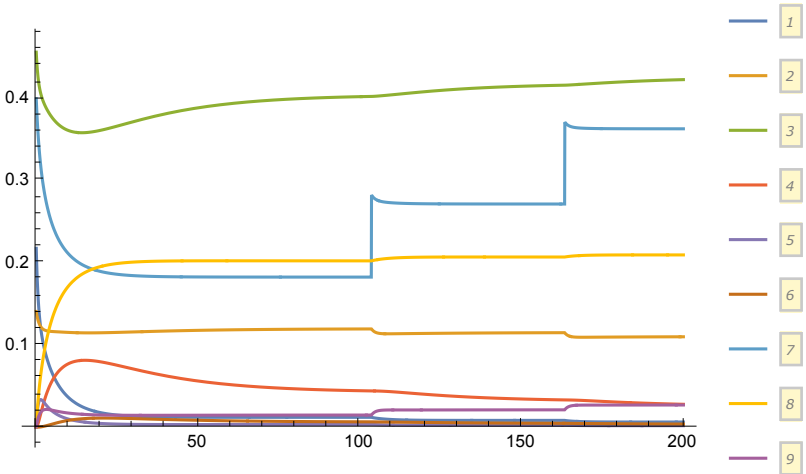
Numeical trial

```
Clear["Global`*"];

des = {x[1]'[t], x[2]'[t], x[3]'[t], x[4]'[t],
     x[5]'[t], x[6]'[t], x[7]'[t], x[8]'[t], x[9]'[t]} ==
    {-k[1] x[1][t] x[3][t] + k[2] x[5][t] + k[3] x[5][t] - k[7] x[1][t] x[7][t] +
      k[8] x[8][t], -k[4] x[2][t] x[4][t] + k[5] x[6][t] + k[6] x[6][t] -
      k[9] x[2][t] x[7][t] + k[10] x[9][t], -k[1] x[1][t] x[3][t] + k[2] x[5][t] +
      k[6] x[6][t], -k[4] x[2][t] x[4][t] + k[3] x[5][t] + k[5] x[6][t],
     k[1] x[1][t] x[3][t] - k[2] x[5][t] - k[3] x[5][t],
     k[4] x[2][t] x[4][t] - k[5] x[6][t] - k[6] x[6][t],
     -k[7] x[1][t] x[7][t] - k[9] x[2][t] x[7][t] + k[8] x[8][t] + k[10] x[9][t],
     k[7] x[1][t] x[7][t] - k[8] x[8][t], k[9] x[2][t] x[7][t] - k[10] x[9][t]};

init = {T[1], T[2], T[3], 0, 0, 0, T[4], 0, 0};

vars = Array[x, 9];
dvars = Thread[Derivative[1][vars]];

Block[{k, T, ssthreshold}, k[n_] := k[n] = (SeedRandom[n];
      RandomReal[]);
  T[n_] := T[n] = (SeedRandom[n + 10]; RandomReal[]);
  ssthreshold = 1.*^-4;
  (*Print[des];*)(*to see the ODE*)
  {sol} = NDSolve[{des, Through[vars[0]] == init, With[{df = Through[dvars[t]]},
      WhenEvent[Norm[df] < ssthreshold, x[7][t] → x[7][t] + 0.1]]},
    vars, {t, 0, 200}, MaxSteps → 100 000]];

Plot @@ {Through[vars[t]] /. sol,
  Flatten@{t, x[1]["Domain"] /. sol}, PlotLegends → Automatic}
```



Analytical solution trial

```
Solve[Table[0, {i, Length[des[[1]]]}] == des[[2]],
 Table[x[i][t], {i, Length[des[[1]]]}]]
```

Solve::svars: Equations may not give solutions for all "solve" variables. >>

$$\left\{\left\{x[3][t] \to \frac{(k[2]+k[3])\,x[5][t]}{k[1]\,x[1][t]},\ x[4][t] \to \frac{k[3]\,(k[5]+k[6])\,x[5][t]}{k[4]\,k[6]\,x[2][t]},\right.\right.$$
$$x[6][t] \to \frac{k[3]\,x[5][t]}{k[6]},\ x[8][t] \to \frac{k[7]\,x[1][t]\,x[7][t]}{k[8]},$$
$$\left.x[9][t] \to \frac{k[9]\,x[2][t]\,x[7][t]}{k[10]}\right\},\ \{x[1][t] \to 0,\ x[4][t] \to 0,$$
$$x[5][t] \to 0,\ x[6][t] \to 0,\ x[8][t] \to 0,\ x[9][t] \to \frac{k[9]\,x[2][t]\,x[7][t]}{k[10]}\},$$
$$\{x[1][t] \to 0,\ x[2][t] \to 0,\ x[5][t] \to 0,\ x[6][t] \to 0,\ x[8][t] \to 0,\ x[9][t] \to 0\},$$
$$\left\{x[2][t] \to 0,\ x[3][t] \to 0,\ x[5][t] \to 0,\ x[6][t] \to 0,\right.$$
$$\left.\left.x[8][t] \to \frac{k[7]\,x[1][t]\,x[7][t]}{k[8]},\ x[9][t] \to 0\right\}\right\}$$

Here we have substitution:

$$\left\{\frac{k[2]+k[3]}{k[1]} \to km[1],\ \frac{k[5]+k[6]}{k[4]} \to km[2],\right.$$
$$\left.\frac{k[3]}{k[6]} \to kcr,\ \frac{k[7]}{k[8]} \to kd[1],\ \frac{k[9]}{k[10]} \to kd[2]\right\}$$

$$\mathbf{solution = \left\{x[3] \to \frac{km[1]\,x[5]}{x[1]},\ x[4] \to \frac{kcr * km[2]\,x[5]}{x[2]},\right.}$$
$$\mathbf{\left.x[6] \to kcr\,x[5],\ x[8] \to kd[1]\,x[1]\,x[7],\ x[9] \to kd[2]\,x[2]\,x[7]\right\}}$$

$$\left\{x[3] \to \frac{km[1]\,x[5]}{x[1]},\ x[4] \to \frac{kcr\,km[2]\,x[5]}{x[2]},\right.$$
$$\left.x[6] \to kcr\,x[5],\ x[8] \to kd[1]\,x[1]\,x[7],\ x[9] \to kd[2]\,x[2]\,x[7]\right\}$$

Here we have

$$\{T[1] == x[1]+x[5]+x[8],\ T[2] == x[2]+x[6]+x[9],$$
$$T[3] == x[3]+x[4]+x[5]+x[6],\ T[4] == x[7]+x[8]+x[9]\}$$

Continue

$$\mathbf{t4 = \left\{T[4] == x[7] + \frac{kd[2]\,km[2]\,T[2]\,x[7]}{km[2]+x[4]+kd[2]\,km[2]\,x[7]} -\right.}$$
$$\mathbf{(kd[1]\,x[7]\,(-km[2]\,T[1]-T[1]\,x[4]+kcr\,T[2]\,x[4]-kd[2]\,km[2]\,T[1]\,x[7]))\,/}$$
$$\mathbf{\left.((1+kd[1]\,x[7])\,(km[2]+x[4]+kd[2]\,km[2]\,x[7]))\right\}}$$

$$\left\{T[4] == x[7] + \frac{kd[2]\,km[2]\,T[2]\,x[7]}{km[2]+x[4]+kd[2]\,km[2]\,x[7]} -\right.$$
$$(kd[1]\,x[7]\,(-km[2]\,T[1]-T[1]\,x[4]+kcr\,T[2]\,x[4]-kd[2]\,km[2]\,T[1]\,x[7]))\,/$$
$$\left.((1+kd[1]\,x[7])\,(km[2]+x[4]+kd[2]\,km[2]\,x[7]))\right\}$$

```
t42 = Collect[ExpandAll[{((1 + kd[1] x[7]) (km[2] + x[4] + kd[2] km[2] x[7])) *
       (km[2] + x[4] + kd[2] km[2] x[7]) * T[4] ==
      ((1 + kd[1] x[7]) (km[2] + x[4] + kd[2] km[2] x[7])) *
       (km[2] + x[4] + kd[2] km[2] x[7]) * x[7] +
      ((1 + kd[1] x[7]) (km[2] + x[4] + kd[2] km[2] x[7])) * kd[2] km[2] T[2] x[7] -
      ((km[2] + x[4] + kd[2] km[2] x[7]) * kd[1] x[7] (-km[2] T[1] - T[1] x[4] +
          kcr T[2] x[4] - kd[2] km[2] T[1] x[7]))}], {x[4], x[7]}]
```

