

L^AT_EX Graphics with PSTricks

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

<http://www.math.msu.edu/~hensh>

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 L^AT_EX Graphics Companion.

- Paperback: 608 pages
- Publisher: Addison-Wesley Pub Co; 1st edition (April 15, 1997)
- ISBN: 0201854694

- (c) The L^AT_EX Graphics Companion (2nd Edition).

- Paperback: 976 pages
- Publisher: Addison-Wesley Professional; 2 edition (August 12, 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.

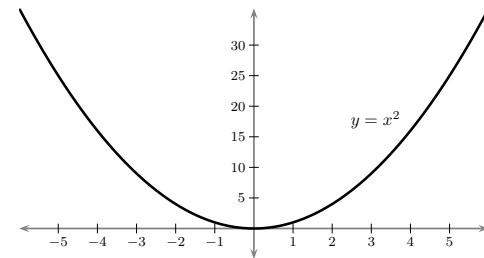


Figure 1: Graphing simple functions.

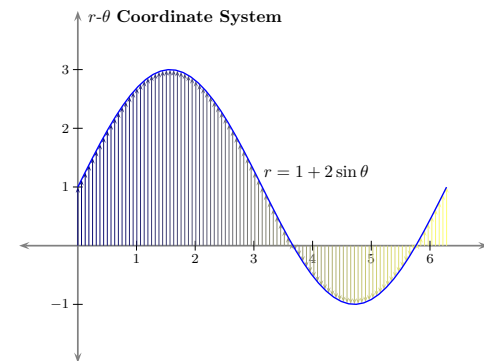


Figure 2: Graphing with some fancy effects.

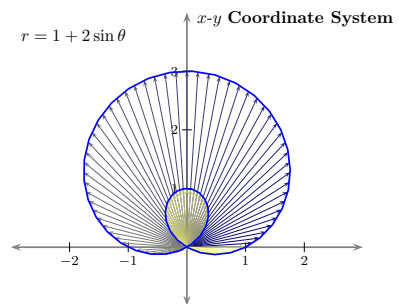


Figure 3: Polar Graphs

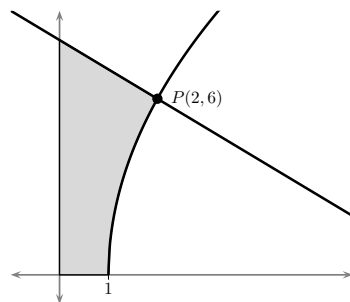


Figure 4: Area between two curves.

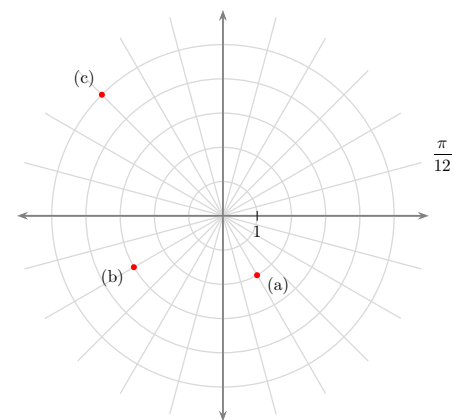


Figure 5: Polar Grid

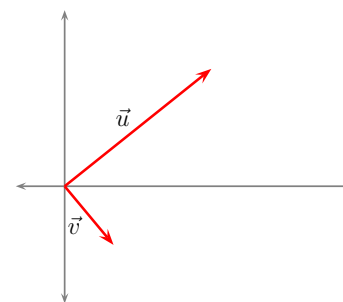


Figure 6: A pair of vectors

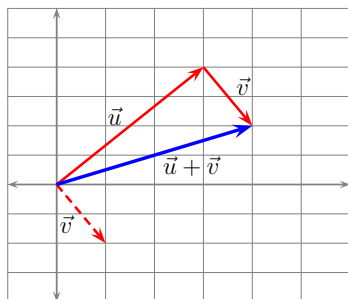


Figure 7: Vector addition with a grid.

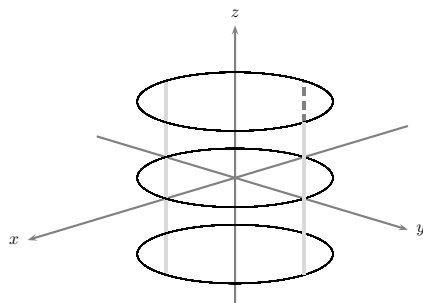


Figure 8: Sketching a cylinder.

