```
> restart:
> m:=1;a:=3;b:=0.5;c:=1:
>
```

$$m := 1$$

$$a := 3$$

$$b := .5$$

```
> x0:=3;v0:=2;
```

$$x0 := 3$$

$$v0 := 2$$

```
> fs:={x(t),v(t)}:ini:=x(0)=x0,v(0)=v0;
```

$$ini := \mathrm{x}(0) = 3, \mathrm{v}(0) = 2$$

```
> de:=diff(x(t),t)=v(t),diff(v(t),t)=-a*x(t)/m-b*signum(v(t))/m;
```

$$de := \frac{\partial}{\partial t}\mathrm{x}(t) = \mathrm{v}(t), \frac{\partial}{\partial t}\mathrm{v}(t) = -\frac{a\,\mathrm{x}(t)}{m} - \frac{b\,\mathrm{signum}(\mathrm{v}(t))}{m}$$

$$de := \frac{\partial}{\partial t}\mathrm{x}(t) = \mathrm{v}(t), \frac{\partial}{\partial t}\mathrm{v}(t) = -3\,\mathrm{x}(t) - .5\,\mathrm{signum}(\mathrm{v}(t))$$

```
> sol:=dsolve([de,ini],fs,type=numeric);
```

$$sol := \mathbf{proc}(rkf45_x) \ \ldots \ \mathbf{end\ proc}$$

```
> op(2,sol(10)[3]);
>
```

$$-.582062691529080634$$

```
> with(plots);
Warning, the name changecoords has been redefined

[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d,
    conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, cylinderplot,
    densityplot, display, display3d, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot,
    implicitplot3d, inequal, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d,
    loglogplot, logplot, matrixplot, odeplot, pareto, pointplot, pointplot3d, polarplot, polygonplot,
    polygonplot3d, polyhedra_supported, polyhedraplot, replot, rootlocus, semilogplot, setoptions,
    setoptions3d, spacecurve, sparsematrixplot, sphereplot, surfdata, textplot, textplot3d, tubeplot
    ]
> pl1:=odeplot(sol,[t,x(t)],0..18):
> t:=0:tm:=18:h:=0.0005;npt:=100:
> imx:=floor(tm/h);np:=floor(imx/npt);
> vi:=v0:xi:=x0:j:=0:
  for i from 1 to imx do
  f1:=vi:
  f2:=-a/m*xi-b/m*signum(vi):
  if(vi*(vi+h*f2)>0 or a*abs(xi)>c) then
  xi:=xi+h*f1:
  vi:=vi+h*f2:
  end if:
```

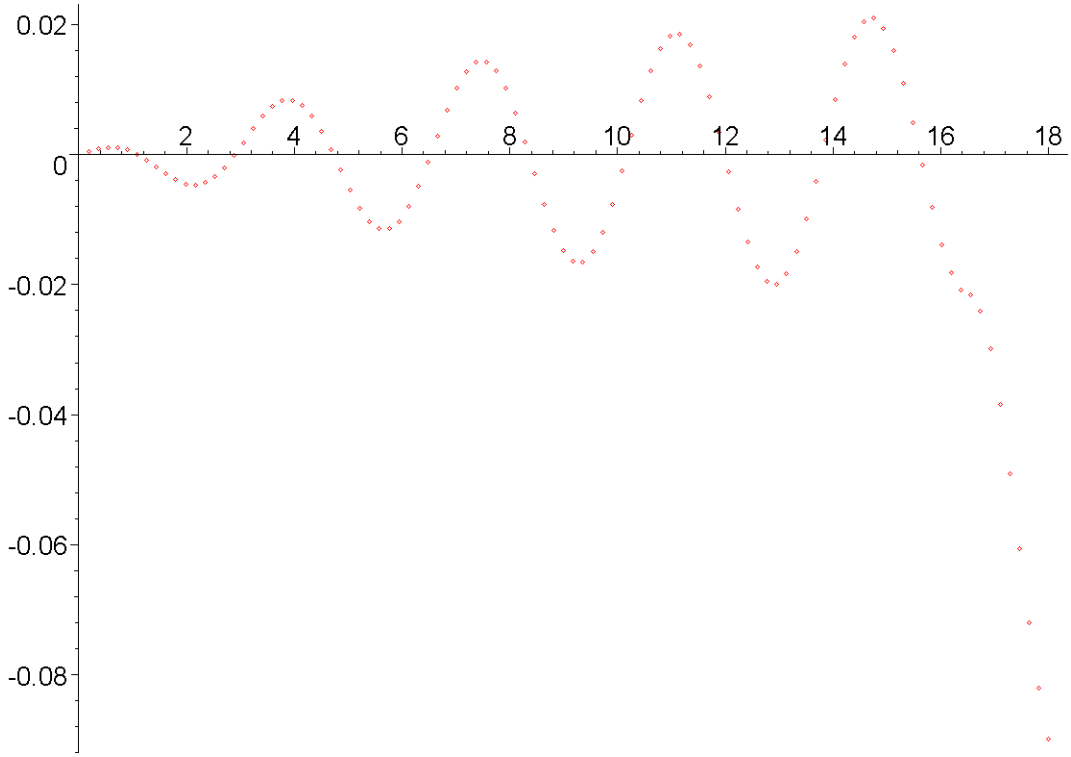
```
t:=t+h:
if ((i mod np)=0) then
j:=j+1:px[j]:=xi:pv[j]:=vi:pt[j]:=t:
rk[j]:=op(2,sol(t)[3])
end if:
od:
```

