In[•]:=
```
p = Subscript[z, 1] + Subscript[z, 1]* -
  Subscript[z, 2] Subscript[z, 2]* - Subscript[z, 3] Subscript[z, 3]* -
  a (Subscript[z, 2]^2 Subscript[z, 2]*^2 + Subscript[z, 3]^2 Subscript[z, 3]*^2 -
     4 Subscript[z, 2] Subscript[z, 2]* Subscript[z, 3] Subscript[z, 3]*) -
  (b Subscript[z, 2] Subscript[z, 3]* + b* Subscript[z, 3] Subscript[z, 2]*)
   (Subscript[z, 2] Subscript[z, 2]* - Subscript[z, 3] Subscript[z, 3]*) -
  c Subscript[z, 2]^2 Subscript[z, 3]*^2 - c* Subscript[z, 3]^2 Subscript[z, 2]*^2
```

Out[•]=
$$\text{Conjugate}[z_1] + z_1 - \text{Conjugate}[z_2]\, z_2 - c\, \text{Conjugate}[z_3]^2\, z_2^2 - \text{Conjugate}[z_3]\, z_3 - \text{Conjugate}[c]\, \text{Conjugate}[z_2]^2\, z_3^2 - \left(b\, \text{Conjugate}[z_3]\, z_2 + \text{Conjugate}[b]\, \text{Conjugate}[z_2]\, z_3\right)\left(\text{Conjugate}[z_2]\, z_2 - \text{Conjugate}[z_3]\, z_3\right) - a\left(\text{Conjugate}[z_2]^2\, z_2^2 - 4\, \text{Conjugate}[z_2]\, \text{Conjugate}[z_3]\, z_2\, z_3 + \text{Conjugate}[z_3]^2\, z_3^2\right)$$

In[•]:=
```
f = z1 + Z1 - z2 Z2 - z3 Z3 - a (z2^2 * Z2^2 + z3^2 * Z3^2 - 4 z2 z3 Z2 Z3) -
  (bz2 Z3 + BZ2 z3) (z2 Z2 - z3 Z3) - cz2^2 * Z3^2 - CZ2^2 z3^2
```

Out[•]=
$$z_1 - CZ_2^2\, z_3^2 + Z_1 - z_2\, Z_2 - z_3\, Z_3 - cz_2^2\, Z_3^2 - \left(BZ_2\, z_3 + bz_2\, Z_3\right)\left(z_2\, Z_2 - z_3\, Z_3\right) - a\left(z_2^2\, Z_2^2 - 4\, z_2\, z_3\, Z_2\, Z_3 + z_3^2\, Z_3^2\right)$$

In[•]:=
```
D[f, Z1]
```

Out[•]=
```
1
```

In[•]:=
```
D[f, Z2]
```

Out[•]=
$$-z_2 - z_2\left(BZ_2\, z_3 + bz_2\, Z_3\right) - a\left(2\, z_2^2\, Z_2 - 4\, z_2\, z_3\, Z_3\right)$$

In[•]:=
```
ClearAll
```

Out[•]=
```
ClearAll
```

In[•]:=
```
f = z1 + Z1 - z2 Z2 - z3 Z3 - a (z2^2 * Z2^2 + z3^2 * Z3^2 - 4 z2 z3 Z2 Z3) -
  (bz2 Z3 + BZ2 z3) (z2 Z2 - z3 Z3) - cz2^2 * Z3^2 - CZ2^2 z3^2
```

Out[•]=
$$z_1 - CZ_2^2\, z_3^2 + Z_1 - z_2\, Z_2 - z_3\, Z_3 - cz_2^2\, Z_3^2 - \left(BZ_2\, z_3 + bz_2\, Z_3\right)\left(z_2\, Z_2 - z_3\, Z_3\right) - a\left(z_2^2\, Z_2^2 - 4\, z_2\, z_3\, Z_2\, Z_3 + z_3^2\, Z_3^2\right)$$

In[•]:=
```
Expand[f]
```

Out[•]=
$$z_1 - CZ_2^2\, z_3^2 + Z_1 - z_2\, Z_2 - BZ_2\, z_2\, z_3\, Z_2 - a\, z_2^2\, Z_2^2 - z_3\, Z_3 + BZ_2\, z_3^2\, Z_3 - bz_2\, z_2\, Z_2\, Z_3 + 4\, a\, z_2\, z_3\, Z_2\, Z_3 - cz_2^2\, Z_3^2 + bz_2\, z_3\, Z_3^2 - a\, z_3^2\, Z_3^2$$

In[•]:=
```
f[z_, Z_, w_, W_, y_, Y_] :=
 z + Z - w * W - y * Y - a * (y^2 * Y^2 + w^2 * W^2 - 4 * w * y * W * Y) -
  (b * w * Y + B * W * y) * (w * W - y * Y) - g * w^2 * Y^2 - G * W^2 * y^2
```

SetDelayed: Tag Plus in $\left(z_1 - CZ_2^2\, z_3^2 + Z_1 - z_2\, Z_2 - z_3\, Z_3 - cz_2^2\, Z_3^2 - \left(BZ_2\, z_3 + bz_2\, Z_3\right)\left(z_2\, Z_2 - z_3\, Z_3\right) - a\left(z_2^2\, Z_2^2 - 4\, z_2\, z_3\, Z_2\, Z_3 + z_3^2\, Z_3^2\right)\right)[z\_, Z\_, w\_, W\_, y\_, Y\_]$ is Protected.

Out[•]=
```
$Failed
```

```
In[•]:= ClearAll
Out[•]= ClearAll

In[•]:= f[z_, Z_, w_, W_, y_, Y_] :=
  z + Z - w * W - y * Y - a * (y^2 * Y^2 + w^2 * W^2 - 4 * w * y * W * Y) -
   (b * w * Y + B * W * y) * (w * W - y * Y) - g * w^2 * Y^2 - G * W^2 * y^2
```

SetDelayed: Tag Plus in $(z_1 - CZ_2^2 z_3^2 + Z_1 - z_2 Z_2 - z_3 Z_3 - cz_2^2 Z_3^2 - (BZ_2 z_3 + bz_2 Z_3)(z_2 Z_2 - z_3 Z_3) - a(z_2^2 Z_2^2 - 4 z_2 z_3 Z_2 Z_3 + z_3^2 Z_3^2))$[z_, Z_, w_, W_, y_, Y_] is Protected.

```
Out[•]= $Failed

In[•]:= Remove["Global`*"]

In[•]:= f[z_, Z_, w_, W_, y_, Y_] :=
  z + Z - w * W - y * Y - a * (y^2 * Y^2 + w^2 * W^2 - 4 * w * y * W * Y) -
   (b * w * Y + B * W * y) * (w * W - y * Y) - g * w^2 * Y^2 - G * W^2 * y^2

In[•]:= F := f[z1, Z1, z2, Z2, z3, Z3]

In[•]:= F
```

$$\text{Out[•]= } z_1 + Z_1 - z_2 Z_2 - G z_3^2 Z_2^2 - z_3 Z_3 - g z_2^2 Z_3^2 - (B z_3 Z_2 + b z_2 Z_3)(z_2 Z_2 - z_3 Z_3) - a(z_2^2 Z_2^2 - 4 z_2 z_3 Z_2 Z_3 + z_3^2 Z_3^2)$$

```
In[•]:= D[F, Z1]
Out[•]= 1

In[•]:= D[F, Z2]
```

$$\text{Out[•]= } -z_2 - 2 G z_3^2 Z_2 - z_2 (B z_3 Z_2 + b z_2 Z_3) - B z_3 (z_2 Z_2 - z_3 Z_3) - a(2 z_2^2 Z_2 - 4 z_2 z_3 Z_3)$$

```
In[•]:= D[F, Z3]
```

$$\text{Out[•]= } -z_3 - 2 g z_2^2 Z_3 + z_3 (B z_3 Z_2 + b z_2 Z_3) - b z_2 (z_2 Z_2 - z_3 Z_3) - a(-4 z_2 z_3 Z_2 + 2 z_3^2 Z_3)$$

```
In[•]:= D[F, {z3, 0}]
```

$$\text{Out[•]= } z_1 + Z_1 - z_2 Z_2 - G z_3^2 Z_2^2 - z_3 Z_3 - g z_2^2 Z_3^2 - (B z_3 Z_2 + b z_2 Z_3)(z_2 Z_2 - z_3 Z_3) - a(z_2^2 Z_2^2 - 4 z_2 z_3 Z_2 Z_3 + z_3^2 Z_3^2)$$

```
In[•]:= F22 = D[F, z2, Z2]
```

$$\text{Out[•]= } -1 - 2 B z_3 Z_2 - 2 b z_2 Z_3 - a(4 z_2 Z_2 - 4 z_3 Z_3)$$

```
In[•]:= F23 = D[F, z2, Z3]
```

$$\text{Out[•]= } -b z_2 Z_2 + 4 a z_3 Z_2 - 4 g z_2 Z_3 + b z_3 Z_3 - b(z_2 Z_2 - z_3 Z_3)$$

```
In[•]:= F32 = D[F, z3, Z2]
```

$$\text{Out[•]= } -B z_2 Z_2 - 4 G z_3 Z_2 + 4 a z_2 Z_3 + B z_3 Z_3 - B(z_2 Z_2 - z_3 Z_3)$$

In[•]:= $F_{33} = D[F, z_3, Z_3]$

Out[•]= $-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\,(-4\,z_2\,Z_2 + 4\,z_3\,Z_3)$

In[•]:= $d := F_{22} * F_{33} - F_{23} * F_{32}$

In[•]:= d

Out[•]= $-(-b\,z_2\,Z_2 + 4\,a\,z_3\,Z_2 - 4\,g\,z_2\,Z_3 + b\,z_3\,Z_3 - b\,(z_2\,Z_2 - z_3\,Z_3))$
$(-B\,z_2\,Z_2 - 4\,G\,z_3\,Z_2 + 4\,a\,z_2\,Z_3 + B\,z_3\,Z_3 - B\,(z_2\,Z_2 - z_3\,Z_3)) +$
$(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\,(4\,z_2\,Z_2 - 4\,z_3\,Z_3))\,(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\,(-4\,z_2\,Z_2 + 4\,z_3\,Z_3))$

In[•]:= $\text{ExpandAll}[d]$

Out[•]= $1 - 16\,a^2\,z_2^2\,Z_2^2 - 4\,b\,B\,z_2^2\,Z_2^2 - 8\,a\,B\,z_2\,z_3\,Z_2^2 - 8\,b\,G\,z_2\,z_3\,Z_2^2 - 4\,B^2\,z_3^2\,Z_2^2 + 16\,a\,G\,z_3^2\,Z_2^2 -$
$8\,a\,b\,z_2^2\,Z_2\,Z_3 - 8\,B\,g\,z_2^2\,Z_2\,Z_3 + 16\,a^2\,z_2\,z_3\,Z_2\,Z_3 - 16\,g\,G\,z_2\,z_3\,Z_2\,Z_3 + 8\,a\,B\,z_3^2\,Z_2\,Z_3 +$
$8\,b\,G\,z_3^2\,Z_2\,Z_3 - 4\,b^2\,z_2^2\,Z_3^2 + 16\,a\,g\,z_2^2\,Z_3^2 + 8\,a\,b\,z_2\,z_3\,Z_3^2 + 8\,B\,g\,z_2\,z_3\,Z_3^2 - 16\,a^2\,z_3^2\,Z_3^2 - 4\,b\,B\,z_3^2\,Z_3^2$

In[•]:= $F_{22} * F_{33}$

Out[•]= $(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\,(4\,z_2\,Z_2 - 4\,z_3\,Z_3))\,(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\,(-4\,z_2\,Z_2 + 4\,z_3\,Z_3))$

In[•]:= $\text{ExpandAll}[\%]$

Out[•]= $1 - 16\,a^2\,z_2^2\,Z_2^2 - 16\,a\,B\,z_2\,z_3\,Z_2^2 - 4\,B^2\,z_3^2\,Z_2^2 - 16\,a\,b\,z_2^2\,Z_2\,Z_3 + 32\,a^2\,z_2\,z_3\,Z_2\,Z_3 -$
$8\,b\,B\,z_2\,z_3\,Z_2\,Z_3 + 16\,a\,B\,z_3^2\,Z_2\,Z_3 - 4\,b^2\,z_2^2\,Z_3^2 + 16\,a\,b\,z_2\,z_3\,Z_3^2 - 16\,a^2\,z_3^2\,Z_3^2$

In[•]:= F_{22}

Out[•]= $-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\,(4\,z_2\,Z_2 - 4\,z_3\,Z_3)$

In[•]:= F_{22} / d

Out[•]= $(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\,(4\,z_2\,Z_2 - 4\,z_3\,Z_3)) /$
$(-(-b\,z_2\,Z_2 + 4\,a\,z_3\,Z_2 - 4\,g\,z_2\,Z_3 + b\,z_3\,Z_3 - b\,(z_2\,Z_2 - z_3\,Z_3))$
$(-B\,z_2\,Z_2 - 4\,G\,z_3\,Z_2 + 4\,a\,z_2\,Z_3 + B\,z_3\,Z_3 - B\,(z_2\,Z_2 - z_3\,Z_3)) +$
$(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\,(4\,z_2\,Z_2 - 4\,z_3\,Z_3))$
$(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\,(-4\,z_2\,Z_2 + 4\,z_3\,Z_3)))$

In[•]:= $\text{FullSimplify}[\%29]$

Out[•]= $-z_2^2\,(2\,a\,Z_2 + b\,Z_3) + z_3^2\,(-2\,G\,Z_2 + B\,Z_3) + z_2\,(-1 + z_3\,(-2\,B\,Z_2 + 4\,a\,Z_3))$

In[•]:= $F_2 = D[F, z_2]$

Out[•]= $-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,(B\,z_3\,Z_2 + b\,z_2\,Z_3) - b\,Z_3\,(z_2\,Z_2 - z_3\,Z_3) - a\,(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3)$

In[•]:= $M := \{\{p, p_1^*, p_2^*, p_3^*\}, \{p_1, p_{11}, p_{12}, p_{13}\}, \{p_2, p_{21}, p_{22}, p_{23}\}, \{p_3, p_{31}, p_{32}, p_{33}\}\}$

In[•]:= **Det[M]**

Out[•]= $\text{Conjugate}[p_3]\, p_3\, p_{12}\, p_{21} - \text{Conjugate}[p_2]\, p_3\, p_{13}\, p_{21} - \text{Conjugate}[p_3]\, p_3\, p_{11}\, p_{22} + \text{Conjugate}[p_1]\, p_3\, p_{13}\, p_{22} + \text{Conjugate}[p_2]\, p_3\, p_{11}\, p_{23} - \text{Conjugate}[p_1]\, p_3\, p_{12}\, p_{23} - \text{Conjugate}[p_3]\, p_2\, p_{12}\, p_{31} + \text{Conjugate}[p_2]\, p_2\, p_{13}\, p_{31} + \text{Conjugate}[p_3]\, p_1\, p_{22}\, p_{31} - p\, p_{13}\, p_{22}\, p_{31} - \text{Conjugate}[p_2]\, p_1\, p_{23}\, p_{31} + p\, p_{12}\, p_{23}\, p_{31} + \text{Conjugate}[p_3]\, p_2\, p_{11}\, p_{32} - \text{Conjugate}[p_1]\, p_2\, p_{13}\, p_{32} - \text{Conjugate}[p_3]\, p_1\, p_{21}\, p_{32} + p\, p_{13}\, p_{21}\, p_{32} + \text{Conjugate}[p_1]\, p_1\, p_{23}\, p_{32} - p\, p_{11}\, p_{23}\, p_{32} - \text{Conjugate}[p_2]\, p_2\, p_{11}\, p_{33} + \text{Conjugate}[p_1]\, p_2\, p_{12}\, p_{33} + \text{Conjugate}[p_2]\, p_1\, p_{21}\, p_{33} - p\, p_{12}\, p_{21}\, p_{33} - \text{Conjugate}[p_1]\, p_1\, p_{22}\, p_{33} + p\, p_{11}\, p_{22}\, p_{33}$

In[•]:= **FullSimplify[%33]**

Out[•]= $2\, z_3\, \left(2\, a\, Z_2 + b\, Z_3\right) - 2\, z_2\, \left(b\, Z_2 + 2\, g\, Z_3\right)$

In[•]:= **M /. p → 0**

Out[•]= $\{\{0, \text{Conjugate}[0_1], \text{Conjugate}[0_2], \text{Conjugate}[0_3]\}, \{0_1, 0_{11}, 0_{12}, 0_{13}\}, \{0_2, 0_{21}, 0_{22}, 0_{23}\}, \{0_3, 0_{31}, 0_{32}, 0_{33}\}\}$

In[•]:= **ClearAll[M]**

In[•]:= **M**

Out[•]= M

In[•]:= **M := {{p, p₁*, p₂*, p₃*}, {p₁, p₁₁, p₁₂, p₁₃}, {p₂, p₂₁, p₂₂, p₂₃}, {p₃, p₃₁, p₃₂, p₃₃}} /. p → 0**

In[•]:= **M**

Out[•]= $\{\{0, \text{Conjugate}[0_1], \text{Conjugate}[0_2], \text{Conjugate}[0_3]\}, \{0_1, 0_{11}, 0_{12}, 0_{13}\}, \{0_2, 0_{21}, 0_{22}, 0_{23}\}, \{0_3, 0_{31}, 0_{32}, 0_{33}\}\}$

In[•]:= **ClearAll[M]**

In[•]:= **M := {{0, p₁*, p₂*, p₃*}, {p₁, p₁₁, p₁₂, p₁₃}, {p₂, p₂₁, p₂₂, p₂₃}, {p₃, p₃₁, p₃₂, p₃₃}}**

In[•]:= **Det[M]**

Out[•]= $\text{Conjugate}[p_3]\, p_3\, p_{12}\, p_{21} - \text{Conjugate}[p_2]\, p_3\, p_{13}\, p_{21} - \text{Conjugate}[p_3]\, p_3\, p_{11}\, p_{22} + \text{Conjugate}[p_1]\, p_3\, p_{13}\, p_{22} + \text{Conjugate}[p_2]\, p_3\, p_{11}\, p_{23} - \text{Conjugate}[p_1]\, p_3\, p_{12}\, p_{23} - \text{Conjugate}[p_3]\, p_2\, p_{12}\, p_{31} + \text{Conjugate}[p_2]\, p_2\, p_{13}\, p_{31} + \text{Conjugate}[p_3]\, p_1\, p_{22}\, p_{31} - \text{Conjugate}[p_2]\, p_1\, p_{23}\, p_{31} + \text{Conjugate}[p_3]\, p_2\, p_{11}\, p_{32} - \text{Conjugate}[p_1]\, p_2\, p_{13}\, p_{32} - \text{Conjugate}[p_3]\, p_1\, p_{21}\, p_{32} + \text{Conjugate}[p_1]\, p_1\, p_{23}\, p_{32} - \text{Conjugate}[p_2]\, p_2\, p_{11}\, p_{33} + \text{Conjugate}[p_1]\, p_2\, p_{12}\, p_{33} + \text{Conjugate}[p_2]\, p_1\, p_{21}\, p_{33} - \text{Conjugate}[p_1]\, p_1\, p_{22}\, p_{33}$

In[•]:= **FullSimplify[%42]**

Out[•]= $\left(1 + 2\, z_3\, \left(B\, Z_2 - 2\, a\, Z_3\right) + 2\, z_2\, \left(2\, a\, Z_2 + b\, Z_3\right)\right) \Big/ \left(-1 + 4\, z_3^2\, \left(\left(B^2 - 4\, a\, G\right)\, Z_2^2 - 2\, \left(a\, B + b\, G\right)\, Z_2\, Z_3 + \left(4\, a^2 + b\, B\right)\, Z_3^2\right) + 4\, z_2^2\, \left(\left(4\, a^2 + b\, B\right)\, Z_2^2 + 2\, \left(a\, b + B\, g\right)\, Z_2\, Z_3 + \left(b^2 - 4\, a\, g\right)\, Z_3^2\right) + 8\, z_2\, z_3\, \left(\left(a\, B + b\, G\right)\, Z_2^2 - 2\, \left(a^2 - g\, G\right)\, Z_2\, Z_3 - \left(a\, b + B\, g\right)\, Z_3^2\right)\right)$

In[•]:= **F₁ := D[F, z₁]**

In[•]:= $F_{01} := D[F, Z_1]$

In[•]:= F_1

Out[•]= 1

In[•]:= F_{01}

Out[•]= 1

In[•]:= $F_2 := D[F, z_2]$

In[•]:= $F_{20} := D[F, Z_2]$

In[•]:= $F_3 := D[F, z_3]$

In[•]:= $-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right) F$

Out[•]= $-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\left(z_1 + Z_1 - z_2\,Z_2 - G\,z_3^2\,Z_2^2 - z_3\,Z_3 - g\,z_2^2\,Z_3^2 - \left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right)\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(z_2^2\,Z_2^2 - 4\,z_2\,z_3\,Z_2\,Z_3 + z_3^2\,Z_3^2\right)\right)$

In[•]:= $F_{30} = D[F, Z_3]$

Out[•]= $-z_3 - 2\,g\,z_2^2\,Z_3 + z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,z_3\,Z_2 + 2\,z_3^2\,Z_3\right)$

In[•]:= `ClearAll[M]`

In[•]:= `M`

Out[•]= M

In[•]:= $M := \{\{F, F_{01}, F_{02}, F_{03}\}, \{F_1, 0, 0, 0\}, \{F_2, 0, F_{22}, F_{23}\}, \{F_3, 0, F_{32}, F_{33}\}\}$

In[•]:= `MatrixForm[M]`

Out[•]//MatrixForm=

$$\begin{pmatrix} z_1 + Z_1 - z_2\,Z_2 - G\,z_3^2\,Z_2^2 - z_3\,Z_3 - g\,z_2^2\,Z_3^2 - \left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right)\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(z_2^2\,Z_2^2 - 4\,z_2\,z_3\,Z_2\,Z_3 + z \\ 1 \\ -Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right) \\ -2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right) \end{pmatrix}$$

In[•]:= `Grid[%55]`

Out[•]= `Grid[Conjugate[p3] p3 p12 p21 - Conjugate[p2] p3 p13 p21 - Conjugate[p3] p3 p11 p22 + Conjugate[p1] p3 p13 p22 + Conjugate[p2] p3 p11 p23 - Conjugate[p1] p3 p12 p23 - Conjugate[p3] p2 p12 p31 + Conjugate[p2] p2 p13 p31 + Conjugate[p3] p1 p22 p31 - Conjugate[p2] p1 p23 p31 + Conjugate[p3] p2 p11 p32 - Conjugate[p1] p2 p13 p32 - Conjugate[p3] p1 p21 p32 + Conjugate[p1] p1 p23 p32 - Conjugate[p2] p2 p11 p33 + Conjugate[p1] p2 p12 p33 + Conjugate[p2] p1 p21 p33 - Conjugate[p1] p1 p22 p33]`

