LaTeX Graphics with PSTricks

This presentation is also available online. Please visit my home page and follow the links.

http://www.math.msu.edu/∼hensh/latex/pstricks/seminar/

1. Resources

   (a) ImageMagick is a collection of (free) image manipulation tools. You can find out more by visiting

      http://www.imagemagick.com

   (b) The LaTeX Graphics Companion.
      - Paperback: 608 pages
      - Publisher: Addison-Wesley Pub Co; 1st edition (April 15, 1997)
      - ISBN: 0201854694

   (c) The LaTeX Graphics Companion (2nd Edition).
      - Paperback: 1024 pages
      - Publisher: Addison-Wesley Pub Co; 1st edition (June, 2007)
      - ISBN: 0321508920

   (d) The PSTricks web site.

      http://www.pstricks.de

   (e) PostScript(R) Language Tutorial and Cookbook (also called the "The Blue Book")
      - Paperback: 256 pages
      - Publisher: Addison-Wesley Professional (January 1, 1985)
      - ISBN: 0201101793

2. PSTricks

   (a) We start with some examples.
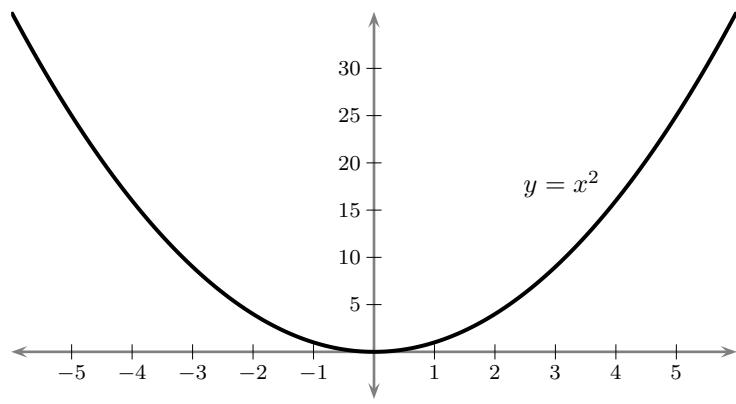
Figure 1: Graphing simple functions.
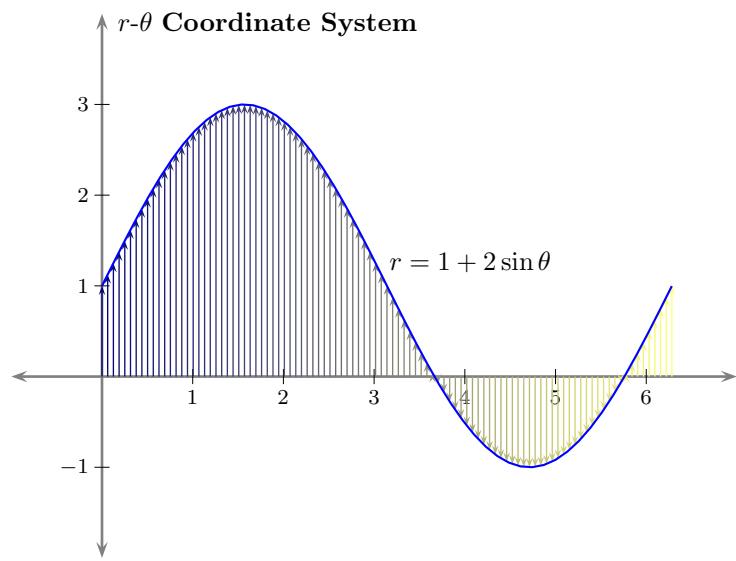

Figure 2: Graphing with some fancy effects.
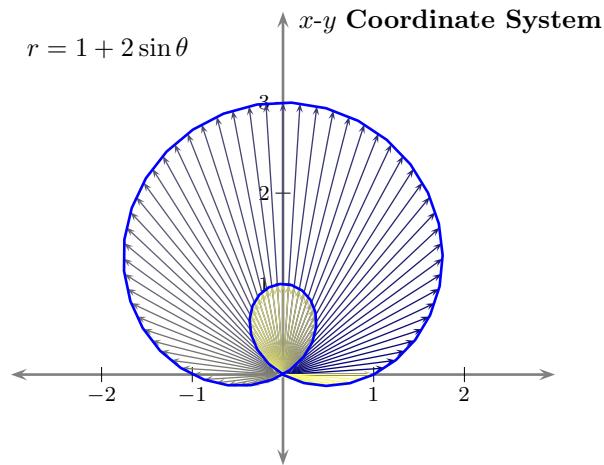
Figure 3: Polar Graphs
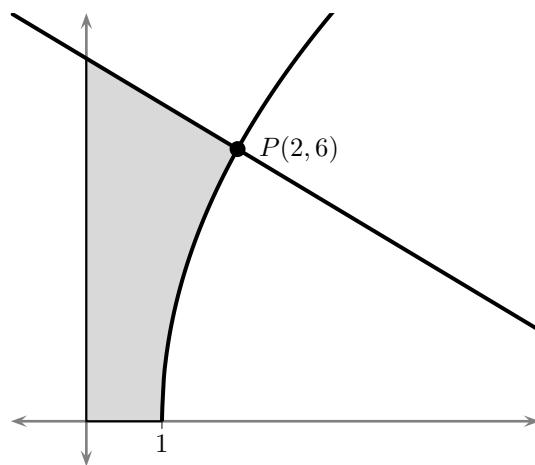