$$h := .0005$$

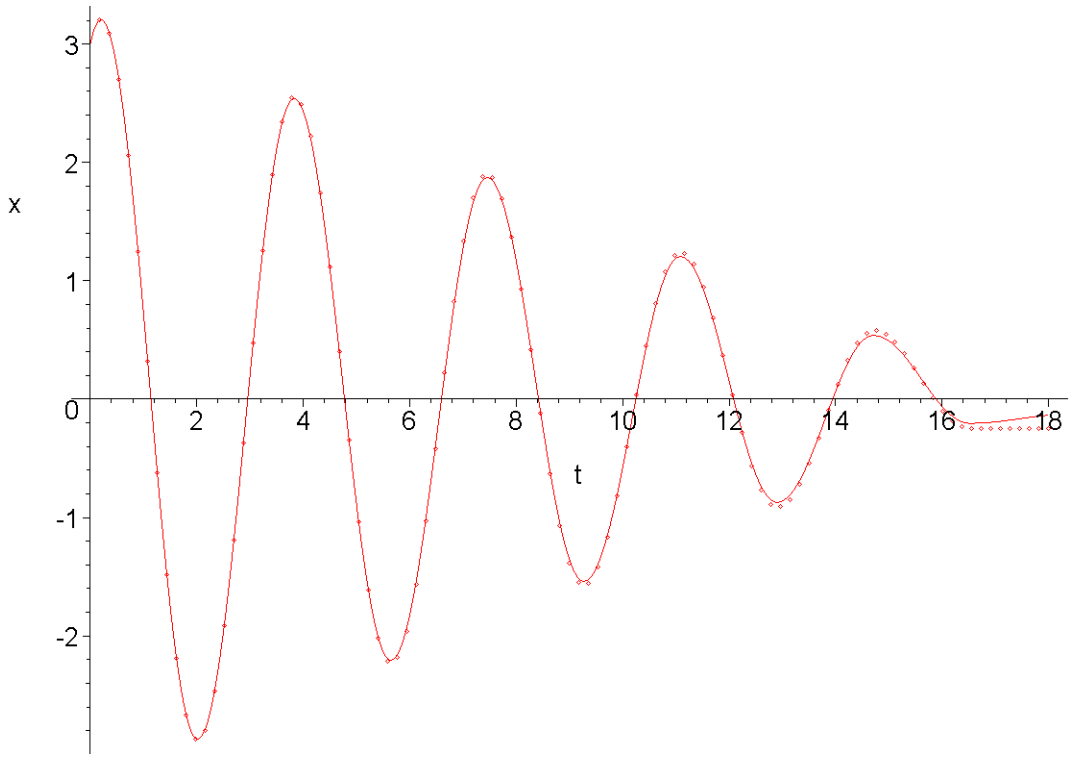
$$imx := 36000$$

$$np := 360$$

```
> plot({[pt[s],px[s]-rk[s]] $s=1..j},style=point);
```




```
> pl2:=plot({[pt[s],px[s]] $s=1..j},style=point):
> display([pl1,pl2]);
```


x
3
2
1
0
-1
-2
2
4
6
8
10
12
14
16
18
t

>