad 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - \\
& \quad 6 a^3 d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 + \\
& \quad \sqrt{\left((-2 b^3 d m_1^3 d u_1^3 + 3 a b^2 d m_1^3 d u_1^2 d u_2 + 3 a^2 b d m_1^3 d u_1 d u_2^2 - 2 a^3 d m_1^3 d u_2^3 - \right. \\
& \quad 3 a b^3 d m_1^2 d u_1^2 k m_1 + 12 a^2 b^2 d m_1^2 d u_1 d u_2 k m_1 - 3 a^3 b d m_1^2 d u_2^2 k m_1 + \\
& \quad 3 a^2 b^3 d m_1 d u_1 k m_1^2 + 3 a^3 b^2 d m_1 d u_2 k m_1^2 + 2 a^3 b^3 k m_1^3 - \\
& \quad 6 b^3 c d m_1^2 d u_1^2 k u_1 + 6 a b^2 c d m_1^2 d u_1 d u_2 k u_1 + 3 a^2 b c d m_1^2 d u_2^2 k u_1 + \\
& \quad 3 a b^3 c d m_1 d u_1 k m_1 k u_1 - 6 a^2 b^2 c d m_1 d u_2 k m_1 k u_1 - 6 a^2 b^3 c k m_1^2 k u_1 - \\
& \quad 6 b^3 c^2 d m_1 d u_1 k u_1^2 + 3 a b^2 c^2 d m_1 d u_2 k u_1^2 + 6 a b^3 c^2 k m_1 k u_1^2 - \\
& \quad 2 b^3 c^3 k u_1^3 + 3 a b^2 d d m_1^2 d u_1^2 k u_2 + 6 a^2 b d d m_1^2 d u_1 d u_2 k u_2 - \\
& \quad 6 a^3 d d m_1^2 d u_2^2 k u_2 - 6 a^2 b^2 d d m_1 d u_1 k m_1 k u_2 + 3 a^3 b d d m_1 d u_2 k m_1 k u_2 - \\
& \quad 6 a^3 b^2 d k m_1^2 k u_2 - 3 a b^2 c d d m_1 d u_1 k u_1 k u_2 - 3 a^2 b c d d m_1 d u_2 k u_1 k u_2 + \\
& \quad 12 a^2 b^2 c d k m_1 k u_1 k u_2 - 6 a b^2 c^2 d k u_1^2 k u_2 + 3 a^2 b d^2 d m_1 d u_1 k u_2^2 - 6 a^3 \\
& \quad \left. d^2 d m_1 d u_2 k u_2^2 + 6 a^3 b d^2 k m_1 k u_2^2 - 6 a^2 b c d^2 k u_1 k u_2^2 - 2 a^3 d^3 k u_2^3 \right)^2 + \\
& \quad 4 \left(- (b d m_1 d u_1 + a d m_1 d u_2 - a b k m_1 + b c k u_1 + a d k u_2)^2 + 3 a b d m_1 \right. \\
& \quad \left. (d m_1 d u_1 d u_2 - b d u_1 k m_1 - a d u_2 k m_1 + c d u_2 k u_1 + d d u_1 k u_2) \right)^3 \Big)^{1/3} \Big)
\end{aligned}$$