

N > restart;

```
conj := proc(x) local y; y := op(1, x) : if (type(x, '+' ) = true) then add(conj(op(i,
x)), i = 1 .. nops(x)) elif
    (type(x, '*' ) = true) then simplify( conj(y) · conj(  $\frac{x}{y}$  ) ) elif
    (type(x, '^' ) = true) then conj(y)op(2, x) elif (type(x, complex)
= true) then conjugate(x) elif
    x = Q then Q# elif x = P then P# elif x = B then B# elif x = A then A#
elif x = Q# then Q elif x = P# then P elif x = A# then A elif x = B#
then B elif x = a then a elif x = d then d elif x = d then d elif (type(x, function)
= true) then if op(0, x) = L then (L#(conj(y))) elif op(0, x) = L#
then (L(conj(y))) elif op(0, x) = S then B · S(conj(y)) + A · Tau(conj(y)) end if
end if ; end proc;
```

N > conjugue := **proc**(x) ; expand(Sub(conj(x))) **end proc**:

> substitution := **proc**(s) ; subs(sqrt($\frac{1}{B}$) = $\frac{1}{\text{sqrt}(B)}$, s) **end proc**:

> Sub := **proc**(s) ; **if** (type(s, '+') = true) **then** add(Sub(op(i, s)), i = 1 .. nops(s))
elif (type(s, '^') **and** op(2, s) < 0) = true
then $\frac{1}{\text{substitution}(op(1, s)^{-op(2, s)})}$ **elif** (type(s, '*') = true) **then** Sub(op(1, s))
· Sub($\frac{s}{op(1, s)}$) **else** substitution(s) **fi** **end proc**:

> L := **proc**(x) **local** y; y := op(1, x) : **if** (type(x, '+') = true) **then** add(L(op(i, x)), i = 1
.. nops(x)) **elif**

```
(type(x, '*' ) = true) then expand( L(y) ·  $\frac{x}{y}$  + y · L(  $\frac{x}{y}$  ) ) elif
(type(x, '^' ) = true) then op(2, x) · y(op(2, x) - 1) · L(y) elif
(type(x, function) = true) then 'L'(x) elif
(type(x, symbol) = true) then 'L'(x) else 0 fi end proc;
```

> L[#] := **proc**(x) **local** y; y := op(1, x) : **if** (type(x, '+') = true) **then** add(L[#](op(i, x)), i = 1
.. nops(x)) **elif**

```
(type(x, '*' ) = true) then expand( L#(y) ·  $\frac{x}{y}$  + y · L#(  $\frac{x}{y}$  ) ) elif
(type(x, '^' ) = true) then op(2, x) · y(op(2, x) - 1) · L#(y) elif
(type(x, function) = true) then 'L#(x)' elif
(type(x, symbol) = true) then 'L#(x)' else 0 fi end proc;
```

> B[#] := $\frac{1}{B}$; A[#] := -B[#] · A :

> expand(solve(L(B) + B · Q + A - B · L[#](B[#]) - Q[#] - A[#] · B, A)) :

> Q[#] := expand(solve(L(B) + B · Q + A - B · L[#](B[#]) - Q[#] - A[#] · B, Q)) :

> eq2 := -P[#] - A · Q[#] + L[#](A) + A² + B · L(A) + B² · P :

> P[#] := expand(solve(eq2, P[#])) :

$$\begin{aligned} > \text{expr1} := & \frac{\frac{1}{2} \text{IL}(L^\#(B))}{B a^2} - \frac{\frac{1}{4} \text{IL}^\#(B) Q}{B a^2} + \frac{\frac{1}{4} \text{IL}(B) Q}{a^2} - \frac{\frac{1}{2} \text{IL}(B) A}{B a^2} - \frac{\frac{1}{4} \text{IL}(B)^2}{B a^2} \\ & - \frac{\frac{3}{4} \text{IL}^\#(B) L(B)}{B^2 a^2} + \frac{\text{IL}(A)}{a^2} - \frac{\frac{1}{2} \text{IL}^\#(Q)}{a^2} + \frac{\frac{1}{2} \text{IL}(L(B))}{a^2} + \frac{\frac{1}{2} \text{IL}(Q)}{a^2} : \end{aligned}$$