Figure 4: Area between two curves.
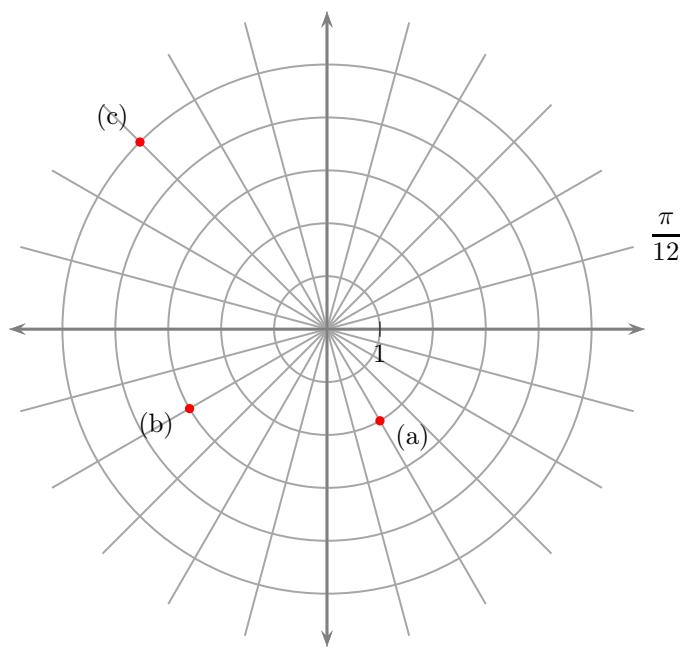
Figure 5: Polar Grid
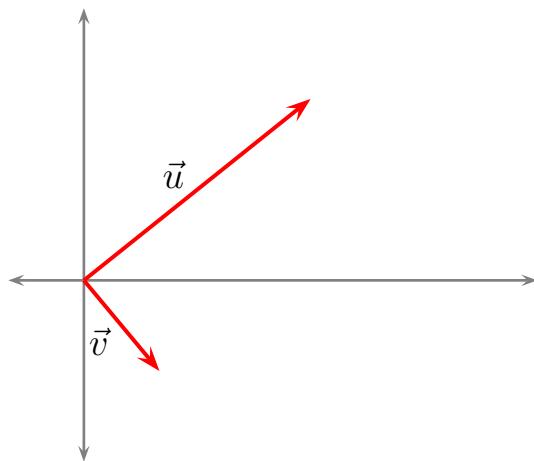