In[•]:= `Det[M]`

Out[•]= $-1 + 16\,a^2\,z_2^2\,Z_2^2 + 4\,b\,B\,z_2^2\,Z_2^2 + 8\,a\,B\,z_2\,z_3\,Z_2^2 + 8\,b\,G\,z_2\,z_3\,Z_2^2 + 4\,B^2\,z_3^2\,Z_2^2 - 16\,a\,G\,z_3^2\,Z_2^2 + 8\,a\,b\,z_2^2\,Z_2\,Z_3 + 8\,B\,g\,z_2^2\,Z_2\,Z_3 - 16\,a^2\,z_2\,z_3\,Z_2\,Z_3 + 16\,g\,G\,z_2\,z_3\,Z_2\,Z_3 - 8\,a\,B\,z_3^2\,Z_2\,Z_3 - 8\,b\,G\,z_3^2\,Z_2\,Z_3 + 4\,b^2\,z_2^2\,Z_3^2 - 16\,a\,g\,z_2^2\,Z_3^2 - 8\,a\,b\,z_2\,z_3\,Z_3^2 - 8\,B\,g\,z_2\,z_3\,Z_3^2 + 16\,a^2\,z_3^2\,Z_3^2 + 4\,b\,B\,z_3^2\,Z_3^2$

In[•]:=
$$A_{22} := -\left(F_2 * F_{03} * F_{32} + F_{02} * F_3 * F_{23} - F_2 * F_{02} * F_{33} - F_3 * F_{03} * F_{22}\right)$$

In[•]:=
$$A_{22}$$

Out[•]=
$$\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)$$
$$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)^2 -$$
$$\left(-b\,z_2\,Z_2 + 4\,a\,z_3\,Z_2 - 4\,g\,z_2\,Z_3 + b\,z_3\,Z_3 - b\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$$
$$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)$$
$$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right) -$$
$$\left(-B\,z_2\,Z_2 - 4\,G\,z_3\,Z_2 + 4\,a\,z_2\,Z_3 + B\,z_3\,Z_3 - B\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$$
$$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)$$
$$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right) +$$
$$\left(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\left(4\,z_2\,Z_2 - 4\,z_3\,Z_3\right)\right)$$
$$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right)^2$$

In[•]:= **ExpandAll[%]**

Out[•]=
$$
\begin{aligned}
&- Z_2^2 + 12\,a^2\,z_2^2\,Z_2^4 + 2\,b\,B\,z_2^2\,Z_2^4 + B^2\,z_2^2\,Z_2^4 + 8\,a\,B\,z_2\,z_3\,Z_2^4 + 4\,b\,G\,z_2\,z_3\,Z_2^4 + 4\,B\,G\,z_2\,z_3\,Z_2^4 + 3\,B^2\,z_3^2\,Z_2^4 - \\
&8\,a\,G\,z_3^2\,Z_2^4 + 4\,G^2\,z_3^2\,Z_2^4 + 16\,a^3\,z_2^3\,Z_2^5 + 4\,a\,b\,B\,z_2^3\,Z_2^5 + 16\,a^2\,B\,z_2^2\,z_3\,Z_2^5 + 2\,b\,B^2\,z_2^2\,z_3\,Z_2^5 + \\
&8\,a\,b\,G\,z_2^2\,z_3\,Z_2^5 + 8\,a\,B^2\,z_2\,z_3^2\,Z_2^5 - 16\,a^2\,G\,z_2\,z_3^2\,Z_2^5 + 4\,b\,B\,G\,z_2\,z_3^2\,Z_2^5 + 2\,B^3\,z_3^3\,Z_2^5 - 8\,a\,B\,G\,z_3^3\,Z_2^5 + \\
&12\,a\,b\,z_2^2\,Z_2^3\,Z_3 - 8\,a\,B\,z_2^2\,Z_2^3\,Z_3 + 4\,B\,g\,z_2^2\,Z_2^3\,Z_3 - 24\,a^2\,z_2\,z_3\,Z_2^3\,Z_3 + 4\,b\,B\,z_2\,z_3\,Z_2^3\,Z_3 - \\
&4\,B^2\,z_2\,z_3\,Z_2^3\,Z_3 - 16\,a\,G\,z_2\,z_3\,Z_2^3\,Z_3 + 8\,g\,G\,z_2\,z_3\,Z_2^3\,Z_3 - 12\,a\,B\,z_3^2\,Z_2^3\,Z_3 - 4\,b\,G\,z_3^2\,Z_2^3\,Z_3 - \\
&8\,B\,G\,z_3^2\,Z_2^3\,Z_3 + 24\,a^2\,b\,z_2^3\,Z_2^4\,Z_3 + 8\,a^2\,B\,z_2^3\,Z_2^4\,Z_3 + 4\,b^2\,B\,z_2^3\,Z_2^4\,Z_3 + 2\,b\,B^2\,z_2^3\,Z_2^4\,Z_3 + 8\,a\,B\,g\,z_2^3\,Z_2^4\,Z_3 - \\
&48\,a^3\,z_2^2\,z_3\,Z_2^4\,Z_3 + 4\,a\,b\,B\,z_2^2\,z_3\,Z_2^4\,Z_3 + 4\,a\,B^2\,z_2^2\,z_3\,Z_2^4\,Z_3 + 4\,B^2\,g\,z_2^2\,z_3\,Z_2^4\,Z_3 + 16\,a^2\,G\,z_2^2\,z_3\,Z_2^4\,Z_3 + \\
&8\,b^2\,G\,z_2^2\,z_3\,Z_2^4\,Z_3 + 8\,b\,B\,G\,z_2^2\,z_3\,Z_2^4\,Z_3 + 16\,a\,g\,G\,z_2^2\,z_3\,Z_2^4\,Z_3 - 32\,a^2\,B\,z_2\,z_3^2\,Z_2^4\,Z_3 + 4\,b\,B^2\,z_2\,z_3^2\,Z_2^4\,Z_3 + \\
&2\,B^3\,z_2\,z_3^2\,Z_2^4\,Z_3 - 40\,a\,b\,G\,z_2\,z_3^2\,Z_2^4\,Z_3 + 8\,B\,g\,G\,z_2\,z_3^2\,Z_2^4\,Z_3 + 8\,b\,G^2\,z_2\,z_3^2\,Z_2^4\,Z_3 - 12\,a\,B^2\,z_3^3\,Z_2^4\,Z_3 + \\
&32\,a^2\,G\,z_3^3\,Z_2^4\,Z_3 - 4\,b\,B\,G\,z_3^3\,Z_2^4\,Z_3 + 4\,B^2\,G\,z_3^3\,Z_2^4\,Z_3 - 16\,a\,G^2\,z_3^3\,Z_2^4\,Z_3 - Z_3^2 + 24\,a^2\,z_2^2\,Z_2^2\,Z_3^2 + \\
&6\,b^2\,z_2^2\,Z_2^2\,Z_3^2 - 24\,a\,b\,z_2\,z_3\,Z_2^2\,Z_3^2 + 24\,a\,B\,z_2\,z_3\,Z_2^2\,Z_3^2 + 24\,a^2\,z_3^2\,Z_2^2\,Z_3^2 + 6\,B^2\,z_3^2\,Z_2^2\,Z_3^2 - 32\,a^3\,z_2^3\,Z_2^3\,Z_3^2 + \\
&12\,a\,b^2\,z_2^3\,Z_2^3\,Z_3^2 - 4\,a\,b\,B\,z_2^3\,Z_2^3\,Z_3^2 + 12\,b\,B\,g\,z_2^3\,Z_2^3\,Z_3^2 + 4\,B^2\,g\,z_2^3\,Z_2^3\,Z_3^2 - 48\,a^2\,b\,z_2^2\,z_3\,Z_2^3\,Z_3^2 - \\
&40\,a^2\,B\,z_2^2\,z_3\,Z_2^3\,Z_3^2 - 4\,b\,B^2\,z_2^2\,z_3\,Z_2^3\,Z_3^2 - 24\,a\,B\,g\,z_2^2\,z_3\,Z_2^3\,Z_3^2 - 8\,a\,b\,G\,z_2^2\,z_3\,Z_2^3\,Z_3^2 + \\
&24\,b\,g\,G\,z_2^2\,z_3\,Z_2^3\,Z_3^2 + 16\,B\,g\,G\,z_2^2\,z_3\,Z_2^3\,Z_3^2 + 48\,a^3\,z_2\,z_3^2\,Z_2^3\,Z_3^2 - 12\,a\,b\,B\,z_2\,z_3^2\,Z_2^3\,Z_3^2 - \\
&20\,a\,B^2\,z_2\,z_3^2\,Z_2^3\,Z_3^2 + 16\,a^2\,G\,z_2\,z_3^2\,Z_2^3\,Z_3^2 - 12\,b^2\,G\,z_2\,z_3^2\,Z_2^3\,Z_3^2 - 12\,b\,B\,G\,z_2\,z_3^2\,Z_2^3\,Z_3^2 - \\
&48\,a\,g\,G\,z_2\,z_3^2\,Z_2^3\,Z_3^2 + 16\,g\,G^2\,z_2\,z_3^2\,Z_2^3\,Z_3^2 + 24\,a^2\,B\,z_3^3\,Z_2^3\,Z_3^2 - 4\,B^3\,z_3^3\,Z_2^3\,Z_3^2 + 24\,a\,b\,G\,z_3^3\,Z_2^3\,Z_3^2 + \\
&8\,a\,B\,G\,z_3^3\,Z_2^3\,Z_3^2 - 8\,b\,G^2\,z_3^3\,Z_2^3\,Z_3^2 + 12\,a\,b\,z_2^2\,Z_2\,Z_3^3 + 8\,b\,g\,z_2^2\,Z_2\,Z_3^3 + 4\,B\,g\,z_2^2\,Z_2\,Z_3^3 - 24\,a^2\,z_2\,z_3\,Z_2\,Z_3^3 - \\
&4\,b^2\,z_2\,z_3\,Z_2\,Z_3^3 + 4\,b\,B\,z_2\,z_3\,Z_2\,Z_3^3 - 16\,a\,g\,z_2\,z_3\,Z_2\,Z_3^3 + 8\,g\,G\,z_2\,z_3\,Z_2\,Z_3^3 + 8\,a\,b\,z_3^2\,Z_2\,Z_3^3 - \\
&12\,a\,B\,z_3^2\,Z_2\,Z_3^3 - 4\,b\,G\,z_3^2\,Z_2\,Z_3^3 - 24\,a^2\,b\,z_2^3\,Z_2^2\,Z_3^3 + 4\,b^3\,z_2^3\,Z_2^2\,Z_3^3 - 8\,a\,b\,g\,z_2^3\,Z_2^2\,Z_3^3 - 24\,a\,B\,g\,z_2^3\,Z_2^2\,Z_3^3 + \\
&8\,B\,g^2\,z_2^3\,Z_2^2\,Z_3^3 + 48\,a^3\,z_2^2\,z_3\,Z_2^2\,Z_3^3 - 20\,a\,b^2\,z_2^2\,z_3\,Z_2^2\,Z_3^3 - 12\,a\,b\,B\,z_2^2\,z_3\,Z_2^2\,Z_3^3 + 16\,a^2\,g\,z_2^2\,z_3\,Z_2^2\,Z_3^3 - \\
&12\,b\,B\,g\,z_2^2\,z_3\,Z_2^2\,Z_3^3 - 12\,B^2\,g\,z_2^2\,z_3\,Z_2^2\,Z_3^3 - 48\,a\,g\,G\,z_2^2\,z_3\,Z_2^2\,Z_3^3 + 16\,g^2\,G\,z_2^2\,z_3\,Z_2^2\,Z_3^3 + \\
&40\,a^2\,b\,z_2\,z_3^2\,Z_2^2\,Z_3^3 + 48\,a^2\,B\,z_2\,z_3^2\,Z_2^2\,Z_3^3 + 4\,b^2\,B\,z_2\,z_3^2\,Z_2^2\,Z_3^3 + 8\,a\,B\,g\,z_2\,z_3^2\,Z_2^2\,Z_3^3 + 24\,a\,b\,G\,z_2\,z_3^2\,Z_2^2\,Z_3^3 - \\
&16\,b\,g\,G\,z_2\,z_3^2\,Z_2^2\,Z_3^3 - 24\,B\,g\,G\,z_2\,z_3^2\,Z_2^2\,Z_3^3 - 32\,a^3\,z_3^3\,Z_2^2\,Z_3^3 - 4\,a\,b\,B\,z_3^3\,Z_2^2\,Z_3^3 + 12\,a\,B^2\,z_3^3\,Z_2^2\,Z_3^3 + \\
&4\,b^2\,G\,z_3^3\,Z_2^2\,Z_3^3 + 12\,b\,B\,G\,z_3^3\,Z_2^2\,Z_3^3 + 3\,b^2\,z_2^2\,Z_3^4 - 8\,a\,g\,z_2^2\,Z_3^4 + 4\,g^2\,z_2^2\,Z_3^4 - 8\,a\,b\,z_2\,z_3\,Z_3^4 - \\
&4\,b\,g\,z_2\,z_3\,Z_3^4 - 4\,B\,g\,z_2\,z_3\,Z_3^4 + 12\,a^2\,z_3^2\,Z_3^4 + b^2\,z_3^2\,Z_3^4 + 2\,b\,B\,z_3^2\,Z_3^4 - 12\,a\,b^2\,z_2^3\,Z_2\,Z_3^4 + 32\,a^2\,g\,z_2^3\,Z_2\,Z_3^4 + \\
&4\,b^2\,g\,z_2^3\,Z_2\,Z_3^4 - 4\,b\,B\,g\,z_2^3\,Z_2\,Z_3^4 - 16\,a\,g^2\,z_2^3\,Z_2\,Z_3^4 + 32\,a^2\,b\,z_2^2\,z_3\,Z_2\,Z_3^4 - 2\,b^3\,z_2^2\,z_3\,Z_2\,Z_3^4 - \\
&4\,b^2\,B\,z_2^2\,z_3\,Z_2\,Z_3^4 + 40\,a\,B\,g\,z_2^2\,z_3\,Z_2\,Z_3^4 - 8\,B\,g^2\,z_2^2\,z_3\,Z_2\,Z_3^4 - 8\,b\,g\,G\,z_2^2\,z_3\,Z_2\,Z_3^4 - 48\,a^3\,z_2\,z_3^2\,Z_2\,Z_3^4 + \\
&4\,a\,b^2\,z_2\,z_3^2\,Z_2\,Z_3^4 + 4\,a\,b\,B\,z_2\,z_3^2\,Z_2\,Z_3^4 + 16\,a^2\,g\,z_2\,z_3^2\,Z_2\,Z_3^4 + 8\,b\,B\,g\,z_2\,z_3^2\,Z_2\,Z_3^4 + 8\,B^2\,g\,z_2\,z_3^2\,Z_2\,Z_3^4 + \\
&4\,b^2\,G\,z_2\,z_3^2\,Z_2\,Z_3^4 + 16\,a\,g\,G\,z_2\,z_3^2\,Z_2\,Z_3^4 - 8\,a^2\,b\,z_3^3\,Z_2\,Z_3^4 - 24\,a^2\,B\,z_3^3\,Z_2\,Z_3^4 - 2\,b^2\,B\,z_3^3\,Z_2\,Z_3^4 - \\
&4\,b\,B^2\,z_3^3\,Z_2\,Z_3^4 - 8\,a\,b\,G\,z_3^3\,Z_2\,Z_3^4 - 2\,b^3\,z_2^3\,Z_3^5 + 8\,a\,b\,g\,z_2^3\,Z_3^5 + 8\,a\,b^2\,z_2^2\,z_3\,Z_3^5 - 16\,a^2\,g\,z_2^2\,z_3\,Z_3^5 + \\
&4\,b\,B\,g\,z_2^2\,z_3\,Z_3^5 - 16\,a^2\,b\,z_2\,z_3^2\,Z_3^5 - 2\,b^2\,B\,z_2\,z_3^2\,Z_3^5 - 8\,a\,B\,g\,z_2\,z_3^2\,Z_3^5 + 16\,a^3\,z_3^3\,Z_3^5 + 4\,a\,b\,B\,z_3^3\,Z_3^5
\end{aligned}
$$

In[•]:= **D[A_{22}, a]**

Out[•]=
$$
\begin{aligned}
&-\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)-\\
&\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+\\
&2\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+\\
&\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)^2+\\
&2\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\left(-1-2\,B\,z_3\,Z_2-2\,b\,z_2\,Z_3-a\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-\\
&\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-\\
&\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-\\
&4\,z_3\,Z_2\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-\\
&4\,z_2\,Z_3\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)+\\
&\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)^2
\end{aligned}
$$

In[•]:= **% /. a → 0**

Out[•]=
$$
\begin{aligned}
&2\left(-1-2\,B\,z_3\,Z_2-2\,b\,z_2\,Z_3\right)\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)\right)-\\
&\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\left(-b\,z_2\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)\right)-\\
&\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)\right)+\\
&\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)\right)^2+\\
&2\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3\right)\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)-\\
&\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\left(-b\,z_2\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)-\\
&\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)-\\
&4\,z_3\,Z_2\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)-\\
&4\,z_2\,Z_3\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)+\\
&\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)^2
\end{aligned}
$$

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

Out[•]= $-4\,z_3\,Z_2^2\,Z_3-4\,z_2\,Z_2\,Z_3^2+Z_2^2\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)+$
$Z_3^2\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)+2\,Z_2\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)+2\,Z_3\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)$

In[•]:= **ExpandAll[%]**

Out[•]= 0

In[•]:= **D[A_{22}, b]**

Out[•]= $-z_2\,Z_3^2\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)$
$\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)-$
$z_2\,Z_3^2\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)$
$\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+$
$2\left(-z_2\,Z_2\,Z_3-Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)$
$\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+$
$2\,z_2\,Z_3\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)^2+$
$2\,z_2\,Z_3^2\left(-1-2\,B\,z_3\,Z_2-2\,b\,z_2\,Z_3-a\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-$
$\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\left(-z_2\,Z_2\,Z_3-Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-$
$\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\left(-z_2\,Z_2\,Z_3-Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-$
$\left(-2\,z_2\,Z_2+2\,z_3\,Z_3\right)$
$\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-$
$2\,z_2\,Z_3\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)^2$

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

Out[•]= $2\,z_2\,Z_2^2\,Z_3-Z_2\,Z_3\left(-2\,z_2\,Z_2+2\,z_3\,Z_3\right)+2\,Z_2\left(-z_2\,Z_2\,Z_3-Z_3\left(z_2\,Z_2-z_3\,Z_3\right)\right)$

In[•]:= **ExpandAll[%]**

Out[•]= 0

In[•]:= **D[A_{22}, g]**

Out[•]= $-4\,z_2\,Z_3^2\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)$
$\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+$
$2\,z_2\,Z_3^2\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)+$
$2\,z_2\,Z_3^2\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)+$
$4\,z_2\,Z_3\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)$

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

Out[•]= 0

In[•]:= **H_{22} := A_{22} /. {a → 0, b → 0, B → 0, g → 0, G → 0}**

In[•]:= **H_{22}**

Out[•]= $-Z_2^2 - Z_3^2$

In[•]:= **f[1 + I, 1 - I, 1.5 - 3.2 * I, 1.5 + 3.2 * I, 4.33 + 2.1 * I, 4.33 - 2.1 * I]**

Out[•]= $(-33.6489 + 0.\,i) + (464.684 + 0.\,i)\,a + (10.6689 + 0.\,i)\,((-0.225 - 17.006\,i)\,b - (0.225 - 17.006\,i)\,B) + (289.153 - 7.6527\,i)\,g + (289.153 + 7.6527\,i)\,G$

In[•]:= **FullSimplify[%78]**

Out[•]= 0

In[•]:= **% /. {a → 1, b → I, B → -I, g → 1 - I, G → 1 + I}**

Out[•]= 0

In[•]:= **ClearAll[F]**

In[•]:= **F**

Out[•]= F

In[•]:= **F[1 + I, 1 - I, 1.5 - 3.2 * I, 1.5 + 3.2 * I, 4.33 + 2.1 * I, 4.33 - 2.1 * I]**

Out[•]= F[1 + i, 1 - i, 1.5 - 3.2 i, 1.5 + 3.2 i, 4.33 + 2.1 i, 4.33 - 2.1 i]

In[•]:= **F := f[z_1, Z_1, z_2, Z_2, z_3, Z_3]**

In[•]:= **F_2 * F_{02}**

Out[•]= $(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,(B\,z_3\,Z_2 + b\,z_2\,Z_3) - b\,Z_3\,(z_2\,Z_2 - z_3\,Z_3) - a\,(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3))^2$

In[•]:= **F_2**

Out[•]= $-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,(B\,z_3\,Z_2 + b\,z_2\,Z_3) - b\,Z_3\,(z_2\,Z_2 - z_3\,Z_3) - a\,(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3)$

In[•]:= **F_{02}**

Out[•]= $-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,(B\,z_3\,Z_2 + b\,z_2\,Z_3) - b\,Z_3\,(z_2\,Z_2 - z_3\,Z_3) - a\,(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3)$

In[•]:= **F_2**

Out[•]= $-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,(B\,z_3\,Z_2 + b\,z_2\,Z_3) - b\,Z_3\,(z_2\,Z_2 - z_3\,Z_3) - a\,(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3)$

In[•]:= **F_{20}**

Out[•]= $-z_2 - 2\,G\,z_3^2\,Z_2 - z_2\,(B\,z_3\,Z_2 + b\,z_2\,Z_3) - B\,z_3\,(z_2\,Z_2 - z_3\,Z_3) - a\,(2\,z_2^2\,Z_2 - 4\,z_2\,z_3\,Z_3)$

In[•]:= **F_3**

Out[•]= $-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,(B\,z_3\,Z_2 + b\,z_2\,Z_3) - B\,Z_2\,(z_2\,Z_2 - z_3\,Z_3) - a\,(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2)$

In[]:= F_{30}

Out[]= $-z_3 - 2\,g\,z_2^2\,Z_3 + z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,z_3\,Z_2 + 2\,z_3^2\,Z_3\right)$

In[]:= `M := {{F, 1, F20, F30}, {1, 0, 0, 0}, {F2, 0, F22, F23}, {F3, 0, F32, F33}}`

In[]:= `MatrixForm[M]`

Out[]//MatrixForm=

$$\begin{pmatrix} z_1 + Z_1 - z_2\,Z_2 - G\,z_3^2\,Z_2^2 - z_3\,Z_3 - g\,z_2^2\,Z_3^2 - \left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right)\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(z_2^2\,Z_2^2 - 4\,z_2\,z_3\,Z_2\,Z_3 + z \\ 1 \\ -Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right) \\ -2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right) \end{pmatrix}$$

In[]:= `Det[M]`

Out[]= $-1 + 16\,a^2\,z_2^2\,Z_2^2 + 4\,b\,B\,z_2^2\,Z_2^2 + 8\,a\,B\,z_2\,z_3\,Z_2^2 + 8\,b\,G\,z_2\,z_3\,Z_2^2 + 4\,B^2\,z_3^2\,Z_2^2 - 16\,a\,G\,z_3^2\,Z_2^2 +$
$8\,a\,b\,z_2^2\,Z_2\,Z_3 + 8\,B\,g\,z_2^2\,Z_2\,Z_3 - 16\,a^2\,z_2\,z_3\,Z_2\,Z_3 + 16\,g\,G\,z_2\,z_3\,Z_2\,Z_3 - 8\,a\,B\,z_3^2\,Z_2\,Z_3 -$
$8\,b\,G\,z_3^2\,Z_2\,Z_3 + 4\,b^2\,z_2^2\,Z_3^2 - 16\,a\,g\,z_2^2\,Z_3^2 - 8\,a\,b\,z_2\,z_3\,Z_3^2 - 8\,B\,g\,z_2\,z_3\,Z_3^2 + 16\,a^2\,z_3^2\,Z_3^2 + 4\,b\,B\,z_3^2\,Z_3^2$

In[]:= A_{22}

Out[]= $\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\,\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)$
$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)^2 -$
$\left(-b\,z_2\,Z_2 + 4\,a\,z_3\,Z_2 - 4\,g\,z_2\,Z_3 + b\,z_3\,Z_3 - b\,\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$
$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right) -$
$\left(-B\,z_2\,Z_2 - 4\,G\,z_3\,Z_2 + 4\,a\,z_2\,Z_3 + B\,z_3\,Z_3 - B\,\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$
$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right) +$
$\left(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\,\left(4\,z_2\,Z_2 - 4\,z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right)^2$

In[]:= `ClearAll[A22]`

ClearAll: A_{22} is not a symbol or a string.

