```
dSdteqn[t_, a_] = m T[a] - β S[t, a] II[t, a] / (S[t, a] + EE[t, a] + II[t, a]) -
  μS S[t, a] - D[S[t, a], t] - D[S[t, a], a]
dEEdteqn[t_, a_] = (1 - ϵ) β S[t, a] II[t, a] / (S[t, a] + EE[t, a] + II[t, a]) -
  δ EE[t, a] - μE EE[t, a] - D[EE[t, a], t] - D[EE[t, a], a]
dIIdteqn[t_, a_] = ϵ β S[t, a] II[t, a] / (S[t, a] + EE[t, a] + II[t, a]) +
  δ EE[t, a] - μI II[t, a] - D[II[t, a], t] - D[II[t, a], a]
```

$$-\mu S\, S[t, a] - \frac{\beta\, II[t, a]\, S[t, a]}{EE[t, a] + II[t, a] + S[t, a]} + m\, T[a] - S^{(0,1)}[t, a] - S^{(1,0)}[t, a]$$

$$-\delta\, EE[t, a] - \mu E\, EE[t, a] + \frac{\beta\, (1 - \epsilon)\, II[t, a]\, S[t, a]}{EE[t, a] + II[t, a] + S[t, a]} - EE^{(0,1)}[t, a] - EE^{(1,0)}[t, a]$$

$$\delta\, EE[t, a] - \mu I\, II[t, a] + \frac{\beta \epsilon\, II[t, a]\, S[t, a]}{EE[t, a] + II[t, a] + S[t, a]} - II^{(0,1)}[t, a] - II^{(1,0)}[t, a]$$

```
yEeqn[t_, a_] = kE EE[t, a] - yE[t, a]
yIeqn[t_, a_] = kI II[t, a] - yI[t, a]
```

$$kE\, EE[t, a] - yE[t, a]$$

$$kI\, II[t, a] - yI[t, a]$$

```
yEmap[t_, a_] = Solve[yEeqn[t, a] == 0, EE[t, a]][[1]]
yImap[t_, a_] = Solve[yIeqn[t, a] == 0, II[t, a]][[1]]
```

$$\left\{EE[t, a] \to \frac{yE[t, a]}{kE}\right\}$$

$$\left\{II[t, a] \to \frac{yI[t, a]}{kI}\right\}$$

```
dSdteqn2[t_, a_] =
 dSdteqn[t, a] /. yEmap[t, a] /. D[yEmap[t, a], t] /. D[yEmap[t, a], a] /. yImap[t, a] /.
   D[yImap[t, a], t] /. D[yImap[t, a], a]
dEEdteqn2[t_, a_] = dEEdteqn[t, a] /. yEmap[t, a] /. D[yEmap[t, a], t] /.
     D[yEmap[t, a], a] /. yImap[t, a] /. D[yImap[t, a], t] /. D[yImap[t, a], a]
dIIdteqn2[t_, a_] = dIIdteqn[t, a] /. yEmap[t, a] /. D[yEmap[t, a], t] /.
     D[yEmap[t, a], a] /. yImap[t, a] /. D[yImap[t, a], t] /. D[yImap[t, a], a]
```

$$-\mu S\, S[t, a] + m\, T[a] - \frac{\beta\, S[t, a]\, yI[t, a]}{kI\left(S[t, a] + \frac{yE[t,a]}{kE} + \frac{yI[t,a]}{kI}\right)} - S^{(0,1)}[t, a] - S^{(1,0)}[t, a]$$

$$-\frac{\delta\, yE[t, a]}{kE} - \frac{\mu E\, yE[t, a]}{kE} + \frac{\beta\, (1 - \epsilon)\, S[t, a]\, yI[t, a]}{kI\left(S[t, a] + \frac{yE[t,a]}{kE} + \frac{yI[t,a]}{kI}\right)} - \frac{yE^{(0,1)}[t, a]}{kE} - \frac{yE^{(1,0)}[t, a]}{kE}$$

$$\frac{\delta\, yE[t, a]}{kE} - \frac{\mu I\, yI[t, a]}{kI} + \frac{\beta \epsilon\, S[t, a]\, yI[t, a]}{kI\left(S[t, a] + \frac{yE[t,a]}{kE} + \frac{yI[t,a]}{kI}\right)} - \frac{yI^{(0,1)}[t, a]}{kI} - \frac{yI^{(1,0)}[t, a]}{kI}$$

```
Smap[t_, a_] = Solve[dIIdteqn2[t, a] == 0, S[t, a]][[1]]
```

$$\left\{S[t, a] \to -\left(\left((kI\, yE[t, a] + kE\, yI[t, a])\right.\right.\right.$$
$$\left.\left.\left.\left(kI\, \delta\, yE[t, a] - kE\, \mu I\, yI[t, a] - kE\, yI^{(0,1)}[t, a] - kE\, yI^{(1,0)}[t, a]\right)\right)\right/$$
$$\left(kE\, kI\, \left(kI\, \delta\, yE[t, a] + kE\, \beta \in yI[t, a] - kE\, \mu I\, yI[t, a] - \right.\right.$$
$$\left.\left.\left.kE\, yI^{(0,1)}[t, a] - kE\, yI^{(1,0)}[t, a]\right)\right)\right)\Bigg\}$$

```
dSdteqn3[t_, a_] = dSdteqn2[t, a] /. Smap[t, a] /. D[Smap[t, a], t] /. D[Smap[t, a], a]
dEEdteqn3[t_, a_] =
 dEEdteqn2[t, a] /. Smap[t, a] /. D[Smap[t, a], t] /. D[Smap[t, a], a]
```

$$
\begin{aligned}
&\mathrm{m}\,\mathrm{T}[\mathrm{a}] + \Big(\mu\mathrm{S}\,(\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}[\mathrm{t},\mathrm{a}])\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) +\\
&\Big(\Big(\mathrm{kI}\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\Big)\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) +\\
&\Big(\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\\
&\quad\Big(\mathrm{kI}\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) +\\
&\Big(\beta\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,(\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}[\mathrm{t},\mathrm{a}])\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/\\
&\quad\Big(\mathrm{kE}\,\mathrm{kI}^2\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\\
&\qquad\Big(\frac{\mathrm{yE}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}} + \frac{\mathrm{yI}[\mathrm{t},\mathrm{a}]}{\mathrm{kI}} - \Big((\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}[\mathrm{t},\mathrm{a}])\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] -\\
&\qquad\quad\mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] +\\
&\qquad\quad\mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big)\Big)\Big) +\\
&\Big((\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}[\mathrm{t},\mathrm{a}])\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] -\\
&\quad\mathrm{kE}\,\mathrm{yI}^{(0,2)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) -\\
&\Big((\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}[\mathrm{t},\mathrm{a}])\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] -\\
&\quad\mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] -\\
&\quad\mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,2)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)^2\Big) +\\
&\Big((\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}[\mathrm{t},\mathrm{a}])\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}] -\\
&\quad\mathrm{kE}\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(2,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) -\\
&\Big((\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\mathrm{yI}[\mathrm{t},\mathrm{a}])\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] -\\
&\quad\mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)\,\Big(\mathrm{kI}\,\delta\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}] -\\
&\quad\mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(2,0)}[\mathrm{t},\mathrm{a}]\Big)\Big) \Big/ \Big(\mathrm{kE}\,\mathrm{kI}\\
&\quad\Big(\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}\,\beta\in\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mu\mathrm{I}\,\mathrm{yI}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}] - \mathrm{kE}\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big)^2\Big)
\end{aligned}
$$

$$-\frac{\delta\, yE[t,a]}{kE}-\frac{\mu E\, yE[t,a]}{kE}-\frac{yE^{(0,1)}[t,a]}{kE}-\frac{yE^{(1,0)}[t,a]}{kE}-\Big(\beta\,(1-\epsilon)\,yI[t,a]\,(kI\,yE[t,a]+kE\,yI[t,a])\,\big(kI\,\delta\,yE[t,a]-kE\,\mu I\,yI[t,a]-kE\,yI^{(0,1)}[t,a]-kE\,yI^{(1,0)}[t,a]\big)\Big)\Big/\Big(kE\,kI^2\,\big(kI\,\delta\,yE[t,a]+kE\,\beta\,\epsilon\,yI[t,a]-kE\,\mu I\,yI[t,a]-kE\,yI^{(0,1)}[t,a]-kE\,yI^{(1,0)}[t,a]\big)\Big(\frac{yE[t,a]}{kE}+\frac{yI[t,a]}{kI}-\big((kI\,yE[t,a]+kE\,yI[t,a])\,\big(kI\,\delta\,yE[t,a]-kE\,\mu I\,yI[t,a]-kE\,yI^{(0,1)}[t,a]-kE\,yI^{(1,0)}[t,a]\big)\Big)\Big/\big(kE\,kI\,\big(kI\,\delta\,yE[t,a]+kE\,\beta\,\epsilon\,yI[t,a]-kE\,\mu I\,yI[t,a]-kE\,yI^{(0,1)}[t,a]-kE\,yI^{(1,0)}[t,a]\big)\big)\Big)\Big)$$

```
IPOPish1[t_, a_] = Denominator[Together[dSdteqn3[t, a]]] Together[dSdteqn3[t, a]]
IPOPish2[t_, a_] = Denominator[Together[dEEdteqn3[t, a]]] Together[dEEdteqn3[t, a]]
```