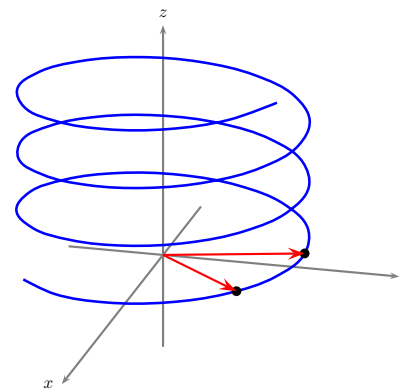


Figure 9: Position Vectors

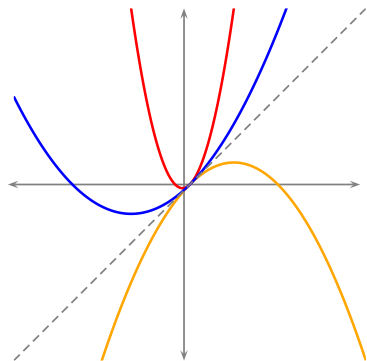


Figure 10: Level Curves

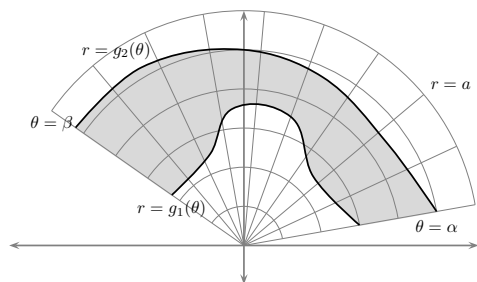


Figure 11: Polar Area

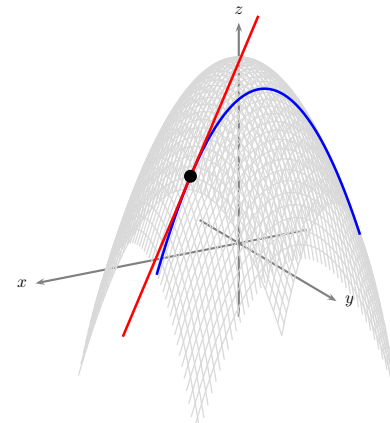
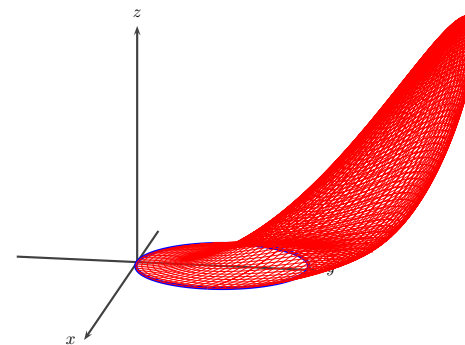


Figure 12: A Tangent Line



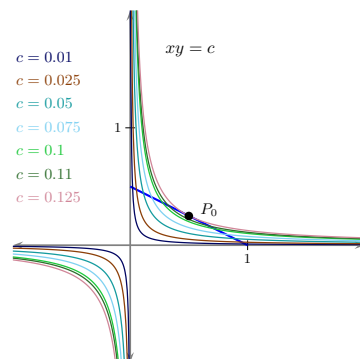


Figure 13: Lagrange Multipliers

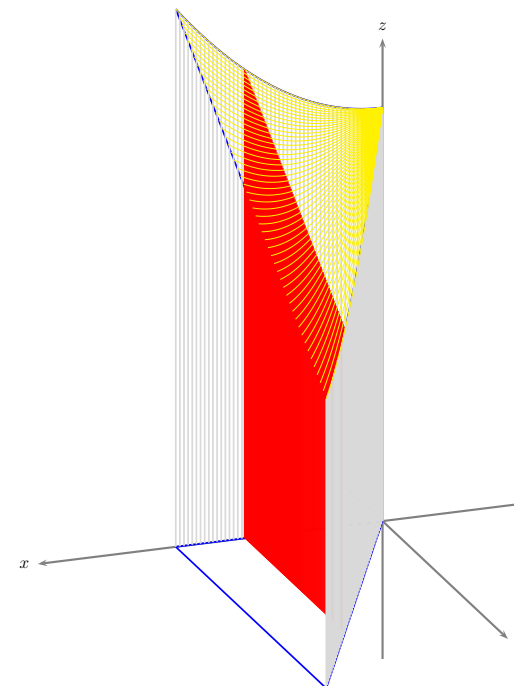
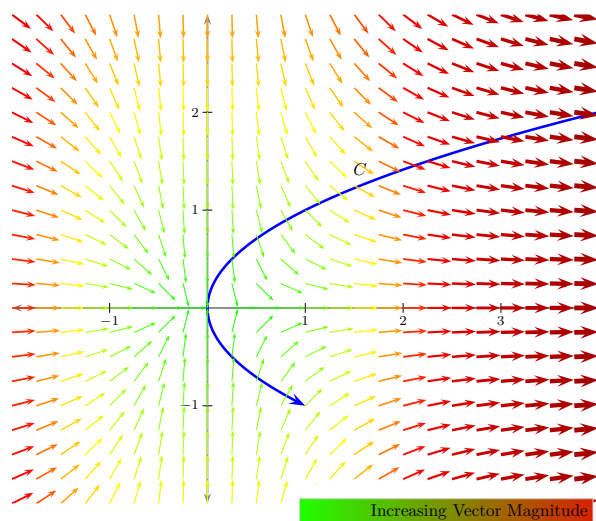


