

```

rhs = With[{}, FullSimplify[
  RHS -  $\frac{1}{2} b \epsilon v^2 (2 \delta^2 + 4 \alpha \beta \delta v + \alpha^2 \beta^2 v^2)$  RHS +  $2 \epsilon v (\delta + \alpha \beta v) U[c]$  ** RHS -
   $\beta (1 + 2 b \delta) \epsilon v^3 (2 \delta + \alpha \beta v) U[u]$  ** RHS +  $\alpha \epsilon v^3 (2 \delta + \alpha \beta v) RHS$  ** U[w] +  $2 \beta \delta v^2 \epsilon$ 
   $U[c, u]$  ** RHS +  $2 \alpha \delta v^2 \epsilon U[c]$  ** RHS ** U[w] -  $\frac{1}{2} \beta^2 \delta (2 + 3 b \delta) \epsilon v^4 U[u, u]$  ** RHS +
   $\frac{1}{2} \alpha^2 \delta (2 + b \delta) \epsilon v^4 RHS$  ** U[w, w] -  $2 b \delta^2 \epsilon v^3 (\delta + \alpha \beta v) U[u]$  ** RHS ** U[w]
  +  $2 \delta^2 v^2 \epsilon U[c, u]$  ** RHS ** U[w] -  $\beta \delta^2 (1 + 2 b \delta) \epsilon v^4 U[u, u]$  ** RHS ** U[w] +
   $\alpha \delta^2 v^4 \epsilon U[u]$  ** RHS ** U[w, w] -  $\frac{1}{2} b \delta^4 v^4 \epsilon U[u, u]$  ** RHS ** U[w, w] /.
  {NonCommutativeMultiply | U  $\rightarrow$  Times, RHS  $\rightarrow$  1}
]]

```

$$\frac{1}{2} (2 + \epsilon v (4 c (\delta + (\alpha + u \delta) (\beta + w \delta) v) + v (-2 b \delta^2 - 4 \delta (\beta (u + b \alpha + 2 b u \delta) + w (-\alpha + b u \delta^2)) v - (\alpha + u \delta) (\beta + w \delta) (2 u \beta + b \beta (\alpha + 3 u \delta) + w (b u \delta^2 - \alpha (2 + b \delta))) v^2))$$

```
Collect[rhs, {c, u, w}, C[Simplify[#]] &] // Expand
```

$$c w c [2 \alpha \delta \epsilon v^2] + c u c [2 \beta \delta \epsilon v^2] + c u w c [2 \delta^2 \epsilon v^2] + u w^2 c [\alpha \delta^2 \epsilon v^4] + u^2 w^2 c [-\frac{1}{2} b \delta^4 \epsilon v^4] + w^2 c [\frac{1}{2} \alpha^2 \delta (2 + b \delta) \epsilon v^4] + u^2 w c [-\beta \delta^2 (1 + 2 b \delta) \epsilon v^4] + u^2 c [-\frac{1}{2} \beta^2 \delta (2 + 3 b \delta) \epsilon v^4] + c c [2 \epsilon v (\delta + \alpha \beta v)] + u w c [-2 b \delta^2 \epsilon v^3 (\delta + \alpha \beta v)] + w c [\alpha \epsilon v^3 (2 \delta + \alpha \beta v)] + u c [-\beta (1 + 2 b \delta) \epsilon v^3 (2 \delta + \alpha \beta v)] + c [1 - \frac{1}{2} b \epsilon v^2 (2 \delta^2 + 4 \alpha \beta \delta v + \alpha^2 \beta^2 v^2)]$$

```
Simplify[rhs /.  $\epsilon \rightarrow 0$ ]
```

1

$\Lambda =$

```
(Collect[Simplify[Coefficient[ $\frac{rhs}{v}$ ,  $\epsilon$ ]], {c, u, w}, C[Simplify[#]] &] // Expand) /.

```

C[x\_]  $\rightarrow$  x

$$2 c w \alpha \delta v + 2 c u \beta \delta v + 2 c u w \delta^2 v + u w^2 \alpha \delta^2 v^3 - \frac{1}{2} b u^2 w^2 \delta^4 v^3 + \frac{1}{2} w^2 \alpha^2 \delta (2 + b \delta) v^3 - u^2 w \beta \delta^2 (1 + 2 b \delta) v^3 - \frac{1}{2} u^2 \beta^2 \delta (2 + 3 b \delta) v^3 + 2 c (\delta + \alpha \beta v) - 2 b u w \delta^2 v^2 (\delta + \alpha \beta v) + w \alpha v^2 (2 \delta + \alpha \beta v) - u \beta (1 + 2 b \delta) v^2 (2 \delta + \alpha \beta v) - \frac{1}{2} b v (2 \delta^2 + 4 \alpha \beta \delta v + \alpha^2 \beta^2 v^2)$$

$\Lambda$  // TeXForm

$$-\frac{1}{2} b \nu \left( \alpha^2 \beta^2 \nu^2 + 4 \alpha \beta \delta \nu + 2 \delta^2 \right) - \frac{1}{2} b \delta^4 \nu^3 u^2 w^2 - \beta \delta^2 \nu^3 u^2 w (1 + 2 b \delta) - 2 b \delta^2 \nu^2 u w (\alpha \beta \nu + \delta) + \frac{1}{2} \beta^2 \delta (2 + 3 b \delta) \nu^3 + 2 c (\delta + \alpha \beta \nu) - 2 b u w \delta^2 \nu^2 (\delta + \alpha \beta \nu) + w \alpha \nu^2 (2 \delta + \alpha \beta \nu) - u \beta (1 + 2 b \delta) \nu^2 (2 \delta + \alpha \beta \nu) - \frac{1}{2} b \nu (2 \delta^2 + 4 \alpha \beta \delta \nu + \alpha^2 \beta^2 \nu^2)$$