$$\begin{aligned}
&\{km[2]^2\,T[4] + \left(kd[1]\,km[2]^2\,T[4] + 2\,kd[2]\,km[2]^2\,T[4]\right)x[7] + \\
&\quad \left(2\,kd[1]\,kd[2]\,km[2]^2\,T[4] + kd[2]^2\,km[2]^2\,T[4]\right)x[7]^2 + \\
&\quad kd[1]\,kd[2]^2\,km[2]^2\,T[4]\,x[7]^3 + x[4]^2\,(T[4] + kd[1]\,T[4]\,x[7]) + x[4]\,\left(2\,km[2]\,T[4] + \right. \\
&\qquad \left.(2\,kd[1]\,km[2]\,T[4] + 2\,kd[2]\,km[2]\,T[4])\,x[7] + 2\,kd[1]\,kd[2]\,km[2]\,T[4]\,x[7]^2\right) == \\
&\quad \left(km[2]^2 + kd[1]\,km[2]^2\,T[1] + kd[2]\,km[2]^2\,T[2]\right)x[7] + \\
&\quad \left(kd[1]\,km[2]^2 + 2\,kd[2]\,km[2]^2 + 2\,kd[1]\,kd[2]\,km[2]^2\,T[1] + \right. \\
&\qquad \left.kd[1]\,kd[2]\,km[2]^2\,T[2] + kd[2]^2\,km[2]^2\,T[2]\right)x[7]^2 + \\
&\quad \left(2\,kd[1]\,kd[2]\,km[2]^2 + kd[2]^2\,km[2]^2 + kd[1]\,kd[2]^2\,km[2]^2\,T[1] + \right. \\
&\qquad \left.kd[1]\,kd[2]^2\,km[2]^2\,T[2]\right)x[7]^3 + kd[1]\,kd[2]^2\,km[2]^2\,x[7]^4 + \\
&\quad x[4]^2\,\left((1 + kd[1]\,T[1] - kcr\,kd[1]\,T[2])\,x[7] + kd[1]\,x[7]^2\right) + \\
&\quad x[4]\,\left((2\,km[2] + 2\,kd[1]\,km[2]\,T[1] - kcr\,kd[1]\,km[2]\,T[2] + kd[2]\,km[2]\,T[2])\,x[7] + \right. \\
&\qquad (2\,kd[1]\,km[2] + 2\,kd[2]\,km[2] + 2\,kd[1]\,kd[2]\,km[2]\,T[1] + kd[1]\,kd[2]\,km[2] \\
&\qquad\quad \left.T[2] - kcr\,kd[1]\,kd[2]\,km[2]\,T[2])\,x[7]^2 + 2\,kd[1]\,kd[2]\,km[2]\,x[7]^3\right)\}
\end{aligned}$$

```
Collect[km[2]^2 T[4] + (kd[1] km[2]^2 T[4] + 2 kd[2] km[2]^2 T[4]) x[7] +
  (2 kd[1] kd[2] km[2]^2 T[4] + kd[2]^2 km[2]^2 T[4]) x[7]^2 +
  kd[1] kd[2]^2 km[2]^2 T[4] x[7]^3 + x[4]^2 (T[4] + kd[1] T[4] x[7]) + x[4] (2 km[2] T[4] +
     (2 kd[1] km[2] T[4] + 2 kd[2] km[2] T[4]) x[7] + 2 kd[1] kd[2] km[2] T[4] x[7]^2) -
  ((km[2]^2 + kd[1] km[2]^2 T[1] + kd[2] km[2]^2 T[2]) x[7] +
     (kd[1] km[2]^2 + 2 kd[2] km[2]^2 + 2 kd[1] kd[2] km[2]^2 T[1] +
        kd[1] kd[2] km[2]^2 T[2] + kd[2]^2 km[2]^2 T[2]) x[7]^2 +
     (2 kd[1] kd[2] km[2]^2 + kd[2]^2 km[2]^2 + kd[1] kd[2]^2 km[2]^2 T[1] +
        kd[1] kd[2]^2 km[2]^2 T[2]) x[7]^3 + kd[1] kd[2]^2 km[2]^2 x[7]^4 +
     x[4]^2 ((1 + kd[1] T[1] - kcr kd[1] T[2]) x[7] + kd[1] x[7]^2) +
     x[4] ((2 km[2] + 2 kd[1] km[2] T[1] - kcr kd[1] km[2] T[2] + kd[2] km[2] T[2]) x[7] +
        (2 kd[1] km[2] + 2 kd[2] km[2] + 2 kd[1] kd[2] km[2] T[1] +
           kd[1] kd[2] km[2] T[2] - kcr kd[1] kd[2] km[2] T[2])
         x[7]^2 + 2 kd[1] kd[2] km[2] x[7]^3)), {x[4], x[7]}]
```