In[]:= A_{22}

Out[]= $\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\,\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)$
$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)^2 -$
$\left(-b\,z_2\,Z_2 + 4\,a\,z_3\,Z_2 - 4\,g\,z_2\,Z_3 + b\,z_3\,Z_3 - b\,\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$
$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right) -$
$\left(-B\,z_2\,Z_2 - 4\,G\,z_3\,Z_2 + 4\,a\,z_2\,Z_3 + B\,z_3\,Z_3 - B\,\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$
$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right) +$
$\left(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\,\left(4\,z_2\,Z_2 - 4\,z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\,\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\,\left(z_2\,Z_2 - z_3\,Z_3\right) - a\,\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right)^2$

In[]:= **A**

Out[]= A

In[]:= **Clear[A_{22}]**

Clear: A_{22} is not a symbol or a string.

In[]:= **A_{22}**

Out[]=
$$\begin{aligned}
&\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)^2-\\
&\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-\\
&\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)+\\
&\left(-1-2\,B\,z_3\,Z_2-2\,b\,z_2\,Z_3-a\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)^2
\end{aligned}$$

In[]:= **A_{22} := $F_2 * F_{30} * F_{32} + F_{20} * F_3 * F_{23} - F_2 * F_{20} * F_{33} - F_3 * F_{30} * F_{22}$**

In[]:= **A_{22}**

Out[]=
$$\begin{aligned}
&-\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)\\
&\quad\left(-z_2-2\,G\,z_3^2\,Z_2-z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2^2\,Z_2-4\,z_2\,z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+\\
&\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-z_3-2\,g\,z_2^2\,Z_3+z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,z_3\,Z_2+2\,z_3^2\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+\\
&\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-z_2-2\,G\,z_3^2\,Z_2-z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2^2\,Z_2-4\,z_2\,z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-\\
&\left(-1-2\,B\,z_3\,Z_2-2\,b\,z_2\,Z_3-a\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\right)\\
&\quad\left(-z_3-2\,g\,z_2^2\,Z_3+z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,z_3\,Z_2+2\,z_3^2\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)
\end{aligned}$$

In[•]:= **ExpandAll[%]**

Out[•]= $z_2\,Z_2 - 12\,a^2\,z_2^3\,Z_2^3 - 3\,b\,B\,z_2^3\,Z_2^3 - 6\,a\,B\,z_2^2\,z_3\,Z_2^3 - 6\,b\,G\,z_2^2\,z_3\,Z_2^3 - 3\,B^2\,z_2\,z_3^2\,Z_2^3 + 12\,a\,G\,z_2\,z_3^2\,Z_2^3 -$
$16\,a^3\,z_2^4\,Z_2^4 - 4\,a\,b\,B\,z_2^4\,Z_2^4 - 24\,a^2\,B\,z_2^3\,z_3\,Z_2^4 - 4\,b\,B^2\,z_2^3\,z_3\,Z_2^4 - 8\,a\,b\,G\,z_2^3\,z_3\,Z_2^4 - 12\,a\,B^2\,z_2^2\,z_3^2\,Z_2^4 -$
$12\,b\,B\,G\,z_2^2\,z_3^2\,Z_2^4 - 4\,B^3\,z_2\,z_3^3\,Z_2^4 + 8\,a\,B\,G\,z_2\,z_3^3\,Z_2^4 - 8\,b\,G^2\,z_2\,z_3^3\,Z_2^4 - 4\,B^2\,G\,z_3^4\,Z_2^4 + 16\,a\,G^2\,z_3^4\,Z_2^4 +$
$z_3\,Z_3 - 6\,a\,b\,z_2^3\,Z_2^2\,Z_3 - 6\,B\,g\,z_2^3\,Z_2^2\,Z_3 - 3\,b\,B\,z_2^2\,z_3\,Z_2^2\,Z_3 - 12\,g\,G\,z_2^2\,z_3\,Z_2^2\,Z_3 - 3\,B^2\,z_3^3\,Z_2^2\,Z_3 +$
$12\,a\,G\,z_3^3\,Z_2^2\,Z_3 - 24\,a^2\,b\,z_2^4\,Z_2^3\,Z_3 - 4\,b^2\,B\,z_2^4\,Z_2^3\,Z_3 - 8\,a\,B\,g\,z_2^4\,Z_2^3\,Z_3 + 80\,a^3\,z_2^3\,z_3\,Z_2^3\,Z_3 -$
$8\,B^2\,g\,z_2^3\,z_3\,Z_2^3\,Z_3 - 8\,b^2\,G\,z_2^3\,z_3\,Z_2^3\,Z_3 - 16\,a\,g\,G\,z_2^3\,z_3\,Z_2^3\,Z_3 + 72\,a^2\,B\,z_2^2\,z_3^2\,Z_2^3\,Z_3 +$
$48\,a\,b\,G\,z_2^2\,z_3^2\,Z_2^3\,Z_3 - 24\,B\,g\,G\,z_2^2\,z_3^2\,Z_2^3\,Z_3 + 32\,a\,B^2\,z_2\,z_3^3\,Z_2^3\,Z_3 - 48\,a^2\,G\,z_2\,z_3^3\,Z_2^3\,Z_3 +$
$16\,b\,B\,G\,z_2\,z_3^3\,Z_2^3\,Z_3 - 16\,g\,G^2\,z_2\,z_3^3\,Z_2^3\,Z_3 + 4\,B^3\,z_3^4\,Z_2^3\,Z_3 - 8\,a\,B\,G\,z_3^4\,Z_2^3\,Z_3 + 8\,b\,G^2\,z_3^4\,Z_2^3\,Z_3 -$
$3\,b^2\,z_2^3\,Z_2\,Z_3^2 + 12\,a\,g\,z_2^3\,Z_2\,Z_3^2 - 3\,b\,B\,z_2\,z_3^2\,Z_2\,Z_3^2 - 12\,g\,G\,z_2\,z_3^2\,Z_2\,Z_3^2 + 6\,a\,B\,z_3^3\,Z_2\,Z_3^2 +$
$6\,b\,G\,z_3^3\,Z_2\,Z_3^2 - 12\,a\,b^2\,z_2^4\,Z_2^2\,Z_3^2 - 12\,b\,B\,g\,z_2^4\,Z_2^2\,Z_3^2 + 72\,a^2\,b\,z_2^3\,z_3\,Z_2^2\,Z_3^2 + 48\,a\,B\,g\,z_2^3\,z_3\,Z_2^2\,Z_3^2 -$
$24\,b\,g\,G\,z_2^3\,z_3\,Z_2^2\,Z_3^2 - 96\,a^3\,z_2^2\,z_3^2\,Z_2^2\,Z_3^2 + 24\,a\,b\,B\,z_2^2\,z_3^2\,Z_2^2\,Z_3^2 + 12\,B^2\,g\,z_2^2\,z_3^2\,Z_2^2\,Z_3^2 +$
$12\,b^2\,G\,z_2^2\,z_3^2\,Z_2^2\,Z_3^2 + 96\,a\,g\,G\,z_2^2\,z_3^2\,Z_2^2\,Z_3^2 - 72\,a^2\,B\,z_2\,z_3^3\,Z_2^2\,Z_3^2 - 48\,a\,b\,G\,z_2\,z_3^3\,Z_2^2\,Z_3^2 +$
$24\,B\,g\,G\,z_2\,z_3^3\,Z_2^2\,Z_3^2 - 12\,a\,B^2\,z_3^4\,Z_2^2\,Z_3^2 - 12\,b\,B\,G\,z_3^4\,Z_2^2\,Z_3^2 - 3\,b^2\,z_2^2\,z_3\,Z_3^3 + 12\,a\,g\,z_2^2\,z_3\,Z_3^3 +$
$6\,a\,b\,z_2\,z_3^2\,Z_3^3 + 6\,B\,g\,z_2\,z_3^2\,Z_3^3 - 12\,a^2\,z_3^3\,Z_3^3 - 3\,b\,B\,z_3^3\,Z_3^3 - 4\,b^3\,z_2^4\,Z_2\,Z_3^3 + 8\,a\,b\,g\,z_2^4\,Z_2\,Z_3^3 -$
$8\,B\,g^2\,z_2^4\,Z_2\,Z_3^3 + 32\,a\,b^2\,z_2^3\,z_3\,Z_2\,Z_3^3 - 48\,a^2\,g\,z_2^3\,z_3\,Z_2\,Z_3^3 + 16\,b\,B\,g\,z_2^3\,z_3\,Z_2\,Z_3^3 - 16\,g^2\,G\,z_2^3\,z_3\,Z_2\,Z_3^3 -$
$72\,a^2\,b\,z_2^2\,z_3^2\,Z_2\,Z_3^3 - 48\,a\,B\,g\,z_2^2\,z_3^2\,Z_2\,Z_3^3 + 24\,b\,g\,G\,z_2^2\,z_3^2\,Z_2\,Z_3^3 + 80\,a^3\,z_2\,z_3^3\,Z_2\,Z_3^3 - 8\,B^2\,g\,z_2\,z_3^3\,Z_2\,Z_3^3 -$
$8\,b^2\,G\,z_2\,z_3^3\,Z_2\,Z_3^3 - 16\,a\,g\,G\,z_2\,z_3^3\,Z_2\,Z_3^3 + 24\,a^2\,B\,z_3^4\,Z_2\,Z_3^3 + 4\,b\,B^2\,z_3^4\,Z_2\,Z_3^3 + 8\,a\,b\,G\,z_3^4\,Z_2\,Z_3^3 -$
$4\,b^2\,g\,z_2^4\,Z_3^4 + 16\,a\,g^2\,z_2^4\,Z_3^4 + 4\,b^3\,z_2^3\,z_3\,Z_3^4 - 8\,a\,b\,g\,z_2^3\,z_3\,Z_3^4 + 8\,B\,g^2\,z_2^3\,z_3\,Z_3^4 - 12\,a\,b^2\,z_2^2\,z_3^2\,Z_3^4 -$
$12\,b\,B\,g\,z_2^2\,z_3^2\,Z_3^4 + 24\,a^2\,b\,z_2\,z_3^3\,Z_3^4 + 4\,b^2\,B\,z_2\,z_3^3\,Z_3^4 + 8\,a\,B\,g\,z_2\,z_3^3\,Z_3^4 - 16\,a^3\,z_3^4\,Z_3^4 - 4\,a\,b\,B\,z_3^4\,Z_3^4$

In[•]:= **A_{22} /. {a → 0, b → 0, B → 0, g → 0, G → 0}**

Out[•]= $z_2\,Z_2 + z_3\,Z_3$

In[•]:= **D[A_{22}, a]**

Out[•]=
$$\begin{aligned}
&\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-z_2-2\,G\,z_3^2\,Z_2-z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2^2\,Z_2-4\,z_2\,z_3\,Z_3\right)\right)-\\
&\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)\\
&\quad\left(-z_2-2\,G\,z_3^2\,Z_2-z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2^2\,Z_2-4\,z_2\,z_3\,Z_3\right)\right)-\\
&\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)\left(-1-2\,B\,z_3\,Z_2-2\,b\,z_2\,Z_3-a\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\right)\\
&\quad\left(-z_3-2\,g\,z_2^2\,Z_3+z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,z_3\,Z_2+2\,z_3^2\,Z_3\right)\right)+\\
&\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-z_3-2\,g\,z_2^2\,Z_3+z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,z_3\,Z_2+2\,z_3^2\,Z_3\right)\right)+\\
&\left(4\,z_2\,z_3\,Z_2-2\,z_3^2\,Z_3\right)\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)-\\
&\left(-2\,z_2^2\,Z_2+4\,z_2\,z_3\,Z_3\right)\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)-\\
&\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\\
&\quad\left(-z_2-2\,G\,z_3^2\,Z_2-z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2^2\,Z_2-4\,z_2\,z_3\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)+\\
&4\,z_2\,Z_3\left(-z_3-2\,g\,z_2^2\,Z_3+z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,z_3\,Z_2+2\,z_3^2\,Z_3\right)\right)\\
&\quad\left(-Z_2-2\,g\,z_2\,Z_3^2-Z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,Z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2\,Z_2^2-4\,z_3\,Z_2\,Z_3\right)\right)-\\
&\left(4\,z_2\,z_3\,Z_2-2\,z_3^2\,Z_3\right)\left(-1-2\,B\,z_3\,Z_2-2\,b\,z_2\,Z_3-a\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)+\\
&\left(-2\,z_2^2\,Z_2+4\,z_2\,z_3\,Z_3\right)\left(-b\,z_2\,Z_2+4\,a\,z_3\,Z_2-4\,g\,z_2\,Z_3+b\,z_3\,Z_3-b\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)+\\
&4\,z_3\,Z_2\left(-z_2-2\,G\,z_3^2\,Z_2-z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2^2\,Z_2-4\,z_2\,z_3\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)-\\
&\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\\
&\quad\left(-z_3-2\,g\,z_2^2\,Z_3+z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,z_3\,Z_2+2\,z_3^2\,Z_3\right)\right)\\
&\quad\left(-2\,G\,z_3\,Z_2^2-Z_3+Z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,Z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,Z_2\,Z_3+2\,z_3\,Z_3^2\right)\right)
\end{aligned}$$

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

Out[•]=
$$\begin{aligned}
&8\,z_2\,z_3\,Z_2\,Z_3-z_2\,Z_2\left(4\,z_2\,Z_2-4\,z_3\,Z_3\right)-z_3\,Z_3\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)-Z_2\left(-2\,z_2^2\,Z_2+4\,z_2\,z_3\,Z_3\right)-\\
&Z_3\left(4\,z_2\,z_3\,Z_2-2\,z_3^2\,Z_3\right)-z_2\left(-2\,z_2\,Z_2^2+4\,z_3\,Z_2\,Z_3\right)-z_3\left(4\,z_2\,Z_2\,Z_3-2\,z_3\,Z_3^2\right)
\end{aligned}$$

In[•]:= **Simplify[%]**

Out[•]= 0

In[•]:= **H_{22} := $\left(-z_2\,Z_2-z_3\,Z_3\right)/4$**

In[•]:= **A_{23} := F_{30} * F_{32} - F_{20} * F_{33}**

In[•]:= **A_{23}**

Out[•]=
$$\begin{aligned}
&-\left(-1+2\,B\,z_3\,Z_2+2\,b\,z_2\,Z_3-a\left(-4\,z_2\,Z_2+4\,z_3\,Z_3\right)\right)\\
&\quad\left(-z_2-2\,G\,z_3^2\,Z_2-z_2\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-B\,z_3\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(2\,z_2^2\,Z_2-4\,z_2\,z_3\,Z_3\right)\right)+\\
&\left(-B\,z_2\,Z_2-4\,G\,z_3\,Z_2+4\,a\,z_2\,Z_3+B\,z_3\,Z_3-B\left(z_2\,Z_2-z_3\,Z_3\right)\right)\\
&\quad\left(-z_3-2\,g\,z_2^2\,Z_3+z_3\left(B\,z_3\,Z_2+b\,z_2\,Z_3\right)-b\,z_2\left(z_2\,Z_2-z_3\,Z_3\right)-a\left(-4\,z_2\,z_3\,Z_2+2\,z_3^2\,Z_3\right)\right)
\end{aligned}$$

In[•]:= **ExpandAll[%]**

Out[•]= $-z_2 + 2\,a\,z_2^2\,Z_2 + 2\,B\,z_2\,z_3\,Z_2 + 2\,G\,z_3^2\,Z_2 + 8\,a^2\,z_2^2\,z_3\,Z_2^2 + 2\,b\,B\,z_2^3\,Z_2^2 + 4\,a\,B\,z_2^2\,z_3\,Z_2^2 +$
$4\,b\,G\,z_2^2\,z_3\,Z_2^2 + 2\,B^2\,z_2\,z_3^2\,Z_2^2 - 8\,a\,G\,z_2\,z_3^2\,Z_2^2 + b\,z_2^2\,Z_3 - 4\,a\,z_2\,z_3\,Z_3 - B\,z_3^2\,Z_3 + 4\,a\,b\,z_2^3\,Z_2\,Z_3 +$
$4\,B\,g\,z_2^3\,Z_2\,Z_3 - 8\,a^2\,z_2^2\,z_3\,Z_2\,Z_3 + 8\,g\,G\,z_2^2\,z_3\,Z_2\,Z_3 - 4\,a\,B\,z_2\,z_3^2\,Z_2\,Z_3 - 4\,b\,G\,z_2\,z_3^2\,Z_2\,Z_3 +$
$2\,b^2\,z_2^3\,Z_3^2 - 8\,a\,g\,z_2^3\,Z_3^2 - 4\,a\,b\,z_2^2\,z_3\,Z_3^2 - 4\,B\,g\,z_2^2\,z_3\,Z_3^2 + 8\,a^2\,z_2\,z_3^2\,Z_3^2 + 2\,b\,B\,z_2\,z_3^2\,Z_3^2$

In[•]:= $H_{23} := \left(-z_2 + 2\,a\,z_2^2\,Z_2 + 2\,B\,z_2\,z_3\,Z_2 + 2\,G\,z_3^2\,Z_2 + b\,z_2^2\,Z_3 - 4\,a\,z_2\,z_3\,Z_3 - B\,z_3^2\,Z_3\right)/4$

In[•]:= $A_{24} := F_{20} * F_{23} - F_{30} * F_{22}$

In[•]:= A_{24}

Out[•]= $\left(-b\,z_2\,Z_2 + 4\,a\,z_3\,Z_2 - 4\,g\,z_2\,Z_3 + b\,z_3\,Z_3 - b\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$
$\left(-z_2 - 2\,G\,z_3^2\,Z_2 - z_2\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,z_3\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(2\,z_2^2\,Z_2 - 4\,z_2\,z_3\,Z_3\right)\right) -$
$\left(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\left(4\,z_2\,Z_2 - 4\,z_3\,Z_3\right)\right)$
$\left(-z_3 - 2\,g\,z_2^2\,Z_3 + z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,z_3\,Z_2 + 2\,z_3^2\,Z_3\right)\right)$

In[•]:= **ExpandAll[%]**

Out[•]= $-z_3 + b\,z_2^2\,Z_2 - 4\,a\,z_2\,z_3\,Z_2 - B\,z_3^2\,Z_2 + 8\,a^2\,z_2^2\,z_3\,Z_2^2 + 2\,b\,B\,z_2^2\,z_3\,Z_2^2 + 4\,a\,B\,z_2\,z_3^2\,Z_2^2 +$
$4\,b\,G\,z_2\,z_3^2\,Z_2^2 + 2\,B^2\,z_3^3\,Z_2^2 - 8\,a\,G\,z_3^3\,Z_2^2 + 2\,g\,z_2^2\,Z_3 - 2\,b\,z_2\,z_3\,Z_3 + 2\,a\,z_3^2\,Z_3 + 4\,a\,b\,z_2^2\,z_3\,Z_2\,Z_3 +$
$4\,B\,g\,z_2^2\,z_3\,Z_2\,Z_3 - 8\,a^2\,z_2\,z_3^2\,Z_2\,Z_3 + 8\,g\,G\,z_2\,z_3^2\,Z_2\,Z_3 - 4\,a\,B\,z_3^3\,Z_2\,Z_3 - 4\,b\,G\,z_3^3\,Z_2\,Z_3 +$
$2\,b^2\,z_2^2\,z_3\,Z_3^2 - 8\,a\,g\,z_2^2\,z_3\,Z_3^2 - 4\,a\,b\,z_2\,z_3^2\,Z_3^2 - 4\,B\,g\,z_2\,z_3^2\,Z_3^2 + 8\,a^2\,z_3^3\,Z_3^2 + 2\,b\,B\,z_3^3\,Z_3^2$

In[•]:= $H_{24} := \left(-z_3 + b\,z_2^2\,Z_2 - 4\,a\,z_2\,z_3\,Z_2 - B\,z_3^2\,Z_2 + 2\,g\,z_2^2\,Z_3 - 2\,b\,z_2\,z_3\,Z_3 + 2\,a\,z_3^2\,Z_3\right)/4$

In[•]:= F_{33}

Out[•]= $-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)$

In[•]:= $H_{33} := F_{33}/4$

In[•]:= $H_{44} := F_{22}/4$

In[•]:= $A_{32} := F_3 * F_{23} - F_2 * F_{33}$

In[•]:= A_{32}

Out[•]= $-\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)$
$\left(-Z_2 - 2\,g\,z_2\,Z_3^2 - Z_2\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - b\,Z_3\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(2\,z_2\,Z_2^2 - 4\,z_3\,Z_2\,Z_3\right)\right) +$
$\left(-b\,z_2\,Z_2 + 4\,a\,z_3\,Z_2 - 4\,g\,z_2\,Z_3 + b\,z_3\,Z_3 - b\left(z_2\,Z_2 - z_3\,Z_3\right)\right)$
$\left(-2\,G\,z_3\,Z_2^2 - Z_3 + Z_3\left(B\,z_3\,Z_2 + b\,z_2\,Z_3\right) - B\,Z_2\left(z_2\,Z_2 - z_3\,Z_3\right) - a\left(-4\,z_2\,Z_2\,Z_3 + 2\,z_3\,Z_3^2\right)\right)$