$$\begin{aligned}
&kE\,kI^3\,m\,\delta^2\,\epsilon\,T[a]\,yE[t,a]^2+kI^3\,\delta^3\,yE[t,a]^3+kI^3\,\delta^2\,\epsilon\,\mu S\,yE[t,a]^3+\\
&2\,kE^2\,kI^2\,m\,\beta\,\delta\,\epsilon^2\,T[a]\,yE[t,a]\,yI[t,a]-2\,kE^2\,kI^2\,m\,\delta\,\epsilon\,\mu I\,T[a]\,yE[t,a]\,yI[t,a]+\\
&2\,kE\,kI^2\,\beta\,\delta^2\,\epsilon\,yE[t,a]^2\,yI[t,a]-3\,kE\,kI^2\,\delta^2\,\mu I\,yE[t,a]^2\,yI[t,a]+\\
&kE\,kI^2\,\delta^2\,\epsilon\,\mu S\,yE[t,a]^2\,yI[t,a]+kE\,kI^2\,\beta\,\delta\,\epsilon^2\,\mu S\,yE[t,a]^2\,yI[t,a]-\\
&2\,kE\,kI^2\,\delta\,\epsilon\,\mu I\,\mu S\,yE[t,a]^2\,yI[t,a]+kE^3\,kI\,m\,\beta^2\,\epsilon^3\,T[a]\,yI[t,a]^2-\\
&2\,kE^3\,kI\,m\,\beta\,\epsilon^2\,\mu I\,T[a]\,yI[t,a]^2+kE^3\,kI\,m\,\epsilon\,\mu I^2\,T[a]\,yI[t,a]^2+\\
&kE^2\,kI\,\beta^2\,\delta\,\epsilon^2\,yE[t,a]\,yI[t,a]^2-4\,kE^2\,kI\,\beta\,\delta\,\epsilon\,\mu I\,yE[t,a]\,yI[t,a]^2+\\
&3\,kE^2\,kI\,\delta\,\mu I^2\,yE[t,a]\,yI[t,a]^2+kE^2\,kI\,\beta\,\delta\,\epsilon^2\,\mu S\,yE[t,a]\,yI[t,a]^2-\\
&2\,kE^2\,kI\,\delta\,\epsilon\,\mu I\,\mu S\,yE[t,a]\,yI[t,a]^2-kE^2\,kI\,\beta\,\epsilon^2\,\mu I\,\mu S\,yE[t,a]\,yI[t,a]^2+\\
&kE^2\,kI\,\epsilon\,\mu I^2\,\mu S\,yE[t,a]\,yI[t,a]^2-kE^3\,\beta^2\,\epsilon^2\,\mu I\,yI[t,a]^3+2\,kE^3\,\beta\,\epsilon\,\mu I^2\,yI[t,a]^3-\\
&kE^3\,\mu I^3\,yI[t,a]^3-kE^3\,\beta\,\epsilon^2\,\mu I\,\mu S\,yI[t,a]^3+kE^3\,\epsilon\,\mu I^2\,\mu S\,yI[t,a]^3+\\
&kI^3\,\delta^2\,\epsilon\,yE[t,a]^2\,yE^{(0,1)}[t,a]+2\,kE\,kI^2\,\beta\,\delta\,\epsilon^2\,yE[t,a]\,yI[t,a]\,yE^{(0,1)}[t,a]-\\
&2\,kE\,kI^2\,\delta\,\epsilon\,\mu I\,yE[t,a]\,yI[t,a]\,yE^{(0,1)}[t,a]+kE^2\,kI\,\beta\,\delta\,\epsilon^2\,yI[t,a]^2\,yE^{(0,1)}[t,a]-\\
&kE^2\,kI\,\beta\,\epsilon^2\,\mu I\,yI[t,a]^2\,yE^{(0,1)}[t,a]+kE^2\,kI\,\epsilon\,\mu I^2\,yI[t,a]^2\,yE^{(0,1)}[t,a]-\\
&2\,kE^2\,kI^2\,m\,\delta\,\epsilon\,T[a]\,yE[t,a]\,yI^{(0,1)}[t,a]-3\,kE\,kI^2\,\delta^2\,yE[t,a]^2\,yI^{(0,1)}[t,a]+\\
&kE\,kI^2\,\delta^2\,\epsilon\,yE[t,a]^2\,yI^{(0,1)}[t,a]-kE\,kI^2\,\beta\,\delta\,\epsilon^2\,yE[t,a]^2\,yI^{(0,1)}[t,a]-\\
&2\,kE\,kI^2\,\delta\,\epsilon\,\mu S\,yE[t,a]^2\,yI^{(0,1)}[t,a]-2\,kE^3\,kI\,m\,\beta\,\epsilon^2\,T[a]\,yI[t,a]\,yI^{(0,1)}[t,a]+\\
&2\,kE^3\,kI\,m\,\epsilon\,\mu I\,T[a]\,yI[t,a]\,yI^{(0,1)}[t,a]-4\,kE^2\,kI\,\beta\,\delta\,\epsilon\,yE[t,a]\,yI[t,a]\,yI^{(0,1)}[t,a]+\\
&6\,kE^2\,kI\,\delta\,\mu I\,yE[t,a]\,yI[t,a]\,yI^{(0,1)}[t,a]-2\,kE^2\,kI\,\delta\,\epsilon\,\mu I\,yE[t,a]\,yI[t,a]\,yI^{(0,1)}[t,a]-\\
&2\,kE^2\,kI\,\delta\,\epsilon\,\mu S\,yE[t,a]\,yI[t,a]\,yI^{(0,1)}[t,a]-\\
&kE^2\,kI\,\beta\,\epsilon^2\,\mu S\,yE[t,a]\,yI[t,a]\,yI^{(0,1)}[t,a]+\\
&2\,kE^2\,kI\,\epsilon\,\mu I\,\mu S\,yE[t,a]\,yI[t,a]\,yI^{(0,1)}[t,a]-kE^3\,\beta^2\,\epsilon^2\,yI[t,a]^2\,yI^{(0,1)}[t,a]+\\
&4\,kE^3\,\beta\,\epsilon\,\mu I\,yI[t,a]^2\,yI^{(0,1)}[t,a]-kE^3\,\beta\,\epsilon^2\,\mu I\,yI[t,a]^2\,yI^{(0,1)}[t,a]-\\
&3\,kE^3\,\mu I^2\,yI[t,a]^2\,yI^{(0,1)}[t,a]+kE^3\,\epsilon\,\mu I^2\,yI[t,a]^2\,yI^{(0,1)}[t,a]-\\
&kE^3\,\beta\,\epsilon^2\,\mu S\,yI[t,a]^2\,yI^{(0,1)}[t,a]+2\,kE^3\,\epsilon\,\mu I\,\mu S\,yI[t,a]^2\,yI^{(0,1)}[t,a]-\\
&2\,kE\,kI^2\,\delta\,\epsilon\,yE[t,a]\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a]-\\
&kE^2\,kI\,\beta\,\epsilon^2\,yI[t,a]\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a]+\\
&2\,kE^2\,kI\,\epsilon\,\mu I\,yI[t,a]\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a]+kE^3\,kI\,m\,\epsilon\,T[a]\,yI^{(0,1)}[t,a]^2+\\
&3\,kE^2\,kI\,\delta\,yE[t,a]\,yI^{(0,1)}[t,a]^2-2\,kE^2\,kI\,\delta\,\epsilon\,yE[t,a]\,yI^{(0,1)}[t,a]^2+\\
&kE^2\,kI\,\beta\,\epsilon^2\,yE[t,a]\,yI^{(0,1)}[t,a]^2+kE^2\,kI\,\epsilon\,\mu S\,yE[t,a]\,yI^{(0,1)}[t,a]^2+
\end{aligned}$$