$$\begin{aligned}
&km[2]^2\,T[4] + \left(-km[2]^2 - kd[1]\,km[2]^2\,T[1] - \right. \\
&\quad \left.kd[2]\,km[2]^2\,T[2] + kd[1]\,km[2]^2\,T[4] + 2\,kd[2]\,km[2]^2\,T[4]\right)x[7] + \\
&\quad \left(-kd[1]\,km[2]^2 - 2\,kd[2]\,km[2]^2 - 2\,kd[1]\,kd[2]\,km[2]^2\,T[1] - kd[1]\,kd[2]\,km[2]^2\,T[2] - \right. \\
&\qquad \left.kd[2]^2\,km[2]^2\,T[2] + 2\,kd[1]\,kd[2]\,km[2]^2\,T[4] + kd[2]^2\,km[2]^2\,T[4]\right)x[7]^2 + \\
&\quad \left(-2\,kd[1]\,kd[2]\,km[2]^2 - kd[2]^2\,km[2]^2 - kd[1]\,kd[2]^2\,km[2]^2\,T[1] - kd[1]\,kd[2]^2\right. \\
&\qquad \left.km[2]^2\,T[2] + kd[1]\,kd[2]^2\,km[2]^2\,T[4]\right)x[7]^3 - kd[1]\,kd[2]^2\,km[2]^2\,x[7]^4 + \\
&\quad x[4]^2\,\left(T[4] + (-1 - kd[1]\,T[1] + kcr\,kd[1]\,T[2] + kd[1]\,T[4])\,x[7] - kd[1]\,x[7]^2\right) + \\
&\quad x[4]\,\left(2\,km[2]\,T[4] + (-2\,km[2] - 2\,kd[1]\,km[2]\,T[1] + kcr\,kd[1]\,km[2]\,T[2] - \right. \\
&\qquad kd[2]\,km[2]\,T[2] + 2\,kd[1]\,km[2]\,T[4] + 2\,kd[2]\,km[2]\,T[4])\,x[7] + \\
&\qquad (-2\,kd[1]\,km[2] - 2\,kd[2]\,km[2] - 2\,kd[1]\,kd[2]\,km[2]\,T[1] - \\
&\qquad\quad kd[1]\,kd[2]\,km[2]\,T[2] + kcr\,kd[1]\,kd[2]\,km[2]\,T[2] + \\
&\qquad\quad \left.2\,kd[1]\,kd[2]\,km[2]\,T[4])\,x[7]^2 - 2\,kd[1]\,kd[2]\,km[2]\,x[7]^3\right)
\end{aligned}$$

```
Simplify[km[2]^2 T[4] + (-km[2]^2 - kd[1] km[2]^2 T[1] -
      kd[2] km[2]^2 T[2] + kd[1] km[2]^2 T[4] + 2 kd[2] km[2]^2 T[4]) x[7] +
   (-kd[1] km[2]^2 - 2 kd[2] km[2]^2 - 2 kd[1] kd[2] km[2]^2 T[1] - kd[1] kd[2] km[2]^2 T[2] -
      kd[2]^2 km[2]^2 T[2] + 2 kd[1] kd[2] km[2]^2 T[4] + kd[2]^2 km[2]^2 T[4]) x[7]^2 +
   (-2 kd[1] kd[2] km[2]^2 - kd[2]^2 km[2]^2 - kd[1] kd[2]^2 km[2]^2 T[1] - kd[1] kd[2]^2
      km[2]^2 T[2] + kd[1] kd[2]^2 km[2]^2 T[4]) x[7]^3 - kd[1] kd[2]^2 km[2]^2 x[7]^4 +
   x[4]^2 (T[4] + (-1 - kd[1] T[1] + kcr kd[1] T[2] + kd[1] T[4]) x[7] - kd[1] x[7]^2) +
   x[4] (2 km[2] T[4] + (-2 km[2] - 2 kd[1] km[2] T[1] + kcr kd[1] km[2] T[2] -
        kd[2] km[2] T[2] + 2 kd[1] km[2] T[4] + 2 kd[2] km[2] T[4]) x[7] +
      (-2 kd[1] km[2] - 2 kd[2] km[2] - 2 kd[1] kd[2] km[2] T[1] -
        kd[1] kd[2] km[2] T[2] + kcr kd[1] kd[2] km[2] T[2] +
        2 kd[1] kd[2] km[2] T[4]) x[7]^2 - 2 kd[1] kd[2] km[2] x[7]^3)]
```

```
-(km[2] + x[4] + kd[2] km[2] x[7])
 (x[4] (-T[4] (1 + kd[1] x[7]) + x[7] (1 + kd[1] (T[1] - kcr T[2] + x[7]))) +
   km[2] (-T[4] (1 + kd[1] x[7]) (1 + kd[2] x[7]) + x[7] (1 + kd[2] (T[2] + x[7]) +
       kd[1] (T[1] (1 + kd[2] x[7]) + x[7] (1 + kd[2] (T[2] + x[7])))))))
```

```
FullSimplify[x[4] (-T[4] (1 + kd[1] x[7]) + x[7] (1 + kd[1] (T[1] - kcr T[2] + x[7]))) +
  km[2] (-T[4] (1 + kd[1] x[7]) (1 + kd[2] x[7]) + x[7] (1 + kd[2] (T[2] + x[7]) +
      kd[1] (T[1] (1 + kd[2] x[7]) + x[7] (1 + kd[2] (T[2] + x[7])))))]
```

```
x[4] (-T[4] (1 + kd[1] x[7]) + x[7] (1 + kd[1] (T[1] - kcr T[2] + x[7]))) +
 km[2] (-T[4] (1 + kd[1] x[7]) (1 + kd[2] x[7]) + x[7] (1 + kd[2] (T[2] + x[7]) +
     kd[1] (T[1] + x[7] + kd[2] (T[1] + T[2]) x[7] + kd[2] x[7]^2)))
```

```
t3 = {T[3] == x[4] + T[2] x[4] / (km[2] + x[4] + kd[2] km[2] x[7]) +
    kcr T[2] x[4] / (km[2] + x[4] + kd[2] km[2] x[7]) - (kcr km[1] T[2] x[4] (1 + kd[1] x[7])) /
     (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - kd[2] km[2] T[1] x[7])}
```

```
{T[3] == x[4] + T[2] x[4] / (km[2] + x[4] + kd[2] km[2] x[7]) +
   kcr T[2] x[4] / (km[2] + x[4] + kd[2] km[2] x[7]) - (kcr km[1] T[2] x[4] (1 + kd[1] x[7])) /
    (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - kd[2] km[2] T[1] x[7])}
```

```
t32 = Collect[
  ExpandAll[{(km[2] + x[4] + kd[2] km[2] x[7]) * (km[2] + x[4] + kd[2] km[2] x[7]) *
       (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - kd[2] km[2] T[1] x[7]) * T[3] ==
      (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - kd[2] km[2] T[1] x[7]) *
        (km[2] + x[4] + kd[2] km[2] x[7]) * (km[2] + x[4] + kd[2] km[2] x[7]) * x[4] +
       (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - kd[2] km[2] T[1] x[7]) *
        (km[2] + x[4] + kd[2] km[2] x[7]) * T[2] x[4] +
       (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - kd[2] km[2] T[1] x[7]) *
        (km[2] + x[4] + kd[2] km[2] x[7]) * kcr T[2] x[4] -
       (km[2] + x[4] + kd[2] km[2] x[7]) * (km[2] + x[4] + kd[2] km[2] x[7]) *
        kcr km[1] T[2] x[4] (1 + kd[1] x[7])}], {x[4], x[7]}]
```

