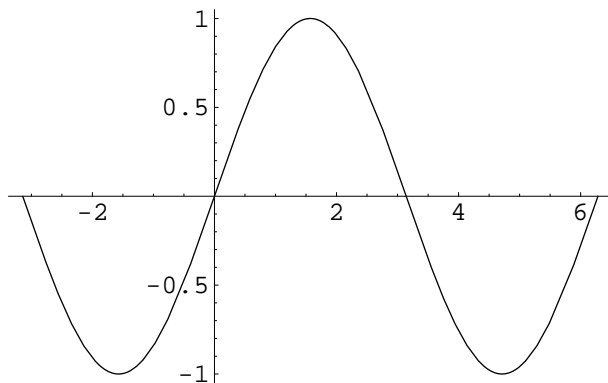


A Mathematica Sampler for Calculus III – Part 1

Commands and functions begin with a capital letter and have their inputs enclosed by square brackets. Curly braces enclose lists of various sorts. Use parentheses only to enclose mathematical expressions.

```
In[1]:= Plot[Sin[x], {x, -Pi, 2 Pi}]
```



```
Out[1]= - Graphics -
```

```
In[2]:= N[Pi, 25]
```

```
Out[2]= 3.141592653589793238462643
```

```
In[3]:= N[100!]
```

```
Out[3]= 9.33262 × 10157
```

```
In[4]:= D[x Exp[x], x]
```

```
Out[4]= ex + ex x
```

The next command computes the third derivative.

```
In[5]:= D[x^5, {x, 3}]
```

```
Out[5]= 60 x2
```

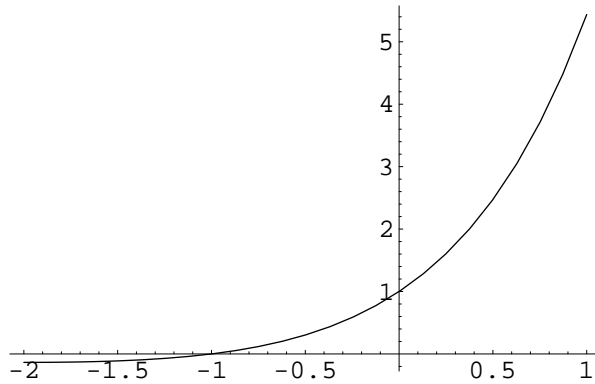
The “Table” command can be used to collect the results of several *Mathematica* commands. Note the role of the index “j” in the following: the table gives the j–th derivative of x⁵ for j = 0, 1, ..., 6, 7.

```
In[6]:= Table[D[x^5, {x, j}], {j, 0, 7}]
```

```
Out[6]= {x5, 5 x4, 20 x3, 60 x2, 120 x, 120, 0, 0}
```

Use "%" to refer to the output of a previous command. The next command plots the function that appears in Output 4, above. (This may not be Output 4 when you reproduce this sampler; you'll have to check your own file.)

```
In[7]:= Plot[%4, {x, -2, 1}]
```



```
Out[7]= - Graphics -
```

```
In[8]:= Integrate[x Sin[x], x]
```

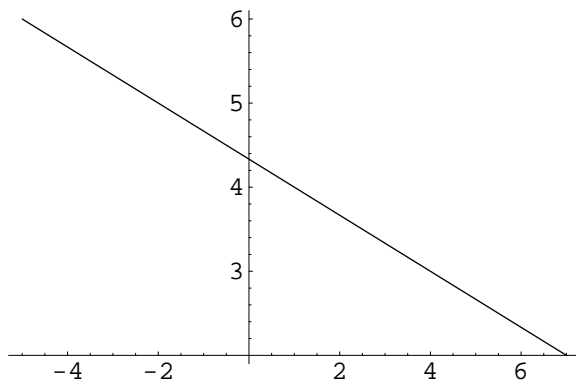
```
Out[8]= -x Cos[x] + Sin[x]
```

```
In[9]:= Integrate[x^3, {x, 0, 2}]
```

```
Out[9]= 4
```

