```
>
> restart;
  with(DEtools):
  with(plots,loglogplot):
```
calcul avec f = - r *V modèle Stoke

calcul avec f= - (signe de V)*0.5 *cx*rho *S* V**2 avec la formule d'Abraham pour l'expression de cx

calcul avec f = -ks *(signe de V) frottement solide

comparaison des 3 modèles

```
Eq0:=m*(D@@2)(y)(x)+ r*diff(y(x),x)+k*y(x)=0;
Eq1:=m*(D@@2)(y)(x)+signum(diff(y(x),x))*0.5*rho*S*A*
((1+b/(sqrt(abs(rho*dia*(diff(y(x),x)))/eta)))**2)*(diff(y(x),x))*
(diff(y(x),x))+k*y(x)=0;
Eq2:=m*(D@@2)(y)(x)+ks*signum(diff(y(x),x))+k*y(x)=0;#solide
uniquement
Eq3:=m*(D@@2)(y)(x)+ks*signum(diff(y(x),x))+r*diff(y(x),x)
+k*y(x)=0;#solide et Stokes
****************************
m:=0.03;
k:=1.2;# k du ressort
rho:=1000;# fluide = eau
eta:=0.002;# fluide = eau
dia:=0.02;
ks:=0.001;# f solide
A:=0.29238;
b:=9.06;
S:=dia*dia*Pi/4;# diametre en m
r:=0.004;# normalement r = 6 pi eta R ou 3 Pi eta D pour stokes
r_stokes:=evalf(3*Pi*eta*dia,6);
lambda:=r/(2*m);
freq=evalf(((2*Pi)**(-1))*((k/m)**(1/2)),4);
***************************
sol0:=dsolve({Eq0,y(0)=0.03, D(y)(0)=0.001},y(x)):
sol0_res:=subs(sol0,y(x)):
sol0a_res:=abs(subs(sol0,y(x))):
sol0log_res:=log(abs(subs(sol0,y(x)))):

sol0Reynolds:=rho*dia*abs(subs(sol0,diff(y(x),x)))/eta:
sol0(1):
plot(sol0Reynolds,x=0..40,numpoints=200,
title="nb de Reynolds, modèle Stokes",color=black,thickness=2);
sol3:=dsolve({Eq3,y(0)=0.03, D(y)(0)=0.001},y(x),type=numeric):
sol3_res:=t->subs(sol3(t),y(x)):
sol3a_res:=t->abs(subs(sol3(t),y(x))):
sol3log_res:=t->log(abs(subs(sol3(t),y(x)))):

sol2:=dsolve({Eq2,y(0)=0.03, D(y)(0)=0.001},y(x),type=numeric):
```

```
sol2_res:=t->subs(sol2(t),y(x)):
sol2a_res:=t->abs(subs(sol2(t),y(x))):
sol2log_res:=t->log(abs(subs(sol2(t),y(x)))):

'_____
__';
sol1:=dsolve({Eq1,y(0)=0.03, D(y)(0)=0.001},y(x),type=numeric):
sol1_res:=t->subs(sol1(t),y(x)):
sol1a_res:=t->abs(subs(sol1(t),y(x))):
sol1log_res:=t->log(abs(subs(sol1(t),y(x)))):

#sol2_res:=t->subs(sol1(t),y(t))-subs(sol0(t),y(t));
#sol2(1);

plot(sol0_res,x=0..40,numpoints=200,title="y=f(t) modèle
Stokes",thickness=2);
plot(sol1_res,0..40,numpoints=200,title="y=f(t) modèle
Abraham",thickness=2);
plot(sol2_res,0..40,numpoints=200,title="y=f(t) modèle frottement
solide",thickness=2);

plot(sol3_res,0..40,numpoints=200,title="y=f(t) modèle frottement
solide+Stokes",thickness=2);


'_____
__';
plot(sol0a_res,x=0..40,numpoints=200,title="y=abs(f(t)) modèle
Stokes",thickness=2);
plot(sol1a_res,0..40,numpoints=200,title="y=abs(f(t)) modèle
Abraham",thickness=2);

plot(sol2a_res,0..40,numpoints=200,
title="y=abs(f(t)) modèle frottement solide",thickness=2);
plot(sol3a_res,0..40,numpoints=200,
title="y=abs(f(t)) modèle frottement solide",thickness=2);
'_____
__';


plot(sol0log_res,x=0..40,-3.5..-6,numpoints=200,
title="log(y)=abs(f(t))modèle Stokes",thickness=2);
plot(sol1log_res,0..40,-3.5..-6,
numpoints=200,title="log(y)=abs(f(t))modèle
Abraham",thickness=2);
plot(sol2log_res,0..40,-3.5..-6,
numpoints=200,title="log(y)=abs(f(t)) modèle frottement
```

```
solide",thickness=2);
plot(sol3log_res,0..40,-3.5..-6,
numpoints=200,title="log(y)=abs(f(t)) modèle frottement
solide+Stokes",thickness=2);
'_____
__';
```

```
"C fini";
```

