```
In[•]:= threterms[a_, b_, c_] := ToExpression[StringJoin[ToString[a], ToString[b]]] * c +
          ToExpression[StringJoin[ToString[a], ToString[c]]] * b +
          a * ToExpression[StringJoin[ToString[b], ToString[c]]] - 2 a * b * c;

In[•]:= fourterms[a_, b_, c_, d_] := a * threterms[b, c, d] + b * threterms[a, c, d] + c * threterms[a, b, d] +
          d * threterms[a, b, c] + ToExpression[StringJoin[ToString[a], ToString[b]]] *
           ToExpression[StringJoin[ToString[c], ToString[d]]] +
          ToExpression[StringJoin[ToString[a], ToString[c]]] *
           ToExpression[StringJoin[ToString[b], ToString[d]]] +
          ToExpression[StringJoin[ToString[a], ToString[d]]] *
           ToExpression[StringJoin[ToString[b], ToString[c]]] -
          2 * (a * b * ToExpression[StringJoin[ToString[c], ToString[d]]] +
             a * c * ToExpression[StringJoin[ToString[b], ToString[d]]] +
             a * d * ToExpression[StringJoin[ToString[b], ToString[c]]] +
             ToExpression[StringJoin[ToString[a], ToString[b]]] * c * d +
             ToExpression[StringJoin[ToString[a], ToString[c]]] * b * d +
             ToExpression[StringJoin[ToString[a], ToString[d]]] * b * c) + 6 * a * b * c * d;


In[•]:=

In[•]:= fiveterms[a_, b_, c_, d_, e_] := a * fourterms[b, c, d, e] + b * fourterms[a, c, d, e] +
          c * fourterms[a, b, d, e] + d * fourterms[a, b, c, e] + e * fourterms[a, b, c, d] +
          ToExpression[StringJoin[ToString[a], ToString[b]]] * threterms[c, d, e] +
          ToExpression[StringJoin[ToString[a], ToString[c]]] * threterms[b, d, e] +
          ToExpression[StringJoin[ToString[a], ToString[d]]] * threterms[b, c, e] +
          ToExpression[StringJoin[ToString[a], ToString[e]]] * threterms[b, c, d] +
          ToExpression[StringJoin[ToString[b], ToString[c]]] * threterms[a, d, e] +
          ToExpression[StringJoin[ToString[b], ToString[d]]] * threterms[a, c, e] +
          ToExpression[StringJoin[ToString[b], ToString[e]]] * threterms[a, c, d] +
          ToExpression[StringJoin[ToString[c], ToString[d]]] * threterms[a, b, e] +
          ToExpression[StringJoin[ToString[c], ToString[e]]] * threterms[a, b, d] +
          ToExpression[StringJoin[ToString[d], ToString[e]]] * threterms[a, b, c] +
          (*términos con productos de momentos de 2,2 y 1*)
          ToExpression[StringJoin[ToString[a], ToString[b]]] *
           ToExpression[StringJoin[ToString[c], ToString[d]]] * e +
          ToExpression[StringJoin[ToString[a], ToString[b]]] *
           ToExpression[StringJoin[ToString[c], ToString[e]]] * d +
          ToExpression[StringJoin[ToString[a], ToString[b]]] *
           ToExpression[StringJoin[ToString[d], ToString[e]]] * c +
          ToExpression[StringJoin[ToString[a], ToString[c]]] *
           ToExpression[StringJoin[ToString[b], ToString[d]]] * e +
          ToExpression[StringJoin[ToString[a], ToString[c]]] *
           ToExpression[StringJoin[ToString[b], ToString[e]]] * d +
          ToExpression[StringJoin[ToString[a], ToString[c]]] *
```

```
      ToExpression[StringJoin[ToString[d], ToString[e]]] * b +
   ToExpression[StringJoin[ToString[a], ToString[d]]] *
     ToExpression[StringJoin[ToString[b], ToString[c]]] * e +
   ToExpression[StringJoin[ToString[a], ToString[d]]] *
      ToExpression[StringJoin[ToString[b], ToString[e]]] * c +
   ToExpression[StringJoin[ToString[a], ToString[d]]] *
     ToExpression[StringJoin[ToString[c], ToString[e]]] * b +
   ToExpression[StringJoin[ToString[a], ToString[e]]] *
     ToExpression[StringJoin[ToString[b], ToString[c]]] * d +
   ToExpression[StringJoin[ToString[a], ToString[e]]] *
      ToExpression[StringJoin[ToString[b], ToString[d]]] * c +
   ToExpression[StringJoin[ToString[a], ToString[e]]] *
     ToExpression[StringJoin[ToString[c], ToString[d]]] * b +
   ToExpression[StringJoin[ToString[b], ToString[c]]] *
     ToExpression[StringJoin[ToString[d], ToString[e]]] * a +
   ToExpression[StringJoin[ToString[b], ToString[d]]] *
     ToExpression[StringJoin[ToString[c], ToString[e]]] * a +
   ToExpression[StringJoin[ToString[b], ToString[e]]] *
     ToExpression[StringJoin[ToString[c], ToString[d]]] * a -
   2 * (a * b * threterms[c, d, e] + a * c * threterms[b, d, e] + a * d * threterms[b, c, e] +
        a * e * threterms[b, c, d] + b * c * threterms[a, d, e] + b * d * threterms[a, c, e] +
        b * e * threterms[a, c, d] + c * d * threterms[a, b, e] + c * e * threterms[a, b, d] +
        d * e * threterms[a, b, c]) - 2 * (ToExpression[StringJoin[ToString[a], ToString[b]]] * c * d * e +
        ToExpression[StringJoin[ToString[a], ToString[c]]] * b * d * e +
        ToExpression[StringJoin[ToString[a], ToString[d]]] * b * c * e +
        ToExpression[StringJoin[ToString[a], ToString[e]]] * b * c * d +
        ToExpression[StringJoin[ToString[b], ToString[c]]] * a * d * e +
        ToExpression[StringJoin[ToString[b], ToString[d]]] * a * c * e +
        ToExpression[StringJoin[ToString[b], ToString[e]]] * a * c * d +
        ToExpression[StringJoin[ToString[c], ToString[d]]] * a * b * e +
        ToExpression[StringJoin[ToString[c], ToString[e]]] * a * b * d +
        ToExpression[StringJoin[ToString[d], ToString[e]]] * a * b * c) +
   6 * (a * b * c * ToExpression[StringJoin[ToString[d], ToString[e]]] +
        a * b * d * ToExpression[StringJoin[ToString[c], ToString[e]]] +
        a * b * e * ToExpression[StringJoin[ToString[c], ToString[d]]] +
        a * c * d * ToExpression[StringJoin[ToString[b], ToString[e]]] +
        a * c * e * ToExpression[StringJoin[ToString[b], ToString[d]]] +
        a * d * e * ToExpression[StringJoin[ToString[b], ToString[c]]] +
        b * c * d * ToExpression[StringJoin[ToString[a], ToString[e]]] +
        b * c * e * ToExpression[StringJoin[ToString[a], ToString[d]]] +
        b * d * e * ToExpression[StringJoin[ToString[a], ToString[c]]] +
        c * d * e * ToExpression[StringJoin[ToString[a], ToString[b]]]) - 24 * a * b * c * d * e;
```