$$\begin{aligned} > \text{expr2} := & -\frac{\frac{1}{4} \text{IL}^\#(B) L(B) Q}{B^{3/2} a^3} - \frac{\frac{1}{2} \text{I}\sqrt{B} L(A) Q}{a^3} + \frac{\frac{1}{4} \text{IL}^\#(L(B)) Q}{\sqrt{B} a^3} \\ & - \frac{\frac{1}{4} \text{IL}(B)^2 L^\#(B)}{B^{5/2} a^3} - \frac{\frac{1}{4} \text{IL}^\#(L(B)) L(B)}{B^{3/2} a^3} - \frac{\frac{1}{4} \text{IL}^\#(Q) L(B)}{\sqrt{B} a^3} \\ & - \frac{\frac{1}{4} \text{I}\sqrt{B} L^\#(Q) Q}{a^3} + \frac{\frac{1}{4} \text{I}\sqrt{B} A Q^2}{a^3} + \frac{\text{I}\sqrt{B} A P}{a^3} + \frac{\frac{1}{4} \text{I} A L(B)^2}{B^{3/2} a^3} \\ & - \frac{\frac{1}{2} \text{I} A L(L(B))}{\sqrt{B} a^3} - \frac{\frac{1}{2} \text{I}\sqrt{B} A L(Q)}{a^3} + \frac{\frac{1}{4} \text{I} Q L(B)^2}{\sqrt{B} a^3} + \frac{\frac{1}{4} \text{I}\sqrt{B} Q^2 L(B)}{a^3} \\ & + \frac{\frac{1}{4} \text{I}\sqrt{B} Q L(L(B))}{a^3} + \frac{\frac{1}{4} \text{I} B^{3/2} Q L(Q)}{a^3} + \frac{\frac{1}{4} \text{IL}(B) L(L(B))}{\sqrt{B} a^3} \\ & + \frac{\frac{1}{4} \text{I}\sqrt{B} L(B) L(Q)}{a^3} + \frac{2 \text{I}\sqrt{B} L(B) P}{a^3} + \frac{\frac{1}{2} \text{IL}(A) L(B)}{\sqrt{B} a^3} + \frac{\frac{1}{2} \text{IL}(L^\#(B)) L(B)}{B^{3/2} a^3} \\ & + \frac{\text{I}\sqrt{B} L(L(A))}{a^3} - \frac{\text{I}\sqrt{B} L^\#(P)}{a^3} + \frac{\text{I} B^{3/2} L(P)}{a^3} - \frac{\frac{1}{2} \text{IL}(L^\#(L(B)))}{\sqrt{B} a^3} \\ & - \frac{\frac{1}{2} \text{I}\sqrt{B} L(L^\#(Q))}{a^3} + \frac{\frac{1}{2} \text{IL}^\#(L(L(B)))}{\sqrt{B} a^3} + \frac{\frac{1}{2} \text{I}\sqrt{B} L^\#(L(Q))}{a^3} : \end{aligned}$$

$$\mathbf{N} > \text{expr3} := \frac{1}{6} \frac{\sqrt{B} Q}{a} :$$

$$\mathbf{N} > \text{expr4} := \frac{1}{6} \frac{L^\#(B) + 2 A B + B^2 Q + L(B) B}{a B^{3/2}} :$$

$$> \text{expand}(\text{expr1} - \text{conjugue}(\text{expr1}));$$

0

(1)

$$> \text{expand}(\text{expr2} - \text{conjugue}(\text{expr2}));$$

0

(2)

$$> \text{expand}(\text{expr3} - \text{conjugue}(\text{expr4}));$$

0

(3)