Hooke's Law --> Simple Harmonic Motion

```
In[1]:= Clear["Global`*"];
        Off[General::spell1];
```

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

```
In[3]:= eq1 = m x''[t] == -k x[t];

In[4]:= init = {x[0] == x0, x'[0] == v0};

In[5]:= eq2 = Append[init, eq1];
```

▪ Now solve for x[t]

```
In[6]:= dsol = DSolve[eq2, x[t], t] // Simplify
```

Out[6]= $\left\{\left\{x[t] \to x0\, \mathrm{Cos}\left[\frac{\sqrt{k}\, t}{\sqrt{m}}\right] + \frac{\sqrt{m}\, v0\, \mathrm{Sin}\left[\frac{\sqrt{k}\, t}{\sqrt{m}}\right]}{\sqrt{k}}\right\}\right\}$

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

```
In[7]:= val = {x0 → 10, v0 → 0, m → 1, k → 1};
```

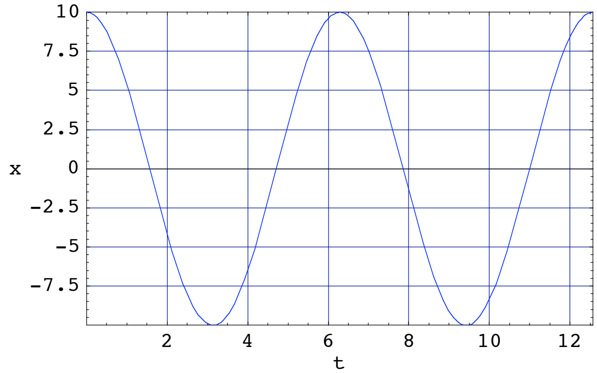
▪ Define (t,x) coordinate pairs for the solution and constants

```
In[8]:= coord[t_] = {t, x[t]} /. dsol /. val // Simplify

Out[8]= {{t, 10 Cos[t]}}
```

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

```
In[9]:=  curve = ParametricPlot[Evaluate[coord[t]], {t, 0, 4 Pi},
           GridLines → Automatic, Frame → True, PlotStyle → {RGBColor[0, 0, 1]},
           PlotRange → {{0, 4 Pi}, {-10, 10}}, FrameLabel → {"t", "x"}, RotateLabel → False];
```



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

```
In[10]:=  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]

In[12]:=  plotarray = Table[plot1[tp], {tp, 0, 4 Pi, Pi / 4}];
```

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

```
In[13]:=  Show[curve, plotarray];
```