In[◦]:= **fiveterms[a, ad, b, bd, b] // Simplify**

Out[◦]= $5\,a\,adbd\,b^2 + 2\,a\,adbd\,bb + abd\,(4\,adb\,b + 5\,ad\,b^2 + 2\,ad\,bb) + 2\,a\,adb\,bbd + 2\,aad\,b\,bbd +$

$5\,a\,ad\,b\,bbd + 10\,a\,adb\,b\,bd + 5\,aad\,b^2\,bd - 54\,a\,ad\,b^2\,bd + 2\,aad\,bb\,bd + 5\,a\,ad\,bb\,bd +$

$2\,a\,adb\,bdb + 2\,aad\,b\,bdb + 5\,a\,ad\,b\,bdb + 2\,ab\,(2\,adbd\,b + 2\,adb\,bd + ad\,(bbd + 5\,b\,bd + bdb))$

In[◦]:=

In[◦]:= (*Definición de las ecuaciones de estado (RHS de las ODEs)*)(*1. d<a>/dt*)

eqa[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_,

adbd_, adaada_, ft_] := -I (ωc a + E0 d1 (bd + b) + E0 d2 (bdbd + 2 bdb + bb + 1) + ft) - κ / 2 a;

(*2. d<a^dag>/dt*)

eqad[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_,

adbd_, adaada_, ft_] := I (ωc ad + E0 d1 (bd + b) + E0 d2 (bdbd + 2 bdb + bb + 1) + ft) - κ / 2 ad;

(*3. d<b>/dt*)

eqb[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_,

adaada_, ft_] := -I (ω0 b - 2 Ub threterms[bd, b, b] + E0 d1 (ad + a) + 2 E0 d2 (ab + abd + adb + adbd));

(*4. d<b^dag>/dt*)

eqbd[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_,

bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=

I (ω0 bd - 2 Ub threterms[bd, bd, b] + E0 d1 (ad + a) + 2 E0 d2 (abd + ab + adbd + adb));

(*5. d<a^dag a>/dt*)

eqada[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_,

bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] := -I (E0 d1 (adbd + adb - abd - ab) +

E0 d2 (threterms[ad, bd, bd] + 2 threterms[ad, bd, b] + threterms[ad, b, b] + ad -

threterms[a, bd, bd] - 2 threterms[a, bd, b] - threterms[a, b, b] - a) + ft (ad - a)) - κ ada;

(*6. d<b^dag b>/dt*)

eqbdb[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_, bdbd_,

ab_, abd_, adb_, adbd_, adaada_, ft_] := -I (E0 d1 (adbd - adb + abd - ab) + 2 E0 d2

