Maple Project I

Polar Plots

To plot in maple the \textbf{parametric equations}

\[ x=f(t), \; y=g(t), \text{ with } t \in [a,b] \]

We type the command:

\[
\text{plot([f(t), g(t), t=a..b]);}\]

For example, to plot a circle of radius 3 centered at the origin, we type

\[
> \text{plot([3*cos(t), 3*sin(t), t=0..2*Pi], scaling=constrained);}\]

To plot the polar equation

\[ r=r(t), \; t \in [\alpha, \beta] \]

where \( \alpha \) and \( \beta \) are certain angles, we need to convert the given equation from \textbf{polar coordinates} to \textbf{rectangular coordinates} using the equations:

\[ x = r \cos(t), \; y = r \sin(t) \]
Example:
Plot the polar equation

\[ r = \cos(3t), \text{ where } t \in [0, 2\pi] \]

In maple format:

```maple
> r:=cos(3*t): plot([r*cos(t), r*sin(t), t=0..2*Pi], scaling=constrained);
> r:=t: plot([r*cos(t), r*sin(t), t=0..2*Pi], scaling=constrained);
```
\texttt{s:=1: r:=1+sin(t): plot([s*cos(t), s*sin(t), t=0..2*Pi], [r*cos(t), r*sin(t), t=0..2*Pi]}, scaling=constrained);}
\[ s := 1/2; \quad r := 1 - \sin(t); \quad \text{plot}\left(\left[\left[s \cos(t), s \sin(t), t = 0..2\pi\right], \left[r \cos(t), r \sin(t), t = 0..2\pi\right]\right], \text{scaling=constrained}\right); \]

\[ s := 2 \cos(t); \quad r := 1 + \cos(t); \quad \text{plot}\left(\left[\left[s \cos(t), s \sin(t), t = 0..2\pi\right], \left[r \cos(t), r \sin(t), t = 0..2\pi\right]\right], \text{scaling=constrained}\right); \]
> r:=1+sin(t): s:=1: plot([r*cos(t), r*sin(t), t=0..2*Pi], [s*cos(t), s*sin(t), t=0..2*Pi], scaling=constrained);

Homework:
1). Using constrained scaling, plot the ellipse

\[ x = 3 \cos (t) \] and \[ y = \sin(t) \]

2). Curves of the form:
- equation1: \( r= a \sin(n \cdot t) \)
- equation2: \( r= a \cos(n \cdot t) \)

are called Roses. For \( a=2 \) and \( n=3 \) draw the graphs of equations 1 and 2, compare them and report your observations. Repeat this step for \( a=2 \) and \( n=4 \). 3). Curves of the form:
equation 1: \( r = a + b \sin (t) \)
equation 2: \( r = a + b \cos (t) \)

are called "limacons". Repeat the steps in problem(2) for this problem with 
"a=2 and b=3", "a=2 and b=-3" and 
"a=2 and b=1".

4). Graph each of the following equations.
   a). \( r = \sin (2t) \)
   b). \( r = 2 \cos (t) + 1 \)
   c). \( r^2 = \cos (2t) \)

5). Find the intersection points of the parabolas

\[
\frac{r}{1 - \cos (t)} \text{ and } \frac{3}{1 + \cos (t)}
\]

Hint: To get a better display of the graphs restrict your plot to the window \([-5, 5] \times [-5, 5]\)