

In[]:= **BBs** = { $r_{2,1}[3, 4]$, $\gamma_{1,-1}[3]$ }

Out[]:=
 $\{r_{2,1}[3, 4], \gamma_{1,-1}[3]\}$

In[]:= **es** = {3, 4}

Out[]:=
 {3, 4}

In[]:= **nes** = Table[v@es[[i]] = ToExpression["i\$" <> ToString[i]], {i, Length@es}]

Out[]:=
 {i\$1, i\$2}

In[]:= ? v

Out[]:=

Symbol
Global`v
Definitions
v[3] = i\$1
v[4] = i\$2
Full Name Global`v
^

In[]:= Table[Pattern[Evaluate@nes[[i], _], {i, Length@es}]

Out[]:=
 {i\$1_, i\$2_}

In[]:= **nBBs** = Replace[BBs, Thread[es → v /@ es], {2}]

Out[]:=
 $\{r_{2,1}[i\$1, i\$2], \gamma_{1,-1}[i\$1]\}$

```
In[ ]:= res = Simplify@ZipJoin@@Table[{p1,α,p2,α,x1,α,x2,α},{α,es}] [Times [
  Times@@ (nBBs /. {
    rd,s_ [i_, j_] => (V[rd,s [i, j]] /. {pi -> p2,i, pj -> p2,j, xi -> x2,i, xj -> x2,j}),
    γd,φ_ [k_] => (V[γd,φ [k]] /. {pk -> p1,k, xk -> x1,k})
  }),
  Exp[Sum[gα,β (π1,α + π2,α) (ξ1,β + ξ2,β), {α, nes}, {β, nes}] - Sum[ξ1,α π2,α, {α, nes}]]]
]]
```

Out[]:=

$$\frac{1}{24} e^{-\pi_2, i\$1 \xi_{1, i\$1} - \pi_2, i\$2 \xi_{1, i\$2} + \beta_{i\$1, i\$1} (\pi_{1, i\$1} + \pi_{2, i\$1}) (\xi_{1, i\$1} + \xi_{2, i\$1}) + \beta_{i\$2, i\$1} (\pi_{1, i\$2} + \pi_{2, i\$2}) (\xi_{1, i\$1} + \xi_{2, i\$1}) + \beta_{i\$1, i\$2} (\pi_{1, i\$1} + \pi_{2, i\$1}) (\xi_{1, i\$2} + \xi_{2, i\$2}) + \beta_{i\$2, i\$2} (\pi_{1, i\$2} + \pi_{2, i\$2}) (\xi_{1, i\$2} + \xi_{2, i\$2})} (-1 + 2 p_{1, i\$1} x_{1, i\$1}) x_{2, i\$1} (2 p_{2, i\$1}^2 p_{2, i\$2} x_{2, i\$1} (2 (-1 + T) x_{2, i\$1} - 3 x_{2, i\$2}) + p_{2, i\$2} (6 + 3 p_{2, i\$2} ((-1 + 3 T) x_{2, i\$1} - 6 x_{2, i\$2}) + 2 p_{2, i\$2}^2 ((-3 + 2 T + T^2) x_{2, i\$1}^2 - 3 (1 + T) x_{2, i\$1} x_{2, i\$2} + 3 x_{2, i\$2}^2)) + p_{2, i\$1} (-6 + 3 p_{2, i\$2} ((1 - 3 T) x_{2, i\$1} + 6 x_{2, i\$2}) - 2 p_{2, i\$2}^2 ((-5 + 4 T + T^2) x_{2, i\$1}^2 - 3 (2 + T) x_{2, i\$1} x_{2, i\$2} + 3 x_{2, i\$2}^2))$$

```
In[ ]:= SetDelayed@@ {
  gPair [
    Replace[BBs, Thread[es -> Table[Pattern[Evaluate@nes[[i]], _], {i, Length@es}]]], {2}],
  Simplify@ZipJoin@@Table[{p1,α,p2,α,x1,α,x2,α},{α,es}] [Times [
    Times@@ (nBBs /. {
      rd,s_ [i_, j_] => (V[rd,s [i, j]] /. {pi -> p2,i, pj -> p2,j, xi -> x2,i, xj -> x2,j}),
      γd,φ_ [k_] => (V[γd,φ [k]] /. {pk -> p1,k, xk -> x1,k})
    }),
    Exp[Sum[gα,β (π1,α + π2,α) (ξ1,β + ξ2,β), {α, nes}, {β, nes}] - Sum[ξ1,α π2,α, {α, nes}]]]
  ]
}
```