(threterms[ad, bd, bd] - threterms[ad, b, b] + threterms[a, bd, bd] - threterms[a, b, b]));

(*7. d<a^2>/dt*)

eqaa[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_,

bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] := -2 I (ωc aa + E0 d1 (abd + ab) +

E0 d2 (threterms[a, bd, bd] + 2 threterms[a, bd, b] + threterms[a, b, b] + a) + ft a) - κ aa;

(*8. d<a^dag^2>/dt*)

eqadad[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_, bdbd_,

ab_, abd_, adb_, adbd_, adaada_, ft_] := 2 I (ωc adad + E0 d1 (abd + adb) + E0 d2

(threterms[ad, bd, bd] + 2 threterms[ad, bd, b] + threterms[ad, b, b] + ad) + ft ad) - κ adad;

```
(*9. d<b^2>/dt*)
eqbb[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_,
   bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=
  -2 I (ω0 bb - Ub (2 fourterms[bd, b, b, b] + bb) + E0 d1 (adb + ab) + E0 d2 (2 threterms[ad, bd, b] +
         ad + 2 threterms[ad, b, b] + 2 threterms[a, bd, b] + a + 2 threterms[a, b, b]));


(*10. d<b^dag^2>/dt*)
eqbdbd[ad_, a_, ada_, aad_, aa_, adad_, bd_,
   b_, bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=
  2 I (ω0 bdbd - Ub (2 fourterms[bd, bd, bd, b] + bdbd) + E0 d1 (adbd + abd) + E0 d2 (2 threterms[ad, bd,
         bd] + ad + 2 threterms[ad, bd, b] + 2 threterms[a, bd, bd] + a + 2 threterms[a, bd, b]));


(*11. d<a b>/dt CORREGIDA*)
(*Los términos como<a^dag a b>son 3 operadores:threterms[ad,a,b]*)
eqab[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_, bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_,
   adaada_, ft_] := -I ((ωc + ω0) ab - 2 Ub fourterms[a, bd, b, b] + E0 d1 (ada + aa + bdb + bb + 1) + E0 d2
        (2 (threterms[ad, a, b] + threterms[ad, a, bd] + threterms[a, a, b] + threterms[a, a, bd]) +
           threterms[b, b, b] + 2 threterms[b, bd, b] + threterms[b, bd, bd] + b) + ft b) - κ ab;


(*12. d<a^dag b^dag>/dt CORREGIDA*)
eqadbd[ad_, a_, ada_, aad_, aa_, adad_, bd_,
   b_, bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=
  I ((ωc + ω0) adbd - 2 Ub fourterms[ad, bd, bd, b] + E0 d1 (ada + adad + bdb + bdbd + 1) +
        E0 d2 (2 (threterms[ad, a, bd] + threterms[ad, a, b] +
              threterms[ad, ad, bd] + threterms[ad, ad, b]) + threterms[bd, bd, bd] +
           2 threterms[bd, b, bd] + threterms[b, b, bd] + bd) + ft bd) - κ adbd;


(*13. d<a^dag b>/dt CORREGIDA*)
(*El error estaba aquí: <a^dag^2 b>es threterms[ad,ad,b],no fourterms[adad,b]*)
eqadb[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_,
   bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=
  -I ((ω0 - ωc) adb - 2 Ub fourterms[ad, bd, b, b] + E0 d1 (ada + adad - bdb - bb) - E0 d2 (threterms[b,
         b, b] + 2 threterms[b, bd, b] + threterms[b, bd, bd] + b - 2 (threterms[ad, ad, b] +
           threterms[ad, ad, bd] + threterms[a, ad, b] + threterms[a, ad, bd])) - ft b) - κ adb;


(*14. d<a b^dag>/dt CORREGIDA*)
eqabd[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_,
   bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=
  I ((ω0 - ωc) abd - 2 Ub fourterms[a, bd, bd, b] + E0 d1 (ada + aa - bdb - bdbd) -
        E0 d2 (threterms[bd, bd, bd] + 2 threterms[bd, b, bd] +
           threterms[b, b, bd] + bd - 2 (threterms[a, a, bd] + threterms[a, a, b] +