Figure 6: A pair of vectors
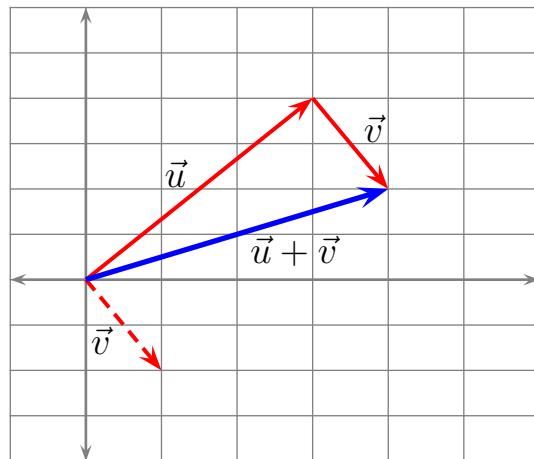
Figure 7: Vector addition with a grid.
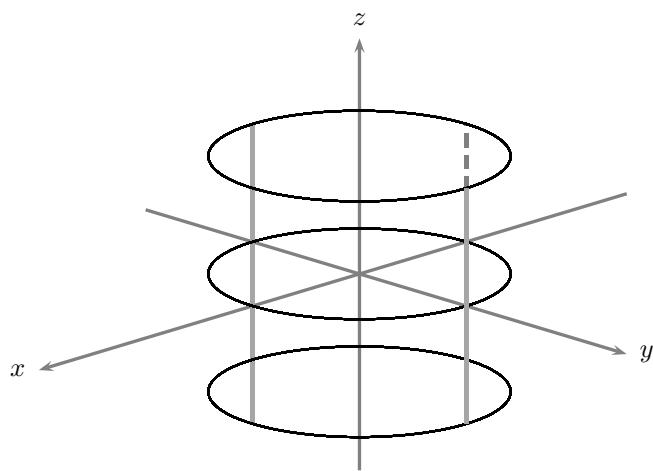
Figure 8: Sketching a cylinder.
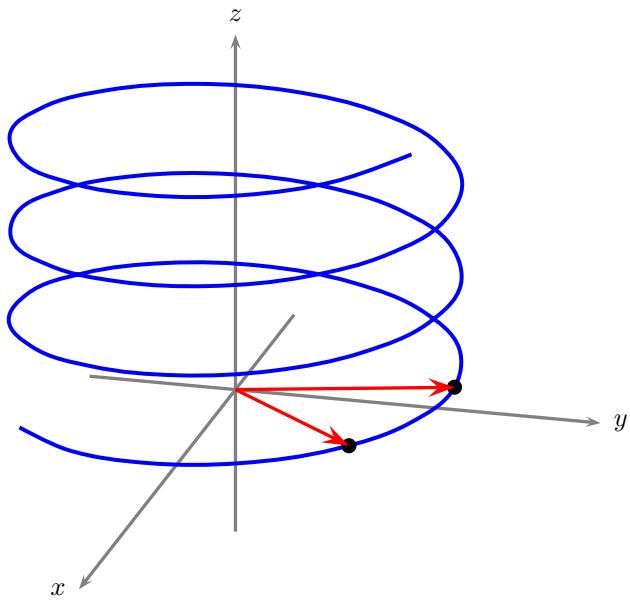
Figure 9: Position Vectors
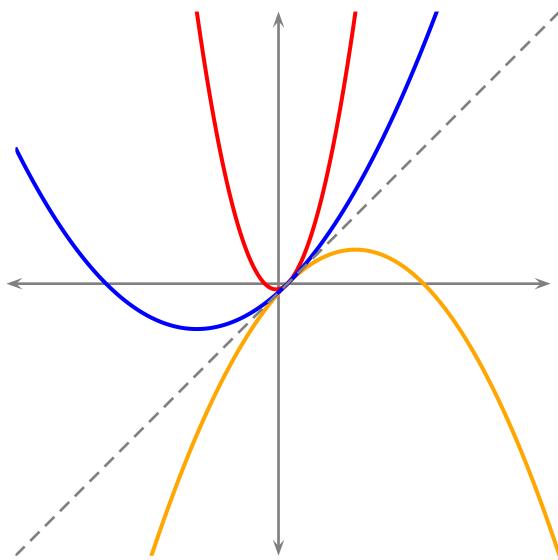
Figure 10: Level Curves
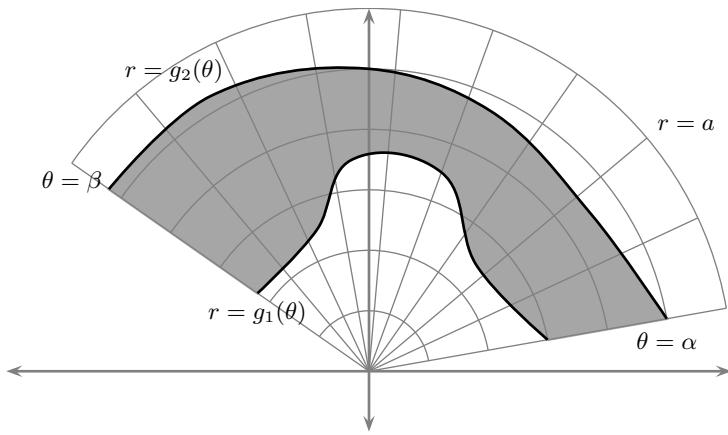
Figure 11: Polar Area
