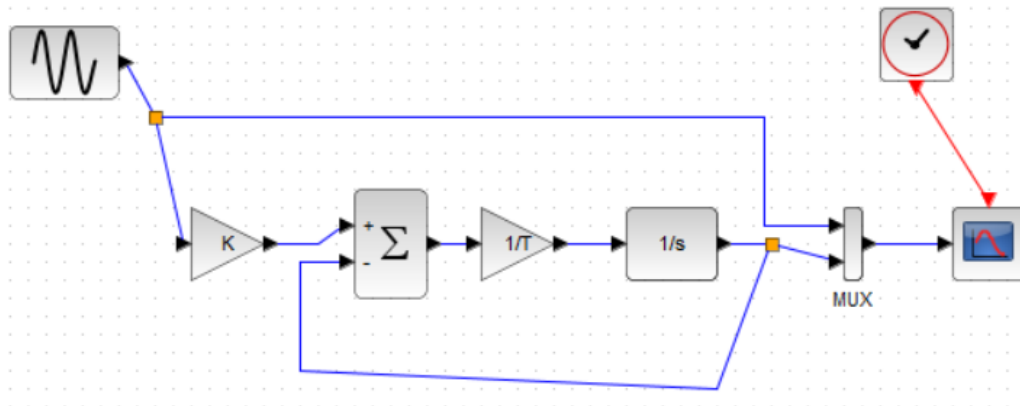


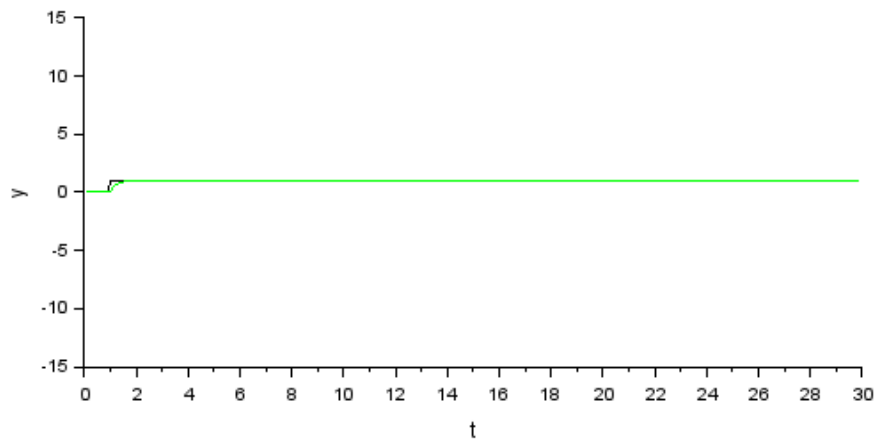
Апериодическое звено



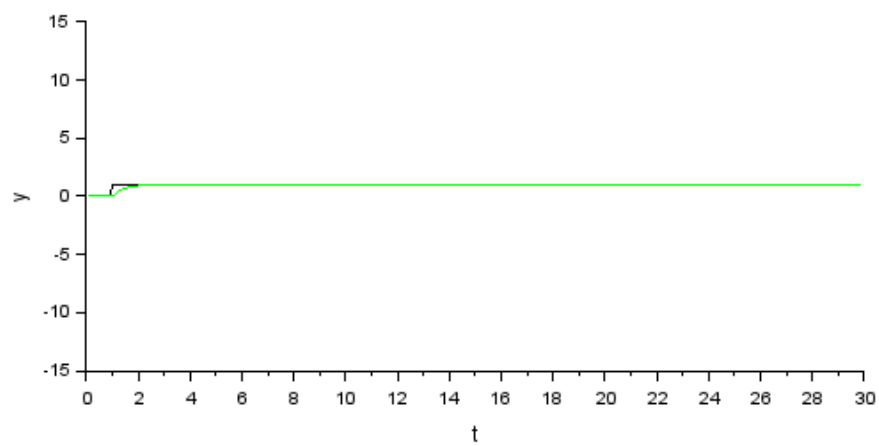
Дифференциальное уравнение $T\dot{y} + y = ku$

Передаточная функция $W(s) = \frac{k}{Ts+1}$

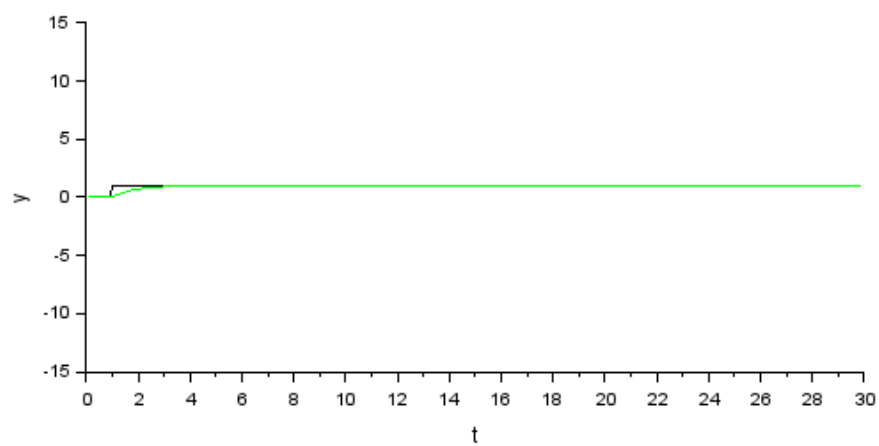
Переходная функция



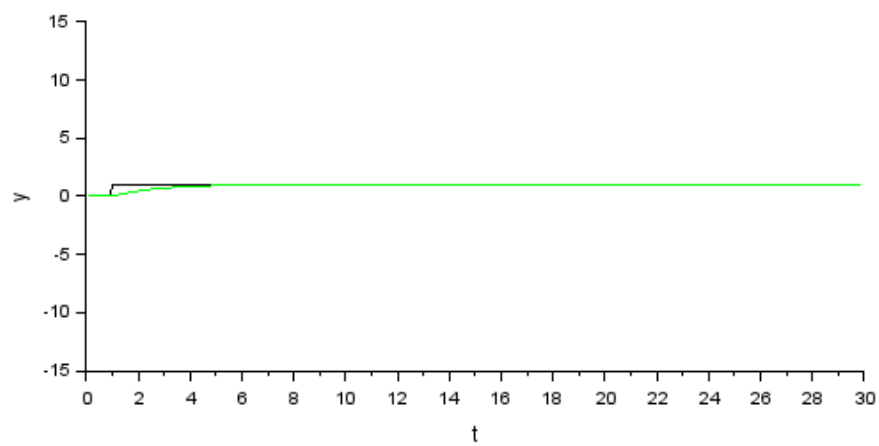
$K=1, T=0.2$



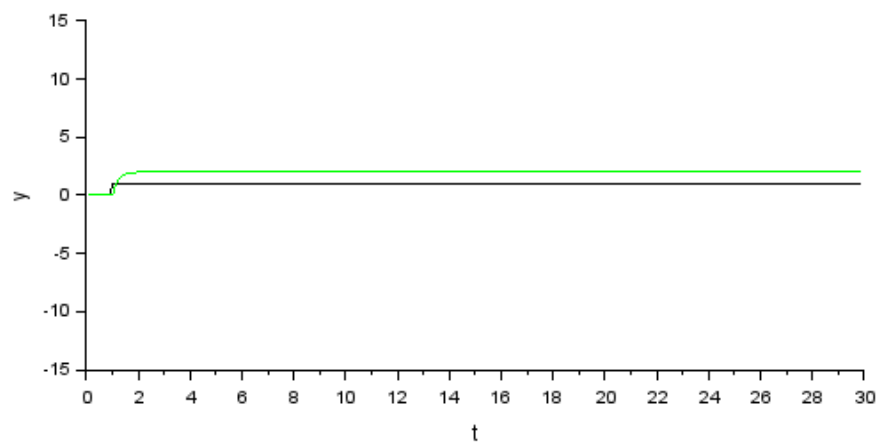
$K=1, T=0.4$



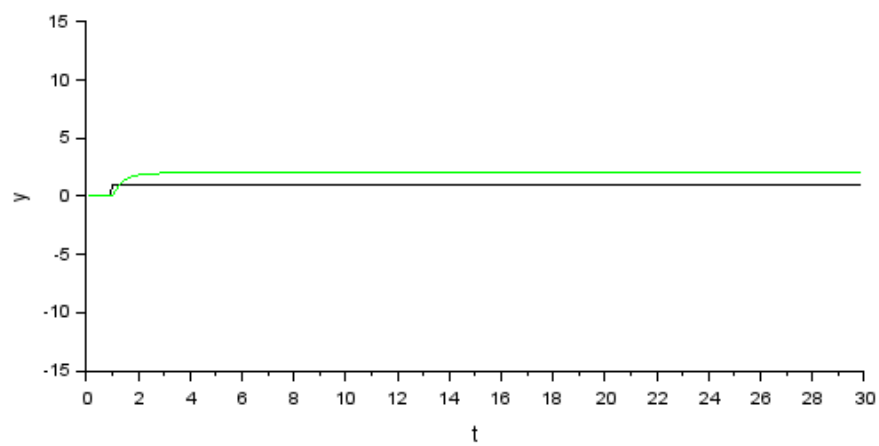
$K=1, T=0.8$



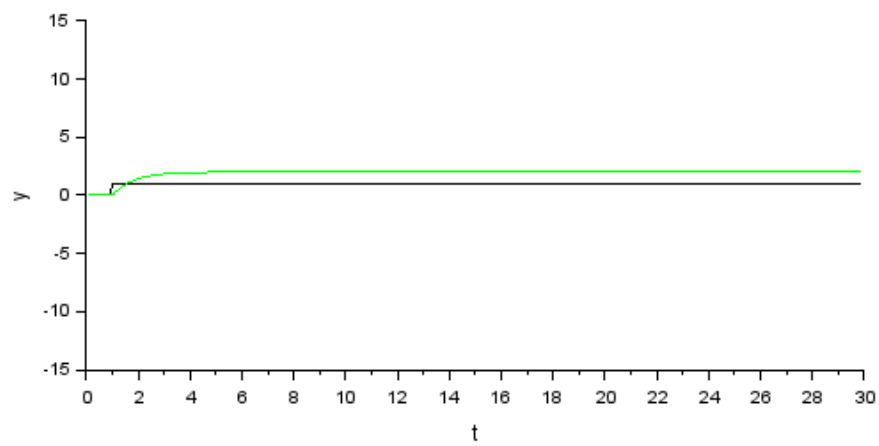
$K=1, T=1.6$



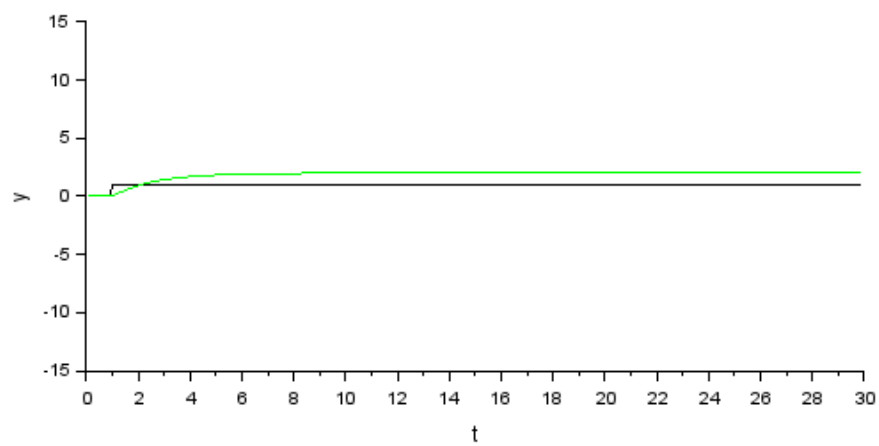
$K=2, T=0.2$



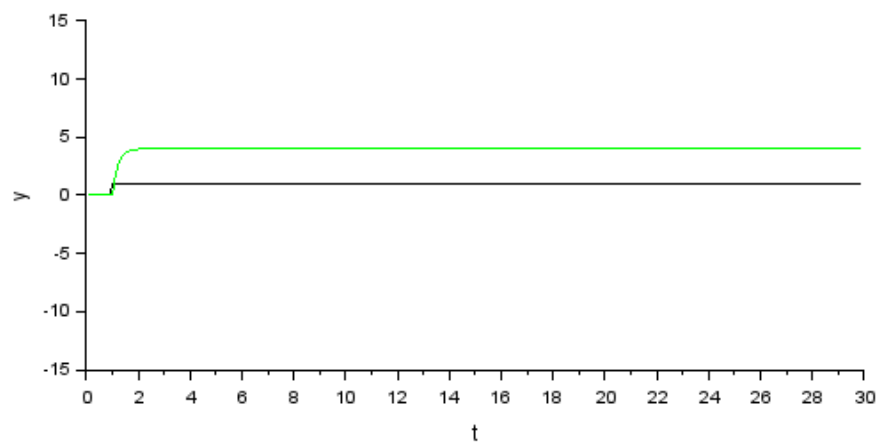
$K=2, T=0.4$



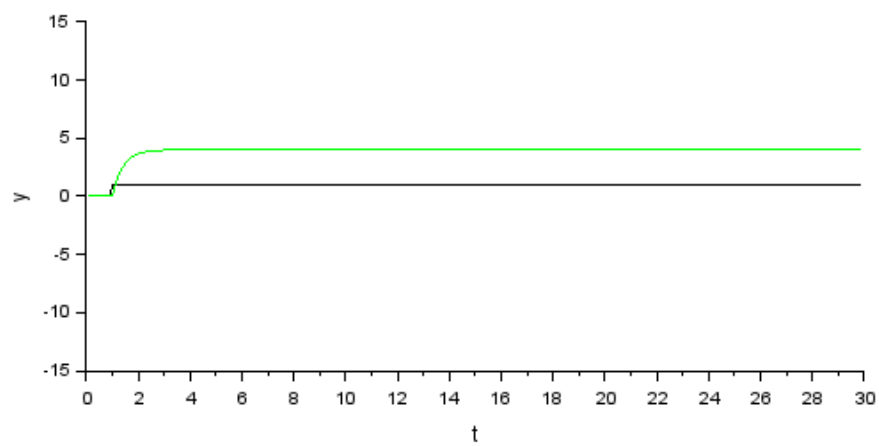
$K=2, T=0.8$



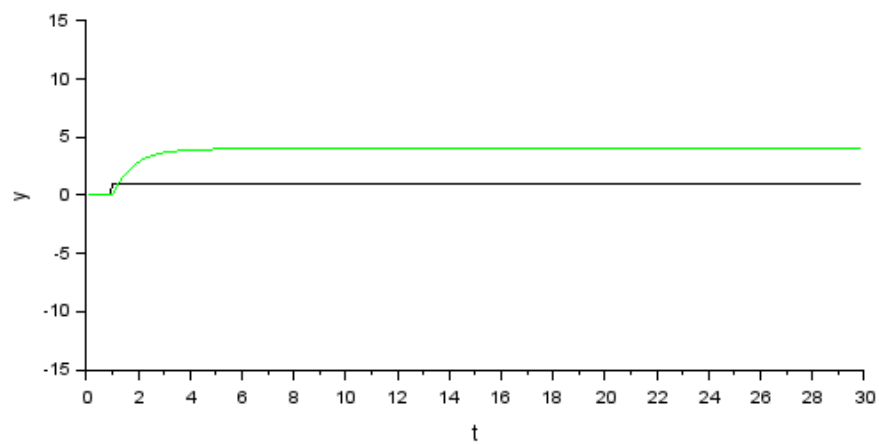
$K=2, T=1.6$



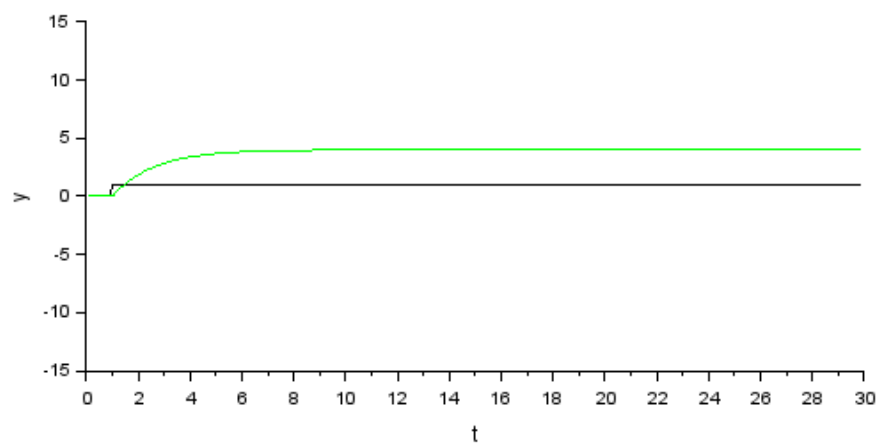
$K=4, T=0.2$



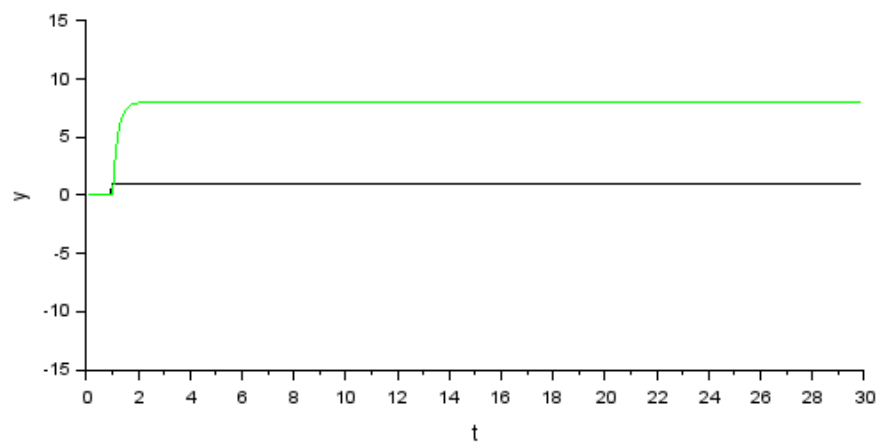
$K=4, T=0.4$



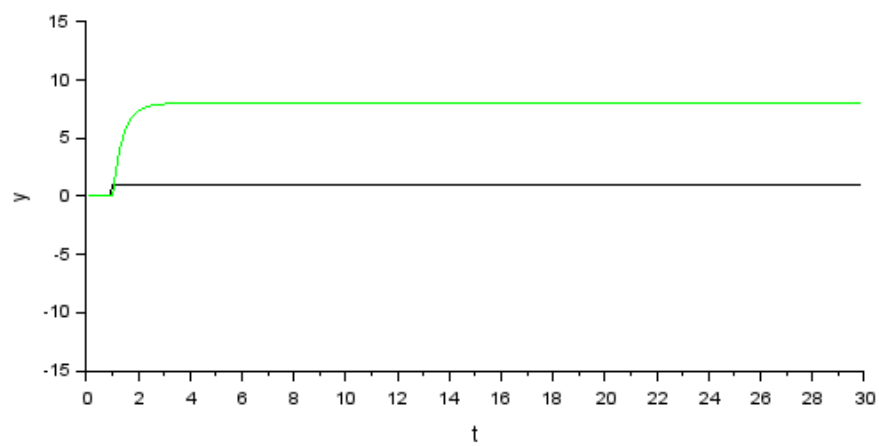
$K=4, T=0.8$



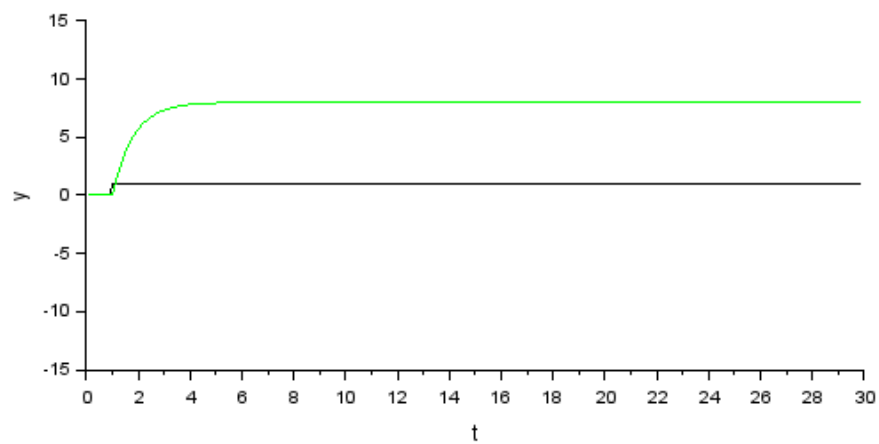
$K=4, T=1.6$



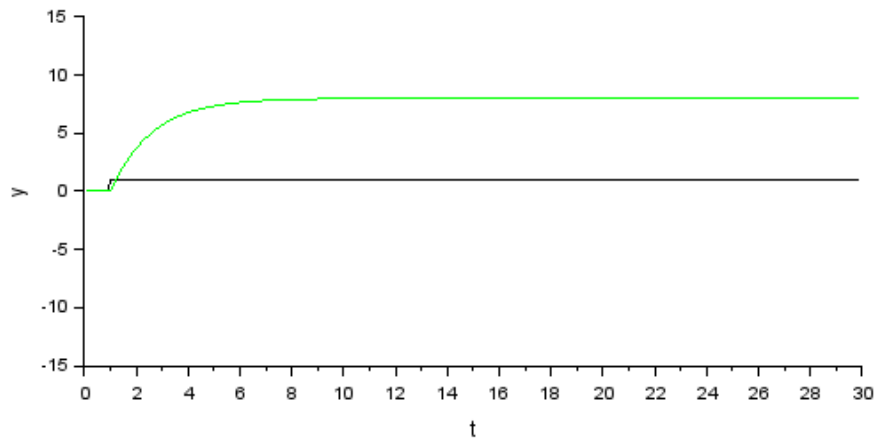
$K=8, T=0.2$



$K=8, T=0.4$



$K=8, T=0.8$

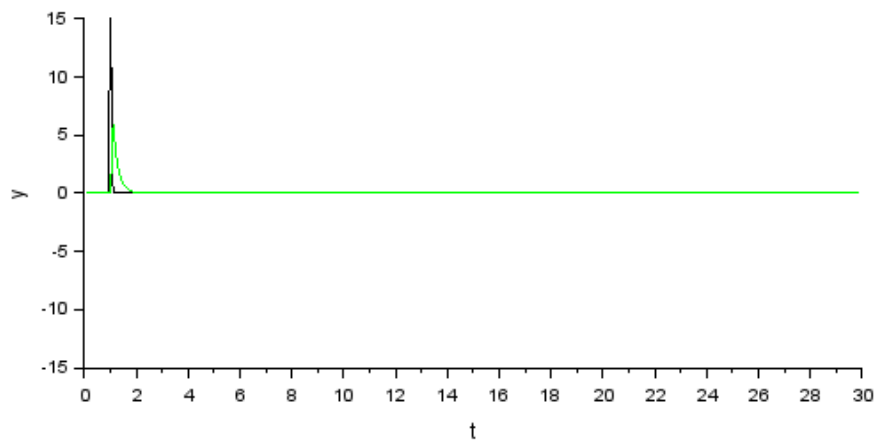


$$K=8, T=1.6$$

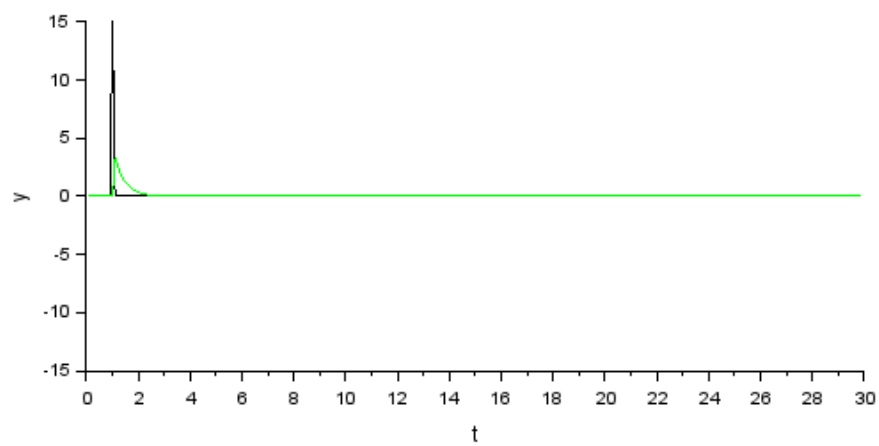
Между k и переходной функцией прямая пропорциональность, при увеличении T переходная функция сходится медленнее

$$\text{Переходная функция } L^{-1}\left(\frac{W(s)}{s}\right) = \frac{k}{T}L^{-1}\left(\frac{1}{s(s+\frac{1}{T})}\right) = k(1(t) - e^{-\frac{t}{T}})$$