In[•]:= **ExpandAll[%]**

Out[•]= $-Z_2 + 2\,a\,z_2\,Z_2^2 + B\,z_3\,Z_2^2 + 8\,a^2\,z_2^2\,Z_2^3 + 2\,b\,B\,z_2^2\,Z_2^3 + 4\,a\,B\,z_2\,z_3\,Z_2^3 + 4\,b\,G\,z_2\,z_3\,Z_2^3 + 2\,B^2\,z_3^2\,Z_2^3 -$
$8\,a\,G\,z_3^2\,Z_2^3 + 2\,b\,z_2\,Z_2\,Z_3 - 4\,a\,z_3\,Z_2\,Z_3 + 4\,a\,b\,z_2^2\,Z_2^2\,Z_3 + 4\,B\,g\,z_2^2\,Z_2^2\,Z_3 - 8\,a^2\,z_2\,z_3\,Z_2^2\,Z_3 +$
$8\,g\,G\,z_2\,z_3\,Z_2^2\,Z_3 - 4\,a\,B\,z_3^2\,Z_2^2\,Z_3 - 4\,b\,G\,z_3^2\,Z_2^2\,Z_3 + 2\,g\,z_2\,Z_3^2 - b\,z_3\,Z_3^2 + 2\,b^2\,z_2^2\,Z_2\,Z_3^2 -$
$8\,a\,g\,z_2^2\,Z_2\,Z_3^2 - 4\,a\,b\,z_2\,z_3\,Z_2\,Z_3^2 - 4\,B\,g\,z_2\,z_3\,Z_2\,Z_3^2 + 8\,a^2\,z_3^2\,Z_2\,Z_3^2 + 2\,b\,B\,z_3^2\,Z_2\,Z_3^2$

In[•]:= $H_{32} := \left(-Z_2 + 2\,a\,z_2\,Z_2^2 + B\,z_3\,Z_2^2 + 2\,b\,z_2\,Z_2\,Z_3 - 4\,a\,z_3\,Z_2\,Z_3 + 2\,g\,z_2\,Z_3^2 - b\,z_3\,Z_3^2\right)/4$

In[]:= H_{23}

Out[]= $\frac{1}{4}\left(-z_2 + 2\,a\,z_2^2\,Z_2 + 2\,B\,z_2\,z_3\,Z_2 + 2\,G\,z_3^2\,Z_2 + b\,z_2^2\,Z_3 - 4\,a\,z_2\,z_3\,Z_3 - B\,z_3^2\,Z_3\right)$

In[]:= H_{32}

Out[]= $\frac{1}{4}\left(-Z_2 + 2\,a\,z_2\,Z_2^2 + B\,z_3\,Z_2^2 + 2\,b\,z_2\,Z_2\,Z_3 - 4\,a\,z_3\,Z_2\,Z_3 + 2\,g\,z_2\,Z_3^2 - b\,z_3\,Z_3^2\right)$

In[]:= $A_{42} := F_2 * F_{32} - F_3 * F_{22}$

In[]:= ExpandAll[A_{42}]

Out[]= $B\,z_2\,Z_2^2 + 2\,G\,z_3\,Z_2^2 - Z_3 - 4\,a\,z_2\,Z_2\,Z_3 - 2\,B\,z_3\,Z_2\,Z_3 + 8\,a^2\,z_2^2\,Z_2^2\,Z_3 + 2\,b\,B\,z_2^2\,Z_2^2\,Z_3 +$
$4\,a\,B\,z_2\,z_3\,Z_2^2\,Z_3 + 4\,b\,G\,z_2\,z_3\,Z_2^2\,Z_3 + 2\,B^2\,z_3^2\,Z_2^2\,Z_3 - 8\,a\,G\,z_3^2\,Z_2^2\,Z_3 - b\,z_2\,Z_3^2 + 2\,a\,z_3\,Z_3^2 +$
$4\,a\,b\,z_2^2\,Z_2\,Z_3^2 + 4\,B\,g\,z_2^2\,Z_2\,Z_3^2 - 8\,a^2\,z_2\,z_3\,Z_2\,Z_3^2 + 8\,g\,G\,z_2\,z_3\,Z_2\,Z_3^2 - 4\,a\,B\,z_3^2\,Z_2\,Z_3^2 -$
$4\,b\,G\,z_3^2\,Z_2\,Z_3^2 + 2\,b^2\,z_2^2\,Z_3^3 - 8\,a\,g\,z_2^2\,Z_3^3 - 4\,a\,b\,z_2\,z_3\,Z_3^3 - 4\,B\,g\,z_2\,z_3\,Z_3^3 + 8\,a^2\,z_3^2\,Z_3^3 + 2\,b\,B\,z_3^2\,Z_3^3$

In[]:= $H_{42} := \left(B\,z_2\,Z_2^2 + 2\,G\,z_3\,Z_2^2 - Z_3 - 4\,a\,z_2\,Z_2\,Z_3 - 2\,B\,z_3\,Z_2\,Z_3 - b\,z_2\,Z_3^2 + 2\,a\,z_3\,Z_3^2\right) / 4$

In[]:= H_{24}

Out[]= $\frac{1}{4}\left(-z_3 + b\,z_2^2\,Z_2 - 4\,a\,z_2\,z_3\,Z_2 - B\,z_3^2\,Z_2 + 2\,g\,z_2^2\,Z_3 - 2\,b\,z_2\,z_3\,Z_3 + 2\,a\,z_3^2\,Z_3\right)$

In[]:= H_{42}

Out[]= $\frac{1}{4}\left(B\,z_2\,Z_2^2 + 2\,G\,z_3\,Z_2^2 - Z_3 - 4\,a\,z_2\,Z_2\,Z_3 - 2\,B\,z_3\,Z_2\,Z_3 - b\,z_2\,Z_3^2 + 2\,a\,z_3\,Z_3^2\right)$

In[]:= $H_{43} := -F_{32} / 4$

In[]:= $H_{34} := -F_{23} / 4$

In[]:= $A := \{\{0, I, 0, 0\}, \{-I, H_{22}, H_{23}, H_{24}\}, \{0, H_{32}, H_{33}, H_{34}\}, \{0, H_{42}, H_{43}, H_{44}\}\}$

In[]:= $p := \{\{p_0, I * p_1, p_2, p_3\}\}$

In[]:= ClearAll[P]

In[]:= P

Out[]= P

In[]:= p

$RecursionLimit: Recursion depth of 1024 exceeded during evaluation of $\{p_0, i\,p_1, p_2, p_3\}$.

Out[]= Hold[{{p_0, i p_1, p_2, p_3}}]

In[]:= $P := \{\{p_0\}, \{-I * p_1\}, \{P_2\}, \{P_3\}\}$

In[]:= P

$RecursionLimit: Recursion depth of 1024 exceeded during evaluation of $\{p_0, i\,p_1, p_2, p_3\}$.

Out[]= Hold[{{p_0}, {$-$i p_1}, {P_2}, {P_3}}]

In[•]:= **p**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of $\{p_0, i\, p_1, p_2, p_3\}$.

Out[•]= Hold[{{p_0, i p_1, p_2, p_3}}]

In[•]:= **p * A * P**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of $\{p_0, i\, p_1, p_2, p_3\}$.

Out[•]= Hold[p A P]

In[•]:= **ExpandAll[%]**

Out[•]= Hold[p A P]

In[•]:= **Dot[p, A, P]**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of $\{p_0, i\, p_1, p_2, p_3\}$.

Out[•]= Hold[p.A.P]

In[•]:= **p := {p_0, p_1, p_2, p_3}**

In[•]:= **p**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[{p_0, p_1, p_2, p_3}]

In[•]:= **p**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[{p_0, p_1, p_2, p_3}]

In[•]:= **ReleaseHold[Hold[{p_0, i p_1, p_2, p_3}]]**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[{p_0, i p_1, p_2, p_3}]

In[•]:= **P := {p_0, -I * p_1, P_2, P_3}**

In[•]:= **Dot[p, A, P]**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[p.A.P]

In[•]:= **p.A.P**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[p.A.P]

In[•]:= **ReleaseHold[Hold[p.A.P]]**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[p.A.P]

In[]:= **MatrixForm[Dot[p, A, P]]**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[]= Hold[p.A.P]

In[]:= **{a, b}.{c, e}**

Out[]= a c + b e

In[]:= **A.P**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[]= Hold[A.P]

In[]:= **A**

Out[]= $\left\{\{0, i, 0, 0\}, \left\{-i, \frac{1}{4}\left(-z_2 Z_2 - z_3 Z_3\right),\right.\right.$
$\frac{1}{4}\left(-z_2 + 2\,a\,z_2^2 Z_2 + 2\,B\,z_2 z_3 Z_2 + 2\,G\,z_3^2 Z_2 + b\,z_2^2 Z_3 - 4\,a\,z_2 z_3 Z_3 - B\,z_3^2 Z_3\right),$
$\left.\frac{1}{4}\left(-z_3 + b\,z_2^2 Z_2 - 4\,a\,z_2 z_3 Z_2 - B\,z_3^2 Z_2 + 2\,g\,z_2^2 Z_3 - 2\,b\,z_2 z_3 Z_3 + 2\,a\,z_3^2 Z_3\right)\right\},$
$\left\{0, \frac{1}{4}\left(-Z_2 + 2\,a\,z_2 Z_2^2 + B\,z_3 Z_2^2 + 2\,b\,z_2 Z_2 Z_3 - 4\,a\,z_3 Z_2 Z_3 + 2\,g\,z_2 Z_3^2 - b\,z_3 Z_3^2\right),\right.$
$\frac{1}{4}\left(-1 + 2\,B\,z_3 Z_2 + 2\,b\,z_2 Z_3 - a\left(-4\,z_2 Z_2 + 4\,z_3 Z_3\right)\right),$
$\left.\frac{1}{4}\left(b\,z_2 Z_2 - 4\,a\,z_3 Z_2 + 4\,g\,z_2 Z_3 - b\,z_3 Z_3 + b\left(z_2 Z_2 - z_3 Z_3\right)\right)\right\},$
$\left\{0, \frac{1}{4}\left(B\,z_2 Z_2^2 + 2\,G\,z_3 Z_2^2 - Z_3 - 4\,a\,z_2 Z_2 Z_3 - 2\,B\,z_3 Z_2 Z_3 - b\,z_2 Z_3^2 + 2\,a\,z_3 Z_3^2\right),\right.$
$\frac{1}{4}\left(B\,z_2 Z_2 + 4\,G\,z_3 Z_2 - 4\,a\,z_2 Z_3 - B\,z_3 Z_3 + B\left(z_2 Z_2 - z_3 Z_3\right)\right),$
$\left.\left.\frac{1}{4}\left(-1 - 2\,B\,z_3 Z_2 - 2\,b\,z_2 Z_3 - a\left(4\,z_2 Z_2 - 4\,z_3 Z_3\right)\right)\right\}\right\}$

In[]:= **P**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[]= Hold[{p_0, -i p_1, P_2, P_3}]

In[]:= **Extract[Hold[{p₀, -i p₁, P₂, P₃}], 2, Hold]**

... Extract: Part 2 of Hold[{p_0, $-i\,p_1$, P_2, P_3}] does not exist.

Out[]= Extract[Hold[{p_0, -i p_1, P_2, P_3}], 2, Hold]

In[]:= **q := {w, e, r, t}**

In[]:= **q**

Out[]= {w, e, r, t}

In[•]:= **A.q**

Out[•]= $\left\{\mathrm{i}\, e,\ -\mathrm{i}\, w+\frac{1}{4} e \left(-z_2 Z_2-z_3 Z_3\right)+\right.$
$\frac{1}{4} t \left(-z_3+b z_2^2 Z_2-4 a z_2 z_3 Z_2-B z_3^2 Z_2+2 g z_2^2 Z_3-2 b z_2 z_3 Z_3+2 a z_3^2 Z_3\right)+$
$\frac{1}{4} r \left(-z_2+2 a z_2^2 Z_2+2 B z_2 z_3 Z_2+2 G z_3^2 Z_2+b z_2^2 Z_3-4 a z_2 z_3 Z_3-B z_3^2 Z_3\right),$
$\frac{1}{4} e \left(-Z_2+2 a z_2 Z_2^2+B z_3 Z_2^2+2 b z_2 Z_2 Z_3-4 a z_3 Z_2 Z_3+2 g z_2 Z_3^2-b z_3 Z_3^2\right)+$
$\frac{1}{4} t \left(b z_2 Z_2-4 a z_3 Z_2+4 g z_2 Z_3-b z_3 Z_3+b \left(z_2 Z_2-z_3 Z_3\right)\right)+$
$\frac{1}{4} r \left(-1+2 B z_3 Z_2+2 b z_2 Z_3-a \left(-4 z_2 Z_2+4 z_3 Z_3\right)\right),$
$\frac{1}{4} e \left(B z_2 Z_2^2+2 G z_3 Z_2^2-Z_3-4 a z_2 Z_2 Z_3-2 B z_3 Z_2 Z_3-b z_2 Z_3^2+2 a z_3 Z_3^2\right)+$
$\frac{1}{4} t \left(-1-2 B z_3 Z_2-2 b z_2 Z_3-a \left(4 z_2 Z_2-4 z_3 Z_3\right)\right)+$
$\left.\frac{1}{4} r \left(B z_2 Z_2+4 G z_3 Z_2-4 a z_2 Z_3-B z_3 Z_3+B \left(z_2 Z_2-z_3 Z_3\right)\right)\right\}$

In[•]:= **q := {w₁, w₂, w₃, w₄}**

In[•]:= **q**

Out[•]= {w₁, w₂, w₃, w₄}

In[•]:= **ClearAll[p]**

In[•]:= **ClearAll[P]**

In[•]:= **p**

Out[•]= p

In[•]:= **P**

Out[•]= P

In[•]:= **o := {p₀, p₁, p₂, p₃}**

In[•]:= **o**

Out[•]= {p₀, p₁, p₂, p₃}

In[•]:= **q**

Out[•]= {w₁, w₂, w₃, w₄}

In[•]:= **p**

Out[•]= p

In[•]:= **ClearAll[p]**

In[•]:= **p**

Out[•]= p

In[•]:= **p := {p_1, p_2, p_3, p_4}**

In[•]:= **p**

... $RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_1.

Out[•]= Hold[{p_1, p_2, p_3, p_4}]

In[•]:= **ClearAll[p]**

In[•]:= **p := {w_1, w_2, w_3, w_4}**

In[•]:= **p**

Out[•]= {w_1, w_2, w_3, w_4}

In[•]:= **p := {e_0, e_2, e_3, e_4}**

In[•]:= **p**

Out[•]= {e_0, e_2, e_3, e_4}

In[•]:= **p**

Out[•]= {e_0, e_2, e_3, e_4}

In[•]:= **p**

Out[•]= {e_0, e_2, e_3, e_4}

In[•]:= **p_0**

Out[•]= {e_0, e_2, e_3, e_4}$_0$

In[•]:= **p_1**

Out[•]= {e_0, e_2, e_3, e_4}$_1$

In[•]:= **o**

Out[•]= {{e_0, e_2, e_3, e_4}$_0$, {e_0, e_2, e_3, e_4}$_1$, {e_0, e_2, e_3, e_4}$_2$, {e_0, e_2, e_3, e_4}$_3$}

In[•]:= **ClearAll[q, p, o]**

In[•]:= **B = {{1, 2}, {3, 4}}**

Out[•]= {{1, 2}, {3, 4}}

In[•]:= **MatrixForm[B]**

Out[•]//MatrixForm=

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

In[•]:= **ClearAll[B]**

In[•]:= **B**

Out[•]= B

In[•]:= **MatrixForm[B]**

Out[•]//MatrixForm=

B

In[•]:= **q := {p₀, I * p₁, p₂, p₃}**

In[•]:= **q**

Out[•]= $\{p_0, i\, p_1, p_2, p_3\}$

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

In[•]:= **Q**

Out[•]= $\{p_0, -i\, p_1, P_2, P_3\}$

In[•]:= **q.A.Q**

Out[•]=
$$p_0\, p_1 - i\, p_1 \left(i\, p_0 + \frac{1}{4} i\, p_1 \left(-z_2 Z_2 - z_3 Z_3\right) + \frac{1}{4} p_3 \left(B\, z_2 Z_2^2 + 2\, G\, z_3 Z_2^2 - Z_3 - 4\, a\, z_2 Z_2 Z_3 - 2\, B\, z_3 Z_2 Z_3 - b\, z_2 Z_3^2 + 2\, a\, z_3 Z_3^2\right) + \frac{1}{4} p_2 \left(-Z_2 + 2\, a\, z_2 Z_2^2 + B\, z_3 Z_2^2 + 2\, b\, z_2 Z_2 Z_3 - 4\, a\, z_3 Z_2 Z_3 + 2\, g\, z_2 Z_3^2 - b\, z_3 Z_3^2\right)\right) + P_3 \left(\frac{1}{4} i\, p_1 \left(-z_3 + b\, z_2^2 Z_2 - 4\, a\, z_2 z_3 Z_2 - B\, z_3^2 Z_2 + 2\, g\, z_2^2 Z_3 - 2\, b\, z_2 z_3 Z_3 + 2\, a\, z_3^2 Z_3\right) + \frac{1}{4} p_3 \left(-1 - 2\, B\, z_3 Z_2 - 2\, b\, z_2 Z_3 - a \left(4\, z_2 Z_2 - 4\, z_3 Z_3\right)\right) + \frac{1}{4} p_2 \left(b\, z_2 Z_2 - 4\, a\, z_3 Z_2 + 4\, g\, z_2 Z_3 - b\, z_3 Z_3 + b \left(z_2 Z_2 - z_3 Z_3\right)\right)\right) + P_2 \left(\frac{1}{4} i\, p_1 \left(-z_2 + 2\, a\, z_2^2 Z_2 + 2\, B\, z_2 z_3 Z_2 + 2\, G\, z_3^2 Z_2 + b\, z_2^2 Z_3 - 4\, a\, z_2 z_3 Z_3 - B\, z_3^2 Z_3\right) + \frac{1}{4} p_3 \left(B\, z_2 Z_2 + 4\, G\, z_3 Z_2 - 4\, a\, z_2 Z_3 - B\, z_3 Z_3 + B \left(z_2 Z_2 - z_3 Z_3\right)\right) + \frac{1}{4} p_2 \left(-1 + 2\, B\, z_3 Z_2 + 2\, b\, z_2 Z_3 - a \left(-4\, z_2 Z_2 + 4\, z_3 Z_3\right)\right)\right)$$

In[•]:= **ExpandAll[%]**

Out[•]= $2\,p_0\,p_1 - \frac{p_2\,P_2}{4} - \frac{p_3\,P_3}{4} - \frac{1}{4}\,i\,p_1\,P_2\,z_2 - \frac{1}{4}\,i\,p_1\,P_3\,z_3 + \frac{1}{4}\,i\,p_1\,p_2\,Z_2 - \frac{1}{4}\,p_1^2\,z_2\,Z_2 + a\,p_2\,P_2\,z_2\,Z_2 +$
$\frac{1}{2}\,B\,p_3\,P_2\,z_2\,Z_2 + \frac{1}{2}\,b\,p_2\,P_3\,z_2\,Z_2 - a\,p_3\,P_3\,z_2\,Z_2 + \frac{1}{2}\,i\,a\,p_1\,P_2\,z_2^2\,Z_2 + \frac{1}{4}\,i\,b\,p_1\,P_3\,z_2^2\,Z_2 +$
$\frac{1}{2}\,B\,p_2\,P_2\,z_3\,Z_2 + G\,p_3\,P_2\,z_3\,Z_2 - a\,p_2\,P_3\,z_3\,Z_2 - \frac{1}{2}\,B\,p_3\,P_3\,z_3\,Z_2 + \frac{1}{2}\,i\,B\,p_1\,P_2\,z_2\,z_3\,Z_2 -$
$i\,a\,p_1\,P_3\,z_2\,z_3\,Z_2 + \frac{1}{2}\,i\,G\,p_1\,P_2\,z_3^2\,Z_2 - \frac{1}{4}\,i\,B\,p_1\,P_3\,z_3^2\,Z_2 - \frac{1}{2}\,i\,a\,p_1\,p_2\,z_2\,Z_2^2 - \frac{1}{4}\,i\,B\,p_1\,p_3\,z_2\,Z_2^2 -$
$\frac{1}{4}\,i\,B\,p_1\,p_2\,z_3\,Z_2^2 - \frac{1}{2}\,i\,G\,p_1\,p_3\,z_3\,Z_2^2 + \frac{1}{4}\,i\,p_1\,p_3\,Z_3 + \frac{1}{2}\,b\,p_2\,P_2\,z_2\,Z_3 - a\,p_3\,P_2\,z_2\,Z_3 +$
$g\,p_2\,P_3\,z_2\,Z_3 - \frac{1}{2}\,b\,p_3\,P_3\,z_2\,Z_3 + \frac{1}{4}\,i\,b\,p_1\,P_2\,z_2^2\,Z_3 + \frac{1}{2}\,i\,g\,p_1\,P_3\,z_2^2\,Z_3 - \frac{1}{4}\,p_1^2\,z_3\,Z_3 - a\,p_2\,P_2\,z_3\,Z_3 -$
$\frac{1}{2}\,B\,p_3\,P_2\,z_3\,Z_3 - \frac{1}{2}\,b\,p_2\,P_3\,z_3\,Z_3 + a\,p_3\,P_3\,z_3\,Z_3 - i\,a\,p_1\,P_2\,z_2\,z_3\,Z_3 - \frac{1}{2}\,i\,b\,p_1\,P_3\,z_2\,z_3\,Z_3 -$
$\frac{1}{4}\,i\,B\,p_1\,P_2\,z_3^2\,Z_3 + \frac{1}{2}\,i\,a\,p_1\,P_3\,z_3^2\,Z_3 - \frac{1}{2}\,i\,b\,p_1\,p_2\,z_2\,Z_2\,Z_3 + i\,a\,p_1\,p_3\,z_2\,Z_2\,Z_3 + i\,a\,p_1\,p_2\,z_3\,Z_2\,Z_3 +$
$\frac{1}{2}\,i\,B\,p_1\,p_3\,z_3\,Z_2\,Z_3 - \frac{1}{2}\,i\,g\,p_1\,p_2\,z_2\,Z_3^2 + \frac{1}{4}\,i\,b\,p_1\,p_3\,z_2\,Z_3^2 + \frac{1}{4}\,i\,b\,p_1\,p_2\,z_3\,Z_3^2 - \frac{1}{2}\,i\,a\,p_1\,p_3\,z_3\,Z_3^2$

In[•]:= **Simplify[%]**

Out[•]= $-\frac{1}{4}\,i\,\big(8\,i\,p_0\,p_1 - i\,p_3\,P_3 + p_1\,P_2\,z_2 + p_1\,P_3\,z_3 - i\,p_1^2\,z_2\,Z_2 + 2\,i\,B\,p_3\,P_2\,z_2\,Z_2 -$
$4\,i\,a\,p_3\,P_3\,z_2\,Z_2 - 2\,a\,p_1\,P_2\,z_2^2\,Z_2 - b\,p_1\,P_3\,z_2^2\,Z_2 + 4\,i\,G\,p_3\,P_2\,z_3\,Z_2 - 2\,i\,B\,p_3\,P_3\,z_3\,Z_2 -$
$2\,B\,p_1\,P_2\,z_2\,z_3\,Z_2 + 4\,a\,p_1\,P_3\,z_2\,z_3\,Z_2 - 2\,G\,p_1\,P_2\,z_3^2\,Z_2 + B\,p_1\,P_3\,z_3^2\,Z_2 + B\,p_1\,p_3\,z_2\,Z_2^2 +$
$2\,G\,p_1\,p_3\,z_3\,Z_2^2 - p_1\,p_3\,Z_3 - 4\,i\,a\,p_3\,P_2\,z_2\,Z_3 - 2\,i\,b\,p_3\,P_3\,z_2\,Z_3 - b\,p_1\,P_2\,z_2^2\,Z_3 -$
$2\,g\,p_1\,P_3\,z_2^2\,Z_3 - i\,p_1^2\,z_3\,Z_3 - 2\,i\,B\,p_3\,P_2\,z_3\,Z_3 + 4\,i\,a\,p_3\,P_3\,z_3\,Z_3 + 4\,a\,p_1\,P_2\,z_2\,z_3\,Z_3 +$
$2\,b\,p_1\,P_3\,z_2\,z_3\,Z_3 + B\,p_1\,P_2\,z_3^2\,Z_3 - 2\,a\,p_1\,P_3\,z_3^2\,Z_3 - 4\,a\,p_1\,p_3\,z_2\,Z_2\,Z_3 - 2\,B\,p_1\,p_3\,z_3\,Z_2\,Z_3 -$
$b\,p_1\,p_3\,z_2\,Z_3^2 + 2\,a\,p_1\,p_3\,z_3\,Z_3^2 + p_2\,\big(i\,P_2\,\big(-1 + 2\,z_3\,\big(B\,Z_2 - 2\,a\,Z_3\big) + 2\,z_2\,\big(2\,a\,Z_2 + b\,Z_3\big)\big) +$
$2\,i\,P_3\,\big(-z_3\,\big(2\,a\,Z_2 + b\,Z_3\big) + z_2\,\big(b\,Z_2 + 2\,g\,Z_3\big)\big) +$
$p_1\,\big(\big(2\,a\,z_2 + B\,z_3\big)\,Z_2^2 + \big(2\,g\,z_2 - b\,z_3\big)\,Z_3^2 + Z_2\,\big(-1 + 2\,b\,z_2\,Z_3 - 4\,a\,z_3\,Z_3\big)\big)\big)\big)$

In[•]:= **ab := 2 + 2**

In[•]:= **ab**

Out[•]= 4

In[•]:= **H**

Out[•]= H

In[•]:= **H := q.A.Q**

In[•]:= **dz$_2$:= 2 * D[H, P$_2$]**

In[•]:= **dz$_2$**

$RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[$2\,\partial_{P_2} H$]

In[•]:= **D**

Out[•]= D

In[•]:= **H**

$RecursionLimit: Recursion depth of 1024 exceeded during evaluation of $\{p_0, i\, p_1, p_2, p_3\}$.