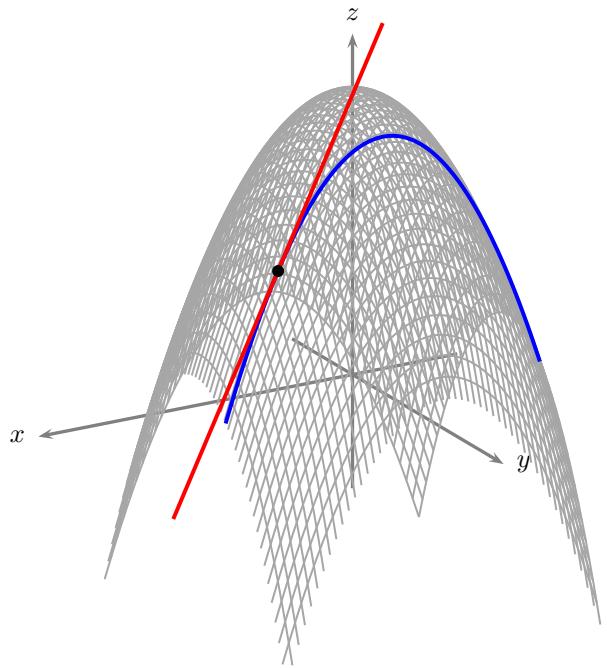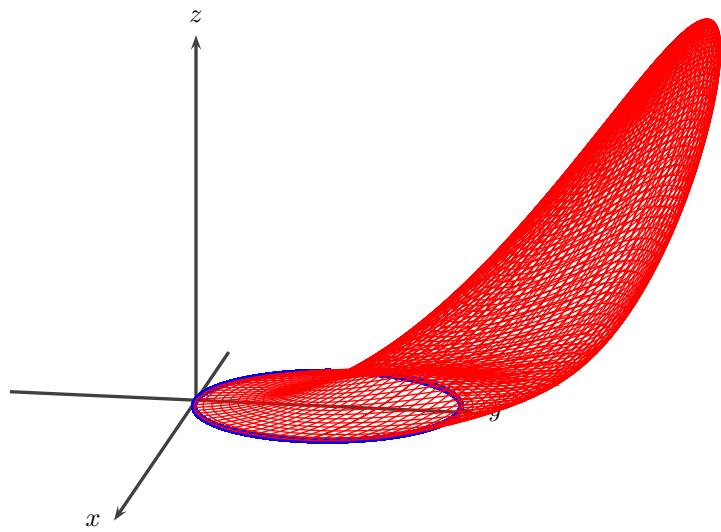
Figure 12: A Tangent Line
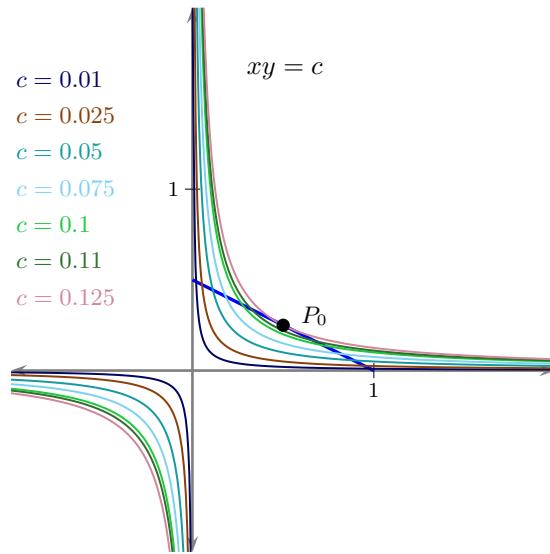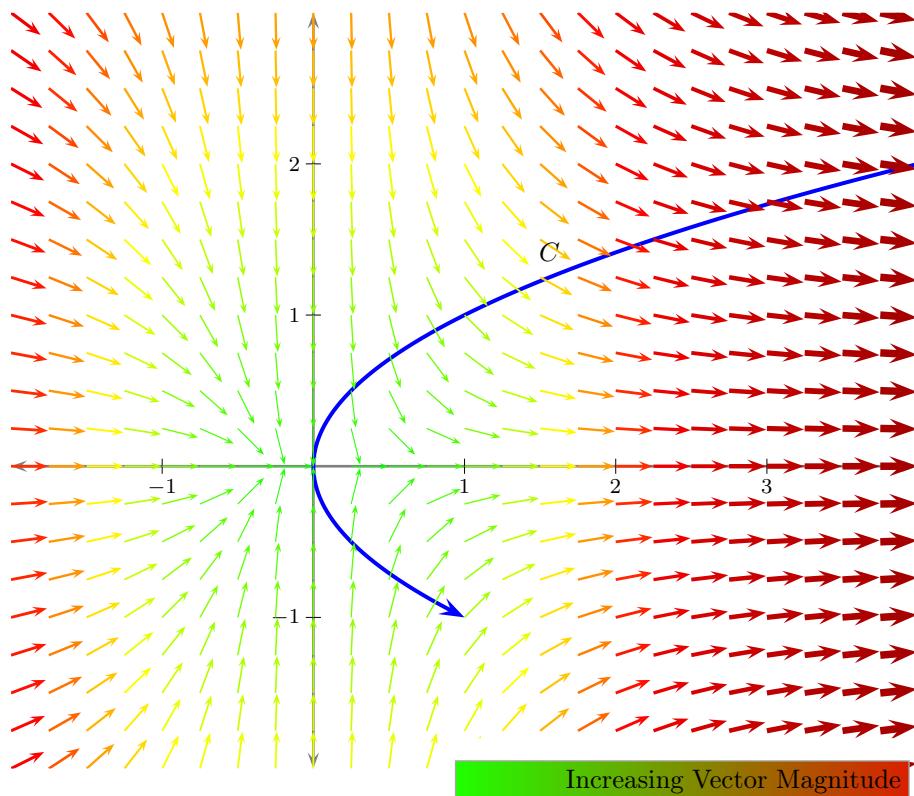
Figure 13: Lagrange Multipliers
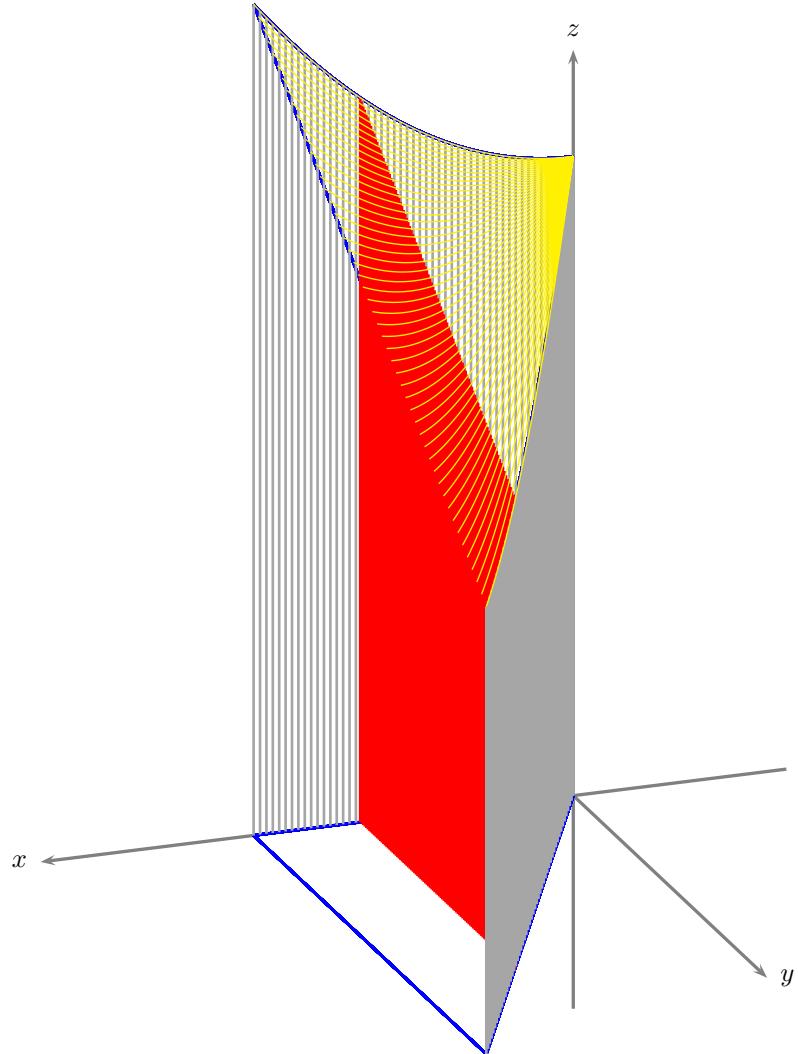
Figure 14: Exposed Solid
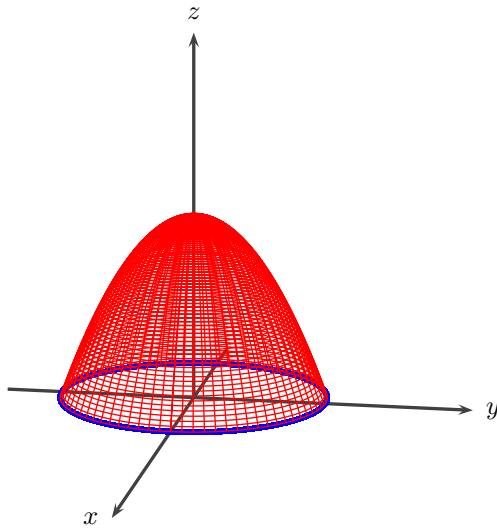
Figure 15: Surface Integrals