```

```
                    threterms[a, ad, bd] + threterms[a, ad, b]) - ft bd) - κ abd;
(*15. d<a^dag a a^dag a>/dt (N^2)*)
(*Se han expandido los términos<N...>usando fiveterms y threterms expandiendo N=ad*a*)
eqadaada[ad_, a_, ada_, aad_, aa_, adad_, bd_,
    b_, bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=
  -I (ft ((ada + 1) ad + 3 ad ada) + E0 d1 (2 abd adad + (ada + 1) adb + 3 ada adb + (ada + 1) adbd + 3 ada adbd -
           (ada + 1) ab - (ada + 1) abd - 3 ab ada - 3 abd ada + 2 ab adad) - 2 aa (ft ad + E0 d1 (adb + adbd)) +
       4 a^2 ad (ft + E0 d1 (b + bd)) - a ((ada + 1 + 3 ada - 2 adad) ft + 4 ad^2 (ft + (b + bd) E0 d1)) +
       E0 d2 (fiveterms[ad, a, ad, bd, bd] + 2 fiveterms[ad, a, ad, bd, b] +
           fiveterms[ad, a, ad, b, b] + threterms[ad, a, ad] + fiveterms[ad, ad, a, bd, bd] +
           2 fiveterms[ad, ad, a, bd, b] + fiveterms[ad, ad, a, b, b] + threterms[ad, ad, a] -
           fiveterms[ad, a, a, bd, bd] - 2 fiveterms[ad, a, a, bd, b] - fiveterms[ad, a, a, b, b] -
           threterms[ad, a, a] - fiveterms[a, ad, a, bd, bd] - 2 fiveterms[a, ad, a, bd, b] -
           fiveterms[a, ad, a, b, b] - threterms[a, ad, a])) + κ (ada - adaada);


(*Función HH Completa (Hamiltoniano de Control)*)
(*Se asume que las variables P (Costates) tienen
 el prefijo'P' seguido del nombre de la variable*)

HH[ad_, a_, ada_, aad_, aa_, adad_, bd_, b_,
    bdb_, bbd_, bb_, bdbd_, ab_, abd_, adb_, adbd_, adaada_, ft_] :=
  ft * ft + Pa * eqa[ad, a, ada, aad, aa, adad, bd, b, bdb, bbd, bb, bdbd, ab, abd,
       adb, adbd, adaada, ft] + Pad * eqad[ad, a, ada, aad, aa, adad, bd, b, bdb,
       bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft] + Pb * eqb[ad, a, ada, aad,
       aa, adad, bd, b, bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft] +
    Pbd * eqbd[ad, a, ada, aad, aa, adad, bd, b, bdb, bbd, bb, bdbd, ab, abd,
       adb, adbd, adaada, ft] + Pada * eqada[ad, a, ada, aad, aa, adad,
       bd, b, bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft] +
    Pbdb * eqbdb[ad, a, ada, aad, aa, adad, bd, b, bdb, bbd, bb, bdbd, ab,
       abd, adb, adbd, adaada, ft] + Paa * eqaa[ad, a, ada, aad, aa, adad,
       bd, b, bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft] +
    Padad * eqadad[ad, a, ada, aad, aa, adad, bd, b, bdb, bbd, bb, bdbd, ab,
       abd, adb, adbd, adaada, ft] + Pbb * eqbb[ad, a, ada, aad, aa, adad,
       bd, b, bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft] +
    Pbdbd * eqbdbd[ad, a, ada, aad, aa, adad, bd, b, bdb, bbd, bb, bdbd, ab,
       abd, adb, adbd, adaada, ft] + Pab * eqab[ad, a, ada, aad, aa, adad,
       bd, b, bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft] +
    Pabd * eqabd[ad, a, ada, aad, aa, adad, bd, b, bdb, bbd, bb, bdbd, ab,
       abd, adb, adbd, adaada, ft] + Padb * eqadb[ad, a, ada, aad, aa,
       adad, bd, b, bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft] +
    Padbd * eqadbd[ad, a, ada, aad, aa, adad, bd, b, bdb, bbd, bb, bdbd, ab,
       abd, adb, adbd, adaada, ft] + Padaada * eqadaada[ad, a, ada, aad, aa,
       adad, bd, b, bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft];
```

