

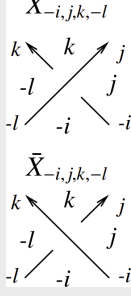
Pensieve header: Analyzing Reidemeister moves by hand.

```
In[ ]:= SetDirectory["C:\\drorbn\\AcademicPensieve\\Projects\\Semi-Seifert"];
<< ../HigherRank/FormalGaussianIntegration.m
```

The Quadratic

Matrices from SSAlexander4Tangles.nb

In[]:=



$$M = \begin{pmatrix} -1 & -1 & 2 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & -1 & 0 \\ 1 & 0 & -1 & 0 \end{pmatrix};$$

$$\bar{M} = \begin{pmatrix} 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -2 & 1 & 1 & 0 \\ 1 & 0 & -1 & 0 \end{pmatrix};$$

```
In[ ]:= Qi_-,j_-,k_-,l_ := {p_i, p_j, p_k, p_l} . (t M - t^-1 M^T) . {x_i, x_j, x_k, x_l};
Q_bar_i_-,j_-,k_-,l_ := {p_i, p_j, p_k, p_l} . (t M_bar - t^-1 M_bar^T) . {x_i, x_j, x_k, x_l};
xp_S_ := Flatten[Table[{x_i, p_i}, {i, S}]]
```

```
In[ ]:= mons_i_-,j_-,k_-,l_ :=
  MonomialList[(x_i + x_j + x_k + x_l)^2 (p_i + p_j + p_k + p_l)^2 + (x_i + x_j + x_k + x_l) (p_i + p_j + p_k + p_l) + 1] /.
  {2 x_ -> x, 4 x_ -> x};
mons_1,2,3,4
```

```
Out[ ]:= {p_1^2 x_1^2, p_1^2 x_1 x_2, p_1^2 x_1 x_3, p_1^2 x_1 x_4, p_1^2 x_2^2, p_1^2 x_2 x_3, p_1^2 x_2 x_4, p_1^2 x_3^2, p_1^2 x_3 x_4, p_1^2 x_4^2, p_1 p_2 x_1^2,
p_1 p_2 x_1 x_2, p_1 p_2 x_1 x_3, p_1 p_2 x_1 x_4, p_1 p_2 x_2^2, p_1 p_2 x_2 x_3, p_1 p_2 x_2 x_4, p_1 p_2 x_3^2, p_1 p_2 x_3 x_4,
p_1 p_2 x_4^2, p_1 p_3 x_1^2, p_1 p_3 x_1 x_2, p_1 p_3 x_1 x_3, p_1 p_3 x_1 x_4, p_1 p_3 x_2^2, p_1 p_3 x_2 x_3, p_1 p_3 x_2 x_4, p_1 p_3 x_3^2,
p_1 p_3 x_3 x_4, p_1 p_3 x_4^2, p_1 p_4 x_1^2, p_1 p_4 x_1 x_2, p_1 p_4 x_1 x_3, p_1 p_4 x_1 x_4, p_1 p_4 x_2^2, p_1 p_4 x_2 x_3,
p_1 p_4 x_2 x_4, p_1 p_4 x_3^2, p_1 p_4 x_3 x_4, p_1 p_4 x_4^2, p_1 x_1, p_1 x_2, p_1 x_3, p_1 x_4, p_2^2 x_1^2, p_2^2 x_1 x_2, p_2^2 x_1 x_3,
p_2^2 x_1 x_4, p_2^2 x_2^2, p_2^2 x_2 x_3, p_2^2 x_2 x_4, p_2^2 x_3^2, p_2^2 x_3 x_4, p_2^2 x_4^2, p_2 p_3 x_1^2, p_2 p_3 x_1 x_2, p_2 p_3 x_1 x_3,
p_2 p_3 x_1 x_4, p_2 p_3 x_2^2, p_2 p_3 x_2 x_3, p_2 p_3 x_2 x_4, p_2 p_3 x_3^2, p_2 p_3 x_3 x_4, p_2 p_3 x_4^2, p_2 p_4 x_1^2,
p_2 p_4 x_1 x_2, p_2 p_4 x_1 x_3, p_2 p_4 x_1 x_4, p_2 p_4 x_2^2, p_2 p_4 x_2 x_3, p_2 p_4 x_2 x_4, p_2 p_4 x_3^2, p_2 p_4 x_3 x_4,
p_2 p_4 x_4^2, p_2 x_1, p_2 x_2, p_2 x_3, p_2 x_4, p_3^2 x_1^2, p_3^2 x_1 x_2, p_3^2 x_1 x_3, p_3^2 x_1 x_4, p_3^2 x_2^2, p_3^2 x_2 x_3, p_3^2 x_2 x_4,
p_3^2 x_3^2, p_3^2 x_3 x_4, p_3^2 x_4^2, p_3 p_4 x_1^2, p_3 p_4 x_1 x_2, p_3 p_4 x_1 x_3, p_3 p_4 x_1 x_4, p_3 p_4 x_2^2, p_3 p_4 x_2 x_3,
p_3 p_4 x_2 x_4, p_3 p_4 x_3^2, p_3 p_4 x_3 x_4, p_3 p_4 x_4^2, p_3 x_1, p_3 x_2, p_3 x_3, p_3 x_4, p_4^2 x_1^2, p_4^2 x_1 x_2, p_4^2 x_1 x_3,
p_4^2 x_1 x_4, p_4^2 x_2^2, p_4^2 x_2 x_3, p_4^2 x_2 x_4, p_4^2 x_3^2, p_4^2 x_3 x_4, p_4^2 x_4^2, p_4 x_1, p_4 x_2, p_4 x_3, p_4 x_4, 1}
```

In[*]:= **Q**_{i,j,k,1} + **ε** Sum[**α**_z **mons**_{i,j,k,1}[[**z**]], {**z**, Length[**mons**_{i,j,k,1}]}]

Out[*]=

$$\begin{aligned}
 & \left(\left(\frac{1}{t} - t \right) p_i + \frac{p_j}{t} - \frac{2 p_k}{t} + t p_1 \right) x_i + (-t p_i + t p_k) x_j + \\
 & \left(2 t p_i - \frac{p_j}{t} + \left(\frac{1}{t} - t \right) p_k - t p_1 \right) x_k + \left(-\frac{p_i}{t} + \frac{p_k}{t} \right) x_1 + \\
 & \in \left(p_1^2 x_i^2 \alpha_1 + p_1^2 x_i x_j \alpha_2 + p_1^2 x_i x_k \alpha_3 + p_1^2 x_i x_1 \alpha_4 + p_1^2 x_j^2 \alpha_5 + p_1^2 x_j x_k \alpha_6 + p_1^2 x_j x_1 \alpha_7 + p_1^2 x_k^2 \alpha_8 + \right. \\
 & p_1^2 x_k x_1 \alpha_9 + p_1^2 x_1^2 \alpha_{10} + p_i p_j x_i^2 \alpha_{11} + p_i p_j x_i x_j \alpha_{12} + p_i p_j x_i x_k \alpha_{13} + p_i p_j x_i x_1 \alpha_{14} + p_i p_j x_j^2 \alpha_{15} + \\
 & p_i p_j x_j x_k \alpha_{16} + p_i p_j x_j x_1 \alpha_{17} + p_i p_j x_k^2 \alpha_{18} + p_i p_j x_k x_1 \alpha_{19} + p_i p_j x_1^2 \alpha_{20} + p_i p_k x_i^2 \alpha_{21} + \\
 & p_i p_k x_i x_j \alpha_{22} + p_i p_k x_i x_k \alpha_{23} + p_i p_k x_i x_1 \alpha_{24} + p_i p_k x_j^2 \alpha_{25} + p_i p_k x_j x_k \alpha_{26} + p_i p_k x_j x_1 \alpha_{27} + \\
 & p_i p_k x_k^2 \alpha_{28} + p_i p_k x_k x_1 \alpha_{29} + p_i p_k x_1^2 \alpha_{30} + p_i p_1 x_i^2 \alpha_{31} + p_i p_1 x_i x_j \alpha_{32} + p_i p_1 x_i x_k \alpha_{33} + \\
 & p_i p_1 x_i x_1 \alpha_{34} + p_i p_1 x_j^2 \alpha_{35} + p_i p_1 x_j x_k \alpha_{36} + p_i p_1 x_j x_1 \alpha_{37} + p_i p_1 x_k^2 \alpha_{38} + p_i p_1 x_k x_1 \alpha_{39} + \\
 & p_i p_1 x_1^2 \alpha_{40} + p_i x_i \alpha_{41} + p_i x_j \alpha_{42} + p_i x_k \alpha_{43} + p_i x_1 \alpha_{44} + p_j^2 x_i^2 \alpha_{45} + p_j^2 x_i x_j \alpha_{46} + p_j^2 x_i x_k \alpha_{47} + \\
 & p_j^2 x_i x_1 \alpha_{48} + p_j^2 x_j^2 \alpha_{49} + p_j^2 x_j x_k \alpha_{50} + p_j^2 x_j x_1 \alpha_{51} + p_j^2 x_k^2 \alpha_{52} + p_j^2 x_k x_1 \alpha_{53} + p_j^2 x_1^2 \alpha_{54} + p_j p_k x_i^2 \alpha_{55} + \\
 & p_j p_k x_i x_j \alpha_{56} + p_j p_k x_i x_k \alpha_{57} + p_j p_k x_i x_1 \alpha_{58} + p_j p_k x_j^2 \alpha_{59} + p_j p_k x_j x_k \alpha_{60} + p_j p_k x_j x_1 \alpha_{61} + \\
 & p_j p_k x_k^2 \alpha_{62} + p_j p_k x_k x_1 \alpha_{63} + p_j p_k x_1^2 \alpha_{64} + p_j p_1 x_i^2 \alpha_{65} + p_j p_1 x_i x_j \alpha_{66} + p_j p_1 x_i x_k \alpha_{67} + \\
 & p_j p_1 x_i x_1 \alpha_{68} + p_j p_1 x_j^2 \alpha_{69} + p_j p_1 x_j x_k \alpha_{70} + p_j p_1 x_j x_1 \alpha_{71} + p_j p_1 x_k^2 \alpha_{72} + p_j p_1 x_k x_1 \alpha_{73} + \\
 & p_j p_1 x_1^2 \alpha_{74} + p_j x_i \alpha_{75} + p_j x_j \alpha_{76} + p_j x_k \alpha_{77} + p_j x_1 \alpha_{78} + p_k^2 x_i^2 \alpha_{79} + p_k^2 x_i x_j \alpha_{80} + p_k^2 x_i x_k \alpha_{81} + \\
 & p_k^2 x_i x_1 \alpha_{82} + p_k^2 x_j^2 \alpha_{83} + p_k^2 x_j x_k \alpha_{84} + p_k^2 x_j x_1 \alpha_{85} + p_k^2 x_k^2 \alpha_{86} + p_k^2 x_k x_1 \alpha_{87} + p_k^2 x_1^2 \alpha_{88} + p_k p_1 x_i^2 \alpha_{89} + \\
 & p_k p_1 x_i x_j \alpha_{90} + p_k p_1 x_i x_k \alpha_{91} + p_k p_1 x_i x_1 \alpha_{92} + p_k p_1 x_j^2 \alpha_{93} + p_k p_1 x_j x_k \alpha_{94} + p_k p_1 x_j x_1 \alpha_{95} + \\
 & p_k p_1 x_k^2 \alpha_{96} + p_k p_1 x_k x_1 \alpha_{97} + p_k p_1 x_1^2 \alpha_{98} + p_k x_i \alpha_{99} + p_k x_j \alpha_{100} + p_k x_k \alpha_{101} + p_k x_1 \alpha_{102} + \\
 & p_1^2 x_i^2 \alpha_{103} + p_1^2 x_i x_j \alpha_{104} + p_1^2 x_i x_k \alpha_{105} + p_1^2 x_i x_1 \alpha_{106} + p_1^2 x_j^2 \alpha_{107} + p_1^2 x_j x_k \alpha_{108} + p_1^2 x_j x_1 \alpha_{109} + \\
 & p_1^2 x_k^2 \alpha_{110} + p_1^2 x_k x_1 \alpha_{111} + p_1^2 x_1^2 \alpha_{112} + p_1 x_i \alpha_{113} + p_1 x_j \alpha_{114} + p_1 x_k \alpha_{115} + p_1 x_1 \alpha_{116} + \alpha_{117} \Big)
 \end{aligned}$$

$$\begin{aligned}
In[*] := & \text{QP}_{i_-, j_-, k_-, l_-} := \left(\left(\frac{1}{t} - t \right) p_i + \frac{p_j}{t} - \frac{2 p_k}{t} + t p_l \right) x_i + \\
& (-t p_i + t p_k) x_j + \left(2 t p_i - \frac{p_j}{t} + \left(\frac{1}{t} - t \right) p_k - t p_l \right) x_k + \left(-\frac{p_i}{t} + \frac{p_k}{t} \right) x_l + \\
& \in \left(p_i^2 x_i^2 \alpha_1 + p_i^2 x_i x_j \alpha_2 + p_i^2 x_i x_k \alpha_3 + p_i^2 x_i x_l \alpha_4 + p_i^2 x_j^2 \alpha_5 + p_i^2 x_j x_k \alpha_6 + p_i^2 x_j x_l \alpha_7 + p_i^2 x_k^2 \alpha_8 + \right. \\
& p_i^2 x_k x_l \alpha_9 + p_i^2 x_l^2 \alpha_{10} + p_i p_j x_i^2 \alpha_{11} + p_i p_j x_i x_j \alpha_{12} + p_i p_j x_i x_k \alpha_{13} + p_i p_j x_i x_l \alpha_{14} + \\
& p_i p_j x_j^2 \alpha_{15} + p_i p_j x_j x_k \alpha_{16} + p_i p_j x_j x_l \alpha_{17} + p_i p_j x_k^2 \alpha_{18} + p_i p_j x_k x_l \alpha_{19} + p_i p_j x_l^2 \alpha_{20} + \\
& p_i p_k x_i^2 \alpha_{21} + p_i p_k x_i x_j \alpha_{22} + p_i p_k x_i x_k \alpha_{23} + p_i p_k x_i x_l \alpha_{24} + p_i p_k x_j^2 \alpha_{25} + p_i p_k x_j x_k \alpha_{26} + \\
& p_i p_k x_j x_l \alpha_{27} + p_i p_k x_k^2 \alpha_{28} + p_i p_k x_k x_l \alpha_{29} + p_i p_k x_l^2 \alpha_{30} + p_i p_l x_i^2 \alpha_{31} + p_i p_l x_i x_j \alpha_{32} + \\
& p_i p_l x_i x_k \alpha_{33} + p_i p_l x_i x_l \alpha_{34} + p_i p_l x_j^2 \alpha_{35} + p_i p_l x_j x_k \alpha_{36} + p_i p_l x_j x_l \alpha_{37} + p_i p_l x_k^2 \alpha_{38} + \\
& p_i p_l x_k x_l \alpha_{39} + p_i p_l x_l^2 \alpha_{40} + p_i x_i \alpha_{41} + p_i x_j \alpha_{42} + p_i x_k \alpha_{43} + p_i x_l \alpha_{44} + p_j^2 x_i^2 \alpha_{45} + \\
& p_j^2 x_i x_j \alpha_{46} + p_j^2 x_i x_k \alpha_{47} + p_j^2 x_i x_l \alpha_{48} + p_j^2 x_j^2 \alpha_{49} + p_j^2 x_j x_k \alpha_{50} + p_j^2 x_j x_l \alpha_{51} + p_j^2 x_k^2 \alpha_{52} + \\
& p_j^2 x_k x_l \alpha_{53} + p_j^2 x_l^2 \alpha_{54} + p_j p_k x_i^2 \alpha_{55} + p_j p_k x_i x_j \alpha_{56} + p_j p_k x_i x_k \alpha_{57} + p_j p_k x_i x_l \alpha_{58} + \\
& p_j p_k x_j^2 \alpha_{59} + p_j p_k x_j x_k \alpha_{60} + p_j p_k x_j x_l \alpha_{61} + p_j p_k x_k^2 \alpha_{62} + p_j p_k x_k x_l \alpha_{63} + p_j p_k x_l^2 \alpha_{64} + \\
& p_j p_l x_i^2 \alpha_{65} + p_j p_l x_i x_j \alpha_{66} + p_j p_l x_i x_k \alpha_{67} + p_j p_l x_i x_l \alpha_{68} + p_j p_l x_j^2 \alpha_{69} + p_j p_l x_j x_k \alpha_{70} + \\
& p_j p_l x_j x_l \alpha_{71} + p_j p_l x_k^2 \alpha_{72} + p_j p_l x_k x_l \alpha_{73} + p_j p_l x_l^2 \alpha_{74} + p_j x_i \alpha_{75} + p_j x_j \alpha_{76} + p_j x_k \alpha_{77} + \\
& p_j x_l \alpha_{78} + p_k^2 x_i^2 \alpha_{79} + p_k^2 x_i x_j \alpha_{80} + p_k^2 x_i x_k \alpha_{81} + p_k^2 x_i x_l \alpha_{82} + p_k^2 x_j^2 \alpha_{83} + p_k^2 x_j x_k \alpha_{84} + \\
& p_k^2 x_j x_l \alpha_{85} + p_k^2 x_k^2 \alpha_{86} + p_k^2 x_k x_l \alpha_{87} + p_k^2 x_l^2 \alpha_{88} + p_k p_l x_i^2 \alpha_{89} + p_k p_l x_i x_j \alpha_{90} + p_k p_l x_i x_k \alpha_{91} + \\
& p_k p_l x_i x_l \alpha_{92} + p_k p_l x_j^2 \alpha_{93} + p_k p_l x_j x_k \alpha_{94} + p_k p_l x_j x_l \alpha_{95} + p_k p_l x_k^2 \alpha_{96} + p_k p_l x_k x_l \alpha_{97} + \\
& p_k p_l x_l^2 \alpha_{98} + p_k x_i \alpha_{99} + p_k x_j \alpha_{100} + p_k x_k \alpha_{101} + p_k x_l \alpha_{102} + p_l^2 x_i^2 \alpha_{103} + p_l^2 x_i x_j \alpha_{104} + \\
& p_l^2 x_i x_k \alpha_{105} + p_l^2 x_i x_l \alpha_{106} + p_l^2 x_j^2 \alpha_{107} + p_l^2 x_j x_k \alpha_{108} + p_l^2 x_j x_l \alpha_{109} + p_l^2 x_k^2 \alpha_{110} + \\
& p_l^2 x_k x_l \alpha_{111} + p_l^2 x_l^2 \alpha_{112} + p_l x_i \alpha_{113} + p_l x_j \alpha_{114} + p_l x_k \alpha_{115} + p_l x_l \alpha_{116} + \alpha_{117} \Big) + O[\epsilon]^2
\end{aligned}$$