$$
\begin{aligned}
&2\,kE^3\,\beta\,\epsilon\,yI[t,a]\,yI^{(0,1)}[t,a]^2 - 3\,kE^3\,\mu I\,yI[t,a]\,yI^{(0,1)}[t,a]^2 + \\
&2\,kE^3\,\epsilon\,\mu I\,yI[t,a]\,yI^{(0,1)}[t,a]^2 + kE^3\,\epsilon\,\mu S\,yI[t,a]\,yI^{(0,1)}[t,a]^2 + \\
&kE^2\,kI\,\epsilon\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a]^2 - kE^3\,yI^{(0,1)}[t,a]^3 + kE^3\,\epsilon\,yI^{(0,1)}[t,a]^3 - \\
&kE^2\,kI\,\beta\,\epsilon^2\,yE[t,a]\,yI[t,a]\,yI^{(0,2)}[t,a] - kE^3\,\beta\,\epsilon^2\,yI[t,a]^2\,yI^{(0,2)}[t,a] + \\
&kI^3\,\delta^2\,\epsilon\,yE[t,a]^2\,yE^{(1,0)}[t,a] + 2\,kE\,kI^2\,\beta\,\delta\,\epsilon^2\,yE[t,a]\,yI[t,a]\,yE^{(1,0)}[t,a] - \\
&2\,kE\,kI^2\,\delta\,\epsilon\,\mu I\,yE[t,a]\,yI[t,a]\,yE^{(1,0)}[t,a] + kE^2\,kI\,\beta\,\delta\,\epsilon^2\,yI[t,a]^2\,yE^{(1,0)}[t,a] - \\
&kE^2\,kI\,\beta\,\epsilon^2\,\mu I\,yI[t,a]^2\,yE^{(1,0)}[t,a] + kE^2\,kI\,\epsilon\,\mu I^2\,yI[t,a]^2\,yE^{(1,0)}[t,a] - \\
&2\,kE\,kI^2\,\delta\,\epsilon\,yE[t,a]\,yI^{(0,1)}[t,a]\,yE^{(1,0)}[t,a] - \\
&kE^2\,kI\,\beta\,\epsilon^2\,yI[t,a]\,yI^{(0,1)}[t,a]\,yE^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\epsilon\,\mu I\,yI[t,a]\,yI^{(0,1)}[t,a]\,yE^{(1,0)}[t,a] + kE^2\,kI\,\epsilon\,yI^{(0,1)}[t,a]^2\,yE^{(1,0)}[t,a] - \\
&2\,kE^2\,kI^2\,m\,\delta\,\epsilon\,T[a]\,yE[t,a]\,yI^{(1,0)}[t,a] - 3\,kE\,kI^2\,\delta^2\,yE[t,a]^2\,yI^{(1,0)}[t,a] + \\
&kE\,kI^2\,\delta^2\,\epsilon\,yE[t,a]^2\,yI^{(1,0)}[t,a] - kE\,kI^2\,\beta\,\delta\,\epsilon^2\,yE[t,a]^2\,yI^{(1,0)}[t,a] - \\
&2\,kE\,kI^2\,\delta\,\epsilon\,\mu S\,yE[t,a]^2\,yI^{(1,0)}[t,a] - 2\,kE^3\,kI\,m\,\beta\,\epsilon^2\,T[a]\,yI[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^3\,kI\,m\,\epsilon\,\mu I\,T[a]\,yI[t,a]\,yI^{(1,0)}[t,a] - 4\,kE^2\,kI\,\beta\,\delta\,\epsilon\,yE[t,a]\,yI[t,a]\,yI^{(1,0)}[t,a] + \\
&6\,kE^2\,kI\,\delta\,\mu I\,yE[t,a]\,yI[t,a]\,yI^{(1,0)}[t,a] - 2\,kE^2\,kI\,\delta\,\epsilon\,\mu I\,yE[t,a]\,yI[t,a]\,yI^{(1,0)}[t,a] - \\
&2\,kE^2\,kI\,\delta\,\epsilon\,\mu S\,yE[t,a]\,yI[t,a]\,yI^{(1,0)}[t,a] - \\
&kE^2\,kI\,\beta\,\epsilon^2\,\mu S\,yE[t,a]\,yI[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\epsilon\,\mu I\,\mu S\,yE[t,a]\,yI[t,a]\,yI^{(1,0)}[t,a] - kE^3\,\beta^2\,\epsilon^2\,yI[t,a]^2\,yI^{(1,0)}[t,a] + \\
&4\,kE^3\,\beta\,\epsilon\,\mu I\,yI[t,a]^2\,yI^{(1,0)}[t,a] - kE^3\,\beta\,\epsilon^2\,\mu I\,yI[t,a]^2\,yI^{(1,0)}[t,a] - \\
&3\,kE^3\,\mu I^2\,yI[t,a]^2\,yI^{(1,0)}[t,a] + kE^3\,\epsilon\,\mu I^2\,yI[t,a]^2\,yI^{(1,0)}[t,a] - \\
&kE^3\,\beta\,\epsilon^2\,\mu S\,yI[t,a]^2\,yI^{(1,0)}[t,a] + 2\,kE^3\,\epsilon\,\mu I\,\mu S\,yI[t,a]^2\,yI^{(1,0)}[t,a] - \\
&2\,kE\,kI^2\,\delta\,\epsilon\,yE[t,a]\,yE^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] - \\
&kE^2\,kI\,\beta\,\epsilon^2\,yI[t,a]\,yE^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\epsilon\,\mu I\,yI[t,a]\,yE^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^3\,kI\,m\,\epsilon\,T[a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + 6\,kE^2\,kI\,\delta\,yE[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] - \\
&4\,kE^2\,kI\,\delta\,\epsilon\,yE[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\beta\,\epsilon^2\,yE[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\epsilon\,\mu S\,yE[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&4\,kE^3\,\beta\,\epsilon\,yI[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] - 6\,kE^3\,\mu I\,yI[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&4\,kE^3\,\epsilon\,\mu I\,yI[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^3\,\epsilon\,\mu S\,yI[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\epsilon\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a] - 3\,kE^3\,yI^{(0,1)}[t,a]^2\,yI^{(1,0)}[t,a] + \\
&3\,kE^3\,\epsilon\,yI^{(0,1)}[t,a]^2\,yI^{(1,0)}[t,a] - 2\,kE\,kI^2\,\delta\,\epsilon\,yE[t,a]\,yE^{(1,0)}[t,a]\,yI^{(1,0)}[t,a] - \\
&kE^2\,kI\,\beta\,\epsilon^2\,yI[t,a]\,yE^{(1,0)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\epsilon\,\mu I\,yI[t,a]\,yE^{(1,0)}[t,a]\,yI^{(1,0)}[t,a] + \\
&2\,kE^2\,kI\,\epsilon\,yI^{(0,1)}[t,a]\,yE^{(1,0)}[t,a]\,yI^{(1,0)}[t,a] + \\
&kE^3\,kI\,m\,\epsilon\,T[a]\,yI^{(1,0)}[t,a]^2 + 3\,kE^2\,kI\,\delta\,yE[t,a]\,yI^{(1,0)}[t,a]^2 - \\
&2\,kE^2\,kI\,\delta\,\epsilon\,yE[t,a]\,yI^{(1,0)}[t,a]^2 + kE^2\,kI\,\beta\,\epsilon^2\,yE[t,a]\,yI^{(1,0)}[t,a]^2 + \\
&kE^2\,kI\,\epsilon\,\mu S\,yE[t,a]\,yI^{(1,0)}[t,a]^2 + 2\,kE^3\,\beta\,\epsilon\,yI[t,a]\,yI^{(1,0)}[t,a]^2 - \\
&3\,kE^3\,\mu I\,yI[t,a]\,yI^{(1,0)}[t,a]^2 + 2\,kE^3\,\epsilon\,\mu I\,yI[t,a]\,yI^{(1,0)}[t,a]^2 + \\
&kE^3\,\epsilon\,\mu S\,yI[t,a]\,yI^{(1,0)}[t,a]^2 + kE^2\,kI\,\epsilon\,yE^{(0,1)}[t,a]\,yI^{(1,0)}[t,a]^2 - \\
&3\,kE^3\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a]^2 + 3\,kE^3\,\epsilon\,yI^{(0,1)}[t,a]\,yI^{(1,0)}[t,a]^2 + \\
&kE^2\,kI\,\epsilon\,yE^{(1,0)}[t,a]\,yI^{(1,0)}[t,a]^2 - kE^3\,yI^{(1,0)}[t,a]^3 + kE^3\,\epsilon\,yI^{(1,0)}[t,a]^3 - \\
&2\,kE^2\,kI\,\beta\,\epsilon^2\,yE[t,a]\,yI[t,a]\,yI^{(1,1)}[t,a] - 2\,kE^3\,\beta\,\epsilon^2\,yI[t,a]^2\,yI^{(1,1)}[t,a] - \\
&kE^2\,kI\,\beta\,\epsilon^2\,yE[t,a]\,yI[t,a]\,yI^{(2,0)}[t,a] - kE^3\,\beta\,\epsilon^2\,yI[t,a]^2\,yI^{(2,0)}[t,a]
\end{aligned}
$$

$$-\text{kI}\,\delta\,\text{yE}[\text{t, a}]-\text{kI}\in\mu\text{E}\,\text{yE}[\text{t, a}]+\text{kE}\,\mu\text{I}\,\text{yI}[\text{t, a}]-\text{kE}\in\mu\text{I}\,\text{yI}[\text{t, a}]-\text{kI}\in\text{yE}^{(0,1)}[\text{t, a}]+\text{kE}\,\text{yI}^{(0,1)}[\text{t, a}]-\text{kE}\in\text{yI}^{(0,1)}[\text{t, a}]-\text{kI}\in\text{yE}^{(1,0)}[\text{t, a}]+\text{kE}\,\text{yI}^{(1,0)}[\text{t, a}]-\text{kE}\in\text{yI}^{(1,0)}[\text{t, a}]$$

```
Monos1 = Sort[MonomialList[IPOPish1[t, a], {yI[t, a], D[yI[t, a], t], D[yI[t, a], a],
    D[yI[t, a], t, a], D[yI[t, a], {t, 2}], D[yI[t, a], {a, 2}], D[yE[t, a], t],
    D[yE[t, a], a], D[yE[t, a], t, a], D[yE[t, a], {t, 2}], D[yE[t, a], {a, 2}]}]]
Monos2 = Sort[MonomialList[IPOPish2[t, a], {yI[t, a], D[yI[t, a], t], D[yI[t, a], a],
    D[yI[t, a], t, a], D[yI[t, a], {t, 2}], D[yI[t, a], {a, 2}], D[yE[t, a], t],
    D[yE[t, a], a], D[yE[t, a], t, a], D[yE[t, a], {t, 2}], D[yE[t, a], {a, 2}]}]]
```

