```
>
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MAPLE WORKSHEET for GRAPHS OF POLAR EQUATIONS (Section 12.7)

Math 142 -- Spring 1994

Prepared by Douglas B. Meade (24 April 1994)

This worksheet illustrates the graphs of ‘simple’ polar equations. These curves can be classified into four major categories: lines, cicles, cardioids and limacons, and roses.

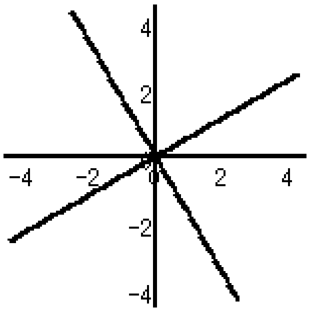
```
> with(plots):
> setoptions(scaling=constrained):
```

LINES

Lines through the ORIGIN are given by theta=constant. Lines which do not include the origin are much more difficult to represent.

Here are the lines with angles Pi/6 and 2*Pi/3...

```
> polarplot( {[r,Pi/6, r=-5..5], [r,2*Pi/3,r=-5..5]} );
```



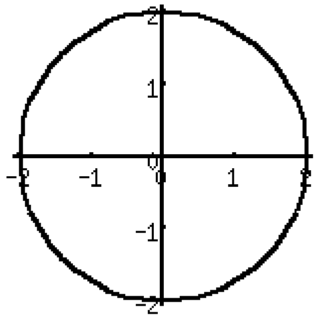
CIRCLES

There are several different forms for circles, depending on where the center is located.

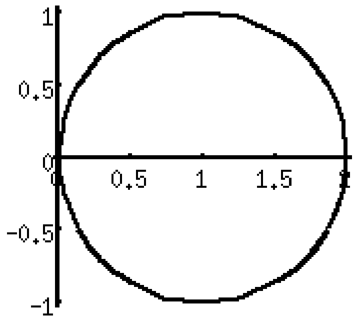
r=a Center: (0,0); Radius: a
r=2*a*cos(theta) Center: (a,0); Radius: a
r=2*a*sin(theta) Center: (0,a); Radius: a

Here are the graphs of one of each type

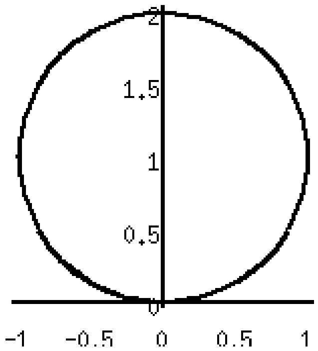
> polarplot(2);



> polarplot(2*cos(theta));



> polarplot(2*sin(theta));



CARDIOIDS and LIMACONS

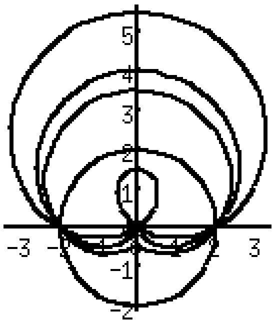
These names are very descriptive (particularly if you know a little French).

Cardioids sounds as though they should have something to do with the hear; they do!
Limacon is French for snail. This seems like a strange description, let's see how this name fits.

General form: r = a + b*cos(theta) and r = a + b*sin(theta)

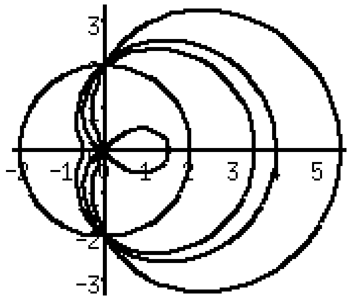
The relative sizes of a and b determine the type of the graph.

```
> C1 := [seq( polarplot( 2+'i'/2*sin(theta) ), 'i'=0..8 )]:
> display( C1, insequence=true );
> #C2 := [seq( polarplot( 2+'i'*sin(theta) ), 'i'={0,3/2,2,7/2} )]:
> #display( C2);
```



Next, we examine the difference between the two forms (i.e. replace sin with cos)

```
> C3 := [seq( polarplot( 2+'i'*cos(theta) ), 'i'=0..4 )]:
> display( C3, insequence=true );
> #C4 := [seq( polarplot( 2+'i'*cos(theta) ), 'i'={0,3/2,2,7/2} )]:
> #display( C4 );
```



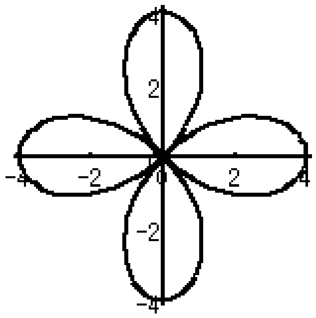
In general:
|a| >= |b| cardioid
|a| < |b| limacon

ROSES

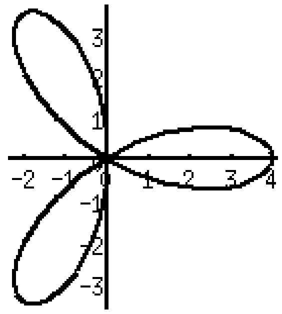
General form: r = a*cos(n*theta) and r = a*sin(theta)

The integer n determines the number of leaves on the rose. Let's look for a pattern.

```
> R1 := [seq( polarplot( 4*cos('n'*theta) ), 'n'=1..8 )]:
> display( R1, insequence=true );
> #polarplot( 4*cos(2*theta) );
```

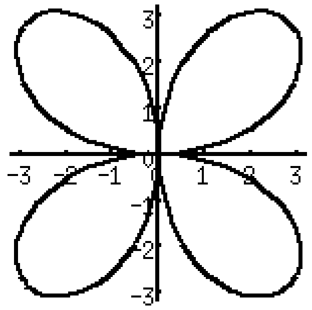


```
> #polarplot( 4*cos(3*theta) );
```



Finally, let's see what happens when cos is replaced with sin

```
> R2 := [seq( polarplot( 4*sin('n'*theta) ), 'n'=1..8 )]:
> display( R2, insequence=true );
> #polarplot( 4*sin(2*theta) );
```



```
> #polarplot( 4*sin(3*theta) );
```