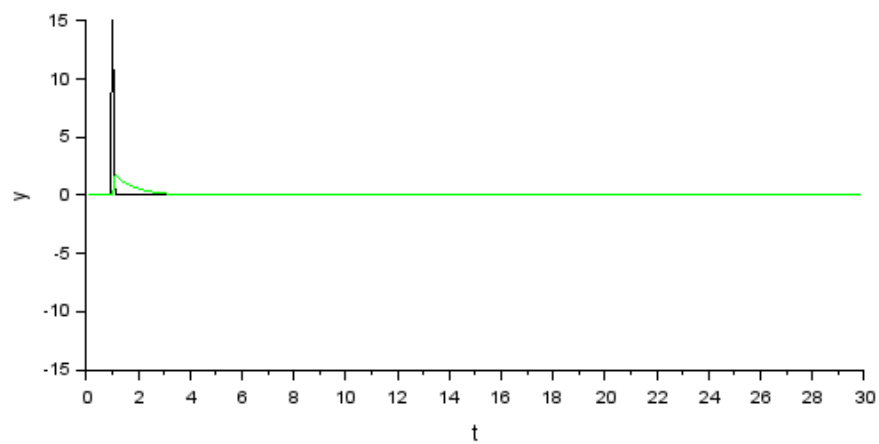
Импульсная функция



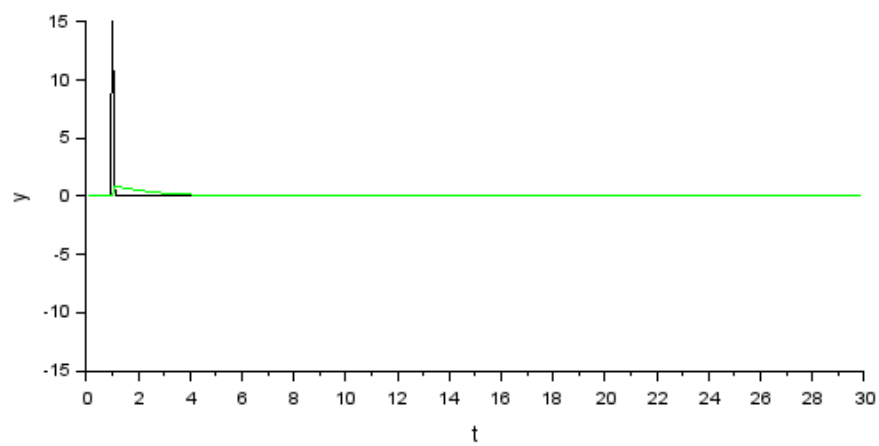
$$K=1, T=0.2$$



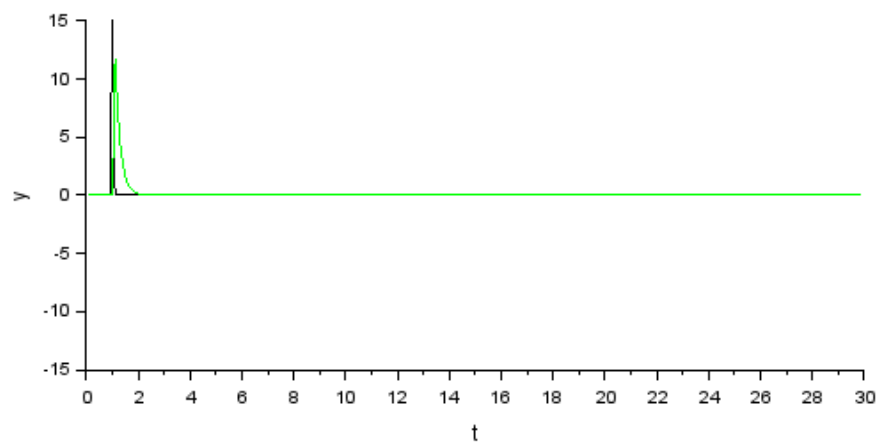
$K=1, T=0.4$



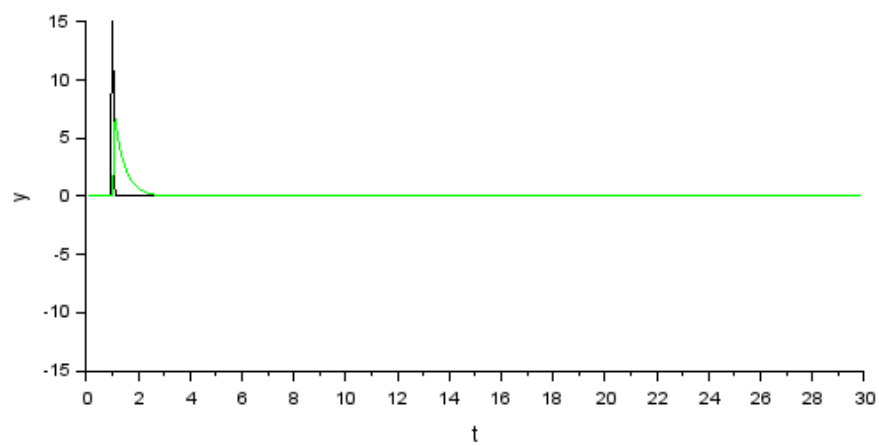
$K=1, T=0.8$



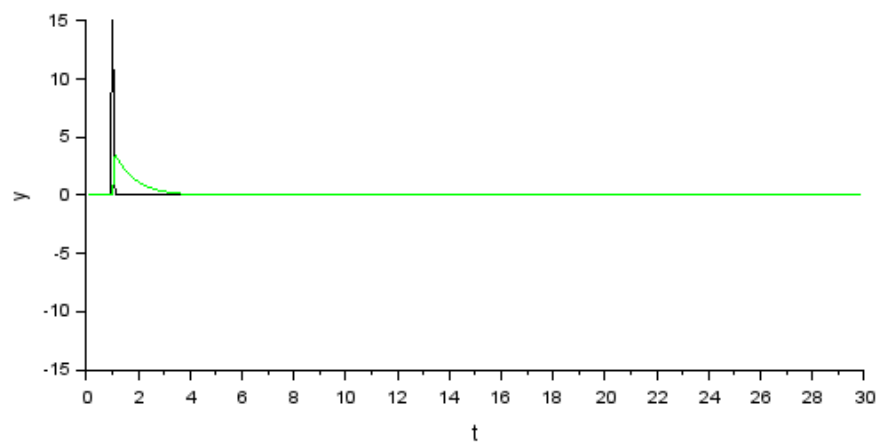
$K=1, T=1.6$



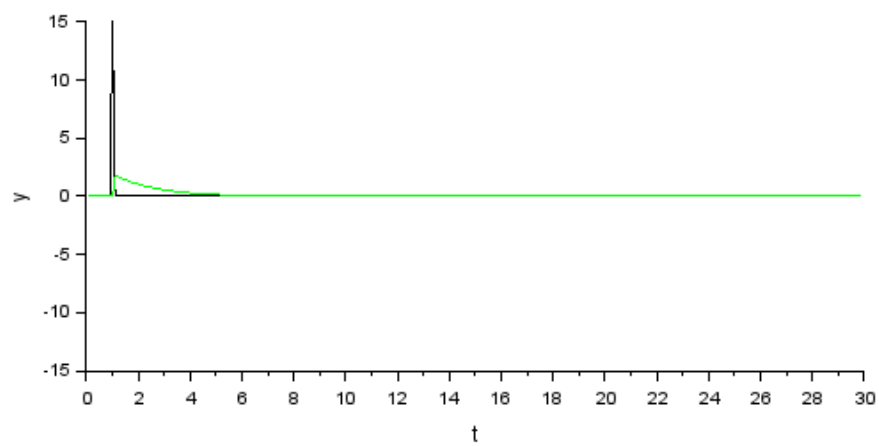
$K=2, T=0.2$



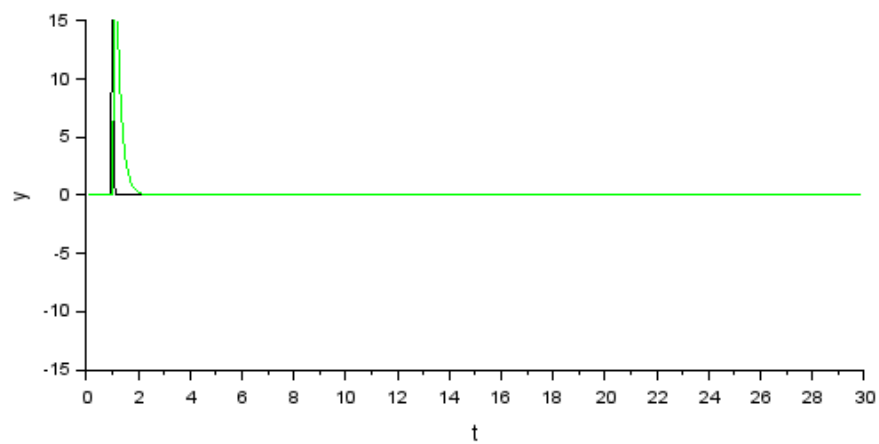
$K=2, T=0.4$



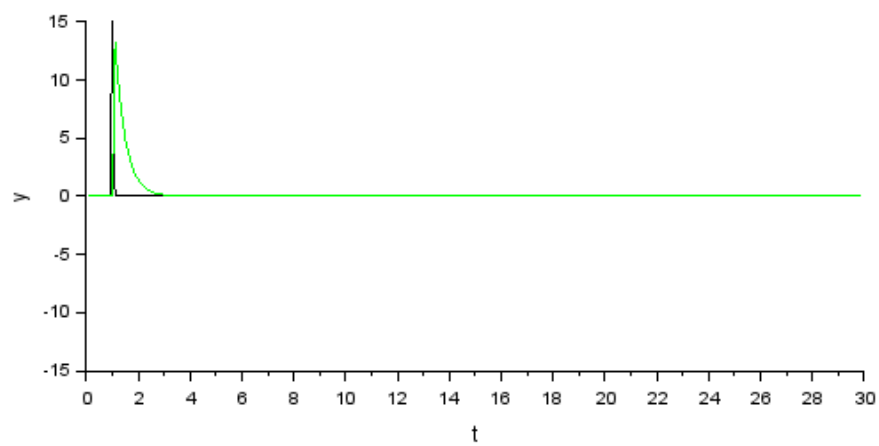
$K=2, T=0.8$



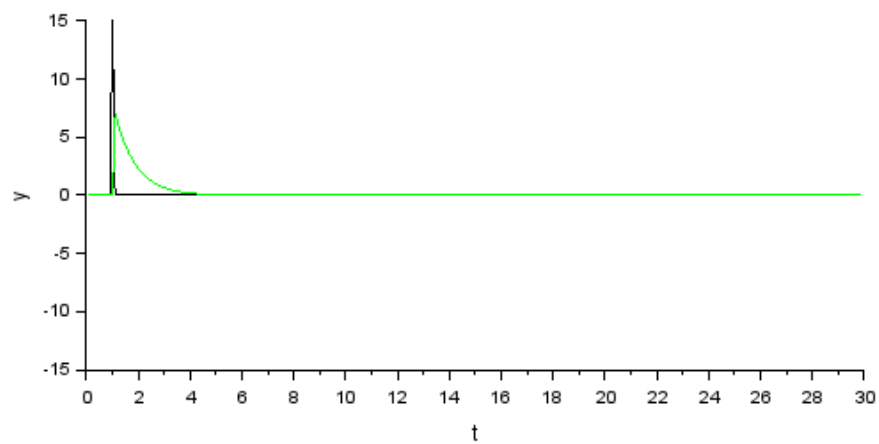
$K=2$, $T=1.6$



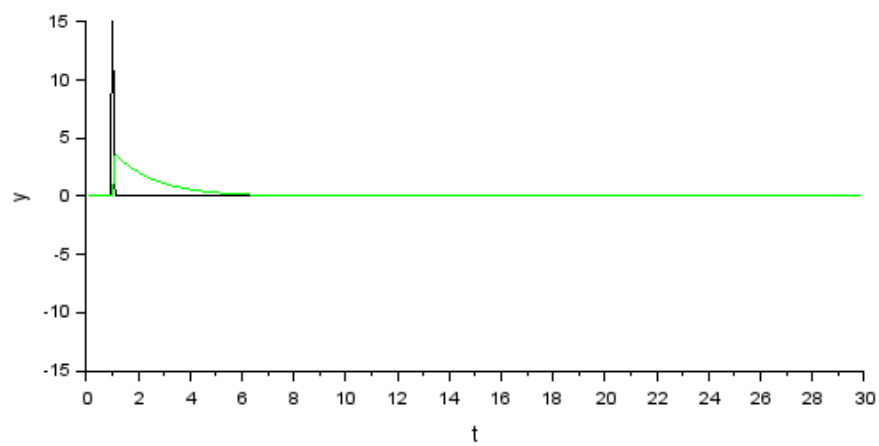
$K=4$, $T=0.2$



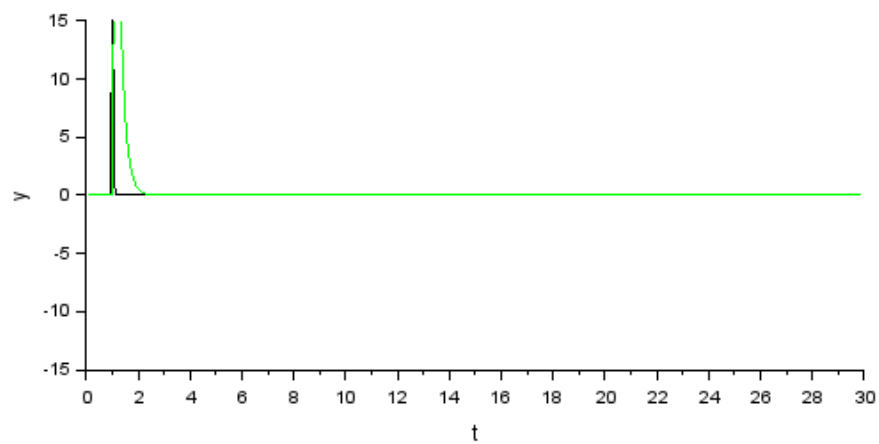
$K=4, T=0.4$



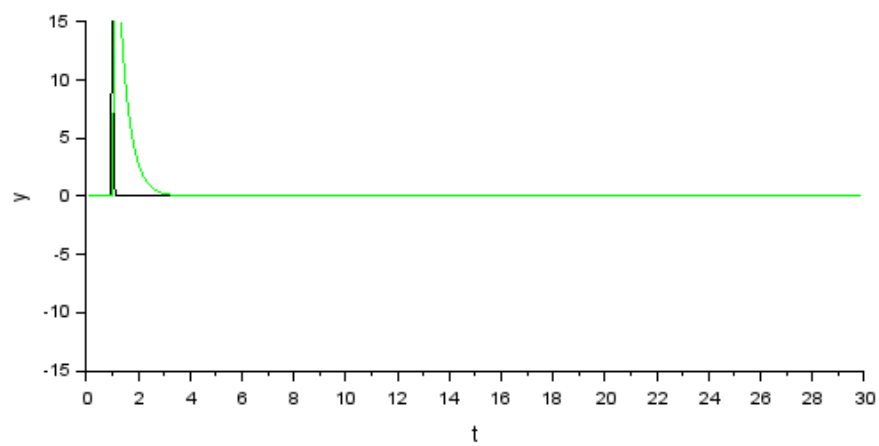
$K=4, T=0.8$



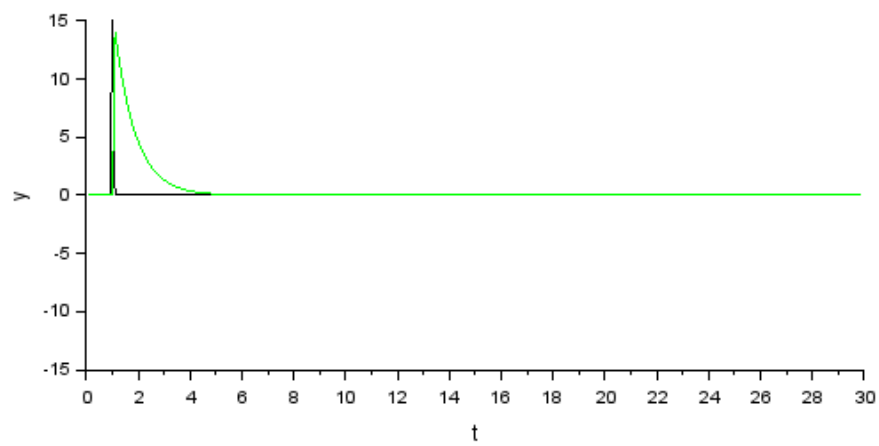
$K=4, T=1.6$



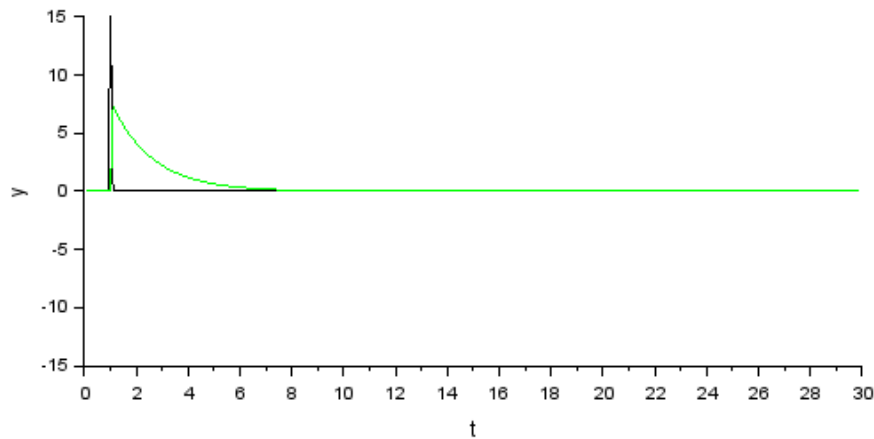
$K=8, T=0.2$



$K=8, T=0.4$



$K=8, T=0.8$

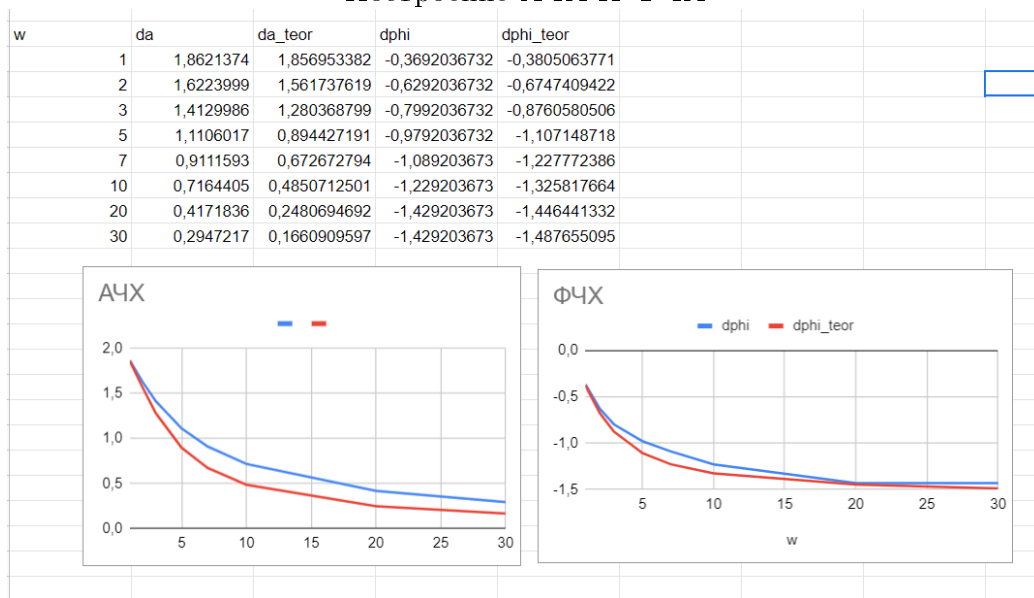


$K=8, T=1.6$

При увеличении k увеличивается максимум импульсной функции. При увеличении T уменьшается максимум, сходится медленнее.

Импульсная функция $L^{-1}(W(s)) = \frac{k}{T} L^{-1}\left(\frac{1}{s - (-\frac{1}{T})}\right) = \frac{k}{T} e^{-\frac{t}{T}} 1(t)$

Построение АЧХ И ФЧХ

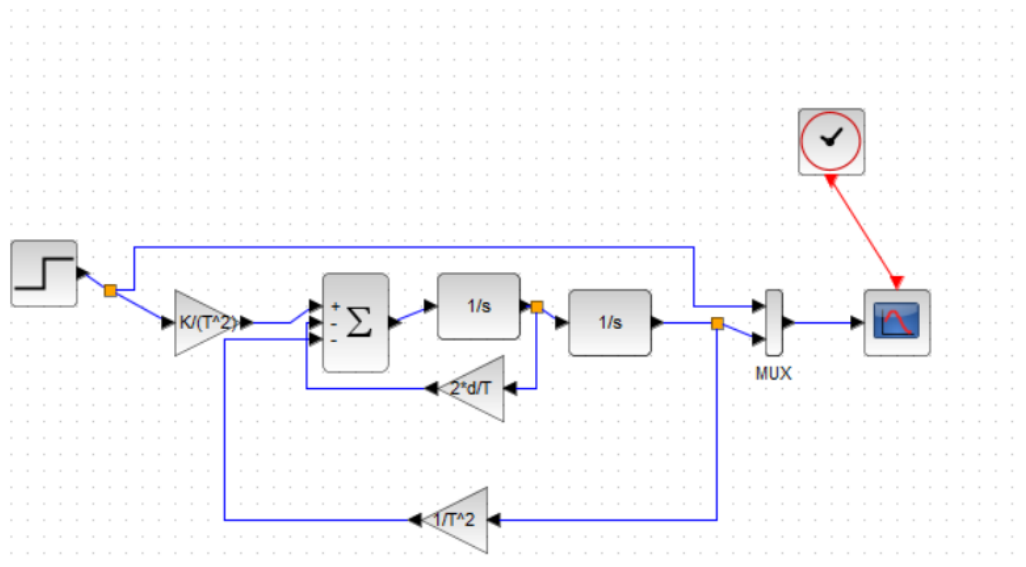


$$W(jw) = \frac{k}{Tjw+1} = \frac{k(1-Tjw)}{T^2w^2+1}$$

$$\text{АЧХ} = \frac{|k|}{\sqrt{(1+T^2w^2)}}$$

$$\text{ФЧХ} = -\arctan Tw$$

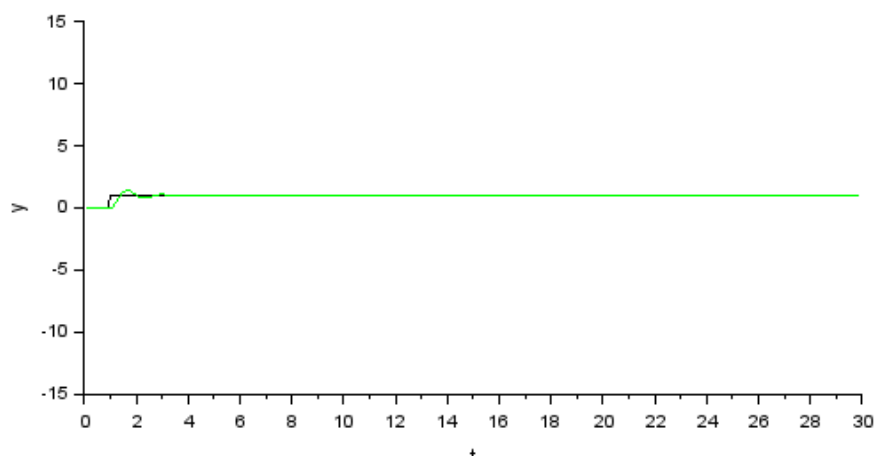
Колебательное звено



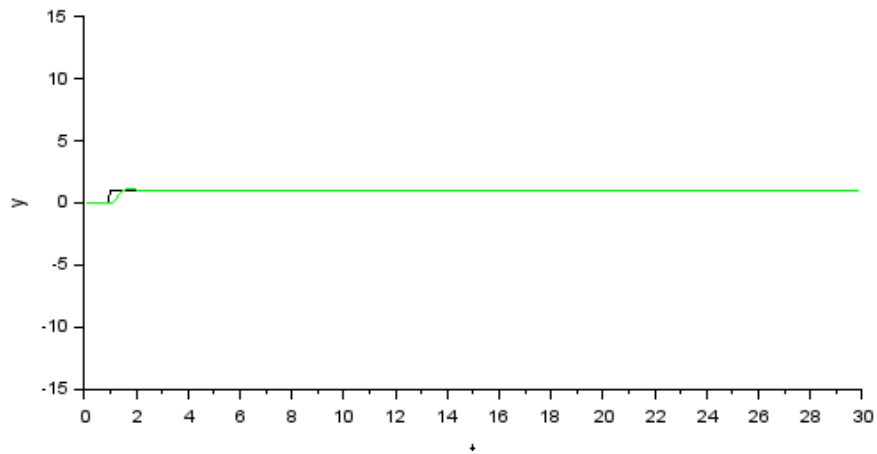
Дифференциальное уравнение $T^2\ddot{y} + 2dT\dot{y} + y = ku$, где $0 < d < 1$

