Pensieve header: Figuring out polynomiality for the NOE1 program.

Initialization

```
SetDirectory["C:\\drorbn\\AcademicPensieve\\2016-12"];
Once[<< KnotTheory`];
Once[<< "../Projects/Profile/Profile.m"]
```

```
Loading KnotTheory` version of September 6, 2014, 13:37:37.2841.
Read more at http://katlas.org/wiki/KnotTheory.

This is Profile.m, Nov 2016 mods of July 1994 version
```

Rotational Virtual Knots

```
RVK::usage =
  "RVK[xs, rots] represents a Rotational Virtual Knot with a list of n Xp/Xm crossings xs and
    a length 2n list of rotation numbers rots. Crossing sites are indexed 1 through
    2n, and rots[[k]] is the rotation between site k-1 and site k. RVK is also a casting
    operator converting to the RVK presentation from other knot presentations.";
RVK[pd_PD] := Module[{n, xs, x, rots, front, k},
   n = Length[pd];
   xs = List @@ pd /. x_X :> If[PositiveQ[x], Xp[x[[4]], x[[1]]], Xm[x[[2]], x[[1]]]];
   rots = Table[0, {2 n}];
   front = {0};
   For[k = 0, k < 2 n, ++k,
    If[k == 0 \[Or] FreeQ[front, -k],
     front = Flatten[front /. k -> Catch[xs /. {
             Xp[k + 1, l_] | Xm[l_, k + 1] :> Throw[{l, k + 1, 1 - l}],
             Xp[l_, k + 1] | Xm[k + 1, l_] :> (++rots[[l]]; Throw[{1 - l, k + 1, l}])
            }]],
     If[MatchQ[front, {___, k, ___, -k, ___}], --rots[[k + 1]]
     ]
    ];
   RVK[xs, rots]
  ];
RVK[K_] := RVK[PD[K]];
```

NOE-1t

Warning: Logos may be disabled.

Logos

```
\[CapitalLambda][k_] := 0 ((t_k - 1) (2 (\[Alpha] \[Beta] + \[Delta] \[Mu])^2 - \[Alpha]^2 \[Beta]^2) - 4 v_k c_k w_k \[Delta]^2 \[Mu]^2 -
      \[Delta] (1 + \[Mu]) (w_k^2 \[Alpha]^2 + v_k^2 \[Beta]^2) - v_k^2 w_k^2 \[Delta]^3 (1 + 3 \[Mu]) -
      2 (\[Alpha] \[Beta] + 2 \[Delta] \[Mu] + v_k w_k \[Delta]^2 (1 + 2 \[Mu]) + 2 c_k \[Delta] \[Mu]^2) (w_k \[Alpha] + v_k \[Beta]) - 4 (c_k \[Mu]^2 + v_k w_k \[Delta] (1 + \[Mu])) (\[Alpha] \[Beta] + \[Delta] \[Mu])) (1 + t_k) / 4;
```

1Gens

```
R+_i_,j_ := \[DoubleStruckCapitalE][1, Log[t_i] c_j, v_i w_j, v_i c_i w_j + c_i c_j + v_i^2 w_j^2 / 4];
R-_i_,j_ := \[DoubleStruckCapitalE][1, -Log[t_i] c_j, -t_i^-1 v_i w_j, -c_i c_j + t_i^-1 v_i c_j w_j - t_i^-2 v_i^2 w_j^2 / 4];
(ur_i_ := \[DoubleStruckCapitalE][t_i^-1/2, 0, 0, c_i t_i^-2]; nr_i_ := \[DoubleStruckCapitalE][t_i^1/2, 0, 0, -c_i t_i^2];)
```

1DP

```
DP[x_→D[α_],y_→D[β_]][P_][f_] := (* means P[∂α,∂β][f] *)
 PP[DP]@Total[CoefficientRules[P, {x, y}] /. ({m_, n_} → c_) :↦ c D[f, {α, m}, {β, n}]]
```

1Util

```
𝔼 /: 𝔼[ω1_, L1_, Q1_, P1_] 𝔼[ω2_, L2_, Q2_, P2_] := CF@𝔼[ω1 ω2, L1 + L2, ω2 Q1 + ω1 Q2, ω2^4 P1 + ω1^4 P2];
```

1NOuw

```
N[w_i_ v_j_→k_][𝔼[ω_, L_, Q_, P_]] := PP[Nwv]@With[{q = ((1 - t_k) α β + β v_k + δ v_k w_k + α w_k) / μ},
    CF[𝔼[μ ω, L, μ ω q + μ (Q /. w_i | v_j → 0), μ^4 (DP[w_i→D[α],v_j→D[β]][P][e^q] /. e_ → 1) + ω^4 Λ[k]] /. μ → 1 + (t_k - 1) δ /.
     {α → ω^-1 (∂[w_i] Q /. v_j → 0), β → ω^-1 (∂[v_j] Q /. w_i → 0), δ → ω^-1 ∂[w_i,v_j] Q}]];
```

