> L:='L';

$$L := L$$

> eq1:=diff(theta(t),t$2)+g/L*sin(theta(t))=0;

$$eq1 := \left(\frac{\partial^2}{\partial t^2}\,\theta(t)\right) + \frac{g\,\sin(\theta(t))}{L} = 0$$

> init1:=theta(0)=Pi/2,D(theta)(0)=0;

$$init1 := \theta(0) = \frac{1}{2}\,\pi,\ \mathrm{D}(\theta)(0) = 0$$

> g:=9.8;L:=1;

$$g := 9.8$$

$$L := 1$$

> sol:=dsolve({eq1,init1},theta(t),numeric);

```
sol := proc(rkf45_x) ... end
```

> with(plots):

> odeplot(sol,[t,theta(t)],0..2*Pi,labels=[t,theta],axes=boxed,title='Large Amplitud e');

> L:='L';

$$L := L$$

> eq2:=diff(theta(t),t$2)+g/L*theta(t)=0;

$$eq2 := \left(\frac{\partial^2}{\partial t^2}\,\theta(t)\right) + 9.8\,\frac{\theta(t)}{L} = 0$$

> g:=9.8;L:=1;

$$g := 9.8$$

$$L := 1$$

> sol2:=dsolve({eq2,init1},theta(t),numeric);

```
sol2 := proc(rkf45_x) ... end
```

> odeplot(sol2,[t,theta(t)],0..2*Pi,labels=[t,theta],axes=boxed,title='Small Amplitu

de approximation, No sine term‘);

> init3:=theta(0)=Pi/10,D(theta)(0)=0;

$$init3 := \theta(0) = \frac{1}{10}\pi, \mathrm{D}(\theta)(0) = 0$$

> sol3:=dsolve({eq1,init3},theta(t),numeric);

```
sol3 := proc(rkf45_x) ... end
```

> odeplot(sol3,[t,theta(t)],0..2*Pi,labels=[t,theta],axes=boxed,title=‘Small Amplitude, sine term‘);

> L:=’L’;

$$L := L$$

> eq4:=diff(theta(t),t$2)+(k/m)*diff(theta(t),t)+g/L*sin(theta(t))=0;

$$eq4 := \left(\frac{\partial^2}{\partial t^2}\theta(t)\right) + \frac{k\left(\frac{\partial}{\partial t}\theta(t)\right)}{m} + 9.8\,\frac{\sin(\theta(t))}{L} = 0$$

> g:=9.8;L:=1;m:=1;k:=1;

$$g := 9.8$$

$$L := 1$$

$$m := 1$$

$$k := 1$$

> sol4:=dsolve({eq4,init1},theta(t),numeric);

```
sol4 := proc(rkf45_x) ... end
```

> odeplot(sol4,[t,theta(t)],0..2*Pi,labels=[t,theta],axes=boxed,title=‘With air resistance‘);

>