$$
\begin{aligned}
&\{-km[2]^3\,T[1]\,T[3] + (-T[1]\,T[3] + kcr\,T[2]\,T[3])\,x[4]^3 - \\
&\quad 3\,kd[2]\,km[2]^3\,T[1]\,T[3]\,x[7] - 3\,kd[2]^2\,km[2]^3\,T[1]\,T[3]\,x[7]^2 - \\
&\quad kd[2]^3\,km[2]^3\,T[1]\,T[3]\,x[7]^3 + x[4]^2\,(-3\,km[2]\,T[1]\,T[3] + 2\,kcr\,km[2]\,T[2]\,T[3] + \\
&\qquad (-3\,kd[2]\,km[2]\,T[1]\,T[3] + 2\,kcr\,kd[2]\,km[2]\,T[2]\,T[3])\,x[7]) + \\
&\quad x[4]\,\left(-3\,km[2]^2\,T[1]\,T[3] + kcr\,km[2]^2\,T[2]\,T[3] + \right. \\
&\qquad \left(-6\,kd[2]\,km[2]^2\,T[1]\,T[3] + 2\,kcr\,kd[2]\,km[2]^2\,T[2]\,T[3]\right)\,x[7] + \\
&\qquad \left.\left(-3\,kd[2]^2\,km[2]^2\,T[1]\,T[3] + kcr\,kd[2]^2\,km[2]^2\,T[2]\,T[3]\right)\,x[7]^2\right) == \\
&\quad (-T[1] + kcr\,T[2])\,x[4]^4 + x[4]^3\,\left(-3\,km[2]\,T[1] - kcr\,km[1]\,T[2] + \right. \\
&\qquad 2\,kcr\,km[2]\,T[2] - T[1]\,T[2] - kcr\,T[1]\,T[2] + kcr\,T[2]^2 + kcr^2\,T[2]^2 + \\
&\qquad \left.(-3\,kd[2]\,km[2]\,T[1] - kcr\,kd[1]\,km[1]\,T[2] + 2\,kcr\,kd[2]\,km[2]\,T[2])\,x[7]\right) + \\
&\quad x[4]^2\,\left(-3\,km[2]^2\,T[1] - 2\,kcr\,km[1]\,km[2]\,T[2] + kcr\,km[2]^2\,T[2] - \right. \\
&\qquad 2\,km[2]\,T[1]\,T[2] - 2\,kcr\,km[2]\,T[1]\,T[2] + kcr\,km[2]\,T[2]^2 + kcr^2\,km[2]\,T[2]^2 + \\
&\qquad \left(-6\,kd[2]\,km[2]^2\,T[1] - 2\,kcr\,kd[1]\,km[1]\,km[2]\,T[2] - 2\,kcr\,kd[2]\,km[1]\right. \\
&\qquad\quad km[2]\,T[2] + 2\,kcr\,kd[2]\,km[2]^2\,T[2] - 2\,kd[2]\,km[2]\,T[1]\,T[2] - \\
&\qquad\quad \left.2\,kcr\,kd[2]\,km[2]\,T[1]\,T[2] + kcr\,kd[2]\,km[2]\,T[2]^2 + kcr^2\,kd[2]\,km[2]\,T[2]^2\right) \\
&\qquad x[7] + \left(-3\,kd[2]^2\,km[2]^2\,T[1] - 2\,kcr\,kd[1]\,kd[2]\,km[1]\,km[2]\,T[2] + \right. \\
&\qquad\quad \left.\left.kcr\,kd[2]^2\,km[2]^2\,T[2]\right)\,x[7]^2\right) + \\
&\quad x[4]\,\left(-km[2]^3\,T[1] - kcr\,km[1]\,km[2]^2\,T[2] - km[2]^2\,T[1]\,T[2] - kcr\,km[2]^2\,T[1]\,T[2] + \right. \\
&\qquad \left(-3\,kd[2]\,km[2]^3\,T[1] - kcr\,kd[1]\,km[1]\,km[2]^2\,T[2] - 2\,kcr\,kd[2]\,km[1]\,km[2]^2\right. \\
&\qquad\quad \left.T[2] - 2\,kd[2]\,km[2]^2\,T[1]\,T[2] - 2\,kcr\,kd[2]\,km[2]^2\,T[1]\,T[2]\right)\,x[7] + \\
&\qquad \left(-3\,kd[2]^2\,km[2]^3\,T[1] - 2\,kcr\,kd[1]\,kd[2]\,km[1]\,km[2]^2\,T[2] - kcr\,kd[2]^2\,km[1]\right. \\
&\qquad\quad km[2]^2\,T[2] - kd[2]^2\,km[2]^2\,T[1]\,T[2] - kcr\,kd[2]^2\,km[2]^2\,T[1]\,T[2]\Big)\,x[7]^2 + \\
&\qquad \left.\left(-kd[2]^3\,km[2]^3\,T[1] - kcr\,kd[1]\,kd[2]^2\,km[1]\,km[2]^2\,T[2]\right)\,x[7]^3\right)\}
\end{aligned}
$$

```
Collect[-km[2]^3 T[1] T[3] + (-T[1] T[3] + kcr T[2] T[3]) x[4]^3 -
  3 kd[2] km[2]^3 T[1] T[3] x[7] - 3 kd[2]^2 km[2]^3 T[1] T[3] x[7]^2 -
  kd[2]^3 km[2]^3 T[1] T[3] x[7]^3 + x[4]^2 (-3 km[2] T[1] T[3] + 2 kcr km[2] T[2] T[3] +
     (-3 kd[2] km[2] T[1] T[3] + 2 kcr kd[2] km[2] T[2] T[3]) x[7]) +
  x[4] (-3 km[2]^2 T[1] T[3] + kcr km[2]^2 T[2] T[3] +
     (-6 kd[2] km[2]^2 T[1] T[3] + 2 kcr kd[2] km[2]^2 T[2] T[3]) x[7] +
     (-3 kd[2]^2 km[2]^2 T[1] T[3] + kcr kd[2]^2 km[2]^2 T[2] T[3]) x[7]^2) -
  ((-T[1] + kcr T[2]) x[4]^4 + x[4]^3 (-3 km[2] T[1] - kcr km[1] T[2] +
       2 kcr km[2] T[2] - T[1] T[2] - kcr T[1] T[2] + kcr T[2]^2 + kcr^2 T[2]^2 +
       (-3 kd[2] km[2] T[1] - kcr kd[1] km[1] T[2] + 2 kcr kd[2] km[2] T[2]) x[7]) +
    x[4]^2 (-3 km[2]^2 T[1] - 2 kcr km[1] km[2] T[2] + kcr km[2]^2 T[2] -
       2 km[2] T[1] T[2] - 2 kcr km[2] T[1] T[2] + kcr km[2] T[2]^2 + kcr^2 km[2] T[2]^2 +
       (-6 kd[2] km[2]^2 T[1] - 2 kcr kd[1] km[1] km[2] T[2] - 2 kcr kd[2] km[1] km[2]
            T[2] + 2 kcr kd[2] km[2]^2 T[2] - 2 kd[2] km[2] T[1] T[2] - 2 kcr kd[2]
            km[2] T[1] T[2] + kcr kd[2] km[2] T[2]^2 + kcr^2 kd[2] km[2] T[2]^2) x[7] +
       (-3 kd[2]^2 km[2]^2 T[1] - 2 kcr kd[1] kd[2] km[1] km[2] T[2] +
          kcr kd[2]^2 km[2]^2 T[2]) x[7]^2) + x[4]
     (-km[2]^3 T[1] - kcr km[1] km[2]^2 T[2] - km[2]^2 T[1] T[2] - kcr km[2]^2 T[1] T[2] +
       (-3 kd[2] km[2]^3 T[1] - kcr kd[1] km[1] km[2]^2 T[2] - 2 kcr kd[2] km[1] km[2]^2
            T[2] - 2 kd[2] km[2]^2 T[1] T[2] - 2 kcr kd[2] km[2]^2 T[1] T[2]) x[7] +
       (-3 kd[2]^2 km[2]^3 T[1] - 2 kcr kd[1] kd[2] km[1] km[2]^2 T[2] - kcr kd[2]^2 km[1]
            km[2]^2 T[2] - kd[2]^2 km[2]^2 T[1] T[2] - kcr kd[2]^2 km[2]^2 T[1] T[2]) x[7]^2 +
       (-kd[2]^3 km[2]^3 T[1] - kcr kd[1] kd[2]^2 km[1] km[2]^2 T[2])
        x[7]^3)), {x[4], x[7]}]
```

```
-km[2]^3 T[1] T[3] + (T[1] - kcr T[2]) x[4]^4 - 3 kd[2] km[2]^3 T[1] T[3] x[7] -
 3 kd[2]^2 km[2]^3 T[1] T[3] x[7]^2 - kd[2]^3 km[2]^3 T[1] T[3] x[7]^3 +
 x[4]^3 (3 km[2] T[1] + kcr km[1] T[2] - 2 kcr km[2] T[2] + T[1] T[2] +
    kcr T[1] T[2] - kcr T[2]^2 - kcr^2 T[2]^2 - T[1] T[3] + kcr T[2] T[3] +
    (3 kd[2] km[2] T[1] + kcr kd[1] km[1] T[2] - 2 kcr kd[2] km[2] T[2]) x[7]) +
 x[4]^2 (3 km[2]^2 T[1] + 2 kcr km[1] km[2] T[2] - kcr km[2]^2 T[2] +
    2 km[2] T[1] T[2] + 2 kcr km[2] T[1] T[2] - kcr km[2] T[2]^2 -
    kcr^2 km[2] T[2]^2 - 3 km[2] T[1] T[3] + 2 kcr km[2] T[2] T[3] +
    (6 kd[2] km[2]^2 T[1] + 2 kcr kd[1] km[1] km[2] T[2] + 2 kcr kd[2] km[1] km[2] T[2] -
       2 kcr kd[2] km[2]^2 T[2] + 2 kd[2] km[2] T[1] T[2] + 2 kcr kd[2] km[2] T[1] T[2] -
       kcr kd[2] km[2] T[2]^2 - kcr^2 kd[2] km[2] T[2]^2 - 3 kd[2] km[2] T[1] T[3] +
       2 kcr kd[2] km[2] T[2] T[3]) x[7] + (3 kd[2]^2 km[2]^2 T[1] +
       2 kcr kd[1] kd[2] km[1] km[2] T[2] - kcr kd[2]^2 km[2]^2 T[2]) x[7]^2) +
 x[4] (km[2]^3 T[1] + kcr km[1] km[2]^2 T[2] + km[2]^2 T[1] T[2] +
    kcr km[2]^2 T[1] T[2] - 3 km[2]^2 T[1] T[3] + kcr km[2]^2 T[2] T[3] +
    (3 kd[2] km[2]^3 T[1] + kcr kd[1] km[1] km[2]^2 T[2] + 2 kcr kd[2] km[1] km[2]^2 T[2] +
       2 kd[2] km[2]^2 T[1] T[2] + 2 kcr kd[2] km[2]^2 T[1] T[2] -
       6 kd[2] km[2]^2 T[1] T[3] + 2 kcr kd[2] km[2]^2 T[2] T[3]) x[7] +
    (3 kd[2]^2 km[2]^3 T[1] + 2 kcr kd[1] kd[2] km[1] km[2]^2 T[2] + kcr kd[2]^2
        km[1] km[2]^2 T[2] + kd[2]^2 km[2]^2 T[1] T[2] + kcr kd[2]^2 km[2]^2 T[1] T[2] -
       3 kd[2]^2 km[2]^2 T[1] T[3] + kcr kd[2]^2 km[2]^2 T[2] T[3]) x[7]^2 +
    (kd[2]^3 km[2]^3 T[1] + kcr kd[1] kd[2]^2 km[1] km[2]^2 T[2]) x[7]^3)
```

```
Simplify[-km[2]^3 T[1] T[3] + (T[1] - kcr T[2]) x[4]^4 - 3 kd[2] km[2]^3 T[1] T[3] x[7] -
  3 kd[2]^2 km[2]^3 T[1] T[3] x[7]^2 - kd[2]^3 km[2]^3 T[1] T[3] x[7]^3 +
  x[4]^3 (3 km[2] T[1] + kcr km[1] T[2] - 2 kcr km[2] T[2] + T[1] T[2] +
     kcr T[1] T[2] - kcr T[2]^2 - kcr^2 T[2]^2 - T[1] T[3] + kcr T[2] T[3] +
     (3 kd[2] km[2] T[1] + kcr kd[1] km[1] T[2] - 2 kcr kd[2] km[2] T[2]) x[7]) +
  x[4]^2 (3 km[2]^2 T[1] + 2 kcr km[1] km[2] T[2] - kcr km[2]^2 T[2] +
     2 km[2] T[1] T[2] + 2 kcr km[2] T[1] T[2] - kcr km[2] T[2]^2 -
     kcr^2 km[2] T[2]^2 - 3 km[2] T[1] T[3] + 2 kcr km[2] T[2] T[3] +
     (6 kd[2] km[2]^2 T[1] + 2 kcr kd[1] km[1] km[2] T[2] + 2 kcr kd[2] km[1] km[2] T[2] -
        2 kcr kd[2] km[2]^2 T[2] + 2 kd[2] km[2] T[1] T[2] + 2 kcr kd[2] km[2] T[1] T[2] -
        kcr kd[2] km[2] T[2]^2 - kcr^2 kd[2] km[2] T[2]^2 - 3 kd[2] km[2] T[1] T[3] +
        2 kcr kd[2] km[2] T[2] T[3]) x[7] + (3 kd[2]^2 km[2]^2 T[1] +
        2 kcr kd[1] kd[2] km[1] km[2] T[2] - kcr kd[2]^2 km[2]^2 T[2]) x[7]^2) +
  x[4] (km[2]^3 T[1] + kcr km[1] km[2]^2 T[2] + km[2]^2 T[1] T[2] +
     kcr km[2]^2 T[1] T[2] - 3 km[2]^2 T[1] T[3] + kcr km[2]^2 T[2] T[3] +
     (3 kd[2] km[2]^3 T[1] + kcr kd[1] km[1] km[2]^2 T[2] + 2 kcr kd[2] km[1] km[2]^2 T[2] +
        2 kd[2] km[2]^2 T[1] T[2] + 2 kcr kd[2] km[2]^2 T[1] T[2] -
        6 kd[2] km[2]^2 T[1] T[3] + 2 kcr kd[2] km[2]^2 T[2] T[3]) x[7] +
     (3 kd[2]^2 km[2]^3 T[1] + 2 kcr kd[1] kd[2] km[1] km[2]^2 T[2] + kcr kd[2]^2
         km[1] km[2]^2 T[2] + kd[2]^2 km[2]^2 T[1] T[2] + kcr kd[2]^2 km[2]^2 T[1] T[2] -
        3 kd[2]^2 km[2]^2 T[1] T[3] + kcr kd[2]^2 km[2]^2 T[2] T[3]) x[7]^2 +
     (kd[2]^3 km[2]^3 T[1] + kcr kd[1] kd[2]^2 km[1] km[2]^2 T[2]) x[7]^3)]
```

```
(km[2] + x[4] + kd[2] km[2] x[7]) (-km[2]^2 T[1] (T[3] - x[4]) (1 + kd[2] x[7])^2 +
   km[2] x[4] (1 + kd[2] x[7]) (T[1] (T[2] - 2 T[3] + 2 x[4]) +
      kcr T[2] (km[1] + T[1] + T[3] - x[4] + kd[1] km[1] x[7])) +
   x[4]^2 (-kcr^2 T[2]^2 + T[1] (T[2] - T[3] + x[4]) +
      kcr T[2] (km[1] + T[1] - T[2] + T[3] - x[4] + kd[1] km[1] x[7])))
```

```
FullSimplify[-km[2]^2 T[1] (T[3] - x[4]) (1 + kd[2] x[7])^2 +
  km[2] x[4] (1 + kd[2] x[7]) (T[1] (T[2] - 2 T[3] + 2 x[4]) +
     kcr T[2] (km[1] + T[1] + T[3] - x[4] + kd[1] km[1] x[7])) +
  x[4]^2 (-kcr^2 T[2]^2 + T[1] (T[2] - T[3] + x[4]) +
     kcr T[2] (km[1] + T[1] - T[2] + T[3] - x[4] + kd[1] km[1] x[7]))]
```

```
-km[2]^2 T[1] (T[3] - x[4]) (1 + kd[2] x[7])^2 +
 km[2] x[4] (1 + kd[2] x[7]) (T[1] (T[2] - 2 T[3] + 2 x[4]) +
    kcr T[2] (km[1] + T[1] + T[3] - x[4] + kd[1] km[1] x[7])) +
 x[4]^2 (-kcr^2 T[2]^2 + T[1] (T[2] - T[3] + x[4]) +
    kcr T[2] (km[1] + T[1] - T[2] + T[3] - x[4] + kd[1] km[1] x[7]))
```

```
simpT4 =
 Collect[{x[4] (-T[4] (1 + kd[1] x[7]) + x[7] (1 + kd[1] (T[1] - kcr T[2] + x[7]))) +
     km[2] (-T[4] (1 + kd[1] x[7]) (1 + kd[2] x[7]) +
        x[7] (1 + kd[2] (T[2] + x[7]) + kd[1] (T[1] + x[7] +
              kd[2] (T[1] + T[2]) x[7] + kd[2] x[7]^2))) == 0}, {x[4], x[7]}]
```

```
{-km[2] T[4] +
   (km[2] + kd[1] km[2] T[1] + kd[2] km[2] T[2] - kd[1] km[2] T[4] - kd[2] km[2] T[4])
    x[7] + (kd[1] km[2] + kd[2] km[2] + kd[1] kd[2] km[2] (T[1] + T[2]) -
      kd[1] kd[2] km[2] T[4]) x[7]^2 + kd[1] kd[2] km[2] x[7]^3 +
   x[4] (-T[4] + (1 + kd[1] T[1] - kcr kd[1] T[2] - kd[1] T[4]) x[7] + kd[1] x[7]^2) == 0}
```

```
subSimpT4 = {-c[1] + c[2] x[7] + c[3] x[7]^2 +
    c[4] x[7]^3 - c[5] x[4] + c[6] x[4] x[7] + c[7] x[4] x[7]^2 == 0}
```