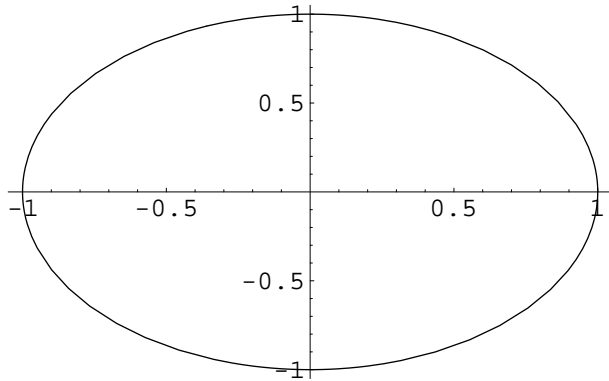
We can plot curves parametrically in the plane and in space. Notice that the pair of functions that make up the “vector function” appear in curly braces.

```
In[10]:= ParametricPlot[{3 s - 2, 5 - s}, {s, -1, 3}]
```



```
Out[10]= - Graphics -
```

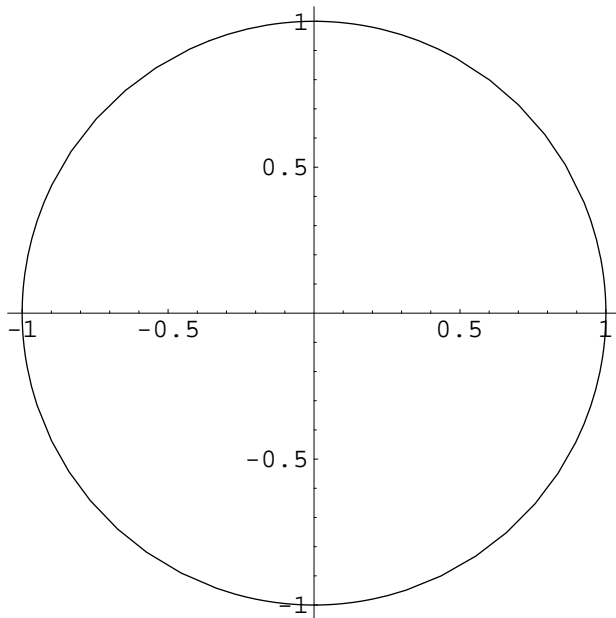
```
In[16]:= ParametricPlot[{Cos[t], Sin[t]}, {t, 0, 2Pi}]
```



```
Out[16]= - Graphics -
```

Wrong proportions! This should be round. Fix the proportions with "AspectRatio"

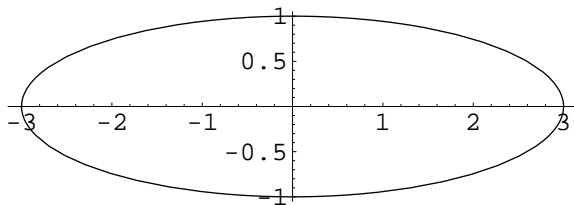
```
In[17]:= ParametricPlot[{Cos[t], Sin[t]}, {t, 0, 2Pi}, AspectRatio -> 1]
```



```
Out[17]= - Graphics -
```

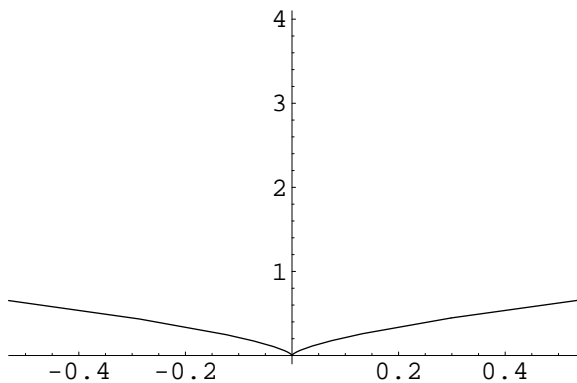
To get the right proportions for the following ellipse, you need a box that has the proportions "1 vertical unit by 3 horizontal units"

```
In[20]:= ParametricPlot[{3 Cos[t], Sin[t]}, {t, 0, 2 Pi}, AspectRatio -> 1 / 3]
```



```
Out[20]= - Graphics -
```

