```
In[•]:= SetDirectory[$UserBaseDirectory];

In[•]:= << CY3Zeta.wl'

Out[•]= Null'

In[•]:= zSetNParameters[1]

In[•]:= zSetNMax[200]

In[•]:= zSetY[{Y[1, 1, 1] → 5}]

Out[•]= {Y[1, 1, 1] → 5}

In[•]:= zSetYhat[{Yhat[1, 1, 1] → 1 / 5}]

Out[•]= {Yhat[1, 1, 1] → 1/5}

In[•]:= zSetConifoldLocus[1]

Out[•]= 1

In[•]:= zSetOtherSingularLocus[(1 + 3125 ϕ[1])]

Out[•]= 1 + 3125 ϕ[1]

In[•]:= Theta[f_, x_] := Theta[f, x] = x D[f, x]

In[•]:= L[f_] := 95 367 431 640 625 ((λ ϕ[1]) ^ 3 (1 / 3125 + λ ϕ[1]) ^ 4 D[f, {ϕ[1], 4}] / λ ^ 4 +
     10 (λ ϕ[1] + 3 / 15 625) (λ ϕ[1]) ^ 2 (1 / 3125 + λ ϕ[1]) ^ 3 D[f, {ϕ[1], 3}] / λ ^ 3 +
     24 λ ϕ[1] (1 / 3125 + λ ϕ[1]) ^ 2
          ((λ ϕ[1]) ^ 2 + 143 / 375 000 λ ϕ[1] + 7 / 234 375 000) D[f, {ϕ[1], 2}] / λ ^ 2 +
     12 ((λ ϕ[1]) ^ 2 + 23 / 93 750 λ ϕ[1] + 1 / 117 187 500) (1 / 3125 + λ ϕ[1]) ^ 2 ×
     D[f, ϕ[1]] / λ - 24 / 19 073 486 328 125 f) λ ϕ[1] / (1 + 3125 λ ϕ[1])

In[•]:= Factor[Coefficient[L[f[ϕ[1]]], D[f[ϕ[1]], {ϕ[1], 4}]]]

Out[•]= ϕ[1]^4 (1 + 3125 λ ϕ[1])^3

In[•]:= oo = 200

Out[•]= 200

In[•]:= ans = Sum[a[i] (λ ϕ[1]) ^ i, {i, 0, oo}];

In[•]:= cfs = CoefficientList[Normal[Series[L[ans], {λ, 0, oo}]] /. λ → 1, {ϕ[1]}];

In[•]:= pi[0] = f[0] = ans /. Solve[Map[# == 0 &, cfs]][[1]] /. a[0] → 1;

In[•]:= cfs = CoefficientList[
     Normal[Series[L[f[0] Log[ϕ[1]] + ans], {λ, 0, oo}]] /. λ → 1, {ϕ[1]}];

In[•]:= f[1] = ans /. Solve[Map[# == 0 &, cfs]][[1]] /. a[0] → 0;
     pi[1] = f[0] Log[ϕ[1]] + f[1];
```

```
cfs = CoefficientList[
  Normal[Series[L[1 / 2 f[0] Log[ϕ[1]] ^ 2 + f[1] Log[ϕ[1]] + ans], {λ, 0, oo}]] /. λ → 1, {ϕ[1]}];

f[2] = ans /. Solve[Map[# == 0 &, cfs]][[1]] /. a[0] → 0;
pi[2] = 5 (1 / 2 f[0] Log[ϕ[1]] ^ 2 + f[1] Log[ϕ[1]] + f[2]);

cfs =
 CoefficientList[Normal[Series[L[1 / 6 f[0] Log[ϕ[1]] ^ 3 + 1 / 2 f[1] Log[ϕ[1]] ^ 2 +
   f[2] Log[ϕ[1]] + ans], {λ, 0, oo}]] /. λ → 1, {ϕ[1]}];

f[3] = ans /. Solve[Map[# == 0 &, cfs]][[1]] /. a[0] → 0;
pi[3] = 5 (1 / 6 f[0] Log[ϕ[1]] ^ 3 + 1 / 2 f[1] Log[ϕ[1]] ^ 2 + f[2] Log[ϕ[1]] + f[3]);

YhatRule = {Yhat[1, 1, 1] → 1 / 5};

pivec = Table[pi[i], {i, 0, 3}];
```

To define the logarithm-free period vectors $\theta\omega$t[1] etc. we need to take the derivatives first, and only then set Log[$\phi$[1]] -> 0.

```
ωt[] = pivec /. Log[ϕ[1]] → 0;
θωt[1] = Map[ExpandAll[Series[Theta[#, ϕ[1]], {λ, 0, oo}]] &, pivec] /. Log[ϕ[1]] → 0;
θ2ωt[1] =
Map[ExpandAll[Yhat[1, 1, 1] * Series[Nest[Theta[#, ϕ[1]] &, #, 2], {λ, 0, oo}]] &, pivec] /.
    YhatRule /. Log[ϕ[1]] → 0;
θ3ωt[] =
Map[ExpandAll[Yhat[1, 1, 1] * Series[Nest[Theta[#, ϕ[1]] &, #, 3], {λ, 0, oo}]] &, pivec] /.
    YhatRule /. Log[ϕ[1]] → 0;
```

Now the matrix zW is found as expected.

```
zFindW[{4}, 100, 50]
```

```
Warning: There are free variables - a denominator of lower degree may exist.
```

```
zW
```

$$\left\{\left\{0,\ 0,\ 0,\ -\frac{i}{8\,\pi^3\left(1+3125\,\phi[1]\right)^2}\right\},\ \left\{0,\ 0,\ \frac{i}{8\,\pi^3\left(1+3125\,\phi[1]\right)^2},\ -\frac{3125\,i\,\phi[1]}{4\,\pi^3\left(1+3125\,\phi[1]\right)^3}\right\},\right.$$

$$\left\{0,\ -\frac{i}{8\,\pi^3\left(1+3125\,\phi[1]\right)^2},\ 0,\ \frac{125\,i\,\phi[1]\left(3+15\,625\,\phi[1]\right)}{8\,\pi^3\left(1+3125\,\phi[1]\right)^4}\right\},$$

$$\left.\left\{\frac{i}{8\,\pi^3\left(1+3125\,\phi[1]\right)^2},\ \frac{3125\,i\,\phi[1]}{4\,\pi^3\left(1+3125\,\phi[1]\right)^3},\ -\frac{125\,i\,\phi[1]\left(3+15\,625\,\phi[1]\right)}{8\,\pi^3\left(1+3125\,\phi[1]\right)^4},\ 0\right\}\right\}$$

```
zComputeEMatrices[]
```

To find the constants appearing in U(0), we need to set the last argument, **maxdeg**, to a value that is slightly lower than **NMax** (=200), in order to obtain enough independent equations to solve for the

constants.

In[•]:=
```
zFindU0Constants[7, 6, 180]
zFindU0Constants[11, 6, 180]
```

Out[•]= $\{\alpha_1 \to 0, \gamma\text{hat} \to 108\}$

Out[•]= $\{\alpha_1 \to 0, \gamma\text{hat} \to 606\}$