```
In[•]:= H11 := 0

In[•]:= H12 := I

In[•]:= H13 := 0

In[•]:= H14 := 0

In[•]:= H21 := -I

In[•]:= H22 := (-z2 Z2 - z3 Z3) / 4

In[•]:= H23 :=
          (-Z2 + 2 a z2 Z2^2 + B Z2^2 z3 + B z2 Z2 Z3 + 4 G Z2 z3 Z3 - 4 a z2 Z3^2 + b z3 Z3^2 - 2 B z3 Z3^2) / 4

In[•]:= (2 b z2 Z2^2 - B z2 Z2^2 - 4 a Z2^2 z3 -
          2 G Z2^2 z3 + 4 g z2 Z2 Z3 - 2 b Z2 z3 Z3 - b z2 Z3^2 + 2 a z3 Z3^2) / 4

Out[•]= 1/4 (2 b z2 Z2^2 - B z2 Z2^2 - 4 a Z2^2 z3 - 2 G Z2^2 z3 + 4 g z2 Z2 Z3 - 2 b Z2 z3 Z3 - b z2 Z3^2 + 2 a z3 Z3^2)

In[•]:= Expand[1/4
          (2 b z2 Z2^2 - B z2 Z2^2 - 4 a Z2^2 z3 - 2 G Z2^2 z3 + 4 g z2 Z2 Z3 - 2 b Z2 z3 Z3 - b z2 Z3^2 + 2 a z3 Z3^2)]

Out[•]= 1/2 b z2 Z2^2 - 1/4 B z2 Z2^2 - a Z2^2 z3 - 1/2 G Z2^2 z3 + g z2 Z2 Z3 - 1/2 b Z2 z3 Z3 - 1/4 b z2 Z3^2 + 1/2 a z3 Z3^2

In[•]:= H24 :=
          1/4 (2 b z2 Z2^2 - B z2 Z2^2 - 4 a Z2^2 z3 - 2 G Z2^2 z3 + 4 g z2 Z2 Z3 - 2 b Z2 z3 Z3 - b z2 Z3^2 + 2 a z3 Z3^2)

In[•]:= H31 := 0

In[•]:= H32 := (-z2 + 2 a z2^2 Z2 + 2 b z2 Z2 z3 -
          4 a Z2 z3^2 - 2 G Z2 z3^2 + b z2^2 Z3 + 4 g z2 z3 Z3 - 2 b z3^2 Z3 + B z3^2 Z3) / 4

In[•]:= H33 := (b z2 Z2)/2 - a Z2 z3 + g z2 Z3 - (b z3 Z3)/2

In[•]:= ClearAll[H33]

In[•]:= H33 := -1/4 + a z2 Z2 + (B Z2 z3)/2 + (b z2 Z3)/2 - a z3 Z3

In[•]:= H34 := (b z2 Z2)/2 - a Z2 z3 + g z2 Z3 - (b z3 Z3)/2

In[•]:= H41 := 0

In[•]:= H42 := (-b z2^2 Z2 + 2 B z2^2 Z2 + 4 G z2 Z2 z3 -
          B Z2 z3^2 - 4 a z2^2 Z3 - 2 g z2^2 Z3 - 2 B z2 z3 Z3 + 2 a z3^2 Z3) / 4

In[•]:= H43 := (B z2 Z2)/2 + G Z2 z3 - a z2 Z3 - (B z3 Z3)/2
```

In[]:=
```
H44 := -1/4 - a z2 Z2 - (B Z2 z3)/2 - (b z2 Z3)/2 + a z3 Z3
```

In[]:=
```
Ainv :=
 {{H11, H12, H13, H14}, {H21, H22, H23, H24}, {H31, H32, H33, H34}, {H41, H42, H43, H44}}
```

In[]:=
```
Ainv
```

Out[]=
$$\left\{\{0, i, 0, 0\}, \left\{-i, \frac{1}{4}\left(-z2\ Z2 - z3\ Z3\right),\right.\right.$$
$$\frac{1}{4}\left(-Z2 + 2\ a\ z2\ Z2^2 + B\ Z2^2\ z3 + B\ z2\ Z2\ Z3 + 4\ G\ Z2\ z3\ Z3 - 4\ a\ z2\ Z3^2 + b\ z3\ Z3^2 - 2\ B\ z3\ Z3^2\right),$$
$$\frac{1}{4}\left(2\ b\ z2\ Z2^2 - B\ z2\ Z2^2 - 4\ a\ Z2^2\ z3 - 2\ G\ Z2^2\ z3 + 4\ g\ z2\ Z2\ Z3 - 2\ b\ Z2\ z3\ Z3 - b\ z2\ Z3^2 + 2\ a\ z3\ Z3^2\right)\Big\},$$
$$\left\{0, \frac{1}{4}\left(-z2 + 2\ a\ z2^2\ Z2 + 2\ b\ z2\ Z2\ z3 - 4\ a\ Z2\ z3^2 - 2\ G\ Z2\ z3^2 + b\ z2^2\ Z3 + 4\ g\ z2\ z3\ Z3 - 2\ b\ z3^2\ Z3 + B\ z3^2\ Z3\right),\right.$$
$$\left.-\frac{1}{4} + a\ z2\ Z2 + \frac{B\ Z2\ z3}{2} + \frac{b\ z2\ Z3}{2} - a\ z3\ Z3,\ \frac{b\ z2\ Z2}{2} - a\ Z2\ z3 + g\ z2\ Z3 - \frac{b\ z3\ Z3}{2}\right\},$$
$$\left\{0, \frac{1}{4}\left(-b\ z2^2\ Z2 + 2\ B\ z2^2\ Z2 + 4\ G\ z2\ Z2\ z3 - B\ Z2\ z3^2 - 4\ a\ z2^2\ Z3 - 2\ g\ z2^2\ Z3 - 2\ B\ z2\ z3\ Z3 + 2\ a\ z3^2\ Z3\right),\right.$$
$$\left.\left.\frac{B\ z2\ Z2}{2} + G\ Z2\ z3 - a\ z2\ Z3 - \frac{B\ z3\ Z3}{2},\ -\frac{1}{4} - a\ z2\ Z2 - \frac{B\ Z2\ z3}{2} - \frac{b\ z2\ Z3}{2} + a\ z3\ Z3\right\}\right\}$$

In[]:=
```
MatrixForm[%20]
```

Out[]//MatrixForm=
$$\begin{pmatrix} 0 & i \\ -i & \frac{1}{4}\left(-z2\ Z2 - z3\ Z3\right) \\ 0 & \frac{1}{4}\left(-z2 + 2\ a\ z2^2\ Z2 + 2\ b\ z2\ Z2\ z3 - 4\ a\ Z2\ z3^2 - 2\ G\ Z2\ z3^2 + b\ z2^2\ Z3 + 4\ g\ z2\ z3\ Z3 - 2\ b\ z3^2\ Z3 + \right. \\ 0 & \left.\frac{1}{4}\left(-b\ z2^2\ Z2 + 2\ B\ z2^2\ Z2 + 4\ G\ z2\ Z2\ z3 - B\ Z2\ z3^2 - 4\ a\ z2^2\ Z3 - 2\ g\ z2^2\ Z3 - 2\ B\ z2\ z3\ Z3 + 2\ a\ z\right. \end{pmatrix}$$

In[]:=
```
q := {p0, I * p1, p2, p3}
```

In[]:=
```
Q := {p0, -I * p1, P2, P3}
```

In[•]:= **q.Ainv.Q**

Out[•]=
$$p0\,p1 - i\,p1\left(i\,p0 + \frac{1}{4}i\,p1\left(-z2\,Z2 - z3\,Z3\right) + \frac{1}{4}p3\left(-b\,z2^2\,Z2 + 2\,B\,z2^2\,Z2 + 4\,G\,z2\,Z2\,z3 - B\,Z2\,z3^2 - 4\,a\,z2^2\,Z3 - 2\,g\,z2^2\,Z3 - 2\,B\,z2\,z3\,Z3 + 2\,a\,z3^2\,Z3\right) + \frac{1}{4}p2\left(-z2 + 2\,a\,z2^2\,Z2 + 2\,b\,z2\,Z2\,z3 - 4\,a\,Z2\,z3^2 - 2\,G\,Z2\,z3^2 + b\,z2^2\,Z3 + 4\,g\,z2\,z3\,Z3 - 2\,b\,z3^2\,Z3 + B\,z3^2\,Z3\right)\right) + P3\left(p3\left(-\frac{1}{4} - a\,z2\,Z2 - \frac{B\,Z2\,z3}{2} - \frac{b\,z2\,Z3}{2} + a\,z3\,Z3\right) + p2\left(\frac{b\,z2\,Z2}{2} - a\,Z2\,z3 + g\,z2\,Z3 - \frac{b\,z3\,Z3}{2}\right) + \frac{1}{4}i\,p1\left(2\,b\,z2\,Z2^2 - B\,z2\,Z2^2 - 4\,a\,Z2^2\,z3 - 2\,G\,Z2^2\,z3 + 4\,g\,z2\,Z2\,Z3 - 2\,b\,Z2\,z3\,Z3 - b\,z2\,Z3^2 + 2\,a\,z3\,Z3^2\right)\right) + P2\left(p2\left(-\frac{1}{4} + a\,z2\,Z2 + \frac{B\,Z2\,z3}{2} + \frac{b\,z2\,Z3}{2} - a\,z3\,Z3\right) + p3\left(\frac{B\,z2\,Z2}{2} + G\,Z2\,z3 - a\,z2\,Z3 - \frac{B\,z3\,Z3}{2}\right) + \frac{1}{4}i\,p1\left(-Z2 + 2\,a\,z2\,Z2^2 + B\,Z2^2\,z3 + B\,z2\,Z2\,Z3 + 4\,G\,Z2\,z3\,Z3 - 4\,a\,z2\,Z3^2 + b\,z3\,Z3^2 - 2\,B\,z3\,Z3^2\right)\right)$$

In[•]:= **Expand[%25]**

Out[•]=
$$2\,p0\,p1 - \frac{p2\,P2}{4} - \frac{p3\,P3}{4} + \frac{1}{4}i\,p1\,p2\,z2 - \frac{1}{4}i\,p1\,P2\,Z2 - \frac{1}{4}p1^2\,z2\,Z2 + a\,p2\,P2\,z2\,Z2 + \frac{1}{2}B\,P2\,p3\,z2\,Z2 + \frac{1}{2}b\,p2\,P3\,z2\,Z2 - a\,p3\,P3\,z2\,Z2 - \frac{1}{2}i\,a\,p1\,p2\,z2^2\,Z2 + \frac{1}{4}i\,b\,p1\,p3\,z2^2\,Z2 - \frac{1}{2}i\,B\,p1\,p3\,z2^2\,Z2 + \frac{1}{2}i\,a\,p1\,P2\,z2\,Z2^2 + \frac{1}{2}i\,b\,p1\,P3\,z2\,Z2^2 - \frac{1}{4}i\,B\,p1\,P3\,z2\,Z2^2 + \frac{1}{2}B\,p2\,P2\,Z2\,z3 + G\,P2\,p3\,Z2\,z3 - a\,p2\,P3\,Z2\,z3 - \frac{1}{2}B\,p3\,P3\,Z2\,z3 - \frac{1}{2}i\,b\,p1\,p2\,z2\,Z2\,z3 - i\,G\,p1\,p3\,z2\,Z2\,z3 + \frac{1}{4}i\,B\,p1\,P2\,Z2^2\,z3 - i\,a\,p1\,P3\,Z2^2\,z3 - \frac{1}{2}i\,G\,p1\,P3\,Z2^2\,z3 + i\,a\,p1\,p2\,Z2\,z3^2 + \frac{1}{2}i\,G\,p1\,p2\,Z2\,z3^2 + \frac{1}{4}i\,B\,p1\,p3\,Z2\,z3^2 + \frac{1}{2}b\,p2\,P2\,z2\,Z3 - a\,P2\,p3\,z2\,Z3 + g\,p2\,P3\,z2\,Z3 - \frac{1}{2}b\,p3\,P3\,z2\,Z3 - \frac{1}{4}i\,b\,p1\,p2\,z2^2\,Z3 + i\,a\,p1\,p3\,z2^2\,Z3 + \frac{1}{2}i\,g\,p1\,p3\,z2^2\,Z3 + \frac{1}{4}i\,B\,p1\,P2\,z2\,Z2\,Z3 + i\,g\,p1\,P3\,z2\,Z2\,Z3 - \frac{1}{4}p1^2\,z3\,Z3 - a\,p2\,P2\,z3\,Z3 - \frac{1}{2}B\,P2\,p3\,z3\,Z3 - \frac{1}{2}b\,p2\,P3\,z3\,Z3 + a\,p3\,P3\,z3\,Z3 - i\,g\,p1\,p2\,z2\,z3\,Z3 + \frac{1}{2}i\,B\,p1\,p3\,z2\,z3\,Z3 + i\,G\,p1\,P2\,Z2\,z3\,Z3 - \frac{1}{2}i\,b\,p1\,P3\,Z2\,z3\,Z3 + \frac{1}{2}i\,b\,p1\,p2\,z3^2\,Z3 - \frac{1}{4}i\,B\,p1\,p2\,z3^2\,Z3 - \frac{1}{2}i\,a\,p1\,p3\,z3^2\,Z3 - i\,a\,p1\,P2\,z2\,Z3^2 - \frac{1}{4}i\,b\,p1\,P3\,z2\,Z3^2 + \frac{1}{4}i\,b\,p1\,P2\,z3\,Z3^2 - \frac{1}{2}i\,B\,p1\,P2\,z3\,Z3^2 + \frac{1}{2}i\,a\,p1\,P3\,z3\,Z3^2$$

In[•]:= **dz2 := 2 * D[H, P2]**

In[•]:= **dz3 := 2 * D[H, P3]**

In[•]:= dp2 := -2 * D[H, Z2]

In[•]:= dp3 := -2 * D[H, Z3]

In[•]:= dz2

Out[•]= 0

In[•]:= ClearAll[dz2, dz3, dp2, dp3]

In[•]:=
$$H := 2\,p0\,p1 - \frac{p2\,P2}{4} - \frac{p3\,P3}{4} + \frac{1}{4}\,i\,p1\,p2\,z2 - \frac{1}{4}\,i\,p1\,P2\,Z2 - \frac{1}{4}\,p1^2\,z2\,Z2 + a\,p2\,P2\,z2\,Z2 + \frac{1}{2}\,B\,P2\,p3\,z2\,Z2 + \frac{1}{2}\,b\,p2\,P3\,z2\,Z2 - a\,p3\,P3\,z2\,Z2 - \frac{1}{2}\,i\,a\,p1\,p2\,z2^2\,Z2 + \frac{1}{4}\,i\,b\,p1\,p3\,z2^2\,Z2 - \frac{1}{2}\,i\,B\,p1\,p3\,z2^2\,Z2 + \frac{1}{2}\,i\,a\,p1\,P2\,z2\,Z2^2 + \frac{1}{2}\,i\,b\,p1\,P3\,z2\,Z2^2 - \frac{1}{4}\,i\,B\,p1\,P3\,z2\,Z2^2 + \frac{1}{2}\,B\,p2\,P2\,Z2\,z3 + G\,P2\,p3\,Z2\,z3 - a\,p2\,P3\,Z2\,z3 - \frac{1}{2}\,B\,p3\,P3\,Z2\,z3 - \frac{1}{2}\,i\,b\,p1\,p2\,z2\,Z2\,z3 - i\,G\,p1\,p3\,z2\,Z2\,z3 + \frac{1}{4}\,i\,B\,p1\,P2\,Z2^2\,z3 - i\,a\,p1\,P3\,Z2^2\,z3 - \frac{1}{2}\,i\,G\,p1\,P3\,Z2^2\,z3 + i\,a\,p1\,p2\,Z2\,z3^2 + \frac{1}{2}\,i\,G\,p1\,p2\,Z2\,z3^2 + \frac{1}{4}\,i\,B\,p1\,p3\,Z2\,z3^2 + \frac{1}{2}\,b\,p2\,P2\,z2\,Z3 - a\,P2\,p3\,z2\,Z3 + g\,p2\,P3\,z2\,Z3 - \frac{1}{2}\,b\,p3\,P3\,z2\,Z3 - \frac{1}{4}\,i\,b\,p1\,p2\,z2^2\,Z3 + i\,a\,p1\,p3\,z2^2\,Z3 + \frac{1}{2}\,i\,g\,p1\,p3\,z2^2\,Z3 + \frac{1}{4}\,i\,B\,p1\,P2\,z2\,Z2\,Z3 + i\,g\,p1\,P3\,z2\,Z2\,Z3 - \frac{1}{4}\,p1^2\,z3\,Z3 - a\,p2\,P2\,z3\,Z3 - \frac{1}{2}\,B\,P2\,p3\,z3\,Z3 - \frac{1}{2}\,b\,p2\,P3\,z3\,Z3 + a\,p3\,P3\,z3\,Z3 - i\,g\,p1\,p2\,z2\,z3\,Z3 + \frac{1}{2}\,i\,B\,p1\,p3\,z2\,z3\,Z3 + i\,G\,p1\,P2\,Z2\,z3\,Z3 - \frac{1}{2}\,i\,b\,p1\,P3\,Z2\,z3\,Z3 + \frac{1}{2}\,i\,b\,p1\,p2\,z3^2\,Z3 - \frac{1}{4}\,i\,B\,p1\,p2\,z3^2\,Z3 - \frac{1}{2}\,i\,a\,p1\,p3\,z3^2\,Z3 - i\,a\,p1\,P2\,z2\,Z3^2 - \frac{1}{4}\,i\,b\,p1\,P3\,z2\,Z3^2 + \frac{1}{4}\,i\,b\,p1\,P2\,z3\,Z3^2 - \frac{1}{2}\,i\,B\,p1\,P2\,z3\,Z3^2 + \frac{1}{2}\,i\,a\,p1\,P3\,z3\,Z3^2$$

In[•]:= dz2 := 2 * D[H, P2]

In[•]:= dz3 := 2 * D[H, P3]

In[•]:= dp2 := -2 * D[H, Z2]

In[•]:= dp2

Out[•]=
$$-2\left(-\frac{1}{4}\,i\,p1\,P2 - \frac{p1^2\,z2}{4} + a\,p2\,P2\,z2 + \frac{1}{2}\,B\,P2\,p3\,z2 + \frac{1}{2}\,b\,p2\,P3\,z2 - a\,p3\,P3\,z2 - \frac{1}{2}\,i\,a\,p1\,p2\,z2^2 + \frac{1}{4}\,i\,b\,p1\,p3\,z2^2 - \frac{1}{2}\,i\,B\,p1\,p3\,z2^2 + i\,a\,p1\,P2\,z2\,Z2 + i\,b\,p1\,P3\,z2\,Z2 - \frac{1}{2}\,i\,B\,p1\,P3\,z2\,Z2 + \frac{1}{2}\,B\,p2\,P2\,z3 + G\,P2\,p3\,z3 - a\,p2\,P3\,z3 - \frac{1}{2}\,B\,p3\,P3\,z3 - \frac{1}{2}\,i\,b\,p1\,p2\,z2\,z3 - i\,G\,p1\,p3\,z2\,z3 + \frac{1}{2}\,i\,B\,p1\,P2\,Z2\,z3 - 2\,i\,a\,p1\,P3\,Z2\,z3 - i\,G\,p1\,P3\,Z2\,z3 + i\,a\,p1\,p2\,z3^2 + \frac{1}{2}\,i\,G\,p1\,p2\,z3^2 + \frac{1}{4}\,i\,B\,p1\,p3\,z3^2 + \frac{1}{4}\,i\,B\,p1\,P2\,z2\,Z3 + i\,g\,p1\,P3\,z2\,Z3 + i\,G\,p1\,P2\,z3\,Z3 - \frac{1}{2}\,i\,b\,p1\,P3\,z3\,Z3\right)$$

In[•]:= dp3 := -2 * D[H, Z3]