Out[•]= Hold[q.A.Q]

In[•]:= **q.A.Q**

$RecursionLimit: Recursion depth of 1024 exceeded during evaluation of p_0.

Out[•]= Hold[q.A.Q]

In[•]:= **ClearAll[H]**

In[•]:= **H**

Out[•]= H

In[•]:= **q.A.Q**

Out[•]=
$$p_0\, p_1 - i\, p_1 \left(i\, p_0 + \frac{1}{4} i\, p_1 \left(- z_2\, Z_2 - z_3\, Z_3 \right) + \right.$$
$$\frac{1}{4} p_3 \left(B\, z_2\, Z_2^2 + 2\, G\, z_3\, Z_2^2 - Z_3 - 4\, a\, z_2\, Z_2\, Z_3 - 2\, B\, z_3\, Z_2\, Z_3 - b\, z_2\, Z_3^2 + 2\, a\, z_3\, Z_3^2 \right) +$$
$$\left. \frac{1}{4} p_2 \left(- Z_2 + 2\, a\, z_2\, Z_2^2 + B\, z_3\, Z_2^2 + 2\, b\, z_2\, Z_2\, Z_3 - 4\, a\, z_3\, Z_2\, Z_3 + 2\, g\, z_2\, Z_3^2 - b\, z_3\, Z_3^2 \right) \right) +$$
$$P_3 \left(\frac{1}{4} i\, p_1 \left(- z_3 + b\, z_2^2\, Z_2 - 4\, a\, z_2\, z_3\, Z_2 - B\, z_3^2\, Z_2 + 2\, g\, z_2^2\, Z_3 - 2\, b\, z_2\, z_3\, Z_3 + 2\, a\, z_3^2\, Z_3 \right) + \right.$$
$$\frac{1}{4} p_3 \left(- 1 - 2\, B\, z_3\, Z_2 - 2\, b\, z_2\, Z_3 - a \left(4\, z_2\, Z_2 - 4\, z_3\, Z_3 \right) \right) +$$
$$\left. \frac{1}{4} p_2 \left(b\, z_2\, Z_2 - 4\, a\, z_3\, Z_2 + 4\, g\, z_2\, Z_3 - b\, z_3\, Z_3 + b \left(z_2\, Z_2 - z_3\, Z_3 \right) \right) \right) +$$
$$P_2 \left(\frac{1}{4} i\, p_1 \left(- z_2 + 2\, a\, z_2^2\, Z_2 + 2\, B\, z_2\, z_3\, Z_2 + 2\, G\, z_3^2\, Z_2 + b\, z_2^2\, Z_3 - 4\, a\, z_2\, z_3\, Z_3 - B\, z_3^2\, Z_3 \right) + \right.$$
$$\frac{1}{4} p_3 \left(B\, z_2\, Z_2 + 4\, G\, z_3\, Z_2 - 4\, a\, z_2\, Z_3 - B\, z_3\, Z_3 + B \left(z_2\, Z_2 - z_3\, Z_3 \right) \right) +$$
$$\left. \frac{1}{4} p_2 \left(- 1 + 2\, B\, z_3\, Z_2 + 2\, b\, z_2\, Z_3 - a \left(- 4\, z_2\, Z_2 + 4\, z_3\, Z_3 \right) \right) \right)$$

In[•]:= **h := q.A.Q**

In[•]:= **h**

Out[•]=
$$p_0\,p_1 - i\,p_1\left(i\,p_0 + \frac{1}{4}\,i\,p_1\left(-z_2\,Z_2 - z_3\,Z_3\right) + \frac{1}{4}\,p_3\left(B\,z_2\,Z_2^2 + 2\,G\,z_3\,Z_2^2 - Z_3 - 4\,a\,z_2\,Z_2\,Z_3 - 2\,B\,z_3\,Z_2\,Z_3 - b\,z_2\,Z_3^2 + 2\,a\,z_3\,Z_3^2\right) + \frac{1}{4}\,p_2\left(-Z_2 + 2\,a\,z_2\,Z_2^2 + B\,z_3\,Z_2^2 + 2\,b\,z_2\,Z_2\,Z_3 - 4\,a\,z_3\,Z_2\,Z_3 + 2\,g\,z_2\,Z_3^2 - b\,z_3\,Z_3^2\right)\right) + P_3\left(\frac{1}{4}\,i\,p_1\left(-z_3 + b\,z_2^2\,Z_2 - 4\,a\,z_2\,z_3\,Z_2 - B\,z_3^2\,Z_2 + 2\,g\,z_2^2\,Z_3 - 2\,b\,z_2\,z_3\,Z_3 + 2\,a\,z_3^2\,Z_3\right) + \frac{1}{4}\,p_3\left(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\left(4\,z_2\,Z_2 - 4\,z_3\,Z_3\right)\right) + \frac{1}{4}\,p_2\left(b\,z_2\,Z_2 - 4\,a\,z_3\,Z_2 + 4\,g\,z_2\,Z_3 - b\,z_3\,Z_3 + b\left(z_2\,Z_2 - z_3\,Z_3\right)\right)\right) + P_2\left(\frac{1}{4}\,i\,p_1\left(-z_2 + 2\,a\,z_2^2\,Z_2 + 2\,B\,z_2\,z_3\,Z_2 + 2\,G\,z_3^2\,Z_2 + b\,z_2^2\,Z_3 - 4\,a\,z_2\,z_3\,Z_3 - B\,z_3^2\,Z_3\right) + \frac{1}{4}\,p_3\left(B\,z_2\,Z_2 + 4\,G\,z_3\,Z_2 - 4\,a\,z_2\,Z_3 - B\,z_3\,Z_3 + B\left(z_2\,Z_2 - z_3\,Z_3\right)\right) + \frac{1}{4}\,p_2\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)\right)$$

In[•]:= **dz₂ := 2 * D[h, P₂]**

In[•]:= **dz₂**

Out[•]=
$$2\left(\frac{1}{4}\,i\,p_1\left(-z_2 + 2\,a\,z_2^2\,Z_2 + 2\,B\,z_2\,z_3\,Z_2 + 2\,G\,z_3^2\,Z_2 + b\,z_2^2\,Z_3 - 4\,a\,z_2\,z_3\,Z_3 - B\,z_3^2\,Z_3\right) + \frac{1}{4}\,p_3\left(B\,z_2\,Z_2 + 4\,G\,z_3\,Z_2 - 4\,a\,z_2\,Z_3 - B\,z_3\,Z_3 + B\left(z_2\,Z_2 - z_3\,Z_3\right)\right) + \frac{1}{4}\,p_2\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)\right)$$

In[•]:= **ExpandAll[%]**

Out[•]=
$$-\frac{p_2}{2} - \frac{1}{2}\,i\,p_1\,z_2 + 2\,a\,p_2\,z_2\,Z_2 + B\,p_3\,z_2\,Z_2 + i\,a\,p_1\,z_2^2\,Z_2 + B\,p_2\,z_3\,Z_2 + 2\,G\,p_3\,z_3\,Z_2 + i\,B\,p_1\,z_2\,z_3\,Z_2 + i\,G\,p_1\,z_3^2\,Z_2 + b\,p_2\,z_2\,Z_3 - 2\,a\,p_3\,z_2\,Z_3 + \frac{1}{2}\,i\,b\,p_1\,z_2^2\,Z_3 - 2\,a\,p_2\,z_3\,Z_3 - B\,p_3\,z_3\,Z_3 - 2\,i\,a\,p_1\,z_2\,z_3\,Z_3 - \frac{1}{2}\,i\,B\,p_1\,z_3^2\,Z_3$$

In[•]:= **dz₂ . / z₂ → 2**

In[•]:= **dz₂**

Out[•]=
$$2\left(\frac{1}{4}\,i\,p_1\left(-z_2 + 2\,a\,z_2^2\,Z_2 + 2\,B\,z_2\,z_3\,Z_2 + 2\,G\,z_3^2\,Z_2 + b\,z_2^2\,Z_3 - 4\,a\,z_2\,z_3\,Z_3 - B\,z_3^2\,Z_3\right) + \frac{1}{4}\,p_3\left(B\,z_2\,Z_2 + 4\,G\,z_3\,Z_2 - 4\,a\,z_2\,Z_3 - B\,z_3\,Z_3 + B\left(z_2\,Z_2 - z_3\,Z_3\right)\right) + \frac{1}{4}\,p_2\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)\right)$$

In[•]:= $dz_2 /. z_2 \to 2$

Out[•]= $2 \left(\frac{1}{4} i\, p_1 \left(-2 + 8\, a\, Z_2 + 4\, B\, z_3\, Z_2 + 2\, G\, z_3^2\, Z_2 + 4\, b\, Z_3 - 8\, a\, z_3\, Z_3 - B\, z_3^2\, Z_3 \right) + \frac{1}{4} p_3 \left(2\, B\, Z_2 + 4\, G\, z_3\, Z_2 - 8\, a\, Z_3 - B\, z_3\, Z_3 + B \left(2\, Z_2 - z_3\, Z_3 \right) \right) + \frac{1}{4} p_2 \left(-1 + 2\, B\, z_3\, Z_2 + 4\, b\, Z_3 - a \left(-8\, Z_2 + 4\, z_3\, Z_3 \right) \right) \right)$

In[•]:= dz_2

Out[•]= $2 \left(\frac{1}{4} i\, p_1 \left(-z_2 + 2\, a\, z_2^2\, Z_2 + 2\, B\, z_2\, z_3\, Z_2 + 2\, G\, z_3^2\, Z_2 + b\, z_2^2\, Z_3 - 4\, a\, z_2\, z_3\, Z_3 - B\, z_3^2\, Z_3 \right) + \frac{1}{4} p_3 \left(B\, z_2\, Z_2 + 4\, G\, z_3\, Z_2 - 4\, a\, z_2\, Z_3 - B\, z_3\, Z_3 + B \left(z_2\, Z_2 - z_3\, Z_3 \right) \right) + \frac{1}{4} p_2 \left(-1 + 2\, B\, z_3\, Z_2 + 2\, b\, z_2\, Z_3 - a \left(-4\, z_2\, Z_2 + 4\, z_3\, Z_3 \right) \right) \right)$

In[•]:= $dz_3 := 2 * D[h, P_3]$

In[•]:= dz_3

Out[•]= $2 \left(\frac{1}{4} i\, p_1 \left(-z_3 + b\, z_2^2\, Z_2 - 4\, a\, z_2\, z_3\, Z_2 - B\, z_3^2\, Z_2 + 2\, g\, z_2^2\, Z_3 - 2\, b\, z_2\, z_3\, Z_3 + 2\, a\, z_3^2\, Z_3 \right) + \frac{1}{4} p_3 \left(-1 - 2\, B\, z_3\, Z_2 - 2\, b\, z_2\, Z_3 - a \left(4\, z_2\, Z_2 - 4\, z_3\, Z_3 \right) \right) + \frac{1}{4} p_2 \left(b\, z_2\, Z_2 - 4\, a\, z_3\, Z_2 + 4\, g\, z_2\, Z_3 - b\, z_3\, Z_3 + b \left(z_2\, Z_2 - z_3\, Z_3 \right) \right) \right)$

In[•]:= $dp_2 := -2 * D[h, Z_2]$

In[•]:= dp_2

Out[•]= $-2 \left(P_3 \left(\frac{1}{4} p_2 \left(2\, b\, z_2 - 4\, a\, z_3 \right) + \frac{1}{4} p_3 \left(-4\, a\, z_2 - 2\, B\, z_3 \right) + \frac{1}{4} i\, p_1 \left(b\, z_2^2 - 4\, a\, z_2\, z_3 - B\, z_3^2 \right) \right) + P_2 \left(\frac{1}{4} p_2 \left(4\, a\, z_2 + 2\, B\, z_3 \right) + \frac{1}{4} p_3 \left(2\, B\, z_2 + 4\, G\, z_3 \right) + \frac{1}{4} i\, p_1 \left(2\, a\, z_2^2 + 2\, B\, z_2\, z_3 + 2\, G\, z_3^2 \right) \right) - i\, p_1 \left(-\frac{1}{4} i\, p_1\, z_2 + \frac{1}{4} p_2 \left(-1 + 4\, a\, z_2\, Z_2 + 2\, B\, z_3\, Z_2 + 2\, b\, z_2\, Z_3 - 4\, a\, z_3\, Z_3 \right) + \frac{1}{4} p_3 \left(2\, B\, z_2\, Z_2 + 4\, G\, z_3\, Z_2 - 4\, a\, z_2\, Z_3 - 2\, B\, z_3\, Z_3 \right) \right) \right)$

In[•]:= $dp_3 := -2 * D[h, Z_3]$

In[•]:= dp_3

Out[•]= $-2 \left(P_3 \left(\frac{1}{4} p_3 \left(-2\, b\, z_2 + 4\, a\, z_3 \right) + \frac{1}{4} p_2 \left(4\, g\, z_2 - 2\, b\, z_3 \right) + \frac{1}{4} i\, p_1 \left(2\, g\, z_2^2 - 2\, b\, z_2\, z_3 + 2\, a\, z_3^2 \right) \right) + P_2 \left(\frac{1}{4} p_2 \left(2\, b\, z_2 - 4\, a\, z_3 \right) + \frac{1}{4} p_3 \left(-4\, a\, z_2 - 2\, B\, z_3 \right) + \frac{1}{4} i\, p_1 \left(b\, z_2^2 - 4\, a\, z_2\, z_3 - B\, z_3^2 \right) \right) - i\, p_1 \left(-\frac{1}{4} i\, p_1\, z_3 + \frac{1}{4} p_3 \left(-1 - 4\, a\, z_2\, Z_2 - 2\, B\, z_3\, Z_2 - 2\, b\, z_2\, Z_3 + 4\, a\, z_3\, Z_3 \right) + \frac{1}{4} p_2 \left(2\, b\, z_2\, Z_2 - 4\, a\, z_3\, Z_2 + 4\, g\, z_2\, Z_3 - 2\, b\, z_3\, Z_3 \right) \right) \right)$

In[•]:=
```
u2 :=
 dz2 /. {z2 → s * Exp[I * t] + s^3 * v2, z3 → c * s + s^3 * v3, Z2 → s * Exp[-I * t] + s^3 * V2,
   Z3 → c * s + s^3 * V3, p1 → -1, p2 → -I * s * Exp[I * t] + s^3 * w2,
   p3 → s * I * c + s^3 * w3, P2 → I * s * Exp[-I * t] + s^3 * W2, P3 → -s * I * c + s^3 * W3}
```

In[•]:=
```
u2
```

Out[•]=
$$2\left(-\frac{1}{4}\,i\left(-e^{i\,t}\,s-s^3\,v_2+2\,a\left(e^{i\,t}\,s+s^3\,v_2\right)^2\left(e^{-i\,t}\,s+s^3\,V_2\right)+2\,B\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,v_3\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)+2\,G\left(c\,s+s^3\,v_3\right)^2\left(e^{-i\,t}\,s+s^3\,V_2\right)+b\left(e^{i\,t}\,s+s^3\,v_2\right)^2\left(c\,s+s^3\,V_3\right)-4\,a\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,v_3\right)\left(c\,s+s^3\,V_3\right)-B\left(c\,s+s^3\,v_3\right)^2\left(c\,s+s^3\,V_3\right)\right)+\frac{1}{4}\left(-1+2\,B\left(c\,s+s^3\,v_3\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)+2\,b\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,V_3\right)-a\left(-4\left(e^{i\,t}\,s+s^3\,v_2\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)+4\left(c\,s+s^3\,v_3\right)\left(c\,s+s^3\,V_3\right)\right)\right)\left(-i\,e^{i\,t}\,s+s^3\,w_2\right)+\frac{1}{4}\left(B\left(e^{i\,t}\,s+s^3\,v_2\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)+4\,G\left(c\,s+s^3\,v_3\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)-4\,a\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,V_3\right)-B\left(c\,s+s^3\,v_3\right)\left(c\,s+s^3\,V_3\right)+B\left(\left(e^{i\,t}\,s+s^3\,v_2\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)-\left(c\,s+s^3\,v_3\right)\left(c\,s+s^3\,V_3\right)\right)\right)\left(i\,c\,s+s^3\,w_3\right)\Bigg)$$

In[•]:=
```
ExpandAll[%]
```

Out[•]=
$$i\,e^{i\,t}\,s-i\,B\,c\,s^3-\frac{1}{2}\,i\,B\,c^3\,s^3-3\,i\,a\,e^{i\,t}\,s^3+2\,i\,a\,c^2\,e^{i\,t}\,s^3-\frac{3}{2}\,i\,b\,c\,e^{2\,i\,t}\,s^3+i\,c^2\,e^{-i\,t}\,G\,s^3+\frac{1}{2}\,i\,s^3\,v_2-4\,i\,a\,s^5\,v_2-2\,i\,b\,c\,e^{i\,t}\,s^5\,v_2-\frac{1}{2}\,i\,b\,c\,s^7\,v_2^2-i\,a\,e^{-i\,t}\,s^7\,v_2^2-2\,i\,B\,s^5\,v_3+4\,i\,a\,c\,e^{i\,t}\,s^5\,v_3+2\,i\,a\,c\,s^7\,v_2\,v_3-i\,B\,e^{-i\,t}\,s^7\,v_2\,v_3+\frac{1}{2}\,i\,B\,c\,s^7\,v_3^2-i\,e^{-i\,t}\,G\,s^7\,v_3^2-i\,B\,c\,e^{i\,t}\,s^5\,V_2-3\,i\,a\,e^{2\,i\,t}\,s^5\,V_2+i\,c^2\,G\,s^5\,V_2-4\,i\,a\,e^{i\,t}\,s^7\,v_2\,V_2-i\,a\,s^9\,v_2^2\,V_2-2\,i\,B\,e^{i\,t}\,s^7\,v_3\,V_2-i\,B\,s^9\,v_2\,v_3\,V_2-i\,G\,s^9\,v_3^2\,V_2-\frac{1}{2}\,i\,B\,c^2\,s^5\,V_3+2\,i\,a\,c\,e^{i\,t}\,s^5\,V_3-\frac{3}{2}\,i\,b\,e^{2\,i\,t}\,s^5\,V_3-2\,i\,b\,e^{i\,t}\,s^7\,v_2\,V_3-\frac{1}{2}\,i\,b\,s^9\,v_2^2\,V_3+4\,i\,a\,e^{i\,t}\,s^7\,v_3\,V_3+2\,i\,a\,s^9\,v_2\,v_3\,V_3+\frac{1}{2}\,i\,B\,s^9\,v_3^2\,V_3-\frac{s^3\,w_2}{2}+2\,a\,s^5\,w_2-2\,a\,c^2\,s^5\,w_2+B\,c\,e^{-i\,t}\,s^5\,w_2+b\,c\,e^{i\,t}\,s^5\,w_2+b\,c\,s^7\,v_2\,w_2+2\,a\,e^{-i\,t}\,s^7\,v_2\,w_2-2\,a\,c\,s^7\,v_3\,w_2+B\,e^{-i\,t}\,s^7\,v_3\,w_2+B\,c\,s^7\,V_2\,w_2+2\,a\,e^{i\,t}\,s^7\,V_2\,w_2+2\,a\,s^9\,v_2\,V_2\,w_2+B\,s^9\,v_3\,V_2\,w_2-2\,a\,c\,s^7\,V_3\,w_2+b\,e^{i\,t}\,s^7\,V_3\,w_2+b\,s^9\,v_2\,V_3\,w_2-2\,a\,s^9\,v_3\,V_3\,w_2+B\,s^5\,w_3-B\,c^2\,s^5\,w_3-2\,a\,c\,e^{i\,t}\,s^5\,w_3+2\,c\,e^{-i\,t}\,G\,s^5\,w_3-2\,a\,c\,s^7\,v_2\,w_3+B\,e^{-i\,t}\,s^7\,v_2\,w_3-B\,c\,s^7\,v_3\,w_3+2\,e^{-i\,t}\,G\,s^7\,v_3\,w_3+B\,e^{i\,t}\,s^7\,V_2\,w_3+2\,c\,G\,s^7\,V_2\,w_3+B\,s^9\,v_2\,V_2\,w_3+2\,G\,s^9\,v_3\,V_2\,w_3-B\,c\,s^7\,V_3\,w_3-2\,a\,e^{i\,t}\,s^7\,V_3\,w_3-2\,a\,s^9\,v_2\,V_3\,w_3-B\,s^9\,v_3\,V_3\,w_3$$