Передаточная функция $W(s) = \frac{k}{T^2s^2 + 2dT s + 1}$

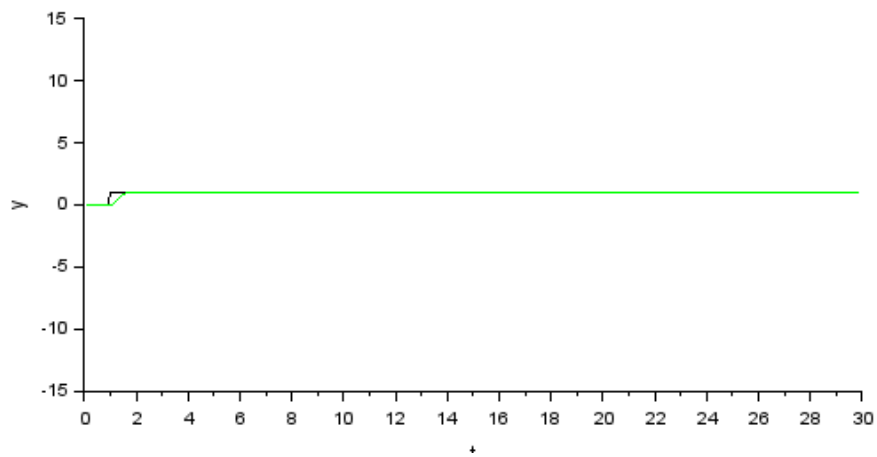
Переходная функция



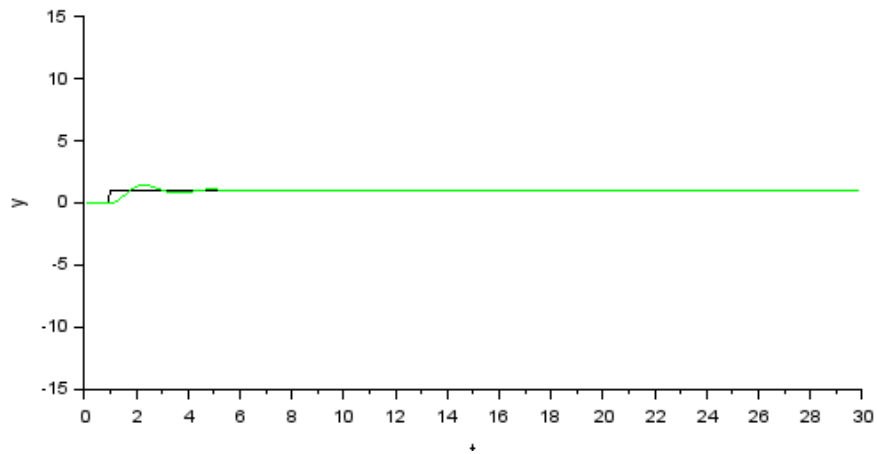
$K=1, T=0.2, d=0.25$



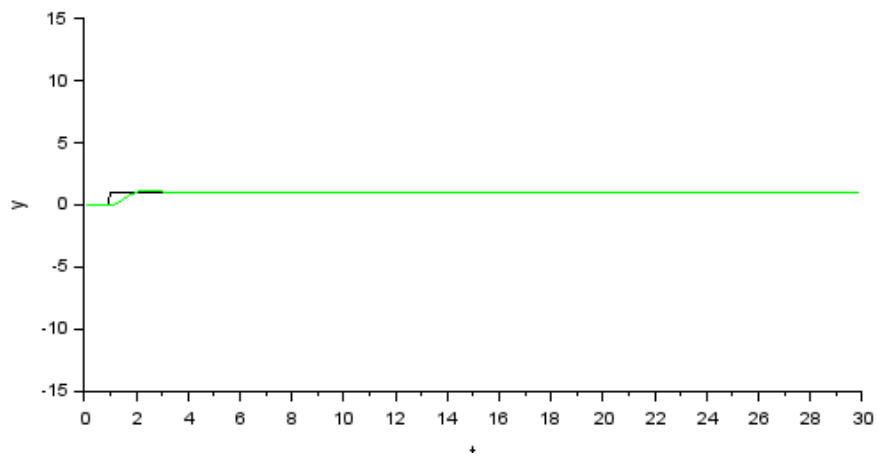
$K=1$, $T=0.2$, $d=0.5$



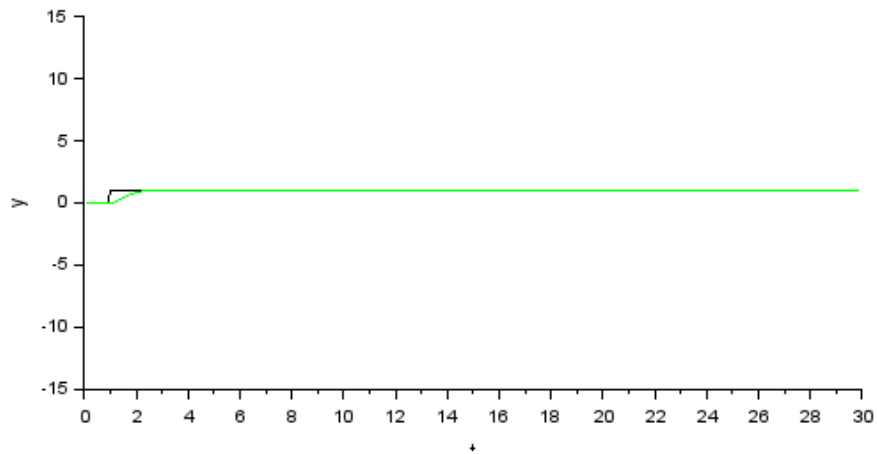
$K=1$, $T=0.2$, $d=0.75$



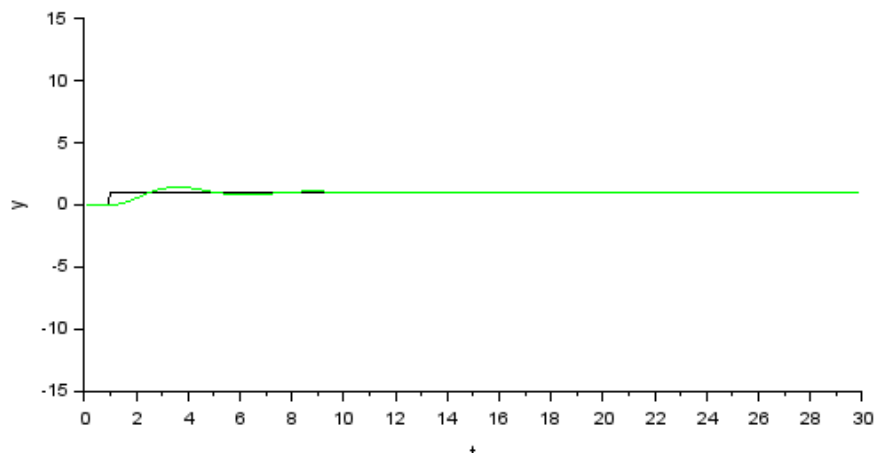
$K=1$, $T=0.4$, $d=0.25$



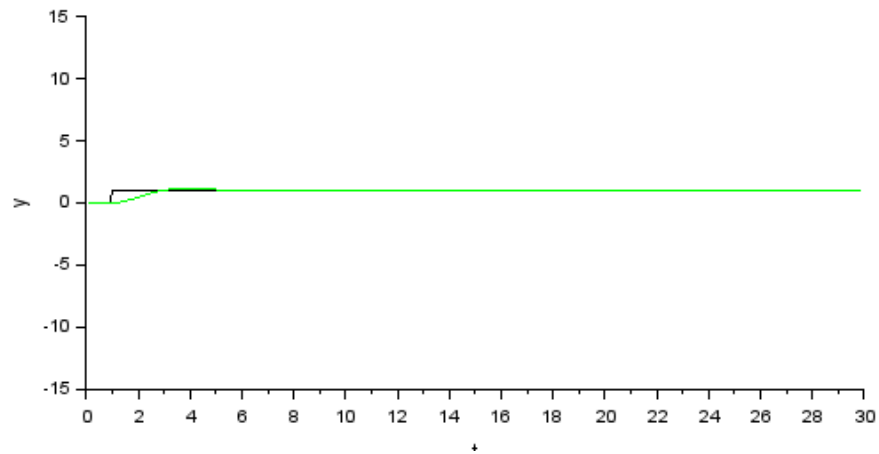
$K=1$, $T=0.4$, $d=0.5$



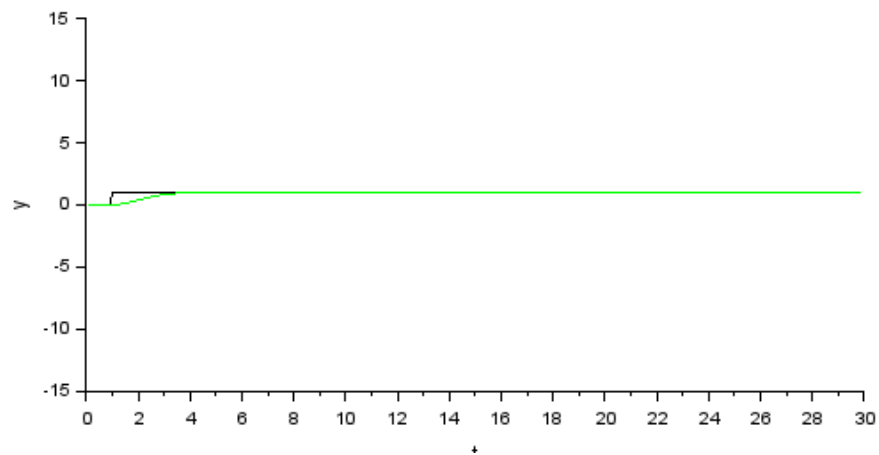
$K=1$, $T=0.4$, $d=0.75$



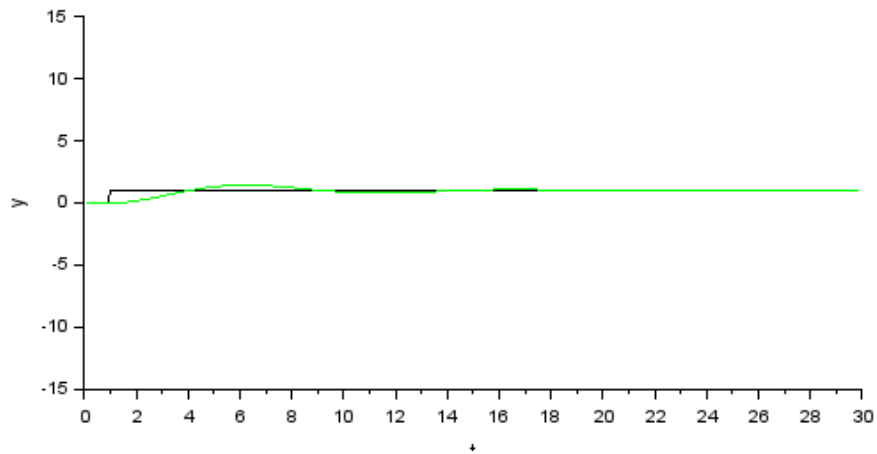
$K=1$, $T=0.8$, $d=0.25$



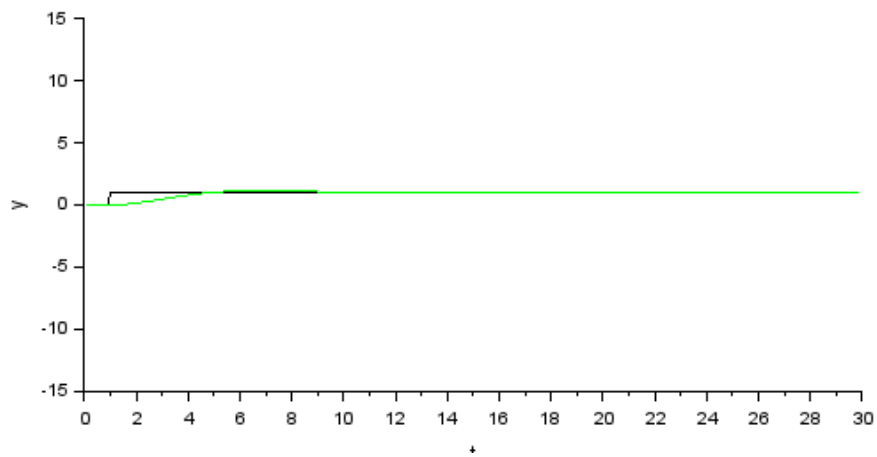
$K=1, T=0.8, d=0.5$



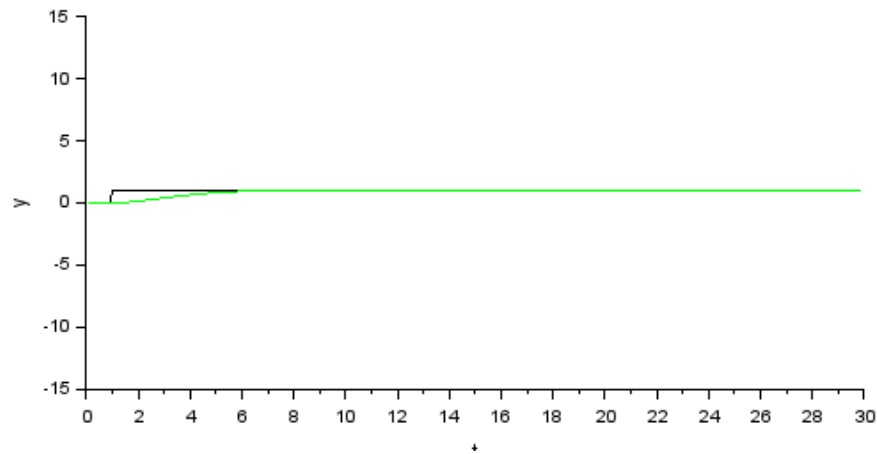
$K=1, T=0.8, d=0.75$



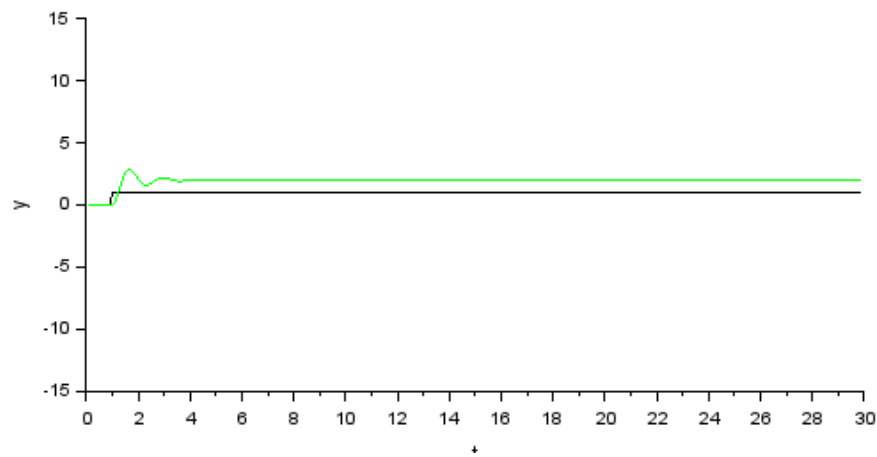
$K=1$, $T=1.6$, $d=0.25$



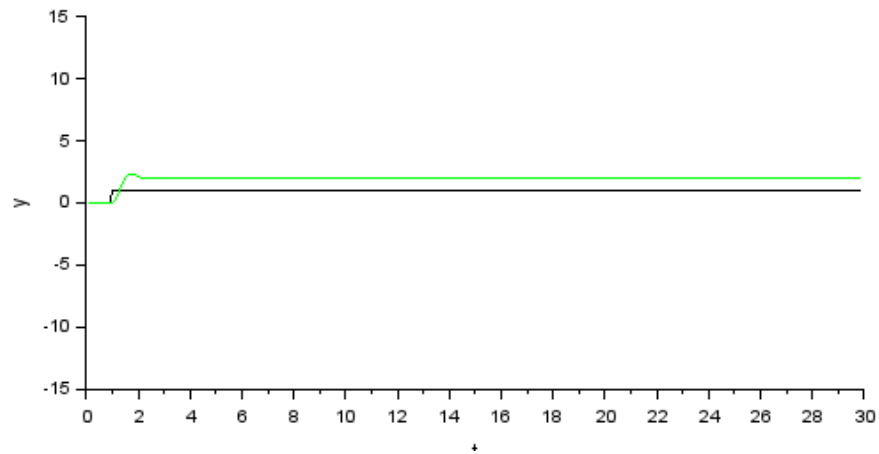
$K=1$, $T=1.6$, $d=0.5$



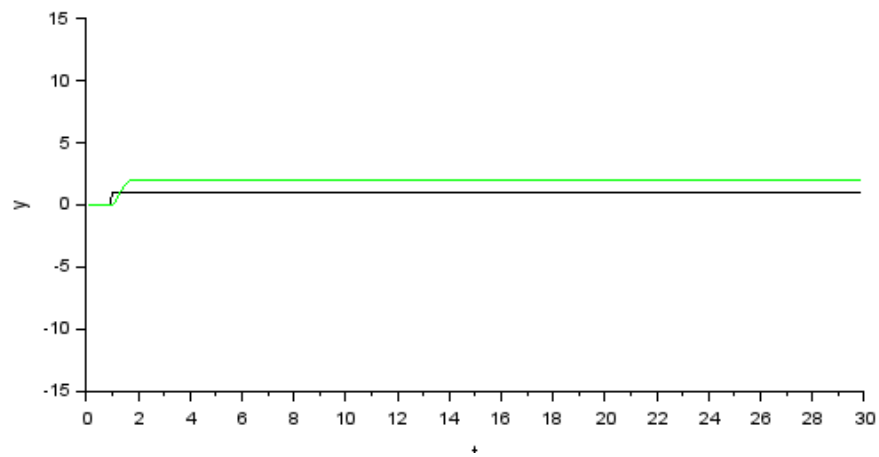
$K=1$, $T=1.6$, $d=0.75$



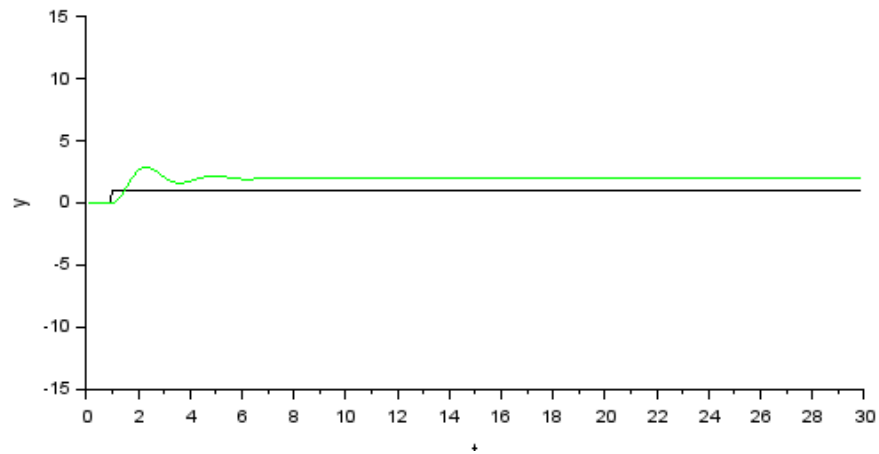
$K=2$, $T=0.2$, $d=0.25$



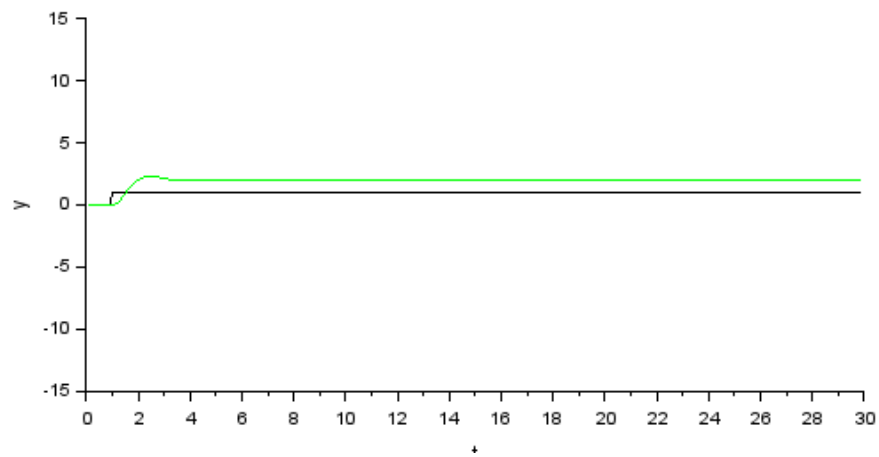
$K=2, T=0.2, d=0.5$



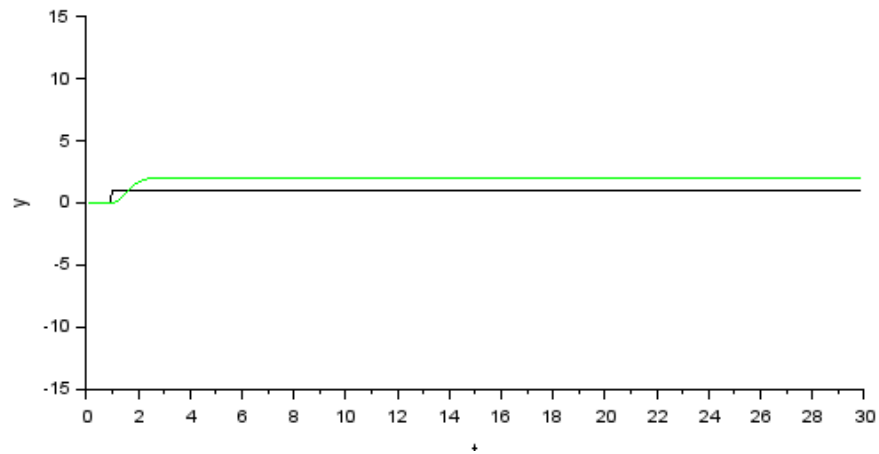
$K=2, T=0.2, d=0.75$



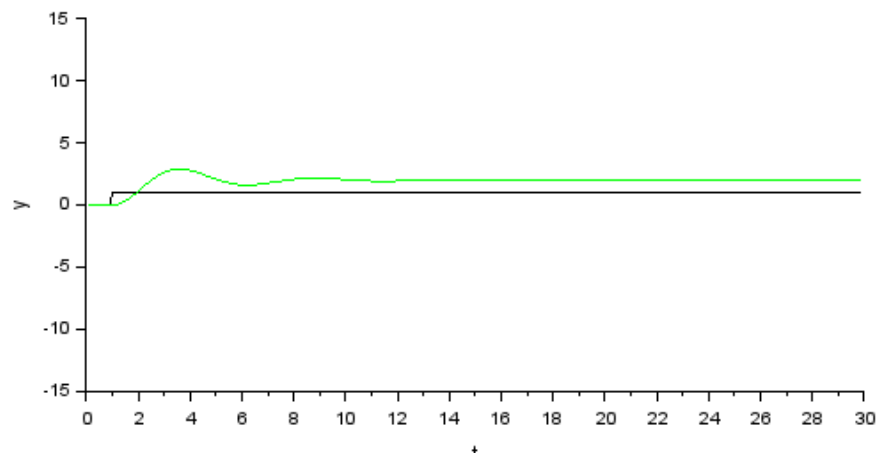
$K=2$, $T=0.4$, $d=0.25$



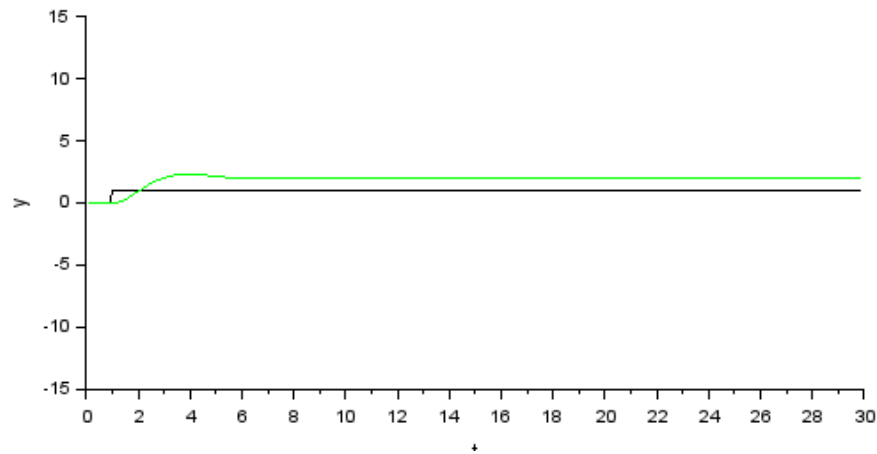
$K=2$, $T=0.4$, $d=0.5$



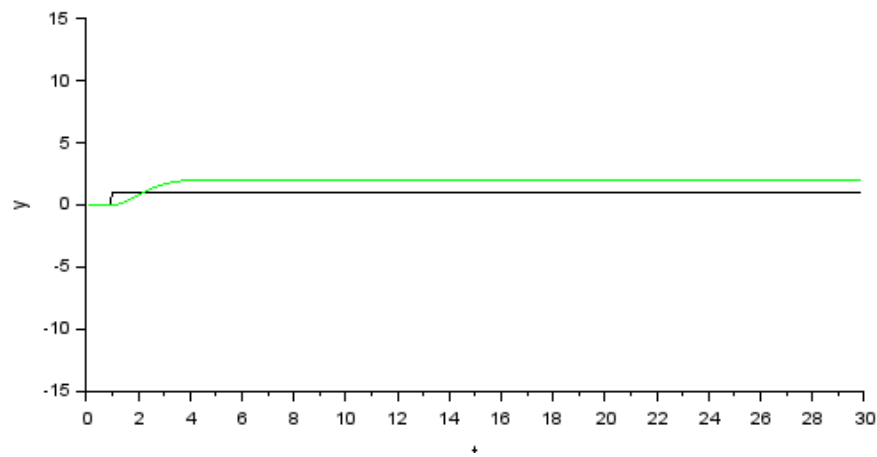
$K=2$, $T=0.4$, $d=0.75$



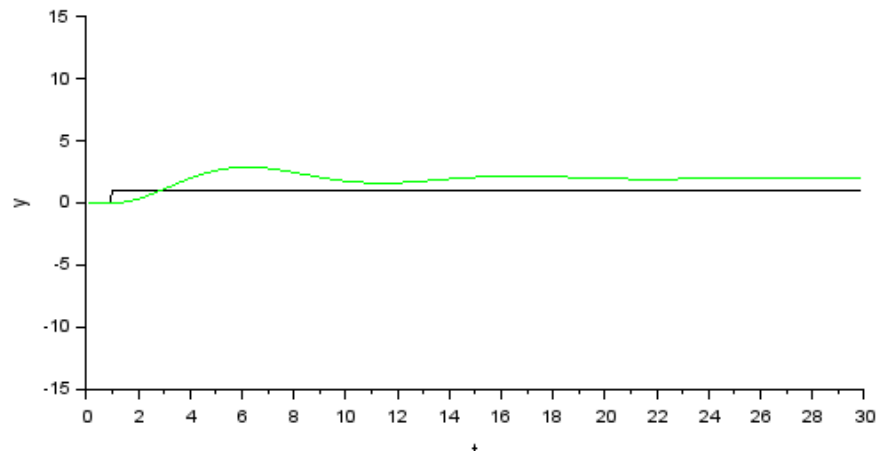
$K=2$, $T=0.8$, $d=0.25$



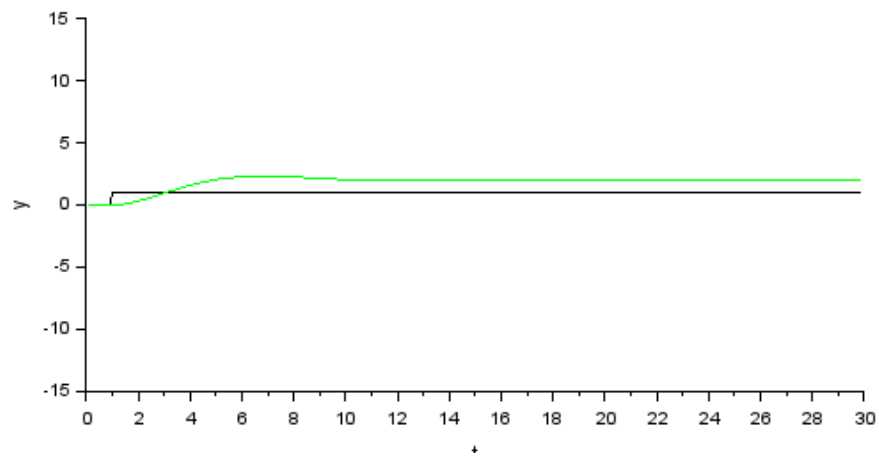
$K=2, T=0.8, d=0.5$



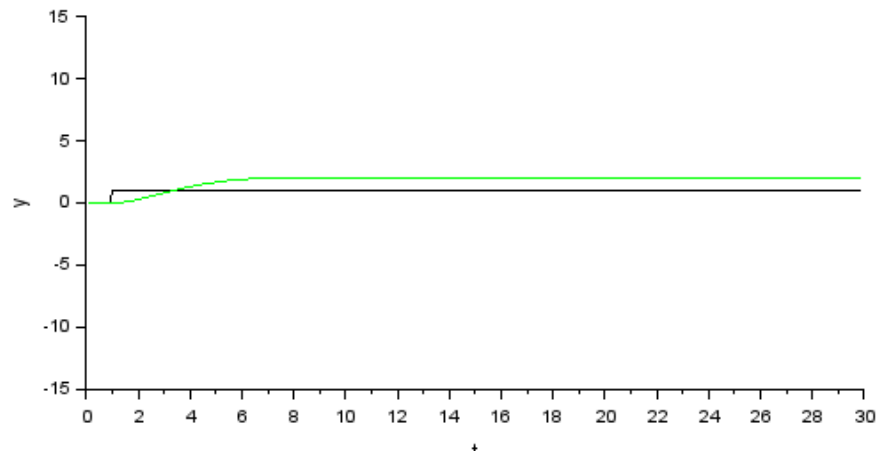
$K=2, T=0.8, d=0.75$



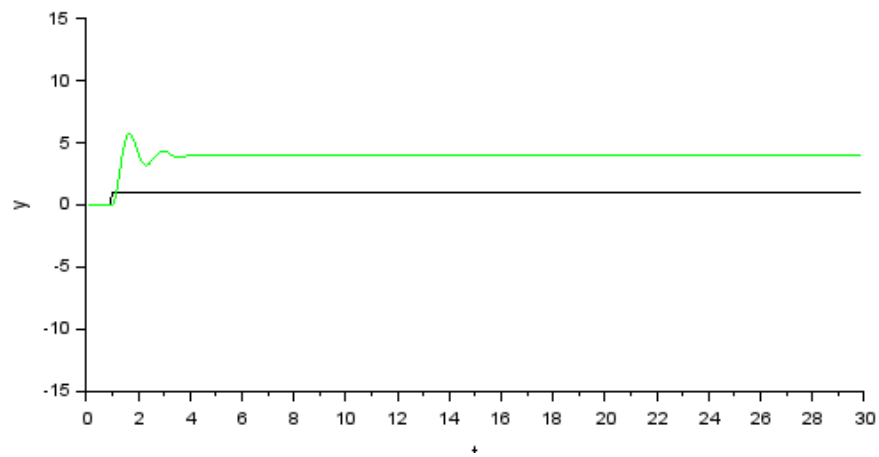
$K=2$, $T=1.6$, $d=0.25$



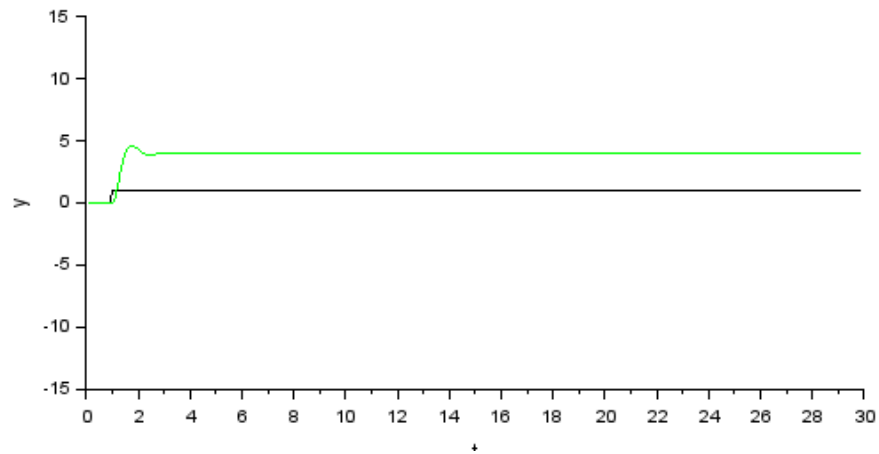
$K=2$, $T=1.6$, $d=0.5$



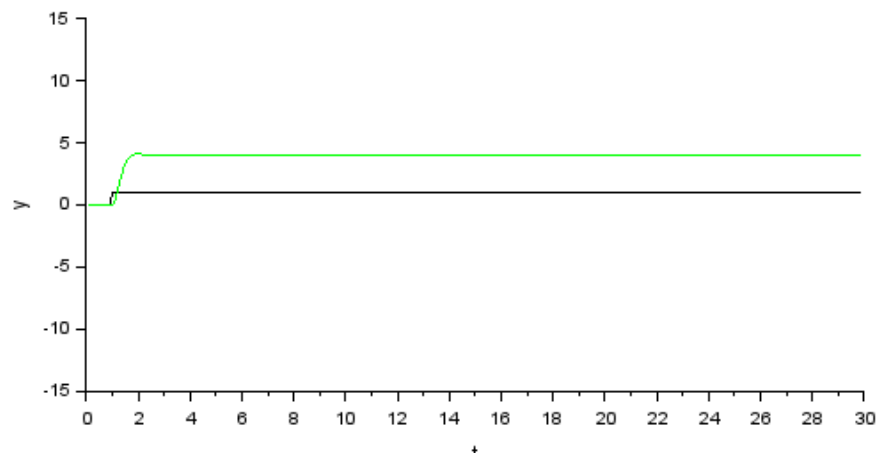