In[•]:= **dp3**

Out[•]= $$-2\left(\frac{1}{2}\,b\,p2\,P2\,z2-a\,P2\,p3\,z2+g\,p2\,P3\,z2-\frac{1}{2}\,b\,p3\,P3\,z2-\frac{1}{4}\,i\,b\,p1\,p2\,z2^2+i\,a\,p1\,p3\,z2^2+\frac{1}{2}\,i\,g\,p1\,p3\,z2^2+\frac{1}{4}\,i\,B\,p1\,P2\,z2\,Z2+i\,g\,p1\,P3\,z2\,Z2-\frac{p1^2\,z3}{4}-a\,p2\,P2\,z3-\frac{1}{2}\,B\,P2\,p3\,z3-\frac{1}{2}\,b\,p2\,P3\,z3+a\,p3\,P3\,z3-i\,g\,p1\,p2\,z2\,z3+\frac{1}{2}\,i\,B\,p1\,p3\,z2\,z3+i\,G\,p1\,P2\,Z2\,z3-\frac{1}{2}\,i\,b\,p1\,P3\,Z2\,z3+\frac{1}{2}\,i\,b\,p1\,p2\,z3^2-\frac{1}{4}\,i\,B\,p1\,p2\,z3^2-\frac{1}{2}\,i\,a\,p1\,p3\,z3^2-2\,i\,a\,p1\,P2\,z2\,Z3-\frac{1}{2}\,i\,b\,p1\,P3\,z2\,Z3+\frac{1}{2}\,i\,b\,p1\,P2\,z3\,Z3-i\,B\,p1\,P2\,z3\,Z3+i\,a\,p1\,P3\,z3\,Z3\right)$$

In[•]:= **Expand[%39]**

Out[•]= $$-b\,p2\,P2\,z2+2\,a\,P2\,p3\,z2-2\,g\,p2\,P3\,z2+b\,p3\,P3\,z2+\frac{1}{2}\,i\,b\,p1\,p2\,z2^2-2\,i\,a\,p1\,p3\,z2^2-i\,g\,p1\,p3\,z2^2-\frac{1}{2}\,i\,B\,p1\,P2\,z2\,Z2-2\,i\,g\,p1\,P3\,z2\,Z2+\frac{p1^2\,z3}{2}+2\,a\,p2\,P2\,z3+B\,P2\,p3\,z3+b\,p2\,P3\,z3-2\,a\,p3\,P3\,z3+2\,i\,g\,p1\,p2\,z2\,z3-i\,B\,p1\,p3\,z2\,z3-2\,i\,G\,p1\,P2\,Z2\,z3+i\,b\,p1\,P3\,Z2\,z3-i\,b\,p1\,p2\,z3^2+\frac{1}{2}\,i\,B\,p1\,p2\,z3^2+i\,a\,p1\,p3\,z3^2+4\,i\,a\,p1\,P2\,z2\,Z3+i\,b\,p1\,P3\,z2\,Z3-i\,b\,p1\,P2\,z3\,Z3+2\,i\,B\,p1\,P2\,z3\,Z3-2\,i\,a\,p1\,P3\,z3\,Z3$$

In[•]:= **z2st := s * z21 + s^3 * z23**

In[•]:= **Z2st := s * Z21 + s^3 * Z23**

In[•]:= **p2st := s * p21 + s^3 * p23**

In[•]:= **P2st := s * P21 + s^3 * P23**

In[•]:= **z3st := s * z31 + s^3 * z33**

In[•]:= **Out[•] =**

In[•]:= **Z3st := s * Z31 + s^3 * Z33**

In[•]:= **p3st := s * p31 + s^3 * p33**

In[•]:= **P3st := s * P31 + s^3 * P33**

In[•]:=
```
dz2 /. {z2 → z2st, Z2 → Z2st, p2 → p2st,
  P2 → P2st, z3 → z3st, Z3 → Z3st, p3 → p3st, P3 → P3st}
```

Out[•]=

$$2\left(\frac{1}{4}\left(-\text{p21 s}-\text{p23 s}^3\right)-\frac{1}{4}\,\text{i p1}\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)+\right.$$
$$\text{a}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)+$$
$$\frac{1}{2}\,\text{B}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)+\frac{1}{2}\,\text{i a p1}\left(\text{s z21}+\text{s}^3\,\text{z23}\right)$$
$$\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)^2+\frac{1}{2}\,\text{B}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)+$$
$$\text{G}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)+\frac{1}{4}\,\text{i B p1}\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)^2$$
$$\left(\text{s z31}+\text{s}^3\,\text{z33}\right)+\frac{1}{2}\,\text{b}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-$$
$$\text{a}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)+$$
$$\frac{1}{4}\,\text{i B p1}\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-$$
$$\text{a}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-$$
$$\frac{1}{2}\,\text{B}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)+$$
$$\text{i G p1}\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-$$
$$\text{i a p1}\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)^2+\frac{1}{4}\,\text{i b p1}\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)^2-$$
$$\left.\frac{1}{2}\,\text{i B p1}\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)^2\right)$$

In[•]:= **Expand[%49]**

Out[•]=
$$-\frac{p21\ s}{2}-\frac{p23\ s^3}{2}-\frac{1}{2}\,i\ p1\ s\ Z21+2\ a\ p21\ s^3\ z21\ Z21+B\ p31\ s^3\ z21\ Z21+2\ a\ p23\ s^5\ z21\ Z21+$$
$$B\ p33\ s^5\ z21\ Z21+i\ a\ p1\ s^3\ z21\ Z21^2+2\ a\ p21\ s^5\ Z21\ z23+B\ p31\ s^5\ Z21\ z23+$$
$$2\ a\ p23\ s^7\ Z21\ z23+B\ p33\ s^7\ Z21\ z23+i\ a\ p1\ s^5\ Z21^2\ z23-\frac{1}{2}\,i\ p1\ s^3\ Z23+2\ a\ p21\ s^5\ z21\ Z23+$$
$$B\ p31\ s^5\ z21\ Z23+2\ a\ p23\ s^7\ z21\ Z23+B\ p33\ s^7\ z21\ Z23+2\ i\ a\ p1\ s^5\ z21\ Z21\ Z23+$$
$$2\ a\ p21\ s^7\ z23\ Z23+B\ p31\ s^7\ z23\ Z23+2\ a\ p23\ s^9\ z23\ Z23+B\ p33\ s^9\ z23\ Z23+$$
$$2\ i\ a\ p1\ s^7\ Z21\ z23\ Z23+i\ a\ p1\ s^7\ z21\ Z23^2+i\ a\ p1\ s^9\ z23\ Z23^2+B\ p21\ s^3\ Z21\ z31+$$
$$2\ G\ p31\ s^3\ Z21\ z31+B\ p23\ s^5\ Z21\ z31+2\ G\ p33\ s^5\ Z21\ z31+\frac{1}{2}\,i\ B\ p1\ s^3\ Z21^2\ z31+$$
$$B\ p21\ s^5\ Z23\ z31+2\ G\ p31\ s^5\ Z23\ z31+B\ p23\ s^7\ Z23\ z31+2\ G\ p33\ s^7\ Z23\ z31+$$
$$i\ B\ p1\ s^5\ Z21\ Z23\ z31+\frac{1}{2}\,i\ B\ p1\ s^7\ Z23^2\ z31+b\ p21\ s^3\ z21\ Z31-2\ a\ p31\ s^3\ z21\ Z31+$$
$$b\ p23\ s^5\ z21\ Z31-2\ a\ p33\ s^5\ z21\ Z31+\frac{1}{2}\,i\ B\ p1\ s^3\ z21\ Z21\ Z31+b\ p21\ s^5\ z23\ Z31-$$
$$2\ a\ p31\ s^5\ z23\ Z31+b\ p23\ s^7\ z23\ Z31-2\ a\ p33\ s^7\ z23\ Z31+\frac{1}{2}\,i\ B\ p1\ s^5\ Z21\ z23\ Z31+$$
$$\frac{1}{2}\,i\ B\ p1\ s^5\ z21\ Z23\ Z31+\frac{1}{2}\,i\ B\ p1\ s^7\ z23\ Z23\ Z31-2\ a\ p21\ s^3\ z31\ Z31-B\ p31\ s^3\ z31\ Z31-$$
$$2\ a\ p23\ s^5\ z31\ Z31-B\ p33\ s^5\ z31\ Z31+2\ i\ G\ p1\ s^3\ Z21\ z31\ Z31+2\ i\ G\ p1\ s^5\ Z23\ z31\ Z31-$$
$$2\ i\ a\ p1\ s^3\ z21\ Z31^2-2\ i\ a\ p1\ s^5\ z23\ Z31^2+\frac{1}{2}\,i\ b\ p1\ s^3\ z31\ Z31^2-i\ B\ p1\ s^3\ z31\ Z31^2+$$
$$B\ p21\ s^5\ Z21\ z33+2\ G\ p31\ s^5\ Z21\ z33+B\ p23\ s^7\ Z21\ z33+2\ G\ p33\ s^7\ Z21\ z33+$$
$$\frac{1}{2}\,i\ B\ p1\ s^5\ Z21^2\ z33+B\ p21\ s^7\ Z23\ z33+2\ G\ p31\ s^7\ Z23\ z33+B\ p23\ s^9\ Z23\ z33+$$
$$2\ G\ p33\ s^9\ Z23\ z33+i\ B\ p1\ s^7\ Z21\ Z23\ z33+\frac{1}{2}\,i\ B\ p1\ s^9\ Z23^2\ z33-2\ a\ p21\ s^5\ Z31\ z33-$$
$$B\ p31\ s^5\ Z31\ z33-2\ a\ p23\ s^7\ Z31\ z33-B\ p33\ s^7\ Z31\ z33+2\ i\ G\ p1\ s^5\ Z21\ Z31\ z33+$$
$$2\ i\ G\ p1\ s^7\ Z23\ Z31\ z33+\frac{1}{2}\,i\ b\ p1\ s^5\ Z31^2\ z33-i\ B\ p1\ s^5\ Z31^2\ z33+b\ p21\ s^5\ z21\ Z33-$$
$$2\ a\ p31\ s^5\ z21\ Z33+b\ p23\ s^7\ z21\ Z33-2\ a\ p33\ s^7\ z21\ Z33+\frac{1}{2}\,i\ B\ p1\ s^5\ z21\ Z21\ Z33+$$
$$b\ p21\ s^7\ z23\ Z33-2\ a\ p31\ s^7\ z23\ Z33+b\ p23\ s^9\ z23\ Z33-2\ a\ p33\ s^9\ z23\ Z33+$$
$$\frac{1}{2}\,i\ B\ p1\ s^7\ Z21\ z23\ Z33+\frac{1}{2}\,i\ B\ p1\ s^7\ z21\ Z23\ Z33+\frac{1}{2}\,i\ B\ p1\ s^9\ z23\ Z23\ Z33-2\ a\ p21\ s^5\ z31\ Z33-$$
$$B\ p31\ s^5\ z31\ Z33-2\ a\ p23\ s^7\ z31\ Z33-B\ p33\ s^7\ z31\ Z33+2\ i\ G\ p1\ s^5\ Z21\ z31\ Z33+$$
$$2\ i\ G\ p1\ s^7\ Z23\ z31\ Z33-4\ i\ a\ p1\ s^5\ z21\ Z31\ Z33-4\ i\ a\ p1\ s^7\ z23\ Z31\ Z33+$$
$$i\ b\ p1\ s^5\ z31\ Z31\ Z33-2\ i\ B\ p1\ s^5\ z31\ Z31\ Z33-2\ a\ p21\ s^7\ z33\ Z33-B\ p31\ s^7\ z33\ Z33-$$
$$2\ a\ p23\ s^9\ z33\ Z33-B\ p33\ s^9\ z33\ Z33+2\ i\ G\ p1\ s^7\ Z21\ z33\ Z33+2\ i\ G\ p1\ s^9\ Z23\ z33\ Z33+$$
$$i\ b\ p1\ s^7\ Z31\ z33\ Z33-2\ i\ B\ p1\ s^7\ Z31\ z33\ Z33-2\ i\ a\ p1\ s^7\ z21\ Z33^2-2\ i\ a\ p1\ s^9\ z23\ Z33^2+$$
$$\frac{1}{2}\,i\ b\ p1\ s^7\ z31\ Z33^2-i\ B\ p1\ s^7\ z31\ Z33^2+\frac{1}{2}\,i\ b\ p1\ s^9\ z33\ Z33^2-i\ B\ p1\ s^9\ z33\ Z33^2$$

In[•]:= **Collect[%50, s]**

Out[•]=

$$
\begin{aligned}
&s\left(-\frac{p21}{2}-\frac{i\ p1\ Z21}{2}\right)+\\
&s^3\left(-\frac{p23}{2}+2\ a\ p21\ z21\ Z21+B\ p31\ z21\ Z21+i\ a\ p1\ z21\ Z21^2-\frac{i\ p1\ Z23}{2}+B\ p21\ Z21\ z31+\right.\\
&\quad 2\ G\ p31\ Z21\ z31+\frac{1}{2}\ i\ B\ p1\ Z21^2\ z31+b\ p21\ z21\ Z31-2\ a\ p31\ z21\ Z31+\\
&\quad \frac{1}{2}\ i\ B\ p1\ z21\ Z21\ Z31-2\ a\ p21\ z31\ Z31-B\ p31\ z31\ Z31+2\ i\ G\ p1\ Z21\ z31\ Z31-\\
&\quad \left.2\ i\ a\ p1\ z21\ Z31^2+\frac{1}{2}\ i\ b\ p1\ z31\ Z31^2-i\ B\ p1\ z31\ Z31^2\right)+\\
&s^5\left(2\ a\ p23\ z21\ Z21+B\ p33\ z21\ Z21+2\ a\ p21\ Z21\ z23+B\ p31\ Z21\ z23+i\ a\ p1\ Z21^2\ z23+\right.\\
&\quad 2\ a\ p21\ z21\ Z23+B\ p31\ z21\ Z23+2\ i\ a\ p1\ z21\ Z21\ Z23+B\ p23\ Z21\ z31+2\ G\ p33\ Z21\ z31+\\
&\quad B\ p21\ Z23\ z31+2\ G\ p31\ Z23\ z31+i\ B\ p1\ Z21\ Z23\ z31+b\ p23\ z21\ Z31-2\ a\ p33\ z21\ Z31+\\
&\quad b\ p21\ z23\ Z31-2\ a\ p31\ z23\ Z31+\frac{1}{2}\ i\ B\ p1\ Z21\ z23\ Z31+\frac{1}{2}\ i\ B\ p1\ z21\ Z23\ Z31-\\
&\quad 2\ a\ p23\ z31\ Z31-B\ p33\ z31\ Z31+2\ i\ G\ p1\ Z23\ z31\ Z31-2\ i\ a\ p1\ z23\ Z31^2+\\
&\quad B\ p21\ Z21\ z33+2\ G\ p31\ Z21\ z33+\frac{1}{2}\ i\ B\ p1\ Z21^2\ z33-2\ a\ p21\ Z31\ z33-B\ p31\ Z31\ z33+\\
&\quad 2\ i\ G\ p1\ Z21\ Z31\ z33+\frac{1}{2}\ i\ b\ p1\ Z31^2\ z33-i\ B\ p1\ Z31^2\ z33+b\ p21\ z21\ Z33-\\
&\quad 2\ a\ p31\ z21\ Z33+\frac{1}{2}\ i\ B\ p1\ z21\ Z21\ Z33-2\ a\ p21\ z31\ Z33-B\ p31\ z31\ Z33+\\
&\quad \left.2\ i\ G\ p1\ Z21\ z31\ Z33-4\ i\ a\ p1\ z21\ Z31\ Z33+i\ b\ p1\ z31\ Z31\ Z33-2\ i\ B\ p1\ z31\ Z31\ Z33\right)+\\
&s^7\left(2\ a\ p23\ Z21\ z23+B\ p33\ Z21\ z23+2\ a\ p23\ z21\ Z23+B\ p33\ z21\ Z23+2\ a\ p21\ z23\ Z23+\right.\\
&\quad B\ p31\ z23\ Z23+2\ i\ a\ p1\ Z21\ z23\ Z23+i\ a\ p1\ z21\ Z23^2+B\ p23\ Z23\ z31+2\ G\ p33\ Z23\ z31+\\
&\quad \frac{1}{2}\ i\ B\ p1\ Z23^2\ z31+b\ p23\ z23\ Z31-2\ a\ p33\ z23\ Z31+\frac{1}{2}\ i\ B\ p1\ z23\ Z23\ Z31+\\
&\quad B\ p23\ Z21\ z33+2\ G\ p33\ Z21\ z33+B\ p21\ Z23\ z33+2\ G\ p31\ Z23\ z33+i\ B\ p1\ Z21\ Z23\ z33-\\
&\quad 2\ a\ p23\ Z31\ z33-B\ p33\ Z31\ z33+2\ i\ G\ p1\ Z23\ Z31\ z33+b\ p23\ z21\ Z33-2\ a\ p33\ z21\ Z33+\\
&\quad b\ p21\ z23\ Z33-2\ a\ p31\ z23\ Z33+\frac{1}{2}\ i\ B\ p1\ Z21\ z23\ Z33+\frac{1}{2}\ i\ B\ p1\ z21\ Z23\ Z33-\\
&\quad 2\ a\ p23\ z31\ Z33-B\ p33\ z31\ Z33+2\ i\ G\ p1\ Z23\ z31\ Z33-4\ i\ a\ p1\ z23\ Z31\ Z33-\\
&\quad 2\ a\ p21\ z33\ Z33-B\ p31\ z33\ Z33+2\ i\ G\ p1\ Z21\ z33\ Z33+i\ b\ p1\ Z31\ z33\ Z33-\\
&\quad \left.2\ i\ B\ p1\ Z31\ z33\ Z33-2\ i\ a\ p1\ z21\ Z33^2+\frac{1}{2}\ i\ b\ p1\ z31\ Z33^2-i\ B\ p1\ z31\ Z33^2\right)+\\
&s^9\left(2\ a\ p23\ z23\ Z23+B\ p33\ z23\ Z23+i\ a\ p1\ z23\ Z23^2+B\ p23\ Z23\ z33+2\ G\ p33\ Z23\ z33+\right.\\
&\quad \frac{1}{2}\ i\ B\ p1\ Z23^2\ z33+b\ p23\ z23\ Z33-2\ a\ p33\ z23\ Z33+\frac{1}{2}\ i\ B\ p1\ z23\ Z23\ Z33-2\ a\ p23\ z33\ Z33-\\
&\quad \left.B\ p33\ z33\ Z33+2\ i\ G\ p1\ Z23\ z33\ Z33-2\ i\ a\ p1\ z23\ Z33^2+\frac{1}{2}\ i\ b\ p1\ z33\ Z33^2-i\ B\ p1\ z33\ Z33^2\right)
\end{aligned}
$$

In[•]:=
```
dp2 /. {z2 → z2st, Z2 → Z2st, p2 → p2st,
  P2 → P2st, z3 → z3st, Z3 → Z3st, p3 → p3st, P3 → P3st}
```