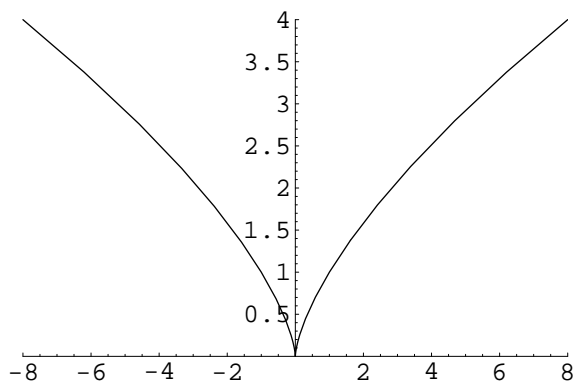
```
In[11]:= ParametricPlot[{t^3, t^2}, {t, -2, 2}]
```



```
Out[11]= - Graphics -
```

Mathematica chooses a range to plot by default—and it may not be a very good choice, as you can see in the last plot. (Too little of the horizontal axis is shown.) We can override the default, though.

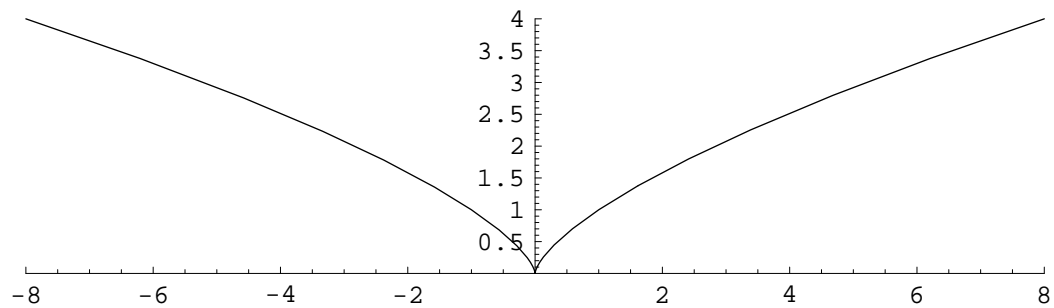
```
In[12]:= ParametricPlot[{t^3, t^2}, {t, -2, 2}, PlotRange -> {{-8, 8}, {0, 4}}]
```



```
Out[12]= - Graphics -
```

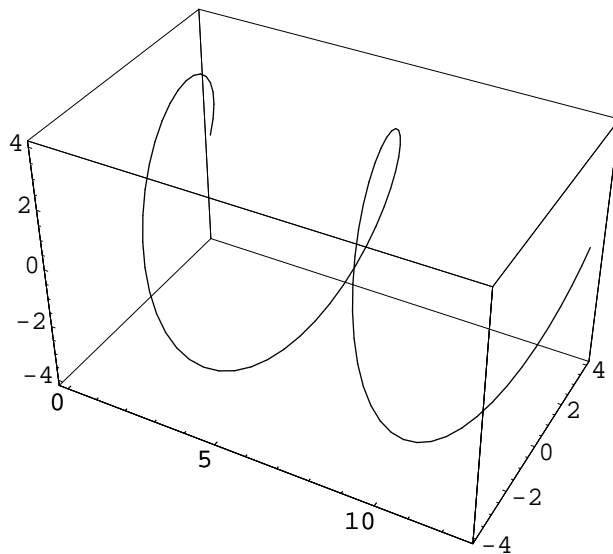
Another problem remains: a vertical unit is very different from a horizontal unit, so the shape of the curve is not shown with its true proportions, and directions and slopes do not appear with their proper values. We can control this, too. Since the picture should really be 4 units tall and 16 units wide, we want its “aspect ratio” to be 4/16 (or 1/4):

```
In[13]:= ParametricPlot[{t^3, t^2}, {t, -2, 2},  
  PlotRange -> {{-8, 8}, {0, 4}}, AspectRatio -> 1/4]
```



```
Out[13]= - Graphics -
```