$$Eq0 := m\,(\mathrm{D}^{(2)})(y)(x) + r\left(\frac{\partial}{\partial x}\,\mathrm{y}(x)\right) + k\,\mathrm{y}(x) = 0$$

$$Eq1 := m\,(\mathrm{D}^{(2)})(y)(x)$$
$$+ .5\,\mathrm{signum}\left(\frac{\partial}{\partial x}\,\mathrm{y}(x)\right)\rho\,S\,A\left(1 + \frac{b}{\sqrt{\dfrac{\left|\rho\,dia\left(\frac{\partial}{\partial x}\,\mathrm{y}(x)\right)\right|}{\eta}}}\right)^2\left(\frac{\partial}{\partial x}\,\mathrm{y}(x)\right)^2 + k\,\mathrm{y}(x) = 0$$

$$Eq2 := m\,(\mathrm{D}^{(2)})(y)(x) + ks\,\mathrm{signum}\left(\frac{\partial}{\partial x}\,\mathrm{y}(x)\right) + k\,\mathrm{y}(x) = 0$$

$$Eq3 := m\,(\mathrm{D}^{(2)})(y)(x) + ks\,\mathrm{signum}\left(\frac{\partial}{\partial x}\,\mathrm{y}(x)\right) + r\left(\frac{\partial}{\partial x}\,\mathrm{y}(x)\right) + k\,\mathrm{y}(x) = 0$$

$$m := .03$$
$$k := 1.2$$
$$\rho := 1000$$
$$\eta := .002$$
$$dia := .02$$
$$ks := .001$$
$$A := .29238$$
$$b := 9.06$$
$$S := .0001000000000\,\pi$$
$$r := .004$$
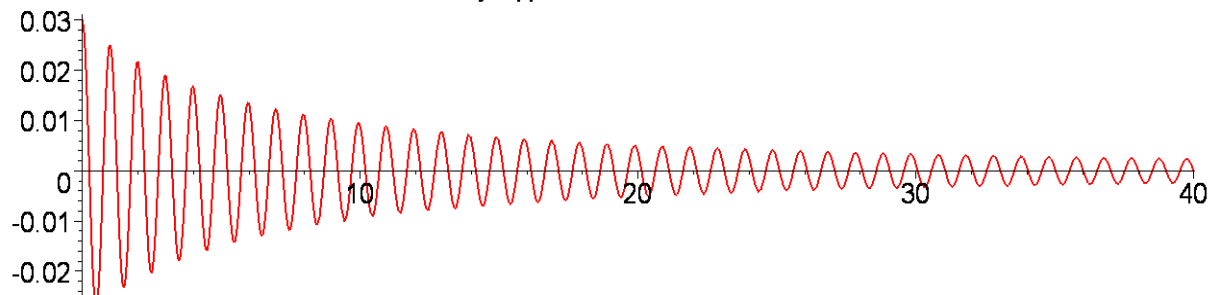$$r\_stokes := .000376991$$
$$\lambda := .06666666665$$
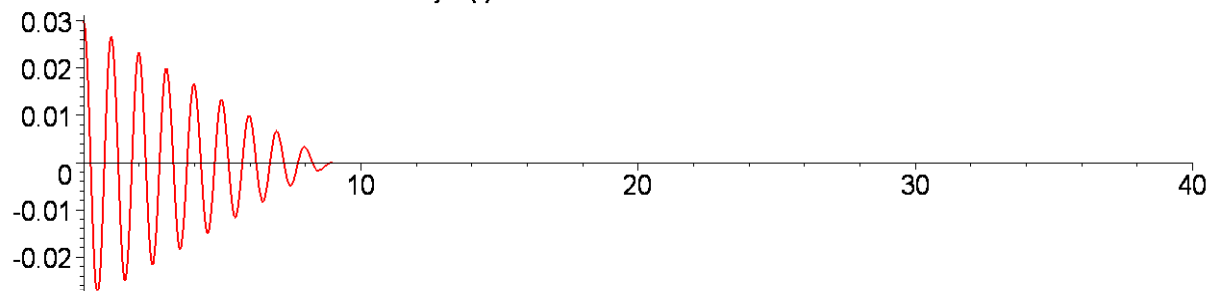$$freq = 1.006$$