In[•]:=
```
Collect[%, s]
```

Out[•]=
$$\begin{aligned}
&\mathbb{i}\, e^{\mathbb{i} t} s + s^3 \left(-\mathbb{i}\, B c - \frac{1}{2}\mathbb{i}\, B c^3 - 3\mathbb{i}\, a e^{\mathbb{i} t} + 2\mathbb{i}\, a c^2 e^{\mathbb{i} t} - \frac{3}{2}\mathbb{i}\, b c e^{2\mathbb{i} t} + \mathbb{i}\, c^2 e^{-\mathbb{i} t} G + \frac{\mathbb{i}\, v_2}{2} - \frac{w_2}{2}\right) + \\
&\quad s^5 \left(-4\mathbb{i}\, a v_2 - 2\mathbb{i}\, b c e^{\mathbb{i} t} v_2 - 2\mathbb{i}\, B v_3 + 4\mathbb{i}\, a c e^{\mathbb{i} t} v_3 - \mathbb{i}\, B c e^{\mathbb{i} t} V_2 - \right. \\
&\qquad 3\mathbb{i}\, a e^{2\mathbb{i} t} V_2 + \mathbb{i}\, c^2 G V_2 - \frac{1}{2}\mathbb{i}\, B c^2 V_3 + 2\mathbb{i}\, a c e^{\mathbb{i} t} V_3 - \frac{3}{2}\mathbb{i}\, b e^{2\mathbb{i} t} V_3 + 2 a w_2 - \\
&\qquad \left. 2 a c^2 w_2 + B c e^{-\mathbb{i} t} w_2 + b c e^{\mathbb{i} t} w_2 + B w_3 - B c^2 w_3 - 2 a c e^{\mathbb{i} t} w_3 + 2 c e^{-\mathbb{i} t} G w_3\right) + \\
&\quad s^7 \left(-\frac{1}{2}\mathbb{i}\, b c v_2^2 - \mathbb{i}\, a e^{-\mathbb{i} t} v_2^2 + 2\mathbb{i}\, a c v_2 v_3 - \mathbb{i}\, B e^{-\mathbb{i} t} v_2 v_3 + \frac{1}{2}\mathbb{i}\, B c v_3^2 - \mathbb{i}\, e^{-\mathbb{i} t} G v_3^2 - \right. \\
&\qquad 4\mathbb{i}\, a e^{\mathbb{i} t} v_2 V_2 - 2\mathbb{i}\, B e^{\mathbb{i} t} v_3 V_2 - 2\mathbb{i}\, b e^{\mathbb{i} t} v_2 V_3 + 4\mathbb{i}\, a e^{\mathbb{i} t} v_3 V_3 + b c v_2 w_2 + 2 a e^{-\mathbb{i} t} v_2 w_2 - \\
&\qquad 2 a c v_3 w_2 + B e^{-\mathbb{i} t} v_3 w_2 + B c V_2 w_2 + 2 a e^{\mathbb{i} t} V_2 w_2 - 2 a c V_3 w_2 + b e^{\mathbb{i} t} V_3 w_2 - 2 a c v_2 w_3 + \\
&\qquad \left. B e^{-\mathbb{i} t} v_2 w_3 - B c v_3 w_3 + 2 e^{-\mathbb{i} t} G v_3 w_3 + B e^{\mathbb{i} t} V_2 w_3 + 2 c G V_2 w_3 - B c V_3 w_3 - 2 a e^{\mathbb{i} t} V_3 w_3\right) + \\
&\quad s^9 \left(-\mathbb{i}\, a v_2^2 V_2 - \mathbb{i}\, B v_2 v_3 V_2 - \mathbb{i}\, G v_3^2 V_2 - \frac{1}{2}\mathbb{i}\, b v_2^2 V_3 + 2\mathbb{i}\, a v_2 v_3 V_3 + \frac{1}{2}\mathbb{i}\, B v_3^2 V_3 + 2 a v_2 V_2 w_2 + \right. \\
&\qquad \left. B v_3 V_2 w_2 + b v_2 V_3 w_2 - 2 a v_3 V_3 w_2 + B v_2 V_2 w_3 + 2 G v_3 V_2 w_3 - 2 a v_2 V_3 w_3 - B v_3 V_3 w_3\right)
\end{aligned}$$

In[•]:=
```
ExpandAll[dz2]
```

Out[•]=
$$\begin{aligned}
&-\frac{p_2}{2} - \frac{1}{2}\mathbb{i}\, p_1 z_2 + 2 a p_2 z_2 Z_2 + B p_3 z_2 Z_2 + \mathbb{i}\, a p_1 z_2^2 Z_2 + B p_2 z_3 Z_2 + \\
&2 G p_3 z_3 Z_2 + \mathbb{i}\, B p_1 z_2 z_3 Z_2 + \mathbb{i}\, G p_1 z_3^2 Z_2 + b p_2 z_2 Z_3 - 2 a p_3 z_2 Z_3 + \\
&\frac{1}{2}\mathbb{i}\, b p_1 z_2^2 Z_3 - 2 a p_2 z_3 Z_3 - B p_3 z_3 Z_3 - 2\mathbb{i}\, a p_1 z_2 z_3 Z_3 - \frac{1}{2}\mathbb{i}\, B p_1 z_3^2 Z_3
\end{aligned}$$

In[•]:=
```
u3 :=
 dz3 /. {z2 → s * Exp[I * t] + s^3 * v2, z3 → c * s + s^3 * v3, Z2 → s * Exp[-I * t] + s^3 * V2,
   Z3 → c * s + s^3 * V3, p1 → -1, p2 → -I * s * Exp[I * t] + s^3 * w2,
   p3 → s * I * c + s^3 * w3, P2 → I * s * Exp[-I * t] + s^3 * W2, P3 → -s * I * c + s^3 * W3}
```

In[•]:=
```
u3
```

Out[•]=
$$\begin{aligned}
&2\left(-\frac{1}{4}\mathbb{i}\left(-c s - s^3 v_3 + b \left(e^{\mathbb{i} t} s + s^3 v_2\right)^2 \left(e^{-\mathbb{i} t} s + s^3 V_2\right) - 4 a \left(e^{\mathbb{i} t} s + s^3 v_2\right) \left(c s + s^3 v_3\right)\right.\right. \\
&\qquad \left(e^{-\mathbb{i} t} s + s^3 V_2\right) - B \left(c s + s^3 v_3\right)^2 \left(e^{-\mathbb{i} t} s + s^3 V_2\right) + 2 g \left(e^{\mathbb{i} t} s + s^3 v_2\right)^2 \left(c s + s^3 V_3\right) - \\
&\qquad \left.\left. 2 b \left(e^{\mathbb{i} t} s + s^3 v_2\right) \left(c s + s^3 v_3\right) \left(c s + s^3 V_3\right) + 2 a \left(c s + s^3 v_3\right)^2 \left(c s + s^3 V_3\right)\right) + \right. \\
&\quad \frac{1}{4}\left(b \left(e^{\mathbb{i} t} s + s^3 v_2\right) \left(e^{-\mathbb{i} t} s + s^3 V_2\right) - 4 a \left(c s + s^3 v_3\right) \left(e^{-\mathbb{i} t} s + s^3 V_2\right) + \right. \\
&\qquad 4 g \left(e^{\mathbb{i} t} s + s^3 v_2\right) \left(c s + s^3 V_3\right) - b \left(c s + s^3 v_3\right) \left(c s + s^3 V_3\right) + \\
&\qquad \left. b \left(\left(e^{\mathbb{i} t} s + s^3 v_2\right) \left(e^{-\mathbb{i} t} s + s^3 V_2\right) - \left(c s + s^3 v_3\right) \left(c s + s^3 V_3\right)\right)\right) \left(-\mathbb{i}\, e^{\mathbb{i} t} s + s^3 w_2\right) + \\
&\quad \frac{1}{4}\left(-1 - 2 B \left(c s + s^3 v_3\right) \left(e^{-\mathbb{i} t} s + s^3 V_2\right) - 2 b \left(e^{\mathbb{i} t} s + s^3 v_2\right) \left(c s + s^3 V_3\right) - \right. \\
&\qquad \left. a \left(4 \left(e^{\mathbb{i} t} s + s^3 v_2\right) \left(e^{-\mathbb{i} t} s + s^3 V_2\right) - 4 \left(c s + s^3 v_3\right) \left(c s + s^3 V_3\right)\right)\right) \left(\mathbb{i}\, c s + s^3 w_3\right)\Bigg)
\end{aligned}$$

In[•]:= **ExpandAll[%]**

Out[•]= $2\,i\,a\,c\,s^3 + i\,a\,c^3\,s^3 - \frac{1}{2}\,i\,B\,c^2\,e^{-i\,t}\,s^3 - \frac{3}{2}\,i\,b\,e^{i\,t}\,s^3 + i\,b\,c^2\,e^{i\,t}\,s^3 - 3\,i\,c\,e^{2\,i\,t}\,g\,s^3 - 2\,i\,b\,s^5\,v_2 -$
$4\,i\,c\,e^{i\,t}\,g\,s^5\,v_2 - \frac{1}{2}\,i\,b\,e^{-i\,t}\,s^7\,v_2^2 - i\,c\,g\,s^7\,v_2^2 + \frac{1}{2}\,i\,s^3\,v_3 + 4\,i\,a\,s^5\,v_3 + 2\,i\,b\,c\,e^{i\,t}\,s^5\,v_3 +$
$i\,b\,c\,s^7\,v_2\,v_3 + 2\,i\,a\,e^{-i\,t}\,s^7\,v_2\,v_3 - i\,a\,c\,s^7\,v_3^2 + \frac{1}{2}\,i\,B\,e^{-i\,t}\,s^7\,v_3^2 - \frac{1}{2}\,i\,B\,c^2\,s^5\,V_2 + 2\,i\,a\,c\,e^{i\,t}\,s^5\,V_2 -$
$\frac{3}{2}\,i\,b\,e^{2\,i\,t}\,s^5\,V_2 - 2\,i\,b\,e^{i\,t}\,s^7\,v_2\,V_2 - \frac{1}{2}\,i\,b\,s^9\,v_2^2\,V_2 + 4\,i\,a\,e^{i\,t}\,s^7\,v_3\,V_2 + 2\,i\,a\,s^9\,v_2\,v_3\,V_2 +$
$\frac{1}{2}\,i\,B\,s^9\,v_3^2\,V_2 + i\,a\,c^2\,s^5\,V_3 + i\,b\,c\,e^{i\,t}\,s^5\,V_3 - 3\,i\,e^{2\,i\,t}\,g\,s^5\,V_3 - 4\,i\,e^{i\,t}\,g\,s^7\,v_2\,V_3 - i\,g\,s^9\,v_2^2\,V_3 +$
$2\,i\,b\,e^{i\,t}\,s^7\,v_3\,V_3 + i\,b\,s^9\,v_2\,v_3\,V_3 - i\,a\,s^9\,v_3^2\,V_3 + b\,s^5\,w_2 - b\,c^2\,s^5\,w_2 - 2\,a\,c\,e^{-i\,t}\,s^5\,w_2 +$
$2\,c\,e^{i\,t}\,g\,s^5\,w_2 + b\,e^{-i\,t}\,s^7\,v_2\,w_2 + 2\,c\,g\,s^7\,v_2\,w_2 - b\,c\,s^7\,v_3\,w_2 - 2\,a\,e^{-i\,t}\,s^7\,v_3\,w_2 - 2\,a\,c\,s^7\,V_2\,w_2 +$
$b\,e^{i\,t}\,s^7\,V_2\,w_2 + b\,s^9\,v_2\,V_2\,w_2 - 2\,a\,s^9\,v_3\,V_2\,w_2 - b\,c\,s^7\,V_3\,w_2 + 2\,e^{i\,t}\,g\,s^7\,V_3\,w_2 + 2\,g\,s^9\,v_2\,V_3\,w_2 -$
$b\,s^9\,v_3\,V_3\,w_2 - \frac{s^3\,w_3}{2} - 2\,a\,s^5\,w_3 + 2\,a\,c^2\,s^5\,w_3 - B\,c\,e^{-i\,t}\,s^5\,w_3 - b\,c\,e^{i\,t}\,s^5\,w_3 - b\,c\,s^7\,v_2\,w_3 -$
$2\,a\,e^{-i\,t}\,s^7\,v_2\,w_3 + 2\,a\,c\,s^7\,v_3\,w_3 - B\,e^{-i\,t}\,s^7\,v_3\,w_3 - B\,c\,s^7\,V_2\,w_3 - 2\,a\,e^{i\,t}\,s^7\,V_2\,w_3 -$
$2\,a\,s^9\,v_2\,V_2\,w_3 - B\,s^9\,v_3\,V_2\,w_3 + 2\,a\,c\,s^7\,V_3\,w_3 - b\,e^{i\,t}\,s^7\,V_3\,w_3 - b\,s^9\,v_2\,V_3\,w_3 + 2\,a\,s^9\,v_3\,V_3\,w_3$

In[•]:= **Collect[%, s]**

Out[•]= $s^3\left(2\,i\,a\,c + i\,a\,c^3 - \frac{1}{2}\,i\,B\,c^2\,e^{-i\,t} - \frac{3}{2}\,i\,b\,e^{i\,t} + i\,b\,c^2\,e^{i\,t} - 3\,i\,c\,e^{2\,i\,t}\,g + \frac{i\,v_3}{2} - \frac{w_3}{2}\right) +$
$s^5\left(-2\,i\,b\,v_2 - 4\,i\,c\,e^{i\,t}\,g\,v_2 + 4\,i\,a\,v_3 + 2\,i\,b\,c\,e^{i\,t}\,v_3 - \frac{1}{2}\,i\,B\,c^2\,V_2 +\right.$
$\left.2\,i\,a\,c\,e^{i\,t}\,V_2 - \frac{3}{2}\,i\,b\,e^{2\,i\,t}\,V_2 + i\,a\,c^2\,V_3 + i\,b\,c\,e^{i\,t}\,V_3 - 3\,i\,e^{2\,i\,t}\,g\,V_3 + b\,w_2 -\right.$
$\left.b\,c^2\,w_2 - 2\,a\,c\,e^{-i\,t}\,w_2 + 2\,c\,e^{i\,t}\,g\,w_2 - 2\,a\,w_3 + 2\,a\,c^2\,w_3 - B\,c\,e^{-i\,t}\,w_3 - b\,c\,e^{i\,t}\,w_3\right) +$
$s^7\left(-\frac{1}{2}\,i\,b\,e^{-i\,t}\,v_2^2 - i\,c\,g\,v_2^2 + i\,b\,c\,v_2\,v_3 + 2\,i\,a\,e^{-i\,t}\,v_2\,v_3 - i\,a\,c\,v_3^2 + \frac{1}{2}\,i\,B\,e^{-i\,t}\,v_3^2 -\right.$
$2\,i\,b\,e^{i\,t}\,v_2\,V_2 + 4\,i\,a\,e^{i\,t}\,v_3\,V_2 - 4\,i\,e^{i\,t}\,g\,v_2\,V_3 + 2\,i\,b\,e^{i\,t}\,v_3\,V_3 + b\,e^{-i\,t}\,v_2\,w_2 + 2\,c\,g\,v_2\,w_2 -$
$b\,c\,v_3\,w_2 - 2\,a\,e^{-i\,t}\,v_3\,w_2 - 2\,a\,c\,V_2\,w_2 + b\,e^{i\,t}\,V_2\,w_2 - b\,c\,V_3\,w_2 + 2\,e^{i\,t}\,g\,V_3\,w_2 - b\,c\,v_2\,w_3 -$
$\left.2\,a\,e^{-i\,t}\,v_2\,w_3 + 2\,a\,c\,v_3\,w_3 - B\,e^{-i\,t}\,v_3\,w_3 - B\,c\,V_2\,w_3 - 2\,a\,e^{i\,t}\,V_2\,w_3 + 2\,a\,c\,V_3\,w_3 - b\,e^{i\,t}\,V_3\,w_3\right) +$
$s^9\left(-\frac{1}{2}\,i\,b\,v_2^2\,V_2 + 2\,i\,a\,v_2\,v_3\,V_2 + \frac{1}{2}\,i\,B\,v_3^2\,V_2 - i\,g\,v_2^2\,V_3 + i\,b\,v_2\,v_3\,V_3 - i\,a\,v_3^2\,V_3 + b\,v_2\,V_2\,w_2 -\right.$
$\left.2\,a\,v_3\,V_2\,w_2 + 2\,g\,v_2\,V_3\,w_2 - b\,v_3\,V_3\,w_2 - 2\,a\,v_2\,V_2\,w_3 - B\,v_3\,V_2\,w_3 - b\,v_2\,V_3\,w_3 + 2\,a\,v_3\,V_3\,w_3\right)$

In[•]:=
```
k2 :=
 dp2 /. {z2 → s * Exp[I * t] + s^3 * v2, z3 → c * s + s^3 * v3, Z2 → s * Exp[-I * t] + s^3 * V2,
   Z3 → c * s + s^3 * V3, p1 → -1, p2 → -I * s * Exp[I * t] + s^3 * w2,
   p3 → s * I * c + s^3 * w3, P2 → I * s * Exp[-I * t] + s^3 * W2, P3 → -s * I * c + s^3 * W3}
```

In[•]:= k_2

Out[•]=
$$
\begin{aligned}
&-2\Big(i\Big(\frac{1}{4}i\left(e^{i t}s+s^3v_2\right)+\\
&\quad\frac{1}{4}\left(-1+4a\left(e^{i t}s+s^3v_2\right)\left(e^{-i t}s+s^3V_2\right)+2B\left(cs+s^3v_3\right)\left(e^{-i t}s+s^3V_2\right)+\right.\\
&\qquad\left.2b\left(e^{i t}s+s^3v_2\right)\left(cs+s^3V_3\right)-4a\left(cs+s^3v_3\right)\left(cs+s^3V_3\right)\right)\left(-i\,e^{i t}s+s^3w_2\right)+\\
&\quad\frac{1}{4}\left(2B\left(e^{i t}s+s^3v_2\right)\left(e^{-i t}s+s^3V_2\right)+4G\left(cs+s^3v_3\right)\left(e^{-i t}s+s^3V_2\right)-\right.\\
&\qquad\left.4a\left(e^{i t}s+s^3v_2\right)\left(cs+s^3V_3\right)-2B\left(cs+s^3v_3\right)\left(cs+s^3V_3\right)\right)\left(i\,cs+s^3w_3\right)\Big)+\\
&\Big(-\frac{1}{4}i\left(2a\left(e^{i t}s+s^3v_2\right)^2+2B\left(e^{i t}s+s^3v_2\right)\left(cs+s^3v_3\right)+2G\left(cs+s^3v_3\right)^2\right)+\\
&\quad\frac{1}{4}\left(4a\left(e^{i t}s+s^3v_2\right)+2B\left(cs+s^3v_3\right)\right)\left(-i\,e^{i t}s+s^3w_2\right)+\\
&\quad\frac{1}{4}\left(2B\left(e^{i t}s+s^3v_2\right)+4G\left(cs+s^3v_3\right)\right)\left(i\,cs+s^3w_3\right)\Big)\left(i\,e^{-i t}s+s^3W_2\right)+\\
&\Big(-\frac{1}{4}i\left(b\left(e^{i t}s+s^3v_2\right)^2-4a\left(e^{i t}s+s^3v_2\right)\left(cs+s^3v_3\right)-B\left(cs+s^3v_3\right)^2\right)+\\
&\quad\frac{1}{4}\left(2b\left(e^{i t}s+s^3v_2\right)-4a\left(cs+s^3v_3\right)\right)\left(-i\,e^{i t}s+s^3w_2\right)+\\
&\quad\frac{1}{4}\left(-4a\left(e^{i t}s+s^3v_2\right)-2B\left(cs+s^3v_3\right)\right)\left(i\,cs+s^3w_3\right)\Big)\left(-i\,cs+s^3W_3\right)\Big)
\end{aligned}
$$

In[•]:= **ExpandAll[%]**

Out[•]=
$$
\begin{aligned}
&e^{i t}s-Bcs^3-\frac{1}{2}Bc^3s^3-5ae^{i t}s^3-2ac^2e^{i t}s^3+\frac{1}{2}bce^{2i t}s^3+3c^2e^{-i t}Gs^3+\\
&\frac{s^3v_2}{2}-6as^5v_2-2ac^2s^5v_2+Bce^{-i t}s^5v_2+bce^{i t}s^5v_2+\frac{1}{2}bcs^7v_2^2-ae^{-i t}s^7v_2^2-\\
&3Bs^5v_3-Bc^2s^5v_3-2ace^{i t}s^5v_3+2ce^{-i t}Gs^5v_3-2acs^7v_2v_3-Be^{-i t}s^7v_2v_3-\\
&\frac{1}{2}Bcs^7v_3^2-e^{-i t}Gs^7v_3^2-2ae^{2i t}s^5V_2+2c^2Gs^5V_2+Bcs^7v_2V_2-2ae^{i t}s^7v_2V_2-\\
&Be^{i t}s^7v_3V_2+2cGs^7v_3V_2-Bc^2s^5V_3-be^{2i t}s^5V_3-2acs^7v_2V_3-be^{i t}s^7v_2V_3-\\
&Bcs^7v_3V_3+2ae^{i t}s^7v_3V_3+\frac{1}{2}is^3w_2-4ias^5w_2-2iBce^{-i t}s^5w_2-4iae^{-i t}s^7v_2w_2-\\
&2iBe^{-i t}s^7v_3w_2-iBcs^7V_2w_2-2iae^{i t}s^7V_2w_2-2ias^9v_2V_2w_2-iBs^9v_3V_2w_2+\\
&2iacs^7V_3w_2-ibe^{i t}s^7V_3w_2-ibs^9v_2V_3w_2+2ias^9v_3V_3w_2-2iBs^5w_3-\\
&4ice^{-i t}Gs^5w_3-2iBe^{-i t}s^7v_2w_3-4ie^{-i t}Gs^7v_3w_3-iBe^{i t}s^7V_2w_3-2icGs^7V_2w_3-\\
&iBs^9v_2V_2w_3-2iGs^9v_3V_2w_3+iBcs^7V_3w_3+2iae^{i t}s^7V_3w_3+2ias^9v_2V_3w_3+\\
&iBs^9v_3V_3w_3+iBce^{i t}s^5W_2+3iae^{2i t}s^5W_2-ic^2Gs^5W_2+4iae^{i t}s^7v_2W_2+\\
&ias^9v_2^2W_2+2iBe^{i t}s^7v_3W_2+ibs^9v_2v_3W_2+iGs^9v_3^2W_2-Bcs^7w_2W_2-2ae^{i t}s^7w_2W_2-\\
&2as^9v_2w_2W_2-Bs^9v_3w_2W_2-Be^{i t}s^7w_3W_2-2cGs^7w_3W_2-Bs^9v_2w_3W_2-2Gs^9v_3w_3W_2+\\
&\frac{1}{2}iBc^2s^5W_3-2iace^{i t}s^5W_3+\frac{3}{2}ibe^{2i t}s^5W_3+2ibe^{i t}s^7v_2W_3+\frac{1}{2}ibs^9v_2^2W_3-\\
&4iae^{i t}s^7v_3W_3-2ias^9v_2v_3W_3-\frac{1}{2}iBs^9v_3^2W_3+2acs^7w_2W_3-be^{i t}s^7w_2W_3-\\
&bs^9v_2w_2W_3+2as^9v_3w_2W_3+Bcs^7w_3W_3+2ae^{i t}s^7w_3W_3+2as^9v_2w_3W_3+Bs^9v_3w_3W_3
\end{aligned}
$$