In[◦]:= **(*Asegúrate de haber evaluado primero todas las definiciones de eq... y HH*)**
costateAdad= –D[HH[ad, a, ada, aad, aa, adad, bd, b,
   bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], adad] // Simplify

Out[◦]= $2\,i\,\big(ab\,(d1 + 8\,(b + bd)\,d2)\,E0 + abd\,(d1 + 8\,(b + bd)\,d2)\,E0 +$
   $a\,((1 + 2\,b^2 + 4\,bb + 4\,b\,bd + 2\,bd^2 + 8\,bdb + 4\,bdbd)\,d2\,E0 + ft))\,Padaada +$
   $i\,(d1 + 2\,(b + bd)\,d2)\,E0\,Padb - i\,(d1 + 2\,(b + bd)\,d2)\,E0\,Padbd + Padad\,(\kappa - 2\,i\,\omega c)$

In[◦]:= **costateAda= –D[HH[ad, a, ada, aad, aa, adad, bd, b,**
   bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], ada] // Simplify

Out[◦]= $-i\,\big(-2\,bd\,d2\,E0\,Pab + 3\,a\,d2\,E0\,Padaada - 3\,ad\,d2\,E0\,Padaada + 6\,(a - ad)\,b^2\,d2\,E0\,Padaada +$
   $12\,a\,bb\,d2\,E0\,Padaada - 12\,ad\,bb\,d2\,E0\,Padaada + 24\,ab\,bd\,d2\,E0\,Padaada +$
   $24\,abd\,bd\,d2\,E0\,Padaada - 24\,adb\,bd\,d2\,E0\,Padaada - 24\,adbd\,bd\,d2\,E0\,Padaada +$
   $6\,a\,bd^2\,d2\,E0\,Padaada - 6\,ad\,bd^2\,d2\,E0\,Padaada + 24\,a\,bdb\,d2\,E0\,Padaada -$
   $24\,ad\,bdb\,d2\,E0\,Padaada + 12\,a\,bdbd\,d2\,E0\,Padaada - 12\,ad\,bdbd\,d2\,E0\,Padaada + 4\,a\,ft\,Padaada -$
   $4\,ad\,ft\,Padaada - 2\,b\,d2\,E0\,(Pab - 12\,ab\,Padaada - 12\,abd\,Padaada + 12\,adb\,Padaada +$
     $12\,adbd\,Padaada - 6\,a\,bd\,Padaada + 6\,ad\,bd\,Padaada - Padbd) + 2\,bd\,d2\,E0\,Padbd +$
   $d1\,E0\,(-Pab + Pabd + 4\,ab\,Padaada + 4\,abd\,Padaada - 4\,adb\,Padaada - 4\,adbd\,Padaada - Padb + Padbd) +$
   $i\,Pada\,\kappa - i\,Padaada\,\kappa\big)$

In[◦]:= `costateAd = -D[HH[ad, a, ada, aad, aa, adad, bd, b,`
`        bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], ad] // Simplify`

Out[◦]= $-\dfrac{1}{2}i$

$($ 8 a b d2 E0 Pab + 8 a bd d2 E0 Pab − 8 a b d2 E0 Pabd − 8 a bd d2 E0 Pabd − 2 d2 E0 Pada + 4 b^2 d2 E0 Pada −

2 bb d2 E0 Pada + 8 b bd d2 E0 Pada + 4 bd^2 d2 E0 Pada − 4 bdb d2 E0 Pada − 2 bdbd d2 E0 Pada −

2 ft Pada − 8 a^2 b d1 E0 Padaada + 16 a ad b d1 E0 Padaada − 8 a^2 bd d1 E0 Padaada +

16 a ad bd d1 E0 Padaada − 8 a^2 d2 E0 Padaada + 4 aa d2 E0 Padaada − 2 aad d2 E0 Padaada +

32 ab^2 d2 E0 Padaada + 32 abd^2 d2 E0 Padaada + 16 a ad d2 E0 Padaada − 6 ada d2 E0 Padaada +

64 a adb b d2 E0 Padaada + 64 a adbd b d2 E0 Padaada + 24 a^2 b^2 d2 E0 Padaada −

16 aa b^2 d2 E0 Padaada + 8 aad b^2 d2 E0 Padaada − 48 a ad b^2 d2 E0 Padaada +

24 ada b^2 d2 E0 Padaada − 16 a^2 bb d2 E0 Padaada + 16 aa bb d2 E0 Padaada −

8 aad bb d2 E0 Padaada + 32 a ad bb d2 E0 Padaada − 24 ada bb d2 E0 Padaada +

64 a adb bd d2 E0 Padaada + 64 a adbd bd d2 E0 Padaada + 48 a^2 b bd d2 E0 Padaada −

32 aa b bd d2 E0 Padaada + 16 aad b bd d2 E0 Padaada − 96 a ad b bd d2 E0 Padaada +

48 ada b bd d2 E0 Padaada + 24 a^2 bd^2 d2 E0 Padaada − 16 aa bd^2 d2 E0 Padaada +

8 aad bd^2 d2 E0 Padaada − 48 a ad bd^2 d2 E0 Padaada + 24 ada bd^2 d2 E0 Padaada −

32 a^2 bdb d2 E0 Padaada + 32 aa bdb d2 E0 Padaada − 16 aad bdb d2 E0 Padaada +

64 a ad bdb d2 E0 Padaada − 48 ada bdb d2 E0 Padaada − 16 a^2 bdbd d2 E0 Padaada +

16 aa bdbd d2 E0 Padaada − 8 aad bdbd d2 E0 Padaada + 32 a ad bdbd d2 E0 Padaada −

24 ada bdbd d2 E0 Padaada − 2 ft Padaada − 8 a^2 ft Padaada + 4 aa ft Padaada +

16 a ad ft Padaada − 8 ada ft Padaada + 4 d2 E0 Padad − 8 b^2 d2 E0 Padad + 4 bb d2 E0 Padad −

16 b bd d2 E0 Padad − 8 bd^2 d2 E0 Padad + 8 bdb d2 E0 Padad + 4 bdbd d2 E0 Padad + 4 ft Padad −

8 adb d2 E0 Padb − 8 adbd d2 E0 Padb + 8 a b d2 E0 Padb + 16 ad b d2 E0 Padb + 8 a bd d2 E0 Padb +

16 ad bd d2 E0 Padb − 4 abd d2 E0 $($ Pab − Pabd + 16 adb Padaada + 16 adbd Padaada +