$$\{\text{kE}\,\text{kI}^3\,\text{m}\,\delta^2\in\text{T}[\text{a}]\,\text{yE}[\text{t, a}]^2+\text{kI}^3\,\delta^3\,\text{yE}[\text{t, a}]^3+\text{kI}^3\,\delta^2\in\mu\text{S}\,\text{yE}[\text{t, a}]^3,$$
$$(2\,\text{kE}^2\,\text{kI}^2\,\text{m}\,\beta\,\delta\,\epsilon^2\,\text{T}[\text{a}]\,\text{yE}[\text{t, a}]-2\,\text{kE}^2\,\text{kI}^2\,\text{m}\,\delta\in\mu\text{I}\,\text{T}[\text{a}]\,\text{yE}[\text{t, a}]+2\,\text{kE}\,\text{kI}^2\,\beta\,\delta^2\in\text{yE}[\text{t, a}]^2-3\,\text{kE}\,\text{kI}^2\,\delta^2\,\mu\text{I}\,\text{yE}[\text{t, a}]^2+\text{kE}\,\text{kI}^2\,\delta^2\in\mu\text{S}\,\text{yE}[\text{t, a}]^2+\text{kE}\,\text{kI}^2\,\beta\,\delta\,\epsilon^2\,\mu\text{S}\,\text{yE}[\text{t, a}]^2-2\,\text{kE}\,\text{kI}^2\,\delta\in\mu\text{I}\,\mu\text{S}\,\text{yE}[\text{t, a}]^2)\,\text{yI}[\text{t, a}],$$
$$(\text{kE}^3\,\text{kI}\,\text{m}\,\beta^2\,\epsilon^3\,\text{T}[\text{a}]-2\,\text{kE}^3\,\text{kI}\,\text{m}\,\beta\,\epsilon^2\,\mu\text{I}\,\text{T}[\text{a}]+\text{kE}^3\,\text{kI}\,\text{m}\in\mu\text{I}^2\,\text{T}[\text{a}]+\text{kE}^2\,\text{kI}\,\beta^2\,\delta\,\epsilon^2\,\text{yE}[\text{t, a}]-4\,\text{kE}^2\,\text{kI}\,\beta\,\delta\in\mu\text{I}\,\text{yE}[\text{t, a}]+3\,\text{kE}^2\,\text{kI}\,\delta\,\mu\text{I}^2\,\text{yE}[\text{t, a}]+\text{kE}^2\,\text{kI}\,\beta\,\delta\,\epsilon^2\,\mu\text{S}\,\text{yE}[\text{t, a}]-2\,\text{kE}^2\,\text{kI}\,\delta\in\mu\text{I}\,\mu\text{S}\,\text{yE}[\text{t, a}]-\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2\,\mu\text{I}\,\mu\text{S}\,\text{yE}[\text{t, a}]+\text{kE}^2\,\text{kI}\in\mu\text{I}^2\,\mu\text{S}\,\text{yE}[\text{t, a}])\,\text{yI}[\text{t, a}]^2,$$
$$(-\text{kE}^3\,\beta^2\,\epsilon^2\,\mu\text{I}+2\,\text{kE}^3\,\beta\in\mu\text{I}^2-\text{kE}^3\,\mu\text{I}^3-\text{kE}^3\,\beta\,\epsilon^2\,\mu\text{I}\,\mu\text{S}+\text{kE}^3\in\mu\text{I}^2\,\mu\text{S})\,\text{yI}[\text{t, a}]^3,$$
$$\text{kI}^3\,\delta^2\in\text{yE}[\text{t, a}]^2\,\text{yE}^{(0,1)}[\text{t, a}],$$
$$(2\,\text{kE}\,\text{kI}^2\,\beta\,\delta\,\epsilon^2\,\text{yE}[\text{t, a}]-2\,\text{kE}\,\text{kI}^2\,\delta\in\mu\text{I}\,\text{yE}[\text{t, a}])\,\text{yI}[\text{t, a}]\,\text{yE}^{(0,1)}[\text{t, a}],$$
$$(\text{kE}^2\,\text{kI}\,\beta\,\delta\,\epsilon^2-\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2\,\mu\text{I}+\text{kE}^2\,\text{kI}\in\mu\text{I}^2)\,\text{yI}[\text{t, a}]^2\,\text{yE}^{(0,1)}[\text{t, a}],$$
$$(-2\,\text{kE}^2\,\text{kI}^2\,\text{m}\,\delta\in\text{T}[\text{a}]\,\text{yE}[\text{t, a}]-3\,\text{kE}\,\text{kI}^2\,\delta^2\,\text{yE}[\text{t, a}]^2+\text{kE}\,\text{kI}^2\,\delta^2\in\text{yE}[\text{t, a}]^2-\text{kE}\,\text{kI}^2\,\beta\,\delta\,\epsilon^2\,\text{yE}[\text{t, a}]^2-2\,\text{kE}\,\text{kI}^2\,\delta\in\mu\text{S}\,\text{yE}[\text{t, a}]^2)\,\text{yI}^{(0,1)}[\text{t, a}],$$
$$(-2\,\text{kE}^3\,\text{kI}\,\text{m}\,\beta\,\epsilon^2\,\text{T}[\text{a}]+2\,\text{kE}^3\,\text{kI}\,\text{m}\in\mu\text{I}\,\text{T}[\text{a}]-4\,\text{kE}^2\,\text{kI}\,\beta\,\delta\in\text{yE}[\text{t, a}]+6\,\text{kE}^2\,\text{kI}\,\delta\,\mu\text{I}\,\text{yE}[\text{t, a}]-2\,\text{kE}^2\,\text{kI}\,\delta\in\mu\text{I}\,\text{yE}[\text{t, a}]-2\,\text{kE}^2\,\text{kI}\,\delta\in\mu\text{S}\,\text{yE}[\text{t, a}]-\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2\,\mu\text{S}\,\text{yE}[\text{t, a}]+2\,\text{kE}^2\,\text{kI}\in\mu\text{I}\,\mu\text{S}\,\text{yE}[\text{t, a}])\,\text{yI}[\text{t, a}]\,\text{yI}^{(0,1)}[\text{t, a}],$$
$$(-\text{kE}^3\,\beta^2\,\epsilon^2+4\,\text{kE}^3\,\beta\in\mu\text{I}-\text{kE}^3\,\beta\,\epsilon^2\,\mu\text{I}-3\,\text{kE}^3\,\mu\text{I}^2+\text{kE}^3\in\mu\text{I}^2-\text{kE}^3\,\beta\,\epsilon^2\,\mu\text{S}+2\,\text{kE}^3\in\mu\text{I}\,\mu\text{S})\,\text{yI}[\text{t, a}]^2\,\text{yI}^{(0,1)}[\text{t, a}],$$
$$-2\,\text{kE}\,\text{kI}^2\,\delta\in\text{yE}[\text{t, a}]\,\text{yE}^{(0,1)}[\text{t, a}]\,\text{yI}^{(0,1)}[\text{t, a}],$$
$$(-\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2+2\,\text{kE}^2\,\text{kI}\in\mu\text{I})\,\text{yI}[\text{t, a}]\,\text{yE}^{(0,1)}[\text{t, a}]\,\text{yI}^{(0,1)}[\text{t, a}],$$
$$(\text{kE}^3\,\text{kI}\,\text{m}\in\text{T}[\text{a}]+3\,\text{kE}^2\,\text{kI}\,\delta\,\text{yE}[\text{t, a}]-2\,\text{kE}^2\,\text{kI}\,\delta\in\text{yE}[\text{t, a}]+\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2\,\text{yE}[\text{t, a}]+\text{kE}^2\,\text{kI}\in\mu\text{S}\,\text{yE}[\text{t, a}])\,\text{yI}^{(0,1)}[\text{t, a}]^2,$$
$$(2\,\text{kE}^3\,\beta\in-3\,\text{kE}^3\,\mu\text{I}+2\,\text{kE}^3\in\mu\text{I}+\text{kE}^3\in\mu\text{S})\,\text{yI}[\text{t, a}]\,\text{yI}^{(0,1)}[\text{t, a}]^2,$$
$$\text{kE}^2\,\text{kI}\in\text{yE}^{(0,1)}[\text{t, a}]\,\text{yI}^{(0,1)}[\text{t, a}]^2,\ (-\text{kE}^3+\text{kE}^3\in)\,\text{yI}^{(0,1)}[\text{t, a}]^3,$$
$$-\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2\,\text{yE}[\text{t, a}]\,\text{yI}[\text{t, a}]\,\text{yI}^{(0,2)}[\text{t, a}],$$
$$-\text{kE}^3\,\beta\,\epsilon^2\,\text{yI}[\text{t, a}]^2\,\text{yI}^{(0,2)}[\text{t, a}],\ \text{kI}^3\,\delta^2\in\text{yE}[\text{t, a}]^2\,\text{yE}^{(1,0)}[\text{t, a}],$$
$$(2\,\text{kE}\,\text{kI}^2\,\beta\,\delta\,\epsilon^2\,\text{yE}[\text{t, a}]-2\,\text{kE}\,\text{kI}^2\,\delta\in\mu\text{I}\,\text{yE}[\text{t, a}])\,\text{yI}[\text{t, a}]\,\text{yE}^{(1,0)}[\text{t, a}],$$
$$(\text{kE}^2\,\text{kI}\,\beta\,\delta\,\epsilon^2-\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2\,\mu\text{I}+\text{kE}^2\,\text{kI}\in\mu\text{I}^2)\,\text{yI}[\text{t, a}]^2\,\text{yE}^{(1,0)}[\text{t, a}],$$
$$-2\,\text{kE}\,\text{kI}^2\,\delta\in\text{yE}[\text{t, a}]\,\text{yI}^{(0,1)}[\text{t, a}]\,\text{yE}^{(1,0)}[\text{t, a}],$$
$$(-\text{kE}^2\,\text{kI}\,\beta\,\epsilon^2+2\,\text{kE}^2\,\text{kI}\in\mu\text{I})\,\text{yI}[\text{t, a}]\,\text{yI}^{(0,1)}[\text{t, a}]\,\text{yE}^{(1,0)}[\text{t, a}],$$
$$\text{kE}^2\,\text{kI}\in\text{yI}^{(0,1)}[\text{t, a}]^2\,\text{yE}^{(1,0)}[\text{t, a}],$$
$$(-2\,\text{kE}^2\,\text{kI}^2\,\text{m}\,\delta\in\text{T}[\text{a}]\,\text{yE}[\text{t, a}]-3\,\text{kE}\,\text{kI}^2\,\delta^2\,\text{yE}[\text{t, a}]^2+\text{kE}\,\text{kI}^2\,\delta^2\in\text{yE}[\text{t, a}]^2-\text{kE}\,\text{kI}^2\,\beta\,\delta\,\epsilon^2\,\text{yE}[\text{t, a}]^2-2\,\text{kE}\,\text{kI}^2\,\delta\in\mu\text{S}\,\text{yE}[\text{t, a}]^2)\,\text{yI}^{(1,0)}[\text{t, a}],$$
$$(-2\,\text{kE}^3\,\text{kI}\,\text{m}\,\beta\,\epsilon^2\,\text{T}[\text{a}]+2\,\text{kE}^3\,\text{kI}\,\text{m}\in\mu\text{I}\,\text{T}[\text{a}]-4\,\text{kE}^2\,\text{kI}\,\beta\,\delta\in\text{yE}[\text{t, a}]+6\,\text{kE}^2\,\text{kI}\,\delta\,\mu\text{I}\,\text{yE}[\text{t, a}]-2\,\text{kE}^2\,\text{kI}\,\delta\in\mu\text{I}\,\text{yE}[\text{t, a}]-2\,\text{kE}^2\,\text{kI}\,\delta\in\mu\text{S}\,\text{yE}[\text{t, a}]-$$