$$In[*] := \text{LHSR3} = \int \mathbb{E} \left[\text{QP}_{f,g,e,a} + \text{QP}_{g,d,c,e} + \text{QP}_{e,c,b,a} \right] d\{x_e, p_e\}$$

Out[*]=



$$In[*] := \text{RHSR3} = \int \mathbb{E} \left[\text{QP}_{g,d,e,f} + \text{QP}_{f,e,b,a} + \text{QP}_{e,d,c,b} \right] d\{x_e, p_e\}$$

Out[*]=



In[*] := (*Unperturbed*)

Cases[LHSR3, $\mathbb{E}[A_-]$, Infinity][[1, 1, 1]] -
 Cases[RHSR3, $\mathbb{E}[A_-]$, Infinity][[1, 1, 1]]

Out[*]=

0

In[*] := eqnR3 =

Cases[LHSR3, $\mathbb{E}[A_-]$, Infinity][[1, 1, 2]] - Cases[RHSR3, $\mathbb{E}[A_-]$, Infinity][[1, 1, 2]] // CF;
 eqnR3

Out[*]=



```
In[ ]:= varsR3 = Union@Cases[eqnR3,  $\alpha_k$ _, Infinity]
Length@varsR3
```

```
Out[ ]:=
```

```
{ $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_4$ ,  $\alpha_5$ ,  $\alpha_6$ ,  $\alpha_7$ ,  $\alpha_8$ ,  $\alpha_9$ ,  $\alpha_{10}$ ,  $\alpha_{11}$ ,  $\alpha_{12}$ ,  $\alpha_{13}$ ,  $\alpha_{14}$ ,  $\alpha_{15}$ ,  $\alpha_{16}$ ,  $\alpha_{17}$ ,  $\alpha_{18}$ ,  $\alpha_{19}$ ,  $\alpha_{20}$ ,  $\alpha_{21}$ ,  $\alpha_{22}$ ,
 $\alpha_{23}$ ,  $\alpha_{24}$ ,  $\alpha_{25}$ ,  $\alpha_{26}$ ,  $\alpha_{27}$ ,  $\alpha_{28}$ ,  $\alpha_{29}$ ,  $\alpha_{30}$ ,  $\alpha_{31}$ ,  $\alpha_{32}$ ,  $\alpha_{33}$ ,  $\alpha_{34}$ ,  $\alpha_{35}$ ,  $\alpha_{36}$ ,  $\alpha_{37}$ ,  $\alpha_{38}$ ,  $\alpha_{39}$ ,  $\alpha_{40}$ ,  $\alpha_{41}$ ,  $\alpha_{42}$ ,
 $\alpha_{43}$ ,  $\alpha_{44}$ ,  $\alpha_{45}$ ,  $\alpha_{46}$ ,  $\alpha_{47}$ ,  $\alpha_{48}$ ,  $\alpha_{49}$ ,  $\alpha_{50}$ ,  $\alpha_{51}$ ,  $\alpha_{52}$ ,  $\alpha_{53}$ ,  $\alpha_{54}$ ,  $\alpha_{55}$ ,  $\alpha_{56}$ ,  $\alpha_{57}$ ,  $\alpha_{58}$ ,  $\alpha_{59}$ ,  $\alpha_{60}$ ,  $\alpha_{61}$ ,
 $\alpha_{62}$ ,  $\alpha_{63}$ ,  $\alpha_{64}$ ,  $\alpha_{65}$ ,  $\alpha_{66}$ ,  $\alpha_{67}$ ,  $\alpha_{68}$ ,  $\alpha_{69}$ ,  $\alpha_{70}$ ,  $\alpha_{71}$ ,  $\alpha_{72}$ ,  $\alpha_{73}$ ,  $\alpha_{74}$ ,  $\alpha_{75}$ ,  $\alpha_{76}$ ,  $\alpha_{77}$ ,  $\alpha_{78}$ ,  $\alpha_{79}$ ,  $\alpha_{80}$ ,
 $\alpha_{81}$ ,  $\alpha_{82}$ ,  $\alpha_{83}$ ,  $\alpha_{84}$ ,  $\alpha_{85}$ ,  $\alpha_{86}$ ,  $\alpha_{87}$ ,  $\alpha_{88}$ ,  $\alpha_{89}$ ,  $\alpha_{90}$ ,  $\alpha_{91}$ ,  $\alpha_{92}$ ,  $\alpha_{93}$ ,  $\alpha_{94}$ ,  $\alpha_{95}$ ,  $\alpha_{96}$ ,  $\alpha_{97}$ ,  $\alpha_{98}$ ,  $\alpha_{99}$ ,
 $\alpha_{100}$ ,  $\alpha_{101}$ ,  $\alpha_{102}$ ,  $\alpha_{103}$ ,  $\alpha_{104}$ ,  $\alpha_{105}$ ,  $\alpha_{106}$ ,  $\alpha_{107}$ ,  $\alpha_{108}$ ,  $\alpha_{109}$ ,  $\alpha_{110}$ ,  $\alpha_{111}$ ,  $\alpha_{112}$ ,  $\alpha_{113}$ ,  $\alpha_{114}$ ,  $\alpha_{115}$ ,  $\alpha_{116}$ }
```

```
Out[ ]:=
```

116

```
In[ ]:= CoefficientRules[eqnR3,  $x_{\{a,b,c,d,f,g\}}$ ]
```

```
Out[ ]:=
```



```
In[ ]:= solR3 = First@Solve[CoefficientRules[eqnR3,  $x_{\{a,b,c,d,f,g\}}$ ] /. {( $u$  ->  $v$ )} ->  $v == 0$ }, varsR3]
```

Solve: Equations may not give solutions for all "solve" variables.

```
Out[ ]:=
```

$$\left\{ \begin{aligned} \alpha_2 &\rightarrow -\alpha_3 - \frac{t^2 \alpha_{12}}{1+t^2} + \frac{t^2 \alpha_{34}}{1+t^2} - \alpha_{111}, \alpha_4 \rightarrow -\frac{\alpha_3}{t^2} + \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{34}}{1+t^2} - \alpha_{50}, \\ \alpha_5 &\rightarrow \frac{t^2 \alpha_3}{-1+t^2} - \alpha_6 + \frac{t^4 \alpha_{21}}{-1+t^2} + \frac{t^2 \alpha_{23}}{-1+t^2} + \frac{t^2 \alpha_{28}}{-1+t^2} - \frac{t^2 \alpha_{34}}{2(-1+t^2)} + t^4 \alpha_{55} + \frac{t^4 \alpha_{81}}{-1+t^2} - \alpha_{83} - \frac{t^2 \alpha_{97}}{2(-1+t^2)}, \\ \alpha_7 &\rightarrow \frac{t^2 \alpha_3}{(-1+t^2)^2} - \frac{(-1+2t^2) \alpha_6}{t^2(-1+t^2)} - \frac{t^2 \alpha_{12}}{1+t^2} + \frac{t^4 \alpha_{21}}{(-1+t^2)^2} + \frac{t^4 \alpha_{23}}{(-1+t^2)^2} + \\ &\quad \frac{t^2 \alpha_{28}}{(-1+t^2)^2} - \frac{(-2t^2+5t^4-t^6) \alpha_{34}}{2(-1+t^2)^2(1+t^2)} + \frac{t^4 \alpha_{55}}{-1+t^2} + \frac{t^4 \alpha_{81}}{(-1+t^2)^2} - \frac{t^4 \alpha_{97}}{2(-1+t^2)^2}, \alpha_8 \rightarrow \\ &\quad -\frac{t^2 \alpha_3}{2(-1+t^2)} - \frac{t^4 \alpha_{21}}{2(-1+t^2)} - \frac{(t^2+t^4) \alpha_{23}}{4(-1+t^2)} - \frac{t^2 \alpha_{28}}{2(-1+t^2)} + \frac{t^2 \alpha_{34}}{2(-1+t^2)} - \frac{t^4 \alpha_{81}}{2(-1+t^2)} + \frac{t^2 \alpha_{97}}{2(-1+t^2)}, \\ \alpha_9 &\rightarrow \frac{\alpha_6}{t^2} + \frac{t^2 \alpha_{12}}{1+t^2} - \frac{t^2 \alpha_{34}}{1+t^2}, \alpha_{10} \rightarrow -\frac{\alpha_3}{2t^2(-1+t^2)} - \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{21}}{2(-1+t^2)} - \frac{(-1+3t^2) \alpha_{23}}{4t^2(-1+t^2)} - \\ &\quad \frac{\alpha_{28}}{2t^2(-1+t^2)} - \frac{(1-3t^2) \alpha_{34}}{2(-1+t^2)(1+t^2)} - \alpha_{52} - \frac{\alpha_{81}}{2(-1+t^2)} + \frac{\alpha_{97}}{2(-1+t^2)}, \\ \alpha_{11} &\rightarrow -\frac{\alpha_{12}}{1+t^2} - \alpha_{21} + \frac{\alpha_{34}}{1+t^2} - \alpha_{98}, \alpha_{13} \rightarrow -\frac{(-2+t^2) \alpha_3}{(-1+t^2)^2} - \frac{(2-t^2) \alpha_6}{t^2(-1+t^2)} + \frac{t^2 \alpha_{21}}{(-1+t^2)^2} - \\ &\quad \frac{t^2(-2+t^2) \alpha_{23}}{(-1+t^2)^2} + \frac{\alpha_{28}}{(-1+t^2)^2} - \frac{(2-t^2) \alpha_{34}}{2(-1+t^2)^2} + \frac{t^2 \alpha_{55}}{-1+t^2} - \frac{t^2(-2+t^2) \alpha_{81}}{(-1+t^2)^2} - \frac{(2-t^2) \alpha_{97}}{2(-1+t^2)^2}, \\ \alpha_{14} &\rightarrow \frac{\alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{t^2(-1+t^2)} - \frac{\alpha_{12}}{t^2(1+t^2)} + \frac{\alpha_{21}}{(-1+t^2)^2} - \frac{(-1+t^2-t^4) \alpha_{23}}{t^2(-1+t^2)^2} + \end{aligned} \right.$$