Out[•]=
$$
\begin{aligned}
&-2\left(-\frac{1}{4}\,i\,p1\,\left(P21\,s+P23\,s^3\right)-\right.\\
&\frac{1}{4}\,p1^2\,\left(s\,z21+s^3\,z23\right)+a\,\left(p21\,s+p23\,s^3\right)\,\left(P21\,s+P23\,s^3\right)\,\left(s\,z21+s^3\,z23\right)+\\
&\frac{1}{2}\,B\,\left(P21\,s+P23\,s^3\right)\,\left(p31\,s+p33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)+\\
&\frac{1}{2}\,b\,\left(p21\,s+p23\,s^3\right)\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)-\\
&a\,\left(p31\,s+p33\,s^3\right)\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)-\\
&\frac{1}{2}\,i\,a\,p1\,\left(p21\,s+p23\,s^3\right)\,\left(s\,z21+s^3\,z23\right)^2+\frac{1}{4}\,i\,b\,p1\,\left(p31\,s+p33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)^2-\\
&\frac{1}{2}\,i\,B\,p1\,\left(p31\,s+p33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)^2+\\
&i\,a\,p1\,\left(P21\,s+P23\,s^3\right)\,\left(s\,z21+s^3\,z23\right)\,\left(s\,Z21+s^3\,Z23\right)+\\
&i\,b\,p1\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)\,\left(s\,Z21+s^3\,Z23\right)-\\
&\frac{1}{2}\,i\,B\,p1\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)\,\left(s\,Z21+s^3\,Z23\right)+\\
&\frac{1}{2}\,B\,\left(p21\,s+p23\,s^3\right)\,\left(P21\,s+P23\,s^3\right)\,\left(s\,z31+s^3\,z33\right)+\\
&G\,\left(P21\,s+P23\,s^3\right)\,\left(p31\,s+p33\,s^3\right)\,\left(s\,z31+s^3\,z33\right)-\\
&a\,\left(p21\,s+p23\,s^3\right)\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z31+s^3\,z33\right)-\\
&\frac{1}{2}\,B\,\left(p31\,s+p33\,s^3\right)\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z31+s^3\,z33\right)-\\
&\frac{1}{2}\,i\,b\,p1\,\left(p21\,s+p23\,s^3\right)\,\left(s\,z21+s^3\,z23\right)\,\left(s\,z31+s^3\,z33\right)-\\
&i\,G\,p1\,\left(p31\,s+p33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)\,\left(s\,z31+s^3\,z33\right)+\\
&\frac{1}{2}\,i\,B\,p1\,\left(P21\,s+P23\,s^3\right)\,\left(s\,Z21+s^3\,Z23\right)\,\left(s\,z31+s^3\,z33\right)-\\
&2\,i\,a\,p1\,\left(P31\,s+P33\,s^3\right)\,\left(s\,Z21+s^3\,Z23\right)\,\left(s\,z31+s^3\,z33\right)-\\
&i\,G\,p1\,\left(P31\,s+P33\,s^3\right)\,\left(s\,Z21+s^3\,Z23\right)\,\left(s\,z31+s^3\,z33\right)+\\
&i\,a\,p1\,\left(p21\,s+p23\,s^3\right)\,\left(s\,z31+s^3\,z33\right)^2+\frac{1}{2}\,i\,G\,p1\,\left(p21\,s+p23\,s^3\right)\,\left(s\,z31+s^3\,z33\right)^2+\\
&\frac{1}{4}\,i\,B\,p1\,\left(p31\,s+p33\,s^3\right)\,\left(s\,z31+s^3\,z33\right)^2+\\
&\frac{1}{4}\,i\,B\,p1\,\left(P21\,s+P23\,s^3\right)\,\left(s\,z21+s^3\,z23\right)\,\left(s\,Z31+s^3\,Z33\right)+\\
&i\,g\,p1\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z21+s^3\,z23\right)\,\left(s\,Z31+s^3\,Z33\right)+\\
&i\,G\,p1\,\left(P21\,s+P23\,s^3\right)\,\left(s\,z31+s^3\,z33\right)\,\left(s\,Z31+s^3\,Z33\right)-\\
&\left.\frac{1}{2}\,i\,b\,p1\,\left(P31\,s+P33\,s^3\right)\,\left(s\,z31+s^3\,z33\right)\,\left(s\,Z31+s^3\,Z33\right)\right)
\end{aligned}
$$

In[•]:=
```
Expand[%52]
```

Out[•]=
$$
\begin{aligned}
&\frac{1}{2}\,i\,p1\,P21\,s+\frac{1}{2}\,i\,p1\,P23\,s^3+\frac{1}{2}\,p1^2\,s\,z21-2\,a\,p21\,P21\,s^3\,z21-B\,P21\,p31\,s^3\,z21-\\
&b\,p21\,P31\,s^3\,z21+2\,a\,p31\,P31\,s^3\,z21-2\,a\,P21\,p23\,s^5\,z21-2\,a\,p21\,P23\,s^5\,z21-B\,P23\,p31\,s^5\,z21-
\end{aligned}
$$

$$b\,p23\,P31\,s^5\,z21 - B\,P21\,p33\,s^5\,z21 + 2\,a\,P31\,p33\,s^5\,z21 - b\,p21\,P33\,s^5\,z21 + 2\,a\,p31\,P33\,s^5\,z21 -$$
$$2\,a\,p23\,P23\,s^7\,z21 - B\,P23\,p33\,s^7\,z21 - b\,p23\,P33\,s^7\,z21 + 2\,a\,p33\,P33\,s^7\,z21 + i\,a\,p1\,p21\,s^3\,z21^2 -$$
$$\frac{1}{2}\,i\,b\,p1\,p31\,s^3\,z21^2 + i\,B\,p1\,p31\,s^3\,z21^2 + i\,a\,p1\,p23\,s^5\,z21^2 - \frac{1}{2}\,i\,b\,p1\,p33\,s^5\,z21^2 +$$
$$i\,B\,p1\,p33\,s^5\,z21^2 - 2\,i\,a\,p1\,P21\,s^3\,z21\,Z21 - 2\,i\,b\,p1\,P31\,s^3\,z21\,Z21 + i\,B\,p1\,P31\,s^3\,z21\,Z21 -$$
$$2\,i\,a\,p1\,P23\,s^5\,z21\,Z21 - 2\,i\,b\,p1\,P33\,s^5\,z21\,Z21 + i\,B\,p1\,P33\,s^5\,z21\,Z21 + \frac{1}{2}\,p1^2\,s^3\,z23 -$$
$$2\,a\,p21\,P21\,s^5\,z23 - B\,P21\,p31\,s^5\,z23 - b\,p21\,P31\,s^5\,z23 + 2\,a\,p31\,P31\,s^5\,z23 - 2\,a\,P21\,p23\,s^7\,z23 -$$
$$2\,a\,p21\,P23\,s^7\,z23 - B\,P23\,p31\,s^7\,z23 - b\,p23\,P31\,s^7\,z23 - B\,P21\,p33\,s^7\,z23 + 2\,a\,P31\,p33\,s^7\,z23 -$$
$$b\,p21\,P33\,s^7\,z23 + 2\,a\,p31\,P33\,s^7\,z23 - 2\,a\,p23\,P23\,s^9\,z23 - B\,P23\,p33\,s^9\,z23 - b\,p23\,P33\,s^9\,z23 +$$
$$2\,a\,p33\,P33\,s^9\,z23 + 2\,i\,a\,p1\,p21\,s^5\,z21\,z23 - i\,b\,p1\,p31\,s^5\,z21\,z23 + 2\,i\,B\,p1\,p31\,s^5\,z21\,z23 +$$
$$2\,i\,a\,p1\,p23\,s^7\,z21\,z23 - i\,b\,p1\,p33\,s^7\,z21\,z23 + 2\,i\,B\,p1\,p33\,s^7\,z21\,z23 - 2\,i\,a\,p1\,P21\,s^5\,Z21\,z23 -$$
$$2\,i\,b\,p1\,P31\,s^5\,Z21\,z23 + i\,B\,p1\,P31\,s^5\,Z21\,z23 - 2\,i\,a\,p1\,P23\,s^7\,Z21\,z23 - 2\,i\,b\,p1\,P33\,s^7\,Z21\,z23 +$$
$$i\,B\,p1\,P33\,s^7\,Z21\,z23 + i\,a\,p1\,p21\,s^7\,z23^2 - \frac{1}{2}\,i\,b\,p1\,p31\,s^7\,z23^2 + i\,B\,p1\,p31\,s^7\,z23^2 +$$
$$i\,a\,p1\,p23\,s^9\,z23^2 - \frac{1}{2}\,i\,b\,p1\,p33\,s^9\,z23^2 + i\,B\,p1\,p33\,s^9\,z23^2 - 2\,i\,a\,p1\,P21\,s^5\,z21\,Z23 -$$
$$2\,i\,b\,p1\,P31\,s^5\,z21\,Z23 + i\,B\,p1\,P31\,s^5\,z21\,Z23 - 2\,i\,a\,p1\,P23\,s^7\,z21\,Z23 - 2\,i\,b\,p1\,P33\,s^7\,z21\,Z23 +$$
$$i\,B\,p1\,P33\,s^7\,z21\,Z23 - 2\,i\,a\,p1\,P21\,s^7\,z23\,Z23 - 2\,i\,b\,p1\,P31\,s^7\,z23\,Z23 + i\,B\,p1\,P31\,s^7\,z23\,Z23 -$$
$$2\,i\,a\,p1\,P23\,s^9\,z23\,Z23 - 2\,i\,b\,p1\,P33\,s^9\,z23\,Z23 + i\,B\,p1\,P33\,s^9\,z23\,Z23 - B\,p21\,P21\,s^3\,z31 -$$
$$2\,G\,P21\,p31\,s^3\,z31 + 2\,a\,p21\,P31\,s^3\,z31 + B\,p31\,P31\,s^3\,z31 - B\,P21\,p23\,s^5\,z31 - B\,p21\,P23\,s^5\,z31 -$$
$$2\,G\,P23\,p31\,s^5\,z31 + 2\,a\,p23\,P31\,s^5\,z31 - 2\,G\,P21\,p33\,s^5\,z31 + B\,P31\,p33\,s^5\,z31 +$$
$$2\,a\,p21\,P33\,s^5\,z31 + B\,p31\,P33\,s^5\,z31 - B\,p23\,P23\,s^7\,z31 - 2\,G\,P23\,p33\,s^7\,z31 +$$
$$2\,a\,p23\,P33\,s^7\,z31 + B\,p33\,P33\,s^7\,z31 + i\,b\,p1\,p21\,s^3\,z21\,z31 + 2\,i\,G\,p1\,p31\,s^3\,z21\,z31 +$$
$$i\,b\,p1\,p23\,s^5\,z21\,z31 + 2\,i\,G\,p1\,p33\,s^5\,z21\,z31 - i\,B\,p1\,P21\,s^3\,Z21\,z31 + 4\,i\,a\,p1\,P31\,s^3\,Z21\,z31 +$$
$$2\,i\,G\,p1\,P31\,s^3\,Z21\,z31 - i\,B\,p1\,P23\,s^5\,Z21\,z31 + 4\,i\,a\,p1\,P33\,s^5\,Z21\,z31 + 2\,i\,G\,p1\,P33\,s^5\,Z21\,z31 +$$
$$i\,b\,p1\,p21\,s^5\,z23\,z31 + 2\,i\,G\,p1\,p31\,s^5\,z23\,z31 + i\,b\,p1\,p23\,s^7\,z23\,z31 + 2\,i\,G\,p1\,p33\,s^7\,z23\,z31 -$$
$$i\,B\,p1\,P21\,s^5\,Z23\,z31 + 4\,i\,a\,p1\,P31\,s^5\,Z23\,z31 + 2\,i\,G\,p1\,P31\,s^5\,Z23\,z31 - i\,B\,p1\,P23\,s^7\,Z23\,z31 +$$
$$4\,i\,a\,p1\,P33\,s^7\,Z23\,z31 + 2\,i\,G\,p1\,P33\,s^7\,Z23\,z31 - 2\,i\,a\,p1\,p21\,s^3\,z31^2 - i\,G\,p1\,p21\,s^3\,z31^2 -$$
$$\frac{1}{2}\,i\,B\,p1\,p31\,s^3\,z31^2 - 2\,i\,a\,p1\,p23\,s^5\,z31^2 - i\,G\,p1\,p23\,s^5\,z31^2 - \frac{1}{2}\,i\,B\,p1\,p33\,s^5\,z31^2 -$$
$$\frac{1}{2}\,i\,B\,p1\,P21\,s^3\,z21\,Z31 - 2\,i\,g\,p1\,P31\,s^3\,z21\,Z31 - \frac{1}{2}\,i\,B\,p1\,P23\,s^5\,z21\,Z31 -$$
$$2\,i\,g\,p1\,P33\,s^5\,z21\,Z31 - \frac{1}{2}\,i\,B\,p1\,P21\,s^5\,z23\,Z31 - 2\,i\,g\,p1\,P31\,s^5\,z23\,Z31 -$$
$$\frac{1}{2}\,i\,B\,p1\,P23\,s^7\,z23\,Z31 - 2\,i\,g\,p1\,P33\,s^7\,z23\,Z31 - 2\,i\,G\,p1\,P21\,s^3\,z31\,Z31 + i\,b\,p1\,P31\,s^3\,z31\,Z31 -$$
$$2\,i\,G\,p1\,P23\,s^5\,z31\,Z31 + i\,b\,p1\,P33\,s^5\,z31\,Z31 - B\,p21\,P21\,s^5\,z33 - 2\,G\,P21\,p31\,s^5\,z33 +$$
$$2\,a\,p21\,P31\,s^5\,z33 + B\,p31\,P31\,s^5\,z33 - B\,P21\,p23\,s^7\,z33 - B\,p21\,P23\,s^7\,z33 - 2\,G\,P23\,p31\,s^7\,z33 +$$
$$2\,a\,p23\,P31\,s^7\,z33 - 2\,G\,P21\,p33\,s^7\,z33 + B\,P31\,p33\,s^7\,z33 + 2\,a\,p21\,P33\,s^7\,z33 +$$
$$B\,p31\,P33\,s^7\,z33 - B\,p23\,P23\,s^9\,z33 - 2\,G\,P23\,p33\,s^9\,z33 + 2\,a\,p23\,P33\,s^9\,z33 +$$
$$B\,p33\,P33\,s^9\,z33 + i\,b\,p1\,p21\,s^5\,z21\,z33 + 2\,i\,G\,p1\,p31\,s^5\,z21\,z33 + i\,b\,p1\,p23\,s^7\,z21\,z33 +$$
$$2\,i\,G\,p1\,p33\,s^7\,z21\,z33 - i\,B\,p1\,P21\,s^5\,Z21\,z33 + 4\,i\,a\,p1\,P31\,s^5\,Z21\,z33 + 2\,i\,G\,p1\,P31\,s^5\,Z21\,z33 -$$
$$i\,B\,p1\,P23\,s^7\,Z21\,z33 + 4\,i\,a\,p1\,P33\,s^7\,Z21\,z33 + 2\,i\,G\,p1\,P33\,s^7\,Z21\,z33 + i\,b\,p1\,p21\,s^7\,z23\,z33 +$$
$$2\,i\,G\,p1\,p31\,s^7\,z23\,z33 + i\,b\,p1\,p23\,s^9\,z23\,z33 + 2\,i\,G\,p1\,p33\,s^9\,z23\,z33 - i\,B\,p1\,P21\,s^7\,Z23\,z33 +$$
$$4\,i\,a\,p1\,P31\,s^7\,Z23\,z33 + 2\,i\,G\,p1\,P31\,s^7\,Z23\,z33 - i\,B\,p1\,P23\,s^9\,Z23\,z33 + 4\,i\,a\,p1\,P33\,s^9\,Z23\,z33 +$$
$$2\,i\,G\,p1\,P33\,s^9\,Z23\,z33 - 4\,i\,a\,p1\,p21\,s^5\,z31\,z33 - 2\,i\,G\,p1\,p21\,s^5\,z31\,z33 -$$

$$i\,B\,p1\,p31\,s^5\,z31\,z33 - 4\,i\,a\,p1\,p23\,s^7\,z31\,z33 - 2\,i\,G\,p1\,p23\,s^7\,z31\,z33 - i\,B\,p1\,p33\,s^7\,z31\,z33 - 2\,i\,G\,p1\,P21\,s^5\,Z31\,z33 + i\,b\,p1\,P31\,s^5\,Z31\,z33 - 2\,i\,G\,p1\,P23\,s^7\,Z31\,z33 + i\,b\,p1\,P33\,s^7\,Z31\,z33 - 2\,i\,a\,p1\,p21\,s^7\,z33^2 - i\,G\,p1\,p21\,s^7\,z33^2 - \frac{1}{2}\,i\,B\,p1\,p31\,s^7\,z33^2 - 2\,i\,a\,p1\,p23\,s^9\,z33^2 - i\,G\,p1\,p23\,s^9\,z33^2 - \frac{1}{2}\,i\,B\,p1\,p33\,s^9\,z33^2 - \frac{1}{2}\,i\,B\,p1\,P21\,s^5\,z21\,Z33 - 2\,i\,g\,p1\,P31\,s^5\,z21\,Z33 - \frac{1}{2}\,i\,B\,p1\,P23\,s^7\,z21\,Z33 - 2\,i\,g\,p1\,P33\,s^7\,z21\,Z33 - \frac{1}{2}\,i\,B\,p1\,P21\,s^7\,z23\,Z33 - 2\,i\,g\,p1\,P31\,s^7\,z23\,Z33 - \frac{1}{2}\,i\,B\,p1\,P23\,s^9\,z23\,Z33 - 2\,i\,g\,p1\,P33\,s^9\,z23\,Z33 - 2\,i\,G\,p1\,P21\,s^5\,z31\,Z33 + i\,b\,p1\,P31\,s^5\,z31\,Z33 - 2\,i\,G\,p1\,P23\,s^7\,z31\,Z33 + i\,b\,p1\,P33\,s^7\,z31\,Z33 - 2\,i\,G\,p1\,P21\,s^7\,z33\,Z33 + i\,b\,p1\,P31\,s^7\,z33\,Z33 - 2\,i\,G\,p1\,P23\,s^9\,z33\,Z33 + i\,b\,p1\,P33\,s^9\,z33\,Z33$$

In[•]:=
```
Collect[%53, s]
```

Out[•]=

$$s\left(\frac{i\,p1\,P21}{2} + \frac{p1^2\,z21}{2}\right) +$$

$$s^3\left(\frac{i\,p1\,P23}{2} - 2\,a\,p21\,P21\,z21 - B\,P21\,p31\,z21 - b\,p21\,P31\,z21 + 2\,a\,p31\,P31\,z21 + i\,a\,p1\,p21\,z21^2 - \frac{1}{2}\,i\,b\,p1\,p31\,z21^2 + i\,B\,p1\,p31\,z21^2 - 2\,i\,a\,p1\,P21\,z21\,Z21 - 2\,i\,b\,p1\,P31\,z21\,Z21 + i\,B\,p1\,P31\,z21\,Z21 + \frac{p1^2\,z23}{2} - B\,p21\,P21\,z31 - 2\,G\,P21\,p31\,z31 + 2\,a\,p21\,P31\,z31 + B\,p31\,P31\,z31 + i\,b\,p1\,p21\,z21\,z31 + 2\,i\,G\,p1\,p31\,z21\,z31 - i\,B\,p1\,P21\,Z21\,z31 + 4\,i\,a\,p1\,P31\,Z21\,z31 + 2\,i\,G\,p1\,P31\,Z21\,z31 - 2\,i\,a\,p1\,p21\,z31^2 - i\,G\,p1\,p21\,z31^2 - \frac{1}{2}\,i\,B\,p1\,p31\,z31^2 - \frac{1}{2}\,i\,B\,p1\,P21\,z21\,Z31 - 2\,i\,g\,p1\,P31\,z21\,Z31 - 2\,i\,G\,p1\,P21\,z31\,Z31 + i\,b\,p1\,P31\,z31\,Z31\right) +$$

$$s^5\left(-2\,a\,P21\,p23\,z21 - 2\,a\,p21\,P23\,z21 - B\,P23\,p31\,z21 - b\,p23\,P31\,z21 - B\,P21\,p33\,z21 + 2\,a\,P31\,p33\,z21 - b\,p21\,P33\,z21 + 2\,a\,p31\,P33\,z21 + i\,a\,p1\,p23\,z21^2 - \frac{1}{2}\,i\,b\,p1\,p33\,z21^2 + i\,B\,p1\,p33\,z21^2 - 2\,i\,a\,p1\,P23\,z21\,Z21 - 2\,i\,b\,p1\,P33\,z21\,Z21 + i\,B\,p1\,P33\,z21\,Z21 - 2\,a\,p21\,P21\,z23 - B\,P21\,p31\,z23 - b\,p21\,P31\,z23 + 2\,a\,p31\,P31\,z23 + 2\,i\,a\,p1\,p21\,z21\,z23 - i\,b\,p1\,p31\,z21\,z23 + 2\,i\,B\,p1\,p31\,z21\,z23 - 2\,i\,a\,p1\,P21\,Z21\,z23 - 2\,i\,b\,p1\,P31\,Z21\,z23 + i\,B\,p1\,P31\,Z21\,z23 - 2\,i\,a\,p1\,P21\,z21\,Z23 - 2\,i\,b\,p1\,P31\,z21\,Z23 + i\,B\,p1\,P31\,z21\,Z23 - B\,P21\,p23\,z31 - B\,p21\,P23\,z31 - 2\,G\,P23\,p31\,z31 + 2\,a\,p23\,P31\,z31 - 2\,G\,P21\,p33\,z31 + B\,P31\,p33\,z31 + 2\,a\,p21\,P33\,z31 + B\,p31\,P33\,z31 + i\,b\,p1\,p23\,z21\,z31 + 2\,i\,G\,p1\,p33\,z21\,z31 - i\,B\,p1\,P23\,Z21\,z31 + 4\,i\,a\,p1\,P33\,Z21\,z31 + 2\,i\,G\,p1\,P33\,Z21\,z31 + i\,b\,p1\,p21\,z23\,z31 + 2\,i\,G\,p1\,p31\,z23\,z31 - i\,B\,p1\,P21\,Z23\,z31 + 4\,i\,a\,p1\,P31\,Z23\,z31 + 2\,i\,G\,p1\,P31\,Z23\,z31 - 2\,i\,a\,p1\,p23\,z31^2 - i\,G\,p1\,p23\,z31^2 - \frac{1}{2}\,i\,B\,p1\,p33\,z31^2 - \frac{1}{2}\,i\,B\,p1\,P23\,z21\,Z31 - 2\,i\,g\,p1\,P33\,z21\,Z31 - \frac{1}{2}\,i\,B\,p1\,P21\,z23\,Z31 - 2\,i\,g\,p1\,P31\,z23\,Z31 - 2\,i\,G\,p1\,P23\,z31\,Z31 + i\,b\,p1\,P33\,z31\,Z31 - B\,p21\,P21\,z33 - 2\,G\,P21\,p31\,z33 + 2\,a\,p21\,P31\,z33 + B\,p31\,P31\,z33 + i\,b\,p1\,p21\,z21\,z33 + 2\,i\,G\,p1\,p31\,z21\,z33 - i\,B\,p1\,P21\,Z21\,z33 + 4\,i\,a\,p1\,P31\,Z21\,z33 + 2\,i\,G\,p1\,P31\,Z21\,z33 - 4\,i\,a\,p1\,p21\,z31\,z33 -$$