Figure 14: Exposed Solid

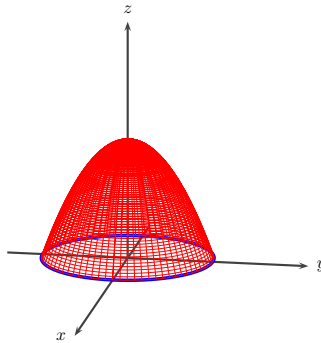


Figure 15: Surface Integrals

3. PSTricks

To use PSTricks you must include the following lines in the preamble of your document.

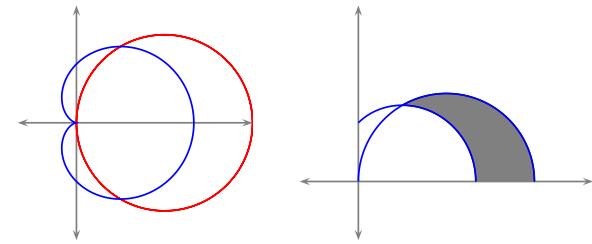
```

1 \usepackage{pst-eucl}
2 \usepackage{calc}
3 \usepackage{pst-3dplot}%
4 \usepackage{pst-grad}
5 \usepackage{pst-plot,pst-math,pstricks-add}%
6 \usepackage{pst-all}
7 \RequirePackage{pst-xkey}

```

We should mention that there have been some incompatibilities between the pstcol package (used by PSTricks) and the graphics packages mentioned above.

Using colors with PSTricks is similar to what has already been discussed. The real power of the PSTricks package is the ability to *create* graphics using LaTeX-like syntax.



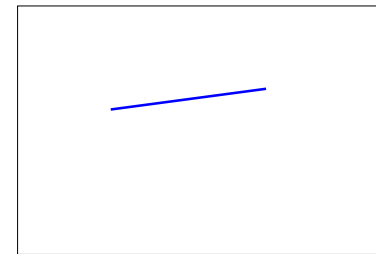
(a) Preliminaries

PSTricks provides users with the capability to draw using the familiar syntax of $\text{\LaTeX}$.

```

1 \psline[linecolor=blue,linewidth=1.5pt](-3,1)(2,2)

```

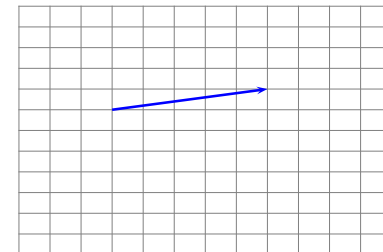


The previous example might be easier to understand if we include more detail in the sketch. Thus

```

1 \showgrid
2 \psline[linecolor=blue,linewidth=1.5pt]{->}(-3,1)(2,2)

```



```

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}

```

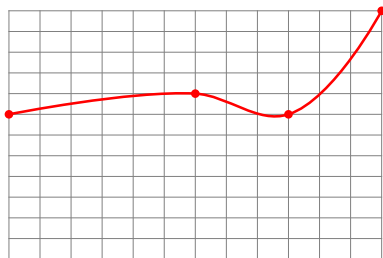
(b) Basic Graphics Objects

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}

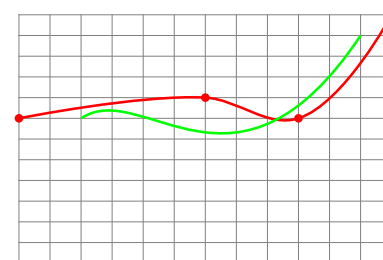
```

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]{-}%
6     (-4,1)(-2,3)(1,-4)(5,5)
7 %\end{pspicture}

```

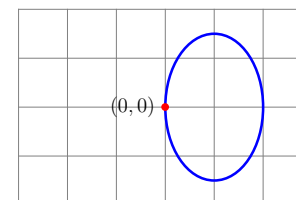


There are built-in shapes

```

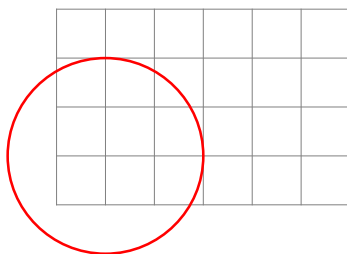
1 %\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2   \showgrid
3   \psellipse[linecolor=blue,linewidth=1.5pt]
4     (1,0)(1,1.5)
5   \psdots[linecolor=red,linewidth=1.25pt](0,0)
6   \SpecialCoor
7     \uput{6pt}[180](0,0){$(0,0)$}
8   \NormalCoor
9 %\end{pspicture}

```



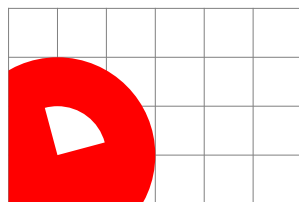
Here is a circle centered at $(-2, -1)$ of radius 2.