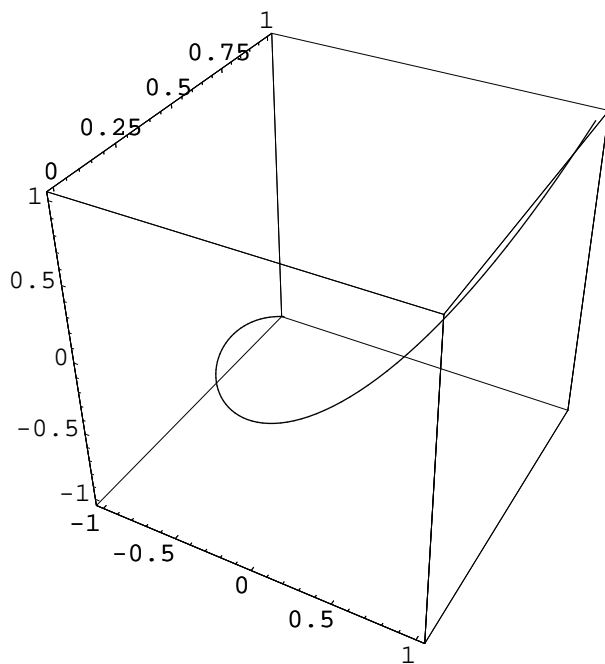
```
In[14]:= ParametricPlot3D[{u, 4 Cos[u], 4 Sin[u]}, {u, 0, 4 Pi}]
```



```
Out[14]= - Graphics3D -
```

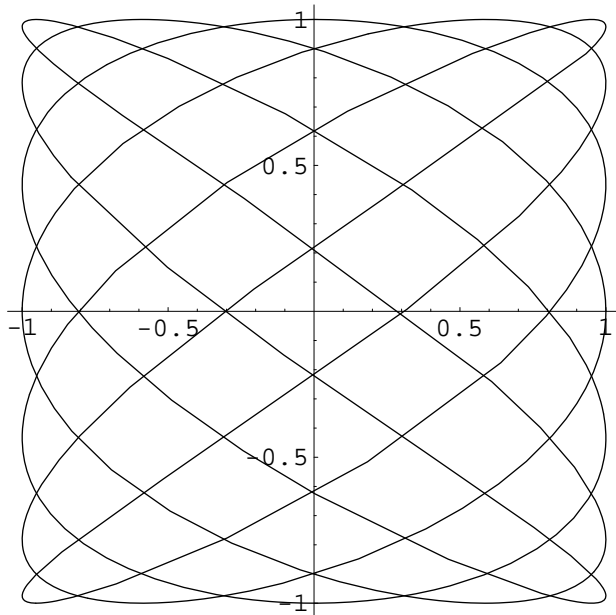
In three dimensions, proportions are correct by default. But you may still wish to alter them; the analogue of “aspect ratio” in three dimensions is “box ratios”. Try the following first without the “BoxRatios” ingredient.

```
In[15]:= ParametricPlot3D[{u, u^2, u^3}, {u, -1, 1}, BoxRatios -> {1, 1, 1}]
```



```
Out[15]= - Graphics3D -
```

```
In[23]:= ParametricPlot[{Cos[7 t], Sin[5 t]}, {t, 0, 2 Pi}, AspectRatio -> 1]
```



```
Out[23]= - Graphics -
```