$$\begin{aligned}
&\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + 2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&\big(-\mathrm{kE}^3\,\beta^2\,\epsilon^2 + 4\,\mathrm{kE}^3\,\beta\,\epsilon\,\mu\mathrm{I} - \mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{I} - 3\,\mathrm{kE}^3\,\mu\mathrm{I}^2 + \mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}^2 - \mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{S} + 2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\big)\\
&\mathrm{yI}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}], -2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&\big(-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2 + 2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&\big(2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mathrm{T}[\mathrm{a}] + 6\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - 4\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}] +\\
&\quad 2\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + 2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\big)\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&\big(4\,\mathrm{kE}^3\,\beta\,\epsilon - 6\,\mathrm{kE}^3\,\mu\mathrm{I} + 4\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I} + 2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{S}\big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&\big(-3\,\mathrm{kE}^3 + 3\,\mathrm{kE}^3\,\epsilon\big)\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&-2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&\big(-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2 + 2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\\
&\big(\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mathrm{T}[\mathrm{a}] + 3\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - 2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}] +\\
&\quad \mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\big)\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2,\\
&\big(2\,\mathrm{kE}^3\,\beta\,\epsilon - 3\,\mathrm{kE}^3\,\mu\mathrm{I} + 2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I} + \mathrm{kE}^3\,\epsilon\,\mu\mathrm{S}\big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2,\\
&\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2, \big(-3\,\mathrm{kE}^3 + 3\,\mathrm{kE}^3\,\epsilon\big)\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2,\\
&\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2, \big(-\mathrm{kE}^3 + \mathrm{kE}^3\,\epsilon\big)\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^3,\\
&-2\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}], -2\,\mathrm{kE}^3\,\beta\,\epsilon^2\,\mathrm{yI}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}],\\
&-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(2,0)}[\mathrm{t},\mathrm{a}], -\mathrm{kE}^3\,\beta\,\epsilon^2\,\mathrm{yI}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(2,0)}[\mathrm{t},\mathrm{a}]\big\}
\end{aligned}$$

Out[95]=
$$\begin{aligned}
&\big\{-\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kI}\,\epsilon\,\mu\mathrm{E}\,\mathrm{yE}[\mathrm{t},\mathrm{a}], (\mathrm{kE}\,\mu\mathrm{I} - \mathrm{kE}\,\epsilon\,\mu\mathrm{I})\,\mathrm{yI}[\mathrm{t},\mathrm{a}], -\mathrm{kI}\,\epsilon\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}],\\
&(\mathrm{kE} - \mathrm{kE}\,\epsilon)\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}], -\mathrm{kI}\,\epsilon\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}], (\mathrm{kE} - \mathrm{kE}\,\epsilon)\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\big\}
\end{aligned}$$

```
MonicMonos1 =
 Monos1 / (Last[Monos1] /. {yI[t, a] → 1, D[yI[t, a], t] → 1, D[yI[t, a], a] → 1,
     D[yI[t, a], t, a] → 1, D[yI[t, a], {t, 2}] → 1, D[yI[t, a], {a, 2}] → 1,
     yE[t, a] → 1, D[yE[t, a], t] → 1, D[yE[t, a], a] → 1,
     D[yE[t, a], t, a] → 1, D[yE[t, a], {t, 2}] → 1, D[yE[t, a], {a, 2}] → 1})
MonicMonos2 = Monos2 / (Last[Monos2] /. {yI[t, a] → 1, D[yI[t, a], t] → 1,
     D[yI[t, a], a] → 1, D[yI[t, a], t, a] → 1, D[yI[t, a], {t, 2}] → 1,
     D[yI[t, a], {a, 2}] → 1, yE[t, a] → 1, D[yE[t, a], t] → 1, D[yE[t, a], a] → 1,
     D[yE[t, a], t, a] → 1, D[yE[t, a], {t, 2}] → 1, D[yE[t, a], {a, 2}] → 1})
```

$$\begin{aligned}
&\Big\{-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\big(\mathrm{kE}\,\mathrm{kI}^3\,\mathrm{m}\,\delta^2\,\epsilon\,\mathrm{T}[\mathrm{a}]\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2 + \mathrm{kI}^3\,\delta^3\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^3 + \mathrm{kI}^3\,\delta^2\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^3\big),\\
&-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\big(2\,\mathrm{kE}^2\,\mathrm{kI}^2\,\mathrm{m}\,\beta\,\delta\,\epsilon^2\,\mathrm{T}[\mathrm{a}]\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - 2\,\mathrm{kE}^2\,\mathrm{kI}^2\,\mathrm{m}\,\delta\,\epsilon\,\mu\mathrm{I}\,\mathrm{T}[\mathrm{a}]\,\mathrm{yE}[\mathrm{t},\mathrm{a}] +\\
&\quad 2\,\mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta^2\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2 - 3\,\mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\mu\mathrm{I}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2 + \mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2 +\\
&\quad \mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta\,\epsilon^2\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2 - 2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2\big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}],\\
&-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\big(\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\beta^2\,\epsilon^3\,\mathrm{T}[\mathrm{a}] - 2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\beta\,\epsilon^2\,\mu\mathrm{I}\,\mathrm{T}[\mathrm{a}] + \mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mu\mathrm{I}^2\,\mathrm{T}[\mathrm{a}] +\\
&\quad \mathrm{kE}^2\,\mathrm{kI}\,\beta^2\,\delta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - 4\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon\,\mu\mathrm{I}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + 3\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mu\mathrm{I}^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}] +\\
&\quad \mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon^2\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - 2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] -\\
&\quad \mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{I}\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}^2\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}]^2,
\end{aligned}$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-kE^3\,\beta^2\,\epsilon^2\,\mu I+2\,kE^3\,\beta\,\epsilon\,\mu I^2-kE^3\,\mu I^3-kE^3\,\beta\,\epsilon^2\,\mu I\,\mu S+kE^3\,\epsilon\,\mu I^2\,\mu S\right)\,yI[t,a]^3,$$

$$-\frac{kI^3\,\delta^2\,yE[t,a]^2\,yE^{(0,1)}[t,a]}{kE^3\,\beta\,\epsilon},$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(2\,kE\,kI^2\,\beta\,\delta\,\epsilon^2\,yE[t,a]-2\,kE\,kI^2\,\delta\,\epsilon\,\mu I\,yE[t,a]\right)\,yI[t,a]\,yE^{(0,1)}[t,a],$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(kE^2\,kI\,\beta\,\delta\,\epsilon^2-kE^2\,kI\,\beta\,\epsilon^2\,\mu I+kE^2\,kI\,\epsilon\,\mu I^2\right)\,yI[t,a]^2\,yE^{(0,1)}[t,a],$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-2\,kE^2\,kI^2\,m\,\delta\,\epsilon\,T[a]\,yE[t,a]-3\,kE\,kI^2\,\delta^2\,yE[t,a]^2+kE\,kI^2\,\delta^2\,\epsilon\,yE[t,a]^2-kE\,kI^2\,\beta\,\delta\,\epsilon^2\,yE[t,a]^2-2\,kE\,kI^2\,\delta\,\epsilon\,\mu S\,yE[t,a]^2\right)\,yI^{(0,1)}[t,a],$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-2\,kE^3\,kI\,m\,\beta\,\epsilon^2\,T[a]+2\,kE^3\,kI\,m\,\epsilon\,\mu I\,T[a]-4\,kE^2\,kI\,\beta\,\delta\,\epsilon\,yE[t,a]+6\,kE^2\,kI\,\delta\,\mu I\,yE[t,a]-2\,kE^2\,kI\,\delta\,\epsilon\,\mu I\,yE[t,a]-2\,kE^2\,kI\,\delta\,\epsilon\,\mu S\,yE[t,a]-kE^2\,kI\,\beta\,\epsilon^2\,\mu S\,yE[t,a]+2\,kE^2\,kI\,\epsilon\,\mu I\,\mu S\,yE[t,a]\right)\,yI[t,a]\,yI^{(0,1)}[t,a],$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-kE^3\,\beta^2\,\epsilon^2+4\,kE^3\,\beta\,\epsilon\,\mu I-kE^3\,\beta\,\epsilon^2\,\mu I-3\,kE^3\,\mu I^2+kE^3\,\epsilon\,\mu I^2-kE^3\,\beta\,\epsilon^2\,\mu S+2\,kE^3\,\epsilon\,\mu I\,\mu S\right)\,yI[t,a]^2\,yI^{(0,1)}[t,a],$$