16 a b Padaada − 16 ad b Padaada + 16 a bd Padaada − 16 ad bd Padaada + Padb − Padbd $)$ −

4 ab d2 E0 $($ Pab − Pabd − 16 abd Padaada + 16 adb Padaada + 16 adbd Padaada + 16 a b Padaada −

16 ad b Padaada + 16 a bd Padaada − 16 ad bd Padaada + Padb − Padbd $)$ + 8 adb d2 E0 Padbd +

8 adbd d2 E0 Padbd − 8 a b d2 E0 Padbd − 16 ad b d2 E0 Padbd − 8 a bd d2 E0 Padbd −

16 ad bd d2 E0 Padbd − 2 d1 E0 Pb − 4 d2 E0 Pbb + 16 b^2 d2 E0 Pbb − 8 bb d2 E0 Pbb +

16 b bd d2 E0 Pbb − 8 bdb d2 E0 Pbb + 2 d1 E0 Pbd − 8 b^2 d2 E0 Pbdb + 4 bb d2 E0 Pbdb +

8 bd^2 d2 E0 Pbdb − 4 bdbd d2 E0 Pbdb + 4 d2 E0 Pbdbd − 16 b bd d2 E0 Pbdbd − 16 bd^2 d2 E0 Pbdbd +

8 bdb d2 E0 Pbdbd + 8 bdbd d2 E0 Pbdbd − 8 b^2 bd Padb Ub + 8 b bd^2 Padbd Ub + i Pad κ + 2 Pad ωc $)$

In[◦]:= `costateBdb = -D[HH[ad, a, ada, aad, aa, adad, bd, b,`
`        bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], bdb] // Simplify`

Out[◦]= i $($ d1 E0 (Pab + Pabd − Padb − Padbd) +

2 d2 E0 $($ Pa + b Pab + bd Pabd − Pad + ad Pada + 8 a^2 ad Padaada − 8 aa ad Padaada + 4 aad ad Padaada +

12 ad ada Padaada − 2 ad Padad − b Padb − bd Padbd + 2 ad Pbb − 2 ad Pbdbd + a $($ 2 Paa − Pada −

2 $($ 2 aad Padaada + 4 ad^2 Padaada + 6 ada Padaada − 4 adad Padaada − Pbb + Pbdbd $)$ $)$ $)$ −

4 $($ ab Pab − abd Pabd + adb Padb − adbd Padbd + b Pb + 3 bb Pbb − bd Pbd − 3 bdbd Pbdbd $)$ Ub $)$

In[◦]:= `costateB = -D[HH[ad, a, ada, aad, aa, adad, bd, b,`
`        bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], b] // Simplify`

Out[◦]= $i \left(4\, abd\, d2\, E0\, Paa - 8\, a\, b\, d2\, E0\, Paa - 8\, a\, bd\, d2\, E0\, Paa + d2\, E0\, Pab - 4\, a^2\, d2\, E0\, Pab + 2\, aa\, d2\, E0\, Pab - \right.$

$4\, a\, ad\, d2\, E0\, Pab + 2\, ada\, d2\, E0\, Pab - 6\, b^2\, d2\, E0\, Pab + 3\, bb\, d2\, E0\, Pab + 2\, bbd\, d2\, E0\, Pab -$

$8\, b\, bd\, d2\, E0\, Pab - 2\, bd^2\, d2\, E0\, Pab + 2\, bdb\, d2\, E0\, Pab + bdbd\, d2\, E0\, Pab + ft\, Pab + 4\, a^2\, d2\, E0\, Pabd -$

$2\, aa\, d2\, E0\, Pabd - 2\, aad\, d2\, E0\, Pabd + 4\, a\, ad\, d2\, E0\, Pabd - 4\, bd^2\, d2\, E0\, Pabd + 2\, bdbd\, d2\, E0\, Pabd -$

$2\, abd\, d2\, E0\, Pada + 2\, adb\, d2\, E0\, Pada + 2\, adbd\, d2\, E0\, Pada + 4\, a\, b\, d2\, E0\, Pada - 4\, ad\, b\, d2\, E0\, Pada +$

$4\, a\, bd\, d2\, E0\, Pada - 4\, ad\, bd\, d2\, E0\, Pada - 8\, aad\, abd\, d2\, E0\, Padaada + 32\, a\, abd\, ad\, d2\, E0\, Padaada -$

$16\, abd\, ad^2\, d2\, E0\, Padaada - 24\, abd\, ada\, d2\, E0\, Padaada + 16\, abd\, adad\, d2\, E0\, Padaada +$

$16\, a^2\, adb\, d2\, E0\, Padaada - 16\, aa\, adb\, d2\, E0\, Padaada + 8\, aad\, adb\, d2\, E0\, Padaada -$

$32\, a\, ad\, adb\, d2\, E0\, Padaada + 24\, ada\, adb\, d2\, E0\, Padaada + 16\, a^2\, adbd\, d2\, E0\, Padaada -$