1NOc

```
N[c_j_ (x:v|w)_i_→k_][𝔼[ω_, L_, Q_, P_]] := PP[Ncx]@With[{q = e^γ β x_k + γ c_k},
    CF[𝔼[ω, γ c_k + (L /. c_j → 0), ω e^γ β x_k + (Q /. x_i → 0), e^-q DP[c_j→D[γ],x_i→D[β]][P][e^q]] /. {γ → ∂[c_j] L, β → ω^-1 ∂[x_i] Q}]];
```

1m

```
m[i_,j_→k_][Z_𝔼] := PP[m]@Module[{x, z},
   CF[(Z // N[w_i v_j→x] // N[c_i v_x→x] // N[w_x c_j→x]) /. z_(i|j|x) → z_k]]
```

Z

```
ul_ = nl_ = rot[_, 0] = 𝔼[1, 0, 0, 0];
rot[i_, 1] := ur_i;
rot[i_, n_Integer] /; n > 1 := Module[{y}, rot[i, n - 1] rot[y, 1] // m[i,y→i]];
rot[i_, -1] := nr_i;
rot[i_, n_Integer] /; n < -1 := Module[{y}, rot[i, n + 1] rot[y, -1] // m[i,y→i]];
```

```
t_ = t;
Z[K_] := Z[RVK@K];
Z[rvk_RVK] := PPz@Module[{todo, n, rots, ℰ, done, st, x, ℰ1, i, j, k, k1, k2, k3},
   {todo, rots} = List@@rvk;
   AppendTo[rots, 0];
   n = Length[todo];
   ℰ = 𝔼[1, 0, 0, 0];
   done = {0};
   st = Range[0, 2 n + 1];
   While[todo =!= {},
    {x} = MaximalBy[todo, Length[done ⋂ {#[[1]], #[[2]], #[[1]] - 1, #[[2]] - 1}] &, 1];
    Z$todo = todo; Z$x = x;
    {i, j} = List@@x;
    ℰ1 = Switch[Head[x],
       Xp, m_{j,k→j}[R+_{i,j} (R-_{k3,k} nr_{k1} ul_{k2} // m_{k,k1→k} // m_{k,k2→k} // m_{k,k3→k})],
       Xm, m_{j,k→j}[R-_{i,j} (R+_{k,k3} nr_{k1} ul_{k2} // m_{k,k1→k} // m_{k,k2→k} // m_{k,k3→k})]
     ];
    ℰ1 = rot[k, rots[[i]]] ℰ1 // m_{k,i→i}; rots[[i]] = 0;
    ℰ1 = ℰ1 rot[k, rots[[i + 1]]] // m_{i,k→i}; rots[[i + 1]] = 0;
    ℰ1 = rot[k, rots[[j]]] ℰ1 // m_{k,j→j}; rots[[j]] = 0;
    ℰ1 = ℰ1 rot[k, rots[[j + 1]]] // m_{j,k→j}; rots[[j + 1]] = 0;
    ℰ *= ℰ1;
    If[MemberQ[done, i], ℰ = ℰ // m_{i,i+1→i}; st = st /. st[[i + 2]] → st[[i + 1]]];
    If[MemberQ[done, i - 1], ℰ = ℰ // m_{st[[i]],i→st[[i]]}; st = st /. st[[i + 1]] → st[[i]]];
    If[MemberQ[done, j], ℰ = ℰ // m_{j,j+1→j}; st = st /. st[[j + 2]] → st[[j + 1]]];
    If[MemberQ[done, j - 1], ℰ = ℰ // m_{st[[j]],j→st[[j]]}; st = st /. st[[j + 1]] → st[[j]]];
    done = done ⋃ {i - 1, i, j - 1, j};
    todo = DeleteCases[todo, x]
   ];
   ℰ /. {v0 → v, c0 → c, w0 → w}
  ]
```

1Util

```
CF1[𝔼[ω_, L_, Q_, P_]] :=
  PPCF1@𝔼[Expand@Together@ω, Expand@Together@L, Expand@Together@Q, Expand@PPTogether4P@Together@P];
CF[𝔼[ω_, L_, Q_, P_]] := PPCF@𝔼[Factor@ω, Factor@L,
    PPCF4Q@Module[{vars},
      vars = Union@Cases[Q, (a | c | v | w)_, ∞];
      Total[CoefficientRules[Q, vars] /. (p_ → cc_) :> (PPFactor@Factor@cc) (Times @@ (vars^p))]],
    PPCF4P@Module[{vars},
      vars = Union@Cases[P, (a | c | v | w)_, ∞];
      Total[CoefficientRules[P, vars] /. (p_ → cc_) :> (PPFactor@Factor@cc) (Times @@ (vars^p))]]
   ];
```

```
Timing[Z[Knot[3, 1]]]
```

KnotTheory: Loading precomputed data in PD4Knots`.