$$2\,i\,G\,p1\,p21\,z31\,z33 - i\,B\,p1\,p31\,z31\,z33 - 2\,i\,G\,p1\,P21\,Z31\,z33 + i\,b\,p1\,P31\,Z31\,z33 - \frac{1}{2}\,i\,B\,p1\,P21\,z21\,Z33 - 2\,i\,g\,p1\,P31\,z21\,Z33 - 2\,i\,G\,p1\,P21\,z31\,Z33 + i\,b\,p1\,P31\,z31\,Z33\Big) +$$

$$s^7\Big(-2\,a\,p23\,P23\,z21 - B\,P23\,p33\,z21 - b\,p23\,P33\,z21 + 2\,a\,p33\,P33\,z21 - 2\,a\,P21\,p23\,z23 - 2\,a\,p21\,P23\,z23 - B\,P23\,p31\,z23 - b\,p23\,P31\,z23 - B\,P21\,p33\,z23 + 2\,a\,P31\,p33\,z23 - b\,p21\,P33\,z23 + 2\,a\,p31\,P33\,z23 + 2\,i\,a\,p1\,p23\,z21\,z23 - i\,b\,p1\,p33\,z21\,z23 + 2\,i\,B\,p1\,p33\,z21\,z23 - 2\,i\,a\,p1\,P23\,Z21\,z23 - 2\,i\,b\,p1\,P33\,Z21\,z23 + i\,B\,p1\,P33\,Z21\,z23 + i\,a\,p1\,p21\,z23^2 - \frac{1}{2}\,i\,b\,p1\,p31\,z23^2 + i\,B\,p1\,p31\,z23^2 - 2\,i\,a\,p1\,P23\,z21\,Z23 - 2\,i\,b\,p1\,P33\,z21\,Z23 + i\,B\,p1\,P33\,z21\,Z23 - 2\,i\,a\,p1\,P21\,z23\,Z23 - 2\,i\,b\,p1\,P31\,z23\,Z23 + i\,B\,p1\,P31\,z23\,Z23 - B\,p23\,P23\,z31 - 2\,G\,P23\,p33\,z31 + 2\,a\,p23\,P33\,z31 + B\,p33\,P33\,z31 + i\,b\,p1\,p23\,z23\,z31 + 2\,i\,G\,p1\,p33\,z23\,z31 - i\,B\,p1\,P23\,Z23\,z31 + 4\,i\,a\,p1\,P33\,Z23\,z31 + 2\,i\,G\,p1\,P33\,Z23\,z31 - \frac{1}{2}\,i\,B\,p1\,P23\,z23\,Z31 - 2\,i\,g\,p1\,P33\,z23\,Z31 - B\,P21\,p23\,z33 - B\,p21\,P23\,z33 - 2\,G\,P23\,p31\,z33 + 2\,a\,p23\,P31\,z33 - 2\,G\,P21\,p33\,z33 + B\,P31\,p33\,z33 + 2\,a\,p21\,P33\,z33 + B\,p31\,P33\,z33 + i\,b\,p1\,p23\,z21\,z33 + 2\,i\,G\,p1\,p33\,z21\,z33 - i\,B\,p1\,P23\,Z21\,z33 + 4\,i\,a\,p1\,P33\,Z21\,z33 + 2\,i\,G\,p1\,P33\,Z21\,z33 + i\,b\,p1\,p21\,z23\,z33 + 2\,i\,G\,p1\,p31\,z23\,z33 - i\,B\,p1\,P21\,Z23\,z33 + 4\,i\,a\,p1\,P31\,Z23\,z33 + 2\,i\,G\,p1\,P31\,Z23\,z33 - 4\,i\,a\,p1\,p23\,z31\,z33 - 2\,i\,G\,p1\,p23\,z31\,z33 - i\,B\,p1\,p33\,z31\,z33 - 2\,i\,G\,p1\,P23\,Z31\,z33 + i\,b\,p1\,P33\,Z31\,z33 - 2\,i\,a\,p1\,p21\,z33^2 - i\,G\,p1\,p21\,z33^2 - \frac{1}{2}\,i\,B\,p1\,p31\,z33^2 - \frac{1}{2}\,i\,B\,p1\,P23\,z21\,Z33 - 2\,i\,g\,p1\,P33\,z21\,Z33 - \frac{1}{2}\,i\,B\,p1\,P21\,z23\,Z33 - 2\,i\,g\,p1\,P31\,z23\,Z33 - 2\,i\,G\,p1\,P23\,z31\,Z33 + i\,b\,p1\,P33\,z31\,Z33 - 2\,i\,G\,p1\,P21\,z33\,Z33 + i\,b\,p1\,P31\,z33\,Z33\Big) +$$

$$s^9\Big(-2\,a\,p23\,P23\,z23 - B\,P23\,p33\,z23 - b\,p23\,P33\,z23 + 2\,a\,p33\,P33\,z23 + i\,a\,p1\,p23\,z23^2 - \frac{1}{2}\,i\,b\,p1\,p33\,z23^2 + i\,B\,p1\,p33\,z23^2 - 2\,i\,a\,p1\,P23\,z23\,Z23 - 2\,i\,b\,p1\,P33\,z23\,Z23 + i\,B\,p1\,P33\,z23\,Z23 - B\,p23\,P23\,z33 - 2\,G\,P23\,p33\,z33 + 2\,a\,p23\,P33\,z33 + B\,p33\,P33\,z33 + i\,b\,p1\,p23\,z23\,z33 + 2\,i\,G\,p1\,p33\,z23\,z33 - i\,B\,p1\,P23\,Z23\,z33 + 4\,i\,a\,p1\,P33\,Z23\,z33 + 2\,i\,G\,p1\,P33\,Z23\,z33 - 2\,i\,a\,p1\,p23\,z33^2 - i\,G\,p1\,p23\,z33^2 - \frac{1}{2}\,i\,B\,p1\,p33\,z33^2 - \frac{1}{2}\,i\,B\,p1\,P23\,z23\,Z33 - 2\,i\,g\,p1\,P33\,z23\,Z33 - 2\,i\,G\,p1\,P23\,z33\,Z33 + i\,b\,p1\,P33\,z33\,Z33\Big)$$

In[•]:=
```
p1 := 1
```

In[•]:=
```
-p21/2 - (i p1 Z21)/2
```

Out[•]=
$$-\frac{p21}{2} - \frac{i\,Z21}{2}$$

In[•]:=
```
(i p1 P21)/2 + (p1^2 z21)/2
```

Out[•]=
$$\frac{i\,P21}{2} + \frac{z21}{2}$$

```
DSolve[{l'[t] == -m[t]/2 - i * conj(l[t])/2, m'[t] == i * m[t]/2 + l[t]/2}, {l[t], m[t]}, t]
```

Out[•]=
$$\left\{\left\{l[t] \to -\frac{C[2]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]}{\sqrt{2}} + \frac{1}{2}C[1]\left(2\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] - i\sqrt{2}\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right),\right.\right.$$
$$\left.\left.m[t] \to \frac{C[1]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]}{\sqrt{2}} + \frac{1}{2}C[2]\left(2\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] + i\sqrt{2}\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right)\right\}\right\}$$

In[•]:=
$$-\frac{C[2]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]}{\sqrt{2}} + \frac{1}{2}C[1]\left(2\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] - i\sqrt{2}\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right)$$

Out[•]=
$$-\frac{C[2]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]}{\sqrt{2}} + \frac{1}{2}C[1]\left(2\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] - i\sqrt{2}\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right)$$

In[•]:=
```
TrigReduce[-C[2] Sin[t/Sqrt[2]]/Sqrt[2] + 1/2 C[1] (2 Cos[t/Sqrt[2]] - i Sqrt[2] Sin[t/Sqrt[2]])]
```

Out[•]=
$$\frac{1}{2}\left(2\,C[1]\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] - i\sqrt{2}\,C[1]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right] - \sqrt{2}\,C[2]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right)$$

In[•]:=
$$\frac{C[1]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]}{\sqrt{2}} + \frac{1}{2}C[2]\left(2\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] + i\sqrt{2}\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right)$$

Out[•]=
$$\frac{C[1]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]}{\sqrt{2}} + \frac{1}{2}C[2]\left(2\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] + i\sqrt{2}\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right)$$

In[•]:=
```
TrigReduce[C[1] Sin[t/Sqrt[2]]/Sqrt[2] + 1/2 C[2] (2 Cos[t/Sqrt[2]] + i Sqrt[2] Sin[t/Sqrt[2]])]
```

Out[•]=
$$\frac{1}{2}\left(2\,C[2]\,\text{Cos}\left[\frac{t}{\sqrt{2}}\right] + \sqrt{2}\,C[1]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right] + i\sqrt{2}\,C[2]\,\text{Sin}\left[\frac{t}{\sqrt{2}}\right]\right)$$

In[•]:=
```
H /. {a → 0, b → 0, g → 0, B → 0, G → 0}
```

Out[•]=
$$2\,p0 - \frac{p2\,P2}{4} - \frac{p3\,P3}{4} + \frac{i\,p2\,z2}{4} - \frac{i\,P2\,Z2}{4} - \frac{z2\,Z2}{4} - \frac{z3\,Z3}{4}$$

In[•]:=
```
Ainv /. {a → 0, b → 0, g → 0, B → 0, G → 0}
```

Out[•]=
$$\left\{\{0, i, 0, 0\}, \left\{-i, \frac{1}{4}\left(-z2\,Z2 - z3\,Z3\right), -\frac{Z2}{4}, 0\right\}, \left\{0, -\frac{z2}{4}, -\frac{1}{4}, 0\right\}, \left\{0, 0, 0, -\frac{1}{4}\right\}\right\}$$

In[•]:=
```
MatrixForm[
 {{0, i, 0, 0}, {-i, 1/4 (-z2 Z2 - z3 Z3), -Z2/4, 0}, {0, -z2/4, -1/4, 0}, {0, 0, 0, -1/4}}]
```

Out[•]//MatrixForm=

$$\begin{pmatrix} 0 & i & 0 & 0 \\ -i & \frac{1}{4}\left(-z2\,Z2 - z3\,Z3\right) & -\frac{Z2}{4} & 0 \\ 0 & -\frac{z2}{4} & -\frac{1}{4} & 0 \\ 0 & 0 & 0 & -\frac{1}{4} \end{pmatrix}$$

In[•]:=
```
A := {{0, I, I * f2, I * f3}, {-I, 0, 0, 0},
  {-I * f20, 0, 4 * f22, 4 * f23}, {-I * f30, 0, 4 * f32, 4 * f33}}
```

In[•]:=
```
A
```

Out[•]=
```
{{0, i, i f2, i f3}, {-i, 0, 0, 0}, {-i f20, 0, 4 f22, 4 f23}, {-i f30, 0, 4 f32, 4 f33}}
```

In[•]:=
```
MatrixForm[
 {{0, i, i f2, i f3}, {-i, 0, 0, 0}, {-i f20, 0, 4 f22, 4 f23}, {-i f30, 0, 4 f32, 4 f33}}]
```

Out[•]//MatrixForm=

$$\begin{pmatrix} 0 & i & i\,f2 & i\,f3 \\ -i & 0 & 0 & 0 \\ -i\,f20 & 0 & 4\,f22 & 4\,f23 \\ -i\,f30 & 0 & 4\,f32 & 4\,f33 \end{pmatrix}$$

In[•]:=
```
ClearAll[A]
```

In[•]:=
```
A := {{0, I, I * f20, I * f30}, {-I, 0, 0, 0},
  {-I * f2, 0, 4 * f22, 4 * f23}, {-I * f3, 0, 4 * f32, 4 * f33}}
```

In[•]:=
```
A
```

Out[•]=
```
{{0, i, i f20, i f30}, {-i, 0, 0, 0}, {-i f2, 0, 4 f22, 4 f23}, {-i f3, 0, 4 f32, 4 f33}}
```

In[•]:=
```
MatrixForm[
 {{0, i, i f20, i f30}, {-i, 0, 0, 0}, {-i f2, 0, 4 f22, 4 f23}, {-i f3, 0, 4 f32, 4 f33}}]
```

Out[•]//MatrixForm=

$$\begin{pmatrix} 0 & i & i\,f20 & i\,f30 \\ -i & 0 & 0 & 0 \\ -i\,f2 & 0 & 4\,f22 & 4\,f23 \\ -i\,f3 & 0 & 4\,f32 & 4\,f33 \end{pmatrix}$$

In[•]:=
```
W := Inverse[A]
```

In[•]:= **W**

Out[•]= $\left\{\left\{0, \frac{16\,i\,f23\,f32 - 16\,i\,f22\,f33}{16\,f23\,f32 - 16\,f22\,f33}, 0, 0\right\}, \left\{\frac{-16\,i\,f23\,f32 + 16\,i\,f22\,f33}{16\,f23\,f32 - 16\,f22\,f33}, \right.\right.$
$\left(4\,f20\,f23\,f3 - 4\,f22\,f3\,f30 + 4\,f2\,f30\,f32 - 4\,f2\,f20\,f33\right) / \left(16\,f23\,f32 - 16\,f22\,f33\right),$
$\frac{-4\,f30\,f32 + 4\,f20\,f33}{16\,f23\,f32 - 16\,f22\,f33}, \left.\frac{-4\,f20\,f23 + 4\,f22\,f30}{16\,f23\,f32 - 16\,f22\,f33}\right\},$
$\left\{0, \frac{-4\,f23\,f3 + 4\,f2\,f33}{16\,f23\,f32 - 16\,f22\,f33}, -\frac{4\,f33}{16\,f23\,f32 - 16\,f22\,f33}, \frac{4\,f23}{16\,f23\,f32 - 16\,f22\,f33}\right\},$
$\left.\left\{0, \frac{4\,f22\,f3 - 4\,f2\,f32}{16\,f23\,f32 - 16\,f22\,f33}, \frac{4\,f32}{16\,f23\,f32 - 16\,f22\,f33}, -\frac{4\,f22}{16\,f23\,f32 - 16\,f22\,f33}\right\}\right\}$

In[•]:= **F23 * F32 - F22 * F33**

Out[•]= $\left(-b\,z2\,Z2 + 4\,a\,Z2\,z3 - 4\,g\,z2\,Z3 + b\,z3\,Z3 - b\left(z2\,Z2 - z3\,Z3\right)\right)$
$\left(-B\,z2\,Z2 - 4\,G\,Z2\,z3 + 4\,a\,z2\,Z3 + B\,z3\,Z3 - B\left(z2\,Z2 - z3\,Z3\right)\right) -$
$\left(-1 - 2\,B\,Z2\,z3 - 2\,b\,z2\,Z3 - a\left(4\,z2\,Z2 - 4\,z3\,Z3\right)\right)$
$\left(-1 + 2\,B\,Z2\,z3 + 2\,b\,z2\,Z3 - a\left(-4\,z2\,Z2 + 4\,z3\,Z3\right)\right)$

In[•]:= **Expand[%94]**

Out[•]= $-1 + 16\,a^2\,z2^2\,Z2^2 + 4\,b\,B\,z2^2\,Z2^2 + 8\,a\,B\,z2\,Z2^2\,z3 + 8\,b\,G\,z2\,Z2^2\,z3 +$
$4\,B^2\,Z2^2\,z3^2 - 16\,a\,G\,Z2^2\,z3^2 + 8\,a\,b\,z2^2\,Z2\,Z3 + 8\,B\,g\,z2^2\,Z2\,Z3 - 16\,a^2\,z2\,Z2\,z3\,Z3 +$
$16\,g\,G\,z2\,Z2\,z3\,Z3 - 8\,a\,B\,Z2\,z3^2\,Z3 - 8\,b\,G\,Z2\,z3^2\,Z3 + 4\,b^2\,z2^2\,Z3^2 -$
$16\,a\,g\,z2^2\,Z3^2 - 8\,a\,b\,z2\,z3\,Z3^2 - 8\,B\,g\,z2\,z3\,Z3^2 + 16\,a^2\,z3^2\,Z3^2 + 4\,b\,B\,z3^2\,Z3^2$

In[•]:= **Ainvpre := {{0, -i f23 f32 + i f22 f33, 0, 0},**
{i f23 f32 - i f22 f33, (-f20 f23 f3 + f22 f3 f30 - f2 f30 f32 + f2 f20 f33) / 4,
(f30 f32 - f20 f33) / 4, (f20 f23 - f22 f30) / 4}, {0, (f23 f3 - f2 f33) / 4,
f33 / 4, -f23 / 4}, {0, (-f22 f3 + f2 f32) / 4, -f32 / 4, f22 / 4}}

In[•]:= **-i f23 f32 + i f22 f33 /. {f2 → F2, f22 → F22,**
f23 → F23, f20 → F20, f3 → F3, f30 → F30, f32 → F32, f33 → F33}

Out[•]= $-i\left(-b\,z2\,Z2 + 4\,a\,Z2\,z3 - 4\,g\,z2\,Z3 + b\,z3\,Z3 - b\left(z2\,Z2 - z3\,Z3\right)\right)$
$\left(-B\,z2\,Z2 - 4\,G\,Z2\,z3 + 4\,a\,z2\,Z3 + B\,z3\,Z3 - B\left(z2\,Z2 - z3\,Z3\right)\right) +$
$i\left(-1 - 2\,B\,Z2\,z3 - 2\,b\,z2\,Z3 - a\left(4\,z2\,Z2 - 4\,z3\,Z3\right)\right)$
$\left(-1 + 2\,B\,Z2\,z3 + 2\,b\,z2\,Z3 - a\left(-4\,z2\,Z2 + 4\,z3\,Z3\right)\right)$

In[•]:= **Expand[%97]**

Out[•]= $i - 16\,i\,a^2\,z2^2\,Z2^2 - 4\,i\,b\,B\,z2^2\,Z2^2 - 8\,i\,a\,B\,z2\,Z2^2\,z3 - 8\,i\,b\,G\,z2\,Z2^2\,z3 - 4\,i\,B^2\,Z2^2\,z3^2 +$
$16\,i\,a\,G\,Z2^2\,z3^2 - 8\,i\,a\,b\,z2^2\,Z2\,Z3 - 8\,i\,B\,g\,z2^2\,Z2\,Z3 + 16\,i\,a^2\,z2\,Z2\,z3\,Z3 -$
$16\,i\,g\,G\,z2\,Z2\,z3\,Z3 + 8\,i\,a\,B\,Z2\,z3^2\,Z3 + 8\,i\,b\,G\,Z2\,z3^2\,Z3 - 4\,i\,b^2\,z2^2\,Z3^2 +$
$16\,i\,a\,g\,z2^2\,Z3^2 + 8\,i\,a\,b\,z2\,z3\,Z3^2 + 8\,i\,B\,g\,z2\,z3\,Z3^2 - 16\,i\,a^2\,z3^2\,Z3^2 - 4\,i\,b\,B\,z3^2\,Z3^2$

In[•]:= **H11 := 0**

In[•]:= **H12 := I**

In[•]:= **H13 := 0**

In[•]:=
```
H14 := 0
```

In[•]:=
```
i f23 f32 - i f22 f33 /. {f2 → F2, f22 → F22,
  f23 → F23, f20 → F20, f3 → F3, f30 → F30, f32 → F32, f33 → F33}
```

Out[•]=
$$\begin{aligned}&i\,\left(-b\,z2\,Z2+4\,a\,Z2\,z3-4\,g\,z2\,Z3+b\,z3\,Z3-b\,\left(z2\,Z2-z3\,Z3\right)\right)\\&\quad\left(-B\,z2\,Z2-4\,G\,Z2\,z3+4\,a\,z2\,Z3+B\,z3\,Z3-B\,\left(z2\,Z2-z3\,Z3\right)\right)-\\&i\,\left(-1-2\,B\,Z2\,z3-2\,b\,z2\,Z3-a\,\left(4\,z2\,Z2-4\,z3\,Z3\right)\right)\\&\quad\left(-1+2\,B\,Z2\,z3+2\,b\,z2\,Z3-a\,\left(-4\,z2\,Z2+4\,z3\,Z3\right)\right)\end{aligned}$$

