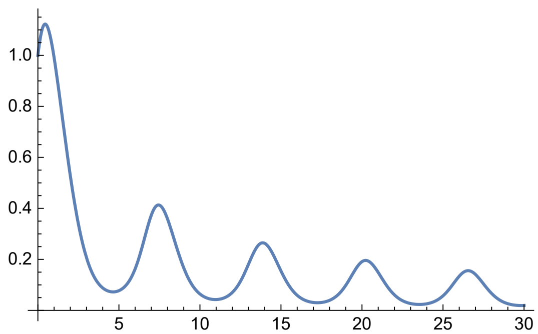
Example of how to use NDSolve

In[1]:=
```
s = NDSolve[{y'[x] == y[x] Cos[x + y[x]], y[0] == 1}, y, {x, 0, 30}]
```

Out[1]=
```
{{y → InterpolatingFunction[ Domain: {{0., 30.}} Output: scalar ]}}
```

Note initial condition y[0]=1. Now use the solution s in a plot:

In[2]:=
```
Plot[Evaluate[y[x] /. s], {x, 0, 30}, PlotRange → All]
```



Try with driven damped pendulum

Our equation: $\frac{d^2}{dt^2}\phi + 2\beta \frac{d}{dt}\phi + \omega_0{}^2 \sin \phi - \gamma\ \omega_0{}^2 \cos \omega t = 0$

Parameters and initial conditions:

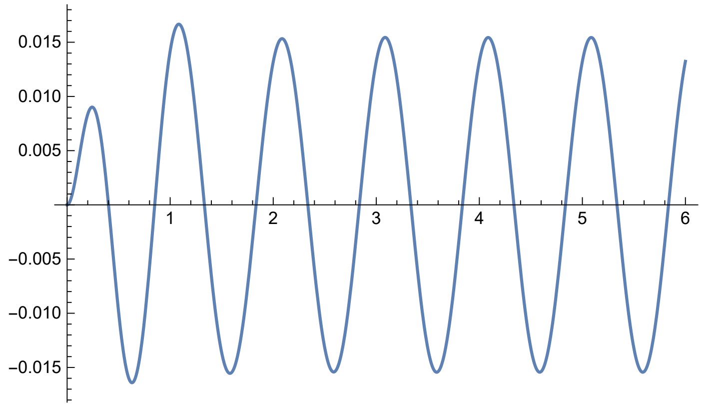
In[37]:=
```
ω = 2 Pi;  ω0  =  1.5 * ω;  β = ω0 / 4.; γ = 0.01;
```

In[38]:=
```
ddp1 = NDSolve[{ϕ''[t] + 2 β ϕ'[t] + ω0^2 Sin[ϕ[t]] - γ ω0^2 Cos[ω t] == 0,
    ϕ[0.] == 0., ϕ'[0.] == 0.}, ϕ, {t, 0, 6}]
```

Out[38]=
```
{{ϕ → InterpolatingFunction[ Domain: {{0., 6.}} Output: scalar ]}}
```

In[39]:=
```
Plot[Evaluate[ϕ[t] /. ddp1], {t, 0, 6}, PlotRange → All]
```

Out[39]=



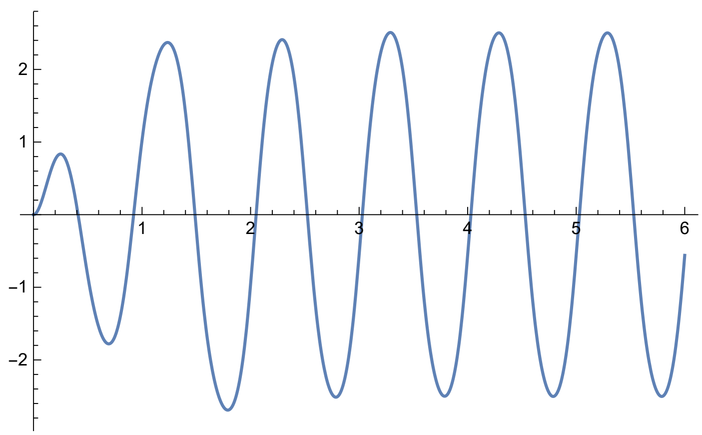
In[44]:=
```
ω = 2 Pi;  ω0  =  1.5 * ω;  β = ω0 / 4.; γ = .9;
```