$$\begin{aligned}
& \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(-2+5t^2-t^4) \alpha_{34}}{2 t^2 (-1+t^2)^2 (1+t^2)} + \frac{\alpha_{55}}{-1+t^2} + \frac{t^2 \alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 (-1+t^2)^2}, \alpha_{15} \rightarrow -\alpha_{59}, \\
\alpha_{16} \rightarrow & -\frac{t^2 \alpha_{34}}{-1+t^2} - \frac{t^2 \alpha_{97}}{-1+t^2}, \alpha_{17} \rightarrow -\frac{2 \alpha_3}{(-1+t^2)^2} + \frac{2 \alpha_6}{t^2 (-1+t^2)} + \frac{\alpha_{12}}{1+t^2} - \frac{2 t^2 \alpha_{21}}{(-1+t^2)^2} - \\
& \frac{(1+t^2) \alpha_{23}}{(-1+t^2)^2} - \frac{2 \alpha_{28}}{(-1+t^2)^2} - \frac{(1-3t^2) \alpha_{34}}{(-1+t^2)^2 (1+t^2)} - \frac{2 t^2 \alpha_{55}}{-1+t^2} - \frac{2 t^2 \alpha_{81}}{(-1+t^2)^2} + \frac{t^2 \alpha_{97}}{(-1+t^2)^2}, \\
\alpha_{18} \rightarrow & -\frac{\alpha_3}{1-t^2} - \frac{\alpha_6}{t^2} + \frac{t^2 \alpha_{21}}{-1+t^2} + \frac{t^2 \alpha_{23}}{-1+t^2} - \frac{\alpha_{28}}{1-t^2} - \frac{\alpha_{34}}{2 (-1+t^2)} + \frac{t^2 \alpha_{81}}{-1+t^2} - \frac{\alpha_{97}}{2 (-1+t^2)}, \\
\alpha_{19} \rightarrow & -\frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{23}}{-1+t^2} + \frac{\alpha_{34}}{1+t^2}, \\
\alpha_{20} \rightarrow & -\frac{\alpha_3}{t^2 (-1+t^2)^2} + \frac{\alpha_6}{t^4 (-1+t^2)} + \frac{\alpha_{12}}{t^2 (1+t^2)} - \frac{\alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{t^2 (-1+t^2)^2} - \\
& \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(1-5t^2+2t^4) \alpha_{34}}{2 t^2 (-1+t^2)^2 (1+t^2)} - \frac{\alpha_{55}}{-1+t^2} - \frac{\alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2 t^2 (-1+t^2)^2}, \\
\alpha_{22} \rightarrow & \frac{t^2 \alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{-1+t^2} + \frac{t^2 (-1+2t^2) \alpha_{21}}{(-1+t^2)^2} - \frac{(1-2t^2) \alpha_{23}}{(-1+t^2)^2} - \frac{(1-2t^2) \alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(-t^2+2t^4) \alpha_{34}}{2 (-1+t^2)^2} - \frac{(t^2-2t^4) \alpha_{55}}{-1+t^2} + \frac{t^4 \alpha_{81}}{(-1+t^2)^2} - \frac{(-t^2+2t^4) \alpha_{97}}{2 (-1+t^2)^2}, \\
\alpha_{24} \rightarrow & \frac{\alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{t^2 (-1+t^2)} - \frac{(-1+t^2) \alpha_{12}}{t^2 (1+t^2)} - \frac{(1-2t^2) \alpha_{21}}{(-1+t^2)^2} - \frac{(1-2t^2) \alpha_{23}}{t^2 (-1+t^2)^2} - \\
& \frac{(1-2t^2) \alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(2-7t^2+7t^4) \alpha_{34}}{2 t^2 (-1+t^2)^2 (1+t^2)} - \frac{(1-2t^2) \alpha_{55}}{-1+t^2} + \frac{t^2 \alpha_{81}}{(-1+t^2)^2} - \frac{(-1+2t^2) \alpha_{97}}{2 (-1+t^2)^2}, \\
\alpha_{25} \rightarrow & -\frac{t^2 \alpha_3}{-1+t^2} + \alpha_6 - \frac{t^4 \alpha_{21}}{-1+t^2} - \frac{t^2 \alpha_{23}}{-1+t^2} - \frac{t^2 \alpha_{28}}{-1+t^2} + \frac{t^2 \alpha_{34}}{2 (-1+t^2)} - t^4 \alpha_{55} - \frac{t^4 \alpha_{81}}{-1+t^2} + \frac{t^2 \alpha_{97}}{2 (-1+t^2)}, \\
\alpha_{26} \rightarrow & \frac{t^2 (-2+t^2) \alpha_3}{(-1+t^2)^2} - \frac{(-2+t^2) \alpha_6}{-1+t^2} - \frac{t^4 \alpha_{21}}{(-1+t^2)^2} - \frac{t^2 \alpha_{23}}{(-1+t^2)^2} - \frac{t^2 \alpha_{28}}{(-1+t^2)^2} + \frac{t^4 \alpha_{34}}{2 (-1+t^2)^2} - \\
& \frac{t^4 \alpha_{55}}{-1+t^2} + \frac{t^4 (-2+t^2) \alpha_{81}}{(-1+t^2)^2} + \frac{t^4 \alpha_{97}}{2 (-1+t^2)^2}, \alpha_{27} \rightarrow -\frac{2 \alpha_3}{-1+t^2} + \frac{2 \alpha_6}{t^2} - \frac{(1-t^2) \alpha_{12}}{1+t^2} - \\
& \frac{2 t^2 \alpha_{21}}{-1+t^2} - \frac{(1+t^2) \alpha_{23}}{-1+t^2} - \frac{2 \alpha_{28}}{-1+t^2} - \frac{(1-3t^2) \alpha_{34}}{(-1+t^2) (1+t^2)} - 2 t^2 \alpha_{55} - \frac{2 t^2 \alpha_{81}}{-1+t^2} + \frac{t^2 \alpha_{97}}{-1+t^2}, \\
\alpha_{29} \rightarrow & -\frac{(2-t^2) \alpha_3}{(-1+t^2)^2} - \frac{(-2+t^2) \alpha_6}{t^2 (-1+t^2)} - \frac{(-1+t^2) \alpha_{12}}{1+t^2} - \frac{t^2 \alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{(-1+t^2)^2} -
\end{aligned}$$

$$\begin{aligned}
& \frac{\alpha_{28}}{(-1+t^2)^2} - \frac{(2-7t^2+5t^4-2t^6)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{t^2\alpha_{55}}{-1+t^2} + \frac{t^2(-2+t^2)\alpha_{81}}{(-1+t^2)^2} + \frac{t^2\alpha_{97}}{2(-1+t^2)^2}, \\
\alpha_{30} \rightarrow & -\frac{\alpha_3}{t^2(-1+t^2)} + \frac{\alpha_6}{t^4} - \frac{(1-t^2)\alpha_{12}}{t^2(1+t^2)} - \frac{\alpha_{21}}{-1+t^2} - \frac{\alpha_{23}}{t^2(-1+t^2)} - \frac{\alpha_{28}}{t^2(-1+t^2)} - \\
& \frac{(1-5t^2+2t^4)\alpha_{34}}{2t^2(-1+t^2)(1+t^2)} - \alpha_{55} - \frac{\alpha_{81}}{-1+t^2} + \frac{\alpha_{97}}{2t^2(-1+t^2)}, \alpha_{31} \rightarrow \frac{t^2\alpha_{12}}{1+t^2} - t^2\alpha_{21} - \frac{t^2\alpha_{34}}{1+t^2} - \alpha_{59}, \\
\alpha_{32} \rightarrow & \frac{t^4\alpha_3}{(-1+t^2)^2} - \frac{t^2\alpha_6}{-1+t^2} - \frac{t^4\alpha_{12}}{1+t^2} + \frac{t^4\alpha_{21}}{(-1+t^2)^2} - \frac{(-t^2+t^4-t^6)\alpha_{23}}{(-1+t^2)^2} + \frac{t^2\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(-t^4+5t^6-2t^8)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} + \frac{t^4\alpha_{55}}{-1+t^2} + \frac{t^6\alpha_{81}}{(-1+t^2)^2} - \frac{t^4\alpha_{97}}{2(-1+t^2)^2}, \\
\alpha_{33} \rightarrow & -\frac{t^2(-2+t^2)\alpha_3}{(-1+t^2)^2} - \frac{(2-t^2)\alpha_6}{-1+t^2} + \frac{t^2(-1+t^2)\alpha_{12}}{1+t^2} + \frac{t^4\alpha_{21}}{(-1+t^2)^2} - \frac{t^4(-2+t^2)\alpha_{23}}{(-1+t^2)^2} + \\
& \frac{t^2\alpha_{28}}{(-1+t^2)^2} - \frac{(7t^4-7t^6+2t^8)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} + \frac{t^4\alpha_{55}}{-1+t^2} - \frac{t^4(-2+t^2)\alpha_{81}}{(-1+t^2)^2} - \frac{(2t^2-t^4)\alpha_{97}}{2(-1+t^2)^2}, \\
\alpha_{35} \rightarrow & -\frac{t^4\alpha_3}{(-1+t^2)^2} + \frac{t^2\alpha_6}{-1+t^2} - \frac{t^6\alpha_{21}}{(-1+t^2)^2} - \frac{t^4\alpha_{23}}{(-1+t^2)^2} - \frac{t^4\alpha_{28}}{(-1+t^2)^2} + \frac{t^4\alpha_{34}}{2(-1+t^2)^2} - \\
& \frac{t^6\alpha_{55}}{-1+t^2} - \frac{t^6\alpha_{81}}{(-1+t^2)^2} + \frac{t^4\alpha_{97}}{2(-1+t^2)^2}, \alpha_{36} \rightarrow \frac{t^4\alpha_{12}}{1+t^2} - \frac{t^4\alpha_{23}}{-1+t^2} - \frac{t^4\alpha_{34}}{1+t^2}, \\
\alpha_{37} \rightarrow & -\frac{2t^2\alpha_3}{(-1+t^2)^2} + \frac{2\alpha_6}{-1+t^2} + \frac{t^2\alpha_{12}}{1+t^2} - \frac{2t^4\alpha_{21}}{(-1+t^2)^2} - \frac{(t^2+t^4)\alpha_{23}}{(-1+t^2)^2} - \frac{2t^2\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(t^2-3t^4)\alpha_{34}}{(-1+t^2)^2(1+t^2)} - \frac{2t^4\alpha_{55}}{-1+t^2} - \frac{2t^4\alpha_{81}}{(-1+t^2)^2} + \frac{t^4\alpha_{97}}{(-1+t^2)^2}, \\
\alpha_{38} \rightarrow & \frac{t^2\alpha_3}{-1+t^2} - \alpha_6 - \frac{t^4\alpha_{12}}{1+t^2} + \frac{t^4\alpha_{21}}{-1+t^2} + \frac{t^4\alpha_{23}}{-1+t^2} + \frac{t^2\alpha_{28}}{-1+t^2} - \frac{(t^2+3t^4-2t^6)\alpha_{34}}{2(-1+t^2)(1+t^2)} + \frac{t^4\alpha_{81}}{-1+t^2} - \frac{t^2\alpha_{97}}{2(-1+t^2)}, \\
\alpha_{39} \rightarrow & -\frac{t^2\alpha_{34}}{-1+t^2} - \frac{t^2\alpha_{97}}{-1+t^2}, \alpha_{40} \rightarrow -\alpha_{98}, \alpha_{45} \rightarrow -\frac{\alpha_3}{t^2(-1+t^2)} + \frac{\alpha_6}{t^4} - \frac{\alpha_{21}}{-1+t^2} - \\
& \frac{\alpha_{23}}{-1+t^2} - \frac{\alpha_{28}}{t^2(-1+t^2)} + \frac{\alpha_{34}}{2(-1+t^2)} - \alpha_{52} - \alpha_{55} - \frac{\alpha_{81}}{-1+t^2} + \frac{\alpha_{97}}{2(-1+t^2)}, \alpha_{46} \rightarrow -\alpha_{50}, \\
\alpha_{47} \rightarrow & \frac{\alpha_3}{t^2(-1+t^2)} - \frac{\alpha_6}{t^4} - \frac{\alpha_{21}}{1-t^2} - \frac{\alpha_{23}}{1-t^2} + \frac{\alpha_{28}}{t^2(-1+t^2)} - \frac{\alpha_{34}}{2(-1+t^2)} + \alpha_{55} - \frac{\alpha_{81}}{1-t^2} - \frac{\alpha_{97}}{2(-1+t^2)}, \\
\alpha_{48} \rightarrow & -\frac{\alpha_3}{t^2(-1+t^2)^2} + \frac{\alpha_6}{t^4(-1+t^2)} - \frac{\alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{(-1+t^2)^2} - \\
& \frac{\alpha_{28}}{t^2(-1+t^2)^2} + \frac{\alpha_{34}}{2(-1+t^2)^2} - \frac{\alpha_{55}}{-1+t^2} - \frac{\alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2(-1+t^2)^2},
\end{aligned}$$

$$\begin{aligned}
\alpha_{49} &\rightarrow \mathbf{0}, \alpha_{51} \rightarrow \mathbf{0}, \alpha_{53} \rightarrow \frac{\alpha_3}{t^2 (-1+t^2)^2} - \frac{\alpha_6}{t^4 (-1+t^2)} + \frac{\alpha_{21}}{(-1+t^2)^2} + \frac{\alpha_{23}}{(-1+t^2)^2} + \\
&\frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{\alpha_{34}}{2 (-1+t^2)^2} + \frac{\alpha_{55}}{-1+t^2} + \frac{\alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 (-1+t^2)^2}, \alpha_{54} \rightarrow \mathbf{0}, \\
\alpha_{56} &\rightarrow -\frac{\alpha_{34}}{1-t^2} - \frac{\alpha_{97}}{1-t^2}, \alpha_{57} \rightarrow -\frac{\alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{t^2 (-1+t^2)} - \frac{(-1+2t^2)\alpha_{21}}{(-1+t^2)^2} - \frac{t^2\alpha_{23}}{(-1+t^2)^2} - \\
&\frac{(-1+2t^2)\alpha_{28}}{t^2 (-1+t^2)^2} + \frac{\alpha_{34}}{2 (-1+t^2)^2} - \frac{(-1+2t^2)\alpha_{55}}{-1+t^2} - \frac{t^2\alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2 (-1+t^2)^2}, \\
\alpha_{58} &\rightarrow \frac{\alpha_{12}}{t^2 (1+t^2)} + \frac{\alpha_{23}}{t^2 (-1+t^2)} - \frac{\alpha_{34}}{t^2 (1+t^2)}, \alpha_{60} \rightarrow -\alpha_{12} + \alpha_{34} + \alpha_{97}, \\
\alpha_{61} &\rightarrow \frac{2\alpha_3}{(-1+t^2)^2} - \frac{2\alpha_6}{t^2 (-1+t^2)} - \frac{\alpha_{12}}{1+t^2} + \frac{2t^2\alpha_{21}}{(-1+t^2)^2} - \frac{(-1-t^2)\alpha_{23}}{(-1+t^2)^2} + \\
&\frac{2\alpha_{28}}{(-1+t^2)^2} - \frac{(-1+3t^2)\alpha_{34}}{(-1+t^2)^2 (1+t^2)} + \frac{2t^2\alpha_{55}}{-1+t^2} + \frac{2t^2\alpha_{81}}{(-1+t^2)^2} - \frac{t^2\alpha_{97}}{(-1+t^2)^2}, \\
\alpha_{62} &\rightarrow \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{28}}{t^2} - \frac{\alpha_{34}}{1+t^2} + \alpha_{98}, \alpha_{63} \rightarrow -\frac{\alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{t^2 (-1+t^2)} + \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{21}}{(-1+t^2)^2} - \\
&\frac{\alpha_{23}}{(-1+t^2)^2} - \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(1-5t^2+2t^4)\alpha_{34}}{2 (-1+t^2)^2 (1+t^2)} - \frac{\alpha_{55}}{-1+t^2} - \frac{t^2\alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2 (-1+t^2)^2}, \\
\alpha_{64} &\rightarrow \frac{\alpha_3}{t^2 (-1+t^2)^2} - \frac{\alpha_6}{t^4 (-1+t^2)} - \frac{\alpha_{12}}{t^2 (1+t^2)} + \frac{\alpha_{21}}{(-1+t^2)^2} + \frac{\alpha_{23}}{t^2 (-1+t^2)^2} + \\
&\frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(-1+5t^2-2t^4)\alpha_{34}}{2 t^2 (-1+t^2)^2 (1+t^2)} + \frac{\alpha_{55}}{-1+t^2} + \frac{\alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 t^2 (-1+t^2)^2}, \\
\alpha_{65} &\rightarrow \frac{\alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{t^2 (-1+t^2)} - \frac{\alpha_{12}}{1+t^2} + \frac{t^2\alpha_{21}}{(-1+t^2)^2} + \frac{\alpha_{23}}{(-1+t^2)^2} + \frac{\alpha_{28}}{(-1+t^2)^2} - \\
&\frac{(-1+5t^2-2t^4)\alpha_{34}}{2 (-1+t^2)^2 (1+t^2)} - \frac{(-2t^2+t^4)\alpha_{55}}{-1+t^2} + \frac{t^2\alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 (-1+t^2)^2}, \\
\alpha_{66} &\rightarrow -\frac{2t^2\alpha_3}{(-1+t^2)^2} + \frac{2\alpha_6}{-1+t^2} + \frac{t^2\alpha_{12}}{1+t^2} - \frac{2t^4\alpha_{21}}{(-1+t^2)^2} - \frac{(t^2+t^4)\alpha_{23}}{(-1+t^2)^2} - \frac{2t^2\alpha_{28}}{(-1+t^2)^2} - \\
&\frac{(-3t^4+t^6)\alpha_{34}}{(-1+t^2)^2 (1+t^2)} - \frac{2t^4\alpha_{55}}{-1+t^2} - \frac{2t^4\alpha_{81}}{(-1+t^2)^2} + \frac{t^2\alpha_{97}}{(-1+t^2)^2}, \alpha_{67} \rightarrow \frac{2\alpha_3}{-1+t^2} - \frac{2\alpha_6}{t^2} - \frac{(-1+t^2)\alpha_{12}}{1+t^2} + \\
&\frac{2t^2\alpha_{21}}{-1+t^2} - \frac{(-1-t^2)\alpha_{23}}{-1+t^2} + \frac{2\alpha_{28}}{-1+t^2} - \frac{(3t^2-t^4)\alpha_{34}}{(-1+t^2)(1+t^2)} + 2t^2\alpha_{55} + \frac{2t^2\alpha_{81}}{-1+t^2} - \frac{\alpha_{97}}{-1+t^2}, \\
\alpha_{68} &\rightarrow -\frac{2\alpha_3}{(-1+t^2)^2} + \frac{2\alpha_6}{t^2 (-1+t^2)} + \frac{\alpha_{12}}{1+t^2} - \frac{2t^2\alpha_{21}}{(-1+t^2)^2} - \frac{(1+t^2)\alpha_{23}}{(-1+t^2)^2} - \frac{2\alpha_{28}}{(-1+t^2)^2} -
\end{aligned}$$