In[•]:=
```
Expand[%103]
```

Out[•]=
$$\begin{aligned}&-i+16\,i\,a^2\,z2^2\,Z2^2+4\,i\,b\,B\,z2^2\,Z2^2+8\,i\,a\,B\,z2\,Z2^2\,z3+8\,i\,b\,G\,z2\,Z2^2\,z3+4\,i\,B^2\,Z2^2\,z3^2-\\&16\,i\,a\,G\,Z2^2\,z3^2+8\,i\,a\,b\,z2^2\,Z2\,Z3+8\,i\,B\,g\,z2^2\,Z2\,Z3-16\,i\,a^2\,z2\,Z2\,z3\,Z3+\\&16\,i\,g\,G\,z2\,Z2\,z3\,Z3-8\,i\,a\,B\,Z2\,z3^2\,Z3-8\,i\,b\,G\,Z2\,z3^2\,Z3+4\,i\,b^2\,z2^2\,Z3^2-\\&16\,i\,a\,g\,z2^2\,Z3^2-8\,i\,a\,b\,z2\,z3\,Z3^2-8\,i\,B\,g\,z2\,z3\,Z3^2+16\,i\,a^2\,z3^2\,Z3^2+4\,i\,b\,B\,z3^2\,Z3^2\end{aligned}$$

In[•]:=
```
H21 := -I
```

In[•]:=
```
-f20 f23 f3 + f22 f3 f30 - f2 f30 f32 + f2 f20 f33 /. {f2 → F2, f22 → F22,
  f23 → F23, f20 → F20, f3 → F3, f30 → F30, f32 → F32, f33 → F33}
```

Out[•]=
$$\begin{aligned}&\left(-1+2\,B\,Z2\,z3+2\,b\,z2\,Z3-a\,\left(-4\,z2\,Z2+4\,z3\,Z3\right)\right)\\&\quad\left(-z2-2\,G\,Z2\,z3^2-z2\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-B\,z3\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(2\,z2^2\,Z2-4\,z2\,z3\,Z3\right)\right)\\&\quad\left(-Z2-2\,g\,z2\,Z3^2-Z2\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-b\,Z3\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(2\,z2\,Z2^2-4\,Z2\,z3\,Z3\right)\right)-\\&\left(-B\,z2\,Z2-4\,G\,Z2\,z3+4\,a\,z2\,Z3+B\,z3\,Z3-B\,\left(z2\,Z2-z3\,Z3\right)\right)\\&\quad\left(-Z2-2\,g\,z2\,Z3^2-Z2\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-b\,Z3\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(2\,z2\,Z2^2-4\,Z2\,z3\,Z3\right)\right)\\&\quad\left(-z3-2\,g\,z2^2\,Z3+z3\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-b\,z2\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(-4\,z2\,Z2\,z3+2\,z3^2\,Z3\right)\right)-\\&\left(-b\,z2\,Z2+4\,a\,Z2\,z3-4\,g\,z2\,Z3+b\,z3\,Z3-b\,\left(z2\,Z2-z3\,Z3\right)\right)\\&\quad\left(-z2-2\,G\,Z2\,z3^2-z2\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-B\,z3\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(2\,z2^2\,Z2-4\,z2\,z3\,Z3\right)\right)\\&\quad\left(-2\,G\,Z2^2\,z3-Z3+Z3\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-B\,Z2\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(-4\,z2\,Z2\,Z3+2\,z3\,Z3^2\right)\right)+\\&\left(-1-2\,B\,Z2\,z3-2\,b\,z2\,Z3-a\,\left(4\,z2\,Z2-4\,z3\,Z3\right)\right)\\&\quad\left(-z3-2\,g\,z2^2\,Z3+z3\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-b\,z2\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(-4\,z2\,Z2\,z3+2\,z3^2\,Z3\right)\right)\\&\quad\left(-2\,G\,Z2^2\,z3-Z3+Z3\,\left(B\,Z2\,z3+b\,z2\,Z3\right)-B\,Z2\,\left(z2\,Z2-z3\,Z3\right)-a\,\left(-4\,z2\,Z2\,Z3+2\,z3\,Z3^2\right)\right)\end{aligned}$$

In[•]:= **Expand[%106]**

Out[•]= $-z2\,Z2+12\,a^2\,z2^3\,Z2^3+3\,b\,B\,z2^3\,Z2^3+16\,a^3\,z2^4\,Z2^4+4\,a\,b\,B\,z2^4\,Z2^4+6\,a\,B\,z2^2\,Z2^3\,z3+$
$6\,b\,G\,z2^2\,Z2^3\,z3+24\,a^2\,B\,z2^3\,Z2^4\,z3+4\,b\,B^2\,z2^3\,Z2^4\,z3+8\,a\,b\,G\,z2^3\,Z2^4\,z3+3\,B^2\,z2\,Z2^3\,z3^2-$
$12\,a\,G\,z2\,Z2^3\,z3^2+12\,a\,B^2\,z2^2\,Z2^4\,z3^2+12\,b\,B\,G\,z2^2\,Z2^4\,z3^2+4\,B^3\,z2\,Z2^4\,z3^3-8\,a\,B\,G\,z2\,Z2^4\,z3^3+$
$8\,b\,G^2\,z2\,Z2^4\,z3^3+4\,B^2\,G\,Z2^4\,z3^4-16\,a\,G^2\,Z2^4\,z3^4+6\,a\,b\,z2^3\,Z2^2\,Z3+6\,B\,g\,z2^3\,Z2^2\,Z3+$
$24\,a^2\,b\,z2^4\,Z2^3\,Z3+4\,b^2\,B\,z2^4\,Z2^3\,Z3+8\,a\,B\,g\,z2^4\,Z2^3\,Z3-z3\,Z3+3\,b\,B\,z2^2\,Z2^2\,z3\,Z3+$
$12\,g\,G\,z2^2\,Z2^2\,z3\,Z3-80\,a^3\,z2^3\,Z2^3\,z3\,Z3+8\,B^2\,g\,z2^3\,Z2^3\,z3\,Z3+8\,b^2\,G\,z2^3\,Z2^3\,z3\,Z3+$
$16\,a\,g\,G\,z2^3\,Z2^3\,z3\,Z3-72\,a^2\,B\,z2^2\,Z2^3\,z3^2\,Z3-48\,a\,b\,G\,z2^2\,Z2^3\,z3^2\,Z3+24\,B\,g\,G\,z2^2\,Z2^3\,z3^2\,Z3+$
$3\,B^2\,Z2^2\,z3^3\,Z3-12\,a\,G\,Z2^2\,z3^3\,Z3-32\,a\,B^2\,z2\,Z2^3\,z3^3\,Z3+48\,a^2\,G\,z2\,Z2^3\,z3^3\,Z3-$
$16\,b\,B\,G\,z2\,Z2^3\,z3^3\,Z3+16\,g\,G^2\,z2\,Z2^3\,z3^3\,Z3-4\,B^3\,Z2^3\,z3^4\,Z3+8\,a\,B\,G\,Z2^3\,z3^4\,Z3-$
$8\,b\,G^2\,Z2^3\,z3^4\,Z3+3\,b^2\,z2^3\,Z2\,Z3^2-12\,a\,g\,z2^3\,Z2\,Z3^2+12\,a\,b^2\,z2^4\,Z2^2\,Z3^2+12\,b\,B\,g\,z2^4\,Z2^2\,Z3^2-$
$72\,a^2\,b\,z2^3\,Z2^2\,z3\,Z3^2-48\,a\,B\,g\,z2^3\,Z2^2\,z3\,Z3^2+24\,b\,g\,G\,z2^3\,Z2^2\,z3\,Z3^2+3\,b\,B\,z2\,Z2\,z3^2\,Z3^2+$
$12\,g\,G\,z2\,Z2\,z3^2\,Z3^2+96\,a^3\,z2^2\,Z2^2\,z3^2\,Z3^2-24\,a\,b\,B\,z2^2\,Z2^2\,z3^2\,Z3^2-12\,B^2\,g\,z2^2\,Z2^2\,z3^2\,Z3^2-$
$12\,b^2\,G\,z2^2\,Z2^2\,z3^2\,Z3^2-96\,a\,g\,G\,z2^2\,Z2^2\,z3^2\,Z3^2-6\,a\,B\,Z2\,z3^3\,Z3^2-6\,b\,G\,Z2\,z3^3\,Z3^2+$
$72\,a^2\,B\,z2\,Z2^2\,z3^3\,Z3^2+48\,a\,b\,G\,z2\,Z2^2\,z3^3\,Z3^2-24\,B\,g\,G\,z2\,Z2^2\,z3^3\,Z3^2+12\,a\,B^2\,Z2^2\,z3^4\,Z3^2+$
$12\,b\,B\,G\,Z2^2\,z3^4\,Z3^2+4\,b^3\,z2^4\,Z2\,Z3^3-8\,a\,b\,g\,z2^4\,Z2\,Z3^3+8\,B\,g^2\,z2^4\,Z2\,Z3^3+3\,b^2\,z2^2\,z3\,Z3^3-$
$12\,a\,g\,z2^2\,z3\,Z3^3-32\,a\,b^2\,z2^3\,Z2\,z3\,Z3^3+48\,a^2\,g\,z2^3\,Z2\,z3\,Z3^3-16\,b\,B\,g\,z2^3\,Z2\,z3\,Z3^3+$
$16\,g^2\,G\,z2^3\,Z2\,z3\,Z3^3-6\,a\,b\,z2\,z3^2\,Z3^3-6\,B\,g\,z2\,z3^2\,Z3^3+72\,a^2\,b\,z2^2\,Z2\,z3^2\,Z3^3+$
$48\,a\,B\,g\,z2^2\,Z2\,z3^2\,Z3^3-24\,b\,g\,G\,z2^2\,Z2\,z3^2\,Z3^3+12\,a^2\,z3^3\,Z3^3+3\,b\,B\,z3^3\,Z3^3-$
$80\,a^3\,z2\,Z2\,z3^3\,Z3^3+8\,B^2\,g\,z2\,Z2\,z3^3\,Z3^3+8\,b^2\,G\,z2\,Z2\,z3^3\,Z3^3+16\,a\,g\,G\,z2\,Z2\,z3^3\,Z3^3-$
$24\,a^2\,B\,Z2\,z3^4\,Z3^3-4\,b\,B^2\,Z2\,z3^4\,Z3^3-8\,a\,b\,G\,Z2\,z3^4\,Z3^3+4\,b^2\,g\,z2^4\,Z3^4-16\,a\,g^2\,z2^4\,Z3^4-$
$4\,b^3\,z2^3\,z3\,Z3^4+8\,a\,b\,g\,z2^3\,z3\,Z3^4-8\,B\,g^2\,z2^3\,z3\,Z3^4+12\,a\,b^2\,z2^2\,z3^2\,Z3^4+12\,b\,B\,g\,z2^2\,z3^2\,Z3^4-$
$24\,a^2\,b\,z2\,z3^3\,Z3^4-4\,b^2\,B\,z2\,z3^3\,Z3^4-8\,a\,B\,g\,z2\,z3^3\,Z3^4+16\,a^3\,z3^4\,Z3^4+4\,a\,b\,B\,z3^4\,Z3^4$

In[•]:= **H22 := (-z2 * Z2 - z3 Z3) / 4**

In[•]:=
```
f30 f32 - f20 f33 /. {f2 → F2, f22 → F22, f23 → F23,
  f20 → F20, f3 → F3, f30 → F30, f32 → F32, f33 → F33}
```

Out[•]= $-\left(-1+2\,B\,Z2\,z3+2\,b\,z2\,Z3-a\left(-4\,z2\,Z2+4\,z3\,Z3\right)\right)$
$\left(-z2-2\,G\,Z2\,z3^2-z2\left(B\,Z2\,z3+b\,z2\,Z3\right)-B\,z3\left(z2\,Z2-z3\,Z3\right)-a\left(2\,z2^2\,Z2-4\,z2\,z3\,Z3\right)\right)+$
$\left(-B\,z2\,Z2-4\,G\,Z2\,z3+4\,a\,z2\,Z3+B\,z3\,Z3-B\left(z2\,Z2-z3\,Z3\right)\right)$
$\left(-z3-2\,g\,z2^2\,Z3+z3\left(B\,Z2\,z3+b\,z2\,Z3\right)-b\,z2\left(z2\,Z2-z3\,Z3\right)-a\left(-4\,z2\,Z2\,z3+2\,z3^2\,Z3\right)\right)$

In[•]:= **Expand[%109]**

Out[•]= $-z2+2\,a\,z2^2\,Z2+8\,a^2\,z2^3\,Z2^2+2\,b\,B\,z2^3\,Z2^2+2\,B\,z2\,Z2\,z3+$
$4\,a\,B\,z2^2\,Z2^2\,z3+4\,b\,G\,z2^2\,Z2^2\,z3+2\,G\,Z2\,z3^2+2\,B^2\,z2\,Z2^2\,z3^2-8\,a\,G\,z2\,Z2^2\,z3^2+$
$b\,z2^2\,Z3+4\,a\,b\,z2^3\,Z2\,Z3+4\,B\,g\,z2^3\,Z2\,Z3-4\,a\,z2\,z3\,Z3-8\,a^2\,z2^2\,Z2\,z3\,Z3+$
$8\,g\,G\,z2^2\,Z2\,z3\,Z3-B\,z3^2\,Z3-4\,a\,B\,z2\,Z2\,z3^2\,Z3-4\,b\,G\,z2\,Z2\,z3^2\,Z3+2\,b^2\,z2^3\,Z3^2-$
$8\,a\,g\,z2^3\,Z3^2-4\,a\,b\,z2^2\,z3\,Z3^2-4\,B\,g\,z2^2\,z3\,Z3^2+8\,a^2\,z2\,z3^2\,Z3^2+2\,b\,B\,z2\,z3^2\,Z3^2$

In[•]:= **H23 := (-z2 + 2 a z2^2 Z2 + 2 B z2 Z2 z3 + 2 G Z2 z3^2 + b z2^2 Z3 - 4 a z2 z3 Z3 - B z3^2 Z3) / 4**

In[•]:=
```
f20 f23 - f22 f30 /. {f2 → F2, f22 → F22, f23 → F23,
  f20 → F20, f3 → F3, f30 → F30, f32 → F32, f33 → F33}
```

Out[•]=
$$\left(-b\, z2\, Z2 + 4\, a\, Z2\, z3 - 4\, g\, z2\, Z3 + b\, z3\, Z3 - b\left(z2\, Z2 - z3\, Z3\right)\right)$$
$$\left(-z2 - 2\, G\, Z2\, z3^2 - z2\left(B\, Z2\, z3 + b\, z2\, Z3\right) - B\, z3\left(z2\, Z2 - z3\, Z3\right) - a\left(2\, z2^2\, Z2 - 4\, z2\, z3\, Z3\right)\right) -$$
$$\left(-1 - 2\, B\, Z2\, z3 - 2\, b\, z2\, Z3 - a\left(4\, z2\, Z2 - 4\, z3\, Z3\right)\right)$$
$$\left(-z3 - 2\, g\, z2^2\, Z3 + z3\left(B\, Z2\, z3 + b\, z2\, Z3\right) - b\, z2\left(z2\, Z2 - z3\, Z3\right) - a\left(-4\, z2\, Z2\, z3 + 2\, z3^2\, Z3\right)\right)$$

In[•]:=
```
Expand[%112]
```

Out[•]=
$$b\, z2^2\, Z2 - z3 - 4\, a\, z2\, Z2\, z3 + 8\, a^2\, z2^2\, Z2^2\, z3 + 2\, b\, B\, z2^2\, Z2^2\, z3 - B\, Z2\, z3^2 +$$
$$4\, a\, B\, z2\, Z2^2\, z3^2 + 4\, b\, G\, z2\, Z2^2\, z3^2 + 2\, B^2\, Z2^2\, z3^3 - 8\, a\, G\, Z2^2\, z3^3 + 2\, g\, z2^2\, Z3 -$$
$$2\, b\, z2\, z3\, Z3 + 4\, a\, b\, z2^2\, Z2\, z3\, Z3 + 4\, B\, g\, z2^2\, Z2\, z3\, Z3 + 2\, a\, z3^2\, Z3 - 8\, a^2\, z2\, Z2\, z3^2\, Z3 +$$
$$8\, g\, G\, z2\, Z2\, z3^2\, Z3 - 4\, a\, B\, Z2\, z3^3\, Z3 - 4\, b\, G\, Z2\, z3^3\, Z3 + 2\, b^2\, z2^2\, z3\, Z3^2 -$$
$$8\, a\, g\, z2^2\, z3\, Z3^2 - 4\, a\, b\, z2\, z3^2\, Z3^2 - 4\, B\, g\, z2\, z3^2\, Z3^2 + 8\, a^2\, z3^3\, Z3^2 + 2\, b\, B\, z3^3\, Z3^2$$

In[•]:=
```
H24 := (b z2^2 Z2 - z3 - 4 a z2 Z2 z3 - B Z2 z3^2 + 2 g z2^2 Z3 - 2 b z2 z3 Z3 + 2 a z3^2 Z3) / 4
```

In[•]:=
```
H31 := 0
```

In[•]:=
```
f23 f3 - f2 f33 /. {f2 → F2, f22 → F22, f23 → F23,
  f20 → F20, f3 → F3, f30 → F30, f32 → F32, f33 → F33}
```

Out[•]=
$$-\left(-1 + 2\, B\, Z2\, z3 + 2\, b\, z2\, Z3 - a\left(-4\, z2\, Z2 + 4\, z3\, Z3\right)\right)$$
$$\left(-Z2 - 2\, g\, z2\, Z3^2 - Z2\left(B\, Z2\, z3 + b\, z2\, Z3\right) - b\, Z3\left(z2\, Z2 - z3\, Z3\right) - a\left(2\, z2\, Z2^2 - 4\, Z2\, z3\, Z3\right)\right) +$$
$$\left(-b\, z2\, Z2 + 4\, a\, Z2\, z3 - 4\, g\, z2\, Z3 + b\, z3\, Z3 - b\left(z2\, Z2 - z3\, Z3\right)\right)$$
$$\left(-2\, G\, Z2^2\, z3 - Z3 + Z3\left(B\, Z2\, z3 + b\, z2\, Z3\right) - B\, Z2\left(z2\, Z2 - z3\, Z3\right) - a\left(-4\, z2\, Z2\, Z3 + 2\, z3\, Z3^2\right)\right)$$

In[•]:=
```
Expand[%116]
```

Out[•]=
$$-Z2 + 2\, a\, z2\, Z2^2 + 8\, a^2\, z2^2\, Z2^3 + 2\, b\, B\, z2^2\, Z2^3 + B\, Z2^2\, z3 + 4\, a\, B\, z2\, Z2^3\, z3 +$$
$$4\, b\, G\, z2\, Z2^3\, z3 + 2\, B^2\, Z2^3\, z3^2 - 8\, a\, G\, Z2^3\, z3^2 + 2\, b\, z2\, Z2\, Z3 + 4\, a\, b\, z2^2\, Z2^2\, Z3 +$$
$$4\, B\, g\, z2^2\, Z2^2\, Z3 - 4\, a\, Z2\, z3\, Z3 - 8\, a^2\, z2\, Z2^2\, z3\, Z3 + 8\, g\, G\, z2\, Z2^2\, z3\, Z3 -$$
$$4\, a\, B\, Z2^2\, z3^2\, Z3 - 4\, b\, G\, Z2^2\, z3^2\, Z3 + 2\, g\, z2\, Z3^2 + 2\, b^2\, z2^2\, Z2\, Z3^2 - 8\, a\, g\, z2^2\, Z2\, Z3^2 -$$
$$b\, z3\, Z3^2 - 4\, a\, b\, z2\, Z2\, z3\, Z3^2 - 4\, B\, g\, z2\, Z2\, z3\, Z3^2 + 8\, a^2\, Z2\, z3^2\, Z3^2 + 2\, b\, B\, Z2\, z3^2\, Z3^2$$

In[•]:=
```
H32 := (-Z2 + 2 a z2 Z2^2 + B Z2^2 z3 + 2 b z2 Z2 Z3 - 4 a Z2 z3 Z3 + 2 g z2 Z3^2 - b z3 Z3^2) / 4
```