In[•]:= **Collect[%, s]**

Out[•]= $$e^{i t}\, s + s^3 \left(-B\, c - \frac{B\, c^3}{2} - 5\, a\, e^{i t} - 2\, a\, c^2\, e^{i t} + \frac{1}{2}\, b\, c\, e^{2 i t} + 3\, c^2\, e^{-i t}\, G + \frac{v_2}{2} + \frac{i\, w_2}{2}\right) +$$
$$s^5 \left(-6\, a\, v_2 - 2\, a\, c^2\, v_2 + B\, c\, e^{-i t}\, v_2 + b\, c\, e^{i t}\, v_2 - 3\, B\, v_3 - B\, c^2\, v_3 - 2\, a\, c\, e^{i t}\, v_3 + 2\, c\, e^{-i t}\, G\, v_3 - \right.$$
$$2\, a\, e^{2 i t}\, V_2 + 2\, c^2\, G\, V_2 - B\, c^2\, V_3 - b\, e^{2 i t}\, V_3 - 4\, i\, a\, w_2 - 2\, i\, B\, c\, e^{-i t}\, w_2 - 2\, i\, B\, w_3 - 4\, i\, c\, e^{-i t}\, G\, w_3 +$$
$$\left. i\, B\, c\, e^{i t}\, W_2 + 3\, i\, a\, e^{2 i t}\, W_2 - i\, c^2\, G\, W_2 + \frac{1}{2}\, i\, B\, c^2\, W_3 - 2\, i\, a\, c\, e^{i t}\, W_3 + \frac{3}{2}\, i\, b\, e^{2 i t}\, W_3\right) +$$
$$s^7 \left(\frac{1}{2}\, b\, c\, v_2^2 - a\, e^{-i t}\, v_2^2 - 2\, a\, c\, v_2\, v_3 - B\, e^{-i t}\, v_2\, v_3 - \frac{1}{2}\, B\, c\, v_3^2 - e^{-i t}\, G\, v_3^2 + B\, c\, v_2\, V_2 - \right.$$
$$2\, a\, e^{i t}\, v_2\, V_2 - B\, e^{i t}\, v_3\, V_2 + 2\, c\, G\, v_3\, V_2 - 2\, a\, c\, v_2\, V_3 - b\, e^{i t}\, v_2\, V_3 - B\, c\, v_3\, V_3 + 2\, a\, e^{i t}\, v_3\, V_3 -$$
$$4\, i\, a\, e^{-i t}\, v_2\, w_2 - 2\, i\, B\, e^{-i t}\, v_3\, w_2 - i\, B\, c\, V_2\, w_2 - 2\, i\, a\, e^{i t}\, V_2\, w_2 + 2\, i\, a\, c\, V_3\, w_2 - i\, b\, e^{i t}\, V_3\, w_2 -$$
$$2\, i\, B\, e^{-i t}\, v_2\, w_3 - 4\, i\, e^{-i t}\, G\, v_3\, w_3 - i\, B\, e^{i t}\, V_2\, w_3 - 2\, i\, c\, G\, V_2\, w_3 + i\, B\, c\, V_3\, w_3 + 2\, i\, a\, e^{i t}\, V_3\, w_3 +$$
$$4\, i\, a\, e^{i t}\, v_2\, W_2 + 2\, i\, B\, e^{i t}\, v_3\, W_2 - B\, c\, w_2\, W_2 - 2\, a\, e^{i t}\, w_2\, W_2 - B\, e^{i t}\, w_3\, W_2 - 2\, c\, G\, w_3\, W_2 +$$
$$\left. 2\, i\, b\, e^{i t}\, v_2\, W_3 - 4\, i\, a\, e^{i t}\, v_3\, W_3 + 2\, a\, c\, w_2\, W_3 - b\, e^{i t}\, w_2\, W_3 + B\, c\, w_3\, W_3 + 2\, a\, e^{i t}\, w_3\, W_3\right) +$$
$$s^9 \left(-2\, i\, a\, v_2\, V_2\, w_2 - i\, B\, v_3\, V_2\, w_2 - i\, b\, v_2\, V_3\, w_2 + 2\, i\, a\, v_3\, V_3\, w_2 - i\, B\, v_2\, V_2\, w_3 - \right.$$
$$2\, i\, G\, v_3\, V_2\, w_3 + 2\, i\, a\, v_2\, V_3\, w_3 + i\, B\, v_3\, V_3\, w_3 + i\, a\, v_2^2\, W_2 + i\, B\, v_2\, v_3\, W_2 +$$
$$i\, G\, v_3^2\, W_2 - 2\, a\, v_2\, w_2\, W_2 - B\, v_3\, w_2\, W_2 - B\, v_2\, w_3\, W_2 - 2\, G\, v_3\, w_3\, W_2 + \frac{1}{2}\, i\, b\, v_2^2\, W_3 -$$
$$\left. 2\, i\, a\, v_2\, v_3\, W_3 - \frac{1}{2}\, i\, B\, v_3^2\, W_3 - b\, v_2\, w_2\, W_3 + 2\, a\, v_3\, w_2\, W_3 + 2\, a\, v_2\, w_3\, W_3 + B\, v_3\, w_3\, W_3\right)$$

In[•]:= **ExpandAll[dp_2]**

Out[•]= $$-\frac{1}{2}\, i\, p_1\, p_2 + \frac{1}{2}\, p_1^2\, z_2 - 2\, a\, p_2\, P_2\, z_2 - B\, p_3\, P_2\, z_2 - b\, p_2\, P_3\, z_2 + 2\, a\, p_3\, P_3\, z_2 - i\, a\, p_1\, P_2\, z_2^2 - \frac{1}{2}\, i\, b\, p_1\, P_3\, z_2^2 -$$
$$B\, p_2\, P_2\, z_3 - 2\, G\, p_3\, P_2\, z_3 + 2\, a\, p_2\, P_3\, z_3 + B\, p_3\, P_3\, z_3 - i\, B\, p_1\, P_2\, z_2\, z_3 + 2\, i\, a\, p_1\, P_3\, z_2\, z_3 -$$
$$i\, G\, p_1\, P_2\, z_3^2 + \frac{1}{2}\, i\, B\, p_1\, P_3\, z_3^2 + 2\, i\, a\, p_1\, p_2\, z_2\, Z_2 + i\, B\, p_1\, p_3\, z_2\, Z_2 + i\, B\, p_1\, p_2\, z_3\, Z_2 +$$
$$2\, i\, G\, p_1\, p_3\, z_3\, Z_2 + i\, b\, p_1\, p_2\, z_2\, Z_3 - 2\, i\, a\, p_1\, p_3\, z_2\, Z_3 - 2\, i\, a\, p_1\, p_2\, z_3\, Z_3 - i\, B\, p_1\, p_3\, z_3\, Z_3$$

In[•]:=

In[•]:= **F**

Out[•]= $$z_1 + Z_1 - z_2\, Z_2 - G\, z_3^2\, Z_2^2 - z_3\, Z_3 - g\, z_2^2\, Z_3^2 -$$
$$\left(B\, z_3\, Z_2 + b\, z_2\, Z_3\right)\, \left(z_2\, Z_2 - z_3\, Z_3\right) - a\, \left(z_2^2\, Z_2^2 - 4\, z_2\, z_3\, Z_2\, Z_3 + z_3^2\, Z_3^2\right)$$

In[•]:= **H_{22}**

Out[•]= $$\frac{1}{4}\, \left(-z_2\, Z_2 - z_3\, Z_3\right)$$

In[•]:= **h**

Out[•]= $$p_0\,p_1 - i\,p_1\left(i\,p_0 + \frac{1}{4}\,i\,p_1\left(-z_2\,Z_2 - z_3\,Z_3\right) + \frac{1}{4}\,p_3\left(B\,z_2\,Z_2^2 + 2\,G\,z_3\,Z_2^2 - Z_3 - 4\,a\,z_2\,Z_2\,Z_3 - 2\,B\,z_3\,Z_2\,Z_3 - b\,z_2\,Z_3^2 + 2\,a\,z_3\,Z_3^2\right) + \frac{1}{4}\,p_2\left(-Z_2 + 2\,a\,z_2\,Z_2^2 + B\,z_3\,Z_2^2 + 2\,b\,z_2\,Z_2\,Z_3 - 4\,a\,z_3\,Z_2\,Z_3 + 2\,g\,z_2\,Z_3^2 - b\,z_3\,Z_3^2\right)\right) + P_3\left(\frac{1}{4}\,i\,p_1\left(-z_3 + b\,z_2^2\,Z_2 - 4\,a\,z_2\,z_3\,Z_2 - B\,z_3^2\,Z_2 + 2\,g\,z_2^2\,Z_3 - 2\,b\,z_2\,z_3\,Z_3 + 2\,a\,z_3^2\,Z_3\right) + \frac{1}{4}\,p_3\left(-1 - 2\,B\,z_3\,Z_2 - 2\,b\,z_2\,Z_3 - a\left(4\,z_2\,Z_2 - 4\,z_3\,Z_3\right)\right) + \frac{1}{4}\,p_2\left(b\,z_2\,Z_2 - 4\,a\,z_3\,Z_2 + 4\,g\,z_2\,Z_3 - b\,z_3\,Z_3 + b\left(z_2\,Z_2 - z_3\,Z_3\right)\right)\right) + P_2\left(\frac{1}{4}\,i\,p_1\left(-z_2 + 2\,a\,z_2^2\,Z_2 + 2\,B\,z_2\,z_3\,Z_2 + 2\,G\,z_3^2\,Z_2 + b\,z_2^2\,Z_3 - 4\,a\,z_2\,z_3\,Z_3 - B\,z_3^2\,Z_3\right) + \frac{1}{4}\,p_3\left(B\,z_2\,Z_2 + 4\,G\,z_3\,Z_2 - 4\,a\,z_2\,Z_3 - B\,z_3\,Z_3 + B\left(z_2\,Z_2 - z_3\,Z_3\right)\right) + \frac{1}{4}\,p_2\left(-1 + 2\,B\,z_3\,Z_2 + 2\,b\,z_2\,Z_3 - a\left(-4\,z_2\,Z_2 + 4\,z_3\,Z_3\right)\right)\right)$$

In[•]:= **ExpandAll[%]**

Out[•]= $$2\,p_0\,p_1 - \frac{p_2\,P_2}{4} - \frac{p_3\,P_3}{4} - \frac{1}{4}\,i\,p_1\,P_2\,z_2 - \frac{1}{4}\,i\,p_1\,P_3\,z_3 + \frac{1}{4}\,i\,p_1\,p_2\,Z_2 - \frac{1}{4}\,p_1^2\,z_2\,Z_2 + a\,p_2\,P_2\,z_2\,Z_2 + \frac{1}{2}\,B\,p_3\,P_2\,z_2\,Z_2 + \frac{1}{2}\,b\,p_2\,P_3\,z_2\,Z_2 - a\,p_3\,P_3\,z_2\,Z_2 + \frac{1}{2}\,i\,a\,p_1\,P_2\,z_2^2\,Z_2 + \frac{1}{4}\,i\,b\,p_1\,P_3\,z_2^2\,Z_2 + \frac{1}{2}\,B\,p_2\,P_2\,z_3\,Z_2 + G\,p_3\,P_2\,z_3\,Z_2 - a\,p_2\,P_3\,z_3\,Z_2 - \frac{1}{2}\,B\,p_3\,P_3\,z_3\,Z_2 + \frac{1}{2}\,i\,B\,p_1\,P_2\,z_2\,z_3\,Z_2 - i\,a\,p_1\,P_3\,z_2\,z_3\,Z_2 + \frac{1}{2}\,i\,G\,p_1\,P_2\,z_3^2\,Z_2 - \frac{1}{4}\,i\,B\,p_1\,P_3\,z_3^2\,Z_2 - \frac{1}{2}\,i\,a\,p_1\,p_2\,z_2\,Z_2^2 - \frac{1}{4}\,i\,B\,p_1\,p_3\,z_2\,Z_2^2 - \frac{1}{4}\,i\,B\,p_1\,p_2\,z_3\,Z_2^2 - \frac{1}{2}\,i\,G\,p_1\,p_3\,z_3\,Z_2^2 + \frac{1}{4}\,i\,p_1\,p_3\,Z_3 + \frac{1}{2}\,b\,p_2\,P_2\,z_2\,Z_3 - a\,p_3\,P_2\,z_2\,Z_3 + g\,p_2\,P_3\,z_2\,Z_3 - \frac{1}{2}\,b\,p_3\,P_3\,z_2\,Z_3 + \frac{1}{4}\,i\,b\,p_1\,P_2\,z_2^2\,Z_3 + \frac{1}{2}\,i\,g\,p_1\,P_3\,z_2^2\,Z_3 - \frac{1}{4}\,p_1^2\,z_3\,Z_3 - a\,p_2\,P_2\,z_3\,Z_3 - \frac{1}{2}\,B\,p_3\,P_2\,z_3\,Z_3 - \frac{1}{2}\,b\,p_2\,P_3\,z_3\,Z_3 + a\,p_3\,P_3\,z_3\,Z_3 - i\,a\,p_1\,P_2\,z_2\,z_3\,Z_3 - \frac{1}{2}\,i\,b\,p_1\,P_3\,z_2\,z_3\,Z_3 - \frac{1}{4}\,i\,B\,p_1\,P_2\,z_3^2\,Z_3 + \frac{1}{2}\,i\,a\,p_1\,P_3\,z_3^2\,Z_3 - \frac{1}{2}\,i\,b\,p_1\,p_2\,z_2\,Z_2\,Z_3 + i\,a\,p_1\,p_3\,z_2\,Z_2\,Z_3 + i\,a\,p_1\,p_2\,z_3\,Z_2\,Z_3 + \frac{1}{2}\,i\,B\,p_1\,p_3\,z_3\,Z_2\,Z_3 - \frac{1}{2}\,i\,g\,p_1\,p_2\,z_2\,Z_3^2 + \frac{1}{4}\,i\,b\,p_1\,p_3\,z_2\,Z_3^2 + \frac{1}{4}\,i\,b\,p_1\,p_2\,z_3\,Z_3^2 - \frac{1}{2}\,i\,a\,p_1\,p_3\,z_3\,Z_3^2$$

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

Out[•]= $$2\,p_0\,p_1 - \frac{p_2\,P_2}{4} - \frac{p_3\,P_3}{4} - \frac{1}{4}\,i\,p_1\,P_2\,z_2 - \frac{1}{4}\,i\,p_1\,P_3\,z_3 + \frac{1}{4}\,i\,p_1\,p_2\,Z_2 - \frac{1}{4}\,p_1^2\,z_2\,Z_2 + \frac{1}{4}\,i\,p_1\,p_3\,Z_3 - \frac{1}{4}\,p_1^2\,z_3\,Z_3$$

In[•]:= **ξ_2 := $-i\,B\,c - \frac{1}{2}\,i\,B\,c^3 - 3\,i\,a\,e^{i\,t} + 2\,i\,a\,c^2\,e^{i\,t} - \frac{3}{2}\,i\,b\,c\,e^{2\,i\,t} + i\,c^2\,e^{-i\,t}\,G + \frac{i\,v_2}{2} - \frac{w_2}{2}$**

In[•]:= ξ_2

Out[•]= $-i\,B\,c-\frac{1}{2}i\,B\,c^3-3\,i\,a\,e^{i\,t}+2\,i\,a\,c^2\,e^{i\,t}-\frac{3}{2}i\,b\,c\,e^{2\,i\,t}+i\,c^2\,e^{-i\,t}\,G+\frac{i\,v_2}{2}-\frac{w_2}{2}$

In[•]:= $\xi_3 := 2\,i\,a\,c+i\,a\,c^3-\frac{1}{2}i\,B\,c^2\,e^{-i\,t}-\frac{3}{2}i\,b\,e^{i\,t}+i\,b\,c^2\,e^{i\,t}-3\,i\,c\,e^{2\,i\,t}\,g+\frac{i\,v_3}{2}-\frac{w_3}{2}$

In[•]:= $\eta_2 := -B\,c-\frac{B\,c^3}{2}-5\,a\,e^{i\,t}-2\,a\,c^2\,e^{i\,t}+\frac{1}{2}b\,c\,e^{2\,i\,t}+3\,c^2\,e^{-i\,t}\,G+\frac{v_2}{2}+\frac{i\,w_2}{2}$

In[•]:=
```
k3 :=
 dp3 /. {z2 → s*Exp[I*t] + s^3*v2, z3 → c*s + s^3*v3, Z2 → s*Exp[-I*t] + s^3*V2,
   Z3 → c*s + s^3*V3, p1 → -1, p2 → -I*s*Exp[I*t] + s^3*w2,
   p3 → s*I*c + s^3*w3, P2 → I*s*Exp[-I*t] + s^3*W2, P3 → -s*I*c + s^3*W3}
```

In[•]:= k_3

Out[•]=
$$-2\left(i\left(\frac{1}{4}i\left(c\,s+s^3\,v_3\right)+\frac{1}{4}\left(2\,b\left(e^{i\,t}\,s+s^3\,v_2\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)-4\,a\left(c\,s+s^3\,v_3\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)+4\,g\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,V_3\right)-2\,b\left(c\,s+s^3\,v_3\right)\left(c\,s+s^3\,V_3\right)\right)\left(-i\,e^{i\,t}\,s+s^3\,w_2\right)+\frac{1}{4}\left(-1-4\,a\left(e^{i\,t}\,s+s^3\,v_2\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)-2\,B\left(c\,s+s^3\,v_3\right)\left(e^{-i\,t}\,s+s^3\,V_2\right)-2\,b\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,V_3\right)+4\,a\left(c\,s+s^3\,v_3\right)\left(c\,s+s^3\,V_3\right)\right)\left(i\,c\,s+s^3\,w_3\right)\right)+\left(-\frac{1}{4}i\left(b\left(e^{i\,t}\,s+s^3\,v_2\right)^2-4\,a\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,v_3\right)-B\left(c\,s+s^3\,v_3\right)^2\right)+\frac{1}{4}\left(2\,b\left(e^{i\,t}\,s+s^3\,v_2\right)-4\,a\left(c\,s+s^3\,v_3\right)\right)\left(-i\,e^{i\,t}\,s+s^3\,w_2\right)+\frac{1}{4}\left(-4\,a\left(e^{i\,t}\,s+s^3\,v_2\right)-2\,B\left(c\,s+s^3\,v_3\right)\right)\left(i\,c\,s+s^3\,w_3\right)\right)\left(i\,e^{-i\,t}\,s+s^3\,W_2\right)+\left(-\frac{1}{4}i\left(2\,g\left(e^{i\,t}\,s+s^3\,v_2\right)^2-2\,b\left(e^{i\,t}\,s+s^3\,v_2\right)\left(c\,s+s^3\,v_3\right)+2\,a\left(c\,s+s^3\,v_3\right)^2\right)+\frac{1}{4}\left(4\,g\left(e^{i\,t}\,s+s^3\,v_2\right)-2\,b\left(c\,s+s^3\,v_3\right)\right)\left(-i\,e^{i\,t}\,s+s^3\,w_2\right)+\frac{1}{4}\left(-2\,b\left(e^{i\,t}\,s+s^3\,v_2\right)+4\,a\left(c\,s+s^3\,v_3\right)\right)\left(i\,c\,s+s^3\,w_3\right)\right)\left(-i\,c\,s+s^3\,W_3\right)\right)$$