$$\{-c[1] - c[5]\, x[4] + c[2]\, x[7] + c[6]\, x[4]\, x[7] + c[3]\, x[7]^2 + c[7]\, x[4]\, x[7]^2 + c[4]\, x[7]^3 == 0\}$$

```
simpT3 = Collect[{-km[2]^2 T[1] (T[3] - x[4]) (1 + kd[2] x[7])^2 +
     km[2] x[4] (1 + kd[2] x[7]) (T[1] (T[2] - 2 T[3] + 2 x[4]) +
        kcr T[2] (km[1] + T[1] + T[3] - x[4] + kd[1] km[1] x[7])) +
     x[4]^2 (-kcr^2 T[2]^2 + T[1] (T[2] - T[3] + x[4]) + kcr T[2]
          (km[1] + T[1] - T[2] + T[3] - x[4] + kd[1] km[1] x[7])) == 0}, {x[4], x[7]}]
```

$$\{-km[2]^2\, T[1]\, T[3] + (T[1] - kcr\, T[2])\, x[4]^3 - 2\, kd[2]\, km[2]^2\, T[1]\, T[3]\, x[7] - kd[2]^2\, km[2]^2\, T[1]\, T[3]\, x[7]^2 + x[4]^2 (2\, km[2]\, T[1] + kcr\, km[1]\, T[2] - kcr\, km[2]\, T[2] + T[1]\, T[2] + kcr\, T[1]\, T[2] - kcr\, T[2]^2 - kcr^2\, T[2]^2 - T[1]\, T[3] + kcr\, T[2]\, T[3] + (2\, kd[2]\, km[2]\, T[1] + kcr\, kd[1]\, km[1]\, T[2] - kcr\, kd[2]\, km[2]\, T[2])\, x[7]) + x[4] (km[2]^2\, T[1] + kcr\, km[1]\, km[2]\, T[2] + km[2]\, T[1]\, T[2] + kcr\, km[2]\, T[1]\, T[2] - 2\, km[2]\, T[1]\, T[3] + kcr\, km[2]\, T[2]\, T[3] + (2\, kd[2]\, km[2]^2\, T[1] + kcr\, kd[1]\, km[1]\, km[2]\, T[2] + kcr\, kd[2]\, km[1]\, km[2]\, T[2] + kd[2]\, km[2]\, T[1]\, T[2] + kcr\, kd[2]\, km[2]\, T[1]\, T[2] - 2\, kd[2]\, km[2]\, T[1]\, T[3] + kcr\, kd[2]\, km[2]\, T[2]\, T[3])\, x[7] + (kd[2]^2\, km[2]^2\, T[1] + kcr\, kd[1]\, kd[2]\, km[1]\, km[2]\, T[2])\, x[7]^2) == 0\}$$

```
subSimpT3 = {-t[1] + t[2] * t[4]^3 - t[3] x[7] - t[4] x[7]^2 + t[5] x[4]^2 +
    t[6] x[4]^2 x[7] + t[7] x[4] + t[8] x[4] x[7] + t[9] x[7]^2 == 0}
```

$$\{-t[1] + t[2]\, t[4]^3 + t[7]\, x[4] + t[5]\, x[4]^2 - t[3]\, x[7] + t[8]\, x[4]\, x[7] + t[6]\, x[4]^2\, x[7] - t[4]\, x[7]^2 + t[9]\, x[7]^2 == 0\}$$

```
Solve[simpT4, x[4]]
```