$$\begin{aligned}
& \frac{(-3t^2 + t^4)\alpha_{34}}{(-1+t^2)^2(1+t^2)} - \frac{2t^2\alpha_{55}}{-1+t^2} - \frac{2t^2\alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{(-1+t^2)^2}, \alpha_{69} \rightarrow 0, \\
\alpha_{70} \rightarrow & \frac{2t^2\alpha_3}{(-1+t^2)^2} - \frac{2\alpha_6}{-1+t^2} - \frac{t^2\alpha_{12}}{1+t^2} + \frac{2t^4\alpha_{21}}{(-1+t^2)^2} - \frac{(-t^2 - t^4)\alpha_{23}}{(-1+t^2)^2} + \frac{2t^2\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(3t^4 - t^6)\alpha_{34}}{(-1+t^2)^2(1+t^2)} + \frac{2t^4\alpha_{55}}{-1+t^2} + \frac{2t^4\alpha_{81}}{(-1+t^2)^2} - \frac{t^2\alpha_{97}}{(-1+t^2)^2}, \alpha_{71} \rightarrow 0, \\
\alpha_{72} \rightarrow & -\frac{(-1+2t^2)\alpha_3}{(-1+t^2)^2} - \frac{(1-2t^2)\alpha_6}{t^2(-1+t^2)} + \frac{t^2\alpha_{12}}{1+t^2} - \frac{t^2(-1+2t^2)\alpha_{21}}{(-1+t^2)^2} - \frac{t^4\alpha_{23}}{(-1+t^2)^2} - \\
& \frac{(-1+2t^2)\alpha_{28}}{(-1+t^2)^2} - \frac{(1+t^2-6t^4+2t^6)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{t^4\alpha_{55}}{-1+t^2} - \frac{t^2(-1+2t^2)\alpha_{81}}{(-1+t^2)^2} - \frac{(1-2t^2)\alpha_{97}}{2(-1+t^2)^2}, \\
\alpha_{73} \rightarrow & \frac{2\alpha_3}{(-1+t^2)^2} - \frac{2\alpha_6}{t^2(-1+t^2)} - \frac{\alpha_{12}}{1+t^2} + \frac{2t^2\alpha_{21}}{(-1+t^2)^2} - \frac{(-1-t^2)\alpha_{23}}{(-1+t^2)^2} + \frac{2\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(3t^2 - t^4)\alpha_{34}}{(-1+t^2)^2(1+t^2)} + \frac{2t^2\alpha_{55}}{-1+t^2} + \frac{2t^2\alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{(-1+t^2)^2}, \alpha_{74} \rightarrow 0, \\
\alpha_{76} \rightarrow & -\frac{t\alpha_{34}}{2(-1+t^2)} - \frac{t\alpha_{97}}{2(-1+t^2)}, \alpha_{77} \rightarrow \frac{t\alpha_3}{2(-1+t^2)^2} - \frac{\alpha_6}{2t(-1+t^2)} + \frac{t(-1+2t^2)\alpha_{21}}{2(-1+t^2)^2} + \\
& \frac{t^3\alpha_{23}}{2(-1+t^2)^2} - \frac{(1-2t^2)\alpha_{28}}{2t(-1+t^2)^2} - \frac{t\alpha_{34}}{4(-1+t^2)^2} + \frac{t\alpha_{55}}{2(-1+t^2)} - \alpha_{75} + \frac{t^3\alpha_{81}}{2(-1+t^2)^2} - \frac{t\alpha_{97}}{4(-1+t^2)^2}, \\
\alpha_{78} \rightarrow & -\frac{\alpha_{12}}{2t(1+t^2)} - \frac{\alpha_{23}}{2t(-1+t^2)} + \frac{\alpha_{34}}{2t(1+t^2)}, \alpha_{79} \rightarrow \frac{\alpha_3}{2t^2(-1+t^2)} + \frac{\alpha_{21}}{2(-1+t^2)} - \\
& \frac{(-1-t^2)\alpha_{23}}{4t^2(-1+t^2)} + \frac{\alpha_{28}}{2t^2(-1+t^2)} - \frac{\alpha_{34}}{2(-1+t^2)} + \frac{\alpha_{81}}{2(-1+t^2)} - \frac{\alpha_{97}}{2(-1+t^2)}, \\
\alpha_{80} \rightarrow & -\frac{\alpha_3}{-1+t^2} - \frac{t^2\alpha_{21}}{-1+t^2} - \frac{\alpha_{23}}{-1+t^2} - \frac{\alpha_{28}}{-1+t^2} + \frac{t^2\alpha_{34}}{2(-1+t^2)} - t^2\alpha_{55} - \frac{t^2\alpha_{81}}{-1+t^2} + \frac{t^2\alpha_{97}}{2(-1+t^2)}, \\
\alpha_{82} \rightarrow & -\frac{\alpha_3}{t^2(-1+t^2)} - \frac{\alpha_{12}}{t^2(1+t^2)} - \frac{\alpha_{21}}{-1+t^2} - \frac{\alpha_{23}}{t^2(-1+t^2)} - \frac{\alpha_{28}}{t^2(-1+t^2)} - \\
& \frac{(2-3t^2-t^4)\alpha_{34}}{2t^2(-1+t^2)(1+t^2)} - \alpha_{55} - \frac{\alpha_{81}}{-1+t^2} + \frac{\alpha_{97}}{2(-1+t^2)}, \alpha_{84} \rightarrow \frac{t^2\alpha_{12}}{1+t^2} - \frac{t^2\alpha_{34}}{1+t^2} - t^2\alpha_{81} + \alpha_{111}, \\
\alpha_{85} \rightarrow & -\frac{(2-t^2)\alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{t^2(-1+t^2)} + \frac{\alpha_{12}}{1+t^2} + \frac{t^2(-2+t^2)\alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{(-1+t^2)^2} - \frac{(2-t^2)\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(2-6t^2+t^4+t^6)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{(2t^2-t^4)\alpha_{55}}{-1+t^2} + \frac{t^2(-2+t^2)\alpha_{81}}{(-1+t^2)^2} - \frac{(-2t^2+t^4)\alpha_{97}}{2(-1+t^2)^2}, \alpha_{86} \rightarrow
\end{aligned}$$

$$\begin{aligned}
& -\alpha_1 - \frac{(-1+t^2)\alpha_3}{2t^2} - \frac{1}{2}(1-t^2)\alpha_{21} - \frac{(-1+2t^2-t^4)\alpha_{23}}{4t^2} - \frac{(-1+t^2)\alpha_{28}}{2t^2} - \frac{\alpha_{34}}{2} - \frac{1}{2}(1-t^2)\alpha_{81} - \frac{\alpha_{97}}{2}, \\
& \alpha_{87} \rightarrow -\frac{\alpha_{12}}{1+t^2} + \frac{\alpha_{34}}{1+t^2} + \alpha_{50} - \alpha_{81}, \alpha_{88} \rightarrow \frac{3\alpha_3}{2t^2(-1+t^2)} - \frac{\alpha_6}{t^4} + \frac{\alpha_{12}}{t^2(1+t^2)} + \frac{3\alpha_{21}}{2(-1+t^2)} + \\
& \frac{3(1+t^2)\alpha_{23}}{4t^2(-1+t^2)} + \frac{3\alpha_{28}}{2t^2(-1+t^2)} - \frac{(-1+4t^2+t^4)\alpha_{34}}{2t^2(-1+t^2)(1+t^2)} + \alpha_{52} + \alpha_{55} + \frac{3\alpha_{81}}{2(-1+t^2)} - \frac{(1+t^2)\alpha_{97}}{2t^2(-1+t^2)}, \\
& \alpha_{89} \rightarrow \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{34}}{1+t^2} + t^2\alpha_{55}, \alpha_{90} \rightarrow -\frac{t^2\alpha_{12}}{1+t^2} + \frac{t^2\alpha_{23}}{-1+t^2} + \frac{t^2\alpha_{34}}{1+t^2}, \\
& \alpha_{91} \rightarrow -\frac{t^2\alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{-1+t^2} - \frac{(1-t^2)\alpha_{12}}{1+t^2} - \frac{t^2(-1+2t^2)\alpha_{21}}{(-1+t^2)^2} - \frac{t^4\alpha_{23}}{(-1+t^2)^2} - \\
& \frac{(-1+2t^2)\alpha_{28}}{(-1+t^2)^2} - \frac{(-2+5t^2-7t^4+2t^6)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{(-t^2+2t^4)\alpha_{55}}{-1+t^2} - \frac{t^4\alpha_{81}}{(-1+t^2)^2} + \frac{t^2\alpha_{97}}{2(-1+t^2)^2}, \\
& \alpha_{92} \rightarrow -\frac{\alpha_{34}}{1-t^2} - \frac{\alpha_{97}}{1-t^2}, \alpha_{93} \rightarrow \frac{t^4\alpha_3}{(-1+t^2)^2} - \frac{t^2\alpha_6}{-1+t^2} + \frac{t^6\alpha_{21}}{(-1+t^2)^2} + \frac{t^4\alpha_{23}}{(-1+t^2)^2} + \\
& \frac{t^4\alpha_{28}}{(-1+t^2)^2} - \frac{t^4\alpha_{34}}{2(-1+t^2)^2} + \frac{t^6\alpha_{55}}{-1+t^2} + \frac{t^6\alpha_{81}}{(-1+t^2)^2} - \frac{t^4\alpha_{97}}{2(-1+t^2)^2}, \\
& \alpha_{94} \rightarrow -\frac{t^4\alpha_3}{(-1+t^2)^2} + \frac{t^2\alpha_6}{-1+t^2} + \frac{t^2\alpha_{12}}{1+t^2} - \frac{t^4\alpha_{21}}{(-1+t^2)^2} - \frac{t^4\alpha_{23}}{(-1+t^2)^2} - \frac{t^2\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(2t^2-5t^4+t^6)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{t^4\alpha_{55}}{-1+t^2} - \frac{t^6\alpha_{81}}{(-1+t^2)^2} + \frac{t^4\alpha_{97}}{2(-1+t^2)^2}, \\
& \alpha_{95} \rightarrow \frac{2t^2\alpha_3}{(-1+t^2)^2} - \frac{2\alpha_6}{-1+t^2} - \frac{t^2\alpha_{12}}{1+t^2} + \frac{2t^4\alpha_{21}}{(-1+t^2)^2} - \frac{(-t^2-t^4)\alpha_{23}}{(-1+t^2)^2} + \frac{2t^2\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(-t^2+3t^4)\alpha_{34}}{(-1+t^2)^2(1+t^2)} + \frac{2t^4\alpha_{55}}{-1+t^2} + \frac{2t^4\alpha_{81}}{(-1+t^2)^2} - \frac{t^4\alpha_{97}}{(-1+t^2)^2}, \alpha_{96} \rightarrow -\frac{t^2\alpha_{12}}{1+t^2} - \alpha_{28} + \frac{t^2\alpha_{34}}{1+t^2} + \alpha_{59}, \\
& \alpha_{100} \rightarrow \frac{t(-2+t^2)\alpha_3}{2(-1+t^2)^2} + \frac{t\alpha_6}{2(-1+t^2)} - \frac{t^3\alpha_{21}}{2(-1+t^2)^2} - \frac{t\alpha_{23}}{2(-1+t^2)^2} - \frac{t\alpha_{28}}{2(-1+t^2)^2} + \\
& \frac{t^3\alpha_{34}}{4(-1+t^2)^2} - \alpha_{42} - \frac{t^3\alpha_{55}}{2(-1+t^2)} + \frac{t^3(-2+t^2)\alpha_{81}}{2(-1+t^2)^2} + \frac{t^3\alpha_{97}}{4(-1+t^2)^2}, \alpha_{101} \rightarrow \\
& -\frac{\alpha_3}{t(-1+t^2)} - \frac{t^3\alpha_{21}}{-1+t^2} - \frac{(1+t^4)\alpha_{23}}{2t(-1+t^2)} - \frac{\alpha_{28}}{t(-1+t^2)} + \frac{t\alpha_{34}}{-1+t^2} - \alpha_{41} - \alpha_{43} - \frac{t^3\alpha_{81}}{-1+t^2} + \frac{t\alpha_{97}}{-1+t^2} - \alpha_{99}, \\
& \alpha_{102} \rightarrow -\frac{(2-t^2)\alpha_3}{2t(-1+t^2)^2} + \frac{\alpha_6}{2t(-1+t^2)} + \frac{\alpha_{12}}{2t} - \frac{t\alpha_{21}}{2(-1+t^2)^2} - \frac{\alpha_{23}}{2t(-1+t^2)^2} -
\end{aligned}$$