(b) Preliminaries

To use this package you must include the following line in the preamble of your document.
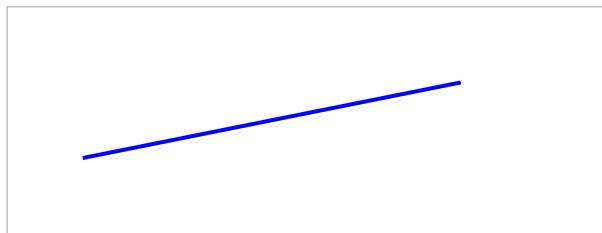
```
1    \usepackage{pst-eucl}
2    \usepackage{calc}
3    \usepackage{pst-3dplot}%
4    \usepackage{pst-grad}
5    \usepackage{pst-plot,pst-math,pstricks-add}%
6    %\RequirePackage{pst-xkey}
```

Using colors with PSTricks is similar to what has already been discussed in the graphic and graphicx packages. (*Note:* Be aware that there are some incompatibilities between PSTricks and the graphic(x) packages.) The real power of the PSTricks package is the ability to *create* graphics using LaTeX-like syntax.
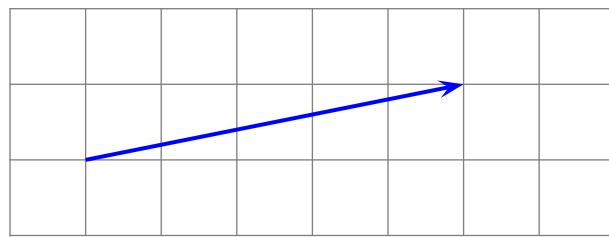
```
1    \psline[linecolor=blue,linewidth=1.5pt](-3,1)(2,2)
```


The previous example might be easier to understand if we include more detail in the sketch.

```
1    \showgrid
2    \psline[linecolor=blue,linewidth=1.5pt,arrowscale=1.5]{->}(-3,1)(2,2)
```
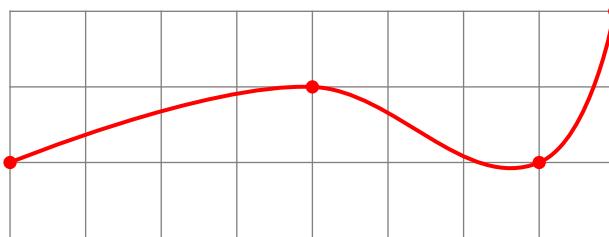
Notice that we have also included the custom macro \showgrid defined below.

```
1        \newpsobject{showgrid}{psgrid}{%
2            gridlabels=0pt%
3            ,griddots=0%
4            ,gridwidth=0.5pt%
5            ,gridcolor=gray%
6            ,subgriddiv=0%
7            ,subgridwidth=0.25pt%
8            ,subgridcolor=red}
```