$$\{\{x[4] \to (km[2]\, T[4] - km[2]\, x[7] - kd[1]\, km[2]\, T[1]\, x[7] - kd[2]\, km[2]\, T[2]\, x[7] + kd[1]\, km[2]\, T[4]\, x[7] + kd[2]\, km[2]\, T[4]\, x[7] - kd[1]\, km[2]\, x[7]^2 - kd[2]\, km[2]\, x[7]^2 - kd[1]\, kd[2]\, km[2]\, T[1]\, x[7]^2 - kd[1]\, kd[2]\, km[2]\, T[2]\, x[7]^2 + kd[1]\, kd[2]\, km[2]\, T[4]\, x[7]^2 - kd[1]\, kd[2]\, km[2]\, x[7]^3) / (-T[4] + x[7] + kd[1]\, T[1]\, x[7] - kcr\, kd[1]\, T[2]\, x[7] - kd[1]\, T[4]\, x[7] + kd[1]\, x[7]^2)\}\}$$

```
FullSimplify[(km[2] T[4] - km[2] x[7] - kd[1] km[2] T[1] x[7] - kd[2] km[2] T[2] x[7] +
     kd[1] km[2] T[4] x[7] + kd[2] km[2] T[4] x[7] - kd[1] km[2] x[7]^2 -
     kd[2] km[2] x[7]^2 - kd[1] kd[2] km[2] T[1] x[7]^2 - kd[1] kd[2] km[2] T[2] x[7]^2 +
     kd[1] kd[2] km[2] T[4] x[7]^2 - kd[1] kd[2] km[2] x[7]^3) /
   (-T[4] + x[7] + kd[1] T[1] x[7] - kcr kd[1] T[2] x[7] - kd[1] T[4] x[7] + kd[1] x[7]^2)]
```

$$(km[2]\, (-T[4]\, (1 + kd[1]\, x[7])\, (1 + kd[2]\, x[7]) + x[7]\, (1 + kd[2]\, (T[2] + x[7]) + kd[1]\, (T[1] + x[7] + kd[2]\, (T[1] + T[2])\, x[7] + kd[2]\, x[7]^2)))) / (T[4]\, (1 + kd[1]\, x[7]) - x[7]\, (1 + kd[1]\, (T[1] - kcr\, T[2] + x[7])))$$

```
t3Sol = Solve[t3, x[7]]
```

```
{{x[7] →
    (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2]
       x[4] - kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
      kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
      kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
      kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 -
      √((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1] km[2]
            T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2] T[1] T[2]
            x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1] T[3] x[4] +
           kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1] x[4]^2 +
           kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
        4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
           kcr kd[1] kd[2] km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] +
           km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] +
           kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3]
            x[4] + 2 km[2] T[1] x[4]^2 + kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 +
           T[1] T[2] x[4]^2 + kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
           T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))) /
     (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
        kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))},
  {x[7] → (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
      kcr kd[1] km[1] km[2] T[2] x[4] -
      kcr kd[2] km[1] km[2] T[2] x[4] -
      kd[2] km[2] T[1] T[2] x[4] -
      kcr kd[2] km[2] T[1] T[2] x[4] +
      2 kd[2] km[2] T[1] T[3] x[4] -
      kcr kd[2] km[2] T[2] T[3] x[4] -
      2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 +
      kcr kd[2] km[2] T[2] x[4]^2 +
      √((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1] km[2]
            T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2] T[1] T[2]
            x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1] T[3] x[4] +
           kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1] x[4]^2 +
           kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
        4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
           kcr kd[1] kd[2] km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] +
           km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] +
           kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3]
            x[4] + 2 km[2] T[1] x[4]^2 + kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 +
           T[1] T[2] x[4]^2 + kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
           T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))) /
     (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
        kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))}}
```

The following is substituting the first solution of x[7]: $\frac{-b-\sqrt{(b^2-4\,ac)}}{2\,a}$

```
t4Inv1 = t4 /. t3Sol[[1]][[1]]
```

```
{T[4] ==
   (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
      kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
```

```
kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 -
Sqrt[(-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1] km[2]
      T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2] T[1] T[2]
      x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1] T[3] x[4] +
     kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1] x[4]^2 +
     kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
   4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
     kcr kd[1] kd[2] km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] +
     km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] +
     kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3]
      x[4] + 2 km[2] T[1] x[4]^2 + kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 +
     T[1] T[2] x[4]^2 + kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
     T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)] /
 (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
     kcr kd[1] kd[2] km[1] km[2] T[2] x[4])) +
 (kd[2] km[2] T[2] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
     kcr kd[1] km[1] km[2] T[2] x[4] -
     kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
     kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
     kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
     kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 -
     Sqrt[(-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1]
           km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2]
           T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1]
           T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1]
           x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
        4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2]
           km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[
            1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] -
          2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
          kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 +
          kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
          T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)]) /
 (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
     kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
   (km[2] + x[4] + (kd[2] km[2] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
        kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
        kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
        2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
        2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
         T[2] x[4]^2 - Sqrt[(-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
             kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
              x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
              x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
              x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
             kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
             kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
           (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
             km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
              T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
```

```
                kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
                 T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
                 x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)))) /
      (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
          kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))))) -
(kd[1] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
    kcr kd[1] km[1] km[2] T[2] x[4] -
    kcr kd[2] km[1] km[2] T[2] x[4] -
    kd[2] km[2] T[1] T[2] x[4] -
    kcr kd[2] km[2] T[1] T[2] x[4] +
    2 kd[2] km[2] T[1] T[3] x[4] -
    kcr kd[2] km[2] T[2] T[3] x[4] -
    2 kd[2] km[2] T[1] x[4]^2 -
    kcr kd[1] km[1] T[2] x[4]^2 +
    kcr kd[2] km[2] T[2] x[4]^2 -
    sqrt((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1]
          km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2]
          T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1]
          T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1]
          x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
       4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2]
          km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[
           1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] -
         2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
         kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 +
         kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
         T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)))
  (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - (kd[2] km[2] T[1]
      (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
        kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
        kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
        2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
        2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
         T[2] x[4]^2 - sqrt((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
              kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
               x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
               x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
               x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
              kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
              kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
            (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
              km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
               T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
              kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
               T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
               x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)))) /
      (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
          kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))))) /
 (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
     kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
   (1 + (kd[1] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
```

```
      kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
      kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
      2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
      2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
       T[2] x[4]^2 - Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
             kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
              x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
              x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
              x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
             kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
             kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))
           (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
             km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
              T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
             kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
              T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
              x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))]) /
    (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
       kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))),
  x[4] -> (km[2] + x[4] + (kd[2] km[2] (2 kd[2] km[2]^2 T[1] T[3] -
       2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
       kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
       kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
       kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
       kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 -
       Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1]
              km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] +
             kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] -
             2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] +
             2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
             kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
             kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))
           (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
             km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
              T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
             kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
              T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
              x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))]) /
    (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
       kcr kd[1] kd[2] km[1] km[2] T[2] x[4])))))}
```

The following is the second solution $\frac{-b+\sqrt{(b^2-4\,ac)}}{2\,a}$, as we studied that the system is monostable thus the following is inverse function of solution x[4], $T_4 == f(x_4)$. And this function should also be monotone. Suppose this solution is positive real then $\sqrt{(b^2 - 4\,ac)}$ should be positive real.

```
-b = 2 kd[2] km[2]^2 T[1] T[3] -
  2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
  kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
  kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
  kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
  kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2
```

```
Simplify[2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
   kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
   kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
   2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
   2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2]
```

```
-kcr kd[1] km[1] T[2] x[4] (km[2] + x[4]) + kd[2] km[2] (2 km[2] T[1] (T[3] - x[4]) +
    x[4] (-kcr T[2] (km[1] + T[1] + T[3] - x[4]) - T[1] (T[2] - 2 T[3] + 2 x[4])))
```