$$\begin{aligned}
& \frac{\alpha_{28}}{2t(-1+t^2)^2} - \frac{(2-5t^2+2t^4)\alpha_{34}}{4t(-1+t^2)^2} - \alpha_{44} - \frac{t\alpha_{55}}{2(-1+t^2)} + \frac{t(-2+t^2)\alpha_{81}}{2(-1+t^2)^2} + \frac{t\alpha_{97}}{4(-1+t^2)^2}, \\
\alpha_{103} \rightarrow & \frac{t^2\alpha_3}{2(-1+t^2)} - \frac{t^2\alpha_{12}}{1+t^2} + \frac{t^4\alpha_{21}}{2(-1+t^2)} - \frac{t^2(-3+t^2)\alpha_{23}}{4(-1+t^2)} + \frac{t^2\alpha_{28}}{2(-1+t^2)} - \\
& \frac{(3t^2-t^4)\alpha_{34}}{2(-1+t^2)(1+t^2)} + \frac{t^4\alpha_{81}}{2(-1+t^2)} - \alpha_{83} - \frac{t^2\alpha_{97}}{2(-1+t^2)}, \\
\alpha_{104} \rightarrow & -\frac{t^4\alpha_3}{(-1+t^2)^2} + \frac{t^2\alpha_6}{-1+t^2} + \frac{t^4\alpha_{12}}{1+t^2} - \frac{t^6\alpha_{21}}{(-1+t^2)^2} - \frac{t^6\alpha_{23}}{(-1+t^2)^2} - \frac{t^4\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(2t^4-5t^6+t^8)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{t^6\alpha_{55}}{-1+t^2} - \frac{t^6\alpha_{81}}{(-1+t^2)^2} + \frac{t^6\alpha_{97}}{2(-1+t^2)^2}, \\
\alpha_{105} \rightarrow & \frac{t^2\alpha_3}{-1+t^2} - \alpha_6 - \frac{t^2(-1+t^2)\alpha_{12}}{1+t^2} + \frac{t^4\alpha_{21}}{-1+t^2} + \frac{t^4\alpha_{23}}{-1+t^2} + \frac{t^2\alpha_{28}}{-1+t^2} - \\
& \frac{(-2t^2+5t^4-t^6)\alpha_{34}}{2(-1+t^2)(1+t^2)} + t^4\alpha_{55} + \frac{t^4\alpha_{81}}{-1+t^2} - \frac{t^4\alpha_{97}}{2(-1+t^2)}, \alpha_{106} \rightarrow -\alpha_{111}, \alpha_{107} \rightarrow 0, \\
\alpha_{108} \rightarrow & \frac{t^4\alpha_3}{(-1+t^2)^2} - \frac{t^2\alpha_6}{-1+t^2} - \frac{t^4\alpha_{12}}{1+t^2} + \frac{t^6\alpha_{21}}{(-1+t^2)^2} + \frac{t^6\alpha_{23}}{(-1+t^2)^2} + \frac{t^4\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(-2t^4+5t^6-t^8)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} + \frac{t^6\alpha_{55}}{-1+t^2} + \frac{t^6\alpha_{81}}{(-1+t^2)^2} - \frac{t^6\alpha_{97}}{2(-1+t^2)^2}, \alpha_{109} \rightarrow 0, \\
\alpha_{110} \rightarrow & -\frac{3t^2\alpha_3}{2(-1+t^2)} + \alpha_6 + \frac{t^4\alpha_{12}}{1+t^2} - \frac{3t^4\alpha_{21}}{2(-1+t^2)} - \frac{3(t^2+t^4)\alpha_{23}}{4(-1+t^2)} - \frac{3t^2\alpha_{28}}{2(-1+t^2)} - \\
& \frac{(-t^2-4t^4+t^6)\alpha_{34}}{2(-1+t^2)(1+t^2)} - t^4\alpha_{55} - \frac{3t^4\alpha_{81}}{2(-1+t^2)} + \alpha_{83} + \frac{t^2(1+t^2)\alpha_{97}}{2(-1+t^2)}, \alpha_{112} \rightarrow 0, \\
\alpha_{113} \rightarrow & \frac{t\alpha_3}{(-1+t^2)^2} - \frac{t\alpha_6}{-1+t^2} - \frac{t\alpha_{12}}{2} + \frac{t^5\alpha_{21}}{(-1+t^2)^2} + \frac{t^3\alpha_{23}}{(-1+t^2)^2} + \frac{t^3\alpha_{28}}{(-1+t^2)^2} - \\
& \frac{(-t+3t^3-t^5)\alpha_{34}}{2(-1+t^2)^2} + \alpha_{42} + \alpha_{43} + t^2\alpha_{44} + \frac{t^3\alpha_{55}}{-1+t^2} - t^2\alpha_{75} + \frac{t^3\alpha_{81}}{(-1+t^2)^2} - \frac{t^3\alpha_{97}}{2(-1+t^2)^2} - t^2\alpha_{99}, \\
\alpha_{114} \rightarrow & \frac{t^3\alpha_{12}}{2(1+t^2)} - \frac{t^3\alpha_{23}}{2(-1+t^2)} - \frac{t^3\alpha_{34}}{2(1+t^2)}, \alpha_{115} \rightarrow \frac{t(-2+t^2)\alpha_3}{2(-1+t^2)^2} + \frac{t\alpha_6}{2(-1+t^2)} - \\
& \frac{t^3\alpha_{21}}{2(-1+t^2)^2} + \frac{t^3(-2+t^2)\alpha_{23}}{2(-1+t^2)^2} - \frac{t\alpha_{28}}{2(-1+t^2)^2} + \frac{t^3\alpha_{34}}{4(-1+t^2)^2} - \alpha_{42} - \alpha_{43} - t^2\alpha_{44} - \frac{t^3\alpha_{55}}{2(-1+t^2)} + \\
& t^2\alpha_{75} + \frac{t^3(-2+t^2)\alpha_{81}}{2(-1+t^2)^2} + \frac{t^3\alpha_{97}}{4(-1+t^2)^2} + t^2\alpha_{99}, \alpha_{116} \rightarrow -\frac{t\alpha_{34}}{2(-1+t^2)} - \frac{t\alpha_{97}}{2(-1+t^2)} \}
\end{aligned}$$

In[]:= Length[varsR3] - Length[soLR3]

Out[*]=

23

In[*]:= $\mathbf{QP1}_{i,j,k,l} := \mathbf{0}[\epsilon]^2 + (\mathbf{QP}_{i,j,k,l} / \mathbf{solR3}) // \mathbf{CF}$ In[*]:= $\mathbf{QP1}_{i,j,k,l}$

Out[*]=

$$\begin{aligned}
& \left(\left(\left(\frac{1}{t} - t \right) p_i + \frac{p_j}{t} - \frac{2 p_k}{t} + t p_l \right) x_i + \right. \\
& \quad \left. (-t p_i + t p_k) x_j + \left(2 t p_i - \frac{p_j}{t} + \left(\frac{1}{t} - t \right) p_k - t p_l \right) x_k + \left(-\frac{p_i}{t} + \frac{p_k}{t} \right) x_l \right) + \\
& \left(p_i^2 x_i^2 \alpha_1 + p_i^2 x_i x_k \alpha_3 + p_i^2 x_j x_k \alpha_6 + p_i p_j x_i x_j \alpha_{12} + p_i p_k x_i^2 \alpha_{21} + p_i p_k x_i x_k \alpha_{23} + \right. \\
& \quad p_i p_k x_k^2 \alpha_{28} + p_i p_l x_i x_l \alpha_{34} + p_i p_j x_k x_l \left(-\frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{23}}{-1+t^2} + \frac{\alpha_{34}}{1+t^2} \right) + \\
& \quad p_j p_k x_i x_l \left(\frac{\alpha_{12}}{t^2 (1+t^2)} + \frac{\alpha_{23}}{t^2 (-1+t^2)} - \frac{\alpha_{34}}{t^2 (1+t^2)} \right) + \\
& \quad p_j x_l \left(-\frac{\alpha_{12}}{2 t (1+t^2)} - \frac{\alpha_{23}}{2 t (-1+t^2)} + \frac{\alpha_{34}}{2 t (1+t^2)} \right) + p_i^2 x_k x_l \left(\frac{\alpha_6}{t^2} + \frac{t^2 \alpha_{12}}{1+t^2} - \frac{t^2 \alpha_{34}}{1+t^2} \right) + \\
& \quad p_k p_l x_i x_j \left(-\frac{t^2 \alpha_{12}}{1+t^2} + \frac{t^2 \alpha_{23}}{-1+t^2} + \frac{t^2 \alpha_{34}}{1+t^2} \right) + p_l x_j \left(\frac{t^3 \alpha_{12}}{2 (1+t^2)} - \frac{t^3 \alpha_{23}}{2 (-1+t^2)} - \frac{t^3 \alpha_{34}}{2 (1+t^2)} \right) + \\
& \quad p_i p_l x_j x_k \left(\frac{t^4 \alpha_{12}}{1+t^2} - \frac{t^4 \alpha_{23}}{-1+t^2} - \frac{t^4 \alpha_{34}}{1+t^2} \right) + p_i x_i \alpha_{41} + p_i x_j \alpha_{42} + p_i x_k \alpha_{43} + p_i x_l \alpha_{44} + \\
& \quad p_i^2 x_i x_l \left(-\frac{\alpha_3}{t^2} + \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{34}}{1+t^2} - \alpha_{50} \right) - p_j^2 x_i x_j \alpha_{50} + p_j^2 x_j x_k \alpha_{50} + p_j^2 x_k^2 \alpha_{52} + p_j p_k x_i^2 \alpha_{55} + \\
& \quad p_k p_l x_i^2 \left(\frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{34}}{1+t^2} + t^2 \alpha_{55} \right) + p_i p_l x_i^2 \left(\frac{t^2 \alpha_{12}}{1+t^2} - t^2 \alpha_{21} - \frac{t^2 \alpha_{34}}{1+t^2} - \alpha_{59} \right) - \\
& \quad p_i p_j x_j^2 \alpha_{59} + p_j p_k x_j^2 \alpha_{59} + p_k p_l x_k^2 \left(-\frac{t^2 \alpha_{12}}{1+t^2} - \alpha_{28} + \frac{t^2 \alpha_{34}}{1+t^2} + \alpha_{59} \right) + p_j x_i \alpha_{75} + \\
& \quad p_k^2 x_k x_l \left(-\frac{\alpha_{12}}{1+t^2} + \frac{\alpha_{34}}{1+t^2} + \alpha_{50} - \alpha_{81} \right) + p_k^2 x_i x_k \alpha_{81} + p_k^2 x_j^2 \alpha_{83} + p_k^2 x_k^2 \left(-\alpha_1 - \frac{(-1+t^2) \alpha_3}{2 t^2} - \right. \\
& \quad \left. \frac{1}{2} (1-t^2) \alpha_{21} - \frac{(-1+2 t^2-t^4) \alpha_{23}}{4 t^2} - \frac{(-1+t^2) \alpha_{28}}{2 t^2} - \frac{\alpha_{34}}{2} - \frac{1}{2} (1-t^2) \alpha_{81} - \frac{\alpha_{97}}{2} \right) + \\
& \quad p_k p_l x_k x_l \alpha_{97} + p_j p_k x_j x_k (-\alpha_{12} + \alpha_{34} + \alpha_{97}) + p_j p_k x_i x_j \left(-\frac{\alpha_{34}}{1-t^2} - \frac{\alpha_{97}}{1-t^2} \right) + \\
& \quad p_k p_l x_i x_l \left(-\frac{\alpha_{34}}{1-t^2} - \frac{\alpha_{97}}{1-t^2} \right) + p_j p_l x_k x_l \left(\frac{2 \alpha_3}{(-1+t^2)^2} - \frac{2 \alpha_6}{t^2 (-1+t^2)} - \frac{\alpha_{12}}{1+t^2} + \frac{2 t^2 \alpha_{21}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-1-t^2) \alpha_{23}}{(-1+t^2)^2} + \frac{2 \alpha_{28}}{(-1+t^2)^2} - \frac{(3 t^2-t^4) \alpha_{34}}{(-1+t^2)^2 (1+t^2)} + \frac{2 t^2 \alpha_{55}}{-1+t^2} + \frac{2 t^2 \alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{(-1+t^2)^2} \right) +
\end{aligned}$$

$$\begin{aligned}
& p_j^2 x_k x_1 \left(\frac{\alpha_3}{t^2 (-1+t^2)^2} - \frac{\alpha_6}{t^4 (-1+t^2)} + \frac{\alpha_{21}}{(-1+t^2)^2} + \frac{\alpha_{23}}{(-1+t^2)^2} + \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \right. \\
& \quad \left. \frac{\alpha_{34}}{2 (-1+t^2)^2} + \frac{\alpha_{55}}{-1+t^2} + \frac{\alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_i p_j x_i x_1 \left(\frac{\alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{t^2 (-1+t^2)} - \frac{\alpha_{12}}{t^2 (1+t^2)} + \frac{\alpha_{21}}{(-1+t^2)^2} - \frac{(-1+t^2-t^4) \alpha_{23}}{t^2 (-1+t^2)^2} + \right. \\
& \quad \left. \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(-2+5t^2-t^4) \alpha_{34}}{2 t^2 (-1+t^2)^2 (1+t^2)} + \frac{\alpha_{55}}{-1+t^2} + \frac{t^2 \alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_j p_i x_1^2 \left(\frac{\alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{t^2 (-1+t^2)} - \frac{\alpha_{12}}{1+t^2} + \frac{t^2 \alpha_{21}}{(-1+t^2)^2} + \frac{\alpha_{23}}{(-1+t^2)^2} + \frac{\alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-1+5t^2-2t^4) \alpha_{34}}{2 (-1+t^2)^2 (1+t^2)} - \frac{(-2t^2+t^4) \alpha_{55}}{-1+t^2} + \frac{t^2 \alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_j^2 x_i x_1 \left(-\frac{\alpha_3}{t^2 (-1+t^2)^2} + \frac{\alpha_6}{t^4 (-1+t^2)} - \frac{\alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{(-1+t^2)^2} - \frac{\alpha_{28}}{t^2 (-1+t^2)^2} + \right. \\
& \quad \left. \frac{\alpha_{34}}{2 (-1+t^2)^2} - \frac{\alpha_{55}}{-1+t^2} - \frac{\alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_j p_k x_k x_1 \left(-\frac{\alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{t^2 (-1+t^2)} + \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(1-5t^2+2t^4) \alpha_{34}}{2 (-1+t^2)^2 (1+t^2)} - \frac{\alpha_{55}}{-1+t^2} - \frac{t^2 \alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_j p_k x_i x_k \left(-\frac{\alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{t^2 (-1+t^2)} - \frac{(-1+2t^2) \alpha_{21}}{(-1+t^2)^2} - \frac{t^2 \alpha_{23}}{(-1+t^2)^2} - \frac{(-1+2t^2) \alpha_{28}}{t^2 (-1+t^2)^2} + \right. \\
& \quad \left. \frac{\alpha_{34}}{2 (-1+t^2)^2} - \frac{(-1+2t^2) \alpha_{55}}{-1+t^2} - \frac{t^2 \alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_j p_i x_i x_1 \left(-\frac{2 \alpha_3}{(-1+t^2)^2} + \frac{2 \alpha_6}{t^2 (-1+t^2)} + \frac{\alpha_{12}}{1+t^2} - \frac{2 t^2 \alpha_{21}}{(-1+t^2)^2} - \frac{(1+t^2) \alpha_{23}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{2 \alpha_{28}}{(-1+t^2)^2} - \frac{(-3t^2+t^4) \alpha_{34}}{(-1+t^2)^2 (1+t^2)} - \frac{2 t^2 \alpha_{55}}{-1+t^2} - \frac{2 t^2 \alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{(-1+t^2)^2} \right) + \\
& p_j p_k x_1^2 \left(\frac{\alpha_3}{t^2 (-1+t^2)^2} - \frac{\alpha_6}{t^4 (-1+t^2)} - \frac{\alpha_{12}}{t^2 (1+t^2)} + \frac{\alpha_{21}}{(-1+t^2)^2} + \frac{\alpha_{23}}{t^2 (-1+t^2)^2} + \right. \\
& \quad \left. \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(-1+5t^2-2t^4) \alpha_{34}}{2 t^2 (-1+t^2)^2 (1+t^2)} + \frac{\alpha_{55}}{-1+t^2} + \frac{\alpha_{81}}{(-1+t^2)^2} - \frac{\alpha_{97}}{2 t^2 (-1+t^2)^2} \right) +
\end{aligned}$$

