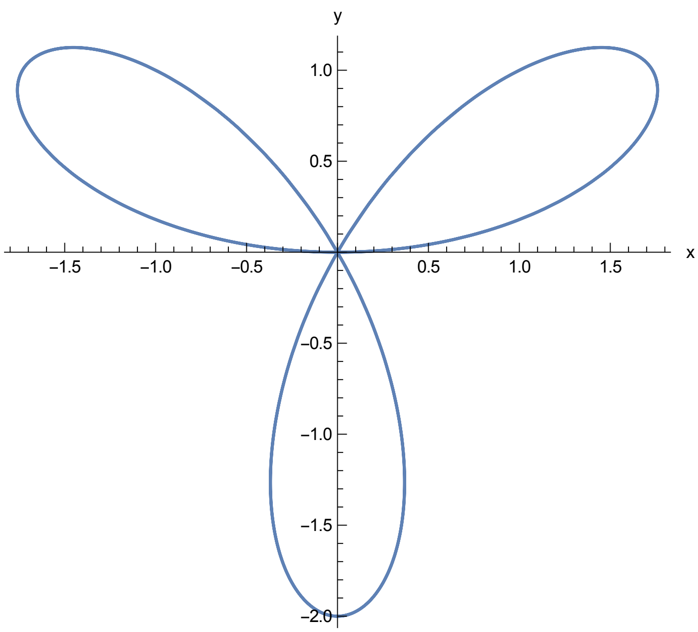
Mathematica Project 2 Help

Polar curves.

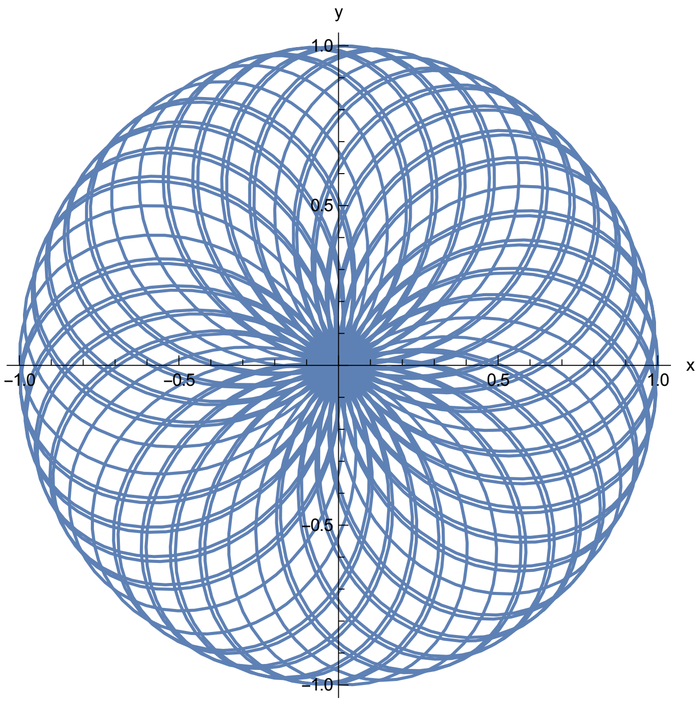
In *Mathematica*, to plot curves given by polar equations in the form r = f(θ) is done by using the function *PolarPlot.* Consider the polar rose curves, r = 2 cos (3θ)

PolarPlot[2 Sin[3 t], {t, 0, 2 Pi}, AxesLabel → {"x", "y"}]



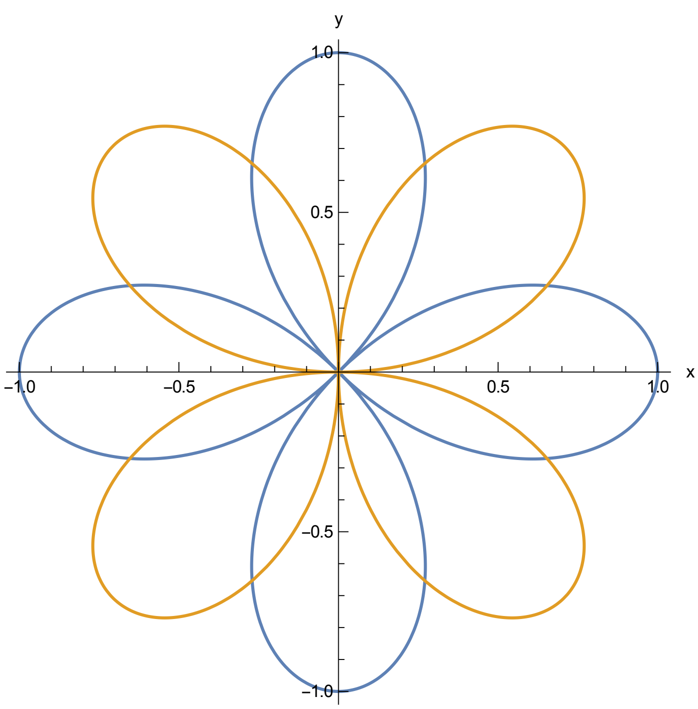
and then r = sin($\sqrt{2}\ \theta$) (note that the factor of θ is irrational; you can use larger multiple of Pi to create fancy roses):