And we have the non-trivial solution of inverse function of solution x[4].

```
t4Inv2 = t4 /. t3Sol[[2]]
```

```
{T[4] ==
  (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
      kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
      kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
      kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
      kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
      Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1] km[2]
              T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2] T[1] T[2]
              x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1] T[3] x[4] +
            kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1] x[4]^2 +
            kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
          4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
            kcr kd[1] kd[2] km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] +
            km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] +
            kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3]
             x[4] + 2 km[2] T[1] x[4]^2 + kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 +
            T[1] T[2] x[4]^2 + kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
            T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))]) /
    (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
        kcr kd[1] kd[2] km[1] km[2] T[2] x[4])) +
   (kd[2] km[2] T[2] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
        kcr kd[1] km[1] km[2] T[2] x[4] -
        kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
        kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
        kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
        kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
        Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1]
                km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2]
                T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1]
                T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1]
                x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
            4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2]
                km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[
                  1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] -
              2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
              kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 +
              kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
              T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))]) /
    (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
        kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
      (km[2] + x[4] + (kd[2] km[2] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
```

```
kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
 T[2] x[4]^2 + √((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
       kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
        x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
        x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
        x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
       kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
       kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
     (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
       km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
        T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
       kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
        T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
        x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)))) /
  (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
     kcr kd[1] kd[2] km[1] km[2] T[2] x[4])))) -
(kd[1] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
   kcr kd[1] km[1] km[2] T[2] x[4] -
   kcr kd[2] km[1] km[2] T[2] x[4] -
   kd[2] km[2] T[1] T[2] x[4] -
   kcr kd[2] km[2] T[1] T[2] x[4] +
   2 kd[2] km[2] T[1] T[3] x[4] -
   kcr kd[2] km[2] T[2] T[3] x[4] -
   2 kd[2] km[2] T[1] x[4]^2 -
   kcr kd[1] km[1] T[2] x[4]^2 +
   kcr kd[2] km[2] T[2] x[4]^2 +
   √((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1]
        km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2]
        T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1]
        T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1]
        x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
     4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2]
        km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[
         1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] -
       2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
       kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 +
       kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
       T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))) /
  (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - (kd[2] km[2] T[1]
     (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
       kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
       kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
       2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
       2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
        T[2] x[4]^2 + √((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
             kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
              x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
              x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
              x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
```

```
                kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
                kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
              (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
                km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
                 T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
                kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
                 T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
                 x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))))/
     (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
         kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))))/
(2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
    kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
  (1 + (kd[1] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
        kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
        kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
        2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
        2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
         T[2] x[4]^2 + Sqrt((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
            kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
             x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
             x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
             x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
            kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
            kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
          (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
            km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
             T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
            kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
             T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
             x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))))/
     (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
         kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))))
(km[2] + x[4] + (kd[2] km[2] (2 kd[2] km[2]^2 T[1] T[3] -
      2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
      kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
      kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
      kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
      kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
      Sqrt((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1]
          km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] +
         kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] -
         2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] +
         2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
         kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
         kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
       (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
         km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
          T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
         kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
          T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
          x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))))/
```

```
(2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
     kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))))}

finverse = Simplify[
  (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
     kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
     kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
     kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
     kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
     Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1] km[2]
           T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2] T[1] T[2]
           x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1] T[3] x[4] +
         kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1] x[4]^2 +
         kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
       4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
         kcr kd[1] kd[2] km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] +
         km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] +
         kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3]
          x[4] + 2 km[2] T[1] x[4]^2 + kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 +
         T[1] T[2] x[4]^2 + kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
         T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))]) /
   (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
      kcr kd[1] kd[2] km[1] km[2] T[2] x[4])) +
  (kd[2] km[2] T[2] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
     kcr kd[1] km[1] km[2] T[2] x[4] -
     kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
     kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
     kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
     kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
     Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1]
           km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2]
           T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1]
           T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1]
           x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
       4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2]
           km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[
            1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] -
         2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
         kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 +
         kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
         T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))]) /
   (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
      kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
     (km[2] + x[4] + (kd[2] km[2] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
          kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
          kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
          2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
          2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
           T[2] x[4]^2 + Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
               kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
                x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
```

```
                x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
                x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
              kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
              kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
            (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
              km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
               T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
              kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
               T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
               x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)))))/
       (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
           kcr kd[1] kd[2] km[1] km[2] T[2] x[4])))) -
(kd[1] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
    kcr kd[1] km[1] km[2] T[2] x[4] -
    kcr kd[2] km[1] km[2] T[2] x[4] -
    kd[2] km[2] T[1] T[2] x[4] -
    kcr kd[2] km[2] T[1] T[2] x[4] +
    2 kd[2] km[2] T[1] T[3] x[4] -
    kcr kd[2] km[2] T[2] T[3] x[4] -
    2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 +
    kcr kd[2] km[2] T[2] x[4]^2 +
    Sqrt[(-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1]
          km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2]
          T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1]
          T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1]
          x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
       4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2]
          km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[
           1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] -
         2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
         kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 +
         kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
         T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)])
  (-km[2] T[1] - T[1] x[4] + kcr T[2] x[4] - (kd[2] km[2] T[1]
     (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
       kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
       kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
       2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
       2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2]
        T[2] x[4]^2 + Sqrt[(-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] +
            kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2]
             x[4] + kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2]
             x[4] - 2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3]
             x[4] + 2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
            kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
            kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
          (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
            km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
             T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
            kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
             T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
             x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)])))/
     (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
         kcr kd[1] kd[2] km[1] km[2] T[2] x[4])))))
```

```
    (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
         kcr kd[1] kd[2] km[1] km[2] T[2] x[4])))) /
  (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
      kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
    (1 + (kd[1] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
           kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
           kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
           2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
           2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 +
           kcr kd[2] km[2] T[2] x[4]^2 + √(((-2 kd[2] km[2]^2 T[1] T[3] +
                2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1] km[2] T[2] x[4] +
                kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2] T[1] T[2] x[4] +
                kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1] T[3] x[4] +
                kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1] x[4]^2 +
                kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
             4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
                kcr kd[1] kd[2] km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] +
                km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] + km[2] T[1] T[2]
                 x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1] T[3] x[4] + kcr
                 km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 + kcr km[1] T[2] x[4]^2 -
                kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr T[1] T[2] x[4]^2 -
                kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3] x[4]^2 +
                kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)))) /
       (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
           kcr kd[1] kd[2] km[1] km[2] T[2] x[4])))
    (km[2] + x[4] + (kd[2] km[2] (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2]
            km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
           kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
           kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
           kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
           kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
           √(((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1]
                 km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] +
                kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] -
                2 kd[2] km[2] T[1] T[3] x[4] + kcr kd[2] km[2] T[2] T[3] x[4] +
                2 kd[2] km[2] T[1] x[4]^2 + kcr kd[1] km[1] T[2] x[4]^2 -
                kcr kd[2] km[2] T[2] x[4]^2)^2 - 4 (-kd[2]^2 km[2]^2 T[1] T[3] +
                kd[2]^2 km[2]^2 T[1] x[4] + kcr kd[1] kd[2] km[1] km[2] T[2] x[4])
              (-km[2]^2 T[1] T[3] + km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] +
                km[2] T[1] T[2] x[4] + kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1]
                 T[3] x[4] + kcr km[2] T[2] T[3] x[4] + 2 km[2] T[1] x[4]^2 +
                kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 + T[1] T[2] x[4]^2 + kcr
                 T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 - T[1] T[3]
                 x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3)))) /
       (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
           kcr kd[1] kd[2] km[1] km[2] T[2] x[4]))))]
((2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] -
    kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
    kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] +
    2 kd[2] km[2] T[1] T[3] x[4] - kcr kd[2] km[2] T[2] T[3] x[4] -
    2 kd[2] km[2] T[1] x[4]^2 - kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
```

```
√(-4 kd[2] km[2] (kcr kd[1] km[1] T[2] x[4] + kd[2] km[2] T[1] (-T[3] + x[4]))
     (km[2]^2 T[1] (-T[3] + x[4]) + x[4]^2 (-kcr^2 T[2]^2 + kcr T[2] (km[1] + T[1] -
           T[2] + T[3] - x[4]) + T[1] (T[2] - T[3] + x[4])) + km[2] x[4]
        (kcr T[2] (km[1] + T[1] + T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))) +
   (kcr kd[1] km[1] T[2] x[4] (km[2] + x[4]) + kd[2] km[2]
        (2 km[2] T[1] (-T[3] + x[4]) + x[4] (kcr T[2] (km[1] + T[1] +
              T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))))^2)) (1 +
(2 kd[2] km[2] T[2] (kd[2] km[2] T[1] (T[3] - x[4]) - kcr kd[1] km[1] T[2] x[4])) /
 (-kcr kd[1] km[1] km[2] T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] +
   kd[2] km[2] T[1] T[2] x[4] + kcr kd[2] km[2] T[1] T[2] x[4] +
   kcr kd[2] km[2] T[2] T[3] x[4] - kcr kd[1] km[1] T[2] x[4]^2 -
   kcr kd[2] km[2] T[2] x[4]^2 - √(-4 kd[2] km[2]
        (kcr kd[1] km[1] T[2] x[4] + kd[2] km[2] T[1] (-T[3] + x[4]))
        (km[2]^2 T[1] (-T[3] + x[4]) + x[4]^2 (-kcr^2 T[2]^2 + kcr T[2] (km[1] + T[1] -
              T[2] + T[3] - x[4]) + T[1] (T[2] - T[3] + x[4])) + km[2] x[4]
           (kcr T[2] (km[1] + T[1] + T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))) +
      (kcr kd[1] km[1] T[2] x[4] (km[2] + x[4]) + kd[2] km[2]
           (2 km[2] T[1] (-T[3] + x[4]) + x[4] (kcr T[2] (km[1] + T[1] +
                 T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))))^2)) -
(2 kd[1] kd[2] km[2] (kcr kd[1] km[1] T[2] x[4] + kd[2] km[2] T[1] (-T[3] + x[4]))
   (kcr kd[1] km[1] km[2] T[1] T[2] x[4] - kcr kd[2] km[1] km[2] T[1] T[2] x[4] -
     kd[2] km[2] T[1]^2 T[2] x[4] - kcr kd[2] km[2] T[1]^2 T[2] x[4] +
     kcr kd[2] km[2] T[1] T[2] T[3] x[4] + kcr kd[1] km[1] T[1] T[2] x[4]^2 -
     kcr kd[2] km[2] T[1] T[2] x[4]^2 - 2 kcr^2 kd[1] km[1] T[2]^2 x[4]^2 +
     T[1] √(-4 kd[2] km[2] (kcr kd[1] km[1] T[2] x[4] +
           kd[2] km[2] T[1] (-T[3] + x[4])) (km[2]^2 T[1] (-T[3] + x[4]) +
           x[4]^2 (-kcr^2 T[2]^2 + kcr T[2] (km[1] + T[1] - T[2] + T[3] - x[4]) +
              T[1] (T[2] - T[3] + x[4])) + km[2] x[4] (kcr T[2]
              (km[1] + T[1] + T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))) +
        (kcr kd[1] km[1] T[2] x[4] (km[2] + x[4]) + kd[2] km[2]
           (2 km[2] T[1] (-T[3] + x[4]) + x[4] (kcr T[2] (km[1] + T[1] +
                 T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))))^2))) /
 ((kcr kd[1] km[1] km[2] T[2] x[4] - kcr kd[2] km[1] km[2] T[2] x[4] -
     kd[2] km[2] T[1] T[2] x[4] - kcr kd[2] km[2] T[1] T[2] x[4] -
     kcr kd[2] km[2] T[2] T[3] x[4] + kcr kd[1] km[1] T[2] x[4]^2 +
     kcr kd[2] km[2] T[2] x[4]^2 + √(-4 kd[2] km[2] (kcr kd[1] km[1] T[2] x[4] +
           kd[2] km[2] T[1] (-T[3] + x[4])) (km[2]^2 T[1] (-T[3] + x[4]) +
           x[4]^2 (-kcr^2 T[2]^2 + kcr T[2] (km[1] + T[1] - T[2] + T[3] - x[4]) +
              T[1] (T[2] - T[3] + x[4])) + km[2] x[4] (kcr T[2]
              (km[1] + T[1] + T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))) +
        (kcr kd[1] km[1] T[2] x[4] (km[2] + x[4]) + kd[2] km[2]
           (2 km[2] T[1] (-T[3] + x[4]) + x[4] (kcr T[2] (km[1] + T[1] +
                 T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))))^2)) /
   (-2 kd[1] kd[2] km[2]^2 T[1] T[3] + 2 kd[2]^2 km[2]^2 T[1] T[3] +
     2 kd[1] kd[2] km[2]^2 T[1] x[4] - 2 kd[2]^2 km[2]^2 T[1] x[4] +
     kcr kd[1]^2 km[1] km[2] T[2] x[4] - kcr kd[1] kd[2] km[1] km[2] T[2] x[4] +
     kd[1] kd[2] km[2] T[1] T[2] x[4] + kcr kd[1] kd[2] km[2] T[1] T[2] x[4] -
     2 kd[1] kd[2] km[2] T[1] T[3] x[4] +
     kcr kd[1] kd[2] km[2] T[2] T[3] x[4] + 2 kd[1] kd[2] km[2] T[1] x[4]^2 +
     kcr kd[1]^2 km[1] T[2] x[4]^2 - kcr kd[1] kd[2] km[2] T[2] x[4]^2 -
     kd[1] √(-4 kd[2] km[2] (kcr kd[1] km[1] T[2] x[4] +
           kd[2] km[2] T[1] (-T[3] + x[4])) (km[2]^2 T[1] (-T[3] + x[4]) +
           x[4]^2 (-kcr^2 T[2]^2 + kcr T[2] (km[1] + T[1] - T[2] + T[3] - x[4]) +
              T[1] (T[2] - T[3] + x[4])) + km[2] x[4] (kcr T[2]
              (km[1] + T[1] + T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4]))) +
```

```
                (kcr kd[1] km[1] T[2] x[4] (km[2] + x[4]) + kd[2] km[2]
                     (2 km[2] T[1] (-T[3] + x[4]) + x[4] (kcr T[2] (km[1] + T[1] +
                              T[3] - x[4]) + T[1] (T[2] - 2 T[3] + 2 x[4])))^2))))) /
 (2 kd[2] km[2] (kcr kd[1] km[1] T[2] x[4] + kd[2] km[2]
      T[
       1] (-T[3] + x[4])))
```