$$\begin{aligned}
& p_i p_j x_1^2 \left(-\frac{\alpha_3}{t^2 (-1+t^2)^2} + \frac{\alpha_6}{t^4 (-1+t^2)} + \frac{\alpha_{12}}{t^2 (1+t^2)} - \frac{\alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{t^2 (-1+t^2)^2} - \right. \\
& \quad \left. \frac{\alpha_{28}}{t^2 (-1+t^2)^2} - \frac{(1-5t^2+2t^4)\alpha_{34}}{2t^2 (-1+t^2)^2 (1+t^2)} - \frac{\alpha_{55}}{-1+t^2} - \frac{\alpha_{81}}{(-1+t^2)^2} + \frac{\alpha_{97}}{2t^2 (-1+t^2)^2} \right) + \\
& p_j x_k \left(\frac{t\alpha_3}{2(-1+t^2)^2} - \frac{\alpha_6}{2t(-1+t^2)} + \frac{t(-1+2t^2)\alpha_{21}}{2(-1+t^2)^2} + \frac{t^3\alpha_{23}}{2(-1+t^2)^2} - \frac{(1-2t^2)\alpha_{28}}{2t(-1+t^2)^2} - \right. \\
& \quad \left. \frac{t\alpha_{34}}{4(-1+t^2)^2} + \frac{t\alpha_{55}}{2(-1+t^2)} - \alpha_{75} + \frac{t^3\alpha_{81}}{2(-1+t^2)^2} - \frac{t\alpha_{97}}{4(-1+t^2)^2} \right) + \\
& p_k x_1 \left(-\frac{(2-t^2)\alpha_3}{2t(-1+t^2)^2} + \frac{\alpha_6}{2t(-1+t^2)} + \frac{\alpha_{12}}{2t} - \frac{t\alpha_{21}}{2(-1+t^2)^2} - \frac{\alpha_{23}}{2t(-1+t^2)^2} - \right. \\
& \quad \left. \frac{\alpha_{28}}{2t(-1+t^2)^2} - \frac{(2-5t^2+2t^4)\alpha_{34}}{4t(-1+t^2)^2} - \alpha_{44} - \frac{t\alpha_{55}}{2(-1+t^2)} + \frac{t(-2+t^2)\alpha_{81}}{2(-1+t^2)^2} + \frac{t\alpha_{97}}{4(-1+t^2)^2} \right) + \\
& p_j p_k x_j x_1 \left(\frac{2\alpha_3}{(-1+t^2)^2} - \frac{2\alpha_6}{t^2(-1+t^2)} - \frac{\alpha_{12}}{1+t^2} + \frac{2t^2\alpha_{21}}{(-1+t^2)^2} - \frac{(-1-t^2)\alpha_{23}}{(-1+t^2)^2} + \right. \\
& \quad \left. \frac{2\alpha_{28}}{(-1+t^2)^2} - \frac{(-1+3t^2)\alpha_{34}}{(-1+t^2)^2(1+t^2)} + \frac{2t^2\alpha_{55}}{-1+t^2} + \frac{2t^2\alpha_{81}}{(-1+t^2)^2} - \frac{t^2\alpha_{97}}{(-1+t^2)^2} \right) + \\
& p_j p_1 x_j x_k \left(\frac{2t^2\alpha_3}{(-1+t^2)^2} - \frac{2\alpha_6}{-1+t^2} - \frac{t^2\alpha_{12}}{1+t^2} + \frac{2t^4\alpha_{21}}{(-1+t^2)^2} - \frac{(-t^2-t^4)\alpha_{23}}{(-1+t^2)^2} + \frac{2t^2\alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(3t^4-t^6)\alpha_{34}}{(-1+t^2)^2(1+t^2)} + \frac{2t^4\alpha_{55}}{-1+t^2} + \frac{2t^4\alpha_{81}}{(-1+t^2)^2} - \frac{t^2\alpha_{97}}{(-1+t^2)^2} \right) + \\
& p_k p_1 x_i x_k \left(-\frac{t^2\alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{-1+t^2} - \frac{(1-t^2)\alpha_{12}}{1+t^2} - \frac{t^2(-1+2t^2)\alpha_{21}}{(-1+t^2)^2} - \frac{t^4\alpha_{23}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-1+2t^2)\alpha_{28}}{(-1+t^2)^2} - \frac{(-2+5t^2-7t^4+2t^6)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{(-t^2+2t^4)\alpha_{55}}{-1+t^2} - \frac{t^4\alpha_{81}}{(-1+t^2)^2} + \frac{t^2\alpha_{97}}{2(-1+t^2)^2} \right) + \\
& p_i p_k x_k x_1 \left(-\frac{(2-t^2)\alpha_3}{(-1+t^2)^2} - \frac{(-2+t^2)\alpha_6}{t^2(-1+t^2)} - \frac{(-1+t^2)\alpha_{12}}{1+t^2} - \frac{t^2\alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{\alpha_{28}}{(-1+t^2)^2} - \frac{(2-7t^2+5t^4-2t^6)\alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{t^2\alpha_{55}}{-1+t^2} + \frac{t^2(-2+t^2)\alpha_{81}}{(-1+t^2)^2} + \frac{t^2\alpha_{97}}{2(-1+t^2)^2} \right) + \\
& p_i p_j x_j x_1 \left(-\frac{2\alpha_3}{(-1+t^2)^2} + \frac{2\alpha_6}{t^2(-1+t^2)} + \frac{\alpha_{12}}{1+t^2} - \frac{2t^2\alpha_{21}}{(-1+t^2)^2} - \frac{(1+t^2)\alpha_{23}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{2\alpha_{28}}{(-1+t^2)^2} - \frac{(1-3t^2)\alpha_{34}}{(-1+t^2)^2(1+t^2)} - \frac{2t^2\alpha_{55}}{-1+t^2} - \frac{2t^2\alpha_{81}}{(-1+t^2)^2} + \frac{t^2\alpha_{97}}{(-1+t^2)^2} \right) +
\end{aligned}$$

$$\begin{aligned}
& p_j p_1 x_i x_j \left(-\frac{2 t^2 \alpha_3}{(-1+t^2)^2} + \frac{2 \alpha_6}{-1+t^2} + \frac{t^2 \alpha_{12}}{1+t^2} - \frac{2 t^4 \alpha_{21}}{(-1+t^2)^2} - \frac{(t^2+t^4) \alpha_{23}}{(-1+t^2)^2} - \frac{2 t^2 \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-3 t^4+t^6) \alpha_{34}}{(-1+t^2)^2 (1+t^2)} - \frac{2 t^4 \alpha_{55}}{-1+t^2} - \frac{2 t^4 \alpha_{81}}{(-1+t^2)^2} + \frac{t^2 \alpha_{97}}{(-1+t^2)^2} \right) + \\
& p_k x_j \left(\frac{t (-2+t^2) \alpha_3}{2 (-1+t^2)^2} + \frac{t \alpha_6}{2 (-1+t^2)} - \frac{t^3 \alpha_{21}}{2 (-1+t^2)^2} - \frac{t \alpha_{23}}{2 (-1+t^2)^2} - \frac{t \alpha_{28}}{2 (-1+t^2)^2} + \right. \\
& \quad \left. \frac{t^3 \alpha_{34}}{4 (-1+t^2)^2} - \alpha_{42} - \frac{t^3 \alpha_{55}}{2 (-1+t^2)} + \frac{t^3 (-2+t^2) \alpha_{81}}{2 (-1+t^2)^2} + \frac{t^3 \alpha_{97}}{4 (-1+t^2)^2} \right) + \\
& p_k p_1 x_j x_1 \left(\frac{2 t^2 \alpha_3}{(-1+t^2)^2} - \frac{2 \alpha_6}{-1+t^2} - \frac{t^2 \alpha_{12}}{1+t^2} + \frac{2 t^4 \alpha_{21}}{(-1+t^2)^2} - \frac{(-t^2-t^4) \alpha_{23}}{(-1+t^2)^2} + \frac{2 t^2 \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-t^2+3 t^4) \alpha_{34}}{(-1+t^2)^2 (1+t^2)} + \frac{2 t^4 \alpha_{55}}{-1+t^2} + \frac{2 t^4 \alpha_{81}}{(-1+t^2)^2} - \frac{t^4 \alpha_{97}}{(-1+t^2)^2} \right) + \\
& p_i^2 x_j x_1 \left(\frac{t^2 \alpha_3}{(-1+t^2)^2} - \frac{(-1+2 t^2) \alpha_6}{t^2 (-1+t^2)} - \frac{t^2 \alpha_{12}}{1+t^2} + \frac{t^4 \alpha_{21}}{(-1+t^2)^2} + \frac{t^4 \alpha_{23}}{(-1+t^2)^2} + \frac{t^2 \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-2 t^2+5 t^4-t^6) \alpha_{34}}{2 (-1+t^2)^2 (1+t^2)} + \frac{t^4 \alpha_{55}}{-1+t^2} + \frac{t^4 \alpha_{81}}{(-1+t^2)^2} - \frac{t^4 \alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_i p_1 x_i x_j \left(\frac{t^4 \alpha_3}{(-1+t^2)^2} - \frac{t^2 \alpha_6}{-1+t^2} - \frac{t^4 \alpha_{12}}{1+t^2} + \frac{t^4 \alpha_{21}}{(-1+t^2)^2} - \frac{(-t^2+t^4-t^6) \alpha_{23}}{(-1+t^2)^2} + \right. \\
& \quad \left. \frac{t^2 \alpha_{28}}{(-1+t^2)^2} - \frac{(-t^4+5 t^6-2 t^8) \alpha_{34}}{2 (-1+t^2)^2 (1+t^2)} + \frac{t^4 \alpha_{55}}{-1+t^2} + \frac{t^6 \alpha_{81}}{(-1+t^2)^2} - \frac{t^4 \alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_k p_1 x_j^2 \left(\frac{t^4 \alpha_3}{(-1+t^2)^2} - \frac{t^2 \alpha_6}{-1+t^2} + \frac{t^6 \alpha_{21}}{(-1+t^2)^2} + \frac{t^4 \alpha_{23}}{(-1+t^2)^2} + \frac{t^4 \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{t^4 \alpha_{34}}{2 (-1+t^2)^2} + \frac{t^6 \alpha_{55}}{-1+t^2} + \frac{t^6 \alpha_{81}}{(-1+t^2)^2} - \frac{t^4 \alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_k p_1 x_j x_k \left(-\frac{t^4 \alpha_3}{(-1+t^2)^2} + \frac{t^2 \alpha_6}{-1+t^2} + \frac{t^2 \alpha_{12}}{1+t^2} - \frac{t^4 \alpha_{21}}{(-1+t^2)^2} - \frac{t^4 \alpha_{23}}{(-1+t^2)^2} - \frac{t^2 \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(2 t^2-5 t^4+t^6) \alpha_{34}}{2 (-1+t^2)^2 (1+t^2)} - \frac{t^4 \alpha_{55}}{-1+t^2} - \frac{t^6 \alpha_{81}}{(-1+t^2)^2} + \frac{t^4 \alpha_{97}}{2 (-1+t^2)^2} \right) + \\
& p_i p_1 x_j^2 \left(-\frac{t^4 \alpha_3}{(-1+t^2)^2} + \frac{t^2 \alpha_6}{-1+t^2} - \frac{t^6 \alpha_{21}}{(-1+t^2)^2} - \frac{t^4 \alpha_{23}}{(-1+t^2)^2} - \frac{t^4 \alpha_{28}}{(-1+t^2)^2} + \right. \\
& \quad \left. \frac{t^4 \alpha_{34}}{2 (-1+t^2)^2} - \frac{t^6 \alpha_{55}}{-1+t^2} - \frac{t^6 \alpha_{81}}{(-1+t^2)^2} + \frac{t^4 \alpha_{97}}{2 (-1+t^2)^2} \right) +
\end{aligned}$$

$$\begin{aligned}
& p_i p_k x_j x_k \left(\frac{t^2 (-2 + t^2) \alpha_3}{(-1 + t^2)^2} - \frac{(-2 + t^2) \alpha_6}{-1 + t^2} - \frac{t^4 \alpha_{21}}{(-1 + t^2)^2} - \frac{t^2 \alpha_{23}}{(-1 + t^2)^2} - \frac{t^2 \alpha_{28}}{(-1 + t^2)^2} + \right. \\
& \quad \left. \frac{t^4 \alpha_{34}}{2 (-1 + t^2)^2} - \frac{t^4 \alpha_{55}}{-1 + t^2} + \frac{t^4 (-2 + t^2) \alpha_{81}}{(-1 + t^2)^2} + \frac{t^4 \alpha_{97}}{2 (-1 + t^2)^2} \right) + \\
& p_i p_1 x_j x_1 \left(-\frac{2 t^2 \alpha_3}{(-1 + t^2)^2} + \frac{2 \alpha_6}{-1 + t^2} + \frac{t^2 \alpha_{12}}{1 + t^2} - \frac{2 t^4 \alpha_{21}}{(-1 + t^2)^2} - \frac{(t^2 + t^4) \alpha_{23}}{(-1 + t^2)^2} - \frac{2 t^2 \alpha_{28}}{(-1 + t^2)^2} - \right. \\
& \quad \left. \frac{(t^2 - 3 t^4) \alpha_{34}}{(-1 + t^2)^2 (1 + t^2)} - \frac{2 t^4 \alpha_{55}}{-1 + t^2} - \frac{2 t^4 \alpha_{81}}{(-1 + t^2)^2} + \frac{t^4 \alpha_{97}}{(-1 + t^2)^2} \right) + \\
& p_1^2 x_j x_k \left(\frac{t^4 \alpha_3}{(-1 + t^2)^2} - \frac{t^2 \alpha_6}{-1 + t^2} - \frac{t^4 \alpha_{12}}{1 + t^2} + \frac{t^6 \alpha_{21}}{(-1 + t^2)^2} + \frac{t^6 \alpha_{23}}{(-1 + t^2)^2} + \frac{t^4 \alpha_{28}}{(-1 + t^2)^2} - \right. \\
& \quad \left. \frac{(-2 t^4 + 5 t^6 - t^8) \alpha_{34}}{2 (-1 + t^2)^2 (1 + t^2)} + \frac{t^6 \alpha_{55}}{-1 + t^2} + \frac{t^6 \alpha_{81}}{(-1 + t^2)^2} - \frac{t^6 \alpha_{97}}{2 (-1 + t^2)^2} \right) + \\
& p_1^2 x_i x_j \left(-\frac{t^4 \alpha_3}{(-1 + t^2)^2} + \frac{t^2 \alpha_6}{-1 + t^2} + \frac{t^4 \alpha_{12}}{1 + t^2} - \frac{t^6 \alpha_{21}}{(-1 + t^2)^2} - \frac{t^6 \alpha_{23}}{(-1 + t^2)^2} - \frac{t^4 \alpha_{28}}{(-1 + t^2)^2} - \right. \\
& \quad \left. \frac{(2 t^4 - 5 t^6 + t^8) \alpha_{34}}{2 (-1 + t^2)^2 (1 + t^2)} - \frac{t^6 \alpha_{55}}{-1 + t^2} - \frac{t^6 \alpha_{81}}{(-1 + t^2)^2} + \frac{t^6 \alpha_{97}}{2 (-1 + t^2)^2} \right) + \\
& p_j p_1 x_k^2 \left(-\frac{(-1 + 2 t^2) \alpha_3}{(-1 + t^2)^2} - \frac{(1 - 2 t^2) \alpha_6}{t^2 (-1 + t^2)} + \frac{t^2 \alpha_{12}}{1 + t^2} - \frac{t^2 (-1 + 2 t^2) \alpha_{21}}{(-1 + t^2)^2} - \frac{t^4 \alpha_{23}}{(-1 + t^2)^2} - \right. \\
& \quad \left. \frac{(-1 + 2 t^2) \alpha_{28}}{(-1 + t^2)^2} - \frac{(1 + t^2 - 6 t^4 + 2 t^6) \alpha_{34}}{2 (-1 + t^2)^2 (1 + t^2)} - \frac{t^4 \alpha_{55}}{-1 + t^2} - \frac{t^2 (-1 + 2 t^2) \alpha_{81}}{(-1 + t^2)^2} - \frac{(1 - 2 t^2) \alpha_{97}}{2 (-1 + t^2)^2} \right) + \\
& p_i p_j x_i x_k \left(-\frac{(-2 + t^2) \alpha_3}{(-1 + t^2)^2} - \frac{(2 - t^2) \alpha_6}{t^2 (-1 + t^2)} + \frac{t^2 \alpha_{21}}{(-1 + t^2)^2} - \frac{t^2 (-2 + t^2) \alpha_{23}}{(-1 + t^2)^2} + \right. \\
& \quad \left. \frac{\alpha_{28}}{(-1 + t^2)^2} - \frac{(2 - t^2) \alpha_{34}}{2 (-1 + t^2)^2} + \frac{t^2 \alpha_{55}}{-1 + t^2} - \frac{t^2 (-2 + t^2) \alpha_{81}}{(-1 + t^2)^2} - \frac{(2 - t^2) \alpha_{97}}{2 (-1 + t^2)^2} \right) + \\
& p_j p_1 x_i x_k \left(\frac{2 \alpha_3}{-1 + t^2} - \frac{2 \alpha_6}{t^2} - \frac{(-1 + t^2) \alpha_{12}}{1 + t^2} + \frac{2 t^2 \alpha_{21}}{-1 + t^2} - \frac{(-1 - t^2) \alpha_{23}}{-1 + t^2} + \frac{2 \alpha_{28}}{-1 + t^2} - \right. \\
& \quad \left. \frac{(3 t^2 - t^4) \alpha_{34}}{(-1 + t^2) (1 + t^2)} + 2 t^2 \alpha_{55} + \frac{2 t^2 \alpha_{81}}{-1 + t^2} - \frac{\alpha_{97}}{-1 + t^2} \right) + p_j^2 x_i x_k \\
& \quad \left(\frac{\alpha_3}{t^2 (-1 + t^2)} - \frac{\alpha_6}{t^4} - \frac{\alpha_{21}}{1 - t^2} - \frac{\alpha_{23}}{1 - t^2} + \frac{\alpha_{28}}{t^2 (-1 + t^2)} - \frac{\alpha_{34}}{2 (-1 + t^2)} + \alpha_{55} - \frac{\alpha_{81}}{1 - t^2} - \frac{\alpha_{97}}{2 (-1 + t^2)} \right) + \\
& p_k^2 x_1^2 \left(\frac{\alpha_3}{2 t^2 (-1 + t^2)} + \frac{\alpha_{21}}{2 (-1 + t^2)} - \frac{(-1 - t^2) \alpha_{23}}{4 t^2 (-1 + t^2)} + \frac{\alpha_{28}}{2 t^2 (-1 + t^2)} - \right.
\end{aligned}$$