$$\left\{1.64063,\ \mathbb{E}\left[\frac{1-t+t^2}{t},\ 0,\ 0,\ -\frac{2c\,(-1+t)\,(1+t)\,(1-t+t^2)^3}{t^4}+\frac{(-1+t)\,(1-t+t^2)^2\,(2-t+t^2)}{t^4}-\frac{2\,(1+t)\,(1-t+t^2)^3\,v\,w}{t^4}\right]\right\}$$

```
Timing[Z[Knot[4, 1]]]
```

$$\left\{0.734375,\ \mathbb{E}\left[-\frac{1-3t+t^2}{t},\ 0,\ 0,\ \frac{(-1+t)(1+t)(1-3t+t^2)^3}{t^4}-\frac{2c(-1+t)(1+t)(1-3t+t^2)^3}{t^4}-\frac{2(1+t)(1-3t+t^2)^3 vw}{t^4}\right]\right\}$$

```
Quuww = 𝔼[ω, Sum[l_{i,j} Log[t_i] c_j, {i, 3}, {j, 3}], Sum[a_{i,j} v_i w_j, {i, 3}, {j, 3}],
    Sum[a_{1000 i+100 j+10 k+k} v_i v_j w_k w_l, {i, 3}, {j, i, 3}, {k, 3}, {l, k, 3}]];
Quuww // N_{w_1 v_2→4}
```

$$\begin{aligned}
&\mathbb{E}\Big[\omega-a_{2,1}+t\,a_{2,1},\ \text{Log}[t]\ (c_1 l_{1,1}+c_2 l_{1,2}+c_3 l_{1,3}+c_1 l_{2,1}+c_2 l_{2,2}+c_3 l_{2,3}+c_1 l_{3,1}+c_2 l_{3,2}+c_3 l_{3,3}),\\
&v_1 w_4 a_{1,1}+v_4 w_4 a_{2,1}+v_4 w_2 a_{2,2}+\frac{v_1 w_2 (\omega a_{1,2}-a_{1,2}a_{2,1}+t\,a_{1,2}a_{2,1}+a_{1,1}a_{2,2}-t\,a_{1,1}a_{2,2})}{\omega}+\\
&v_4 w_3 a_{2,3}+\frac{v_1 w_3 (\omega a_{1,3}-a_{1,3}a_{2,1}+t\,a_{1,3}a_{2,1}+a_{1,1}a_{2,3}-t\,a_{1,1}a_{2,3})}{\omega}+v_3 w_4 a_{3,1}+\\
&\frac{v_3 w_2 (a_{2,2}a_{3,1}-t\,a_{2,2}a_{3,1}+\omega a_{3,2}-a_{2,1}a_{3,2}+t\,a_{2,1}a_{3,2})}{\omega}+\frac{v_3 w_3 (a_{2,3}a_{3,1}-t\,a_{2,3}a_{3,1}+\omega a_{3,3}-a_{2,1}a_{3,3}+t\,a_{2,1}a_{3,3})}{\omega},\\
&a_{2211}v_4^2 w_4^2-\frac{2(-1+t)a_{2211}v_1 v_4 w_4^2 a_{1,1}}{\omega}+\frac{(-1+t)^2 a_{2211}v_1^2 w_4^2 a_{1,1}^2}{\omega^2}-\frac{4(-1+t)a_{2211}v_4 w_4(\omega-a_{2,1}+t\,a_{2,1})}{\omega}+\\
&\frac{a_{1211}v_1 v_4 w_4^2(\omega-a_{2,1}+t\,a_{2,1})}{\omega}+\frac{a_{2311}v_3 v_4 w_4^2(\omega-a_{2,1}+t\,a_{2,1})}{\omega}+\frac{4(-1+t)^2 a_{2211}v_1 w_4 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})}{\omega^2}-\\
&\frac{(-1+t)a_{1211}v_1^2 w_4^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})}{\omega^2}-\frac{(-1+t)a_{2311}v_1 v_3 w_4^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})}{\omega^2}+\\
&\frac{2(-1+t)^2 a_{2211}(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}+\frac{a_{2222}v_4^2 w_2^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}+\frac{a_{2222}v_4^2 w_2 w_3(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}+\\
&\frac{a_{2233}v_4^2 w_3^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}-\frac{2(-1+t)a_{1211}v_1 w_4(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}-\frac{2(-1+t)a_{2311}v_3 w_4(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}+\\
&\frac{a_{1111}v_1^2 w_4^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}+\frac{a_{1311}v_1 v_3 w_4^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}+\frac{a_{3311}v_3^2 w_4^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^2}-\\
&\frac{2(-1+t)a_{2222}v_1 v_4 w_2^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^3}-\frac{2(-1+t)a_{2222}v_1 v_4 w_2 w_3 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^3}-\\
&\frac{2(-1+t)a_{2233}v_1 v_4 w_3^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^3}+\frac{(-1+t)^2 a_{2222}v_1^2 w_2^2 a_{1,1}^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^4}+\\
&\frac{(-1+t)^2 a_{2222}v_1^2 w_2 w_3 a_{1,1}^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^4}+\frac{(-1+t)^2 a_{2233}v_1^2 w_3^2 a_{1,1}^2(\omega-a_{2,1}+t\,a_{2,1})^2}{\omega^4}+\\
&\frac{a_{1222}v_1 v_4 w_2^2(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^3}+\frac{a_{2322}v_3 v_4 w_2^2(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^3}+\frac{a_{1222}v_1 v_4 w_2 w_3(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^3}+\\
&\frac{a_{2322}v_3 v_4 w_2 w_3(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^3}+\frac{a_{1233}v_1 v_4 w_3^2(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^3}+\frac{a_{2333}v_3 v_4 w_3^2(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^3}-\\
&\frac{(-1+t)a_{1222}v_1^2 w_2^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^4}-\frac{(-1+t)a_{2322}v_1 v_3 w_2^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^4}-\\
&\frac{(-1+t)a_{1222}v_1^2 w_2 w_3 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^4}-\frac{(-1+t)a_{2322}v_1 v_3 w_2 w_3 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^4}-\\
&\frac{(-1+t)a_{1233}v_1^2 w_3^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^4}-\frac{(-1+t)a_{2333}v_1 v_3 w_3^2 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1})^3}{\omega^4}+\\
&\frac{a_{1122}v_1^2 w_2^2(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\frac{a_{1322}v_1 v_3 w_2^2(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\frac{a_{3322}v_3^2 w_2^2(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\\
&\frac{a_{1122}v_1^2 w_2 w_3(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\frac{a_{1322}v_1 v_3 w_2 w_3(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\frac{a_{3322}v_3^2 w_2 w_3(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\\
&\frac{a_{1133}v_1^2 w_3^2(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\frac{a_{1333}v_1 v_3 w_3^2(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\frac{a_{3333}v_3^2 w_3^2(\omega-a_{2,1}+t\,a_{2,1})^4}{\omega^4}+\\
&\frac{a_{2211}v_4^2 w_2 w_4(\omega-a_{2,1}+t\,a_{2,1}+2a_{2,2}-2t\,a_{2,2})}{\omega}-\frac{2(-1+t)a_{2211}v_1 v_4 w_2 w_4 a_{1,1}(\omega-a_{2,1}+t\,a_{2,1}+2a_{2,2}-2t\,a_{2,2})}{\omega^2}+\\
&\frac{(-1+t)^2 a_{2211}v_1^2 w_2 w_4 a_{1,1}^2(\omega-a_{2,1}+t\,a_{2,1}+2a_{2,2}-2t\,a_{2,2})}{\omega^3}-\frac{1}{\omega^2}\\
&2(-1+t)a_{2211}v_4 w_2(\omega-a_{2,1}+t\,a_{2,1})(\omega-a_{2,1}+t\,a_{2,1}+2a_{2,2}-2t\,a_{2,2})+\\
&\frac{a_{1211}v_1 v_4 w_2 w_4(\omega-a_{2,1}+t\,a_{2,1})(\omega-a_{2,1}+t\,a_{2,1}+2a_{2,2}-2t\,a_{2,2})}{\omega^2}+
\end{aligned}$$