In[•]:=
```
H32
```

Out[•]=
$$\frac{1}{4}\left(-Z2 + 2\, a\, z2\, Z2^2 + B\, Z2^2\, z3 + 2\, b\, z2\, Z2\, Z3 - 4\, a\, Z2\, z3\, Z3 + 2\, g\, z2\, Z3^2 - b\, z3\, Z3^2\right)$$

In[•]:=
```
H23
```

Out[•]=
$$\frac{1}{4}\left(-z2 + 2\, a\, z2^2\, Z2 + 2\, B\, z2\, Z2\, z3 + 2\, G\, Z2\, z3^2 + b\, z2^2\, Z3 - 4\, a\, z2\, z3\, Z3 - B\, z3^2\, Z3\right)$$

In[•]:=
```
F33 / 4
```

Out[•]=
$$\frac{1}{4}\left(-1 + 2\, B\, Z2\, z3 + 2\, b\, z2\, Z3 - a\left(-4\, z2\, Z2 + 4\, z3\, Z3\right)\right)$$

In[•]:= **Expand[$\frac{1}{4}$ (-1 + 2 B Z2 z3 + 2 b z2 Z3 - a (-4 z2 Z2 + 4 z3 Z3))]**

Out[•]= $-\frac{1}{4} + a\ z2\ Z2 + \frac{B\ Z2\ z3}{2} + \frac{b\ z2\ Z3}{2} - a\ z3\ Z3$

In[•]:= **H33 := $-\frac{1}{4}$ + a z2 Z2 + $\frac{B\ Z2\ z3}{2}$ + $\frac{b\ z2\ Z3}{2}$ - a z3 Z3**

In[•]:= **H33**

Out[•]= $-\frac{1}{4} + a\ z2\ Z2 + \frac{B\ Z2\ z3}{2} + \frac{b\ z2\ Z3}{2} - a\ z3\ Z3$

In[•]:= **- F23 / 4**

Out[•]= $\frac{1}{4}\left(b\ z2\ Z2 - 4\ a\ Z2\ z3 + 4\ g\ z2\ Z3 - b\ z3\ Z3 + b\ (z2\ Z2 - z3\ Z3)\right)$

In[•]:= **Expand[$\frac{1}{4}$ (b z2 Z2 - 4 a Z2 z3 + 4 g z2 Z3 - b z3 Z3 + b (z2 Z2 - z3 Z3))]**

Out[•]= $\frac{b\ z2\ Z2}{2} - a\ Z2\ z3 + g\ z2\ Z3 - \frac{b\ z3\ Z3}{2}$

In[•]:= **H34 := $\frac{b\ z2\ Z2}{2}$ - a Z2 z3 + g z2 Z3 - $\frac{b\ z3\ Z3}{2}$**

In[•]:= **H41 := 0**

In[•]:= **- f22 f3 + f2 f32 /. {f2 → F2, f22 → F22, f23 → F23, f20 → F20, f3 → F3, f30 → F30, f32 → F32, f33 → F33}**

Out[•]= $\left(-B\ z2\ Z2 - 4\ G\ Z2\ z3 + 4\ a\ z2\ Z3 + B\ z3\ Z3 - B\ (z2\ Z2 - z3\ Z3)\right)$
$\left(-Z2 - 2\ g\ z2\ Z3^2 - Z2\ (B\ Z2\ z3 + b\ z2\ Z3) - b\ Z3\ (z2\ Z2 - z3\ Z3) - a\ (2\ z2\ Z2^2 - 4\ Z2\ z3\ Z3)\right) -$
$\left(-1 - 2\ B\ Z2\ z3 - 2\ b\ z2\ Z3 - a\ (4\ z2\ Z2 - 4\ z3\ Z3)\right)$
$\left(-2\ G\ Z2^2\ z3 - Z3 + Z3\ (B\ Z2\ z3 + b\ z2\ Z3) - B\ Z2\ (z2\ Z2 - z3\ Z3) - a\ (-4\ z2\ Z2\ Z3 + 2\ z3\ Z3^2)\right)$

In[•]:= **Expand[%129]**

Out[•]= $B\ z2\ Z2^2 + 2\ G\ Z2^2\ z3 - Z3 - 4\ a\ z2\ Z2\ Z3 + 8\ a^2\ z2^2\ Z2^2\ Z3 + 2\ b\ B\ z2^2\ Z2^2\ Z3 -$
$2\ B\ Z2\ z3\ Z3 + 4\ a\ B\ z2\ Z2^2\ z3\ Z3 + 4\ b\ G\ z2\ Z2^2\ z3\ Z3 + 2\ B^2\ Z2^2\ z3^2\ Z3 -$
$8\ a\ G\ Z2^2\ z3^2\ Z3 - b\ z2\ Z3^2 + 4\ a\ b\ z2^2\ Z2\ Z3^2 + 4\ B\ g\ z2^2\ Z2\ Z3^2 + 2\ a\ z3\ Z3^2 -$
$8\ a^2\ z2\ Z2\ z3\ Z3^2 + 8\ g\ G\ z2\ Z2\ z3\ Z3^2 - 4\ a\ B\ Z2\ z3^2\ Z3^2 - 4\ b\ G\ Z2\ z3^2\ Z3^2 + 2\ b^2\ z2^2\ Z3^3 -$
$8\ a\ g\ z2^2\ Z3^3 - 4\ a\ b\ z2\ z3\ Z3^3 - 4\ B\ g\ z2\ z3\ Z3^3 + 8\ a^2\ z3^2\ Z3^3 + 2\ b\ B\ z3^2\ Z3^3$

In[•]:= **H42 := (B z2 Z2^2 + 2 G Z2^2 z3 - Z3 - 4 a z2 Z2 Z3 - 2 B Z2 z3 Z3 - b z2 Z3^2 + 2 a z3 Z3^2) / 4**

In[•]:= **H42**

Out[•]= $\frac{1}{4}\left(B\ z2\ Z2^2 + 2\ G\ Z2^2\ z3 - Z3 - 4\ a\ z2\ Z2\ Z3 - 2\ B\ Z2\ z3\ Z3 - b\ z2\ Z3^2 + 2\ a\ z3\ Z3^2\right)$

In[•]:= **Expand[1/4 (B z2 Z2^2 + 2 G Z2^2 z3 - Z3 - 4 a z2 Z2 Z3 - 2 B Z2 z3 Z3 - b z2 Z3^2 + 2 a z3 Z3^2)]**

Out[•]= $\frac{1}{4} B\ z2\ Z2^2 + \frac{1}{2} G\ Z2^2\ z3 - \frac{Z3}{4} - a\ z2\ Z2\ Z3 - \frac{1}{2} B\ Z2\ z3\ Z3 - \frac{1}{4} b\ z2\ Z3^2 + \frac{1}{2} a\ z3\ Z3^2$

In[•]:= **H24**

Out[•]= $\frac{1}{4} \left(b\ z2^2\ Z2 - z3 - 4\ a\ z2\ Z2\ z3 - B\ Z2\ z3^2 + 2\ g\ z2^2\ Z3 - 2\ b\ z2\ z3\ Z3 + 2\ a\ z3^2\ Z3\right)$

In[•]:= **Expand[1/4 (b z2^2 Z2 - z3 - 4 a z2 Z2 z3 - B Z2 z3^2 + 2 g z2^2 Z3 - 2 b z2 z3 Z3 + 2 a z3^2 Z3)]**

Out[•]= $\frac{1}{4} b\ z2^2\ Z2 - \frac{z3}{4} - a\ z2\ Z2\ z3 - \frac{1}{4} B\ Z2\ z3^2 + \frac{1}{2} g\ z2^2\ Z3 - \frac{1}{2} b\ z2\ z3\ Z3 + \frac{1}{2} a\ z3^2\ Z3$

In[•]:= **- F32 / 4**

Out[•]= $\frac{1}{4} \left(B\ z2\ Z2 + 4\ G\ Z2\ z3 - 4\ a\ z2\ Z3 - B\ z3\ Z3 + B\ \left(z2\ Z2 - z3\ Z3\right)\right)$

In[•]:= **Expand[1/4 (B z2 Z2 + 4 G Z2 z3 - 4 a z2 Z3 - B z3 Z3 + B (z2 Z2 - z3 Z3))]**

Out[•]= $\frac{B\ z2\ Z2}{2} + G\ Z2\ z3 - a\ z2\ Z3 - \frac{B\ z3\ Z3}{2}$

In[•]:= **H43 := B z2 Z2 / 2 + G Z2 z3 - a z2 Z3 - B z3 Z3 / 2**

In[•]:= **H34**

Out[•]= $\frac{b\ z2\ Z2}{2} - a\ Z2\ z3 + g\ z2\ Z3 - \frac{b\ z3\ Z3}{2}$

In[•]:= **F22 / 4**

Out[•]= $\frac{1}{4} \left(-1 - 2\ B\ Z2\ z3 - 2\ b\ z2\ Z3 - a\ \left(4\ z2\ Z2 - 4\ z3\ Z3\right)\right)$

In[•]:= **Expand[1/4 (-1 - 2 B Z2 z3 - 2 b z2 Z3 - a (4 z2 Z2 - 4 z3 Z3))]**

Out[•]= $-\frac{1}{4} - a\ z2\ Z2 - \frac{B\ Z2\ z3}{2} - \frac{b\ z2\ Z3}{2} + a\ z3\ Z3$

In[•]:= **H44 := - 1/4 - a z2 Z2 - B Z2 z3 / 2 - b z2 Z3 / 2 + a z3 Z3**

In[•]:=
```
Ainvultimate := {{H11, H12, H13, H14},
  {H21, H22, H23, H24}, {H31, H32, H33, H34}, {H41, H42, H43, H44}}
```

In[•]:= **Ainvultimate**

Out[•]= $\left\{\{0, i, 0, 0\}, \left\{-i, \frac{1}{4}\left(-z2\,Z2 - z3\,Z3\right),\right.\right.$
$\frac{1}{4}\left(-z2 + 2\,a\,z2^2\,Z2 + 2\,B\,z2\,Z2\,z3 + 2\,G\,Z2\,z3^2 + b\,z2^2\,Z3 - 4\,a\,z2\,z3\,Z3 - B\,z3^2\,Z3\right),$
$\left.\frac{1}{4}\left(b\,z2^2\,Z2 - z3 - 4\,a\,z2\,Z2\,z3 - B\,Z2\,z3^2 + 2\,g\,z2^2\,Z3 - 2\,b\,z2\,z3\,Z3 + 2\,a\,z3^2\,Z3\right)\right\},$
$\left\{0, \frac{1}{4}\left(-Z2 + 2\,a\,z2\,Z2^2 + B\,Z2^2\,z3 + 2\,b\,z2\,Z2\,Z3 - 4\,a\,Z2\,z3\,Z3 + 2\,g\,z2\,Z3^2 - b\,z3\,Z3^2\right),\right.$
$\left.-\frac{1}{4} + a\,z2\,Z2 + \frac{B\,Z2\,z3}{2} + \frac{b\,z2\,Z3}{2} - a\,z3\,Z3,\ \frac{b\,z2\,Z2}{2} - a\,Z2\,z3 + g\,z2\,Z3 - \frac{b\,z3\,Z3}{2}\right\},$
$\left\{0, \frac{1}{4}\left(B\,z2\,Z2^2 + 2\,G\,Z2^2\,z3 - Z3 - 4\,a\,z2\,Z2\,Z3 - 2\,B\,Z2\,z3\,Z3 - b\,z2\,Z3^2 + 2\,a\,z3\,Z3^2\right),\right.$
$\left.\left.\frac{B\,z2\,Z2}{2} + G\,Z2\,z3 - a\,z2\,Z3 - \frac{B\,z3\,Z3}{2},\ -\frac{1}{4} - a\,z2\,Z2 - \frac{B\,Z2\,z3}{2} - \frac{b\,z2\,Z3}{2} + a\,z3\,Z3\right\}\right\}$

In[•]:= **MatrixForm[%144]**

Out[•]//MatrixForm=

$$\begin{pmatrix} 0 & i & \\ -i & \frac{1}{4}\left(-z2\,Z2 - z3\,Z3\right) & \frac{1}{4}\left(-z2 + 2\,a\,z \\ 0 & \frac{1}{4}\left(-Z2 + 2\,a\,z2\,Z2^2 + B\,Z2^2\,z3 + 2\,b\,z2\,Z2\,Z3 - 4\,a\,Z2\,z3\,Z3 + 2\,g\,z2\,Z3^2 - b\,z3\,Z3^2\right) & \\ 0 & \frac{1}{4}\left(B\,z2\,Z2^2 + 2\,G\,Z2^2\,z3 - Z3 - 4\,a\,z2\,Z2\,Z3 - 2\,B\,Z2\,z3\,Z3 - b\,z2\,Z3^2 + 2\,a\,z3\,Z3^2\right) & \end{pmatrix}$$

In[•]:= **q**

Out[•]= {p0, i, p2, p3}

In[•]:= **Q**

Out[•]= {p0, −i, P2, P3}

In[•]:= **q.Ainvultimate.Q**

Out[•]= $p0 +$
$P3\left(p3\left(-\frac{1}{4} - a\,z2\,Z2 - \frac{B\,Z2\,z3}{2} - \frac{b\,z2\,Z3}{2} + a\,z3\,Z3\right) + p2\left(\frac{b\,z2\,Z2}{2} - a\,Z2\,z3 + g\,z2\,Z3 - \frac{b\,z3\,Z3}{2}\right) +\right.$
$\left.\frac{1}{4}\,i\left(b\,z2^2\,Z2 - z3 - 4\,a\,z2\,Z2\,z3 - B\,Z2\,z3^2 + 2\,g\,z2^2\,Z3 - 2\,b\,z2\,z3\,Z3 + 2\,a\,z3^2\,Z3\right)\right) +$
$P2\left(p2\left(-\frac{1}{4} + a\,z2\,Z2 + \frac{B\,Z2\,z3}{2} + \frac{b\,z2\,Z3}{2} - a\,z3\,Z3\right) + p3\left(\frac{B\,z2\,Z2}{2} + G\,Z2\,z3 - a\,z2\,Z3 - \frac{B\,z3\,Z3}{2}\right) +\right.$
$\left.\frac{1}{4}\,i\left(-z2 + 2\,a\,z2^2\,Z2 + 2\,B\,z2\,Z2\,z3 + 2\,G\,Z2\,z3^2 + b\,z2^2\,Z3 - 4\,a\,z2\,z3\,Z3 - B\,z3^2\,Z3\right)\right) -$
$i\left(i\,p0 + \frac{1}{4}\,i\left(-z2\,Z2 - z3\,Z3\right) +\right.$
$\frac{1}{4}\,p3\left(B\,z2\,Z2^2 + 2\,G\,Z2^2\,z3 - Z3 - 4\,a\,z2\,Z2\,Z3 - 2\,B\,Z2\,z3\,Z3 - b\,z2\,Z3^2 + 2\,a\,z3\,Z3^2\right) +$
$\left.\left.\frac{1}{4}\,p2\left(-Z2 + 2\,a\,z2\,Z2^2 + B\,Z2^2\,z3 + 2\,b\,z2\,Z2\,Z3 - 4\,a\,Z2\,z3\,Z3 + 2\,g\,z2\,Z3^2 - b\,z3\,Z3^2\right)\right)\right)$

In[•]:= **Expand[%148]**

Out[•]= $$2\,p0 - \frac{p2\,P2}{4} - \frac{p3\,P3}{4} - \frac{i\,P2\,z2}{4} + \frac{i\,p2\,Z2}{4} - \frac{z2\,Z2}{4} + a\,p2\,P2\,z2\,Z2 + \frac{1}{2}B\,P2\,p3\,z2\,Z2 + \frac{1}{2}b\,p2\,P3\,z2\,Z2 - a\,p3\,P3\,z2\,Z2 + \frac{1}{2}i\,a\,P2\,z2^2\,Z2 + \frac{1}{4}i\,b\,P3\,z2^2\,Z2 - \frac{1}{2}i\,a\,p2\,z2\,Z2^2 - \frac{1}{4}i\,B\,p3\,z2\,Z2^2 - \frac{i\,P3\,z3}{4} + \frac{1}{2}B\,p2\,P2\,Z2\,z3 + G\,P2\,p3\,Z2\,z3 - a\,p2\,P3\,Z2\,z3 - \frac{1}{2}B\,p3\,P3\,Z2\,z3 + \frac{1}{2}i\,B\,P2\,z2\,Z2\,z3 - i\,a\,P3\,z2\,Z2\,z3 - \frac{1}{4}i\,B\,p2\,Z2^2\,z3 - \frac{1}{2}i\,G\,p3\,Z2^2\,z3 + \frac{1}{2}i\,G\,P2\,Z2\,z3^2 - \frac{1}{4}i\,B\,P3\,Z2\,z3^2 + \frac{i\,p3\,Z3}{4} + \frac{1}{2}b\,p2\,P2\,z2\,Z3 - a\,P2\,p3\,z2\,Z3 + g\,p2\,P3\,z2\,Z3 - \frac{1}{2}b\,p3\,P3\,z2\,Z3 + \frac{1}{4}i\,b\,P2\,z2^2\,Z3 + \frac{1}{2}i\,g\,P3\,z2^2\,Z3 - \frac{1}{2}i\,b\,p2\,z2\,Z2\,Z3 + i\,a\,p3\,z2\,Z2\,Z3 - \frac{z3\,Z3}{4} - a\,p2\,P2\,z3\,Z3 - \frac{1}{2}B\,P2\,p3\,z3\,Z3 - \frac{1}{2}b\,p2\,P3\,z3\,Z3 + a\,p3\,P3\,z3\,Z3 - i\,a\,P2\,z2\,z3\,Z3 - \frac{1}{2}i\,b\,P3\,z2\,z3\,Z3 + i\,a\,p2\,Z2\,z3\,Z3 + \frac{1}{2}i\,B\,p3\,Z2\,z3\,Z3 - \frac{1}{4}i\,B\,P2\,z3^2\,Z3 + \frac{1}{2}i\,a\,P3\,z3^2\,Z3 - \frac{1}{2}i\,g\,p2\,z2\,Z3^2 + \frac{1}{4}i\,b\,p3\,z2\,Z3^2 + \frac{1}{4}i\,b\,p2\,z3\,Z3^2 - \frac{1}{2}i\,a\,p3\,z3\,Z3^2$$

In[•]:= **ClearAll[H]**

In[•]:= **H := 2 p0 - p2 P2/4 - p3 P3/4 - i P2 z2/4 + i p2 Z2/4 - z2 Z2/4 + a p2 P2 z2 Z2 + 1/2 B P2 p3 z2 Z2 + 1/2 b p2 P3 z2 Z2 - a p3 P3 z2 Z2 + 1/2 i a P2 z2^2 Z2 + 1/4 i b P3 z2^2 Z2 - 1/2 i a p2 z2 Z2^2 - 1/4 i B p3 z2 Z2^2 - i P3 z3/4 + 1/2 B p2 P2 Z2 z3 + G P2 p3 Z2 z3 - a p2 P3 Z2 z3 - 1/2 B p3 P3 Z2 z3 + 1/2 i B P2 z2 Z2 z3 - i a P3 z2 Z2 z3 - 1/4 i B p2 Z2^2 z3 - 1/2 i G p3 Z2^2 z3 + 1/2 i G P2 Z2 z3^2 - 1/4 i B P3 Z2 z3^2 + i p3 Z3/4 + 1/2 b p2 P2 z2 Z3 - a P2 p3 z2 Z3 + g p2 P3 z2 Z3 - 1/2 b p3 P3 z2 Z3 + 1/4 i b P2 z2^2 Z3 + 1/2 i g P3 z2^2 Z3 - 1/2 i b p2 z2 Z2 Z3 + i a p3 z2 Z2 Z3 - z3 Z3/4 - a p2 P2 z3 Z3 - 1/2 B P2 p3 z3 Z3 - 1/2 b p2 P3 z3 Z3 + a p3 P3 z3 Z3 - i a P2 z2 z3 Z3 - 1/2 i b P3 z2 z3 Z3 + i a p2 Z2 z3 Z3 + 1/2 i B p3 Z2 z3 Z3 - 1/4 i B P2 z3^2 Z3 + 1/2 i a P3 z3^2 Z3 - 1/2 i g p2 z2 Z3^2 + 1/4 i b p3 z2 Z3^2 + 1/4 i b p2 z3 Z3^2 - 1/2 i a p3 z3 Z3^2**