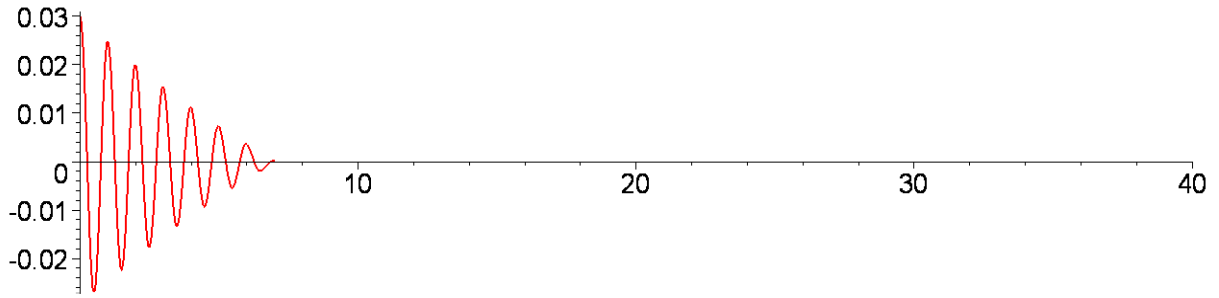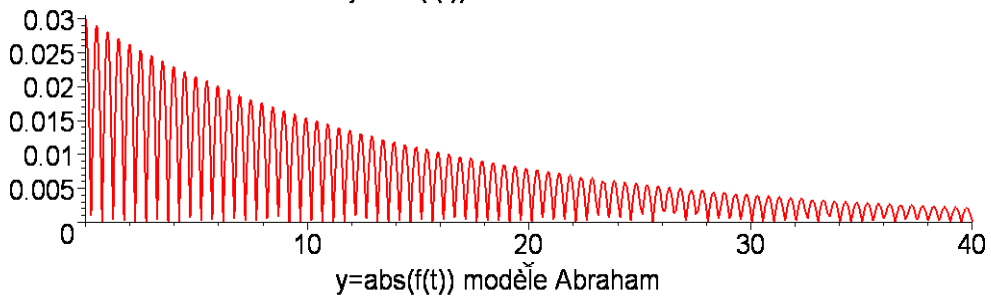nb de Reynolds, modèle Stokes
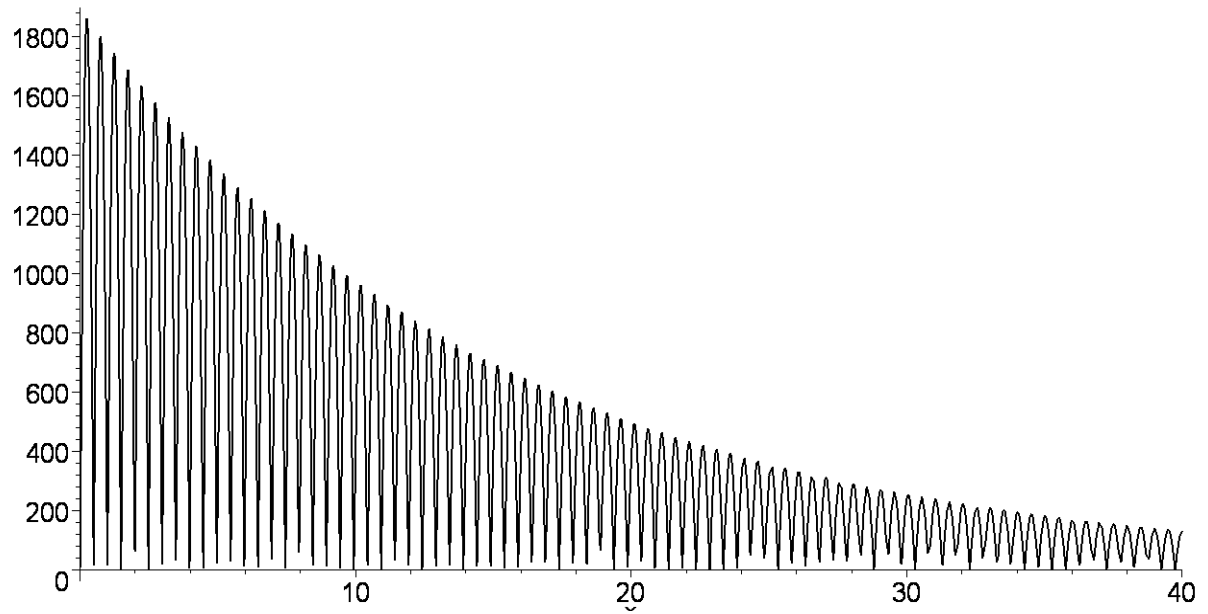
y=f(t) modèle Stokes
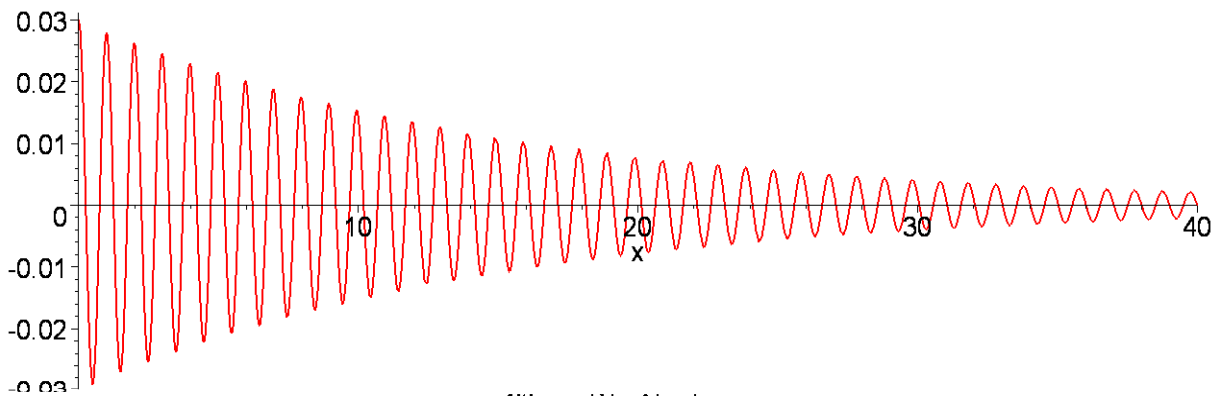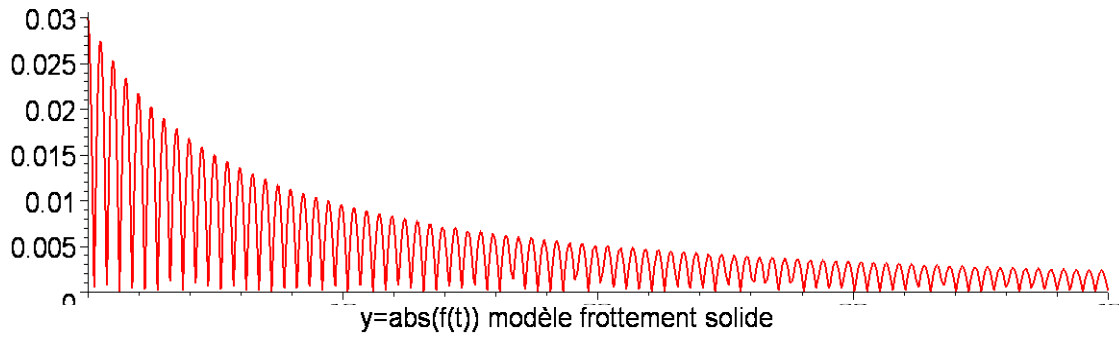
y=f(t) modèle Abraham