$$\frac{a_{2311}\,v_3\,v_4\,w_2\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)}{\omega^2}+\frac{1}{\omega^3}$$
$$2\,\left(-1+t\right)^2\,a_{2211}\,v_1\,w_2\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{1211}\,v_1^2\,w_2\,w_4\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{2311}\,v_1\,v_3\,w_2\,w_4\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)-$$
$$\frac{1}{\omega^3}\left(-1+t\right)\,a_{1211}\,v_1\,w_2\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{2311}\,v_3\,w_2\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)+$$
$$\frac{a_{1111}\,v_1^2\,w_2\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)}{\omega^3}+$$
$$\frac{a_{1311}\,v_1\,v_3\,w_2\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)}{\omega^3}+$$
$$\frac{a_{3311}\,v_3^2\,w_2\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,2}-2\,t\,a_{2,2}\right)}{\omega^3}-$$
$$\frac{\left(-1+t\right)\,a_{2211}\,v_4^2\,w_2^2\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)}{\omega^2}+$$
$$\frac{2\,\left(-1+t\right)^2\,a_{2211}\,v_1\,v_4\,w_2^2\,a_{1,1}\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)}{\omega^3}-$$
$$\frac{\left(-1+t\right)^3\,a_{2211}\,v_1^2\,w_2^2\,a_{1,1}^2\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)}{\omega^4}-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{1211}\,v_1\,v_4\,w_2^2\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{2311}\,v_3\,v_4\,w_2^2\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)+\frac{1}{\omega^4}$$
$$\left(-1+t\right)^2\,a_{1211}\,v_1^2\,w_2^2\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)+\frac{1}{\omega^4}$$
$$\left(-1+t\right)^2\,a_{2311}\,v_1\,v_3\,w_2^2\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)-$$
$$\frac{1}{\omega^4}\left(-1+t\right)\,a_{1111}\,v_1^2\,w_2^2\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)-\frac{1}{\omega^4}$$
$$\left(-1+t\right)\,a_{1311}\,v_1\,v_3\,w_2^2\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)-\frac{1}{\omega^4}$$
$$\left(-1+t\right)\,a_{3311}\,v_3^2\,w_2^2\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,a_{2,2}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,2}-t\,a_{2,2}\right)+$$
$$\frac{a_{2211}\,v_4^2\,w_3\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega}-\frac{2\,\left(-1+t\right)\,a_{2211}\,v_1\,v_4\,w_3\,w_4\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega^2}+$$
$$\frac{\left(-1+t\right)^2\,a_{2211}\,v_1^2\,w_3\,w_4\,a_{1,1}^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega^3}-\frac{1}{\omega^2}$$
$$2\,\left(-1+t\right)\,a_{2211}\,v_4\,w_3\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)+$$
$$\frac{a_{1211}\,v_1\,v_4\,w_3\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega^2}+$$
$$\frac{a_{2311}\,v_3\,v_4\,w_3\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega^2}+\frac{1}{\omega^3}$$
$$2\,\left(-1+t\right)^2\,a_{2211}\,v_1\,w_3\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{1211}\,v_1^2\,w_3\,w_4\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{2311}\,v_1\,v_3\,w_3\,w_4\,a_{1,1}\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)-$$
$$\frac{1}{\omega^3}\left(-1+t\right)\,a_{1211}\,v_1\,w_3\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)-\frac{1}{\omega^3}$$
$$\left(-1+t\right)\,a_{2311}\,v_3\,w_3\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)+$$
$$\frac{a_{1111}\,v_1^2\,w_3\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega^3}+$$
$$\frac{a_{1311}\,v_1\,v_3\,w_3\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega^3}+$$
$$\frac{a_{3311}\,v_3^2\,w_3\,w_4\,\left(\omega-a_{2,1}+t\,a_{2,1}\right)^2\,\left(\omega-a_{2,1}+t\,a_{2,1}+2\,a_{2,3}-2\,t\,a_{2,3}\right)}{\omega^3}-$$
$$\frac{\left(-1+t\right)\,a_{2211}\,v_4^2\,w_3^2\,a_{2,3}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,3}-t\,a_{2,3}\right)}{\omega^2}+$$
$$\frac{2\,\left(-1+t\right)^2\,a_{2211}\,v_1\,v_4\,w_3^2\,a_{1,1}\,a_{2,3}\,\left(\omega-a_{2,1}+t\,a_{2,1}+a_{2,3}-t\,a_{2,3}\right)}{\omega^3}-$$