In[•]:= **H /. {a → 0, b → 0, B → 0, g → 0, G → 0}**

Out[•]= $$2\,p0 - \frac{p2\,P2}{4} - \frac{p3\,P3}{4} - \frac{i\,P2\,z2}{4} + \frac{i\,p2\,Z2}{4} - \frac{z2\,Z2}{4} - \frac{i\,P3\,z3}{4} + \frac{i\,p3\,Z3}{4} - \frac{z3\,Z3}{4}$$

In[•]:= **ClearAll[dz2, dp2, dz3, dp3]**

In[•]:= **dz2 := 2 * D[H, P2]**

In[•]:= **dp2 := -2 * D[H, Z2]**

In[]:=
```
dz3 := 2 * D[H, P3]
```

In[]:=
```
dp3 := -2 * D[H, Z3]
```

In[]:=
```
dz2
```

Out[]=
$$2\left(-\frac{p2}{4}-\frac{i\,z2}{4}+a\,p2\,z2\,Z2+\frac{1}{2}B\,p3\,z2\,Z2+\frac{1}{2}i\,a\,z2^2\,Z2+\frac{1}{2}B\,p2\,Z2\,z3+G\,p3\,Z2\,z3+\frac{1}{2}i\,B\,z2\,Z2\,z3+\frac{1}{2}i\,G\,Z2\,z3^2+\frac{1}{2}b\,p2\,z2\,Z3-a\,p3\,z2\,Z3+\frac{1}{4}i\,b\,z2^2\,Z3-a\,p2\,z3\,Z3-\frac{1}{2}B\,p3\,z3\,Z3-i\,a\,z2\,z3\,Z3-\frac{1}{4}i\,B\,z3^2\,Z3\right)$$

In[]:=
```
Expand[%159]
```

Out[]=
$$-\frac{p2}{2}-\frac{i\,z2}{2}+2\,a\,p2\,z2\,Z2+B\,p3\,z2\,Z2+i\,a\,z2^2\,Z2+B\,p2\,Z2\,z3+2\,G\,p3\,Z2\,z3+i\,B\,z2\,Z2\,z3+i\,G\,Z2\,z3^2+b\,p2\,z2\,Z3-2\,a\,p3\,z2\,Z3+\frac{1}{2}i\,b\,z2^2\,Z3-2\,a\,p2\,z3\,Z3-B\,p3\,z3\,Z3-2\,i\,a\,z2\,z3\,Z3-\frac{1}{2}i\,B\,z3^2\,Z3$$

In[]:=
```
1 /. {z2 → z2st, Z2 → Z2st, p2 → p2st,
  P2 → P2st, z3 → z3st, Z3 → Z3st, p3 → p3st, P3 → P3st}
```

Out[]=
$$1$$

In[]:=
```
dz2 /. {a → 0, b → 0, B → 0, g → 0, G → 0}
```

Out[]=
$$2\left(-\frac{p2}{4}-\frac{i\,z2}{4}\right)$$

In[]:=
```
Expand[2 (-p2/4 - i z2/4)]
```

Out[]=
$$-\frac{p2}{2}-\frac{i\,z2}{2}$$

```
In[•]:= dz2 /. {z2 → z2st, Z2 → Z2st, p2 → p2st,
    P2 → P2st, z3 → z3st, Z3 → Z3st, p3 → p3st, P3 → P3st}
```

$$\begin{aligned}
\text{Out[•]=}\ & 2\left(\frac{1}{4}\left(-\text{p21 s}-\text{p23 s}^3\right)-\frac{1}{4}\,\text{i}\,\left(\text{s z21}+\text{s}^3\,\text{z23}\right)+\right.\\
& \text{a}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)+\\
& \frac{1}{2}\,\text{B}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)+\frac{1}{2}\,\text{i}\,\text{a}\left(\text{s z21}+\text{s}^3\,\text{z23}\right)^2\\
& \left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)+\frac{1}{2}\,\text{B}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)+\\
& \text{G}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)+\frac{1}{2}\,\text{i}\,\text{B}\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\\
& \left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)+\frac{1}{2}\,\text{i}\,\text{G}\left(\text{s Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)^2+\\
& \frac{1}{2}\,\text{b}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-\\
& \text{a}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)+\\
& \frac{1}{4}\,\text{i}\,\text{b}\left(\text{s z21}+\text{s}^3\,\text{z23}\right)^2\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-\text{a}\left(\text{p21 s}+\text{p23 s}^3\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-\\
& \frac{1}{2}\,\text{B}\left(\text{p31 s}+\text{p33 s}^3\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-\\
& \text{i}\,\text{a}\left(\text{s z21}+\text{s}^3\,\text{z23}\right)\left(\text{s z31}+\text{s}^3\,\text{z33}\right)\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)-\\
& \left.\frac{1}{4}\,\text{i}\,\text{B}\left(\text{s z31}+\text{s}^3\,\text{z33}\right)^2\left(\text{s Z31}+\text{s}^3\,\text{Z33}\right)\right)
\end{aligned}$$

In[•]:= **Expand[%164]**

Out[•]=

$$-\frac{p21\,s}{2}-\frac{p23\,s^3}{2}-\frac{i\,s\,z21}{2}+2\,a\,p21\,s^3\,z21\,Z21+B\,p31\,s^3\,z21\,Z21+2\,a\,p23\,s^5\,z21\,Z21+$$
$$B\,p33\,s^5\,z21\,Z21+i\,a\,s^3\,z21^2\,Z21-\frac{1}{2}i\,s^3\,z23+2\,a\,p21\,s^5\,Z21\,z23+B\,p31\,s^5\,Z21\,z23+$$
$$2\,a\,p23\,s^7\,Z21\,z23+B\,p33\,s^7\,Z21\,z23+2\,i\,a\,s^5\,z21\,Z21\,z23+i\,a\,s^7\,Z21\,z23^2+2\,a\,p21\,s^5\,z21\,Z23+$$
$$B\,p31\,s^5\,z21\,Z23+2\,a\,p23\,s^7\,z21\,Z23+B\,p33\,s^7\,z21\,Z23+i\,a\,s^5\,z21^2\,Z23+2\,a\,p21\,s^7\,z23\,Z23+$$
$$B\,p31\,s^7\,z23\,Z23+2\,a\,p23\,s^9\,z23\,Z23+B\,p33\,s^9\,z23\,Z23+2\,i\,a\,s^7\,z21\,z23\,Z23+$$
$$i\,a\,s^9\,z23^2\,Z23+B\,p21\,s^3\,Z21\,z31+2\,G\,p31\,s^3\,Z21\,z31+B\,p23\,s^5\,Z21\,z31+2\,G\,p33\,s^5\,Z21\,z31+$$
$$i\,B\,s^3\,z21\,Z21\,z31+i\,B\,s^5\,Z21\,z23\,z31+B\,p21\,s^5\,Z23\,z31+2\,G\,p31\,s^5\,Z23\,z31+$$
$$B\,p23\,s^7\,Z23\,z31+2\,G\,p33\,s^7\,Z23\,z31+i\,B\,s^5\,z21\,Z23\,z31+i\,B\,s^7\,z23\,Z23\,z31+i\,G\,s^3\,Z21\,z31^2+$$
$$i\,G\,s^5\,Z23\,z31^2+b\,p21\,s^3\,z21\,Z31-2\,a\,p31\,s^3\,z21\,Z31+b\,p23\,s^5\,z21\,Z31-2\,a\,p33\,s^5\,z21\,Z31+$$
$$\frac{1}{2}i\,b\,s^3\,z21^2\,Z31+b\,p21\,s^5\,z23\,Z31-2\,a\,p31\,s^5\,z23\,Z31+b\,p23\,s^7\,z23\,Z31-2\,a\,p33\,s^7\,z23\,Z31+$$
$$i\,b\,s^5\,z21\,z23\,Z31+\frac{1}{2}i\,b\,s^7\,z23^2\,Z31-2\,a\,p21\,s^3\,z31\,Z31-B\,p31\,s^3\,z31\,Z31-$$
$$2\,a\,p23\,s^5\,z31\,Z31-B\,p33\,s^5\,z31\,Z31-2\,i\,a\,s^3\,z21\,z31\,Z31-2\,i\,a\,s^5\,z23\,z31\,Z31-$$
$$\frac{1}{2}i\,B\,s^3\,z31^2\,Z31+B\,p21\,s^5\,Z21\,z33+2\,G\,p31\,s^5\,Z21\,z33+B\,p23\,s^7\,Z21\,z33+2\,G\,p33\,s^7\,Z21\,z33+$$
$$i\,B\,s^5\,z21\,Z21\,z33+i\,B\,s^7\,Z21\,z23\,z33+B\,p21\,s^7\,Z23\,z33+2\,G\,p31\,s^7\,Z23\,z33+$$
$$B\,p23\,s^9\,Z23\,z33+2\,G\,p33\,s^9\,Z23\,z33+i\,B\,s^7\,z21\,Z23\,z33+i\,B\,s^9\,z23\,Z23\,z33+$$
$$2\,i\,G\,s^5\,Z21\,z31\,z33+2\,i\,G\,s^7\,Z23\,z31\,z33-2\,a\,p21\,s^5\,Z31\,z33-B\,p31\,s^5\,Z31\,z33-$$
$$2\,a\,p23\,s^7\,Z31\,z33-B\,p33\,s^7\,Z31\,z33-2\,i\,a\,s^5\,z21\,Z31\,z33-2\,i\,a\,s^7\,z23\,Z31\,z33-$$
$$i\,B\,s^5\,z31\,Z31\,z33+i\,G\,s^7\,Z21\,z33^2+i\,G\,s^9\,Z23\,z33^2-\frac{1}{2}i\,B\,s^7\,Z31\,z33^2+b\,p21\,s^5\,z21\,Z33-$$
$$2\,a\,p31\,s^5\,z21\,Z33+b\,p23\,s^7\,z21\,Z33-2\,a\,p33\,s^7\,z21\,Z33+\frac{1}{2}i\,b\,s^5\,z21^2\,Z33+b\,p21\,s^7\,z23\,Z33-$$
$$2\,a\,p31\,s^7\,z23\,Z33+b\,p23\,s^9\,z23\,Z33-2\,a\,p33\,s^9\,z23\,Z33+i\,b\,s^7\,z21\,z23\,Z33+$$
$$\frac{1}{2}i\,b\,s^9\,z23^2\,Z33-2\,a\,p21\,s^5\,z31\,Z33-B\,p31\,s^5\,z31\,Z33-2\,a\,p23\,s^7\,z31\,Z33-$$
$$B\,p33\,s^7\,z31\,Z33-2\,i\,a\,s^5\,z21\,z31\,Z33-2\,i\,a\,s^7\,z23\,z31\,Z33-\frac{1}{2}i\,B\,s^5\,z31^2\,Z33-$$
$$2\,a\,p21\,s^7\,z33\,Z33-B\,p31\,s^7\,z33\,Z33-2\,a\,p23\,s^9\,z33\,Z33-B\,p33\,s^9\,z33\,Z33-$$
$$2\,i\,a\,s^7\,z21\,z33\,Z33-2\,i\,a\,s^9\,z23\,z33\,Z33-i\,B\,s^7\,z31\,z33\,Z33-\frac{1}{2}i\,B\,s^9\,z33^2\,Z33$$

In[•]:= **Collect[%, s]**

Out[•]=

$$
\begin{aligned}
&s\left(-\frac{p21}{2}-\frac{i\,z21}{2}\right)+\\
&s^3\left(-\frac{p23}{2}+2\,a\,p21\,z21\,Z21+B\,p31\,z21\,Z21+i\,a\,z21^2\,Z21-\frac{i\,z23}{2}+B\,p21\,Z21\,z31+\right.\\
&\quad 2\,G\,p31\,Z21\,z31+i\,B\,z21\,Z21\,z31+i\,G\,Z21\,z31^2+b\,p21\,z21\,Z31-2\,a\,p31\,z21\,Z31+\\
&\quad \left.\frac{1}{2}\,i\,b\,z21^2\,Z31-2\,a\,p21\,z31\,Z31-B\,p31\,z31\,Z31-2\,i\,a\,z21\,z31\,Z31-\frac{1}{2}\,i\,B\,z31^2\,Z31\right)+\\
&s^5\left(2\,a\,p23\,z21\,Z21+B\,p33\,z21\,Z21+2\,a\,p21\,Z21\,z23+B\,p31\,Z21\,z23+2\,i\,a\,z21\,Z21\,z23+\right.\\
&\quad 2\,a\,p21\,z21\,Z23+B\,p31\,z21\,Z23+i\,a\,z21^2\,Z23+B\,p23\,Z21\,z31+2\,G\,p33\,Z21\,z31+\\
&\quad i\,B\,Z21\,z23\,z31+B\,p21\,Z23\,z31+2\,G\,p31\,Z23\,z31+i\,B\,z21\,Z23\,z31+i\,G\,Z23\,z31^2+\\
&\quad b\,p23\,z21\,Z31-2\,a\,p33\,z21\,Z31+b\,p21\,z23\,Z31-2\,a\,p31\,z23\,Z31+i\,b\,z21\,z23\,Z31-\\
&\quad 2\,a\,p23\,z31\,Z31-B\,p33\,z31\,Z31-2\,i\,a\,z23\,z31\,Z31+B\,p21\,Z21\,z33+2\,G\,p31\,Z21\,z33+\\
&\quad i\,B\,z21\,Z21\,z33+2\,i\,G\,Z21\,z31\,z33-2\,a\,p21\,Z31\,z33-B\,p31\,Z31\,z33-\\
&\quad 2\,i\,a\,z21\,Z31\,z33-i\,B\,z31\,Z31\,z33+b\,p21\,z21\,Z33-2\,a\,p31\,z21\,Z33+\frac{1}{2}\,i\,b\,z21^2\,Z33-\\
&\quad \left.2\,a\,p21\,z31\,Z33-B\,p31\,z31\,Z33-2\,i\,a\,z21\,z31\,Z33-\frac{1}{2}\,i\,B\,z31^2\,Z33\right)+\\
&s^7\left(2\,a\,p23\,Z21\,z23+B\,p33\,Z21\,z23+i\,a\,Z21\,z23^2+2\,a\,p23\,z21\,Z23+B\,p33\,z21\,Z23+\right.\\
&\quad 2\,a\,p21\,z23\,Z23+B\,p31\,z23\,Z23+2\,i\,a\,z21\,z23\,Z23+B\,p23\,Z23\,z31+2\,G\,p33\,Z23\,z31+\\
&\quad i\,B\,z23\,Z23\,z31+b\,p23\,z23\,Z31-2\,a\,p33\,z23\,Z31+\frac{1}{2}\,i\,b\,z23^2\,Z31+B\,p23\,Z21\,z33+\\
&\quad 2\,G\,p33\,Z21\,z33+i\,B\,Z21\,z23\,z33+B\,p21\,Z23\,z33+2\,G\,p31\,Z23\,z33+i\,B\,z21\,Z23\,z33+\\
&\quad 2\,i\,G\,Z23\,z31\,z33-2\,a\,p23\,Z31\,z33-B\,p33\,Z31\,z33-2\,i\,a\,z23\,Z31\,z33+\\
&\quad i\,G\,Z21\,z33^2-\frac{1}{2}\,i\,B\,Z31\,z33^2+b\,p23\,z21\,Z33-2\,a\,p33\,z21\,Z33+b\,p21\,z23\,Z33-\\
&\quad 2\,a\,p31\,z23\,Z33+i\,b\,z21\,z23\,Z33-2\,a\,p23\,z31\,Z33-B\,p33\,z31\,Z33-2\,i\,a\,z23\,z31\,Z33-\\
&\quad \left.2\,a\,p21\,z33\,Z33-B\,p31\,z33\,Z33-2\,i\,a\,z21\,z33\,Z33-i\,B\,z31\,z33\,Z33\right)+\\
&s^9\left(2\,a\,p23\,z23\,Z23+B\,p33\,z23\,Z23+i\,a\,z23^2\,Z23+B\,p23\,Z23\,z33+2\,G\,p33\,Z23\,z33+\right.\\
&\quad i\,B\,z23\,Z23\,z33+i\,G\,Z23\,z33^2+b\,p23\,z23\,Z33-2\,a\,p33\,z23\,Z33+\frac{1}{2}\,i\,b\,z23^2\,Z33-\\
&\quad \left.2\,a\,p23\,z33\,Z33-B\,p33\,z33\,Z33-2\,i\,a\,z23\,z33\,Z33-\frac{1}{2}\,i\,B\,z33^2\,Z33\right)
\end{aligned}
$$

In[•]:=
```
dp2 /. {z2 → z2st, Z2 → Z2st, p2 → p2st,
  P2 → P2st, z3 → z3st, Z3 → Z3st, p3 → p3st, P3 → P3st}
```

Out[•]=

$$
\begin{aligned}
&-2\left(\frac{1}{4}\,\mathrm{i}\,\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)+\frac{1}{4}\left(-\text{s}\,\text{z21}-\text{s}^3\,\text{z23}\right)+\right.\\
&\text{a}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\left(\text{P21}\,\text{s}+\text{P23}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)+\\
&\frac{1}{2}\,\text{B}\left(\text{P21}\,\text{s}+\text{P23}\,\text{s}^3\right)\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)+\frac{1}{2}\,\text{b}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\\
&\left(\text{P31}\,\text{s}+\text{P33}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)-\text{a}\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{P31}\,\text{s}+\text{P33}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)+\\
&\frac{1}{2}\,\mathrm{i}\,\text{a}\left(\text{P21}\,\text{s}+\text{P23}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)^2+\frac{1}{4}\,\mathrm{i}\,\text{b}\left(\text{P31}\,\text{s}+\text{P33}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)^2-\\
&\mathrm{i}\,\text{a}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)\left(\text{s}\,\text{Z21}+\text{s}^3\,\text{Z23}\right)-\\
&\frac{1}{2}\,\mathrm{i}\,\text{B}\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)\left(\text{s}\,\text{Z21}+\text{s}^3\,\text{Z23}\right)+\\
&\frac{1}{2}\,\text{B}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\left(\text{P21}\,\text{s}+\text{P23}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)+\\
&\text{G}\left(\text{P21}\,\text{s}+\text{P23}\,\text{s}^3\right)\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)-\\
&\text{a}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\left(\text{P31}\,\text{s}+\text{P33}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)-\\
&\frac{1}{2}\,\text{B}\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{P31}\,\text{s}+\text{P33}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)+\\
&\frac{1}{2}\,\mathrm{i}\,\text{B}\left(\text{P21}\,\text{s}+\text{P23}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)-\\
&\mathrm{i}\,\text{a}\left(\text{P31}\,\text{s}+\text{P33}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)-\\
&\frac{1}{2}\,\mathrm{i}\,\text{B}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\left(\text{s}\,\text{Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)-\\
&\mathrm{i}\,\text{G}\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{s}\,\text{Z21}+\text{s}^3\,\text{Z23}\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)+\\
&\frac{1}{2}\,\mathrm{i}\,\text{G}\left(\text{P21}\,\text{s}+\text{P23}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)^2-\frac{1}{4}\,\mathrm{i}\,\text{B}\left(\text{P31}\,\text{s}+\text{P33}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)^2-\\
&\frac{1}{2}\,\mathrm{i}\,\text{b}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)\left(\text{s}\,\text{Z31}+\text{s}^3\,\text{Z33}\right)+\\
&\mathrm{i}\,\text{a}\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{s}\,\text{z21}+\text{s}^3\,\text{z23}\right)\left(\text{s}\,\text{Z31}+\text{s}^3\,\text{Z33}\right)+\\
&\mathrm{i}\,\text{a}\left(\text{p21}\,\text{s}+\text{p23}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)\left(\text{s}\,\text{Z31}+\text{s}^3\,\text{Z33}\right)+\\
&\left.\frac{1}{2}\,\mathrm{i}\,\text{B}\left(\text{p31}\,\text{s}+\text{p33}\,\text{s}^3\right)\left(\text{s}\,\text{z31}+\text{s}^3\,\text{z33}\right)\left(\text{s}\,\text{Z31}+\text{s}^3\,\text{Z33}\right)\right)
\end{aligned}
$$