$16\, aa\, adbd\, d2\, E0\, Padaada + 8\, aad\, adbd\, d2\, E0\, Padaada - 32\, a\, ad\, adbd\, d2\, E0\, Padaada +$

$24\, ada\, adbd\, d2\, E0\, Padaada + 8\, a\, aad\, b\, d2\, E0\, Padaada - 24\, a^2\, ad\, b\, d2\, E0\, Padaada +$

$16\, aa\, ad\, b\, d2\, E0\, Padaada - 8\, aad\, ad\, b\, d2\, E0\, Padaada + 24\, a\, ad^2\, b\, d2\, E0\, Padaada +$

$24\, a\, ada\, b\, d2\, E0\, Padaada - 24\, ad\, ada\, b\, d2\, E0\, Padaada - 16\, a\, adad\, b\, d2\, E0\, Padaada +$

$8\, a\, aad\, bd\, d2\, E0\, Padaada - 24\, a^2\, ad\, bd\, d2\, E0\, Padaada + 16\, aa\, ad\, bd\, d2\, E0\, Padaada -$

$8\, aad\, ad\, bd\, d2\, E0\, Padaada + 24\, a\, ad^2\, bd\, d2\, E0\, Padaada + 24\, a\, ada\, bd\, d2\, E0\, Padaada -$

$24\, ad\, ada\, bd\, d2\, E0\, Padaada - 16\, a\, adad\, bd\, d2\, E0\, Padaada + d1\, E0 \left(Pa - Pad + 4\, a\, (a - ad)\, ad\, Padaada \right) -$

$4\, adb\, d2\, E0\, Padad - 4\, adbd\, d2\, E0\, Padad + 8\, ad\, b\, d2\, E0\, Padad + 8\, ad\, bd\, d2\, E0\, Padad - d2\, E0\, Padb +$

$2\, aad\, d2\, E0\, Padb - 4\, a\, ad\, d2\, E0\, Padb - 4\, ad^2\, d2\, E0\, Padb + 2\, adad\, d2\, E0\, Padb + 6\, b^2\, d2\, E0\, Padb -$

$3\, bb\, d2\, E0\, Padb - 2\, bbd\, d2\, E0\, Padb + 8\, b\, bd\, d2\, E0\, Padb + 2\, bd^2\, d2\, E0\, Padb - 2\, bdb\, d2\, E0\, Padb -$

$bdbd\, d2\, E0\, Padb - ft\, Padb + 4\, a\, ad\, d2\, E0\, Padbd + 4\, ad^2\, d2\, E0\, Padbd - 2\, ada\, d2\, E0\, Padbd -$

$2\, adad\, d2\, E0\, Padbd + 4\, bd^2\, d2\, E0\, Padbd - 2\, bdbd\, d2\, E0\, Padbd + 4\, abd\, d2\, E0\, Pbb + 8\, adb\, d2\, E0\, Pbb +$

$4\, adbd\, d2\, E0\, Pbb - 16\, a\, b\, d2\, E0\, Pbb - 16\, ad\, b\, d2\, E0\, Pbb - 8\, a\, bd\, d2\, E0\, Pbb - 8\, ad\, bd\, d2\, E0\, Pbb -$

$4\, adb\, d2\, E0\, Pbdb + 8\, a\, b\, d2\, E0\, Pbdb + 8\, ad\, b\, d2\, E0\, Pbdb + 2\, ab\, d2\, E0 \left(2\, Paa - Pada - 2\, (2\, aad\, Padaada - \right.$

$\left. 8\, a\, ad\, Padaada + 4\, ad^2\, Padaada + 6\, ada\, Padaada - 4\, adad\, Padaada - 2\, Pbb + Pbdb) \right) -$

$4\, abd\, d2\, E0\, Pbdbd - 4\, adbd\, d2\, E0\, Pbdbd + 8\, a\, bd\, d2\, E0\, Pbdbd + 8\, ad\, bd\, d2\, E0\, Pbdbd +$

$8\, a\, b\, bd\, Pab\, Ub - 4\, a\, bd^2\, Pabd\, Ub + 8\, ad\, b\, bd\, Padb\, Ub - 4\, ad\, bd^2\, Padbd\, Ub + 8\, b\, bd\, Pb\, Ub -$

$\left. 4\, bdb\, Pb\, Ub + 24\, b^2\, bd\, Pbb\, Ub - 4\, bd^2\, Pbd\, Ub + 2\, bdbd\, Pbd\, Ub - 8\, bd^3\, Pbdbd\, Ub + Pb\, \omega0 \right)$

In[◦]:= `costateBb = -D[HH[ad, a, ada, aad, aa, adad, bd, b,`
`        bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], bb] // Simplify`

Out[◦]= $i \left(d1\, E0\, (Pab - Padb) + \right.$

$d2\, E0 \left(Pa + 3\, b\, Pab + 2\, bd\, Pab + bd\, Pabd - Pad + ad\, Pada + 8\, a^2\, ad\, Padaada - 8\, aa\, ad\, Padaada + \right.$