$K=2$, $T=1.6$, $d=0.75$



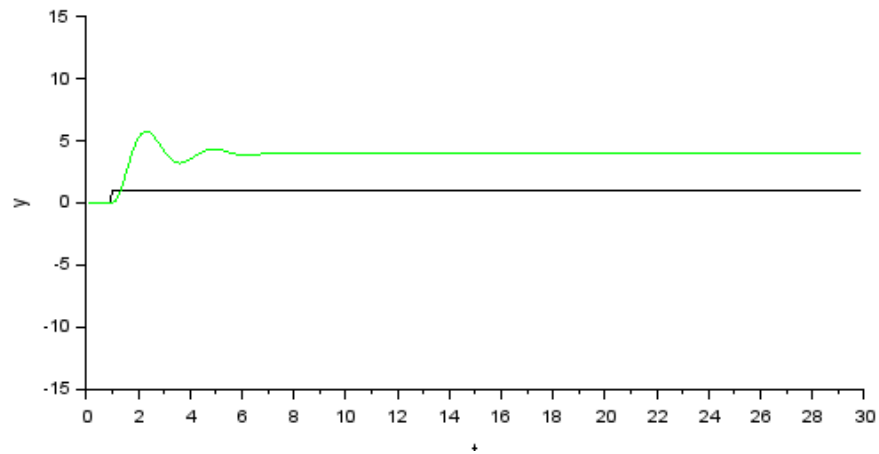
$K=4$, $T=0.2$, $d=0.25$



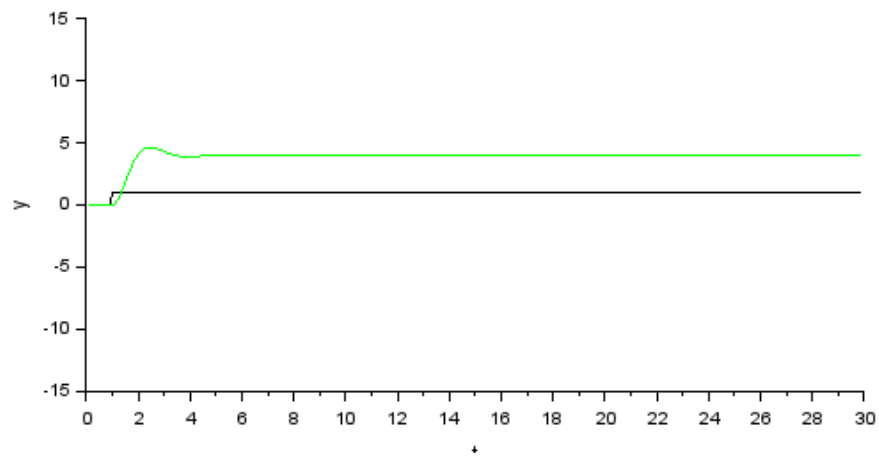
$K=4$, $T=0.2$, $d=0.5$



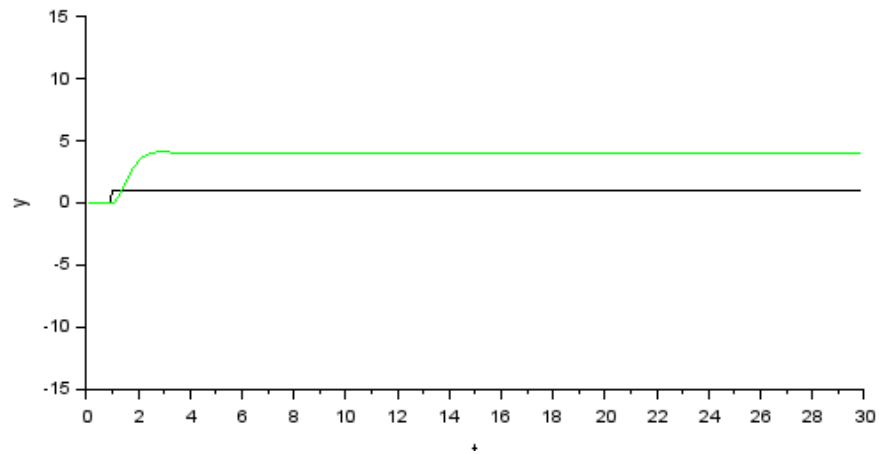
$K=4$, $T=0.2$, $d=0.75$



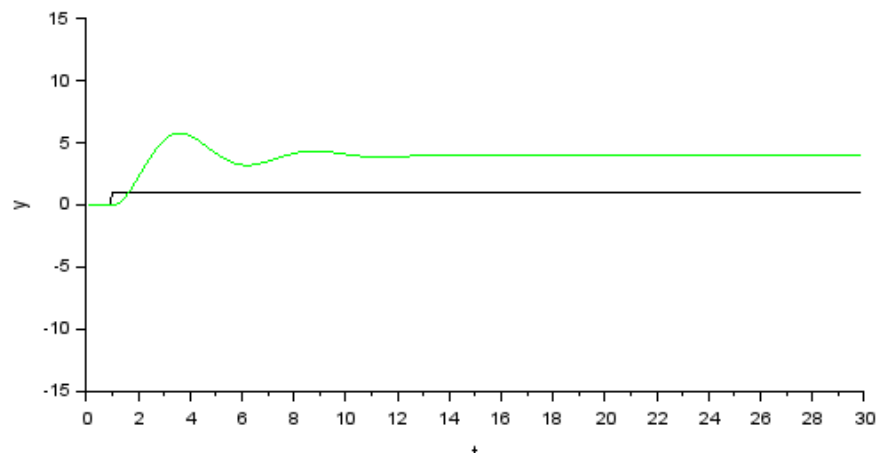
$K=4$, $T=0.4$, $d=0.25$



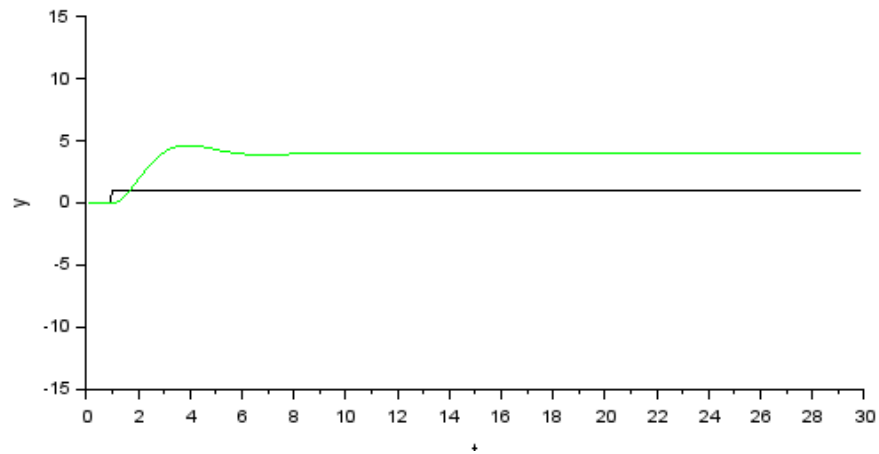
$K=4$, $T=0.4$, $d=0.5$



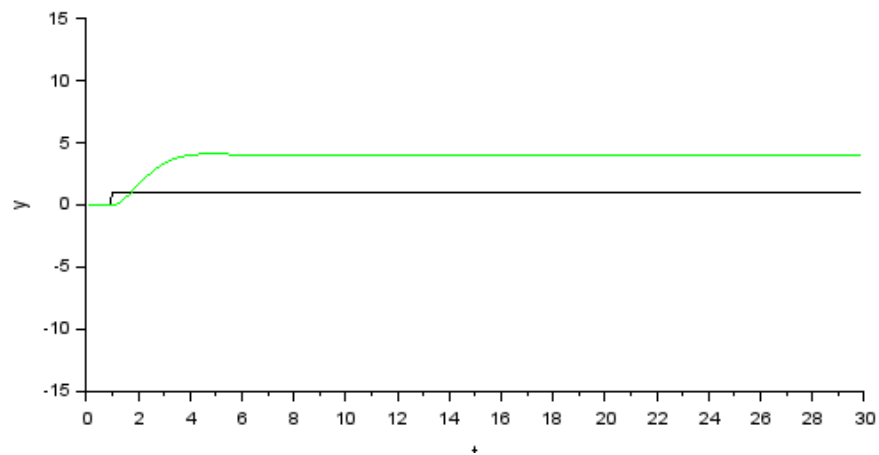
$K=4$, $T=0.4$, $d=0.75$



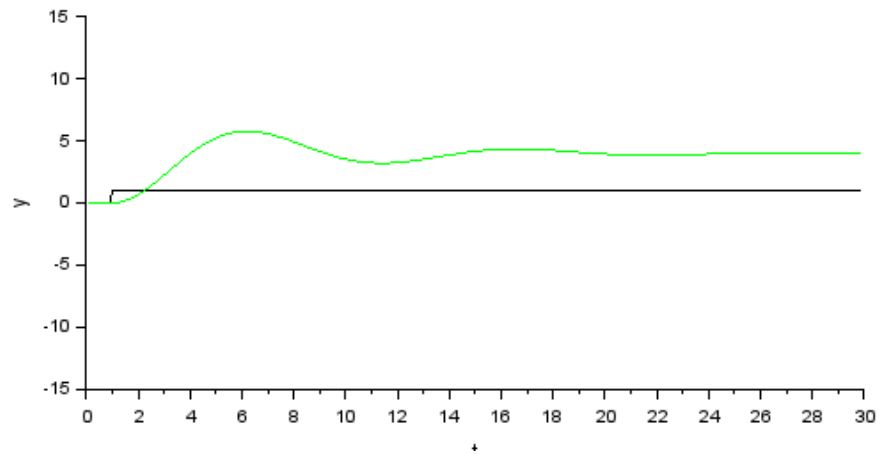
$K=4$, $T=0.8$, $d=0.25$



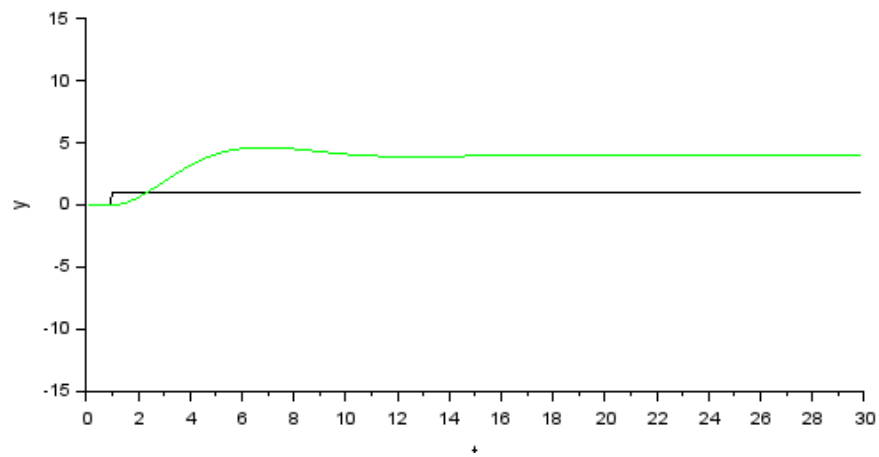
$K=4, T=0.8, d=0.5$



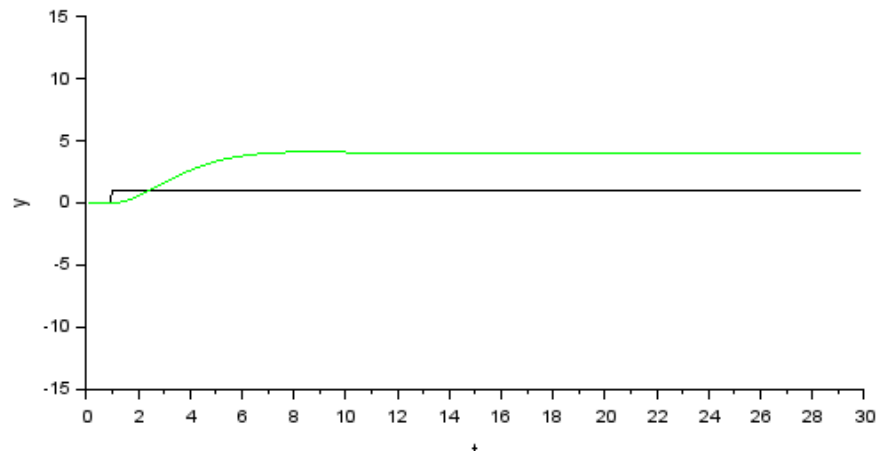
$K=4, T=0.8, d=0.75$



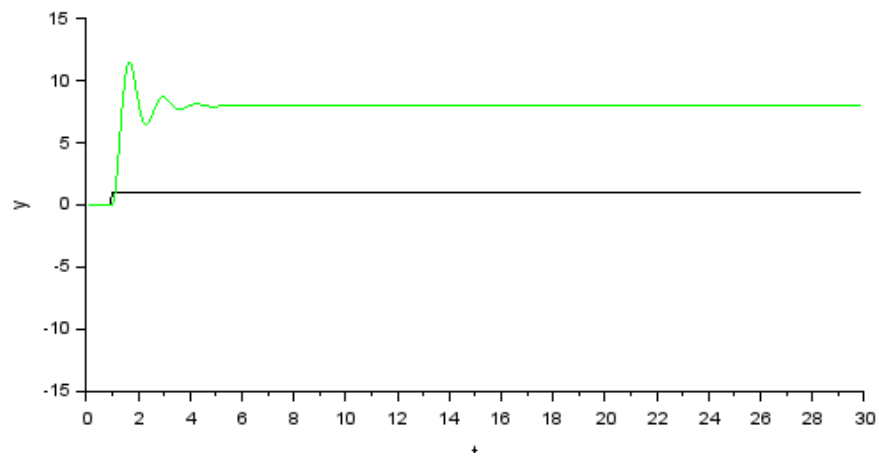
$K=4$, $T=1.6$, $d=0.25$



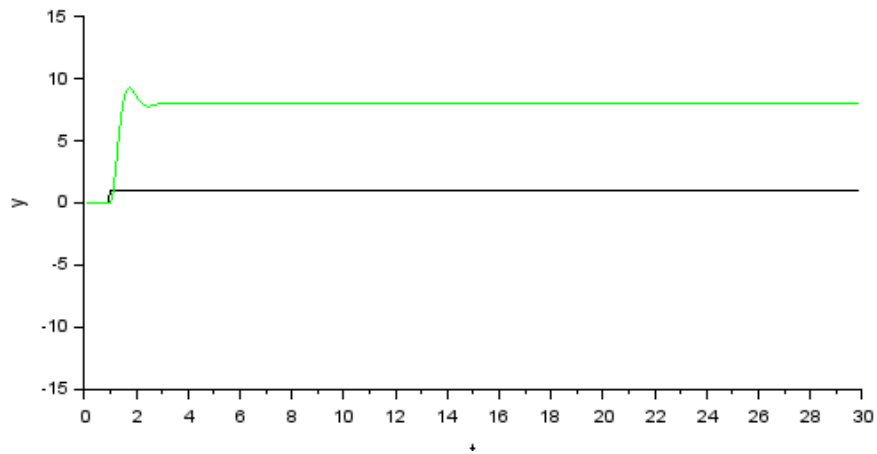
$K=4$, $T=1.6$, $d=0.5$



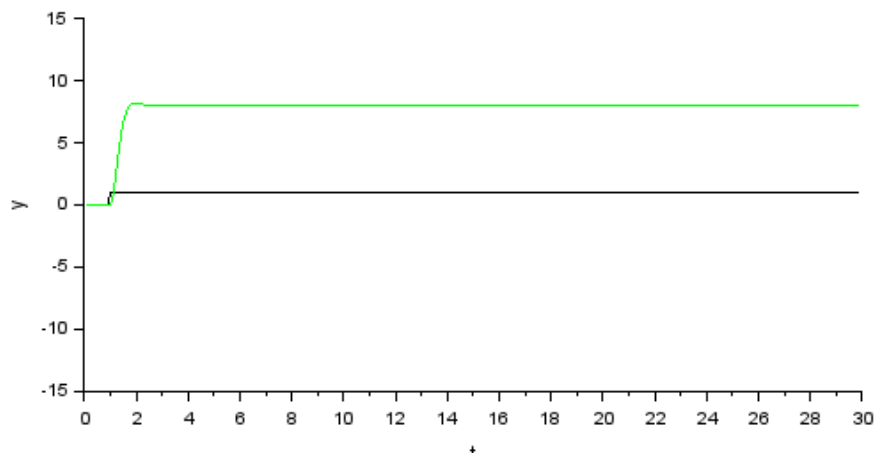
$K=4$, $T=1.6$, $d=0.75$



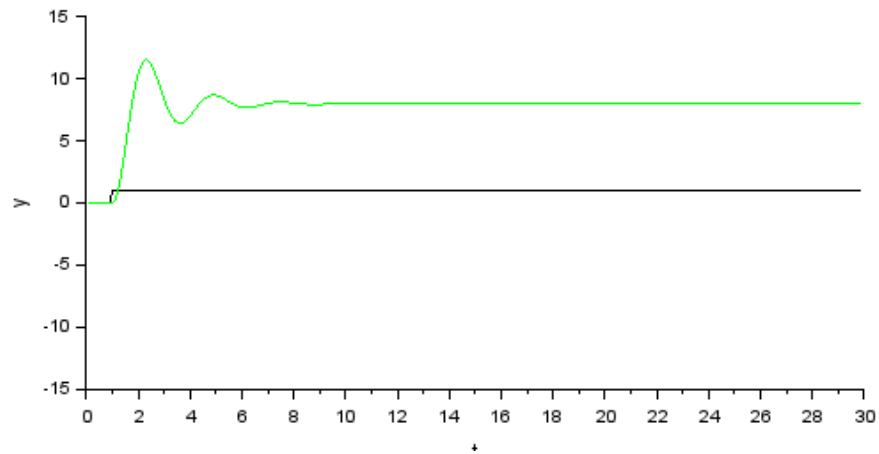
$K=8$, $T=0.2$, $d=0.25$



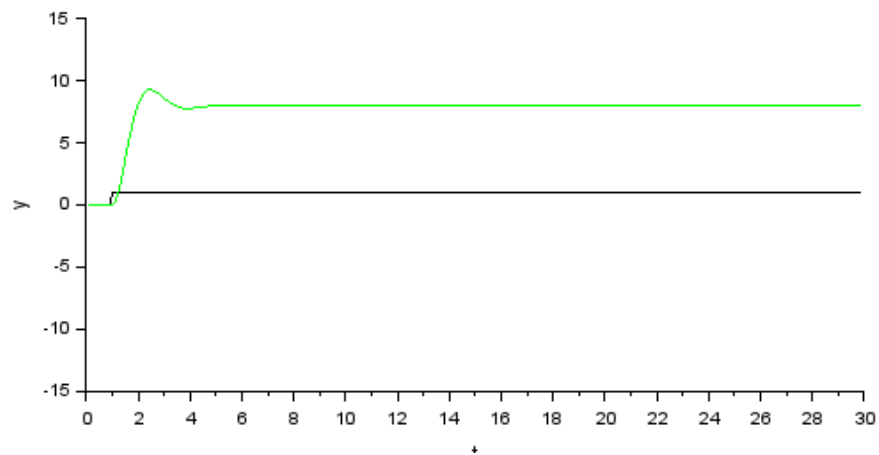
$K=8, T=0.2, d=0.5$



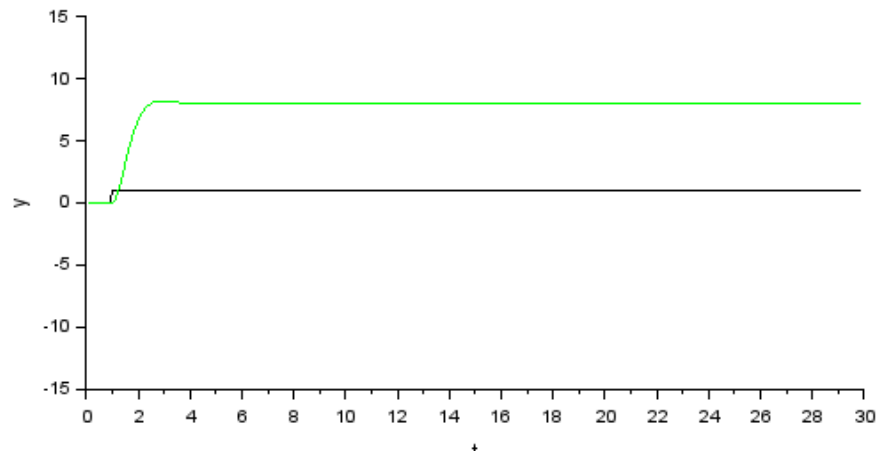
$K=8, T=0.2, d=0.75$



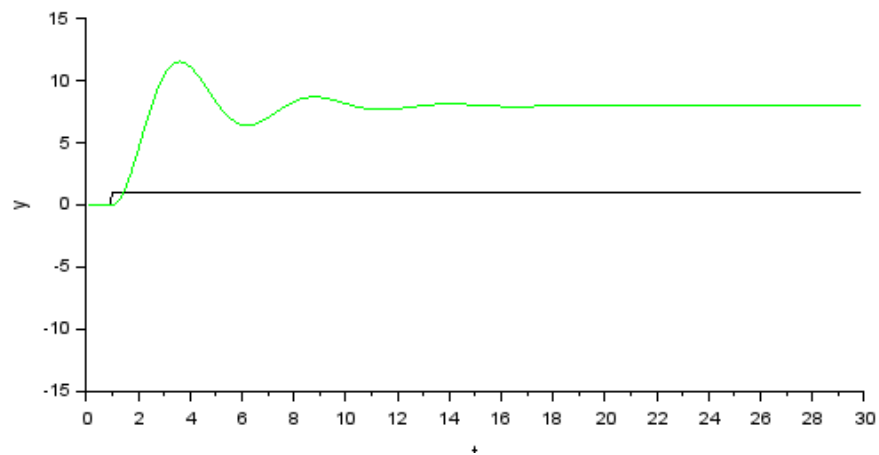
$K=8$, $T=0.4$, $d=0.25$



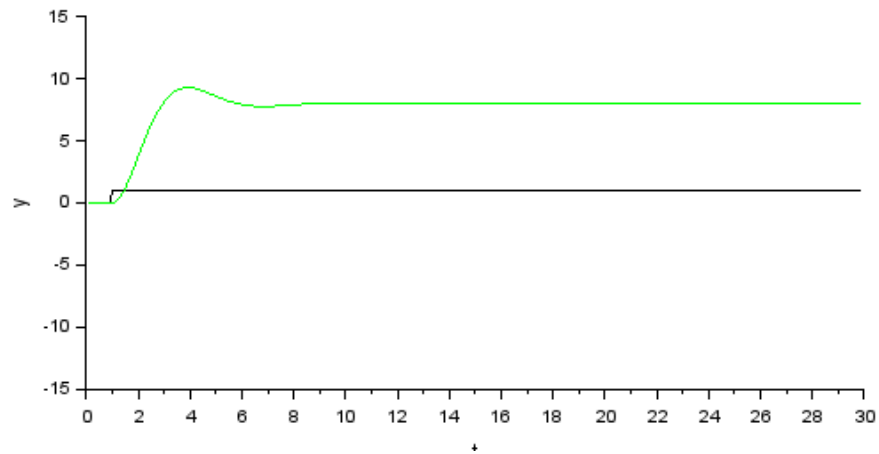
$K=8$, $T=0.4$, $d=0.5$



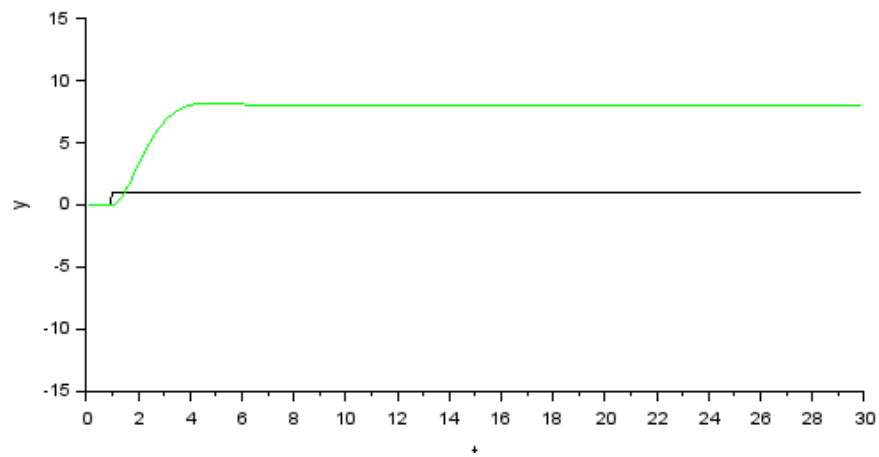
$K=8, T=0.4, d=0.75$



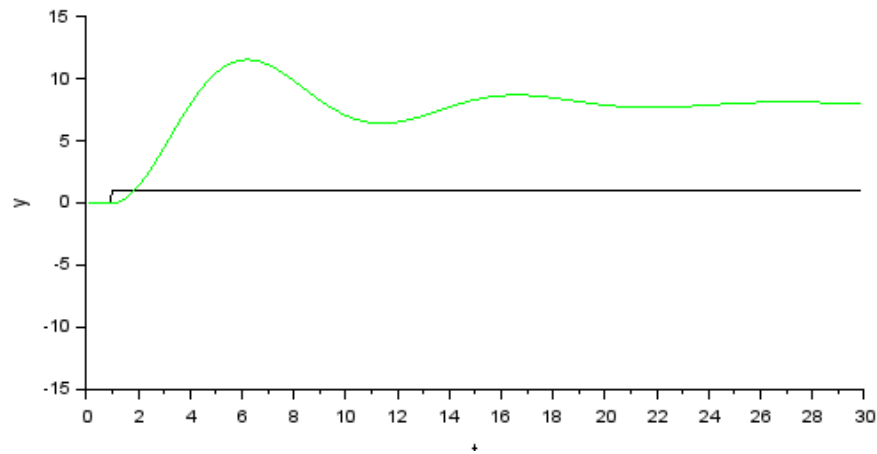
$K=8, T=0.8, d=0.25$



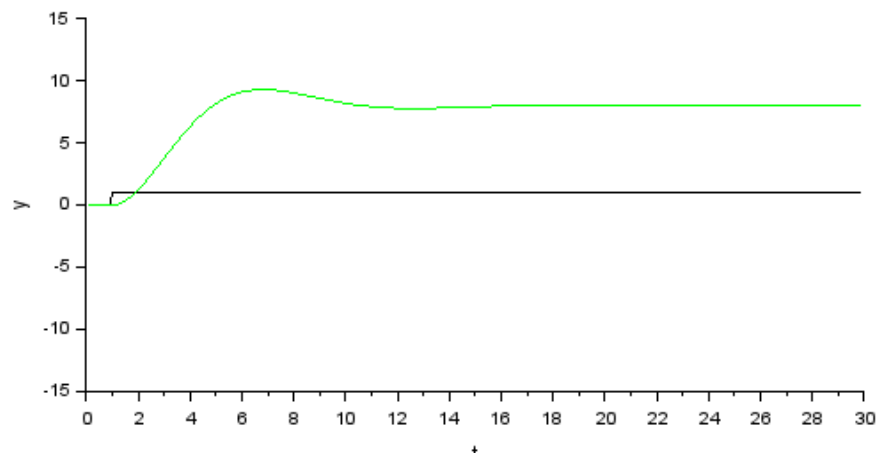
$K=8, T=0.8, d=0.5$



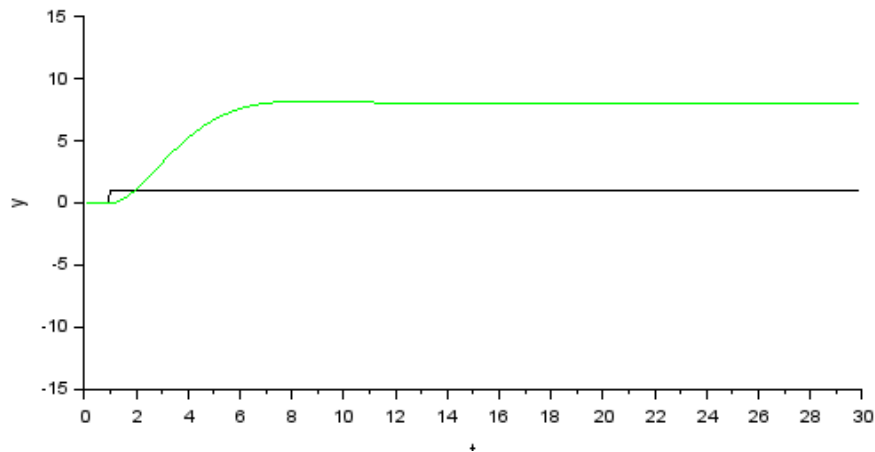
$K=8, T=0.8, d=0.75$



$K=8$, $T=1.6$, $d=0.25$



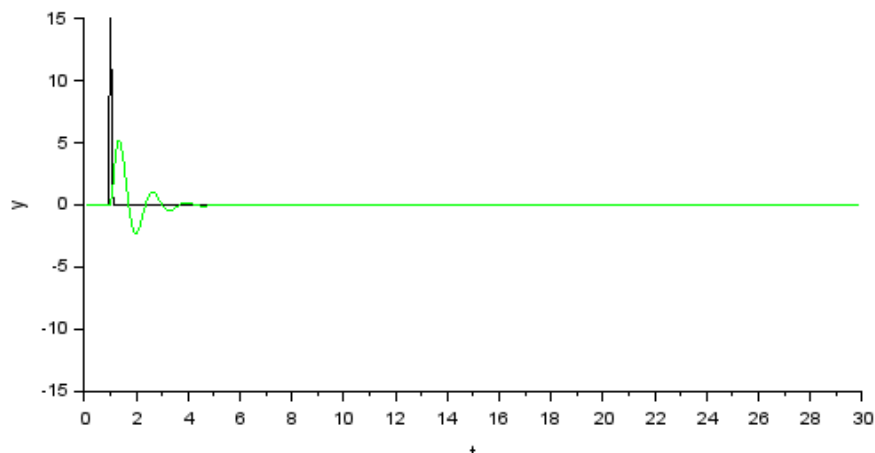
$K=8$, $T=1.6$, $d=0.5$



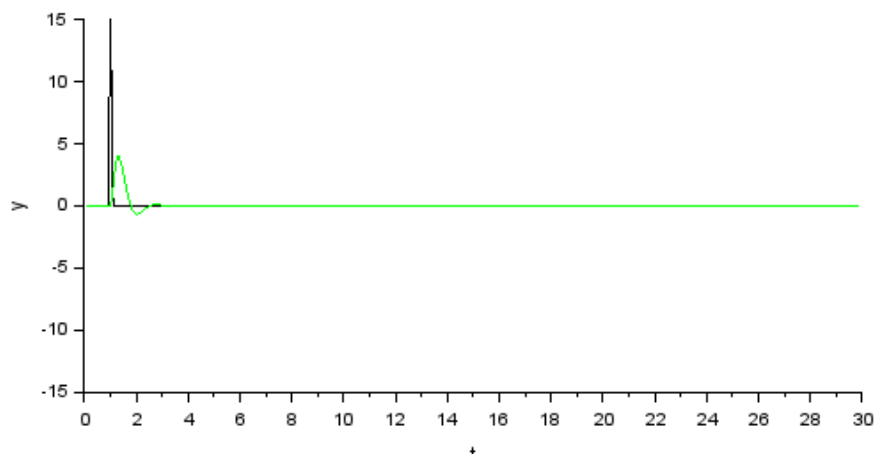
$K=8$, $T=1.6$, $d=0.75$

Чем меньше d , тем меньше колебаний. при увеличении k увеличивается максимум переходной функции, при увеличении T функция сходится медленнее