In[•]:=
```
Expand[%167]
```

Out[•]= $$-\frac{1}{2}\,i\,p21\,s-\frac{1}{2}\,i\,p23\,s^3+\frac{s\,z21}{2}-2\,a\,p21\,P21\,s^3\,z21-B\,P21\,p31\,s^3\,z21-b\,p21\,P31\,s^3\,z21+$$
$$2\,a\,p31\,P31\,s^3\,z21-2\,a\,P21\,p23\,s^5\,z21-2\,a\,p21\,P23\,s^5\,z21-B\,P23\,p31\,s^5\,z21-$$
$$b\,p23\,P31\,s^5\,z21-B\,P21\,p33\,s^5\,z21+2\,a\,P31\,p33\,s^5\,z21-b\,p21\,P33\,s^5\,z21+2\,a\,p31\,P33\,s^5\,z21-$$
$$2\,a\,p23\,P23\,s^7\,z21-B\,P23\,p33\,s^7\,z21-b\,p23\,P33\,s^7\,z21+2\,a\,p33\,P33\,s^7\,z21-i\,a\,P21\,s^3\,z21^2-$$
$$\frac{1}{2}\,i\,b\,P31\,s^3\,z21^2-i\,a\,P23\,s^5\,z21^2-\frac{1}{2}\,i\,b\,P33\,s^5\,z21^2+2\,i\,a\,p21\,s^3\,z21\,Z21+i\,B\,p31\,s^3\,z21\,Z21+$$
$$2\,i\,a\,p23\,s^5\,z21\,Z21+i\,B\,p33\,s^5\,z21\,Z21+\frac{s^3\,z23}{2}-2\,a\,p21\,P21\,s^5\,z23-B\,P21\,p31\,s^5\,z23-$$
$$b\,p21\,P31\,s^5\,z23+2\,a\,p31\,P31\,s^5\,z23-2\,a\,P21\,p23\,s^7\,z23-2\,a\,p21\,P23\,s^7\,z23-$$
$$B\,P23\,p31\,s^7\,z23-b\,p23\,P31\,s^7\,z23-B\,P21\,p33\,s^7\,z23+2\,a\,P31\,p33\,s^7\,z23-b\,p21\,P33\,s^7\,z23+$$
$$2\,a\,p31\,P33\,s^7\,z23-2\,a\,p23\,P23\,s^9\,z23-B\,P23\,p33\,s^9\,z23-b\,p23\,P33\,s^9\,z23+$$
$$2\,a\,p33\,P33\,s^9\,z23-2\,i\,a\,P21\,s^5\,z21\,z23-i\,b\,P31\,s^5\,z21\,z23-2\,i\,a\,P23\,s^7\,z21\,z23-$$
$$i\,b\,P33\,s^7\,z21\,z23+2\,i\,a\,p21\,s^5\,Z21\,z23+i\,B\,p31\,s^5\,Z21\,z23+2\,i\,a\,p23\,s^7\,Z21\,z23+$$
$$i\,B\,p33\,s^7\,Z21\,z23-i\,a\,P21\,s^7\,z23^2-\frac{1}{2}\,i\,b\,P31\,s^7\,z23^2-i\,a\,P23\,s^9\,z23^2-\frac{1}{2}\,i\,b\,P33\,s^9\,z23^2+$$
$$2\,i\,a\,p21\,s^5\,z21\,Z23+i\,B\,p31\,s^5\,z21\,Z23+2\,i\,a\,p23\,s^7\,z21\,Z23+i\,B\,p33\,s^7\,z21\,Z23+$$
$$2\,i\,a\,p21\,s^7\,z23\,Z23+i\,B\,p31\,s^7\,z23\,Z23+2\,i\,a\,p23\,s^9\,z23\,Z23+i\,B\,p33\,s^9\,z23\,Z23-$$
$$B\,p21\,P21\,s^3\,z31-2\,G\,P21\,p31\,s^3\,z31+2\,a\,p21\,P31\,s^3\,z31+B\,p31\,P31\,s^3\,z31-B\,P21\,p23\,s^5\,z31-$$
$$B\,p21\,P23\,s^5\,z31-2\,G\,P23\,p31\,s^5\,z31+2\,a\,p23\,P31\,s^5\,z31-2\,G\,P21\,p33\,s^5\,z31+B\,P31\,p33\,s^5\,z31+$$
$$2\,a\,p21\,P33\,s^5\,z31+B\,p31\,P33\,s^5\,z31-B\,p23\,P23\,s^7\,z31-2\,G\,P23\,p33\,s^7\,z31+2\,a\,p23\,P33\,s^7\,z31+$$
$$B\,p33\,P33\,s^7\,z31-i\,B\,P21\,s^3\,z21\,z31+2\,i\,a\,P31\,s^3\,z21\,z31-i\,B\,P23\,s^5\,z21\,z31+$$
$$2\,i\,a\,P33\,s^5\,z21\,z31+i\,B\,p21\,s^3\,Z21\,z31+2\,i\,G\,p31\,s^3\,Z21\,z31+i\,B\,p23\,s^5\,Z21\,z31+$$
$$2\,i\,G\,p33\,s^5\,Z21\,z31-i\,B\,P21\,s^5\,z23\,z31+2\,i\,a\,P31\,s^5\,z23\,z31-i\,B\,P23\,s^7\,z23\,z31+$$
$$2\,i\,a\,P33\,s^7\,z23\,z31+i\,B\,p21\,s^5\,Z23\,z31+2\,i\,G\,p31\,s^5\,Z23\,z31+i\,B\,p23\,s^7\,Z23\,z31+$$
$$2\,i\,G\,p33\,s^7\,Z23\,z31-i\,G\,P21\,s^3\,z31^2+\frac{1}{2}\,i\,B\,P31\,s^3\,z31^2-i\,G\,P23\,s^5\,z31^2+\frac{1}{2}\,i\,B\,P33\,s^5\,z31^2+$$
$$i\,b\,p21\,s^3\,z21\,Z31-2\,i\,a\,p31\,s^3\,z21\,Z31+i\,b\,p23\,s^5\,z21\,Z31-2\,i\,a\,p33\,s^5\,z21\,Z31+$$
$$i\,b\,p21\,s^5\,z23\,Z31-2\,i\,a\,p31\,s^5\,z23\,Z31+i\,b\,p23\,s^7\,z23\,Z31-2\,i\,a\,p33\,s^7\,z23\,Z31-$$
$$2\,i\,a\,p21\,s^3\,z31\,Z31-i\,B\,p31\,s^3\,z31\,Z31-2\,i\,a\,p23\,s^5\,z31\,Z31-i\,B\,p33\,s^5\,z31\,Z31-$$
$$B\,p21\,P21\,s^5\,z33-2\,G\,P21\,p31\,s^5\,z33+2\,a\,p21\,P31\,s^5\,z33+B\,p31\,P31\,s^5\,z33-B\,P21\,p23\,s^7\,z33-$$
$$B\,p21\,P23\,s^7\,z33-2\,G\,P23\,p31\,s^7\,z33+2\,a\,p23\,P31\,s^7\,z33-2\,G\,P21\,p33\,s^7\,z33+B\,P31\,p33\,s^7\,z33+$$
$$2\,a\,p21\,P33\,s^7\,z33+B\,p31\,P33\,s^7\,z33-B\,p23\,P23\,s^9\,z33-2\,G\,P23\,p33\,s^9\,z33+2\,a\,p23\,P33\,s^9\,z33+$$
$$B\,p33\,P33\,s^9\,z33-i\,B\,P21\,s^5\,z21\,z33+2\,i\,a\,P31\,s^5\,z21\,z33-i\,B\,P23\,s^7\,z21\,z33+$$
$$2\,i\,a\,P33\,s^7\,z21\,z33+i\,B\,p21\,s^5\,Z21\,z33+2\,i\,G\,p31\,s^5\,Z21\,z33+i\,B\,p23\,s^7\,Z21\,z33+$$
$$2\,i\,G\,p33\,s^7\,Z21\,z33-i\,B\,P21\,s^7\,z23\,z33+2\,i\,a\,P31\,s^7\,z23\,z33-i\,B\,P23\,s^9\,z23\,z33+$$
$$2\,i\,a\,P33\,s^9\,z23\,z33+i\,B\,p21\,s^7\,Z23\,z33+2\,i\,G\,p31\,s^7\,Z23\,z33+i\,B\,p23\,s^9\,Z23\,z33+$$
$$2\,i\,G\,p33\,s^9\,Z23\,z33-2\,i\,G\,P21\,s^5\,z31\,z33+i\,B\,P31\,s^5\,z31\,z33-2\,i\,G\,P23\,s^7\,z31\,z33+$$
$$i\,B\,P33\,s^7\,z31\,z33-2\,i\,a\,p21\,s^5\,Z31\,z33-i\,B\,p31\,s^5\,Z31\,z33-2\,i\,a\,p23\,s^7\,Z31\,z33-$$
$$i\,B\,p33\,s^7\,Z31\,z33-i\,G\,P21\,s^7\,z33^2+\frac{1}{2}\,i\,B\,P31\,s^7\,z33^2-i\,G\,P23\,s^9\,z33^2+\frac{1}{2}\,i\,B\,P33\,s^9\,z33^2+$$
$$i\,b\,p21\,s^5\,z21\,Z33-2\,i\,a\,p31\,s^5\,z21\,Z33+i\,b\,p23\,s^7\,z21\,Z33-2\,i\,a\,p33\,s^7\,z21\,Z33+$$
$$i\,b\,p21\,s^7\,z23\,Z33-2\,i\,a\,p31\,s^7\,z23\,Z33+i\,b\,p23\,s^9\,z23\,Z33-2\,i\,a\,p33\,s^9\,z23\,Z33-$$
$$2\,i\,a\,p21\,s^5\,z31\,Z33-i\,B\,p31\,s^5\,z31\,Z33-2\,i\,a\,p23\,s^7\,z31\,Z33-i\,B\,p33\,s^7\,z31\,Z33-$$
$$2\,i\,a\,p21\,s^7\,z33\,Z33-i\,B\,p31\,s^7\,z33\,Z33-2\,i\,a\,p23\,s^9\,z33\,Z33-i\,B\,p33\,s^9\,z33\,Z33$$

In[•]:= **Collect[%, s]**

Out[•]=

$$
\begin{aligned}
&s\left(-\frac{i\,p21}{2}+\frac{z21}{2}\right)+\\
&s^3\left(-\frac{i\,p23}{2}-2\,a\,p21\,P21\,z21-B\,P21\,p31\,z21-b\,p21\,P31\,z21+2\,a\,p31\,P31\,z21-\right.\\
&\quad i\,a\,P21\,z21^2-\frac{1}{2}\,i\,b\,P31\,z21^2+2\,i\,a\,p21\,z21\,Z21+i\,B\,p31\,z21\,Z21+\frac{z23}{2}-\\
&\quad B\,p21\,P21\,z31-2\,G\,P21\,p31\,z31+2\,a\,p21\,P31\,z31+B\,p31\,P31\,z31-i\,B\,P21\,z21\,z31+\\
&\quad 2\,i\,a\,P31\,z21\,z31+i\,B\,p21\,Z21\,z31+2\,i\,G\,p31\,Z21\,z31-i\,G\,P21\,z31^2+\frac{1}{2}\,i\,B\,P31\,z31^2+\\
&\quad \left.i\,b\,p21\,z21\,Z31-2\,i\,a\,p31\,z21\,Z31-2\,i\,a\,p21\,z31\,Z31-i\,B\,p31\,z31\,Z31\right)+\\
&s^5\left(-2\,a\,P21\,p23\,z21-2\,a\,p21\,P23\,z21-B\,P23\,p31\,z21-b\,p23\,P31\,z21-B\,P21\,p33\,z21+\right.\\
&\quad 2\,a\,P31\,p33\,z21-b\,p21\,P33\,z21+2\,a\,p31\,P33\,z21-i\,a\,P23\,z21^2-\frac{1}{2}\,i\,b\,P33\,z21^2+\\
&\quad 2\,i\,a\,p23\,z21\,Z21+i\,B\,p33\,z21\,Z21-2\,a\,p21\,P21\,z23-B\,P21\,p31\,z23-b\,p21\,P31\,z23+\\
&\quad 2\,a\,p31\,P31\,z23-2\,i\,a\,P21\,z21\,z23-i\,b\,P31\,z21\,z23+2\,i\,a\,p21\,Z21\,z23+\\
&\quad i\,B\,p31\,Z21\,z23+2\,i\,a\,p21\,z21\,Z23+i\,B\,p31\,z21\,Z23-B\,P21\,p23\,z31-B\,p21\,P23\,z31-\\
&\quad 2\,G\,P23\,p31\,z31+2\,a\,p23\,P31\,z31-2\,G\,P21\,p33\,z31+B\,P31\,p33\,z31+2\,a\,p21\,P33\,z31+\\
&\quad B\,p31\,P33\,z31-i\,B\,P23\,z21\,z31+2\,i\,a\,P33\,z21\,z31+i\,B\,p23\,Z21\,z31+2\,i\,G\,p33\,Z21\,z31-\\
&\quad i\,B\,P21\,z23\,z31+2\,i\,a\,P31\,z23\,z31+i\,B\,p21\,Z23\,z31+2\,i\,G\,p31\,Z23\,z31-i\,G\,P23\,z31^2+\\
&\quad \frac{1}{2}\,i\,B\,P33\,z31^2+i\,b\,p23\,z21\,Z31-2\,i\,a\,p33\,z21\,Z31+i\,b\,p21\,z23\,Z31-2\,i\,a\,p31\,z23\,Z31-\\
&\quad 2\,i\,a\,p23\,z31\,Z31-i\,B\,p33\,z31\,Z31-B\,p21\,P21\,z33-2\,G\,P21\,p31\,z33+2\,a\,p21\,P31\,z33+\\
&\quad B\,p31\,P31\,z33-i\,B\,P21\,z21\,z33+2\,i\,a\,P31\,z21\,z33+i\,B\,p21\,Z21\,z33+2\,i\,G\,p31\,Z21\,z33-\\
&\quad 2\,i\,G\,P21\,z31\,z33+i\,B\,P31\,z31\,z33-2\,i\,a\,p21\,Z31\,z33-i\,B\,p31\,Z31\,z33+\\
&\quad \left.i\,b\,p21\,z21\,Z33-2\,i\,a\,p31\,z21\,Z33-2\,i\,a\,p21\,z31\,Z33-i\,B\,p31\,z31\,Z33\right)+\\
&s^7\left(-2\,a\,p23\,P23\,z21-B\,P23\,p33\,z21-b\,p23\,P33\,z21+2\,a\,p33\,P33\,z21-2\,a\,P21\,p23\,z23-\right.\\
&\quad 2\,a\,p21\,P23\,z23-B\,P23\,p31\,z23-b\,p23\,P31\,z23-B\,P21\,p33\,z23+2\,a\,P31\,p33\,z23-\\
&\quad b\,p21\,P33\,z23+2\,a\,p31\,P33\,z23-2\,i\,a\,P23\,z21\,z23-i\,b\,P33\,z21\,z23+2\,i\,a\,p23\,Z21\,z23+\\
&\quad i\,B\,p33\,Z21\,z23-i\,a\,P21\,z23^2-\frac{1}{2}\,i\,b\,P31\,z23^2+2\,i\,a\,p23\,z21\,Z23+i\,B\,p33\,z21\,Z23+\\
&\quad 2\,i\,a\,p21\,z23\,Z23+i\,B\,p31\,z23\,Z23-B\,p23\,P23\,z31-2\,G\,P23\,p33\,z31+2\,a\,p23\,P33\,z31+\\
&\quad B\,p33\,P33\,z31-i\,B\,P23\,z23\,z31+2\,i\,a\,P33\,z23\,z31+i\,B\,p23\,Z23\,z31+2\,i\,G\,p33\,Z23\,z31+\\
&\quad i\,b\,p23\,z23\,Z31-2\,i\,a\,p33\,z23\,Z31-B\,P21\,p23\,z33-B\,p21\,P23\,z33-2\,G\,P23\,p31\,z33+\\
&\quad 2\,a\,p23\,P31\,z33-2\,G\,P21\,p33\,z33+B\,P31\,p33\,z33+2\,a\,p21\,P33\,z33+B\,p31\,P33\,z33-\\
&\quad i\,B\,P23\,z21\,z33+2\,i\,a\,P33\,z21\,z33+i\,B\,p23\,Z21\,z33+2\,i\,G\,p33\,Z21\,z33-i\,B\,P21\,z23\,z33+\\
&\quad 2\,i\,a\,P31\,z23\,z33+i\,B\,p21\,Z23\,z33+2\,i\,G\,p31\,Z23\,z33-2\,i\,G\,P23\,z31\,z33+\\
&\quad i\,B\,P33\,z31\,z33-2\,i\,a\,p23\,Z31\,z33-i\,B\,p33\,Z31\,z33-i\,G\,P21\,z33^2+\frac{1}{2}\,i\,B\,P31\,z33^2+\\
&\quad i\,b\,p23\,z21\,Z33-2\,i\,a\,p33\,z21\,Z33+i\,b\,p21\,z23\,Z33-2\,i\,a\,p31\,z23\,Z33-\\
&\quad 2\,i\,a\,p23\,z31\,Z33-i\,B\,p33\,z31\,Z33-2\,i\,a\,p21\,z33\,Z33-i\,B\,p31\,z33\,Z33\left.\right)+\\
&s^9\left(-2\,a\,p23\,P23\,z23-B\,P23\,p33\,z23-b\,p23\,P33\,z23+2\,a\,p33\,P33\,z23-i\,a\,P23\,z23^2-\right.
\end{aligned}
$$

$$\frac{1}{2}\,\mathrm{i}\,b\,P33\,z23^2 + 2\,\mathrm{i}\,a\,p23\,z23\,Z23 + \mathrm{i}\,B\,p33\,z23\,Z23 - B\,p23\,P23\,z33 - 2\,G\,P23\,p33\,z33 + 2\,a\,p23\,P33\,z33 + B\,p33\,P33\,z33 - \mathrm{i}\,B\,P23\,z23\,z33 + 2\,\mathrm{i}\,a\,P33\,z23\,z33 + \mathrm{i}\,B\,p23\,Z23\,z33 + 2\,\mathrm{i}\,G\,p33\,Z23\,z33 - \mathrm{i}\,G\,P23\,z33^2 + \frac{1}{2}\,\mathrm{i}\,B\,P33\,z33^2 + \mathrm{i}\,b\,p23\,z23\,Z33 - 2\,\mathrm{i}\,a\,p33\,z23\,Z33 - 2\,\mathrm{i}\,a\,p23\,z33\,Z33 - \mathrm{i}\,B\,p33\,z33\,Z33\Big)$$

In[•]:=
```
DSolve[{l'[t] == -m[t]/2 - (i * l[t])/2, m'[t] == -(i * m[t])/2 + l[t]/2}, {m[t], l[t]}, t]
```

Out[•]=
$$\left\{\left\{l[t] \to e^{-\frac{i t}{2}} C[1]\,\mathrm{Cos}\left[\frac{t}{2}\right] - e^{-\frac{i t}{2}} C[2]\,\mathrm{Sin}\left[\frac{t}{2}\right],\ m[t] \to e^{-\frac{i t}{2}} C[2]\,\mathrm{Cos}\left[\frac{t}{2}\right] + e^{-\frac{i t}{2}} C[1]\,\mathrm{Sin}\left[\frac{t}{2}\right]\right\}\right\}$$

In[•]:=
```
e^(-(i t)/2) C[1] Cos[t/2] - e^(-(i t)/2) C[2] Sin[t/2]
```

Out[•]=
$$e^{-\frac{i t}{2}} C[1]\,\mathrm{Cos}\left[\frac{t}{2}\right] - e^{-\frac{i t}{2}} C[2]\,\mathrm{Sin}\left[\frac{t}{2}\right]$$

In[•]:=
```
TrigReduce[e^(-(i t)/2) C[1] Cos[t/2] - e^(-(i t)/2) C[2] Sin[t/2]]
```

Out[•]=
$$\frac{1}{2}\,e^{-i t}\left(C[1] + e^{i t} C[1] - i\,C[2] + i\,e^{i t} C[2]\right)$$

In[•]:=
```
Expand[1/2 e^(-i t) (C[1] + e^(i t) C[1] - i C[2] + i e^(i t) C[2])]
```

Out[•]=
$$\frac{C[1]}{2} + \frac{1}{2}\,e^{-i t} C[1] + \frac{1}{2}\,i\,C[2] - \frac{1}{2}\,i\,e^{-i t} C[2]$$

In[•]:=
```
Collect[%, Exp[-I * t]]
```

Out[•]=
$$\frac{C[1]}{2} + e^{-i t}\left(\frac{C[1]}{2} - \frac{1}{2}\,i\,C[2]\right) + \frac{1}{2}\,i\,C[2]$$

In[•]:=
```
ClearAll[p1]
```

In[•]:=
```
p1 := -1
```

In[•]:=
```
ClearAll[p1]
```

In[•]:=
```
p1 := 1
```