$$\frac{(-1+t)^3\, a_{2211}\, v_1^2\, w_3^2\, a_{1,1}^2\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3})}{\omega^4} - \frac{1}{\omega^3}$$

$$(-1+t)\, a_{1211}\, v_1\, v_4\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3}) - \frac{1}{\omega^3}$$

$$(-1+t)\, a_{2311}\, v_3\, v_4\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3}) + \frac{1}{\omega^4}$$

$$(-1+t)^2\, a_{1211}\, v_1^2\, w_3^2\, a_{1,1}\, (\omega - a_{2,1} + t\, a_{2,1})\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3}) + \frac{1}{\omega^4}$$

$$(-1+t)^2\, a_{2311}\, v_1\, v_3\, w_3^2\, a_{1,1}\, (\omega - a_{2,1} + t\, a_{2,1})\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3}) -$$

$$\frac{1}{\omega^4}(-1+t)\, a_{1111}\, v_1^2\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3}) - \frac{1}{\omega^4}$$

$$(-1+t)\, a_{1311}\, v_1\, v_3\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3}) - \frac{1}{\omega^4}$$

$$(-1+t)\, a_{3311}\, v_3^2\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{2,3}\, (\omega - a_{2,1} + t\, a_{2,1} + a_{2,3} - t\, a_{2,3}) - \frac{1}{\omega^2}$$

$$(-1+t)\, a_{2211}\, v_4^2\, w_2\, w_3\, (\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) + \frac{1}{\omega^3}$$

$$2\,(-1+t)^2\, a_{2211}\, v_1\, v_4\, w_2\, w_3\, a_{1,1}\, (\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) -$$

$$\frac{1}{\omega^4}(-1+t)^3\, a_{2211}\, v_1^2\, w_2\, w_3\, a_{1,1}^2\, (\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) -$$

$$\frac{1}{\omega^3}(-1+t)\, a_{1211}\, v_1\, v_4\, w_2\, w_3\, (\omega - a_{2,1} + t\, a_{2,1})$$

$$(\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) - \frac{1}{\omega^3}(-1+t)\, a_{2311}\, v_3\, v_4$$

$$w_2\, w_3\, (\omega - a_{2,1} + t\, a_{2,1})\, (\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) +$$

$$\frac{1}{\omega^4}(-1+t)^2\, a_{1211}\, v_1^2\, w_2\, w_3\, a_{1,1}\, (\omega - a_{2,1} + t\, a_{2,1})$$