(c) Basic Graphics Objects

Here's a curve. Notice that the points used can be turned on (as shown) or off.

```
1        %\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2            \showgrid
3            \pscurve[linecolor=red,linewidth=1.5pt,showpoints=true]%
4                (\xmin,1)(0,2)(3,1)(\xmax,\ymax)
5        %\end{pspicture}
```
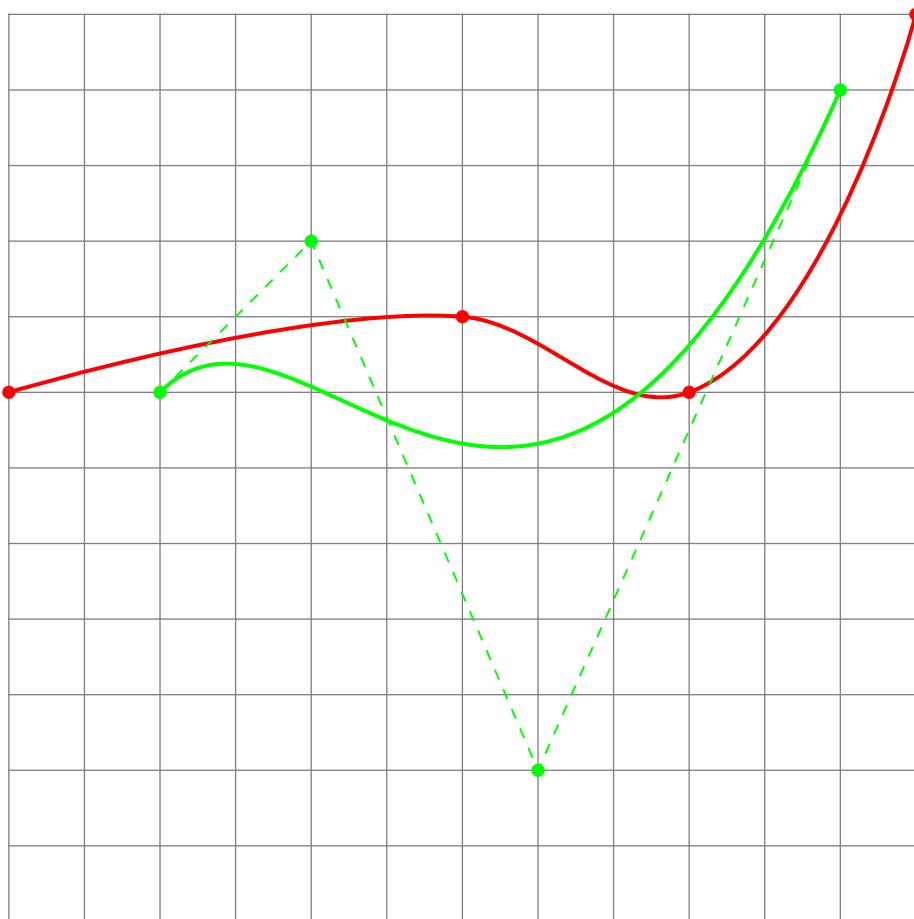