y=f(t) modèle frottement solide

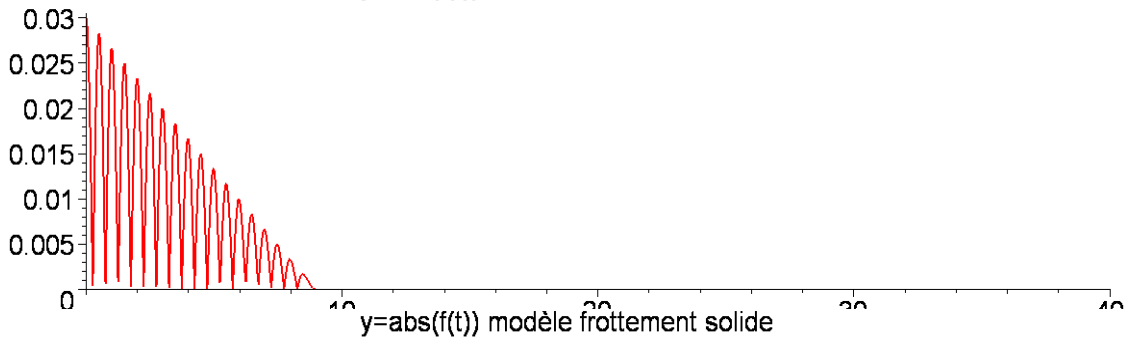## y=f(t) modèle frottement solide+Stokes