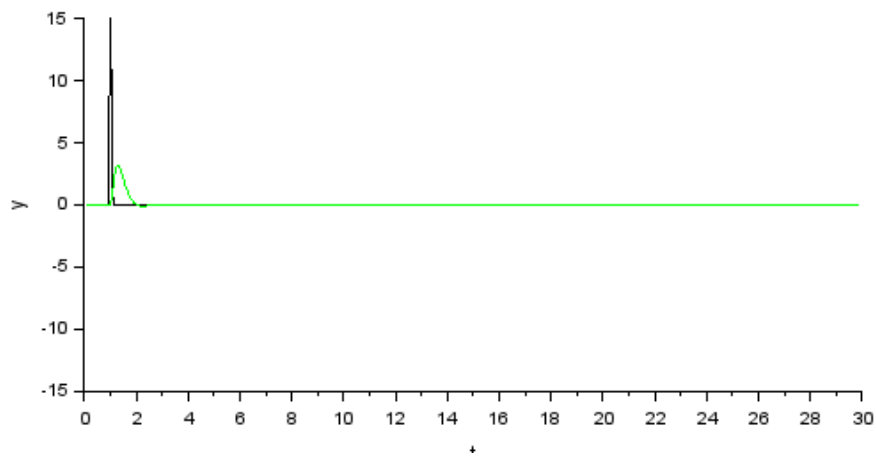
Импульсная функция



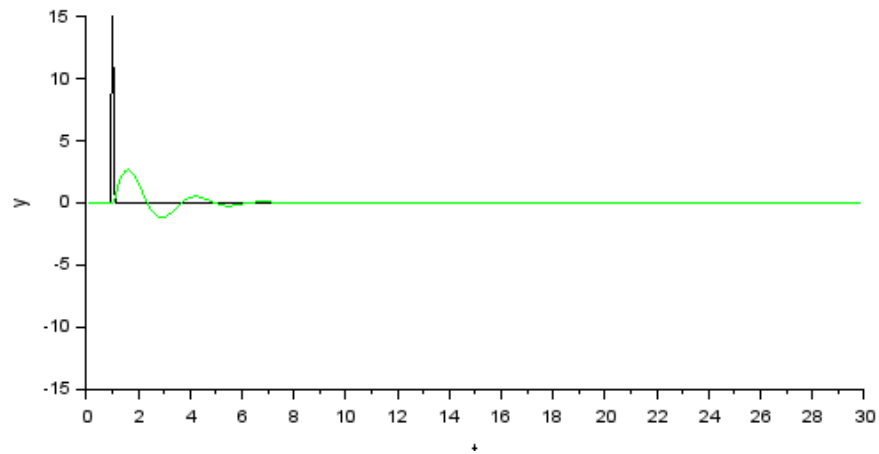
$K=1$, $T=0.2$, $d=0.25$



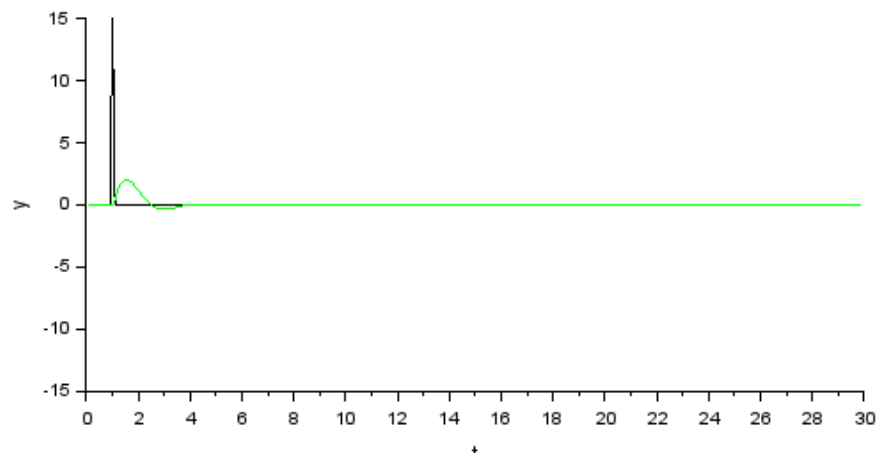
$K=1, T=0.2, d=0.5$



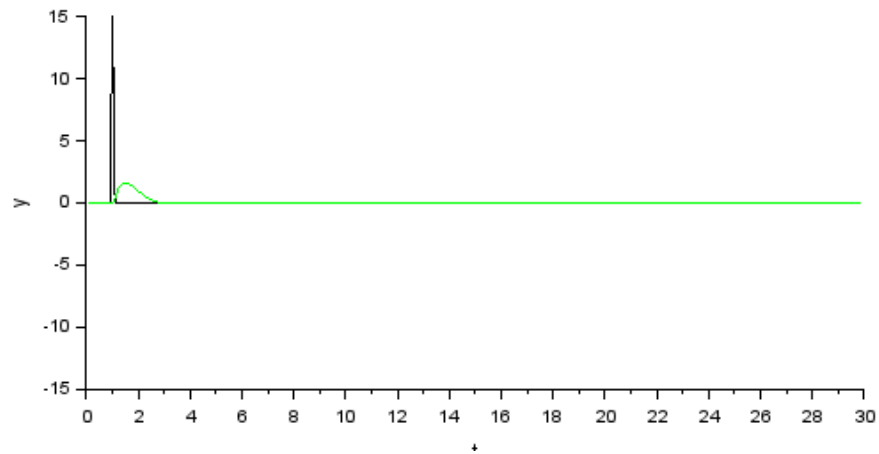
$K=1, T=0.2, d=0.75$



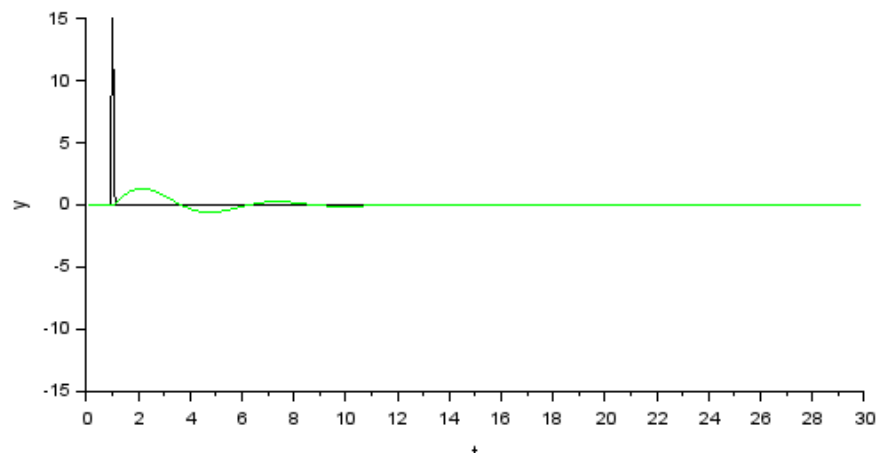
$K=1, T=0.4, d=0.25$



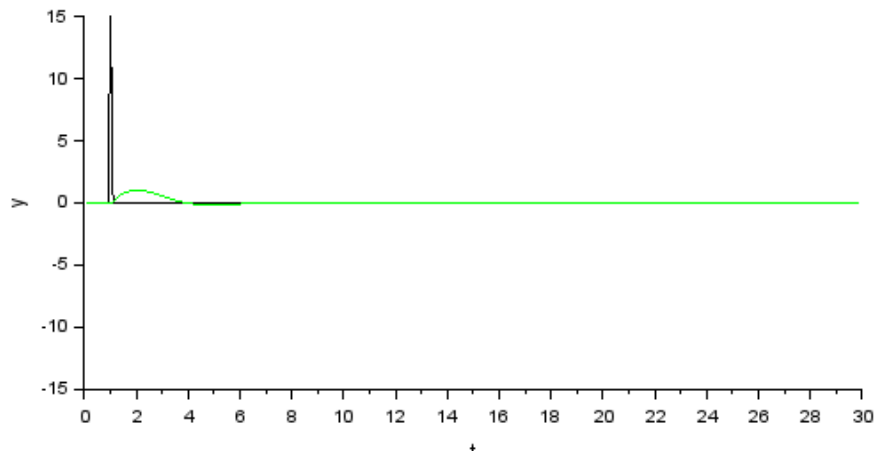
$K=1, T=0.4, d=0.5$



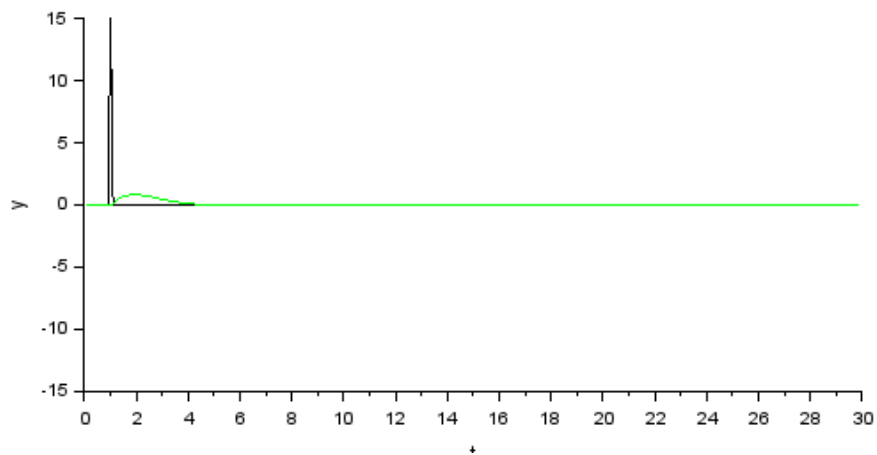
$K=1$, $T=0.4$, $d=0.75$



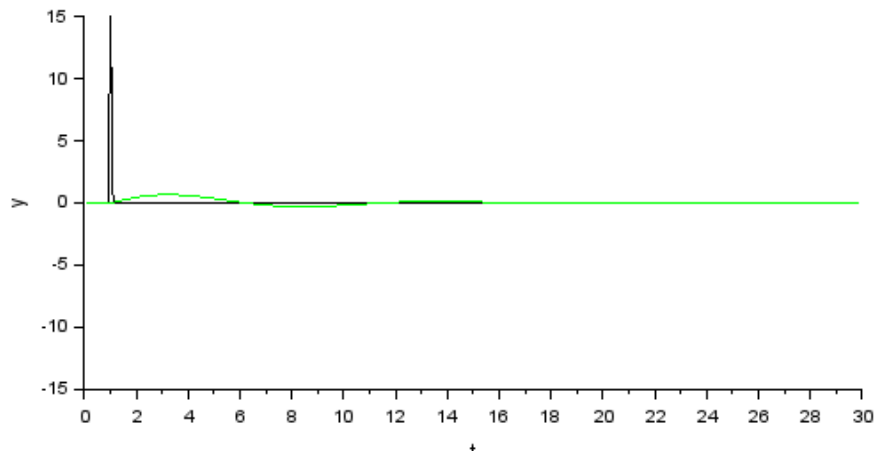
$K=1$, $T=0.8$, $d=0.25$



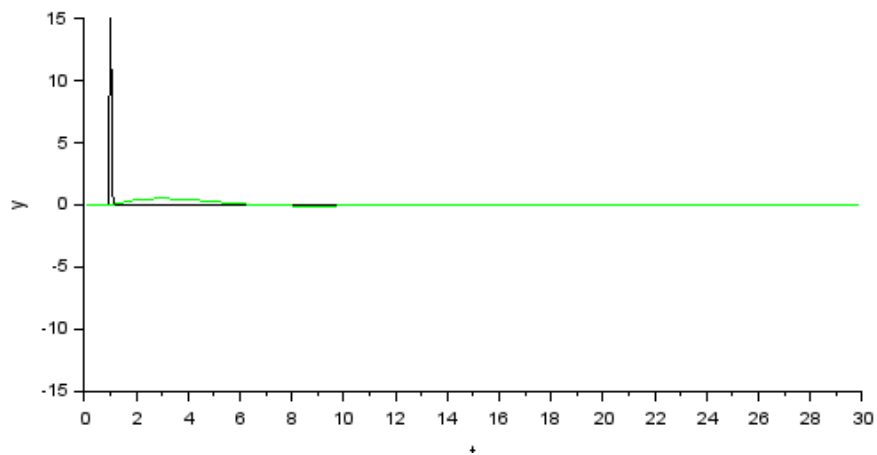
$K=1$, $T=0.8$, $d=0.5$



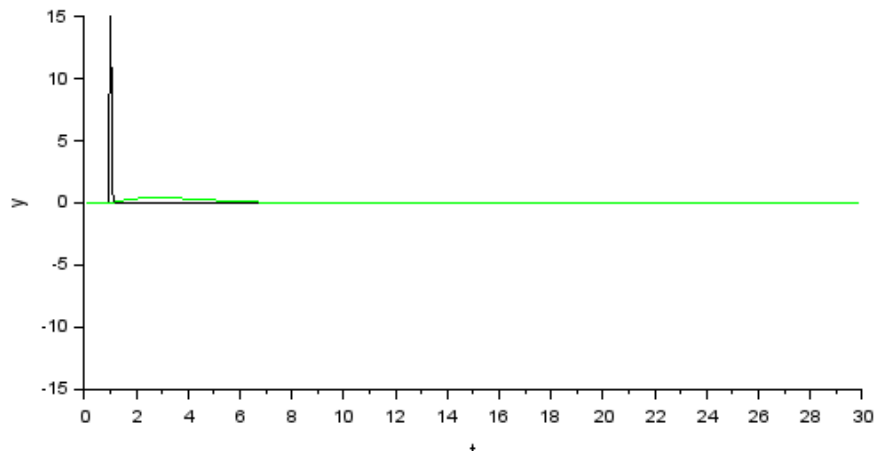
$K=1$, $T=0.8$, $d=0.75$



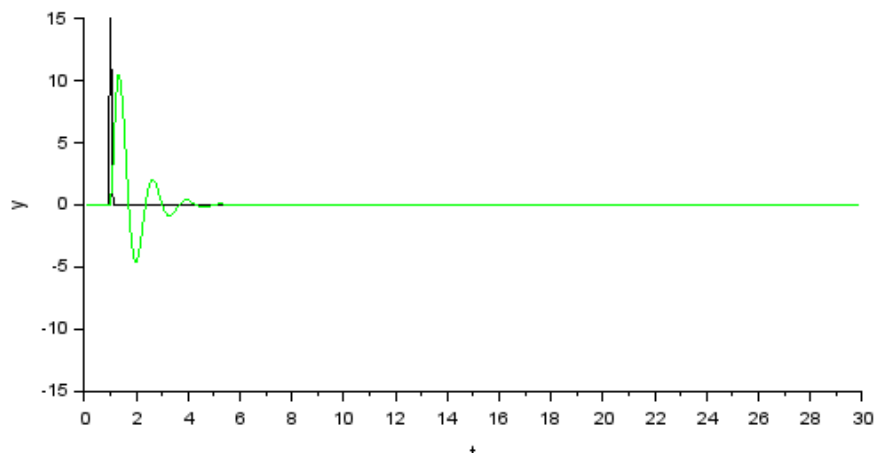
$K=1$, $T=1.6$, $d=0.25$



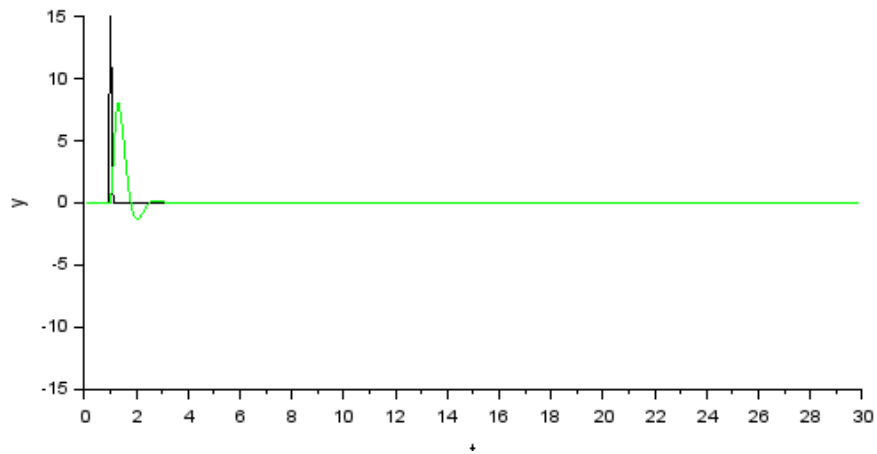
$K=1$, $T=1.6$, $d=0.5$



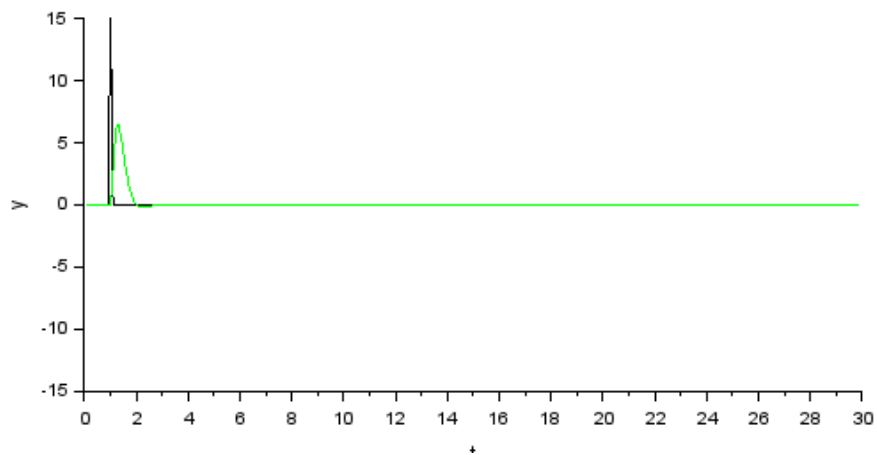
$K=1$, $T=1.6$, $d=0.75$



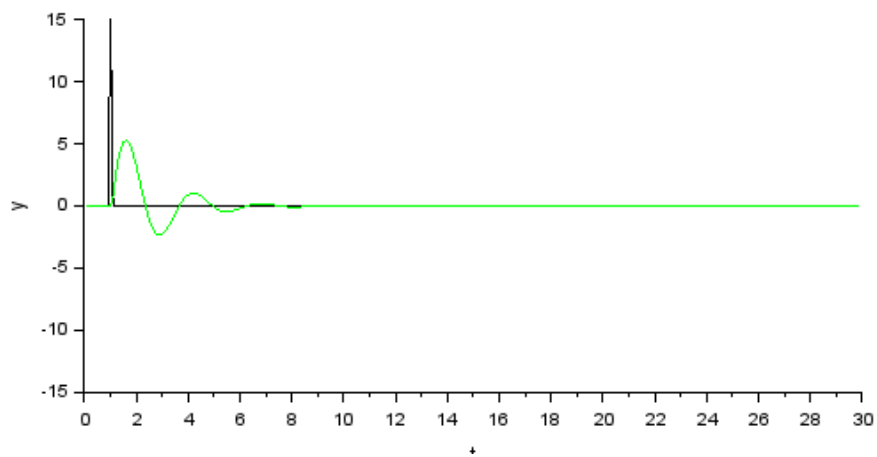
$K=2$, $T=0.2$, $d=0.25$



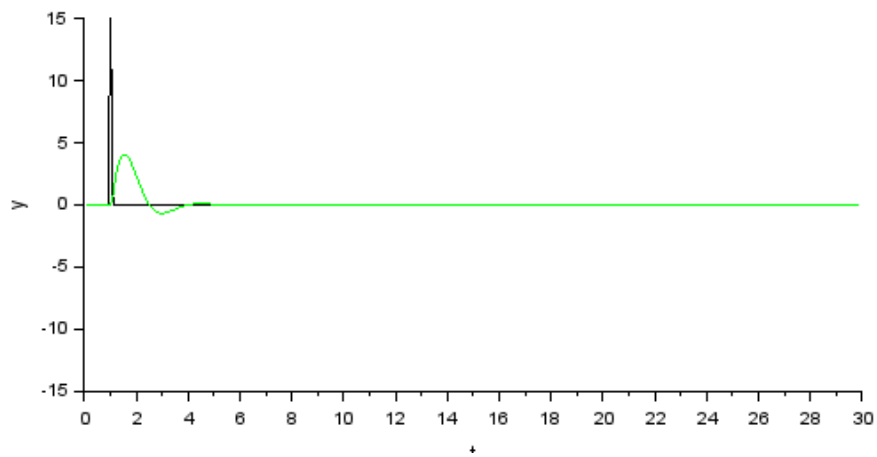
$K=2, T=0.2, d=0.5$



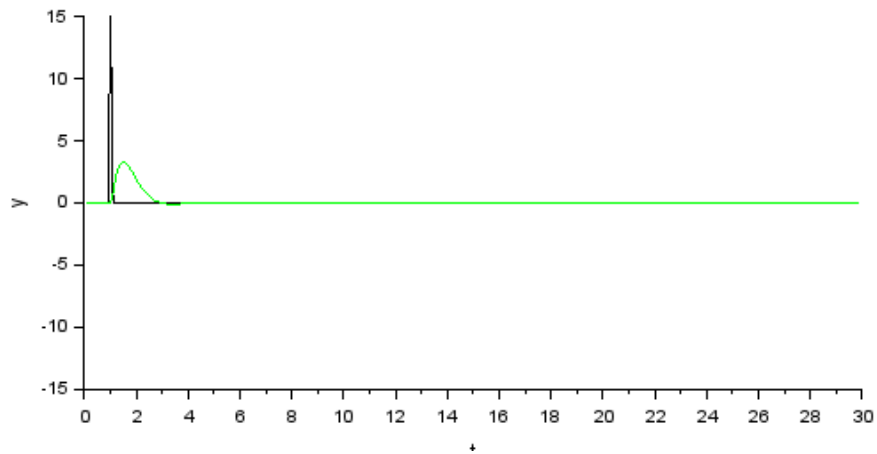
$K=2, T=0.2, d=0.75$



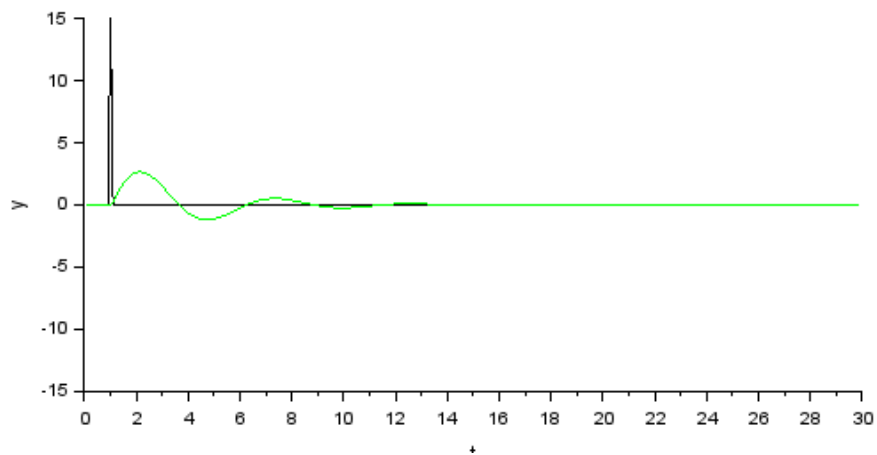
$K=2, T=0.4, d=0.25$



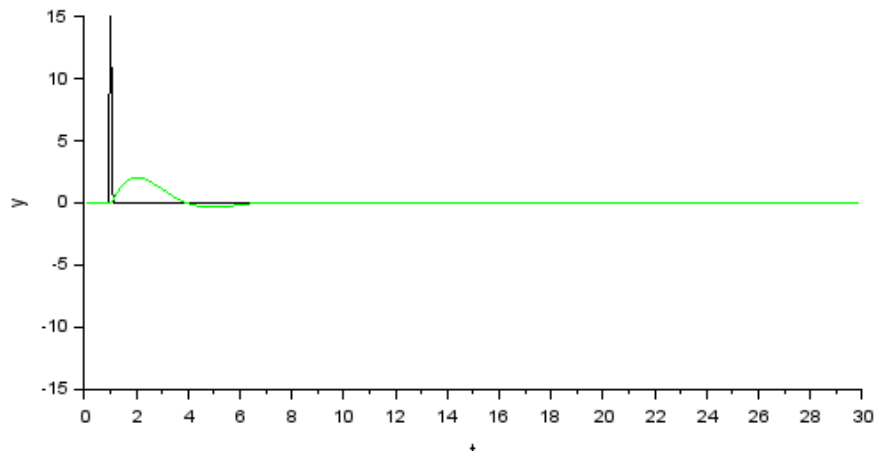
$K=2, T=0.4, d=0.5$



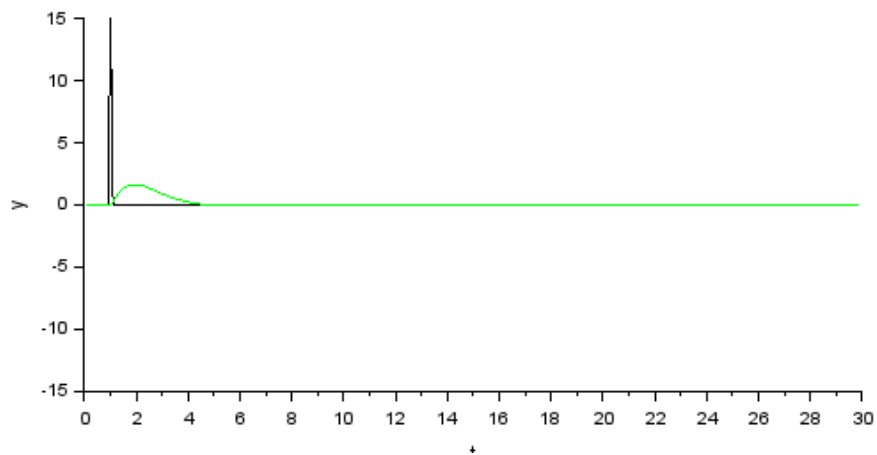
$K=2$, $T=0.4$, $d=0.75$



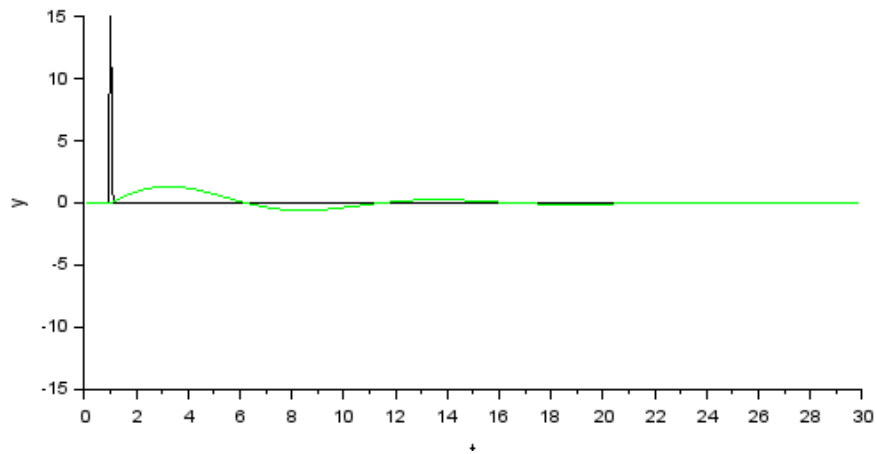
$K=2$, $T=0.8$, $d=0.25$



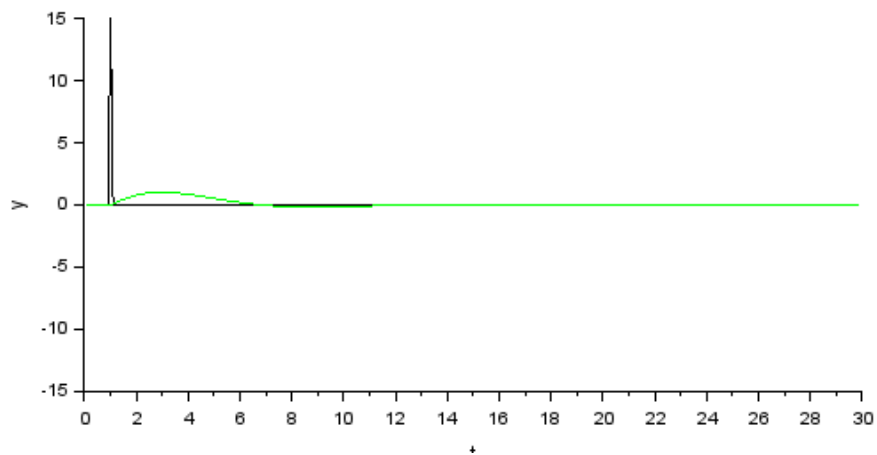
$K=2$, $T=0.8$, $d=0.5$



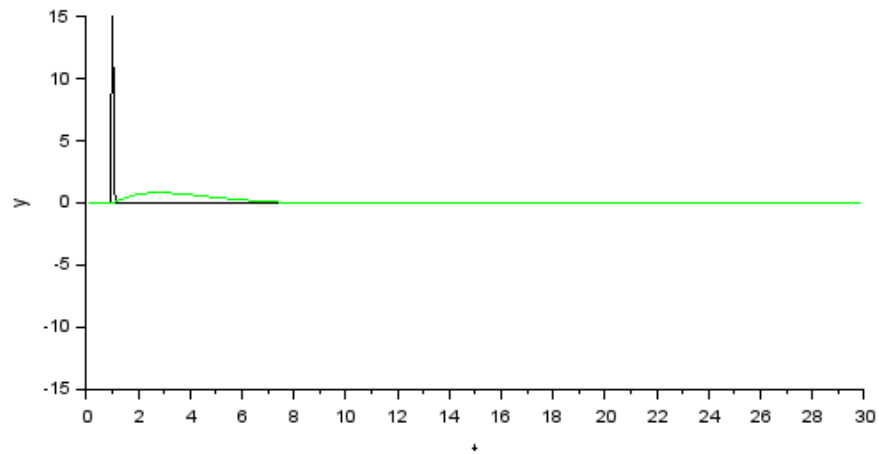
$K=2$, $T=0.8$, $d=0.75$



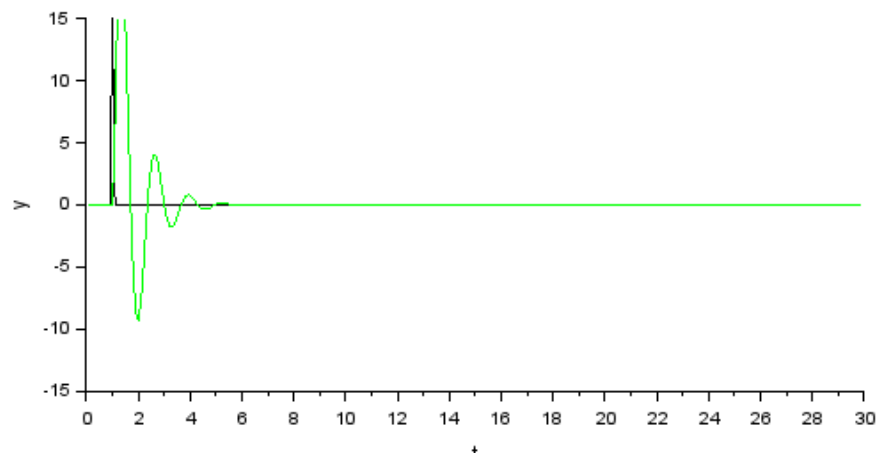
$K=2$, $T=1.6$, $d=0.25$



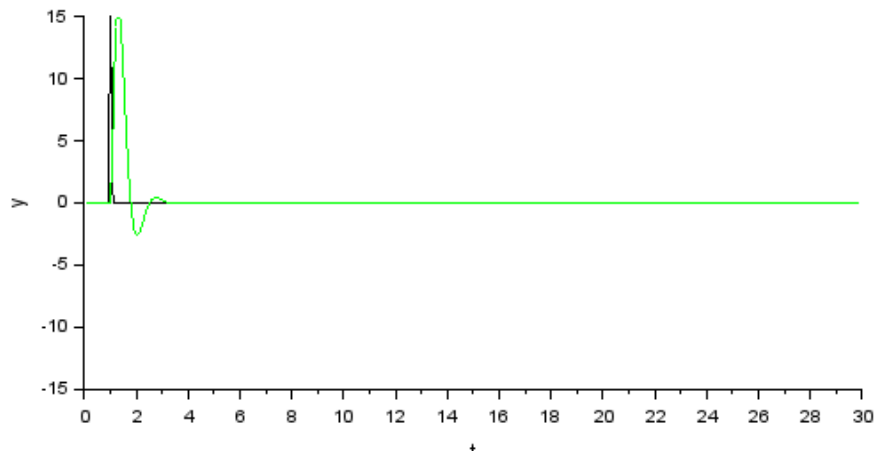
$K=2$, $T=1.6$, $d=0.5$



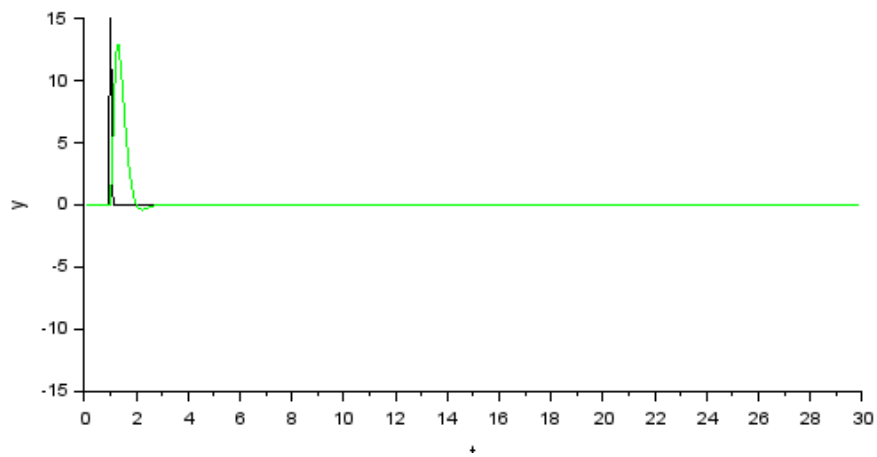
$K=2$, $T=1.6$, $d=0.75$



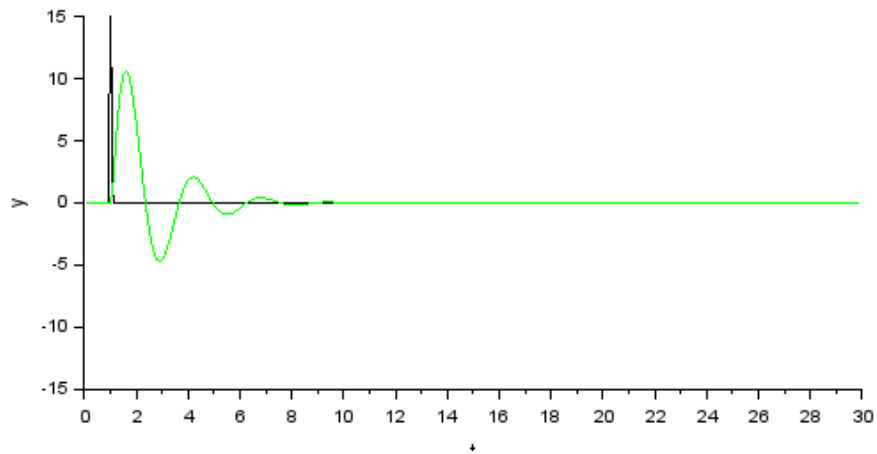
$K=4$, $T=0.2$, $d=0.25$



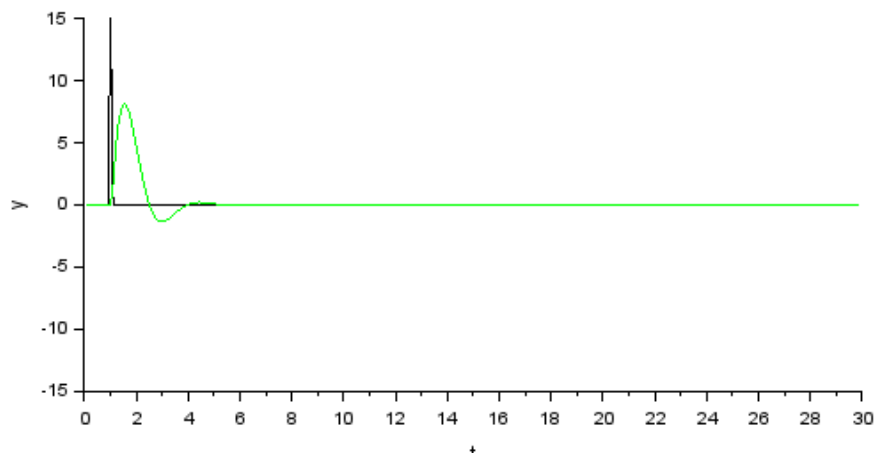
$K=4, T=0.2, d=0.5$