$$(\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) + \frac{1}{\omega^4}(-1+t)^2\, a_{2311}\, v_1\, v_3\, w_2\, w_3\, a_{1,1}$$

$$(\omega - a_{2,1} + t\, a_{2,1})\, (\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) - \frac{1}{\omega^4}(-1+t)$$

$$a_{1111}\, v_1^2\, w_2\, w_3\, (\omega - a_{2,1} + t\, a_{2,1})^2\, (\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) -$$

$$\frac{1}{\omega^4}(-1+t)\, a_{1311}\, v_1\, v_3\, w_2\, w_3\, (\omega - a_{2,1} + t\, a_{2,1})^2$$

$$(\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) - \frac{1}{\omega^4}(-1+t)\, a_{3311}\, v_3^2\, w_2$$

$$w_3\, (\omega - a_{2,1} + t\, a_{2,1})^2\, (\omega\, a_{2,2} - a_{2,1}\, a_{2,2} + t\, a_{2,1}\, a_{2,2} + \omega\, a_{2,3} - a_{2,1}\, a_{2,3} + t\, a_{2,1}\, a_{2,3} + 2\, a_{2,2}\, a_{2,3} - 2\, t\, a_{2,2}\, a_{2,3}) -$$

$$\frac{2\,(-1+t)\, a_{2211}\, v_3\, v_4\, w_4^2\, a_{3,1}}{\omega} + \frac{2\,(-1+t)^2\, a_{2211}\, v_1\, v_3\, w_4^2\, a_{1,1}\, a_{3,1}}{\omega^2} + \frac{4\,(-1+t)^2\, a_{2211}\, v_3\, w_4\, (\omega - a_{2,1} + t\, a_{2,1})\, a_{3,1}}{\omega^2} -$$

$$\frac{(-1+t)\, a_{1211}\, v_1\, v_3\, w_4^2\, (\omega - a_{2,1} + t\, a_{2,1})\, a_{3,1}}{\omega^2} - \frac{(-1+t)\, a_{2311}\, v_3^2\, w_4^2\, (\omega - a_{2,1} + t\, a_{2,1})\, a_{3,1}}{\omega^2} -$$

$$\frac{2\,(-1+t)\, a_{2222}\, v_3\, v_4\, w_2^2\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{3,1}}{\omega^3} - \frac{2\,(-1+t)\, a_{2222}\, v_3\, v_4\, w_2\, w_3\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{3,1}}{\omega^3} -$$

$$\frac{2\,(-1+t)\, a_{2233}\, v_3\, v_4\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{3,1}}{\omega^3} + \frac{2\,(-1+t)^2\, a_{2222}\, v_1\, v_3\, w_2^2\, a_{1,1}\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{3,1}}{\omega^4} +$$

$$\frac{2\,(-1+t)^2\, a_{2222}\, v_1\, v_3\, w_2\, w_3\, a_{1,1}\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{3,1}}{\omega^4} + \frac{2\,(-1+t)^2\, a_{2233}\, v_1\, v_3\, w_3^2\, a_{1,1}\, (\omega - a_{2,1} + t\, a_{2,1})^2\, a_{3,1}}{\omega^4} -$$

$$\frac{(-1+t)\, a_{1222}\, v_1\, v_3\, w_2^2\, (\omega - a_{2,1} + t\, a_{2,1})^3\, a_{3,1}}{\omega^4} - \frac{(-1+t)\, a_{2322}\, v_3^2\, w_2^2\, (\omega - a_{2,1} + t\, a_{2,1})^3\, a_{3,1}}{\omega^4} -$$

$$\frac{(-1+t)\, a_{1222}\, v_1\, v_3\, w_2\, w_3\, (\omega - a_{2,1} + t\, a_{2,1})^3\, a_{3,1}}{\omega^4} - \frac{(-1+t)\, a_{2322}\, v_3^2\, w_2\, w_3\, (\omega - a_{2,1} + t\, a_{2,1})^3\, a_{3,1}}{\omega^4} -$$

$$\frac{(-1+t)\, a_{1233}\, v_1\, v_3\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})^3\, a_{3,1}}{\omega^4} - \frac{(-1+t)\, a_{2333}\, v_3^2\, w_3^2\, (\omega - a_{2,1} + t\, a_{2,1})^3\, a_{3,1}}{\omega^4} -$$

$$\frac{2\,(-1+t)\, a_{2211}\, v_3\, v_4\, w_2\, w_4\, (\omega - a_{2,1} + t\, a_{2,1} + 2\, a_{2,2} - 2\, t\, a_{2,2})\, a_{3,1}}{\omega^2} +$$

$$\frac{2\,(-1+t)^2\, a_{2211}\, v_1\, v_3\, w_2\, w_4\, a_{1,1}\, (\omega - a_{2,1} + t\, a_{2,1} + 2\, a_{2,2} - 2\, t\, a_{2,2})\, a_{3,1}}{\omega^3} + \frac{1}{\omega^3}$$