Here we get the second derivative of the inverse function:

```
ddfinverse = D[finverse, {x[4], 2}];
```

```
Simplify[ddfinverse]
```

```
$Aborted
```

If we don't substitue T_4only consider relationship between x_4 and x_7. Then we will have ts3Sol[[2]] as the inverse function of solution x_4.

```
t3Sol[[2]]
```

```
finversex7 =
  (2 kd[2] km[2]^2 T[1] T[3] - 2 kd[2] km[2]^2 T[1] x[4] - kcr kd[1] km[1] km[2] T[2] x[4] -
     kcr kd[2] km[1] km[2] T[2] x[4] - kd[2] km[2] T[1] T[2] x[4] -
     kcr kd[2] km[2] T[1] T[2] x[4] + 2 kd[2] km[2] T[1] T[3] x[4] -
     kcr kd[2] km[2] T[2] T[3] x[4] - 2 kd[2] km[2] T[1] x[4]^2 -
     kcr kd[1] km[1] T[2] x[4]^2 + kcr kd[2] km[2] T[2] x[4]^2 +
     Sqrt[((-2 kd[2] km[2]^2 T[1] T[3] + 2 kd[2] km[2]^2 T[1] x[4] + kcr kd[1] km[1] km[2]
              T[2] x[4] + kcr kd[2] km[1] km[2] T[2] x[4] + kd[2] km[2] T[1] T[2] x[4] +
            kcr kd[2] km[2] T[1] T[2] x[4] - 2 kd[2] km[2] T[1] T[3] x[4] +
            kcr kd[2] km[2] T[2] T[3] x[4] + 2 kd[2] km[2] T[1] x[4]^2 +
            kcr kd[1] km[1] T[2] x[4]^2 - kcr kd[2] km[2] T[2] x[4]^2)^2 -
        4 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
            kcr kd[1] kd[2] km[1] km[2] T[2] x[4]) (-km[2]^2 T[1] T[3] +
            km[2]^2 T[1] x[4] + kcr km[1] km[2] T[2] x[4] + km[2] T[1] T[2] x[4] +
            kcr km[2] T[1] T[2] x[4] - 2 km[2] T[1] T[3] x[4] + kcr km[2] T[2] T[3]
             x[4] + 2 km[2] T[1] x[4]^2 + kcr km[1] T[2] x[4]^2 - kcr km[2] T[2] x[4]^2 +
            T[1] T[2] x[4]^2 + kcr T[1] T[2] x[4]^2 - kcr T[2]^2 x[4]^2 - kcr^2 T[2]^2 x[4]^2 -
            T[1] T[3] x[4]^2 + kcr T[2] T[3] x[4]^2 + T[1] x[4]^3 - kcr T[2] x[4]^3))]) /
   (2 (-kd[2]^2 km[2]^2 T[1] T[3] + kd[2]^2 km[2]^2 T[1] x[4] +
       kcr kd[1] kd[2] km[1] km[2] T[2] x[4]));
```

```
Simplify[D[finversex7, {x[4], 2}]]
```