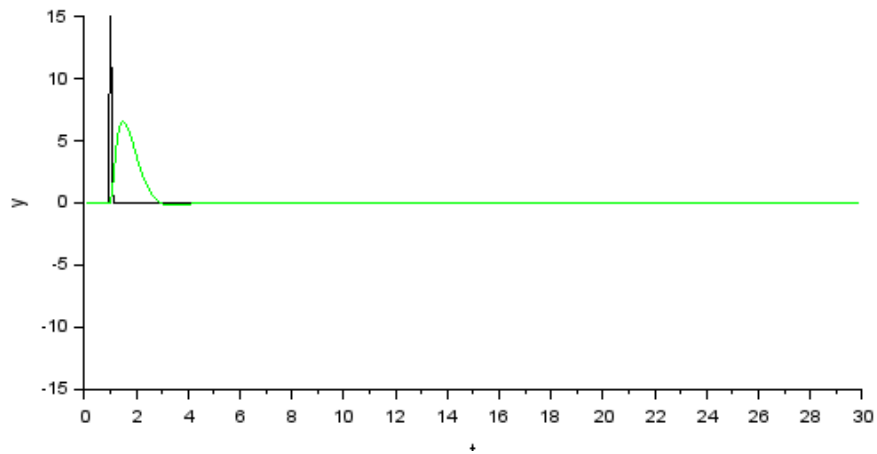
$K=4, T=0.2, d=0.75$



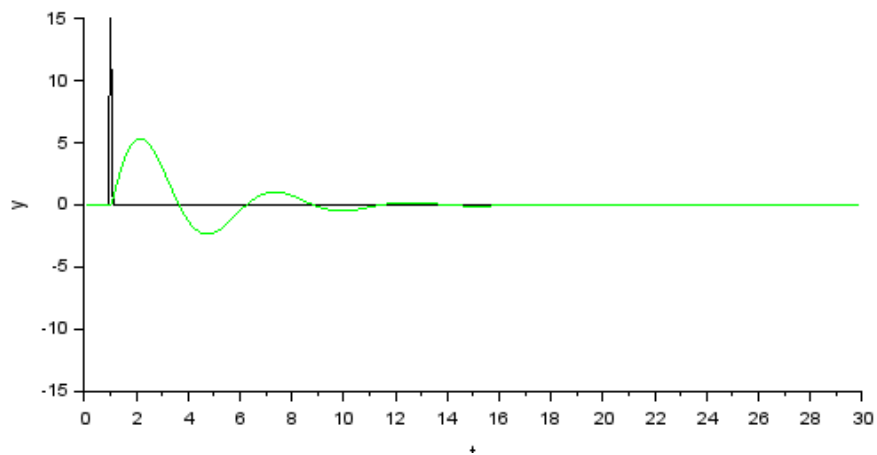
$K=4$, $T=0.4$, $d=0.25$



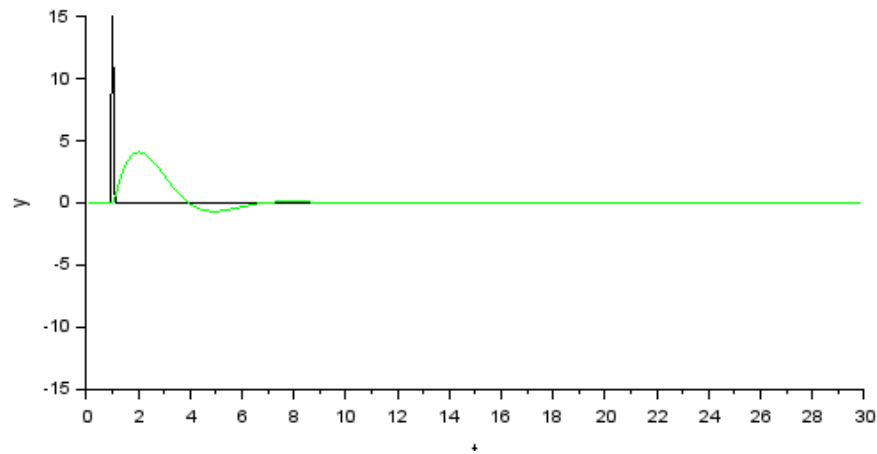
$K=4$, $T=0.4$, $d=0.5$



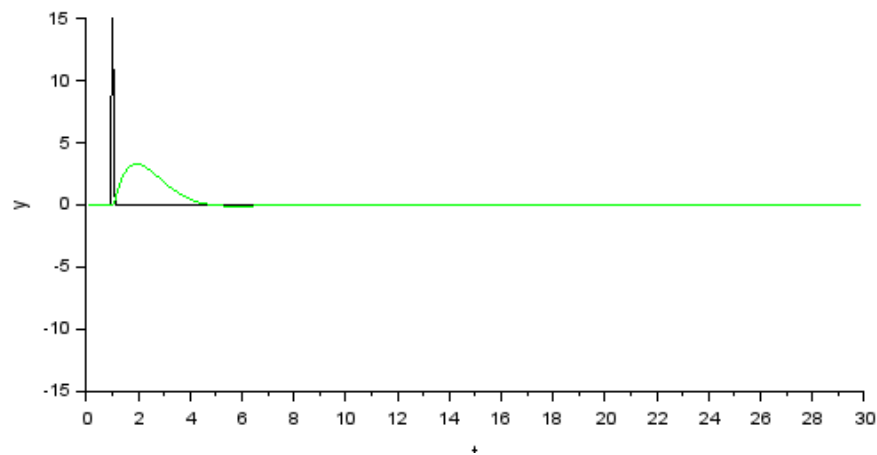
$K=4$, $T=0.4$, $d=0.75$



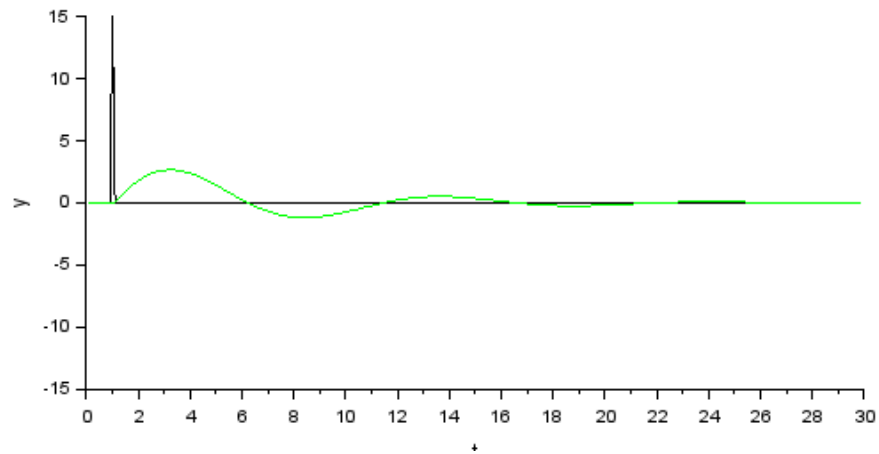
$K=4$, $T=0.8$, $d=0.25$



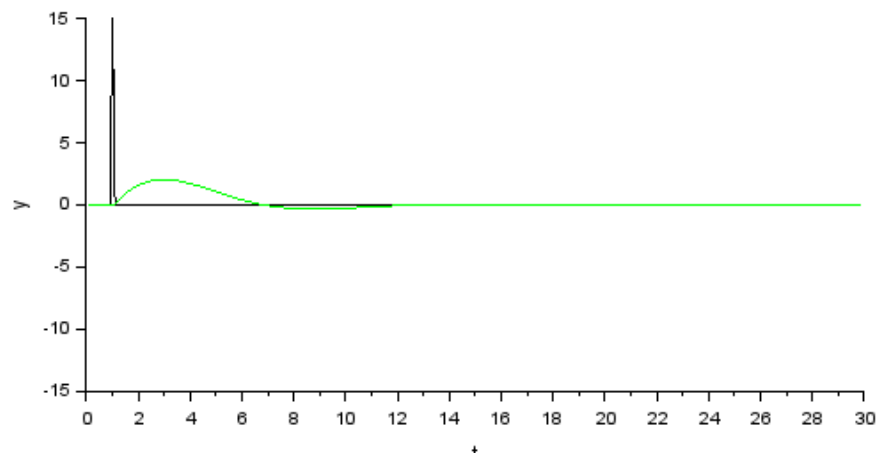
$K=4, T=0.8, d=0.5$



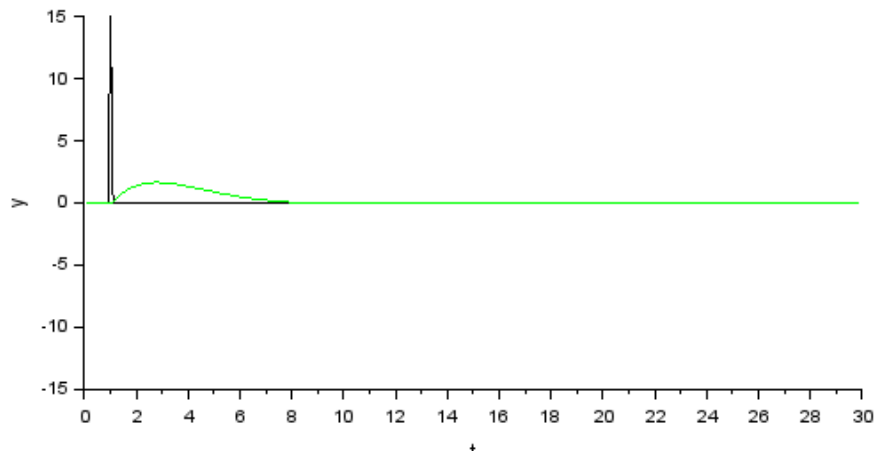
$K=4, T=0.8, d=0.75$



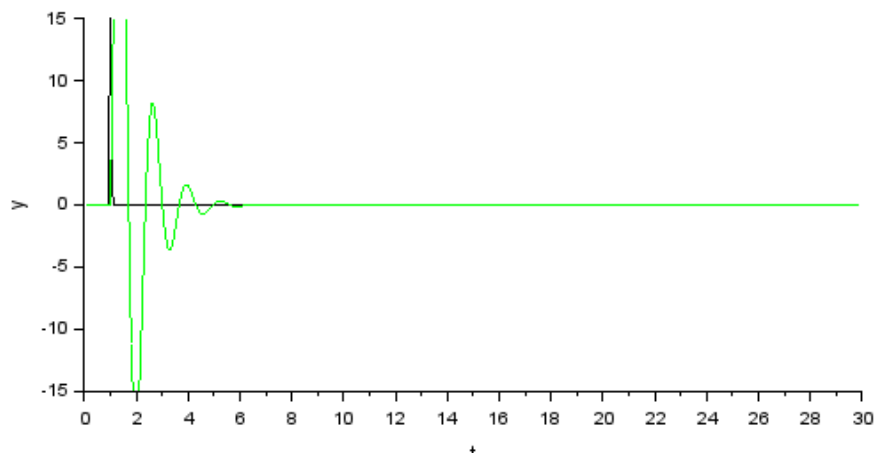
$K=4$, $T=1.6$, $d=0.25$



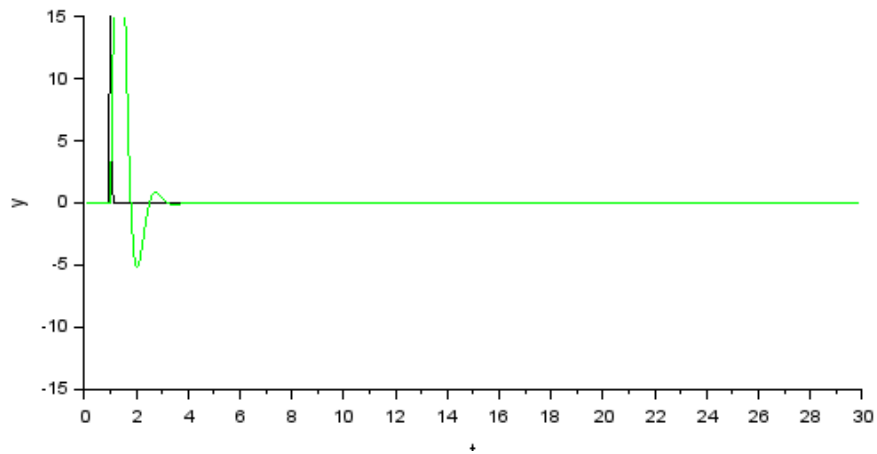
$K=4$, $T=1.6$, $d=0.5$



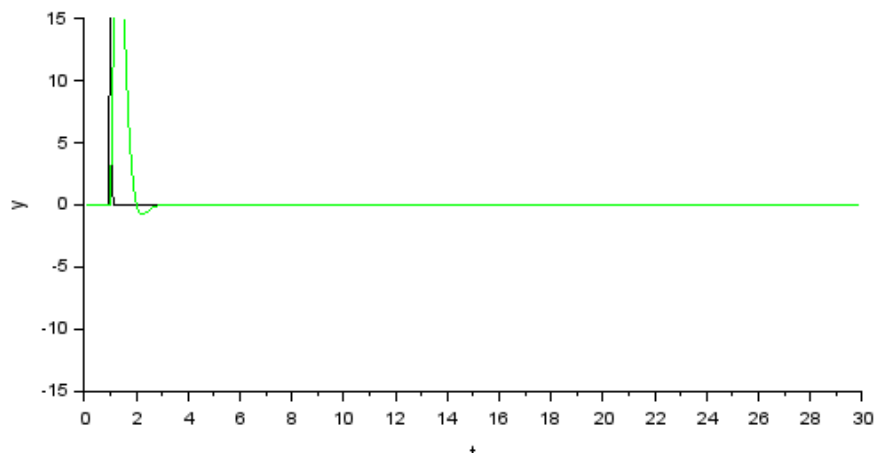
$K=4$, $T=1.6$, $d=0.75$



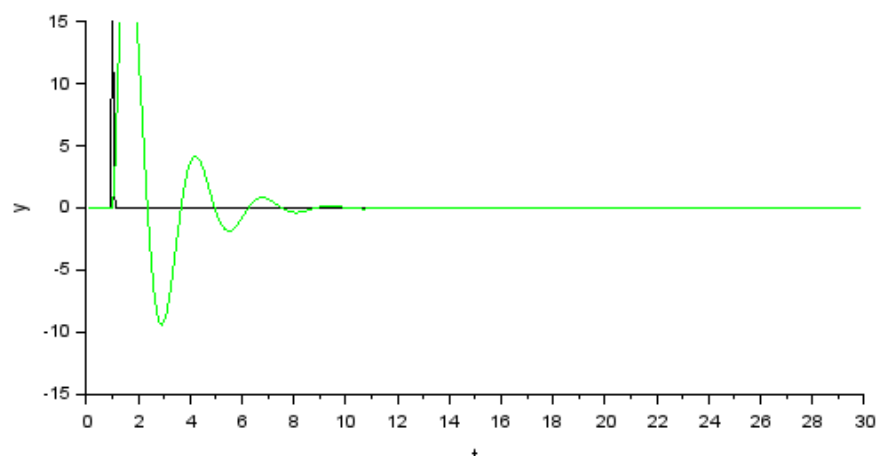
$K=8$, $T=0.2$, $d=0.25$



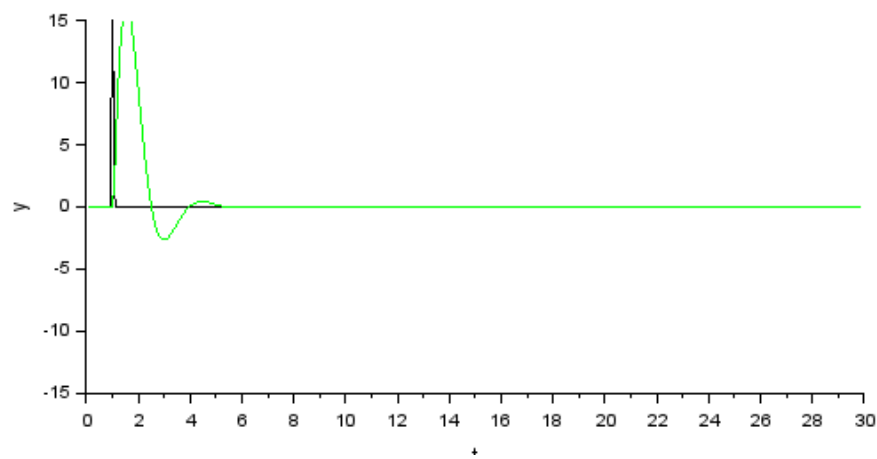
$K=8, T=0.2, d=0.5$



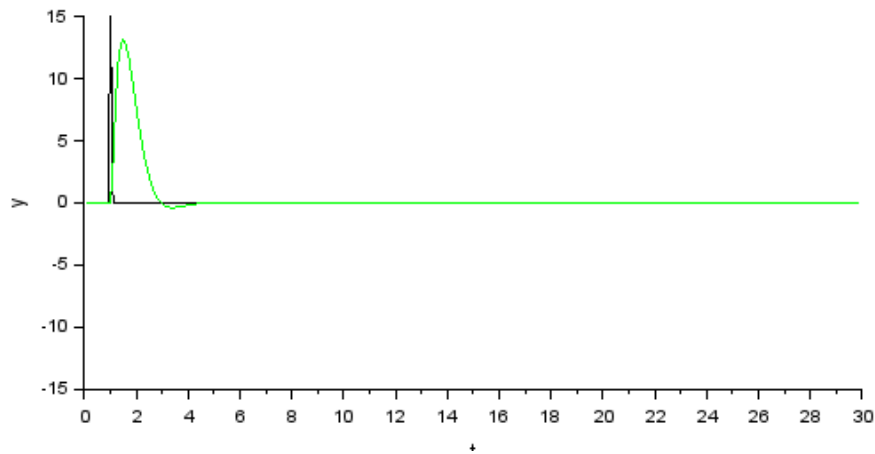
$K=8, T=0.2, d=0.75$



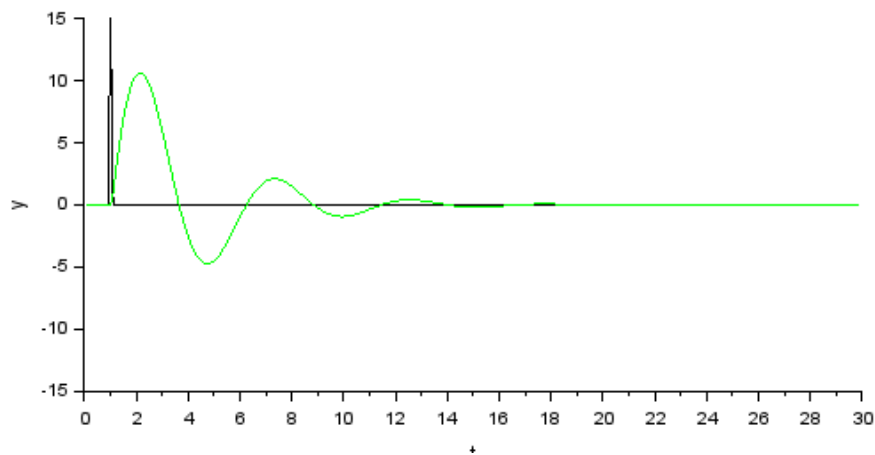
$K=8, T=0.4, d=0.25$



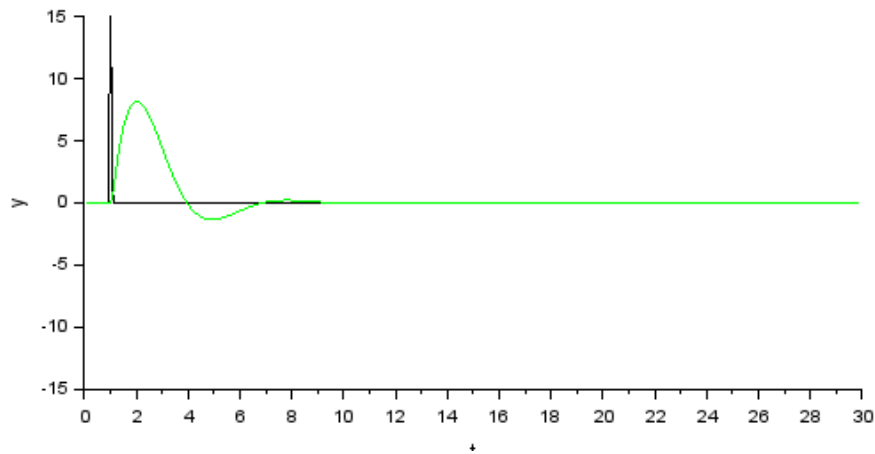
$K=8, T=0.4, d=0.5$



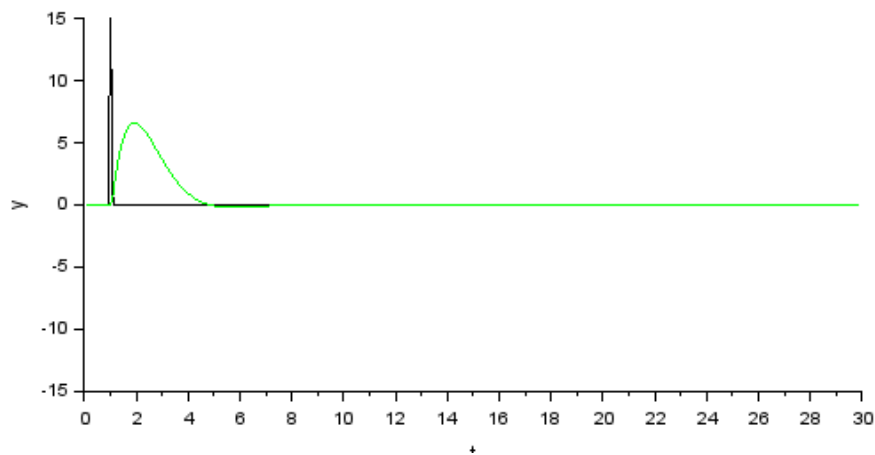
$K=8$, $T=0.4$, $d=0.75$



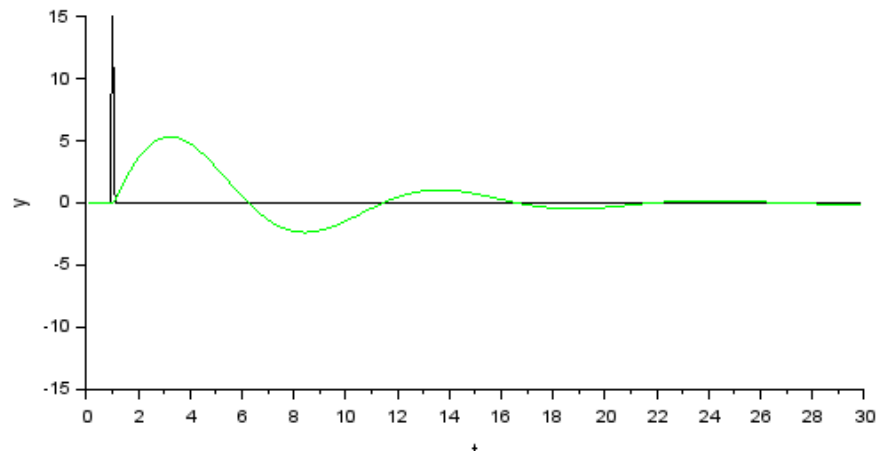
$K=8$, $T=0.8$, $d=0.25$



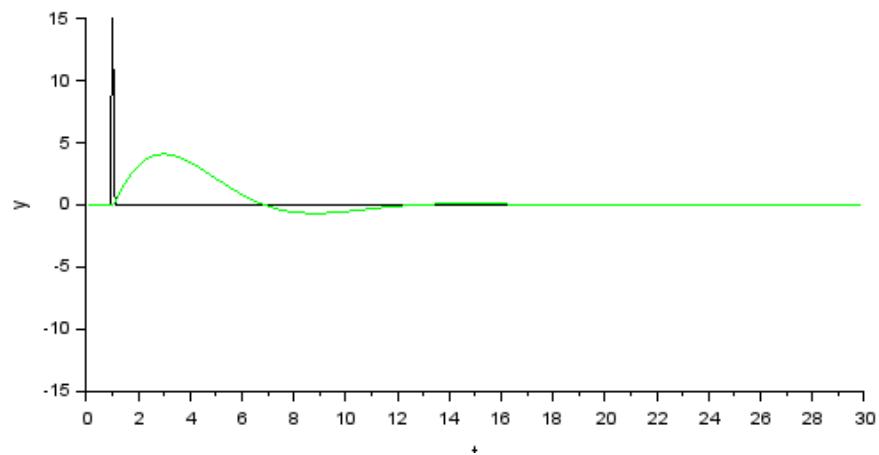
$K=8, T=0.8, d=0.5$



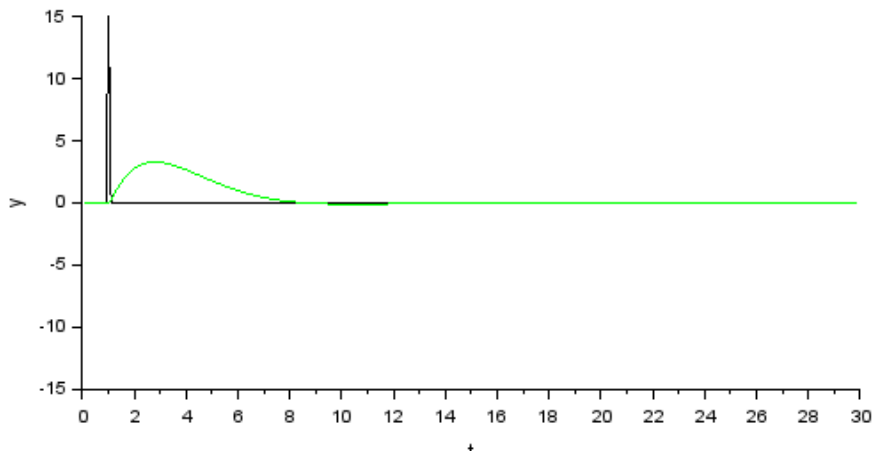
$K=8, T=0.8, d=0.75$



$K=8$, $T=1.6$, $d=0.25$



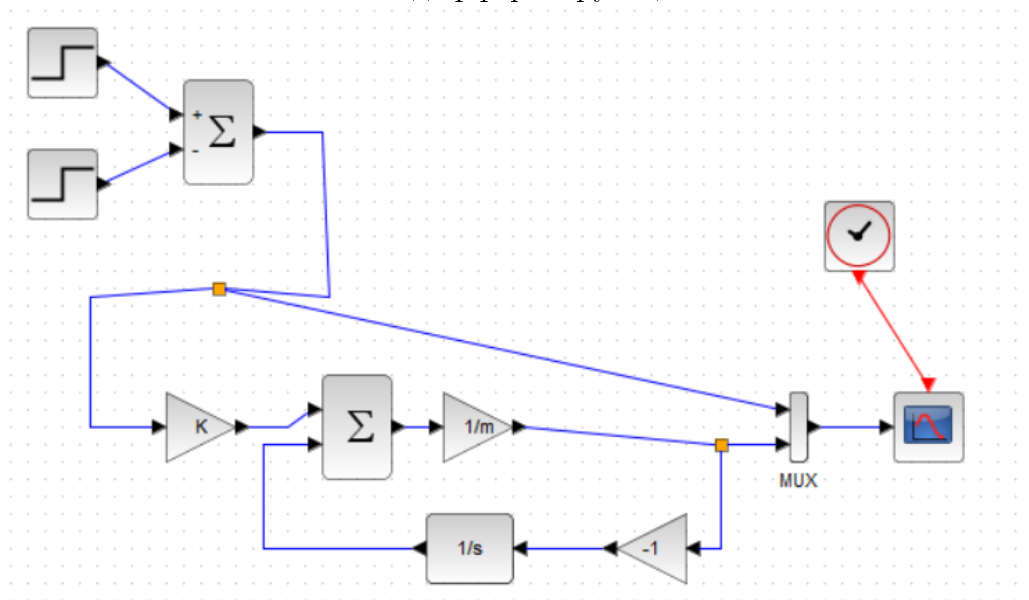
$K=8$, $T=1.6$, $d=0.5$



$K=8$, $T=1.6$, $d=0.75$

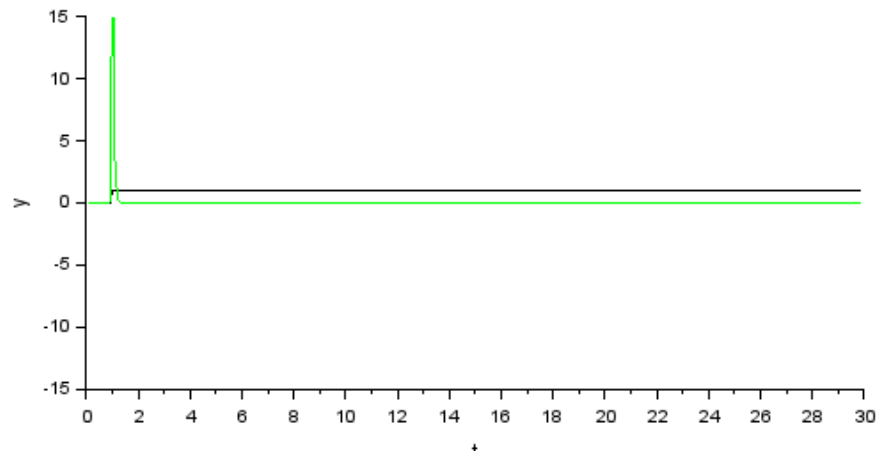
Чем меньше d , тем меньше колебаний. при увеличении k увеличивается максимум переходной функции, при увеличении T функция сходится медленнее

Реальное дифференцирующее звено

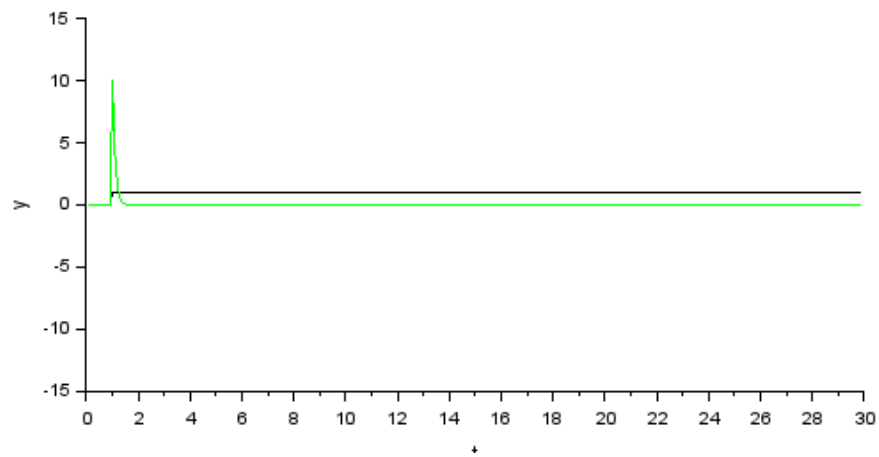


Реальное дифференцирующее звено можно рассматривать как последовательное соединение идеального дифференцирующего и апериодического звена первого порядка