$4\, aad\, ad\, Padaada + 12\, ad\, ada\, Padaada - 2\, ad\, Padad - 3\, b\, Padb - 2\, bd\, Padb -$

$bd\, Padbd + 4\, ad\, Pbb - 2\, ad\, Pbdb + a \left(2\, Paa - Pada - \right.$

$\left. \left. 2\, (2\, aad\, Padaada + 4\, ad^2\, Padaada + 6\, ada\, Padaada - 4\, adad\, Padaada - 2\, Pbb + Pbdb) \right) \right) -$

$\left. 2 \left(abd\, Pab\, Ub + adbd\, Padb\, Ub + bd\, Pb\, Ub + Pbb\, Ub + 6\, bdb\, Pbb\, Ub - Pbb\, \omega0 \right) \right)$

In[ ]:= `costateAdbd= -D[HH[ad, a, ada, aad, aa, adad, bd, b,`
`        bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], adbd] // Simplify`

Out[ ]= $2\,i$ a d2 E0 Pab $- 2\,i$ a d2 E0 Pabd $+ i\left(d1 + 2\,(b + bd)\,d2\right)$ E0 Pada $-$

$i\big(\left(-1 + 2\,aa - 4\,ada\right)d1 - 8\,\big(4\,ab\,ad + 4\,abd\,ad - 2\,aa\,b + aad\,b + 3\,ada\,b - 2\,aa\,bd + aad\,bd +$

$\qquad 3\,ada\,bd + 2\,a^2\,(b + bd) - 4\,a\,(ab + abd - adb - adbd + ad\,b + ad\,bd)\big)\,d2\big)$ E0 Padaada $-$

$2\,i\left(d1 + 2\,(b + bd)\,d2\right)$ E0 Padad $+ 2\,i$ d2 E0 Pb $+ 4\,i$ b d2 E0 Pbb $- 2\,i$ d2 E0 Pbd $+$

$i\left(d1 + 4\,bd\,d2\right)$ E0 Pbdb $- 2\,i\left(d1 + 2\,(b + 2\,bd)\,d2\right)$ E0 Pbdbd $+$

$2\,i$ Padb$\left(a\,d2\,E0 + 2\,ad\,d2\,E0 - bb\,Ub\right) +$

Padbd$\left(\kappa - i\,\left(2\,(a + 2\,ad)\,d2\,E0 - 4\,bdb\,Ub + \omega0 + \omega c\right)\right)$

In[ ]:= `costateAbd= -D[HH[ad, a, ada, aad, aa, adad, bd, b,`
`        bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], abd] // Simplify`

Out[ ]= $2\,i\left(d1 + 2\,(b + bd)\,d2\right)$ E0 Paa $- i\left(d1 + 2\,(b + bd)\,d2\right)$ E0 Pada $-$

$i\big(\left(1 + 4\,ada - 2\,adad\right)d1 + 8\,\big(4\,ab\,ad + 4\,abd\,ad + 4\,a\,adb - 4\,ad\,adb + 4\,a\,adbd - 4\,ad\,adbd + aad\,b - 4\,a\,ad\,b +$

$\qquad 2\,ad^2\,b + 3\,ada\,b - 2\,adad\,b + aad\,bd - 4\,a\,ad\,bd + 2\,ad^2\,bd + 3\,ada\,bd - 2\,adad\,bd\big)\,d2\big)$ E0 Padaada $+$

$2\,i$ ad d2 E0 Padb $- 2\,i$ ad d2 E0 Padbd $+ 2\,i$ d2 E0 Pb $+ 4\,i$ b d2 E0 Pbb $- 2\,i$ d2 E0 Pbd $+$

$i\left(d1 + 4\,bd\,d2\right)$ E0 Pbdb $- 2\,i\left(d1 + 2\,(b + 2\,bd)\,d2\right)$ E0 Pbdbd $+$

$2\,i$ Pab$\left(2\,a\,d2\,E0 + ad\,d2\,E0 - bb\,Ub\right) +$

Pabd$\left(\kappa - i\,\left(2\,(2\,a + ad)\,d2\,E0 - 4\,bdb\,Ub + \omega0 - \omega c\right)\right)$

In[ ]:= `costateAad= -D[HH[ad, a, ada, aad, aa, adad, bd, b,`
`        bdb, bbd, bb, bdbd, ab, abd, adb, adbd, adaada, ft], aad] // Simplify`

Out[ ]= $-i$ d2 E0

$\big(2\,(b + bd)\,Pabd - \big(-8\,(ab + abd - adb - adbd)\,(b + bd) + a\,\big(-1 + 4\,b^2 - 4\,bb + 8\,b\,bd + 4\,bd^2 - 8\,bdb - 4\,bdbd\big) +$

$\qquad ad\,\big(1 - 4\,b^2 + 4\,bb - 8\,b\,bd - 4\,bd^2 + 8\,bdb + 4\,bdbd\big)\big)$ Padaada $- 2\,(b + bd)\,Padb\big)$