$$\frac{2\,kI^2\,\delta\,yE[t,a]\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a]}{kE^2\,\beta\,\epsilon},$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-kE^2\,kI\,\beta\,\epsilon^2+2\,kE^2\,kI\,\epsilon\,\mu I\right)\,yI[t,a]\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a],$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(kE^3\,kI\,m\,\epsilon\,T[a]+3\,kE^2\,kI\,\delta\,yE[t,a]-2\,kE^2\,kI\,\delta\,\epsilon\,yE[t,a]+kE^2\,kI\,\beta\,\epsilon^2\,yE[t,a]+kE^2\,kI\,\epsilon\,\mu S\,yE[t,a]\right)\,yI^{(0,1)}[t,a]^2,$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(2\,kE^3\,\beta\,\epsilon-3\,kE^3\,\mu I+2\,kE^3\,\epsilon\,\mu I+kE^3\,\epsilon\,\mu S\right)\,yI[t,a]\,yI^{(0,1)}[t,a]^2,$$

$$-\frac{kI\,yE^{(0,1)}[t,a]\,yI^{(0,1)}[t,a]^2}{kE\,\beta\,\epsilon},$$

$$-\frac{\left(-kE^3+kE^3\,\epsilon\right)\,yI^{(0,1)}[t,a]^3}{kE^3\,\beta\,\epsilon^2},$$

$$\frac{kI\,yE[t,a]\,yI[t,a]\,yI^{(0,2)}[t,a]}{kE},$$

$$yI[t,a]^2\,yI^{(0,2)}[t,a],$$

$$-\frac{kI^3\,\delta^2\,yE[t,a]^2\,yE^{(1,0)}[t,a]}{kE^3\,\beta\,\epsilon},$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(2\,kE\,kI^2\,\beta\,\delta\,\epsilon^2\,yE[t,a]-2\,kE\,kI^2\,\delta\,\epsilon\,\mu I\,yE[t,a]\right)\,yI[t,a]\,yE^{(1,0)}[t,a],$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon^2-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{I}+\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}^2\right)\mathrm{yI}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}],$$

$$\frac{2\,\mathrm{kI}^2\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}^2\,\beta\,\epsilon},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\right)\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}],$$

$$-\frac{\mathrm{kI}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-2\,\mathrm{kE}^2\,\mathrm{kI}^2\,\mathrm{m}\,\delta\,\epsilon\,\mathrm{T}[\mathrm{a}]\,\mathrm{yE}[\mathrm{t},\mathrm{a}]-3\,\mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2+\mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2-\right.$$
$$\left.\mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2-2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]^2\right)\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\beta\,\epsilon^2\,\mathrm{T}[\mathrm{a}]+2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mu\mathrm{I}\,\mathrm{T}[\mathrm{a}]-4\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}]+\right.$$
$$6\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mu\mathrm{I}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]-2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{I}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]-2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]-$$
$$\left.\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\right)\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}$$
$$\left(-\mathrm{kE}^3\,\beta^2\,\epsilon^2+4\,\mathrm{kE}^3\,\beta\,\epsilon\,\mu\mathrm{I}-\mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{I}-3\,\mathrm{kE}^3\,\mu\mathrm{I}^2+\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}^2-\mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{S}+2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\right)$$
$$\mathrm{yI}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],\ \frac{2\,\mathrm{kI}^2\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}^2\,\beta\,\epsilon},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\right)\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mathrm{T}[\mathrm{a}]+6\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}]-4\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}]+\right.$$
$$\left.2\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}]+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\right)\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(4\,\mathrm{kE}^3\,\beta\,\epsilon-6\,\mathrm{kE}^3\,\mu\mathrm{I}+4\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}+2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{S}\right)\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],$$

$$-\frac{2\,\mathrm{kI}\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{\left(-3\,\mathrm{kE}^3+3\,\mathrm{kE}^3\,\epsilon\right)\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$\frac{2\,\mathrm{kI}^2\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}^2\,\beta\,\epsilon},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\right)\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}],$$

$$-\frac{2\,\mathrm{kI}\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mathrm{T}[\mathrm{a}]+3\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}]-2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mathrm{yE}[\mathrm{t},\mathrm{a}]+\right.$$

$$\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mathrm{yE}[\mathrm{t},\mathrm{a}] + \mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{S}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\Big)\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2,$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\Big(2\,\mathrm{kE}^3\,\beta\,\epsilon - 3\,\mathrm{kE}^3\,\mu\mathrm{I} + 2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I} + \mathrm{kE}^3\,\epsilon\,\mu\mathrm{S}\Big)\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2,$$

$$-\frac{\mathrm{kI}\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{\left(-3\,\mathrm{kE}^3 + 3\,\mathrm{kE}^3\,\epsilon\right)\,\mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{\mathrm{kI}\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^2}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{\left(-\mathrm{kE}^3 + \mathrm{kE}^3\,\epsilon\right)\,\mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]^3}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$\frac{2\,\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}},$$

$$2\,\mathrm{yI}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(1,1)}[\mathrm{t},\mathrm{a}],$$

$$\frac{\mathrm{kI}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}[\mathrm{t},\mathrm{a}]\,\mathrm{yI}^{(2,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE}},$$

$$\mathrm{yI}[\mathrm{t},\mathrm{a}]^2\,\mathrm{yI}^{(2,0)}[\mathrm{t},\mathrm{a}]\Big\}$$

$$\Big\{\frac{-\mathrm{kI}\,\delta\,\mathrm{yE}[\mathrm{t},\mathrm{a}] - \mathrm{kI}\,\epsilon\,\mu\mathrm{E}\,\mathrm{yE}[\mathrm{t},\mathrm{a}]}{\mathrm{kE} - \mathrm{kE}\,\epsilon},\ \frac{(\mathrm{kE}\,\mu\mathrm{I} - \mathrm{kE}\,\epsilon\,\mu\mathrm{I})\,\mathrm{yI}[\mathrm{t},\mathrm{a}]}{\mathrm{kE} - \mathrm{kE}\,\epsilon},$$

$$-\frac{\mathrm{kI}\,\epsilon\,\mathrm{yE}^{(0,1)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE} - \mathrm{kE}\,\epsilon},\ \mathrm{yI}^{(0,1)}[\mathrm{t},\mathrm{a}],\ -\frac{\mathrm{kI}\,\epsilon\,\mathrm{yE}^{(1,0)}[\mathrm{t},\mathrm{a}]}{\mathrm{kE} - \mathrm{kE}\,\epsilon},\ \mathrm{yI}^{(1,0)}[\mathrm{t},\mathrm{a}]\Big\}$$

```
Coeffs1 = MonicMonos1 /. {yI[t, a] → 1, D[yI[t, a], t] → 1, D[yI[t, a], a] → 1,
    D[yI[t, a], t, a] → 1, D[yI[t, a], {t, 2}] → 1, D[yI[t, a], {a, 2}] → 1,
    yE[t, a] → 1, D[yE[t, a], t] → 1, D[yE[t, a], a] → 1, D[yE[t, a], t, a] → 1,
    D[yE[t, a], {t, 2}] → 1, D[yE[t, a], {a, 2}] → 1, T[a] → 1}
Coeffs2 = MonicMonos2 /. {yI[t, a] → 1, D[yI[t, a], t] → 1, D[yI[t, a], a] → 1,
    D[yI[t, a], t, a] → 1, D[yI[t, a], {t, 2}] → 1, D[yI[t, a], {a, 2}] → 1,
    yE[t, a] → 1, D[yE[t, a], t] → 1, D[yE[t, a], a] → 1, D[yE[t, a], t, a] → 1,
    D[yE[t, a], {t, 2}] → 1, D[yE[t, a], {a, 2}] → 1, T[a] → 1}
```

$$\Big\{-\frac{\mathrm{kI}^3\,\delta^3 + \mathrm{kE}\,\mathrm{kI}^3\,\mathrm{m}\,\delta^2\,\epsilon + \mathrm{kI}^3\,\delta^2\,\epsilon\,\mu\mathrm{S}}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\Big(2\,\mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta^2\,\epsilon + 2\,\mathrm{kE}^2\,\mathrm{kI}^2\,\mathrm{m}\,\beta\,\delta\,\epsilon^2 - 3\,\mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\mu\mathrm{I} -$$
$$2\,\mathrm{kE}^2\,\mathrm{kI}^2\,\mathrm{m}\,\delta\,\epsilon\,\mu\mathrm{I} + \mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\epsilon\,\mu\mathrm{S} + \mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta\,\epsilon^2\,\mu\mathrm{S} - 2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\Big),$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\Big(\mathrm{kE}^2\,\mathrm{kI}\,\beta^2\,\delta\,\epsilon^2 + \mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\beta^2\,\epsilon^3 - 4\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon\,\mu\mathrm{I} - 2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\beta\,\epsilon^2\,\mu\mathrm{I} + 3\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mu\mathrm{I}^2 +$$
$$\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mu\mathrm{I}^2 + \mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon^2\,\mu\mathrm{S} - 2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S} - \mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{I}\,\mu\mathrm{S} + \mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}^2\,\mu\mathrm{S}\Big),$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\Big(-\mathrm{kE}^3\,\beta^2\,\epsilon^2\,\mu\mathrm{I} + 2\,\mathrm{kE}^3\,\beta\,\epsilon\,\mu\mathrm{I}^2 - \mathrm{kE}^3\,\mu\mathrm{I}^3 - \mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{I}\,\mu\mathrm{S} + \mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}^2\,\mu\mathrm{S}\Big),$$