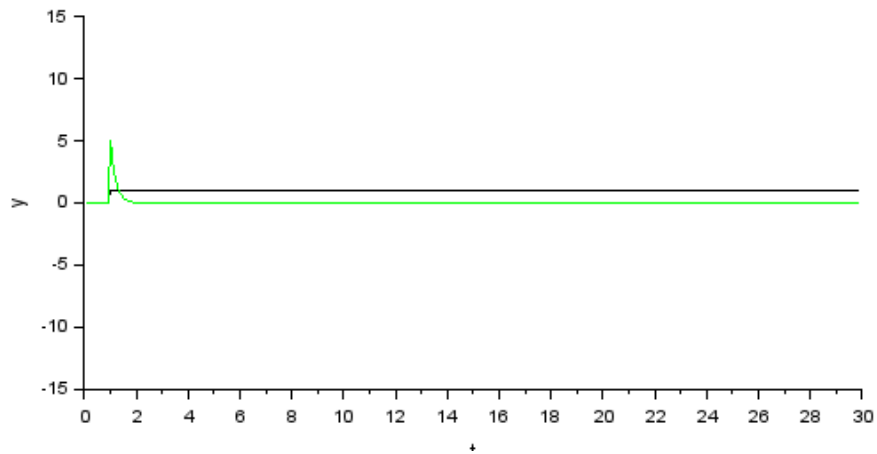
Переходная функция



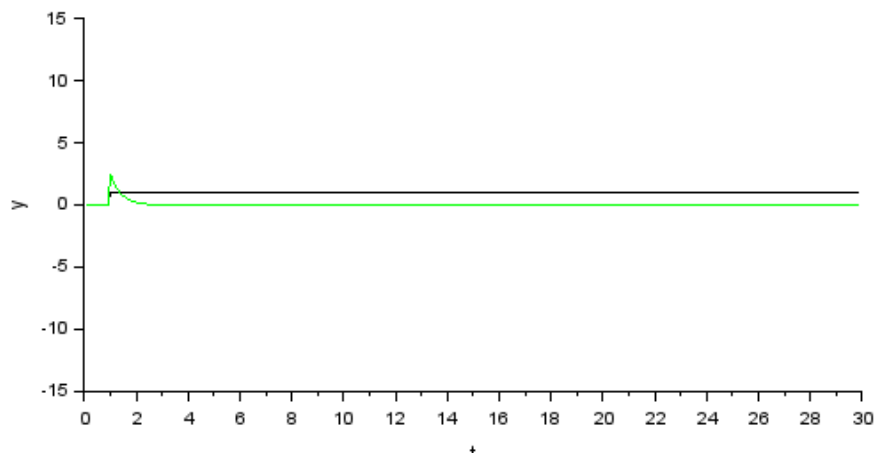
$K=1$, $M=0.05$



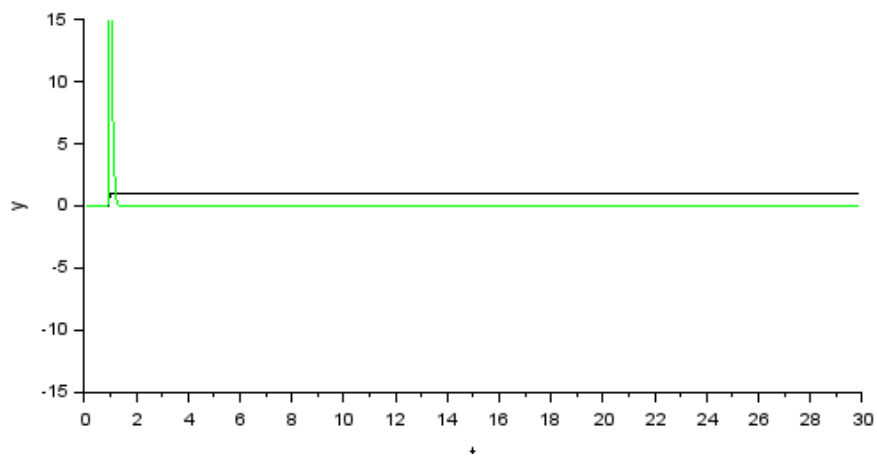
$K=1$, $M=0.1$



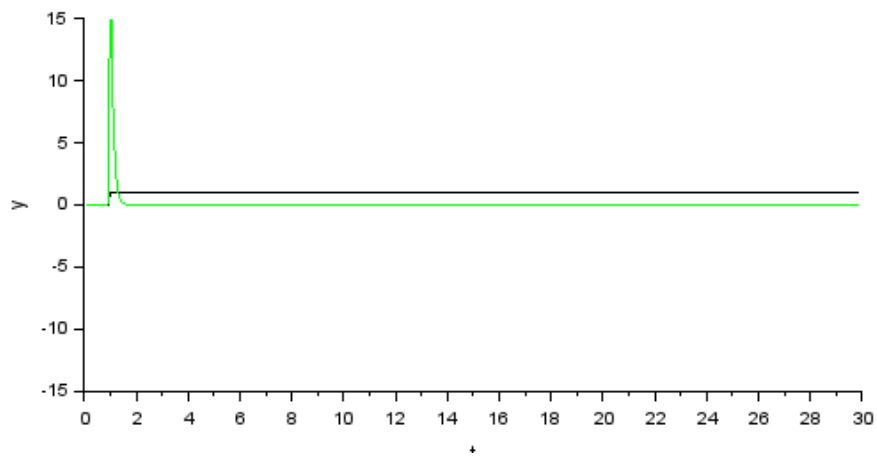
$K=1, M=0.2$



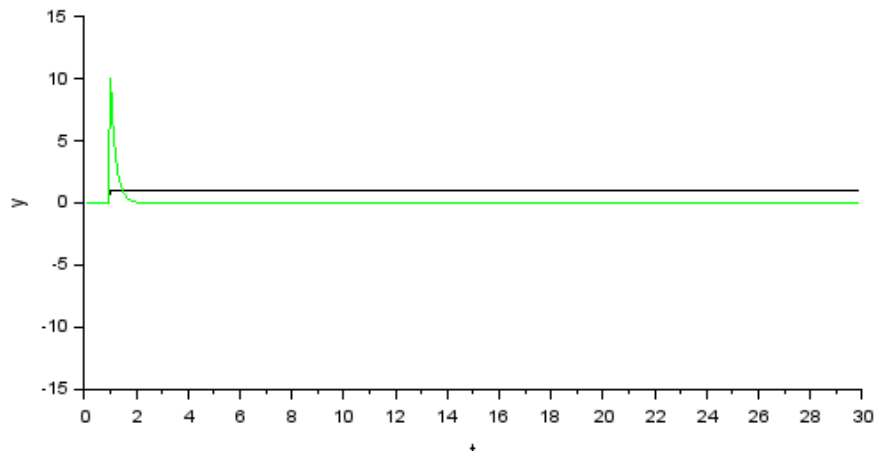
$K=1, M=0.4$



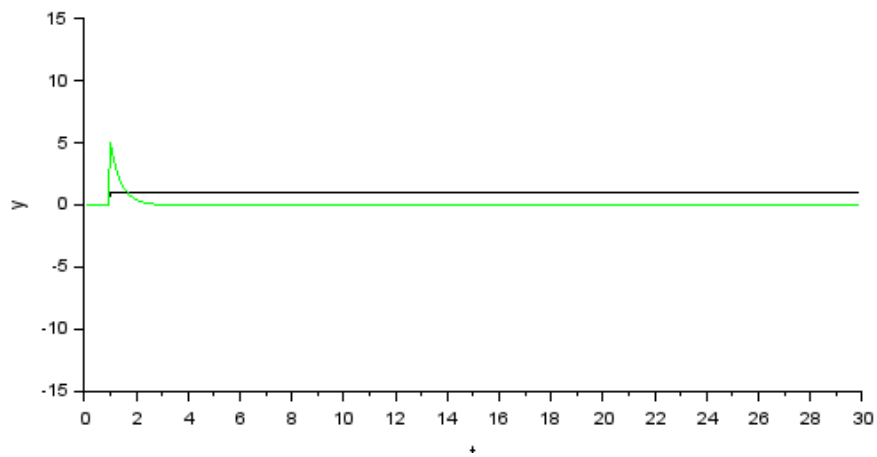
$K=2$, $M=0.05$



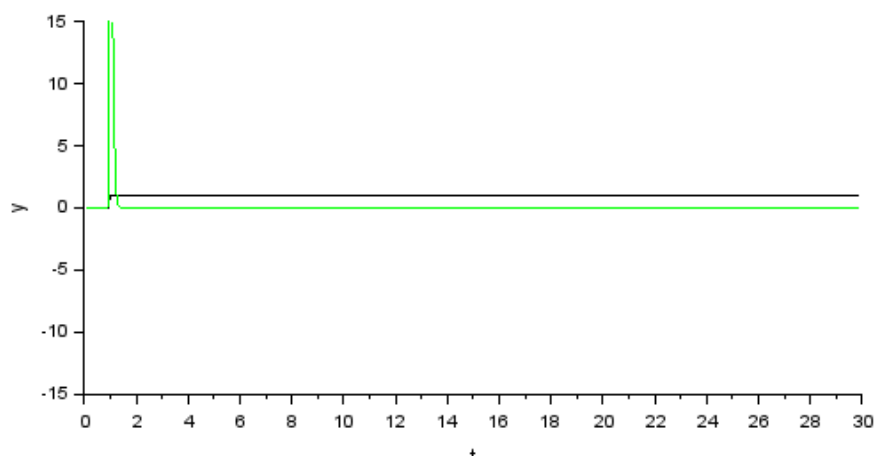
$K=2$, $M=0.1$



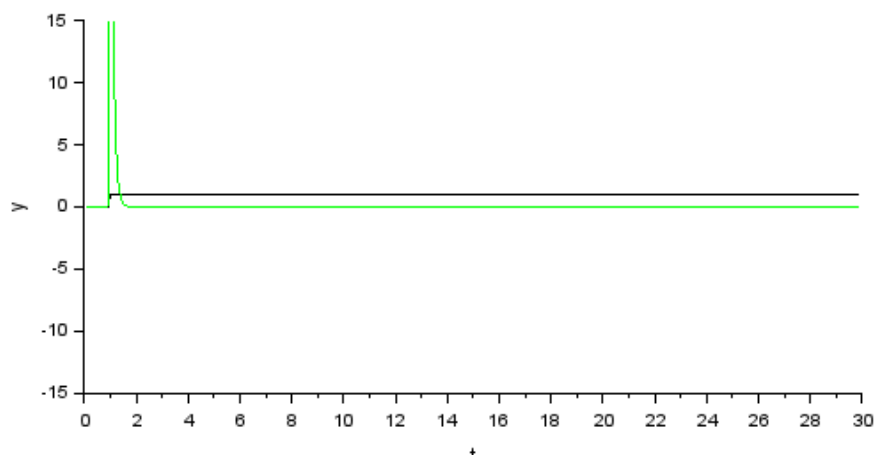
$K=2, M=0.2$



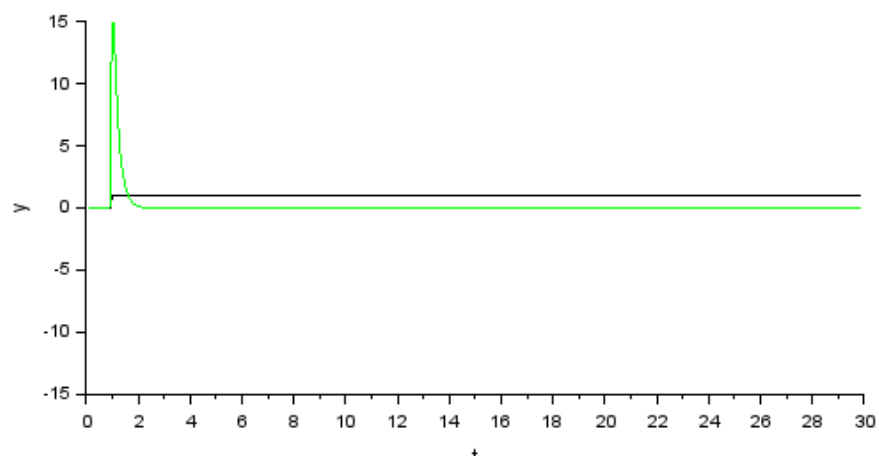
$K=2, M=0.4$



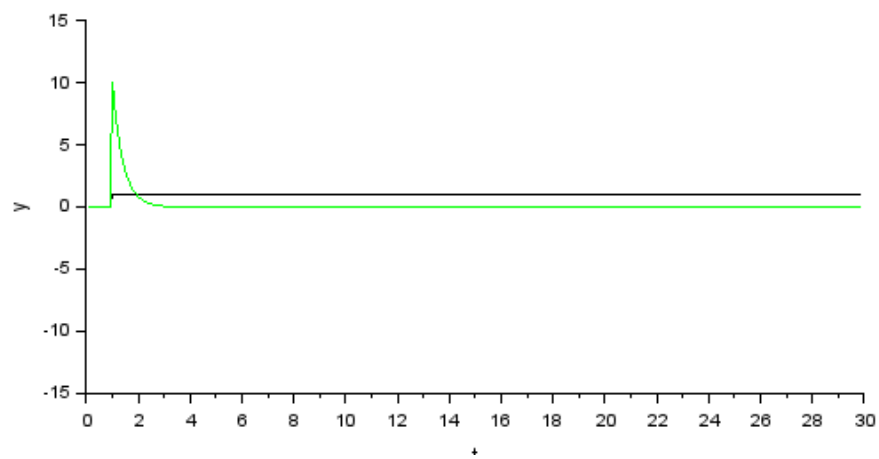
$K=4$, $M=0.05$



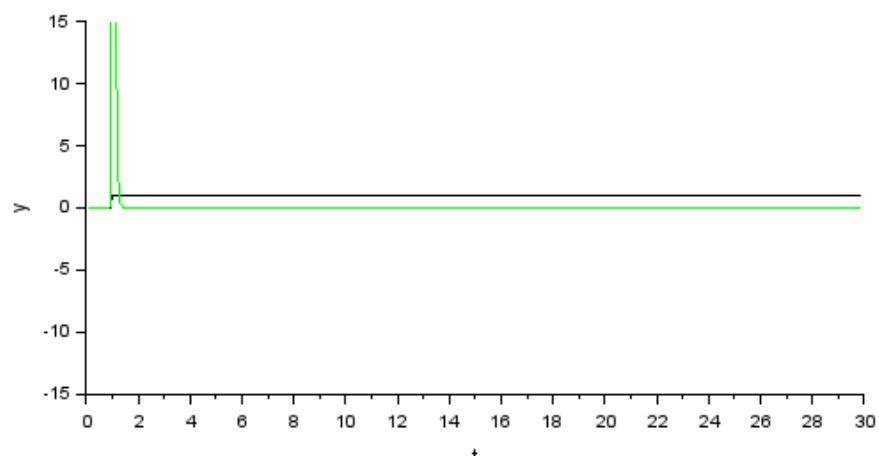
$K=4$, $M=0.1$



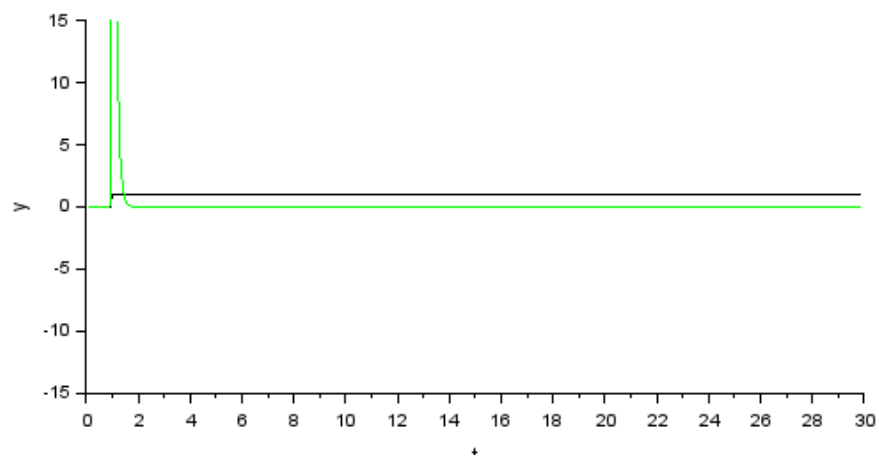
$K=4, M=0.2$



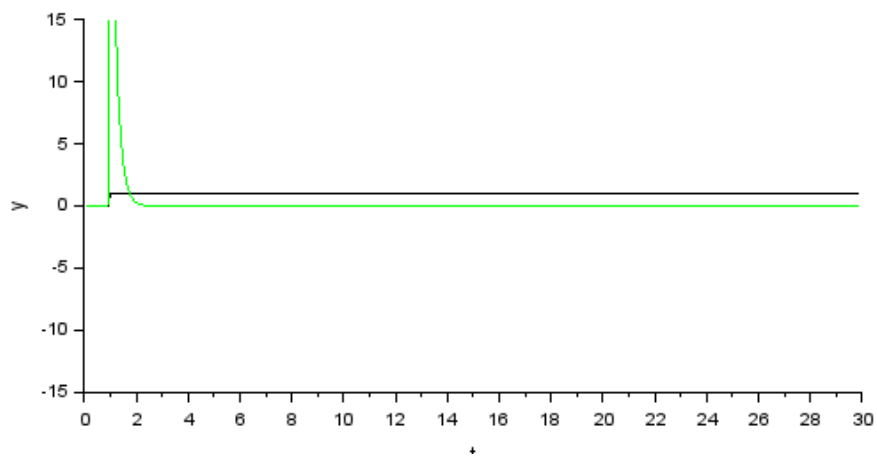
$K=4, M=0.4$



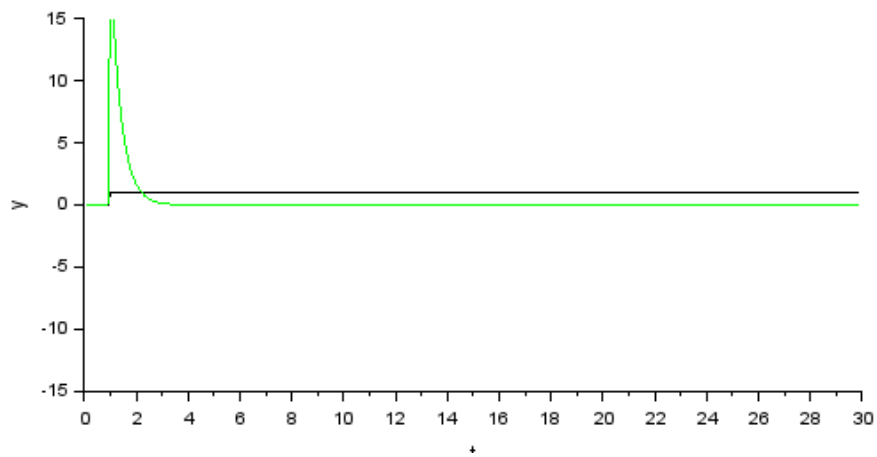
$K=8, M=0.05$



$K=8, M=0.1$

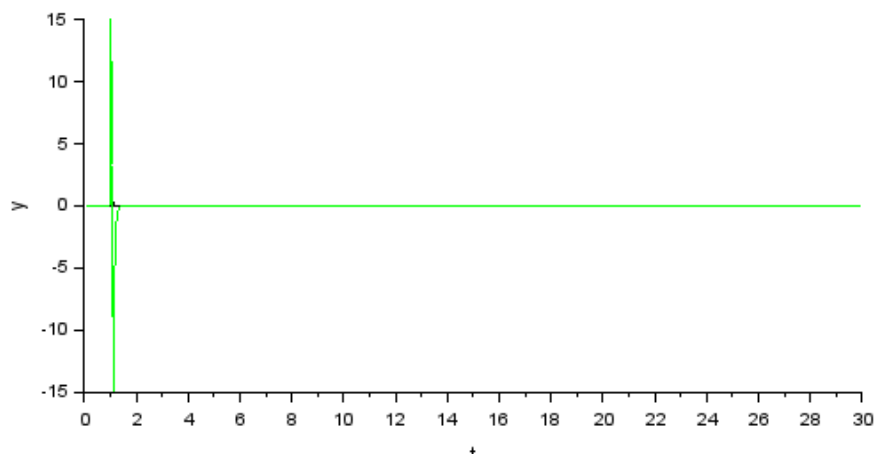


$K=8, M=0.2$

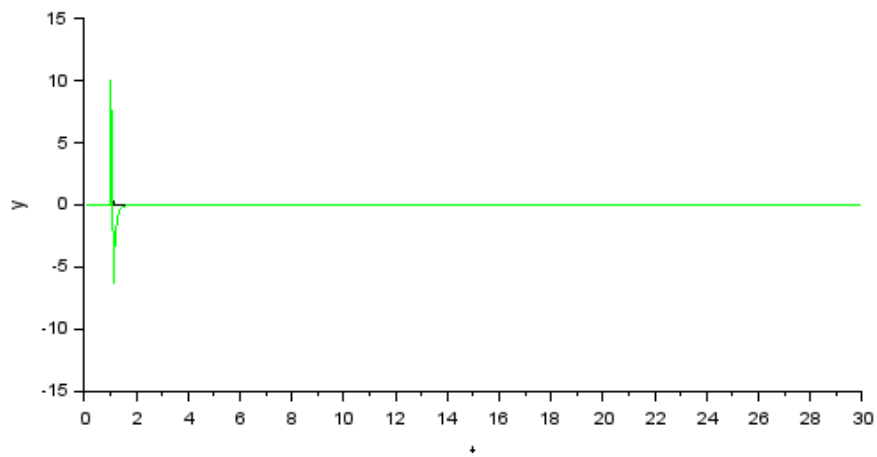


$K=8, M=0.4$

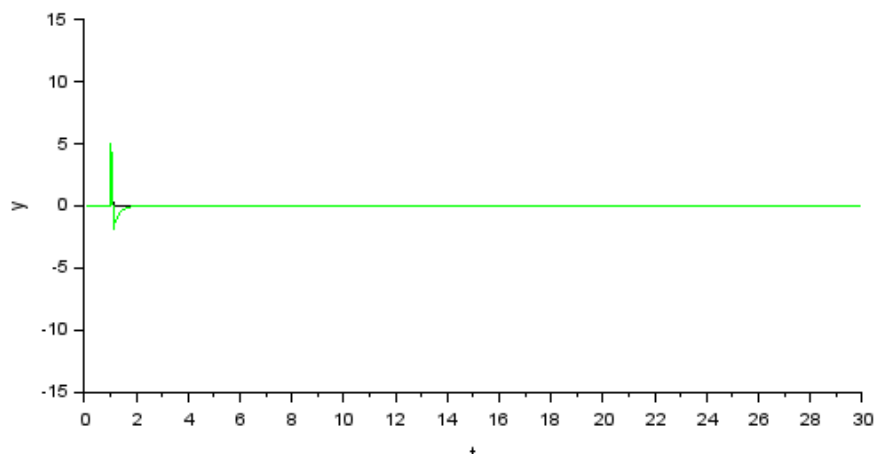
от k и M зависит максимум