$$2\,(-1+t)^2\, a_{2211}\, v_3\, w_2\, (\omega - a_{2,1} + t\, a_{2,1})\, (\omega - a_{2,1} + t\, a_{2,1} + 2\, a_{2,2} - 2\, t\, a_{2,2})\, a_{3,1} - \frac{1}{\omega^3}$$

$$(-1+t)\, a_{1211}\, v_1\, v_3\, w_2\, w_4\, (\omega - a_{2,1} + t\, a_{2,1})\, (\omega - a_{2,1} + t\, a_{2,1} + 2\, a_{2,2} - 2\, t\, a_{2,2})\, a_{3,1} -$$

$$\frac{1}{\omega^3}(-1+t)\, a_{2311}\, v_3^2\, w_2\, w_4\, (\omega - a_{2,1} + t\, a_{2,1})\, (\omega - a_{2,1} + t\, a_{2,1} + 2\, a_{2,2} - 2\, t\, a_{2,2})\, a_{3,1} +$$

$$\frac{2\left(-1+t\right)^2 a_{2211}\, v_3\, v_4\, w_2^2\, a_{2,2}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,2}-t\, a_{2,2}\right) a_{3,1}}{\omega^3} -$$

$$\frac{2\left(-1+t\right)^3 a_{2211}\, v_1\, v_3\, w_2^2\, a_{1,1}\, a_{2,2}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,2}-t\, a_{2,2}\right) a_{3,1}}{\omega^4} + \frac{1}{\omega^4}$$

$$\left(-1+t\right)^2 a_{1211}\, v_1\, v_3\, w_2^2\left(\omega-a_{2,1}+t\, a_{2,1}\right) a_{2,2}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,2}-t\, a_{2,2}\right) a_{3,1} + \frac{1}{\omega^4}$$

$$\left(-1+t\right)^2 a_{2311}\, v_3^2\, w_2^2\left(\omega-a_{2,1}+t\, a_{2,1}\right) a_{2,2}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,2}-t\, a_{2,2}\right) a_{3,1} -$$

$$\frac{2\left(-1+t\right) a_{2211}\, v_3\, v_4\, w_3\, w_4\left(\omega-a_{2,1}+t\, a_{2,1}+2\, a_{2,3}-2\, t\, a_{2,3}\right) a_{3,1}}{\omega^2} +$$

$$\frac{2\left(-1+t\right)^2 a_{2211}\, v_1\, v_3\, w_3\, w_4\, a_{1,1}\left(\omega-a_{2,1}+t\, a_{2,1}+2\, a_{2,3}-2\, t\, a_{2,3}\right) a_{3,1}}{\omega^3} + \frac{1}{\omega^3}$$

$$2\left(-1+t\right)^2 a_{2211}\, v_3\, w_3\left(\omega-a_{2,1}+t\, a_{2,1}\right)\left(\omega-a_{2,1}+t\, a_{2,1}+2\, a_{2,3}-2\, t\, a_{2,3}\right) a_{3,1} - \frac{1}{\omega^3}$$

$$\left(-1+t\right) a_{1211}\, v_1\, v_3\, w_3\, w_4\left(\omega-a_{2,1}+t\, a_{2,1}\right)\left(\omega-a_{2,1}+t\, a_{2,1}+2\, a_{2,3}-2\, t\, a_{2,3}\right) a_{3,1} -$$

$$\frac{1}{\omega^3}\left(-1+t\right) a_{2311}\, v_3^2\, w_3\, w_4\left(\omega-a_{2,1}+t\, a_{2,1}\right)\left(\omega-a_{2,1}+t\, a_{2,1}+2\, a_{2,3}-2\, t\, a_{2,3}\right) a_{3,1} +$$

$$\frac{2\left(-1+t\right)^2 a_{2211}\, v_3\, v_4\, w_3^2\, a_{2,3}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,3}-t\, a_{2,3}\right) a_{3,1}}{\omega^3} -$$

$$\frac{2\left(-1+t\right)^3 a_{2211}\, v_1\, v_3\, w_3^2\, a_{1,1}\, a_{2,3}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,3}-t\, a_{2,3}\right) a_{3,1}}{\omega^4} + \frac{1}{\omega^4}$$

$$\left(-1+t\right)^2 a_{1211}\, v_1\, v_3\, w_3^2\left(\omega-a_{2,1}+t\, a_{2,1}\right) a_{2,3}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,3}-t\, a_{2,3}\right) a_{3,1} + \frac{1}{\omega^4}$$

$$\left(-1+t\right)^2 a_{2311}\, v_3^2\, w_3^2\left(\omega-a_{2,1}+t\, a_{2,1}\right) a_{2,3}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,3}-t\, a_{2,3}\right) a_{3,1} + \frac{1}{\omega^3}$$