$$-\frac{\mathrm{kI}^3\,\delta^2}{\mathrm{kE}^3\,\beta\,\epsilon},\ -\frac{2\,\mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta\,\epsilon^2-2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mu\mathrm{I}}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon^2-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{I}+\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}^2}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-3\,\mathrm{kE}\,\mathrm{kI}^2\,\delta^2-2\,\mathrm{kE}^2\,\mathrm{kI}^2\,\mathrm{m}\,\delta\,\epsilon+\mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\epsilon-\mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta\,\epsilon^2-2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mu\mathrm{S}\right),$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-4\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon-2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\beta\,\epsilon^2+6\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mu\mathrm{I}+2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mu\mathrm{I}-\right.$$
$$\left.2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{I}-2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{S}-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{S}+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\right),\ -\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}$$
$$\left(-\mathrm{kE}^3\,\beta^2\,\epsilon^2+4\,\mathrm{kE}^3\,\beta\,\epsilon\,\mu\mathrm{I}-\mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{I}-3\,\mathrm{kE}^3\,\mu\mathrm{I}^2+\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}^2-\mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{S}+2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\right),$$

$$\frac{2\,\mathrm{kI}^2\,\delta}{\mathrm{kE}^2\,\beta\,\epsilon},\ -\frac{-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{3\,\mathrm{kE}^2\,\mathrm{kI}\,\delta+\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon-2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon+\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{S}}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{2\,\mathrm{kE}^3\,\beta\,\epsilon-3\,\mathrm{kE}^3\,\mu\mathrm{I}+2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}+\mathrm{kE}^3\,\epsilon\,\mu\mathrm{S}}{\mathrm{kE}^3\,\beta\,\epsilon^2},\ -\frac{\mathrm{kI}}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{-\mathrm{kE}^3+\mathrm{kE}^3\,\epsilon}{\mathrm{kE}^3\,\beta\,\epsilon^2},\ \frac{\mathrm{kI}}{\mathrm{kE}},\ 1,\ -\frac{\mathrm{kI}^3\,\delta^2}{\mathrm{kE}^3\,\beta\,\epsilon},\ -\frac{2\,\mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta\,\epsilon^2-2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mu\mathrm{I}}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon^2-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{I}+\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}^2}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$\frac{2\,\mathrm{kI}^2\,\delta}{\mathrm{kE}^2\,\beta\,\epsilon},\ -\frac{-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}}{\mathrm{kE}^3\,\beta\,\epsilon^2},\ -\frac{\mathrm{kI}}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-3\,\mathrm{kE}\,\mathrm{kI}^2\,\delta^2-2\,\mathrm{kE}^2\,\mathrm{kI}^2\,\mathrm{m}\,\delta\,\epsilon+\mathrm{kE}\,\mathrm{kI}^2\,\delta^2\,\epsilon-\mathrm{kE}\,\mathrm{kI}^2\,\beta\,\delta\,\epsilon^2-2\,\mathrm{kE}\,\mathrm{kI}^2\,\delta\,\epsilon\,\mu\mathrm{S}\right),$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(-4\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\delta\,\epsilon-2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\beta\,\epsilon^2+6\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\mu\mathrm{I}+2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon\,\mu\mathrm{I}-\right.$$
$$\left.2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{I}-2\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon\,\mu\mathrm{S}-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2\,\mu\mathrm{S}+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\right),\ -\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}$$
$$\left(-\mathrm{kE}^3\,\beta^2\,\epsilon^2+4\,\mathrm{kE}^3\,\beta\,\epsilon\,\mu\mathrm{I}-\mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{I}-3\,\mathrm{kE}^3\,\mu\mathrm{I}^2+\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}^2-\mathrm{kE}^3\,\beta\,\epsilon^2\,\mu\mathrm{S}+2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}\,\mu\mathrm{S}\right),$$

$$\frac{2\,\mathrm{kI}^2\,\delta}{\mathrm{kE}^2\,\beta\,\epsilon},\ -\frac{-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}}{\mathrm{kE}^3\,\beta\,\epsilon^2},$$

$$-\frac{1}{\mathrm{kE}^3\,\beta\,\epsilon^2}\left(6\,\mathrm{kE}^2\,\mathrm{kI}\,\delta+2\,\mathrm{kE}^3\,\mathrm{kI}\,\mathrm{m}\,\epsilon-4\,\mathrm{kE}^2\,\mathrm{kI}\,\delta\,\epsilon+2\,\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{S}\right),$$

$$-\frac{4\,\mathrm{kE}^3\,\beta\,\epsilon-6\,\mathrm{kE}^3\,\mu\mathrm{I}+4\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{I}+2\,\mathrm{kE}^3\,\epsilon\,\mu\mathrm{S}}{\mathrm{kE}^3\,\beta\,\epsilon^2},\ -\frac{2\,\mathrm{kI}}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{-3\,\mathrm{kE}^3+3\,\mathrm{kE}^3\,\epsilon}{\mathrm{kE}^3\,\beta\,\epsilon^2},\ \frac{2\,\mathrm{kI}^2\,\delta}{\mathrm{kE}^2\,\beta\,\epsilon},\ -\frac{-\mathrm{kE}^2\,\mathrm{kI}\,\beta\,\epsilon^2+2\,\mathrm{kE}^2\,\mathrm{kI}\,\epsilon\,\mu\mathrm{I}}{\mathrm{kE}^3\,\beta\,\epsilon^2},\ -\frac{2\,\mathrm{kI}}{\mathrm{kE}\,\beta\,\epsilon},$$

$$-\frac{3\,kE^2\,kI\,\delta+kE^3\,kI\,m\,\epsilon-2\,kE^2\,kI\,\delta\,\epsilon+kE^2\,kI\,\beta\,\epsilon^2+kE^2\,kI\,\epsilon\,\mu S}{kE^3\,\beta\,\epsilon^2},$$

$$-\frac{2\,kE^3\,\beta\,\epsilon-3\,kE^3\,\mu I+2\,kE^3\,\epsilon\,\mu I+kE^3\,\epsilon\,\mu S}{kE^3\,\beta\,\epsilon^2},\ -\frac{kI}{kE\,\beta\,\epsilon},$$

$$-\frac{-3\,kE^3+3\,kE^3\,\epsilon}{kE^3\,\beta\,\epsilon^2},\ -\frac{kI}{kE\,\beta\,\epsilon},\ -\frac{-kE^3+kE^3\,\epsilon}{kE^3\,\beta\,\epsilon^2},\ \frac{2\,kI}{kE},\ 2,\ \frac{kI}{kE},\ 1\Big\}$$

$$\Big\{\frac{-kI\,\delta-kI\,\epsilon\,\mu E}{kE-kE\,\epsilon},\ \frac{kE\,\mu I-kE\,\epsilon\,\mu I}{kE-kE\,\epsilon},\ -\frac{kI\,\epsilon}{kE-kE\,\epsilon},\ 1,\ -\frac{kI\,\epsilon}{kE-kE\,\epsilon},\ 1\Big\}$$

Coeffs = Union[Coeffs1, Coeffs2]

$$\Big\{1,\ 2,\ \frac{kI}{kE},\ \frac{2\,kI}{kE},\ -\frac{2\,kI}{kE\,\beta\,\epsilon},\ -\frac{kI}{kE\,\beta\,\epsilon},\ \frac{2\,kI^2\,\delta}{kE^2\,\beta\,\epsilon},\ -\frac{kI^3\,\delta^2}{kE^3\,\beta\,\epsilon},\ -\frac{kI\,\epsilon}{kE-kE\,\epsilon},\ -\frac{-kE^3+kE^3\,\epsilon}{kE^3\,\beta\,\epsilon^2},$$

$$-\frac{-3\,kE^3+3\,kE^3\,\epsilon}{kE^3\,\beta\,\epsilon^2},\ \frac{-kI\,\delta-kI\,\epsilon\,\mu E}{kE-kE\,\epsilon},\ \frac{kE\,\mu I-kE\,\epsilon\,\mu I}{kE-kE\,\epsilon},\ -\frac{-kE^2\,kI\,\beta\,\epsilon^2+2\,kE^2\,kI\,\epsilon\,\mu I}{kE^3\,\beta\,\epsilon^2},$$

$$-\frac{2\,kE\,kI^2\,\beta\,\delta\,\epsilon^2-2\,kE\,kI^2\,\delta\,\epsilon\,\mu I}{kE^3\,\beta\,\epsilon^2},\ -\frac{kE^2\,kI\,\beta\,\delta\,\epsilon^2-kE^2\,kI\,\beta\,\epsilon^2\,\mu I+kE^2\,kI\,\epsilon\,\mu I^2}{kE^3\,\beta\,\epsilon^2},$$

$$-\frac{2\,kE^3\,\beta\,\epsilon-3\,kE^3\,\mu I+2\,kE^3\,\epsilon\,\mu I+kE^3\,\epsilon\,\mu S}{kE^3\,\beta\,\epsilon^2},\ -\frac{4\,kE^3\,\beta\,\epsilon-6\,kE^3\,\mu I+4\,kE^3\,\epsilon\,\mu I+2\,kE^3\,\epsilon\,\mu S}{kE^3\,\beta\,\epsilon^2},$$

$$-\frac{3\,kE^2\,kI\,\delta+kE^3\,kI\,m\,\epsilon-2\,kE^2\,kI\,\delta\,\epsilon+kE^2\,kI\,\beta\,\epsilon^2+kE^2\,kI\,\epsilon\,\mu S}{kE^3\,\beta\,\epsilon^2},$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(6\,kE^2\,kI\,\delta+2\,kE^3\,kI\,m\,\epsilon-4\,kE^2\,kI\,\delta\,\epsilon+2\,kE^2\,kI\,\beta\,\epsilon^2+2\,kE^2\,kI\,\epsilon\,\mu S\right),$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-3\,kE\,kI^2\,\delta^2-2\,kE^2\,kI^2\,m\,\delta\,\epsilon+kE\,kI^2\,\delta^2\,\epsilon-kE\,kI^2\,\beta\,\delta\,\epsilon^2-2\,kE\,kI^2\,\delta\,\epsilon\,\mu S\right),$$