where the values \xmin, \ymin, etc. have been defined previously as

```
1        \def\xmin{-6}\def\xmax{6}
2        \def\ymin{-6}\def\ymax{6}
```
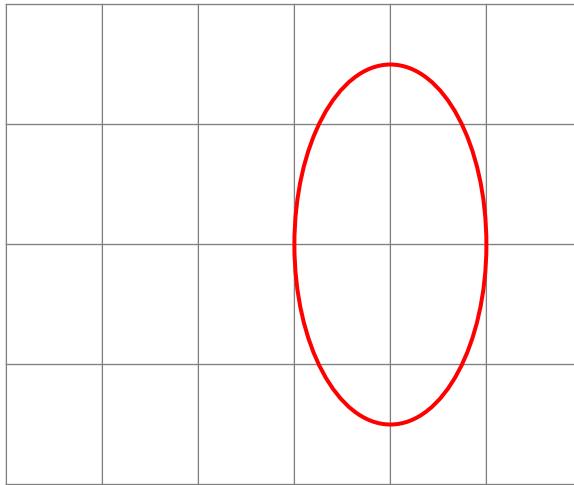
We begin by setting the default unit(s) in PSTricks using the command `\psset{unit=1cm}`. This is actually the default value.

```
1  %\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2     \showgrid
3     \pscurve[linecolor=red,linewidth=1.5pt,showpoints=true]
4        (\xmin,1)(0,2)(3,1)(\xmax,\ymax)
5     \psbezier[style=myCurveStyle,linecolor=green,showpoints=true]{-}%
6        (-4,1)(-2,3)(1,-4)(5,5)
7  %\end{pspicture}
```
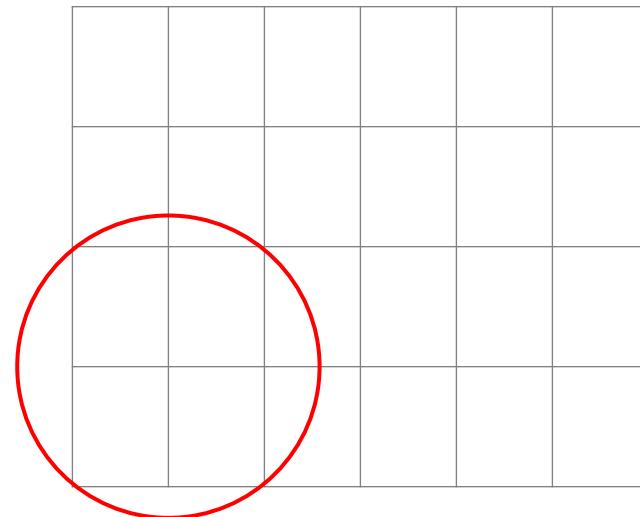
There are built-in shapes

```
%\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
    \showgrid
    \psellipse[linecolor=red,linewidth=1.5pt]
        (1,0)(1,1.5)
%\end{pspicture}
```
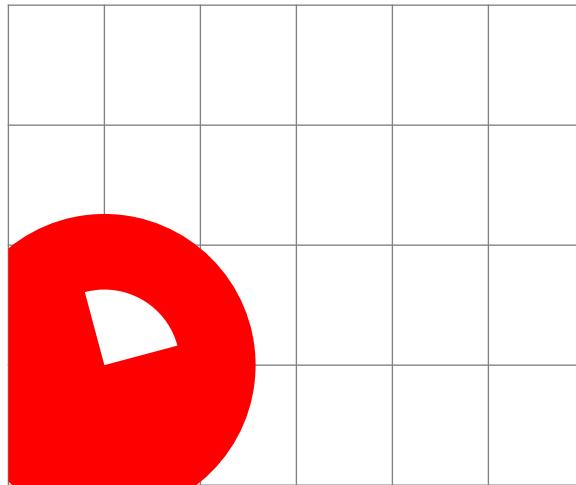
Here is a circle centered at $(-2, -1)$ of radius 2.

```
%\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
    \showgrid
    \pscircle[linecolor=red,linewidth=1.5pt]
        (-2,-1){2}
%\end{pspicture}
```

Here is the same object filled-in and clipped.

```
%\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
    \showgrid
    \psclip{\myframe(\xmin,\ymin)(\xmax,\ymax)}
        \pscircle*[linecolor=red,linewidth=1.5pt]
            (-2,-1){2}
    \endpsclip
    \pswedge*[linecolor=white](-2,-1){1}{15}{105}
%\end{pspicture}
```
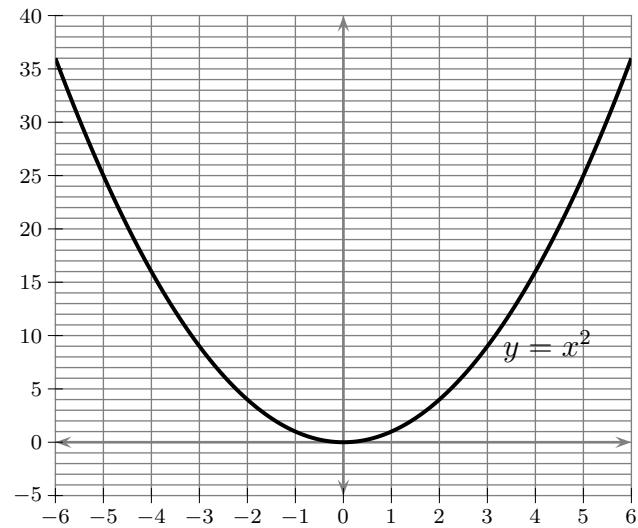
Finally, we plot some functions. To do this we'll use some custom macros that give the user better control over the coordinate system.
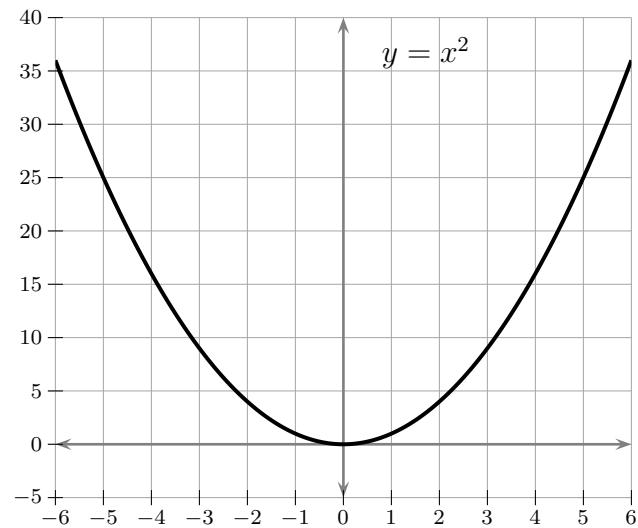
```
1    \begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2        \showgrid
3        \pstVerb{%
4            /f@ {dup mul} def % x^2
5            }
6        %%%%%%%%%%%%%%%%%%%
7        %% Axes and Ticks %%
8        %%%%%%%%%%%%%%%%%%%%%%%
9        \myaxes{<->}(0,0)(\xmin,\ymin)(\xmax,\ymax)
10       \xTickMarks{\xmin}{\xmax}{1}
11       \yTickMarks{\ymin}{\ymax}{5}
12       %%%%%%%%%%%%%%%%%%%%%%%%
13       %% Graphical Objects %%
14       %%%%%%%%%%%%%%%%%%%%%%%%
15       \psclip{\myframe(\xmin,\ymin)(\xmax,\ymax)}
16           \psplot[style=myPlotStyle]
17               {\xmin}{\xmax}{x f@}
18       \endpsclip
19       %%%%%%%%%%%%%
20       %% Labels %%
21       %%%%%%%%%%%%%
22       \SpecialCoor
23           \uput{6pt}[0](!3 dup f@){$y=x^2$}
24       \NormalCoor
25   \end{pspicture}
```
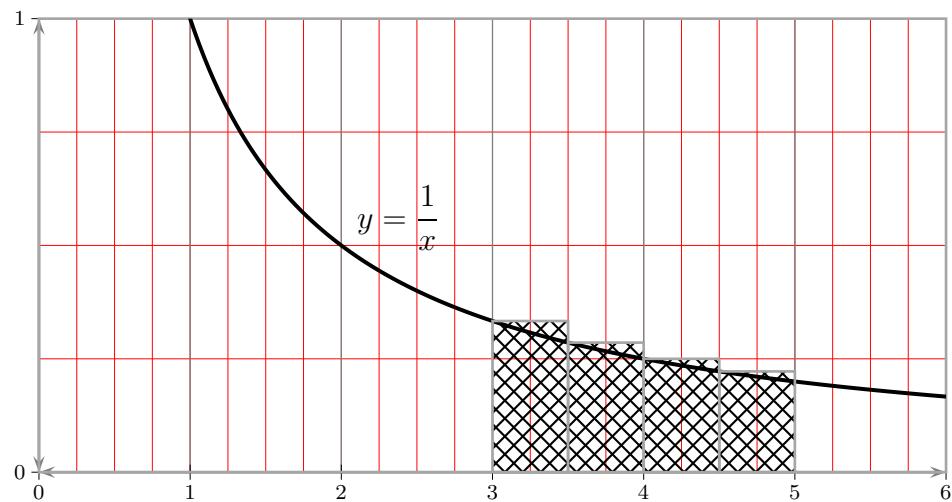
And again, using better grid controls.

