Notes For Lab 5: Ants on a Doughnut

Think of this last lab as your final exam. Show me what you've learned! In particular, keep in mind the following things that I'll be looking for:

1. General: Spelling, spacing, basic grammar (standard rules).
2. Make your discussion take a logical path. Take the reader on an adventure, point out the sights and dangers!
   - Does the paper set up the problem?
   - Does the paper take the reader through the construction of the appropriate equations? Take the reader from the torus to the α, β plane ($\alpha =$`\alpha`, and $\beta =$`\beta`)
   - Does the paper investigate several paths with enough detail so that the reader can duplicate the results?
   - Is there a conclusion with perhaps some future directions one might take?
3. Use of graphs and equations:
   - Label appropriate equations (only label those you want to refer to, then refer to them properly).
   - Include equations that you'll use to compute arc length and let Maple do the work. You do not need to refer to Maple.
   - Refer to figures- don't say things like "See the figure below", say "See Figure 1, where we plot ..."
   - Give figure captions enough of a description so that the reader knows why it is there and what to look at.

The first version will be due on **Monday, December 9**, and it will be returned during our last lab session. Final copy will be due on Wednesday of Finals week- But, do your best for the first draft!

Some Maple Notes

Here are some additional comments about Maple that you might find useful.

- Maple may not be able to find an antiderivative for your function. To force Maple to use a numerical approximation, use the `Int` command instead of `int` That is:

  ```
  evalf(Int(f,x=a..b))
  ```

  will give a numerical approximation to the integral of the expression f, for $x = a$ to $x = b$.

- Graph options: Here's an example of graphing the torus with a dark path. In this example, I'm going half way around the "big circle", and winding a couple of times around the "little circle" (see this in the line that starts with `F:=subs({...`)

```
> with(plots):
> f:=cos(alpha)*(cos(beta)+2):
> g:=sin(alpha)*(cos(beta)+2):
> h:=sin(beta):

> A:=plot3d([f,g,h],alpha=0..2*Pi,beta=0..2*Pi,
scaling=constrained,style=patchnogrid,shading=ZHUE):

> F:=subs({alpha=t/2, beta=3*t},[f,g,h]);

  F := [cos(t/2) (cos(3 t) + 2), sin(t/2) (cos(3 t) + 2), sin(3 t)]

> B:=spacecurve(F,t=0..2*Pi,color=black,thickness=3):
> display3d({A,B});
```

Finally, a note about mathematical notation for a torus: Because a torus can be defined by two circles, we sometimes denote one circle by S_1, a second circle by S_2, so that the full torus is $T = S_1 \times S_2$. You can use this notation if you like, rather than using the words "small circle-big circle".