Surfaces of Revolution

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Objective

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

Narrative

In this project we illustrate how Mathematica 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 the Comments.)

Task

1. Type the command lines in the left-hand column below into Mathematica in the order in which they are listed. These commands produce graphics of surfaces of revolution. (The angle *phi* is used to adjust the viewpoint.)

```
In[1]:= (* Your name, today's date *)
In[2]:= (* Surfaces of Revolution *)
In[3]:= f[x_] := Sqrt[x]
```

Let $f(x) = \sqrt{x}$.

```
In[4]:= Plot[f[x], {x,0,1}]
```

Graph f over the interval $[0, 1]$.

```
In[5]:= phi = -Pi/3
```

Let $phi = -\pi/3$.

```
In[6]:= ParametricPlot3D[{t, f[t]*Cos[theta], f[t]*Sin[theta]}, {t,0,1}, {theta,0,2Pi},
          ViewPoint->{2Cos[phi],2Sin[phi],0}]
```

Rotate the graph of f about the x-axis, ...

```
In[7]:= ParametricPlot3D[{t*Cos[theta], t*Sin[theta], f[t]}, {t,0,1}, {theta,0,2Pi},
          ViewPoint->{2Cos[phi],2Sin[phi],0}]
```

and about the y-axis.

```
In[8]:= k = -0.5
```

Assuming $k = -0.5$, ...

```
In[9]:= ParametricPlot3D[{t, (f[t]-k)*Cos[theta], (f[t]-k)*Sin[theta]}, {t,0,1}, {theta,0,2Pi},
          ViewPoint->{2Cos[phi],2Sin[phi],0}]
```

rotate the graph about the line $y = k$, ...

```
In[10]:= ParametricPlot3D[{(t-k)*Cos[theta], (t-k)*Sin[theta], f[t]}, {t,0,1}, {theta,0,2Pi},
          ViewPoint->{2Cos[phi],2Sin[phi],0}]
```

and about the line $x = k$.

At this time, make a hard-copy of your typed input and Mathematica's responses. Then:

2. To the right of the image of each surface of revolution you created in Task 1, 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 Mathematica 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.)

Your lab report will be a hard-copy of your typed input and Mathematica's responses (both text and hand-drawn graphics).

Comments

1. By altering the function f in line 6 and the constant k in line 10 you can produce graphics of the surfaces of revolution referred to in the exercises in your text. If you do this, you might also find it useful to omit those lines which do not contribute to exactly what you need.

2. 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!

3. 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? Try it, and see if you're right!