■ Damped Harmonic Motion

■ Define the equation of motion and the initial conditions and then combine them

(Local) In[1]:=
```
Clear["Global`*"];
```

(Local) In[2]:=
```
eq1 = m x''[t] ä -k x[t] - b x'[t];
```

(Local) In[3]:=
```
init = {x[0] ä x0, x'[0] ä 0};
```

(Local) In[4]:=
```
eq2 = Append[init, eq1];
```

■ Now solve for x[t]

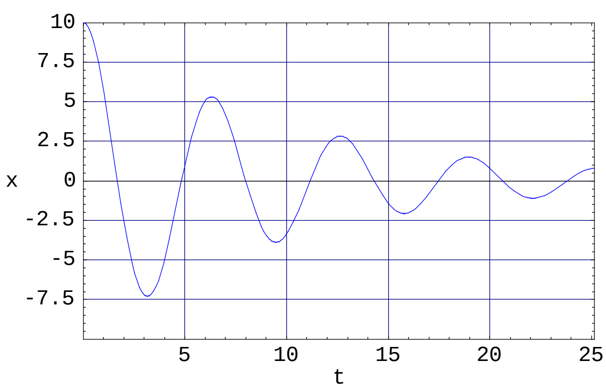
(Local) In[5]:=
```
dsol = DSolve[eq2, x[t], t];
```

■ Define the constants to some useful values (try changing these)

(Local) In[6]:=
```
val = {x0 Æ 10, m Æ 1, k Æ 1, b Æ 0.2};
```

■ Make up a graph of a x as a function of t

(Local) In[7]:=
```
curve = ParametricPlot[Evaluate[{t, x[t]} /. dsol /. val], {t, 0, 8 Pi},
   GridLines Æ Automatic, Frame Æ True, PlotStyle Æ {RGBColor[0, 0, 1]},
   PlotRange Æ {{0, 8 Pi}, {-10, 10}}, FrameLabel Æ {"t", "x"}, RotateLabel Æ False];
```



■ Plot the envelope as a function of t

(Local) In[8]:=

```
env1 = ParametricPlot[Evaluate[{t, x0 „^(-b t/2 m)} /. val], {t, 0, 8 Pi},
   GridLines Æ Automatic, Frame Æ True, PlotStyle Æ {RGBColor[1, 0, 0]},
   PlotRange Æ {{0, 8 Pi}, {-10, 10}}, FrameLabel Æ {"t", "x"}, RotateLabel Æ False];
```

(Local) In[9]:=

```
env2 = ParametricPlot[Evaluate[{t, -x0 „^(-b t/2 m)} /. val], {t, 0, 8 Pi},
   GridLines Æ Automatic, Frame Æ True, PlotStyle Æ {RGBColor[1, 0, 0]},
   PlotRange Æ {{0, 8 Pi}, {-10, 10}}, FrameLabel Æ {"t", "x"}, RotateLabel Æ False];
```

(Local) In[10]:=

```
Show[curve, env1, env2];
```