Импульсная функция



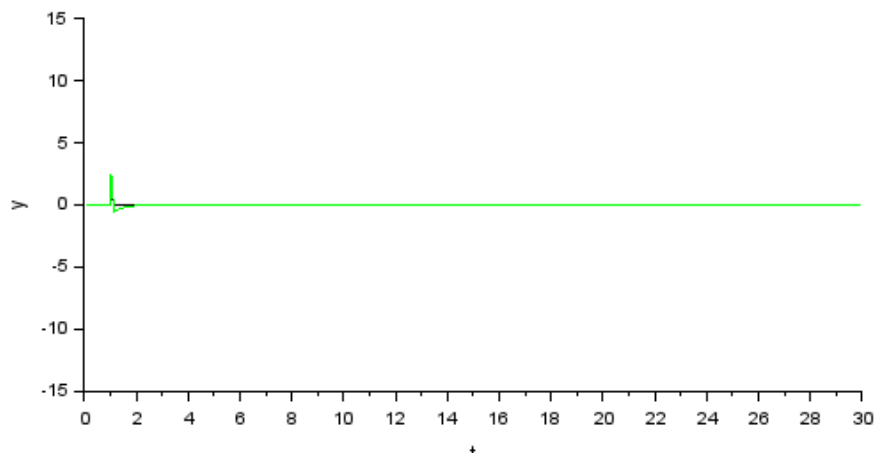
$K=1$, $M=0.05$



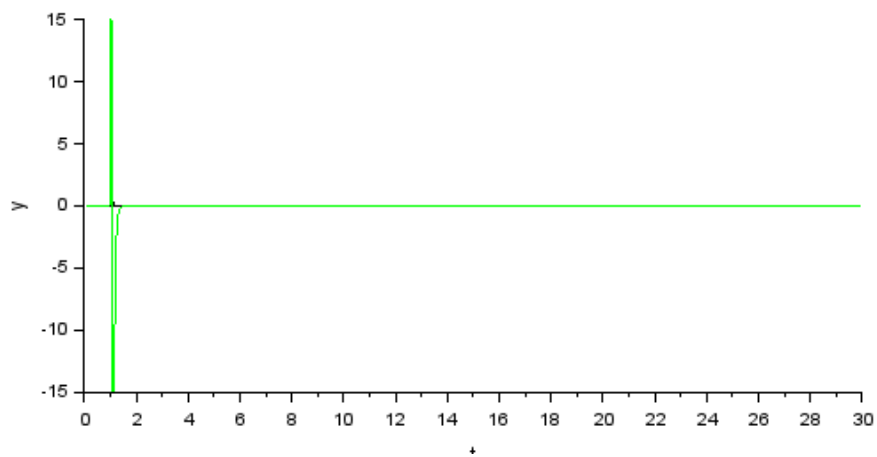
$K=1$, $M=0.1$



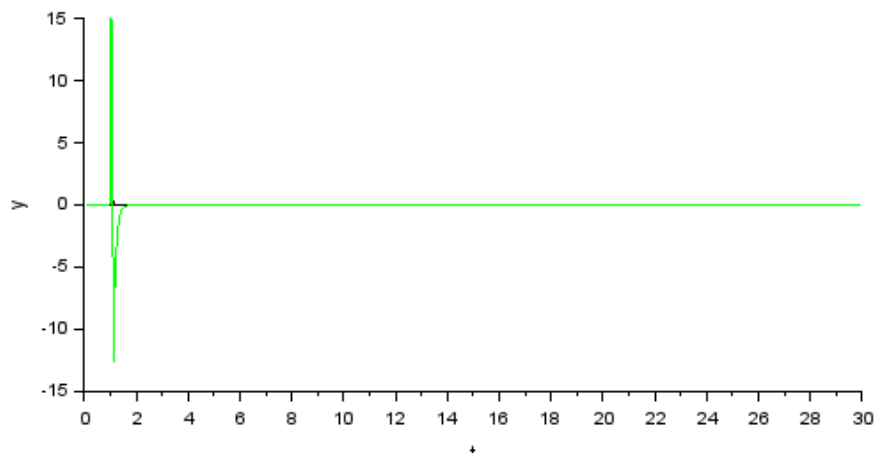
$K=1, M=0.2$



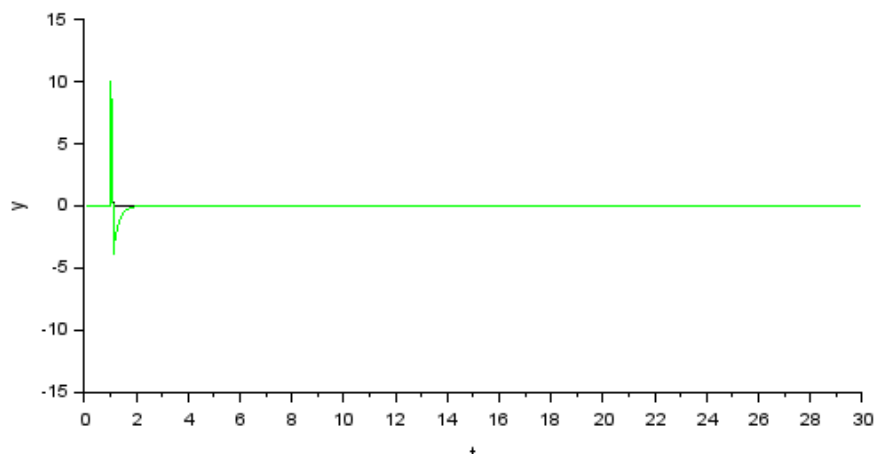
$K=1, M=0.4$



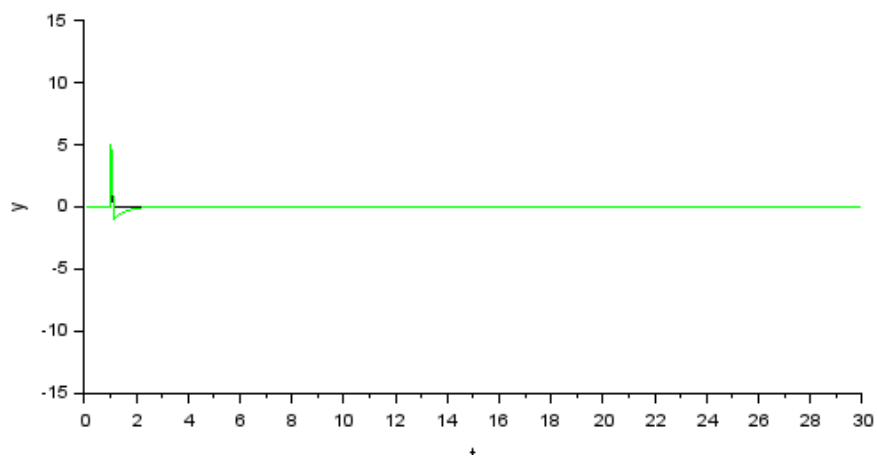
$K=2$, $M=0.05$



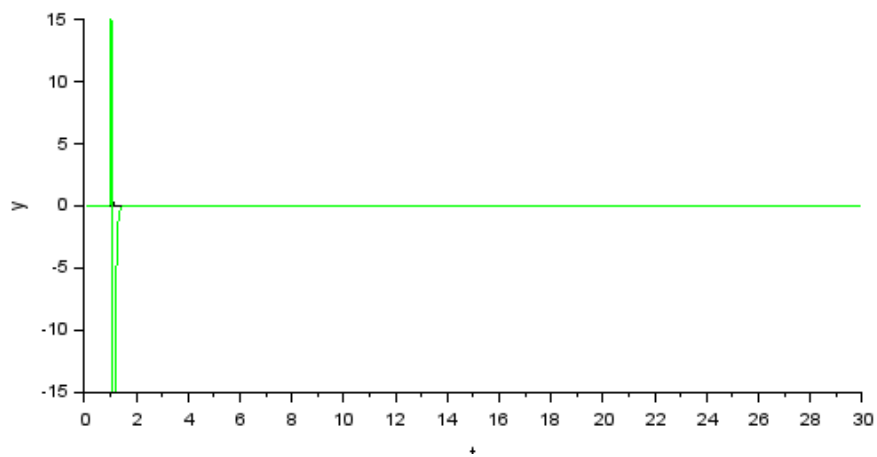
$K=2$, $M=0.1$



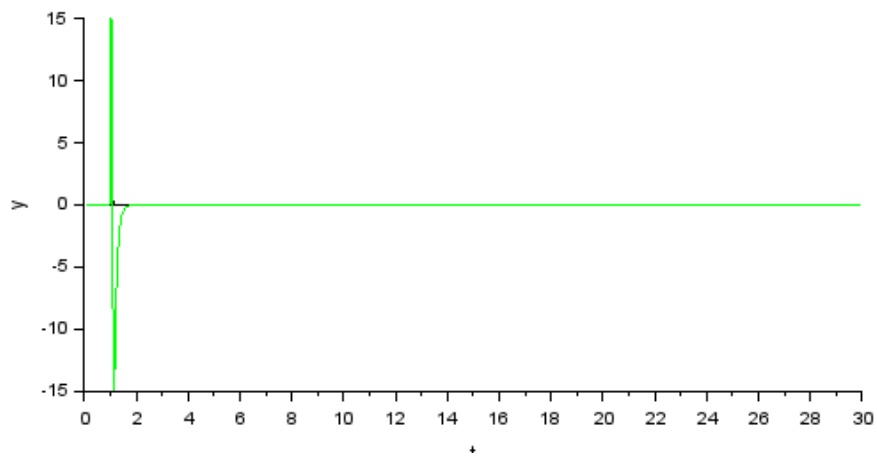
$K=2$, $M=0.2$



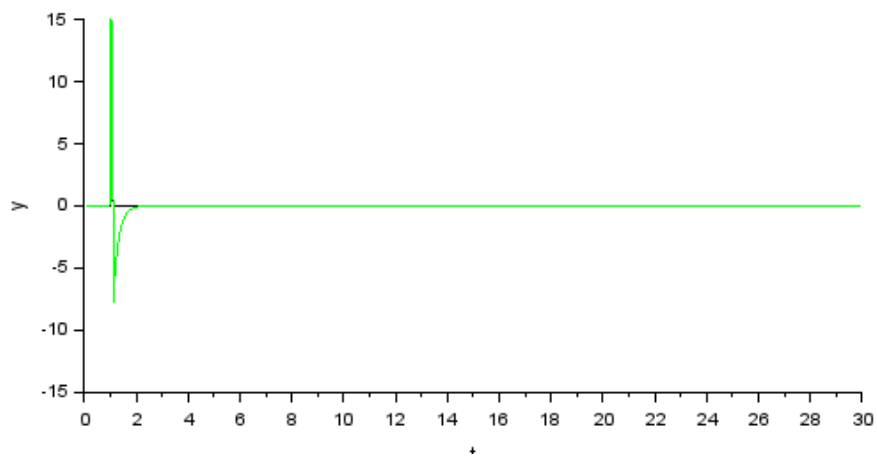
$K=2$, $M=0.4$



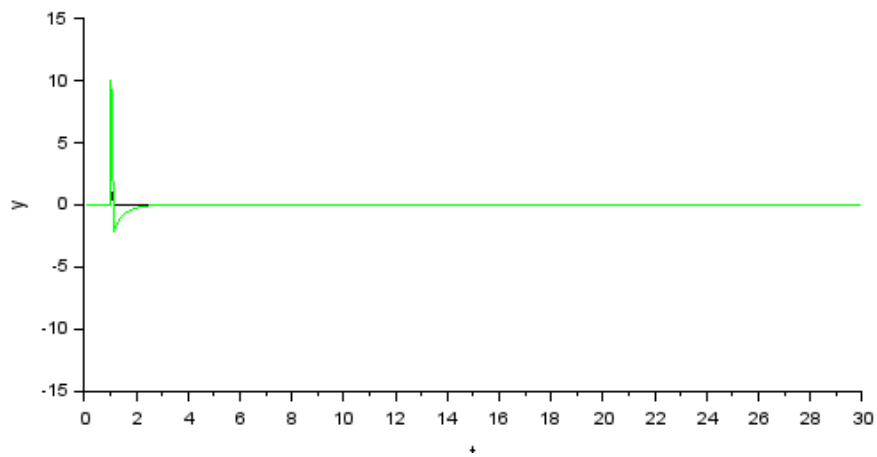
$K=4$, $M=0.05$



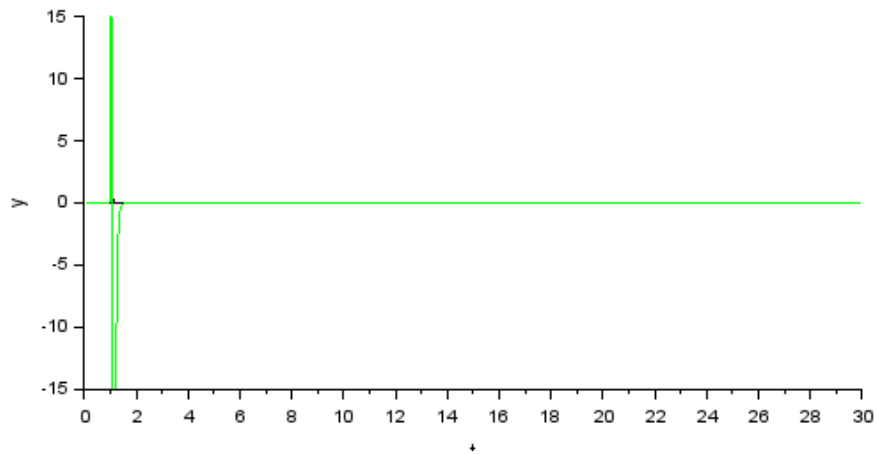
$K=4$, $M=0.1$



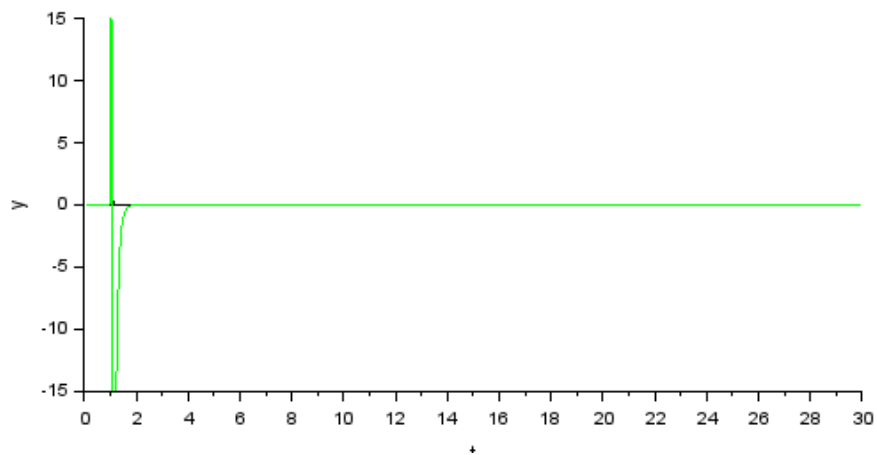
$K=4$, $M=0.2$



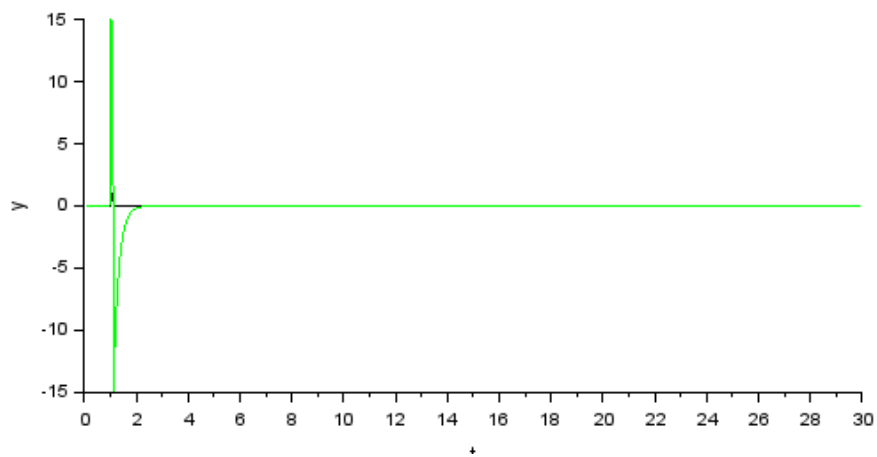
$K=4$, $M=0.4$



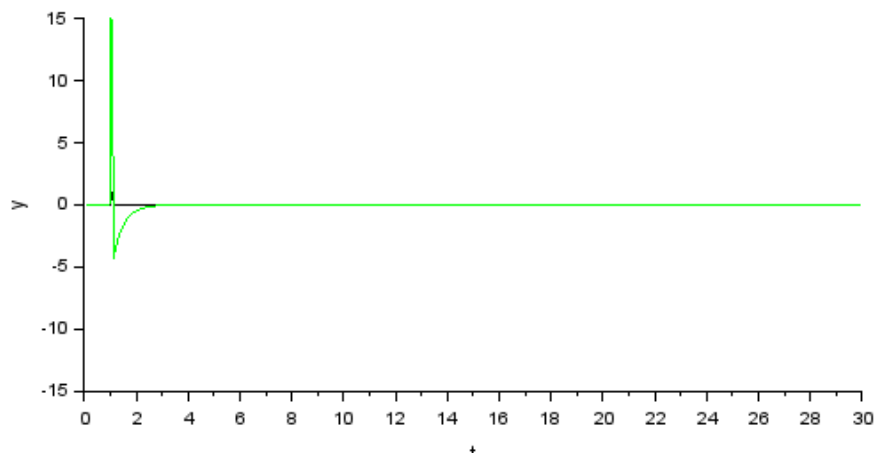
$K=8, M=0.05$



$K=8, M=0.1$



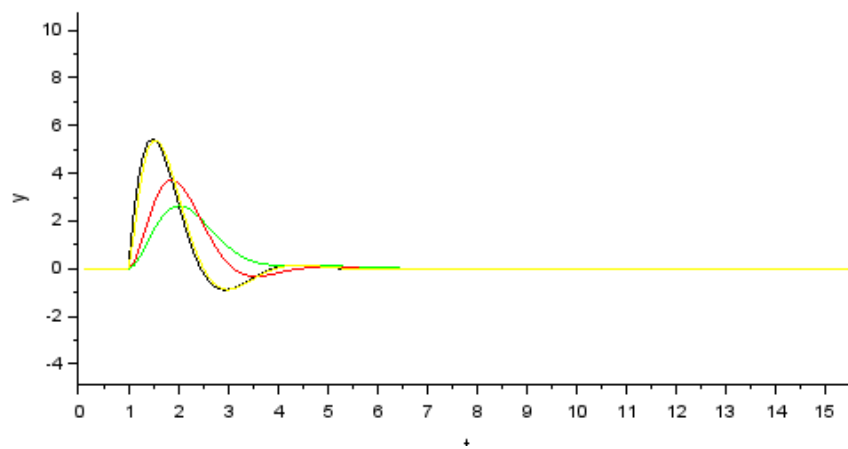
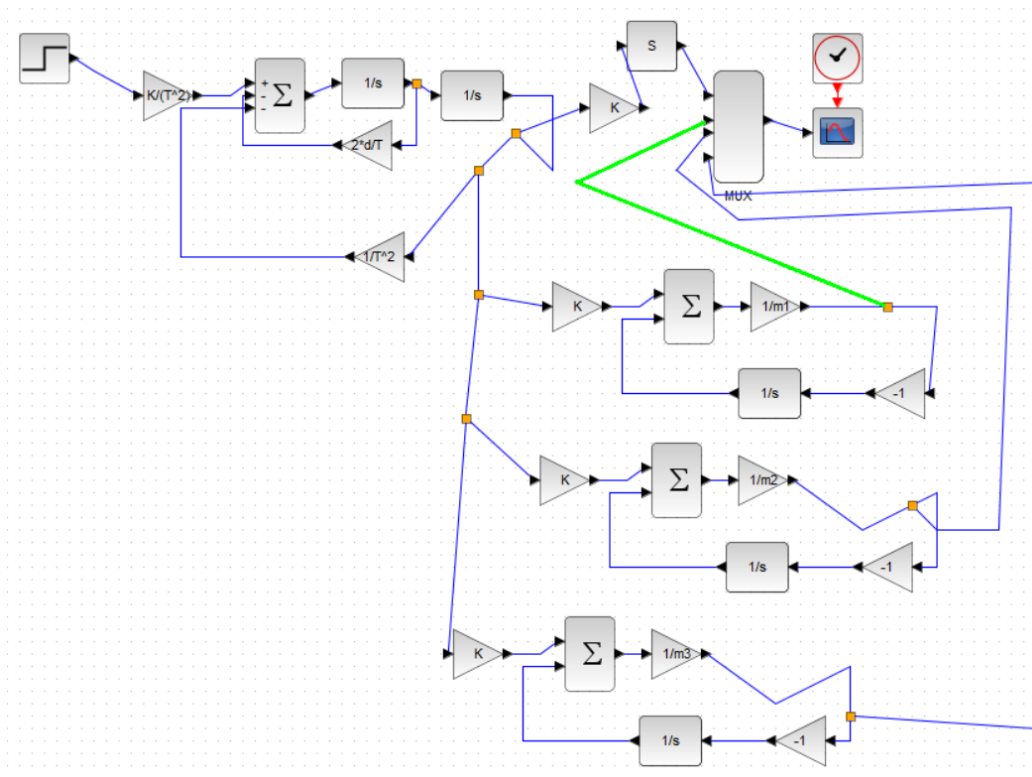
$K=8, M=0.2$



$K=8, M=0.4$

от k зависит максимум, от M минимум

Последняя штука



чем M меньше, тем точнее