Here's something useful for integration theory.

$$y = \frac{1}{x}$$

and here is the code.

```
1   \def\xmin{0}\def\xmax{6}
2   \def\ymin{0}\def\ymax{1}
3   \def\dommin{\xmin}\def\dommax{\xmax}
4   \psset{xunit=20mm,yunit=60mm}
5   \newpsobject{showgrid}{psgrid}{%
6   gridlabels=0pt%
7   ,griddots=0%
8   ,gridwidth=0.5pt%
9   ,gridcolor=gray%
10  ,subgriddiv=4%
11  ,subgridwidth=0.25pt%
12  ,subgridcolor=red}
13  \begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
14  \showgrid
15  \pstVerb{%
16      /f@ {1 exch div} def %
17      }
18      \SpecialCoor
19          \uput{6pt}[30](!2 dup f@){$y=\Dfrac{1}{x}$}
20      \myaxes{<->}(0,0)(\xmin,\ymin)(\xmax,\ymax)
21      \xTickMarks{\xmin}{\xmax}{1}
22      \yTickMarks{\ymin}{\ymax}{1}
23      \psclip{\psframe(\xmin,\ymin)(\xmax,\ymax)}
24              \psplot[style=myPlotStyle]
25                      {0.1}{\xmax}{x f@}
26      \endpsclip
27      \SpecialCoor
28          \psline[fillstyle=crosshatch]{-}(3,0)(3.5,0)(!3.5 1 3
29          div)(!3 dup f@)(3,0)
30          \psline[fillstyle=crosshatch]{-}(3.5,0)(4,0)(!4 1 3.5
31          div)(!3.5 dup f@)(3.5,0)
32          \psline[fillstyle=crosshatch]{-}(4,0)(4.5,0)(!4.5 1 4
33          div)(!4 dup f@)(4,0)
34          \psline[fillstyle=crosshatch]{-}(4.5,0)(5,0)(!5 1 4.5
35          div)(!4.5 dup f@)(4.5,0)
36      \NormalCoor
37  \end{pspicture}
```

(d) Plotting Data from a File

Suppose that you wish to plot the following data.

0,	0
0.0628,	0.06279
0.1256,	0.12533
...	...

The following code does the trick.

```
1   %\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2   \showgrid
3   \myaxes{<->}(0,0)(\xmin,\ymin)(\xmax,\ymax)
4   \psclip{\myframe(\xmin,\ymin)(\xmax,\ymax)}
5       \fileplot{plotData.txt}
6   \endpsclip
7   \SpecialCoor
8       \uput{6pt}[0](1,1.5){$y=\sin x$}
9   \NormalCoor
10  %\end{pspicture}
```