In[45]:=
```
ddp1 = NDSolve[{ϕ''[t] + 2 β ϕ'[t] + ω0^2 Sin[ϕ[t]] - γ ω0^2 Cos[ω t] == 0,
   ϕ[0.] == 0., ϕ'[0.] == 0.}, ϕ, {t, 0, 6}]
```

Out[45]=
```
{{ϕ → InterpolatingFunction[ Domain: {{0., 6.}} Output: scalar ]}}
```

In[46]:=
```
Plot[Evaluate[ϕ[t] /. ddp1], {t, 0, 6}, PlotRange → All]
```

Out[46]=



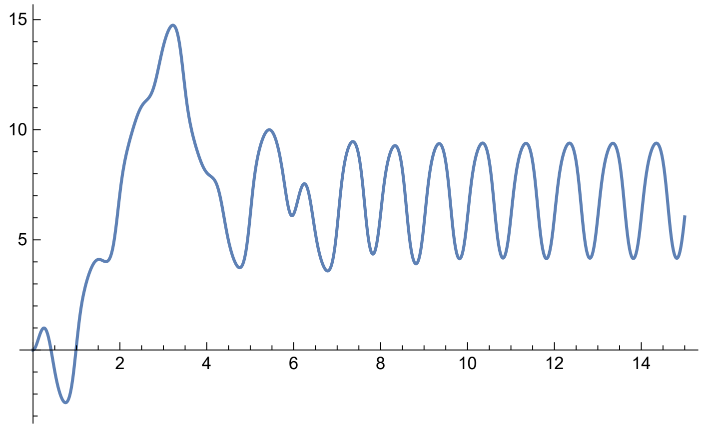
In[47]:=
```
ω = 2 Pi;  ω0  =  1.5 * ω;  β = ω0 / 4.; γ = 1.06;
```

In[50]:=
```
ddp1 = NDSolve[{ϕ''[t] + 2 β ϕ'[t] + ω0^2 Sin[ϕ[t]] - γ ω0^2 Cos[ω t] == 0,
   ϕ[0.] == 0., ϕ'[0.] == 0.}, ϕ, {t, 0, 15}]
```

Out[50]=
```
{{ϕ → InterpolatingFunction[ Domain: {{0., 15.}} Output: scalar ]}}
```

In[51]:=
```
Plot[Evaluate[ϕ[t] /. ddp1], {t, 0, 15}, PlotRange → All]
```

Out[51]=



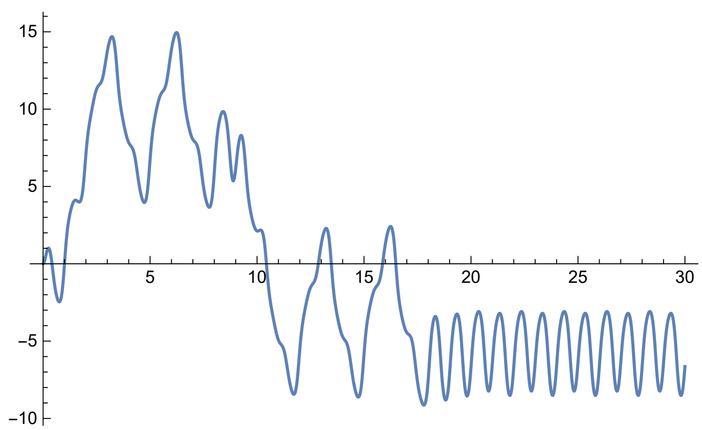
In[52]:=
```
ω = 2 Pi;  ω0  =  1.5 * ω;  β = ω0 / 4.; γ = 1.073;
```

In[53]:=
```
ddp1 = NDSolve[{ϕ''[t] + 2 β ϕ'[t] + ω0^2 Sin[ϕ[t]] - γ ω0^2 Cos[ω t] == 0,
    ϕ[0.] == 0., ϕ'[0.] == 0.}, ϕ, {t, 0, 30}]
```

Out[53]=
```
{{ϕ → InterpolatingFunction[ Domain: {{0., 30.}} Output: scalar ]}}
```

In[54]:=
```
Plot[Evaluate[ϕ[t] /. ddp1], {t, 0, 30}, PlotRange → All]
```

Out[54]=



In[55]:=

```
Plot[Evaluate[ϕ[t] /. ddp1], {t, 20, 30}, PlotRange → {-9., -7.5}]
```

Out[55]=