PolarPlot[Sin[Sqrt[2] t], {t, 0, 50 Pi}, AxesLabel → {"x", "y"}]



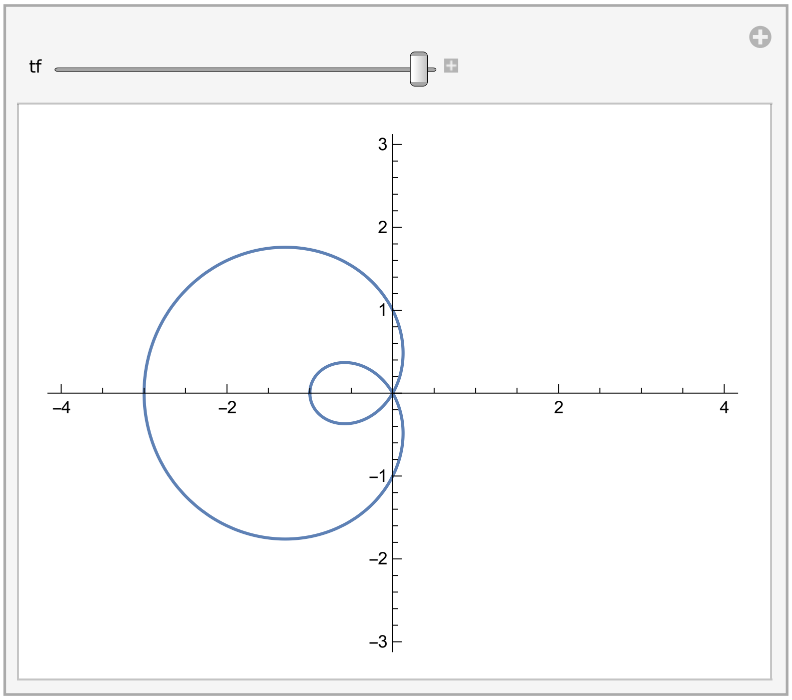
In the next example, two polar roses are plotted in one plane:

PolarPlot[{Cos[2 t], Sin[2 t]}, {t, 0, 2 Pi}, AxesLabel → {"x", "y"}]



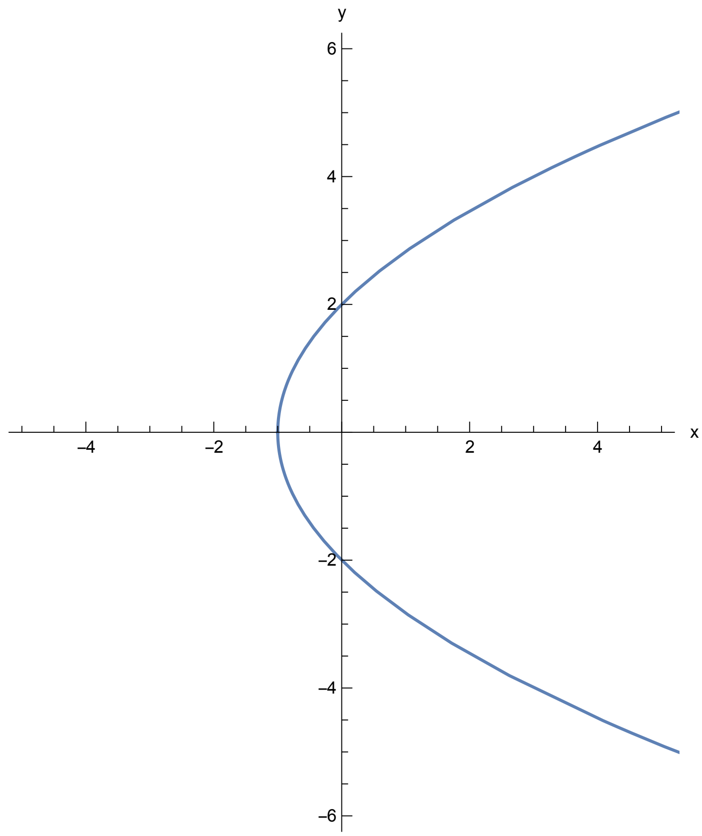
Now let us plot the limacon curve r = 1-2cosθ using a slider graph:

Manipulate[PolarPlot[1 – 2 Cos[t], {t, 0, tf}, PlotRange → {{–4, 4}, {–3, 3}}], {tf, .01, 2 Pi}]

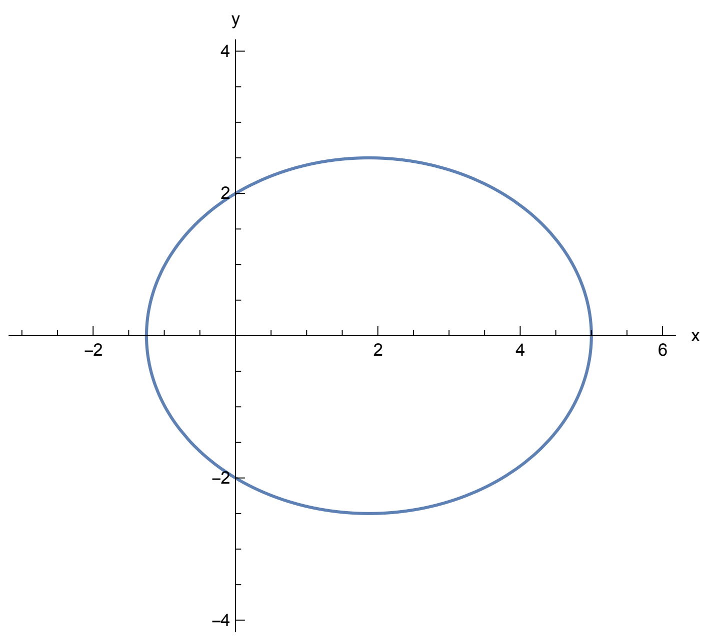


Let us now consider several polar plots for conic sections:

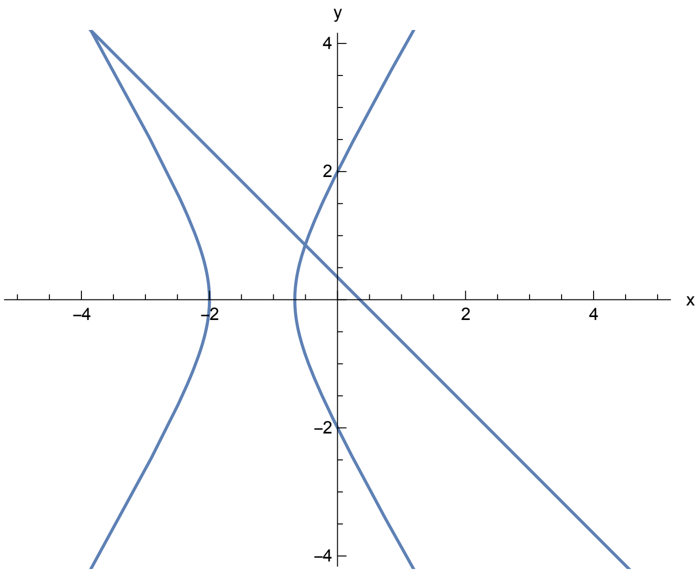
```
(*parabola*)  PolarPlot[-2/( 1 + Cos[t]), {t, 0, 2 Pi},
  PlotRange → {{-5, 5}, {-6, 6}}, AxesLabel → {"x", "y"}]
```




```
(*ellipse*)   PolarPlot[-2/(1 + 0.6 Cos[t]),
  {t, 0,  2 Pi}, PlotRange → {{-3, 6}, {-4, 4}}, AxesLabel → {"x", "y"}]
```