$$-\frac{kI^3\,\delta^3+kE\,kI^3\,m\,\delta^2\,\epsilon+kI^3\,\delta^2\,\epsilon\,\mu S}{kE^3\,\beta\,\epsilon^2},\ -\frac{1}{kE^3\,\beta\,\epsilon^2}$$

$$\left(-kE^3\,\beta^2\,\epsilon^2+4\,kE^3\,\beta\,\epsilon\,\mu I-kE^3\,\beta\,\epsilon^2\,\mu I-3\,kE^3\,\mu I^2+kE^3\,\epsilon\,\mu I^2-kE^3\,\beta\,\epsilon^2\,\mu S+2\,kE^3\,\epsilon\,\mu I\,\mu S\right),$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-4\,kE^2\,kI\,\beta\,\delta\,\epsilon-2\,kE^3\,kI\,m\,\beta\,\epsilon^2+6\,kE^2\,kI\,\delta\,\mu I+2\,kE^3\,kI\,m\,\epsilon\,\mu I-\right.$$
$$\left.2\,kE^2\,kI\,\delta\,\epsilon\,\mu I-2\,kE^2\,kI\,\delta\,\epsilon\,\mu S-kE^2\,kI\,\beta\,\epsilon^2\,\mu S+2\,kE^2\,kI\,\epsilon\,\mu I\,\mu S\right),$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(2\,kE\,kI^2\,\beta\,\delta^2\,\epsilon+2\,kE^2\,kI^2\,m\,\beta\,\delta\,\epsilon^2-3\,kE\,kI^2\,\delta^2\,\mu I-2\,kE^2\,kI^2\,m\,\delta\,\epsilon\,\mu I+\right.$$
$$\left.kE\,kI^2\,\delta^2\,\epsilon\,\mu S+kE\,kI^2\,\beta\,\delta\,\epsilon^2\,\mu S-2\,kE\,kI^2\,\delta\,\epsilon\,\mu I\,\mu S\right),$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(-kE^3\,\beta^2\,\epsilon^2\,\mu I+2\,kE^3\,\beta\,\epsilon\,\mu I^2-kE^3\,\mu I^3-kE^3\,\beta\,\epsilon^2\,\mu I\,\mu S+kE^3\,\epsilon\,\mu I^2\,\mu S\right),$$

$$-\frac{1}{kE^3\,\beta\,\epsilon^2}\left(kE^2\,kI\,\beta^2\,\delta\,\epsilon^2+kE^3\,kI\,m\,\beta^2\,\epsilon^3-4\,kE^2\,kI\,\beta\,\delta\,\epsilon\,\mu I-2\,kE^3\,kI\,m\,\beta\,\epsilon^2\,\mu I+3\,kE^2\,kI\,\delta\,\mu I^2+\right.$$
$$\left.kE^3\,kI\,m\,\epsilon\,\mu I^2+kE^2\,kI\,\beta\,\delta\,\epsilon^2\,\mu S-2\,kE^2\,kI\,\delta\,\epsilon\,\mu I\,\mu S-kE^2\,kI\,\beta\,\epsilon^2\,\mu I\,\mu S+kE^2\,kI\,\epsilon\,\mu I^2\,\mu S\right)\Big\}$$

```
xCoeffs = Coeffs /.
  {β → a1, δ → a2, ϵ → a3, μS → a4, μE → a5, μI → a6, c → a7, kE → a8, kI → a9, m → a10}
```

$$\left\{1,\ 2,\ \frac{a9}{a8},\ \frac{2\,a9}{a8},\ -\frac{2\,a9}{a1\,a3\,a8},\ -\frac{a9}{a1\,a3\,a8},\ \frac{2\,a2\,a9^2}{a1\,a3\,a8^2},\ -\frac{a2^2\,a9^3}{a1\,a3\,a8^3},\ -\frac{a3\,a9}{a8-a3\,a8},\ -\frac{-a8^3+a3\,a8^3}{a1\,a3^2\,a8^3},\right.$$

$$-\frac{-3\,a8^3+3\,a3\,a8^3}{a1\,a3^2\,a8^3},\ \frac{-a2\,a9-a3\,a5\,a9}{a8-a3\,a8},\ \frac{a6\,a8-a3\,a6\,a8}{a8-a3\,a8},\ -\frac{-a1\,a3^2\,a8^2\,a9+2\,a3\,a6\,a8^2\,a9}{a1\,a3^2\,a8^3},$$

$$-\frac{2\,a1\,a2\,a3^2\,a8\,a9^2-2\,a2\,a3\,a6\,a8\,a9^2}{a1\,a3^2\,a8^3},\ -\frac{a1\,a2\,a3^2\,a8^2\,a9-a1\,a3^2\,a6\,a8^2\,a9+a3\,a6^2\,a8^2\,a9}{a1\,a3^2\,a8^3},$$

$$-\frac{2\,a1\,a3\,a8^3+a3\,a4\,a8^3-3\,a6\,a8^3+2\,a3\,a6\,a8^3}{a1\,a3^2\,a8^3},$$

$$-\frac{4\,a1\,a3\,a8^3+2\,a3\,a4\,a8^3-6\,a6\,a8^3+4\,a3\,a6\,a8^3}{a1\,a3^2\,a8^3},$$

$$-\frac{1}{a1\,a3^2\,a8^3}\left(3\,a2\,a8^2\,a9-2\,a2\,a3\,a8^2\,a9+a1\,a3^2\,a8^2\,a9+a3\,a4\,a8^2\,a9+a10\,a3\,a8^3\,a9\right),$$

$$-\frac{1}{a1\,a3^2\,a8^3}\left(6\,a2\,a8^2\,a9-4\,a2\,a3\,a8^2\,a9+2\,a1\,a3^2\,a8^2\,a9+2\,a3\,a4\,a8^2\,a9+2\,a10\,a3\,a8^3\,a9\right),$$

$$-\frac{1}{a1\,a3^2\,a8^3}$$
$$\left(-3\,a2^2\,a8\,a9^2+a2^2\,a3\,a8\,a9^2-a1\,a2\,a3^2\,a8\,a9^2-2\,a2\,a3\,a4\,a8\,a9^2-2\,a10\,a2\,a3\,a8^2\,a9^2\right),$$

$$-\frac{a2^3\,a9^3+a2^2\,a3\,a4\,a9^3+a10\,a2^2\,a3\,a8\,a9^3}{a1\,a3^2\,a8^3},\ -\frac{1}{a1\,a3^2\,a8^3}\left(-a1^2\,a3^2\,a8^3-a1\,a3^2\,a4\,a8^3+\right.$$
$$\left.4\,a1\,a3\,a6\,a8^3-a1\,a3^2\,a6\,a8^3+2\,a3\,a4\,a6\,a8^3-3\,a6^2\,a8^3+a3\,a6^2\,a8^3\right),$$

$$-\frac{1}{a1\,a3^2\,a8^3}\left(-4\,a1\,a2\,a3\,a8^2\,a9-2\,a2\,a3\,a4\,a8^2\,a9-a1\,a3^2\,a4\,a8^2\,a9+6\,a2\,a6\,a8^2\,a9-\right.$$
$$\left.2\,a2\,a3\,a6\,a8^2\,a9+2\,a3\,a4\,a6\,a8^2\,a9-2\,a1\,a10\,a3^2\,a8^3\,a9+2\,a10\,a3\,a6\,a8^3\,a9\right),$$

$$-\frac{1}{a1\,a3^2\,a8^3}\left(2\,a1\,a2^2\,a3\,a8\,a9^2+a2^2\,a3\,a4\,a8\,a9^2+a1\,a2\,a3^2\,a4\,a8\,a9^2-3\,a2^2\,a6\,a8\,a9^2-\right.$$
$$\left.2\,a2\,a3\,a4\,a6\,a8\,a9^2+2\,a1\,a10\,a2\,a3^2\,a8^2\,a9^2-2\,a10\,a2\,a3\,a6\,a8^2\,a9^2\right),$$

$$-\frac{1}{a1\,a3^2\,a8^3}\left(-a1^2\,a3^2\,a6\,a8^3-a1\,a3^2\,a4\,a6\,a8^3+2\,a1\,a3\,a6^2\,a8^3+a3\,a4\,a6^2\,a8^3-a6^3\,a8^3\right),$$

$$-\frac{1}{a1\,a3^2\,a8^3}\left(a1^2\,a2\,a3^2\,a8^2\,a9+a1\,a2\,a3^2\,a4\,a8^2\,a9-4\,a1\,a2\,a3\,a6\,a8^2\,a9-\right.$$
$$2\,a2\,a3\,a4\,a6\,a8^2\,a9-a1\,a3^2\,a4\,a6\,a8^2\,a9+3\,a2\,a6^2\,a8^2\,a9+a3\,a4\,a6^2\,a8^2\,a9+$$
$$\left.a1^2\,a10\,a3^3\,a8^3\,a9-2\,a1\,a10\,a3^2\,a6\,a8^3\,a9+a10\,a3\,a6^2\,a8^3\,a9\right)\Big\}$$

```
Solve[Coeffs == xCoeffs, {β, δ, ϵ, μS, μE, μI, c, kE, kI, m}]
```

```
MessageTemplate[Solve, svars, Equations may not give solutions for all "solve" variables., 2, 106, 4, 33627900467745714090, Local]
```

$$\left\{\left\{\beta \to \text{a1},\ \delta \to \text{a2},\ \epsilon \to \text{a3},\ \mu\text{S} \to \text{a4},\ \mu\text{E} \to \text{a5},\ \mu\text{I} \to \text{a6},\ \text{kI} \to \frac{\text{a9 kE}}{\text{a8}},\ \text{m} \to \frac{\text{a10 a8}}{\text{kE}}\right\}\right\}$$