$$\begin{aligned}
& \left. \frac{\alpha_{34}}{2(-1+t^2)} + \frac{\alpha_{81}}{2(-1+t^2)} - \frac{\alpha_{97}}{2(-1+t^2)} \right) + \\
& p_i p_j x_k^2 \left(-\frac{\alpha_3}{1-t^2} - \frac{\alpha_6}{t^2} + \frac{t^2 \alpha_{21}}{-1+t^2} + \frac{t^2 \alpha_{23}}{-1+t^2} - \frac{\alpha_{28}}{1-t^2} - \frac{\alpha_{34}}{2(-1+t^2)} + \frac{t^2 \alpha_{81}}{-1+t^2} - \frac{\alpha_{97}}{2(-1+t^2)} \right) + \\
& p_k^2 x_i x_1 \left(-\frac{\alpha_3}{t^2(-1+t^2)} - \frac{\alpha_{12}}{t^2(1+t^2)} - \frac{\alpha_{21}}{-1+t^2} - \frac{\alpha_{23}}{t^2(-1+t^2)} - \right. \\
& \quad \left. \frac{\alpha_{28}}{t^2(-1+t^2)} - \frac{(2-3t^2-t^4)\alpha_{34}}{2t^2(-1+t^2)(1+t^2)} - \alpha_{55} - \frac{\alpha_{81}}{-1+t^2} + \frac{\alpha_{97}}{2(-1+t^2)} \right) + \\
& p_j^2 x_1^2 \left(-\frac{\alpha_3}{t^2(-1+t^2)} + \frac{\alpha_6}{t^4} - \frac{\alpha_{21}}{-1+t^2} - \frac{\alpha_{23}}{-1+t^2} - \frac{\alpha_{28}}{t^2(-1+t^2)} + \frac{\alpha_{34}}{2(-1+t^2)} - \alpha_{52} - \alpha_{55} - \right. \\
& \quad \left. \frac{\alpha_{81}}{-1+t^2} + \frac{\alpha_{97}}{2(-1+t^2)} \right) + p_i^2 x_1^2 \left(-\frac{\alpha_3}{2t^2(-1+t^2)} - \frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{21}}{2(-1+t^2)} - \frac{(-1+3t^2)\alpha_{23}}{4t^2(-1+t^2)} - \right. \\
& \quad \left. \frac{\alpha_{28}}{2t^2(-1+t^2)} - \frac{(1-3t^2)\alpha_{34}}{2(-1+t^2)(1+t^2)} - \alpha_{52} - \frac{\alpha_{81}}{2(-1+t^2)} + \frac{\alpha_{97}}{2(-1+t^2)} \right) + \\
& p_i p_k x_1^2 \left(-\frac{\alpha_3}{t^2(-1+t^2)} + \frac{\alpha_6}{t^4} - \frac{(1-t^2)\alpha_{12}}{t^2(1+t^2)} - \frac{\alpha_{21}}{-1+t^2} - \frac{\alpha_{23}}{t^2(-1+t^2)} - \frac{\alpha_{28}}{t^2(-1+t^2)} - \right. \\
& \quad \left. \frac{(1-5t^2+2t^4)\alpha_{34}}{2t^2(-1+t^2)(1+t^2)} - \alpha_{55} - \frac{\alpha_{81}}{-1+t^2} + \frac{\alpha_{97}}{2t^2(-1+t^2)} \right) + \\
& p_j x_j \left(-\frac{t\alpha_{34}}{2(-1+t^2)} - \frac{t\alpha_{97}}{2(-1+t^2)} \right) + p_1 x_1 \left(-\frac{t\alpha_{34}}{2(-1+t^2)} - \frac{t\alpha_{97}}{2(-1+t^2)} \right) + \\
& p_i p_j x_j x_k \left(-\frac{t^2\alpha_{34}}{-1+t^2} - \frac{t^2\alpha_{97}}{-1+t^2} \right) + p_i p_1 x_k x_1 \left(-\frac{t^2\alpha_{34}}{-1+t^2} - \frac{t^2\alpha_{97}}{-1+t^2} \right) + \\
& p_i p_1 x_k^2 \left(\frac{t^2\alpha_3}{-1+t^2} - \alpha_6 - \frac{t^4\alpha_{12}}{1+t^2} + \frac{t^4\alpha_{21}}{-1+t^2} + \frac{t^4\alpha_{23}}{-1+t^2} + \right. \\
& \quad \left. \frac{t^2\alpha_{28}}{-1+t^2} - \frac{(t^2+3t^4-2t^6)\alpha_{34}}{2(-1+t^2)(1+t^2)} + \frac{t^4\alpha_{81}}{-1+t^2} - \frac{t^2\alpha_{97}}{2(-1+t^2)} \right) + \\
& p_1^2 x_1^2 \left(\frac{t^2\alpha_3}{2(-1+t^2)} - \frac{t^2\alpha_{12}}{1+t^2} + \frac{t^4\alpha_{21}}{2(-1+t^2)} - \frac{t^2(-3+t^2)\alpha_{23}}{4(-1+t^2)} + \frac{t^2\alpha_{28}}{2(-1+t^2)} - \right. \\
& \quad \left. \frac{(3t^2-t^4)\alpha_{34}}{2(-1+t^2)(1+t^2)} + \frac{t^4\alpha_{81}}{2(-1+t^2)} - \alpha_{83} - \frac{t^2\alpha_{97}}{2(-1+t^2)} \right) + p_i^2 x_j^2 \\
& \left(\frac{t^2\alpha_3}{-1+t^2} - \alpha_6 + \frac{t^4\alpha_{21}}{-1+t^2} + \frac{t^2\alpha_{23}}{-1+t^2} + \frac{t^2\alpha_{28}}{-1+t^2} - \frac{t^2\alpha_{34}}{2(-1+t^2)} + t^4\alpha_{55} + \frac{t^4\alpha_{81}}{-1+t^2} - \alpha_{83} - \frac{t^2\alpha_{97}}{2(-1+t^2)} \right) + \\
& p_k^2 x_i x_j \left(-\frac{\alpha_3}{-1+t^2} - \frac{t^2\alpha_{21}}{-1+t^2} - \frac{\alpha_{23}}{-1+t^2} - \frac{\alpha_{28}}{-1+t^2} + \frac{t^2\alpha_{34}}{2(-1+t^2)} - t^2\alpha_{55} - \frac{t^2\alpha_{81}}{-1+t^2} + \frac{t^2\alpha_{97}}{2(-1+t^2)} \right) +
\end{aligned}$$

$$\begin{aligned}
& p_i p_k x_j^2 \left(-\frac{t^2 \alpha_3}{-1+t^2} + \alpha_6 - \frac{t^4 \alpha_{21}}{-1+t^2} - \frac{t^2 \alpha_{23}}{-1+t^2} - \frac{t^2 \alpha_{28}}{-1+t^2} + \frac{t^2 \alpha_{34}}{2(-1+t^2)} - t^4 \alpha_{55} - \frac{t^4 \alpha_{81}}{-1+t^2} + \frac{t^2 \alpha_{97}}{2(-1+t^2)} \right) + \\
& p_i^2 x_k^2 \left(-\frac{t^2 \alpha_3}{2(-1+t^2)} - \frac{t^4 \alpha_{21}}{2(-1+t^2)} - \frac{(t^2+t^4) \alpha_{23}}{4(-1+t^2)} - \frac{t^2 \alpha_{28}}{2(-1+t^2)} + \frac{t^2 \alpha_{34}}{2(-1+t^2)} - \right. \\
& \quad \left. \frac{t^4 \alpha_{81}}{2(-1+t^2)} + \frac{t^2 \alpha_{97}}{2(-1+t^2)} \right) + p_i p_k x_j x_1 \left(-\frac{2 \alpha_3}{-1+t^2} + \frac{2 \alpha_6}{t^2} - \frac{(1-t^2) \alpha_{12}}{1+t^2} - \frac{2 t^2 \alpha_{21}}{-1+t^2} - \right. \\
& \quad \left. \frac{(1+t^2) \alpha_{23}}{-1+t^2} - \frac{2 \alpha_{28}}{-1+t^2} - \frac{(1-3t^2) \alpha_{34}}{(-1+t^2)(1+t^2)} - 2 t^2 \alpha_{55} - \frac{2 t^2 \alpha_{81}}{-1+t^2} + \frac{t^2 \alpha_{97}}{-1+t^2} \right) + \\
& p_i^2 x_i x_k \left(\frac{t^2 \alpha_3}{-1+t^2} - \alpha_6 - \frac{t^2(-1+t^2) \alpha_{12}}{1+t^2} + \frac{t^4 \alpha_{21}}{-1+t^2} + \frac{t^4 \alpha_{23}}{-1+t^2} + \frac{t^2 \alpha_{28}}{-1+t^2} - \right. \\
& \quad \left. \frac{(-2t^2+5t^4-t^6) \alpha_{34}}{2(-1+t^2)(1+t^2)} + t^4 \alpha_{55} + \frac{t^4 \alpha_{81}}{-1+t^2} - \frac{t^4 \alpha_{97}}{2(-1+t^2)} \right) + \\
& p_k^2 x_1^2 \left(\frac{3 \alpha_3}{2t^2(-1+t^2)} - \frac{\alpha_6}{t^4} + \frac{\alpha_{12}}{t^2(1+t^2)} + \frac{3 \alpha_{21}}{2(-1+t^2)} + \frac{3(1+t^2) \alpha_{23}}{4t^2(-1+t^2)} + \frac{3 \alpha_{28}}{2t^2(-1+t^2)} - \right. \\
& \quad \left. \frac{(-1+4t^2+t^4) \alpha_{34}}{2t^2(-1+t^2)(1+t^2)} + \alpha_{52} + \alpha_{55} + \frac{3 \alpha_{81}}{2(-1+t^2)} - \frac{(1+t^2) \alpha_{97}}{2t^2(-1+t^2)} \right) + \\
& p_i^2 x_k^2 \left(-\frac{3t^2 \alpha_3}{2(-1+t^2)} + \alpha_6 + \frac{t^4 \alpha_{12}}{1+t^2} - \frac{3t^4 \alpha_{21}}{2(-1+t^2)} - \frac{3(t^2+t^4) \alpha_{23}}{4(-1+t^2)} - \frac{3t^2 \alpha_{28}}{2(-1+t^2)} - \right. \\
& \quad \left. \frac{(-t^2-4t^4+t^6) \alpha_{34}}{2(-1+t^2)(1+t^2)} - t^4 \alpha_{55} - \frac{3t^4 \alpha_{81}}{2(-1+t^2)} + \alpha_{83} + \frac{t^2(1+t^2) \alpha_{97}}{2(-1+t^2)} \right) + \\
& p_i p_k x_i x_1 \left(\frac{\alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{t^2(-1+t^2)} - \frac{(-1+t^2) \alpha_{12}}{t^2(1+t^2)} - \frac{(1-2t^2) \alpha_{21}}{(-1+t^2)^2} - \frac{(1-2t^2) \alpha_{23}}{t^2(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(1-2t^2) \alpha_{28}}{t^2(-1+t^2)^2} - \frac{(2-7t^2+7t^4) \alpha_{34}}{2t^2(-1+t^2)^2(1+t^2)} - \frac{(1-2t^2) \alpha_{55}}{-1+t^2} + \frac{t^2 \alpha_{81}}{(-1+t^2)^2} - \frac{(-1+2t^2) \alpha_{97}}{2(-1+t^2)^2} \right) + \\
& p_i p_1 x_i x_k \left(-\frac{t^2(-2+t^2) \alpha_3}{(-1+t^2)^2} - \frac{(2-t^2) \alpha_6}{-1+t^2} + \frac{t^2(-1+t^2) \alpha_{12}}{1+t^2} + \frac{t^4 \alpha_{21}}{(-1+t^2)^2} - \frac{t^4(-2+t^2) \alpha_{23}}{(-1+t^2)^2} + \right. \\
& \quad \left. \frac{t^2 \alpha_{28}}{(-1+t^2)^2} - \frac{(7t^4-7t^6+2t^8) \alpha_{34}}{2(-1+t^2)^2(1+t^2)} + \frac{t^4 \alpha_{55}}{-1+t^2} - \frac{t^4(-2+t^2) \alpha_{81}}{(-1+t^2)^2} - \frac{(2t^2-t^4) \alpha_{97}}{2(-1+t^2)^2} \right) + \\
& p_k^2 x_j x_1 \left(-\frac{(2-t^2) \alpha_3}{(-1+t^2)^2} + \frac{\alpha_6}{t^2(-1+t^2)} + \frac{\alpha_{12}}{1+t^2} + \frac{t^2(-2+t^2) \alpha_{21}}{(-1+t^2)^2} - \frac{\alpha_{23}}{(-1+t^2)^2} - \frac{(2-t^2) \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(2-6t^2+t^4+t^6) \alpha_{34}}{2(-1+t^2)^2(1+t^2)} - \frac{(2t^2-t^4) \alpha_{55}}{-1+t^2} + \frac{t^2(-2+t^2) \alpha_{81}}{(-1+t^2)^2} - \frac{(-2t^2+t^4) \alpha_{97}}{2(-1+t^2)^2} \right) +
\end{aligned}$$