In[•]:= **ExpandAll[%]**

Out[•]= $2\,a\,c\,s^3 + a\,c^3\,s^3 - \frac{3}{2}\,B\,c^2\,e^{-i\,t}\,s^3 - \frac{5}{2}\,b\,e^{i\,t}\,s^3 - b\,c^2\,e^{i\,t}\,s^3 + c\,e^{2\,i\,t}\,g\,s^3 - 3\,b\,s^5\,v_2 -$
$b\,c^2\,s^5\,v_2 - 2\,a\,c\,e^{-i\,t}\,s^5\,v_2 + 2\,c\,e^{i\,t}\,g\,s^5\,v_2 - \frac{1}{2}\,b\,e^{-i\,t}\,s^7\,v_2^2 + c\,g\,s^7\,v_2^2 + \frac{s^3\,v_3}{2} +$
$6\,a\,s^5\,v_3 + 2\,a\,c^2\,s^5\,v_3 - B\,c\,e^{-i\,t}\,s^5\,v_3 - b\,c\,e^{i\,t}\,s^5\,v_3 - b\,c\,s^7\,v_2\,v_3 + 2\,a\,e^{-i\,t}\,s^7\,v_2\,v_3 +$
$a\,c\,s^7\,v_3^2 + \frac{1}{2}\,B\,e^{-i\,t}\,s^7\,v_3^2 - B\,c^2\,s^5\,V_2 - b\,e^{2\,i\,t}\,s^5\,V_2 - 2\,a\,c\,s^7\,v_2\,V_2 - b\,e^{i\,t}\,s^7\,v_2\,V_2 -$
$B\,c\,s^7\,v_3\,V_2 + 2\,a\,e^{i\,t}\,s^7\,v_3\,V_2 + 2\,a\,c^2\,s^5\,V_3 - 2\,e^{2\,i\,t}\,g\,s^5\,V_3 - b\,c\,s^7\,v_2\,V_3 - 2\,e^{i\,t}\,g\,s^7\,v_2\,V_3 +$
$2\,a\,c\,s^7\,v_3\,V_3 + b\,e^{i\,t}\,s^7\,v_3\,V_3 - 2\,i\,b\,s^5\,w_2 + 4\,i\,a\,c\,e^{-i\,t}\,s^5\,w_2 - 2\,i\,b\,e^{-i\,t}\,s^7\,v_2\,w_2 +$
$4\,i\,a\,e^{-i\,t}\,s^7\,v_3\,w_2 + 2\,i\,a\,c\,s^7\,V_2\,w_2 - i\,b\,e^{i\,t}\,s^7\,V_2\,w_2 - i\,b\,s^9\,v_2\,V_2\,w_2 + 2\,i\,a\,s^9\,v_3\,V_2\,w_2 +$
$i\,b\,c\,s^7\,V_3\,w_2 - 2\,i\,e^{i\,t}\,g\,s^7\,V_3\,w_2 - 2\,i\,g\,s^9\,v_2\,V_3\,w_2 + i\,b\,s^9\,v_3\,V_3\,w_2 + \frac{1}{2}\,i\,s^3\,w_3 + 4\,i\,a\,s^5\,w_3 +$
$2\,i\,B\,c\,e^{-i\,t}\,s^5\,w_3 + 4\,i\,a\,e^{-i\,t}\,s^7\,v_2\,w_3 + 2\,i\,B\,e^{-i\,t}\,s^7\,v_3\,w_3 + i\,B\,c\,s^7\,V_2\,w_3 + 2\,i\,a\,e^{i\,t}\,s^7\,V_2\,w_3 +$
$2\,i\,a\,s^9\,v_2\,V_2\,w_3 + i\,B\,s^9\,v_3\,V_2\,w_3 - 2\,i\,a\,c\,s^7\,V_3\,w_3 + i\,b\,e^{i\,t}\,s^7\,V_3\,w_3 + i\,b\,s^9\,v_2\,V_3\,w_3 -$
$2\,i\,a\,s^9\,v_3\,V_3\,w_3 + \frac{1}{2}\,i\,B\,c^2\,s^5\,W_2 - 2\,i\,a\,c\,e^{i\,t}\,s^5\,W_2 + \frac{3}{2}\,i\,b\,e^{2\,i\,t}\,s^5\,W_2 + 2\,i\,b\,e^{i\,t}\,s^7\,v_2\,W_2 +$
$\frac{1}{2}\,i\,b\,s^9\,v_2^2\,W_2 - 4\,i\,a\,e^{i\,t}\,s^7\,v_3\,W_2 - 2\,i\,a\,s^9\,v_2\,v_3\,W_2 - \frac{1}{2}\,i\,B\,s^9\,v_3^2\,W_2 + 2\,a\,c\,s^7\,w_2\,W_2 -$
$b\,e^{i\,t}\,s^7\,w_2\,W_2 - b\,s^9\,v_2\,w_2\,W_2 + 2\,a\,s^9\,v_3\,w_2\,W_2 + B\,c\,s^7\,w_3\,W_2 + 2\,a\,e^{i\,t}\,s^7\,w_3\,W_2 + 2\,a\,s^9\,v_2\,w_3\,W_2 +$
$B\,s^9\,v_3\,w_3\,W_2 - i\,a\,c^2\,s^5\,W_3 - i\,b\,c\,e^{i\,t}\,s^5\,W_3 + 3\,i\,e^{2\,i\,t}\,g\,s^5\,W_3 + 4\,i\,e^{i\,t}\,g\,s^7\,v_2\,W_3 +$
$i\,g\,s^9\,v_2^2\,W_3 - 2\,i\,b\,e^{i\,t}\,s^7\,v_3\,W_3 - i\,b\,s^9\,v_2\,v_3\,W_3 + i\,a\,s^9\,v_3^2\,W_3 + b\,c\,s^7\,w_2\,W_3 - 2\,e^{i\,t}\,g\,s^7\,w_2\,W_3 -$
$2\,g\,s^9\,v_2\,w_2\,W_3 + b\,s^9\,v_3\,w_2\,W_3 - 2\,a\,c\,s^7\,w_3\,W_3 + b\,e^{i\,t}\,s^7\,w_3\,W_3 + b\,s^9\,v_2\,w_3\,W_3 - 2\,a\,s^9\,v_3\,w_3\,W_3$

In[•]:= **Collect[%, s]**

Out[•]= $$s^3 \left(2\,a\,c + a\,c^3 - \frac{3}{2}\,B\,c^2\,e^{-i\,t} - \frac{5}{2}\,b\,e^{i\,t} - b\,c^2\,e^{i\,t} + c\,e^{2\,i\,t}\,g + \frac{v_3}{2} + \frac{i\,w_3}{2}\right) +$$
$$s^5 \left(-3\,b\,v_2 - b\,c^2\,v_2 - 2\,a\,c\,e^{-i\,t}\,v_2 + 2\,c\,e^{i\,t}\,g\,v_2 + 6\,a\,v_3 + 2\,a\,c^2\,v_3 - B\,c\,e^{-i\,t}\,v_3 - b\,c\,e^{i\,t}\,v_3 - \right.$$
$$B\,c^2\,V_2 - b\,e^{2\,i\,t}\,V_2 + 2\,a\,c^2\,V_3 - 2\,e^{2\,i\,t}\,g\,V_3 - 2\,i\,b\,w_2 + 4\,i\,a\,c\,e^{-i\,t}\,w_2 + 4\,i\,a\,w_3 + 2\,i\,B\,c\,e^{-i\,t}\,w_3 +$$
$$\left.\frac{1}{2}\,i\,B\,c^2\,W_2 - 2\,i\,a\,c\,e^{i\,t}\,W_2 + \frac{3}{2}\,i\,b\,e^{2\,i\,t}\,W_2 - i\,a\,c^2\,W_3 - i\,b\,c\,e^{i\,t}\,W_3 + 3\,i\,e^{2\,i\,t}\,g\,W_3\right) +$$
$$s^7 \left(-\frac{1}{2}\,b\,e^{-i\,t}\,v_2^2 + c\,g\,v_2^2 - b\,c\,v_2\,v_3 + 2\,a\,e^{-i\,t}\,v_2\,v_3 + a\,c\,v_3^2 + \frac{1}{2}\,B\,e^{-i\,t}\,v_3^2 - 2\,a\,c\,v_2\,V_2 - \right.$$
$$b\,e^{i\,t}\,v_2\,V_2 - B\,c\,v_3\,V_2 + 2\,a\,e^{i\,t}\,v_3\,V_2 - b\,c\,v_2\,V_3 - 2\,e^{i\,t}\,g\,v_2\,V_3 + 2\,a\,c\,v_3\,V_3 + b\,e^{i\,t}\,v_3\,V_3 -$$
$$2\,i\,b\,e^{-i\,t}\,v_2\,w_2 + 4\,i\,a\,e^{-i\,t}\,v_3\,w_2 + 2\,i\,a\,c\,V_2\,w_2 - i\,b\,e^{i\,t}\,V_2\,w_2 + i\,b\,c\,V_3\,w_2 - 2\,i\,e^{i\,t}\,g\,V_3\,w_2 +$$
$$4\,i\,a\,e^{-i\,t}\,v_2\,w_3 + 2\,i\,B\,e^{-i\,t}\,v_3\,w_3 + i\,B\,c\,V_2\,w_3 + 2\,i\,a\,e^{i\,t}\,V_2\,w_3 - 2\,i\,a\,c\,V_3\,w_3 + i\,b\,e^{i\,t}\,V_3\,w_3 +$$
$$2\,i\,b\,e^{i\,t}\,v_2\,W_2 - 4\,i\,a\,e^{i\,t}\,v_3\,W_2 + 2\,a\,c\,w_2\,W_2 - b\,e^{i\,t}\,w_2\,W_2 + B\,c\,w_3\,W_2 + 2\,a\,e^{i\,t}\,w_3\,W_2 +$$
$$\left.4\,i\,e^{i\,t}\,g\,v_2\,W_3 - 2\,i\,b\,e^{i\,t}\,v_3\,W_3 + b\,c\,w_2\,W_3 - 2\,e^{i\,t}\,g\,w_2\,W_3 - 2\,a\,c\,w_3\,W_3 + b\,e^{i\,t}\,w_3\,W_3\right) +$$
$$s^9 \left(-i\,b\,v_2\,V_2\,w_2 + 2\,i\,a\,v_3\,V_2\,w_2 - 2\,i\,g\,v_2\,V_3\,w_2 + i\,b\,v_3\,V_3\,w_2 + 2\,i\,a\,v_2\,V_2\,w_3 + \right.$$
$$i\,B\,v_3\,V_2\,w_3 + i\,b\,v_2\,V_3\,w_3 - 2\,i\,a\,v_3\,V_3\,w_3 + \frac{1}{2}\,i\,b\,v_2^2\,W_2 - 2\,i\,a\,v_2\,v_3\,W_2 -$$
$$\frac{1}{2}\,i\,B\,v_3^2\,W_2 - b\,v_2\,w_2\,W_2 + 2\,a\,v_3\,w_2\,W_2 + 2\,a\,v_2\,w_3\,W_2 + B\,v_3\,w_3\,W_2 + i\,g\,v_2^2\,W_3 -$$
$$\left.i\,b\,v_2\,v_3\,W_3 + i\,a\,v_3^2\,W_3 - 2\,g\,v_2\,w_2\,W_3 + b\,v_3\,w_2\,W_3 + b\,v_2\,w_3\,W_3 - 2\,a\,v_3\,w_3\,W_3\right)$$

In[•]:= $\eta_3 := 2\,a\,c + a\,c^3 - \frac{3}{2}\,B\,c^2\,e^{-i\,t} - \frac{5}{2}\,b\,e^{i\,t} - b\,c^2\,e^{i\,t} + c\,e^{2\,i\,t}\,g + \frac{v_3}{2} + \frac{i\,w_3}{2}$

In[•]:= ξ_2

Out[•]= $$-i\,B\,c - \frac{1}{2}\,i\,B\,c^3 - 3\,i\,a\,e^{i\,t} + 2\,i\,a\,c^2\,e^{i\,t} - \frac{3}{2}\,i\,b\,c\,e^{2\,i\,t} + i\,c^2\,e^{-i\,t}\,G + \frac{i\,v_2}{2} - \frac{w_2}{2}$$

In[•]:= η_2

Out[•]= $$-B\,c - \frac{B\,c^3}{2} - 5\,a\,e^{i\,t} - 2\,a\,c^2\,e^{i\,t} + \frac{1}{2}\,b\,c\,e^{2\,i\,t} + 3\,c^2\,e^{-i\,t}\,G + \frac{v_2}{2} + \frac{i\,w_2}{2}$$

In[•]:=
```
sol = DSolve[
  {l'[t] == -i B c - 1/2 i B c^3 - 3 i a e^(i t) + 2 i a c^2 e^(i t) - 3/2 i b c e^(2 i t) + i c^2 e^(-i t) G + (i l[t])/2 - m[t]/2,
   m'[t] == -B c - (B c^3)/2 - 5 a e^(i t) - 2 a c^2 e^(i t) + 1/2 b c e^(2 i t) + 3 c^2 e^(-i t) G + l[t]/2 + (i m[t])/2}, {l[t],
   m[t]}, t]
```

Out[•]=
$$\left\{\left\{l[t] \to -\frac{1}{2} i\, e^{\frac{i t}{2}} \left(i \left(2 a - b c + 4 a c^2\right) e^{i t} - i b c e^{2 i t} - 2 i c^2 e^{-2 i t} G + i c e^{-i t} \left(2 B + B c^2 + 2 c G\right) + 8 a t\right) \text{Cos}\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[1] \text{Cos}\left[\frac{t}{2}\right] - \frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2 + c^2\right) e^{-i t} + i b c e^{i t} + 2 i a \left(1 + 2 c^2\right) e^{i t} - i b c e^{2 i t} + 2 i c^2 e^{-i t} G + 2 i c^2 e^{-2 i t} G - 8 a t\right) \text{Sin}\left[\frac{t}{2}\right] - e^{\frac{i t}{2}} C[2] \text{Sin}\left[\frac{t}{2}\right],\right.$$
$$\left. m[t] \to \frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2 + c^2\right) e^{-i t} + i b c e^{i t} + 2 i a \left(1 + 2 c^2\right) e^{i t} - i b c e^{2 i t} + 2 i c^2 e^{-i t} G + 2 i c^2 e^{-2 i t} G - 8 a t\right) \text{Cos}\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[2] \text{Cos}\left[\frac{t}{2}\right] - \frac{1}{2} i e^{\frac{i t}{2}} \left(i \left(2 a - b c + 4 a c^2\right) e^{i t} - i b c e^{2 i t} - 2 i c^2 e^{-2 i t} G + i c e^{-i t} \left(2 B + B c^2 + 2 c G\right) + 8 a t\right) \text{Sin}\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[1] \text{Sin}\left[\frac{t}{2}\right]\right\}\right\}$$

In[•]:=
```
V2[t_] := l[t] /. sol[[1]]
```

In[•]:=
```
V2[t]
```

Out[•]=
$$-\frac{1}{2} i\, e^{\frac{i t}{2}} \left(i \left(2 a - b c + 4 a c^2\right) e^{i t} - i b c e^{2 i t} - 2 i c^2 e^{-2 i t} G + i c e^{-i t} \left(2 B + B c^2 + 2 c G\right) + 8 a t\right) \text{Cos}\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[1] \text{Cos}\left[\frac{t}{2}\right] - \frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2 + c^2\right) e^{-i t} + i b c e^{i t} + 2 i a \left(1 + 2 c^2\right) e^{i t} - i b c e^{2 i t} + 2 i c^2 e^{-i t} G + 2 i c^2 e^{-2 i t} G - 8 a t\right) \text{Sin}\left[\frac{t}{2}\right] - e^{\frac{i t}{2}} C[2] \text{Sin}\left[\frac{t}{2}\right]$$

In[•]:=
```
v2 := V2[t]
```

In[•]:=
```
v2
```

Out[•]=
$$-\frac{1}{2} i\, e^{\frac{i t}{2}} \left(i \left(2 a - b c + 4 a c^2\right) e^{i t} - i b c e^{2 i t} - 2 i c^2 e^{-2 i t} G + i c e^{-i t} \left(2 B + B c^2 + 2 c G\right) + 8 a t\right) \text{Cos}\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[1] \text{Cos}\left[\frac{t}{2}\right] - \frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2 + c^2\right) e^{-i t} + i b c e^{i t} + 2 i a \left(1 + 2 c^2\right) e^{i t} - i b c e^{2 i t} + 2 i c^2 e^{-i t} G + 2 i c^2 e^{-2 i t} G - 8 a t\right) \text{Sin}\left[\frac{t}{2}\right] - e^{\frac{i t}{2}} C[2] \text{Sin}\left[\frac{t}{2}\right]$$

In[•]:=
```
TrigReduce[%268]
```

Out[•]=
$$\frac{1}{2} \left(2 B c + B c^3 + 2 a e^{i t} + 4 a c^2 e^{i t} - 2 b c e^{2 i t} - 8 i a e^{i t} t + C[1] + e^{i t} C[1] - i C[2] + i e^{i t} C[2]\right)$$

In[•]:= **ExpandAll[%]**

Out[•]= $B c + \frac{B c^3}{2} + a e^{i t} + 2 a c^2 e^{i t} - b c e^{2 i t} - 4 i a e^{i t} t + \frac{C[1]}{2} + \frac{1}{2} e^{i t} C[1] - \frac{1}{2} i C[2] + \frac{1}{2} i e^{i t} C[2]$

In[•]:= **v_2**

Out[•]= $-\frac{1}{2} i e^{\frac{i t}{2}} \left(i \left(2 a - b c + 4 a c^2\right) e^{i t} - i b c e^{2 i t} - 2 i c^2 e^{-2 i t} G + i c e^{-i t} \left(2 B + B c^2 + 2 c G\right) + 8 a t\right)$
$\cos\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[1] \cos\left[\frac{t}{2}\right] -$
$\frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2 + c^2\right) e^{-i t} + i b c e^{i t} + 2 i a \left(1 + 2 c^2\right) e^{i t} - i b c e^{2 i t} +$
$2 i c^2 e^{-i t} G + 2 i c^2 e^{-2 i t} G - 8 a t\right) \sin\left[\frac{t}{2}\right] - e^{\frac{i t}{2}} C[2] \sin\left[\frac{t}{2}\right]$

In[•]:= **FullSimplify[%271]**

Out[•]= $\frac{1}{2} \left(B c \left(2 + c^2\right) - 2 b c e^{2 i t} + C[1] + e^{i t} \left(a \left(2 + 4 c^2 - 8 i t\right) + C[1] + i C[2]\right) - i C[2]\right)$

In[•]:= **Collect[v_2, G]**

Out[•]= $B c e^{-\frac{i t}{2}} \cos\left[\frac{t}{2}\right] + \frac{1}{2} B c^3 e^{-\frac{i t}{2}} \cos\left[\frac{t}{2}\right] + \frac{1}{2} \left(2 a - b c + 4 a c^2\right) e^{\frac{3 i t}{2}} \cos\left[\frac{t}{2}\right] - \frac{1}{2} b c e^{\frac{5 i t}{2}} \cos\left[\frac{t}{2}\right] -$
$4 i a e^{\frac{i t}{2}} t \cos\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[1] \cos\left[\frac{t}{2}\right] + \frac{1}{2} i B c \left(2 + c^2\right) e^{-\frac{i t}{2}} \sin\left[\frac{t}{2}\right] - \frac{1}{2} i b c e^{\frac{3 i t}{2}} \sin\left[\frac{t}{2}\right] -$
$i a \left(1 + 2 c^2\right) e^{\frac{3 i t}{2}} \sin\left[\frac{t}{2}\right] + \frac{1}{2} i b c e^{\frac{5 i t}{2}} \sin\left[\frac{t}{2}\right] + 4 a e^{\frac{i t}{2}} t \sin\left[\frac{t}{2}\right] - e^{\frac{i t}{2}} C[2] \sin\left[\frac{t}{2}\right] +$
$G \left(c^2 e^{-\frac{i t}{2}} \cos\left[\frac{t}{2}\right] - c^2 e^{-\frac{3 i t}{2}} \cos\left[\frac{t}{2}\right] - i c^2 e^{-\frac{i t}{2}} \sin\left[\frac{t}{2}\right] - i c^2 e^{-\frac{3 i t}{2}} \sin\left[\frac{t}{2}\right]\right)$

In[•]:= **$c^2 e^{-\frac{i t}{2}} \cos\left[\frac{t}{2}\right] - c^2 e^{-\frac{3 i t}{2}} \cos\left[\frac{t}{2}\right] - i c^2 e^{-\frac{i t}{2}} \sin\left[\frac{t}{2}\right] - i c^2 e^{-\frac{3 i t}{2}} \sin\left[\frac{t}{2}\right]$**

Out[•]= $c^2 e^{-\frac{i t}{2}} \cos\left[\frac{t}{2}\right] - c^2 e^{-\frac{3 i t}{2}} \cos\left[\frac{t}{2}\right] - i c^2 e^{-\frac{i t}{2}} \sin\left[\frac{t}{2}\right] - i c^2 e^{-\frac{3 i t}{2}} \sin\left[\frac{t}{2}\right]$

In[•]:= **W_2[t_] := m[t] /. sol[[1]]**

In[•]:= **W_2[t]**

Out[•]= $\frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2 + c^2\right) e^{-i t} + i b c e^{i t} + 2 i a \left(1 + 2 c^2\right) e^{i t} -$
$i b c e^{2 i t} + 2 i c^2 e^{-i t} G + 2 i c^2 e^{-2 i t} G - 8 a t\right) \cos\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[2] \cos\left[\frac{t}{2}\right] -$
$\frac{1}{2} i e^{\frac{i t}{2}} \left(i \left(2 a - b c + 4 a c^2\right) e^{i t} - i b c e^{2 i t} - 2 i c^2 e^{-2 i t} G + i c e^{-i t} \left(2 B + B c^2 + 2 c G\right) + 8 a t\right)$
$\sin\left[\frac{t}{2}\right] + e^{\frac{i t}{2}} C[1] \sin\left[\frac{t}{2}\right]$

In[•]:= **w_2 := W_2[t]**

In[•]:= **W_2**

Out[•]= $\frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2+c^2\right) e^{-i t}+i b c e^{i t}+2 i a \left(1+2 c^2\right) e^{i t}-\right.$
$\left. i b c e^{2 i t}+2 i c^2 e^{-i t} G+2 i c^2 e^{-2 i t} G-8 a t\right) \text{Cos}\left[\frac{t}{2}\right]+e^{\frac{i t}{2}} C[2] \text{Cos}\left[\frac{t}{2}\right]-$
$\frac{1}{2} i e^{\frac{i t}{2}} \left(i \left(2 a-b c+4 a c^2\right) e^{i t}-i b c e^{2 i t}-2 i c^2 e^{-2 i t} G+i c e^{-i t} \left(2 B+B c^2+2 c G\right)+8 a t\right)$
$\text{Sin}\left[\frac{t}{2}\right]+e^{\frac{i t}{2}} C[1] \text{Sin}\left[\frac{t}{2}\right]$

In[•]:= **TrigReduce[%278]**

Out[•]= $\frac{1}{2} e^{-i t} \left(-2 i B c e^{i t}-i B c^3 e^{i t}+2 i a e^{2 i t}+4 i a c^2 e^{2 i t}+\right.$
$\left. 4 i c^2 G-8 a e^{2 i t} t+i e^{i t} C[1]-i e^{2 i t} C[1]+e^{i t} C[2]+e^{2 i t} C[2]\right)$

In[•]:= **ξ_3**

Out[•]= $2 i a c+i a c^3-\frac{1}{2} i B c^2 e^{-i t}-\frac{3}{2} i b e^{i t}+i b c^2 e^{i t}-3 i c e^{2 i t} g+$
$\frac{1}{2}\left(-\frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2+c^2\right) e^{-i t}+i b c e^{i t}+2 i a \left(1+2 c^2\right) e^{i t}-i b c e^{2 i t}+\right.\right.$
$\left. 2 i c^2 e^{-i t} G+2 i c^2 e^{-2 i t} G-8 a t\right) \text{Cos}\left[\frac{t}{2}\right]-e^{\frac{i t}{2}} C[2] \text{Cos}\left[\frac{t}{2}\right]+\frac{1}{2} i e^{\frac{i t}{2}}$
$\left(i \left(2 a-b c+4 a c^2\right) e^{i t}-i b c e^{2 i t}-2 i c^2 e^{-2 i t} G+i c e^{-i t} \left(2 B+B c^2+2 c G\right)+8 a t\right)$
$\left.\text{Sin}\left[\frac{t}{2}\right]-e^{\frac{i t}{2}} C[1] \text{Sin}\left[\frac{t}{2}\right]\right)+\frac{i v_3}{2}$

In[•]:= **ClearAll[W_3]**

… ClearAll: W_3 is not a symbol or a string.

In[•]:= **W_3**

Out[•]= W_3

In[•]:= **W_3[t]**

Out[•]= $\frac{1}{2} e^{\frac{i t}{2}} \left(-i B c \left(2+c^2\right) e^{-i t}+i b c e^{i t}+2 i a \left(1+2 c^2\right) e^{i t}-\right.$
$\left. i b c e^{2 i t}+2 i c^2 e^{-i t} G+2 i c^2 e^{-2 i t} G-8 a t\right) \text{Cos}\left[\frac{t}{2}\right]+e^{\frac{i t}{2}} C[2] \text{Cos}\left[\frac{t}{2}\right]-$
$\frac{1}{2} i e^{\frac{i t}{2}} \left(i \left(2 a-b c+4 a c^2\right) e^{i t}-i b c e^{2 i t}-2 i c^2 e^{-2 i t} G+i c e^{-i t} \left(2 B+B c^2+2 c G\right)+8 a t\right)$
$\text{Sin}\left[\frac{t}{2}\right]+e^{\frac{i t}{2}} C[1] \text{Sin}\left[\frac{t}{2}\right]$

W_3[t_] :=

… Clear: W_3[t_] is not a symbol or a string.