Project 6.3a: Surfaces of Revolution

Objective

To illustrate how Maple can be used to draw some surfaces of revolution.

Narrative

If you have not already done so, read Sections 6.2 and 6.3 of the text.

In this project we illustrate how Maple can be used to draw some surfaces of revolution. While you may or may not understand how and why the commands you type produce the graphics they produce, the objective of this project is to provide you with some tools that will allow you to better visualize the surfaces of revolution discussed in the examples and exercises in the text: by making some relatively simple changes in the code below, you can draw a number of interesting surfaces. (See Comments.)

Task

a) Type the command lines in the left-hand column below into Maple in the order in which they are listed. The effect of each command is described in the right-hand column. These commands produce graphics of surfaces of revolution.

```
> # Your name, today's date
> # Project 6.3a:  Surfaces of Revolution
> restart;                                    Clear Maple's memory.
> f := x -> sqrt(x);                          Let f(x) = √x.
> plot(f(x),x=0..1);                          Plot the graph of f over the interval [0,1].
> with(plots):                               Using the plots package, ...
> setoptions3d(axes=normal,orientation=[-140,80]):   and the "appropriate" options ...
> plot3d([x,f(x)*cos(t),f(x)*sin(t)],        rotate the graph of f about the x-axis, and
    x=0..1,t=0..2*Pi,color=x);
> plot3d([x*cos(t),x*sin(t),f(x)],           rotate the graph of f about the y-axis.
    x=0..1,t=0..2*Pi,color=x);
> k := -0.5;                                  Let k = −1/2.
> plot3d([x,(f(x)-k)*cos(t)+k,(f(x)-k)*sin(t)],   Rotate the graph of f about the line y = k.
    x=0..1,t=0..2*Pi,color=x);
> plot3d([(x-k)*cos(t)+k,(x-k)*sin(t),f(x)],  Rotate the graph of f about the line x = k.
    x=0..1,t=0..2*Pi,color=x);
```

The effect of each command is described in the right-hand column, rendered in running text:

Clear Maple's memory.
Let $f(x) = \sqrt{x}$.
Plot the graph of f over the interval $[0, 1]$.
Using the `plots` package, ...
and the "appropriate" options ...
rotate the graph of f about the x-axis, and
rotate the graph of f about the y-axis.
Let $k = -1/2$.
Rotate the graph of f about the line $y = k$.
Rotate the graph of f about the line $x = k$.

At this point, make a hard-copy of your typed input and Maple's responses. Then ...

b) to the right of the image of each surface of revolution you created in part (a), draw the image — including the coordinate axes, the axis of revolution, and the surface of revolution — by hand, illustrating the main features of the surface. (Since Maple will not always be available when you need a sketch of a surface of revolution, it is important to learn how to visualize and sketch a surface of revolution by hand.)

Comments

1. Upon clicking on a graphic generated by Maple, a (new) menu bar appears which allows you to change the appearance of the graphic. In particular, you can change the angles $\theta = -140°$ and $\phi = 80°$ from which each surface is viewed. These angles can be changed by: a) using the scroll arrows in the menu, b) retyping the values in the value boxes in the menu, and c) manually rotating the graphic

itself. (We discuss 3-dimensional graphics in considerably more depth in MATH 261. By the time that course is over, you will not only have gained considerable experience adjusting the parameters in the 3-dimensional graphics menu bar, but you will also understand the commands we used in this project.)

2. By altering the function f in line 3 and the constant k in line 9 of the above code, you can produce graphics of the surfaces of revolution referred to in the exercises in the text. If you *do* use this code to assist you doing the exercises in the text, you might also find it useful to omit those of lines 7, 8, 10, and 11 which do not contribute to exactly what you need.

3. What do you think would happen if you replaced $f(x) = \sqrt{x}$ by $f(x) = x^2$ in the above code? Try it, and see if you're right!

4. How would you have to modify the above code to get the correct graphics if, instead of revolving the curve whose equation is $y = f(x)$ about various axes, you were to revolve the curve whose equation is $x = g(y)$ around the same set of axes?