$$\begin{aligned}
& p_i p_k x_i x_j \left(\frac{t^2 \alpha_3}{(-1+t^2)^2} - \frac{\alpha_6}{-1+t^2} + \frac{t^2 (-1+2t^2) \alpha_{21}}{(-1+t^2)^2} - \frac{(1-2t^2) \alpha_{23}}{(-1+t^2)^2} - \frac{(1-2t^2) \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-t^2+2t^4) \alpha_{34}}{2(-1+t^2)^2} - \frac{(t^2-2t^4) \alpha_{55}}{-1+t^2} + \frac{t^4 \alpha_{81}}{(-1+t^2)^2} - \frac{(-t^2+2t^4) \alpha_{97}}{2(-1+t^2)^2} \right) + \\
& p_i p_j x_i^2 \left(-\frac{\alpha_{12}}{1+t^2} - \alpha_{21} + \frac{\alpha_{34}}{1+t^2} - \alpha_{98} \right) - p_i p_l x_l^2 \alpha_{98} + p_k p_l x_l^2 \alpha_{98} + \\
& p_j p_k x_k^2 \left(\frac{\alpha_{12}}{1+t^2} - \frac{\alpha_{28}}{t^2} - \frac{\alpha_{34}}{1+t^2} + \alpha_{98} \right) + p_k x_k \left(-\frac{\alpha_3}{t(-1+t^2)} - \frac{t^3 \alpha_{21}}{-1+t^2} - \right. \\
& \quad \left. \frac{(1+t^4) \alpha_{23}}{2t(-1+t^2)} - \frac{\alpha_{28}}{t(-1+t^2)} + \frac{t \alpha_{34}}{-1+t^2} - \alpha_{41} - \alpha_{43} - \frac{t^3 \alpha_{81}}{-1+t^2} + \frac{t \alpha_{97}}{-1+t^2} - \alpha_{99} \right) + \\
& p_k x_i \alpha_{99} + p_l x_i \left(\frac{t \alpha_3}{(-1+t^2)^2} - \frac{t \alpha_6}{-1+t^2} - \frac{t \alpha_{12}}{2} + \frac{t^5 \alpha_{21}}{(-1+t^2)^2} + \frac{t^3 \alpha_{23}}{(-1+t^2)^2} + \frac{t^3 \alpha_{28}}{(-1+t^2)^2} - \right. \\
& \quad \left. \frac{(-t+3t^3-t^5) \alpha_{34}}{2(-1+t^2)^2} + \alpha_{42} + \alpha_{43} + t^2 \alpha_{44} + \frac{t^3 \alpha_{55}}{-1+t^2} - t^2 \alpha_{75} + \frac{t^3 \alpha_{81}}{(-1+t^2)^2} - \frac{t^3 \alpha_{97}}{2(-1+t^2)^2} - t^2 \alpha_{99} \right) + \\
& p_l x_k \left(\frac{t(-2+t^2) \alpha_3}{2(-1+t^2)^2} + \frac{t \alpha_6}{2(-1+t^2)} - \frac{t^3 \alpha_{21}}{2(-1+t^2)^2} + \frac{t^3(-2+t^2) \alpha_{23}}{2(-1+t^2)^2} - \frac{t \alpha_{28}}{2(-1+t^2)^2} + \frac{t^3 \alpha_{34}}{4(-1+t^2)^2} - \right. \\
& \quad \left. \alpha_{42} - \alpha_{43} - t^2 \alpha_{44} - \frac{t^3 \alpha_{55}}{2(-1+t^2)} + t^2 \alpha_{75} + \frac{t^3(-2+t^2) \alpha_{81}}{2(-1+t^2)^2} + \frac{t^3 \alpha_{97}}{4(-1+t^2)^2} + t^2 \alpha_{99} \right) + \\
& p_i^2 x_i x_j \left(-\alpha_3 - \frac{t^2 \alpha_{12}}{1+t^2} + \frac{t^2 \alpha_{34}}{1+t^2} - \alpha_{111} \right) - p_l^2 x_i x_l \alpha_{111} + p_l^2 x_k x_l \alpha_{111} + \\
& p_k^2 x_j x_k \left(\frac{t^2 \alpha_{12}}{1+t^2} - \frac{t^2 \alpha_{34}}{1+t^2} - t^2 \alpha_{81} + \alpha_{111} \right) + \alpha_{117} \Big) \in \mathcal{O}[\epsilon]^2
\end{aligned}$$

(*Checking R3:*)

$$In[] := \text{LHS31} = \int \mathbb{E} \left[\text{QP1}_{f,g,e,a} + \text{QP1}_{g,d,c,e} + \text{QP1}_{e,c,b,a} \right] d\{\mathbf{x}_e, \mathbf{p}_e\}$$

$$\text{RHS31} = \int \mathbb{E} \left[\text{QP1}_{g,d,e,f} + \text{QP1}_{f,e,b,a} + \text{QP1}_{e,d,c,b} \right] d\{\mathbf{x}_e, \mathbf{p}_e\}$$

Out[] =



Out[] =



$$In[] := \text{LHS31} - \text{RHS31} // \text{Simplify}$$

Out[] =

0

In[*]:= (*Trefoil, perturbed and unperturbed*)

$$\text{PertTref} = \int \mathbb{E} [\text{QP1}_{4,3,2,1} + \text{QP1}_{5,3,4,1} + \text{QP1}_{2,3,5,1}] \, d\{\mathbf{x}_4, \mathbf{p}_4, \mathbf{x}_5, \mathbf{p}_5\}$$

$$\int \mathbb{E} [\text{Q}_{4,3,2,1} + \text{Q}_{5,3,4,1} + \text{Q}_{2,3,5,1}] \, d\{\mathbf{x}_4, \mathbf{p}_4, \mathbf{x}_5, \mathbf{p}_5\}$$

Out[*]=

$$\begin{aligned} & \frac{1}{4 (1 - t^2 + t^4)} t^2 \mathbb{E} \left[\text{Series} \left[0, \frac{t^3 p_1 x_3 (-\alpha_{12} + t^2 \alpha_{12} - \alpha_{23} - t^2 \alpha_{23} + \alpha_{34} - t^2 \alpha_{34})}{2 (-1 + t) (1 + t) (1 + t^2)} - \right. \right. \\ & \quad \frac{p_3 x_1 (-\alpha_{12} + t^2 \alpha_{12} + \alpha_{23} + t^2 \alpha_{23} + \alpha_{34} - t^2 \alpha_{34})}{2 (-1 + t) t (1 + t) (1 + t^2)} - \frac{t p_1 x_1 (\alpha_{34} + \alpha_{97})}{2 (-1 + t) (1 + t)} - \frac{t p_3 x_3 (\alpha_{34} + \alpha_{97})}{2 (-1 + t) (1 + t)} - \\ & \quad \frac{p_2 x_2 (2 \alpha_3 + 2 t^4 \alpha_{21} + \alpha_{23} + t^4 \alpha_{23} + 2 \alpha_{28} - 2 t^2 \alpha_{34} + 2 t^4 \alpha_{81} - 2 t^2 \alpha_{97})}{2 (-1 + t) t (1 + t)} - \\ & \quad \frac{1}{4 (-1 + t)^2 (1 + t)^2} t p_2 x_3 (4 \alpha_3 - 2 t^2 \alpha_3 + 2 \alpha_6 - 2 t^2 \alpha_6 + 2 t^2 \alpha_{21} + \\ & \quad 2 \alpha_{23} + 2 \alpha_{28} - t^2 \alpha_{34} - 2 t^2 \alpha_{55} + 2 t^4 \alpha_{55} + 4 t^2 \alpha_{81} - 2 t^4 \alpha_{81} - t^2 \alpha_{97}) + \\ & \quad \frac{1}{4 (-1 + t)^2 t (1 + t)^2} p_3 x_2 (2 t^2 \alpha_3 + 2 \alpha_6 - 2 t^2 \alpha_6 - 2 t^2 \alpha_{21} + 4 t^4 \alpha_{21} + 2 t^4 \alpha_{23} - \\ & \quad 2 \alpha_{28} + 4 t^2 \alpha_{28} - t^2 \alpha_{34} - 2 t^2 \alpha_{55} + 2 t^4 \alpha_{55} + 2 t^4 \alpha_{81} - t^2 \alpha_{97}) - \frac{1}{4 (-1 + t)^2 (1 + t)^2} \\ & \quad t p_1 x_2 (-2 t^2 \alpha_3 - 2 \alpha_6 + 2 t^2 \alpha_6 + 2 \alpha_{12} - 4 t^2 \alpha_{12} + 2 t^4 \alpha_{12} + 2 t^2 \alpha_{21} - 4 t^4 \alpha_{21} - 2 t^4 \alpha_{23} + \\ & \quad 2 \alpha_{28} - 4 t^2 \alpha_{28} - 2 \alpha_{34} + 5 t^2 \alpha_{34} - 2 t^4 \alpha_{34} + 2 t^2 \alpha_{55} - 2 t^4 \alpha_{55} - 2 t^4 \alpha_{81} + t^2 \alpha_{97}) + \\ & \quad \frac{1}{4 (-1 + t)^2 t (1 + t)^2} p_2 x_1 (-4 \alpha_3 + 2 t^2 \alpha_3 - 2 \alpha_6 + 2 t^2 \alpha_6 + 2 \alpha_{12} - 4 t^2 \alpha_{12} + 2 t^4 \alpha_{12} - 2 t^2 \alpha_{21} - \\ & \quad 2 \alpha_{23} - 2 \alpha_{28} - 2 \alpha_{34} + 5 t^2 \alpha_{34} - 2 t^4 \alpha_{34} + 2 t^2 \alpha_{55} - 2 t^4 \alpha_{55} - 4 t^2 \alpha_{81} + 2 t^4 \alpha_{81} + t^2 \alpha_{97}) - \\ & \quad \frac{1}{4 (1 - t^2 + t^4)^2} (2 \alpha_3 + 2 t^6 \alpha_3 + 2 t^2 \alpha_{21} + 2 t^8 \alpha_{21} + \alpha_{23} + t^2 \alpha_{23} + t^4 \alpha_{23} + t^6 \alpha_{23} + \\ & \quad t^8 \alpha_{23} + 2 \alpha_{28} + 2 t^6 \alpha_{28} - 2 t^2 \alpha_{34} + t^4 \alpha_{34} - 2 t^6 \alpha_{34} - 2 t \alpha_{43} + 6 t^3 \alpha_{43} - 6 t^5 \alpha_{43} + \\ & \quad 4 t^7 \alpha_{43} + 2 t^2 \alpha_{81} + 2 t^8 \alpha_{81} - 2 t^2 \alpha_{97} + t^4 \alpha_{97} - 2 t^6 \alpha_{97} - 4 t \alpha_{99} + 6 t^3 \alpha_{99} - \\ & \quad 6 t^5 \alpha_{99} + 2 t^7 \alpha_{99} - 12 \alpha_{117} + 24 t^2 \alpha_{117} - 36 t^4 \alpha_{117} + 24 t^6 \alpha_{117} - 12 t^8 \alpha_{117}) \left. \right] \end{aligned}$$

Out[*]=

$$\frac{t^2 \mathbb{E} [0]}{4 (1 - t^2 + t^4)}$$

$$\text{In[*]} := \text{CF} [\text{PertTref} /. \{\alpha_{34} \rightarrow -\alpha_{97}, \alpha_{12} \rightarrow -\alpha_{23} - \alpha_{97}\} /. \alpha_{23} \rightarrow 0 /. \alpha_3 \rightarrow -(t^4 \alpha_{21} + \alpha_{28} + t^4 \alpha_{81}) /. \\ \alpha_6 \rightarrow -t^2 \alpha_{21} + t^4 \alpha_{21} + \alpha_{28} + t^2 \alpha_{55} - 2 t^2 \alpha_{81} + t^4 \alpha_{81} /. \alpha_{21} \rightarrow -\alpha_{81}]$$

Out[*]=

$$\frac{t^2 \mathbb{E} \left[\text{Series} \left[0, \frac{t \alpha_{43} - 2 t^3 \alpha_{43} + 2 t \alpha_{99} - t^3 \alpha_{99} + 6 t \alpha_{117} - 6 t^2 \alpha_{117} + 6 t^4 \alpha_{117}}{2 (1 - t^2 + t^4)} \right] \right]}{4 (1 - t^2 + t^4)}$$

In[*]:= **Coefficient**[**QP1**_{i,j,k,1}, **$\alpha_{\#}$**] & /@ {43, 99, 117}

Out[*]=

$$\left\{ \in p_1 x_i + \in p_i x_k - \in p_k x_k - \in p_1 x_k, \in p_k x_i - t^2 \in p_1 x_i - \in p_k x_k + t^2 \in p_1 x_k, \in \right\}$$

In[*]:= (***5₂***)

$$\int \mathbb{E}[\mathbf{Q}_{1,2,4,3} + \mathbf{Q}_{4,5,1,3} + \mathbf{Q}_{1,5,4,6} + \mathbf{Q}_{7,2,1,6} + \mathbf{Q}_{4,2,7,6}] \, d\mathbf{x}_{\{4,7\}}$$

Out[*]=

$$\frac{t^2 \mathbb{E}[\emptyset]}{4(2 - 3t^2 + 2t^4)}$$

In[*]:= **Pert52** = $\int \mathbb{E}[\mathbf{QP1}_{1,2,4,3} + \mathbf{QP1}_{4,5,1,3} + \mathbf{QP1}_{1,5,4,6} + \mathbf{QP1}_{7,2,1,6} + \mathbf{QP1}_{4,2,7,6}] \, d\mathbf{x}_{\{4,7\}};$

CF[**Pert52** /. { **$\alpha_{34} \rightarrow -\alpha_{97}$** , **$\alpha_{12} \rightarrow -\alpha_{23} - \alpha_{97}$** } /. **$\alpha_{23} \rightarrow 0$** /. **$\alpha_3 \rightarrow - (t^4 \alpha_{21} + \alpha_{28} + t^4 \alpha_{81})$** /.
 $\alpha_6 \rightarrow -t^2 \alpha_{21} + t^4 \alpha_{21} + \alpha_{28} + t^2 \alpha_{55} - 2t^2 \alpha_{81} + t^4 \alpha_{81}$ /. **$\alpha_{21} \rightarrow -\alpha_{81}$**]

Out[*]=

$$\frac{1}{4(2 - 3t^2 + 2t^4)} t^2 \mathbb{E} \left[\in \text{Series} \left[0, -\frac{t^3 p_3 x_2 (-\alpha_{28} + t^2 \alpha_{81})}{2 - 3t^2 + 2t^4} + \frac{t^3 p_6 x_2 (-\alpha_{28} + t^2 \alpha_{81})}{2 - 3t^2 + 2t^4} - \frac{p_2 x_3 (-\alpha_{28} + t^2 \alpha_{81})}{t(2 - 3t^2 + 2t^4)} + \right. \right. \\ \left. \frac{p_5 x_3 (-\alpha_{28} + t^2 \alpha_{81})}{t(2 - 3t^2 + 2t^4)} + \frac{t^3 p_3 x_5 (-\alpha_{28} + t^2 \alpha_{81})}{2 - 3t^2 + 2t^4} - \frac{t^3 p_6 x_5 (-\alpha_{28} + t^2 \alpha_{81})}{2 - 3t^2 + 2t^4} + \right. \\ \left. \frac{p_2 x_6 (-\alpha_{28} + t^2 \alpha_{81})}{t(2 - 3t^2 + 2t^4)} - \frac{p_5 x_6 (-\alpha_{28} + t^2 \alpha_{81})}{t(2 - 3t^2 + 2t^4)} + \frac{1}{2(2 - 3t^2 + 2t^4)^2} \right. \\ \left. \left(t^2 \alpha_{28} - t^4 \alpha_{28} + 6t \alpha_{43} - 17t^3 \alpha_{43} + 18t^5 \alpha_{43} - 8t^7 \alpha_{43} - t^4 \alpha_{81} + t^6 \alpha_{81} + 8t \alpha_{99} - 18t^3 \alpha_{99} + \right. \right. \\ \left. \left. 17t^5 \alpha_{99} - 6t^7 \alpha_{99} + 40 \alpha_{117} - 120t^2 \alpha_{117} + 170t^4 \alpha_{117} - 120t^6 \alpha_{117} + 40t^8 \alpha_{117} \right) \right] \right]$$

In[*]:= **CF**[**Pert52** /. { **$\alpha_{34} \rightarrow -\alpha_{97}$** , **$\alpha_{12} \rightarrow -\alpha_{23} - \alpha_{97}$** } /. **$\alpha_{23} \rightarrow 0$** /. **$\alpha_3 \rightarrow - (t^4 \alpha_{21} + \alpha_{28} + t^4 \alpha_{81})$** /.
 $\alpha_6 \rightarrow -t^2 \alpha_{21} + t^4 \alpha_{21} + \alpha_{28} + t^2 \alpha_{55} - 2t^2 \alpha_{81} + t^4 \alpha_{81}$ /. **$\alpha_{21} \rightarrow -\alpha_{81}$** /. **$\alpha_{28} \rightarrow t^2 \alpha_{81}$**]

Out[*]=

$$\frac{t^2 \mathbb{E} \left[\in \text{Series} \left[0, \frac{3t \alpha_{43} - 4t^3 \alpha_{43} + 4t \alpha_{99} - 3t^3 \alpha_{99} + 20 \alpha_{117} - 30t^2 \alpha_{117} + 20t^4 \alpha_{117}}{2(2 - 3t^2 + 2t^4)} \right] \right]}{4(2 - 3t^2 + 2t^4)}$$