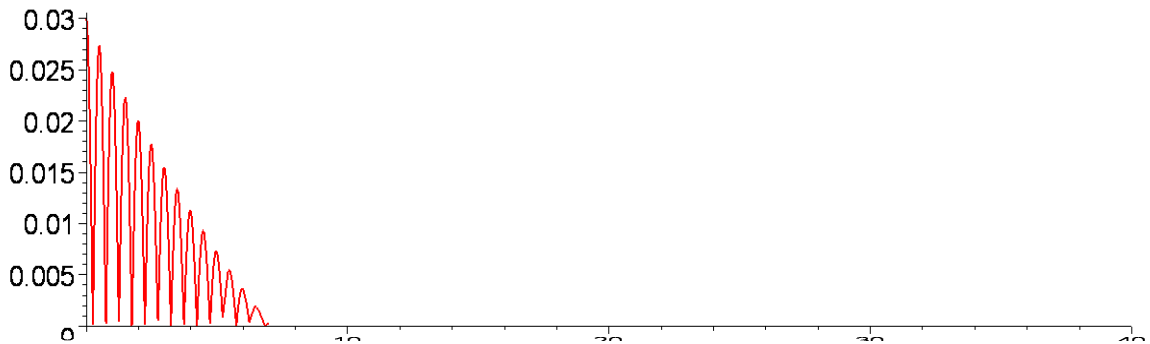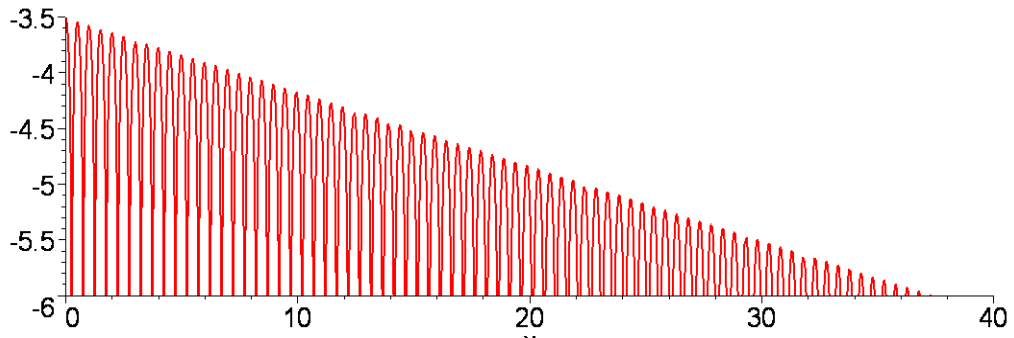## y=abs(f(t)) modèle Stokes
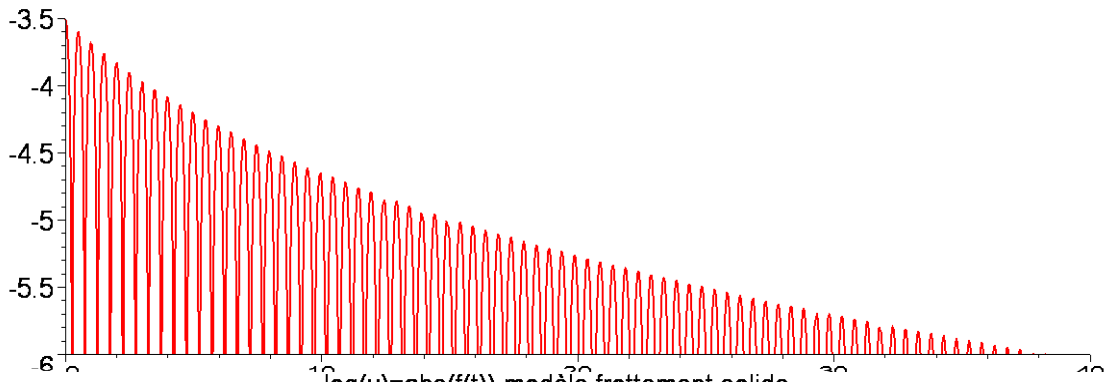

y=abs(f(t)) modèle Abraham

y=abs(f(t)) modèle frottement solide

y=abs(f(t)) modèle frottement solide

log(y)=abs(f(t))modèle Stokes

log(y)=abs(f(t))modèle Abraham

log(y)=abs(f(t)) modèle frottement solide

log(y)=abs(f(t)) modèle frottement solide+Stokes

"C fini"

>