■ Hooke's Law --> Simple Harmonic Motion

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

(Local) In[440]:=

```
eq1 = m x''[t] ä -k x[t];
```

(Local) In[441]:=

```
init = {x[0] ä x0, x'[0] ä v0};
```

(Local) In[442]:=

```
eq2 = Append[init, eq1];
```

■ Now solve for x[t]

(Local) In[443]:=

```
dsol = DSolve[eq2, x[t], t] // Simplify
```

(Local) Out[443]=

$$\left\{\left\{x[t] \text{ Æ } x0\ \text{Cos}\left[\frac{\sqrt{k}\ t}{\sqrt{m}}\right] + \frac{\sqrt{m}\ v0\ \text{Sin}\left[\frac{\sqrt{k}\ t}{\sqrt{m}}\right]}{\sqrt{k}}\right\}\right\}$$

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

(Local) In[444]:=

```
val = {x0 Æ 10, v0 Æ 0,  m Æ 1, k Æ 1};
```

■ Define (t,x) coordinate pairs for the solution and constants

(Local) In[445]:=

```
coord[t_] = {t, x[t]} /. dsol /. val // Simplify
```

(Local) Out[445]=

```
{{t, 10 Cos[t]}}
```

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

(Local) In[446]:=

```
curve = ParametricPlot[Evaluate[coord[t] /. val], {t, 0, 4 Pi},
   GridLines Æ Automatic, Frame Æ True, PlotStyle Æ {RGBColor[0, 0, 1]},
   PlotRange Æ {{0, 4 Pi}, {-10, 10}}, FrameLabel Æ {"t", "x"}, RotateLabel Æ False];
```

■ Make a set of plots of coordinate pairs (t,x) for ten t values - animate by selecting them and Animate Selected Graphics

(Local) In[447]:=

```
Clear[plot1];
plot1[t_] := ListPlot[coord[t], PlotStyle → {PointSize[0.03], RGBColor[1, 0, 0]},
  GridLines → Automatic, Frame → True, PlotRange → {{0, 4 Pi}, {-10, 10}},
  FrameLabel → {"t", "x"}, RotateLabel → False]
```

■ Combine all the x vs t plots into a single plot

(Local) In[450]:=

```
Show[curve, plotarray];
```