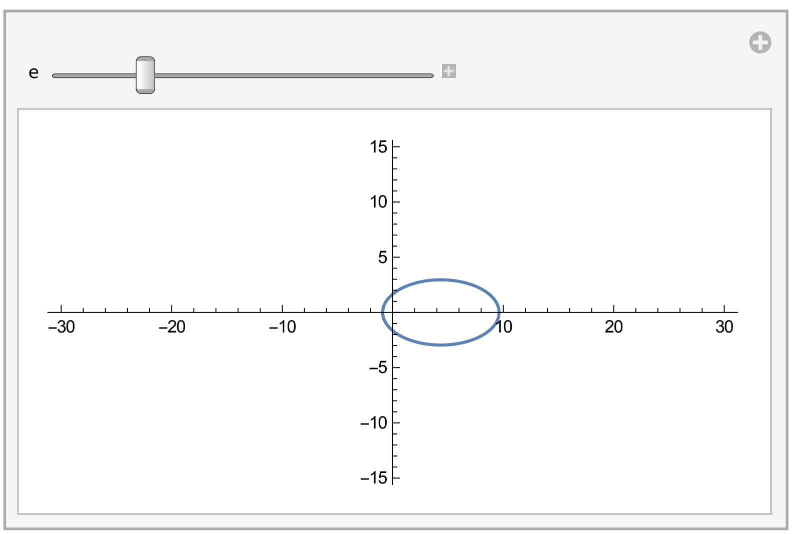


(*hyperbola*) PolarPlot[−2 / (1 + 2 Cos[t]), {t, 0, 2 Pi},
PlotRange → {{−5, 5}, {−4, 4}}, AxesLabel → {"x", "y"}]

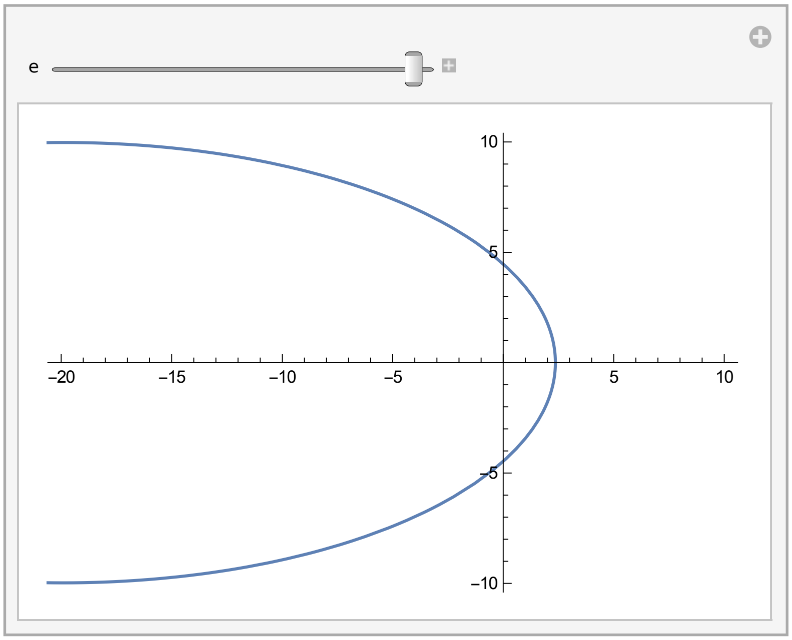


Slider graphs can be used to show how conis change as the eccentricity varies :

Manipulate[PolarPlot[−2 * e / (1 + e * Cos[t]), {t, 0, 2 Pi}, PlotRange → {{−30, 30}, {−15, 15}}], {e, 0.5, 2}]



```
Manipulate[PolarPlot[5*e/(1 + e*Cos[t]), {t, 0, 2 Pi}, PlotRange → {{−20, 10}, {−10, 10}}], {e, 0, 0.9}]
```



Finally, let us show several 3D objects:

Graphing in 3D Space.

In Chapter 11 we will be studying objects in the xyz-space. We can get some intuition about graphs by plotting them in *Mathematica* using *ContourPlot3D*. Note that the resulting plots can be rotated (try it).

Consider equation x=2 in the xyz-space. What do you think it is? Run the following command in *Mathematica:*

```
ContourPlot3D[x == 2, {x, −5, 5}, {y, −5, 5}, {z, −5, 5}, AxesLabel → Automatic]
```

Next, consider the equation $x^2 + y^2 + z^2 = 1$ and two equations $x^2 + y^2 = 1$ and $z = 2$. Run the following commands to see the corresponding 3D objects:

```
ContourPlot3D[x^2 + y^2 + z^2 == 16, {x, −5, 5}, {y, −5, 5}, {z, −5, 5}, AxesLabel → Automatic]
```

```
ContourPlot3D[{x^2 + y^2 == 9, z == 2}, {x, −5, 5}, {y, −5, 5}, {z, −5, 5}, AxesLabel → Automatic]
```