$$2\left(-1+t\right)^2 a_{2211}\, v_3\, v_4\, w_2\, w_3\left(\omega\, a_{2,2}-a_{2,1}\, a_{2,2}+t\, a_{2,1}\, a_{2,2}+\omega\, a_{2,3}-a_{2,1}\, a_{2,3}+t\, a_{2,1}\, a_{2,3}+2\, a_{2,2}\, a_{2,3}-2\, t\, a_{2,2}\, a_{2,3}\right) a_{3,1} -$$

$$\frac{1}{\omega^4} 2\left(-1+t\right)^3 a_{2211}\, v_1\, v_3\, w_2\, w_3\, a_{1,1}\left(\omega\, a_{2,2}-a_{2,1}\, a_{2,2}+t\, a_{2,1}\, a_{2,2}+\omega\, a_{2,3}-a_{2,1}\, a_{2,3}+t\, a_{2,1}\, a_{2,3}+2\, a_{2,2}\, a_{2,3}-2\, t\, a_{2,2}\, a_{2,3}\right)$$

$$a_{3,1} + \frac{1}{\omega^4}\left(-1+t\right)^2 a_{1211}\, v_1\, v_3\, w_2\, w_3\left(\omega-a_{2,1}+t\, a_{2,1}\right)$$

$$\left(\omega\, a_{2,2}-a_{2,1}\, a_{2,2}+t\, a_{2,1}\, a_{2,2}+\omega\, a_{2,3}-a_{2,1}\, a_{2,3}+t\, a_{2,1}\, a_{2,3}+2\, a_{2,2}\, a_{2,3}-2\, t\, a_{2,2}\, a_{2,3}\right) a_{3,1} + \frac{1}{\omega^4}\left(-1+t\right)^2 a_{2311}\, v_3^2$$

$$w_2\, w_3\left(\omega-a_{2,1}+t\, a_{2,1}\right)\left(\omega\, a_{2,2}-a_{2,1}\, a_{2,2}+t\, a_{2,1}\, a_{2,2}+\omega\, a_{2,3}-a_{2,1}\, a_{2,3}+t\, a_{2,1}\, a_{2,3}+2\, a_{2,2}\, a_{2,3}-2\, t\, a_{2,2}\, a_{2,3}\right) a_{3,1} +$$

$$\frac{\left(-1+t\right)^2 a_{2211}\, v_3^2\, w_4^2\, a_{3,1}^2}{\omega^2} + \frac{\left(-1+t\right)^2 a_{2222}\, v_3^2\, w_2^2\left(\omega-a_{2,1}+t\, a_{2,1}\right)^2 a_{3,1}^2}{\omega^4} + \frac{\left(-1+t\right)^2 a_{2222}\, v_3^2\, w_2\, w_3\left(\omega-a_{2,1}+t\, a_{2,1}\right)^2 a_{3,1}^2}{\omega^4} +$$

$$\frac{\left(-1+t\right)^2 a_{2233}\, v_3^2\, w_3^2\left(\omega-a_{2,1}+t\, a_{2,1}\right)^2 a_{3,1}^2}{\omega^4} + \frac{\left(-1+t\right)^2 a_{2211}\, v_3^2\, w_2\, w_4\left(\omega-a_{2,1}+t\, a_{2,1}+2\, a_{2,2}-2\, t\, a_{2,2}\right) a_{3,1}^2}{\omega^3} -$$

$$\frac{\left(-1+t\right)^3 a_{2211}\, v_3^2\, w_2^2\, a_{2,2}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,2}-t\, a_{2,2}\right) a_{3,1}^2}{\omega^4} +$$

$$\frac{\left(-1+t\right)^2 a_{2211}\, v_3^2\, w_3\, w_4\left(\omega-a_{2,1}+t\, a_{2,1}+2\, a_{2,3}-2\, t\, a_{2,3}\right) a_{3,1}^2}{\omega^3} -$$

$$\frac{\left(-1+t\right)^3 a_{2211}\, v_3^2\, w_3^2\, a_{2,3}\left(\omega-a_{2,1}+t\, a_{2,1}+a_{2,3}-t\, a_{2,3}\right) a_{3,1}^2}{\omega^4} - \frac{1}{\omega^4}$$

$$\left(-1+t\right)^3 a_{2211}\, v_3^2\, w_2\, w_3\left(\omega\, a_{2,2}-a_{2,1}\, a_{2,2}+t\, a_{2,1}\, a_{2,2}+\omega\, a_{2,3}-a_{2,1}\, a_{2,3}+t\, a_{2,1}\, a_{2,3}+2\, a_{2,2}\, a_{2,3}-2\, t\, a_{2,2}\, a_{2,3}\right) a_{3,1}^2\Big]$$

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Quuww = 𝔼[ω, Sum[l_{i,j} Log[t_i] c_j, {i, 3}, {j, 3}], Sum[a_{i,j} v_i w_j, {i, 3}, {j, 3}],
    Sum[a_{1000 i+100 j+10 k+k} v_i v_j w_k w_l, {i, 3}, {j, 3}, {k, 3}, {l, 3}]];
Quuww // m_{1,2→4}
```