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



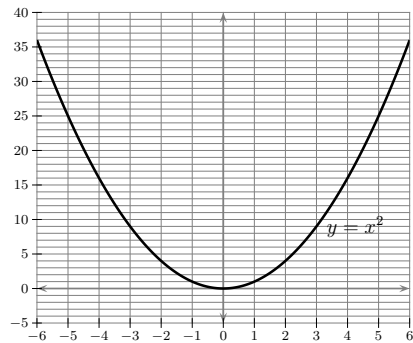
Here is the same object filled-in and clipped.

```
1 %\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2   \showgrid
3   \psclip{\myframe(\xmin,\ymin)(\xmax,\ymax)}
4     \pscircle*[linecolor=red,linewidth=1.5pt]
5       (-2,-1){2}
6   \endpsclip
7   \pswedge*[linecolor=white](-2,-1){1}{15}{105}
8 %\end{pspicture}
```

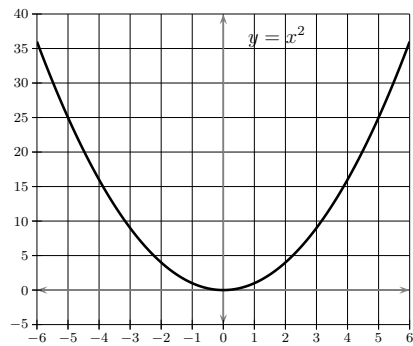


Finally, we plot some functions. To do this we'll use some custom macros that give the user better control over the coordinate system.

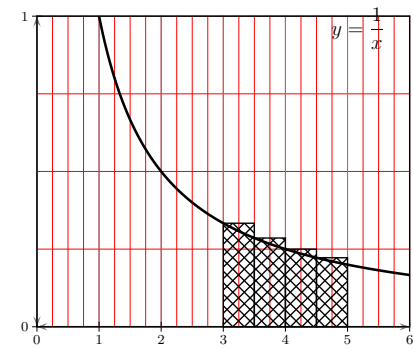
```
1 \begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2   \showgrid
3   \pstVerb{
4     /f@ {dup mul} def % x^2
5   }
6   %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
7   %% Axes and Ticks %%
8   %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
9   \myaxes{<->}(0,0)(\xmin,\ymin)(\xmax,\ymax)
10  \xTickMarks{\xmin}{\xmax}{1}
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



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  \VR{3in}{2.5in}
5
6  \newpsobject{newgrid}{psgrid}{%
7  gridlabels=0pt%
8  ,griddots=0%
9  ,gridwidth=0.5pt%
10 ,gridcolor=gray%
11 ,subgriddiv=4%
12 ,subgridwidth=0.25pt%
13 ,subgridcolor=red}
14 \begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
15 \newgrid
16 %%%%%%%%%%%%%%%
17 %% Axes and Ticks %%
18 %%%%%%%%%%%%%%%
19 \SpecialCoor
20 %% Labels go here
21 \rput[lr](!\xmax\space\xmax\space\xmin\space sub 15 div sub
22 \ymax\space\ymax\space\ymin\space sub 25 div sub){\mathfrak{1}{x}
23 \NormalCoor
24
25 \myaxes{<->}(0,0)(\xmin,\ymin)(\xmax,\ymax)
26
27 %% Change these as needed. #1 - start, #2 - end, #3 - increment
28
29 \xTickMarks{\xmin}{\xmax}{1}
30 \yTickMarks{\ymin}{\ymax}{1}
31
32 \psclip{\psframe(\xmin,\ymin)(\xmax,\ymax)}
33 %% Graphing directives go here, e.g.,
34 \psplot[style=myPlotStyle]
35 {0.1}{\xmax}{1 x div}
36 \endpsclip
37
38 \SpecialCoor
39
40 \psline[fillstyle=crosshatch]{-}(3,0)(3.5,0)(!3.5 1 3
41 div)(!3 1 3 div)(3,0)
42 \psline[fillstyle=crosshatch]{-}(3.5,0)(4,0)(!4 1 3.5
43 div)(!3.5 1 3.5 div)(3.5,0)
44 \psline[fillstyle=crosshatch]{-}(4,0)(4.5,0)(!4.5 1 4

```

```

45 div)(!4 1 4 div)(4,0)
46 \psline[fillstyle=crosshatch]{-}(4.5,0)(5,0)(!5 1 4.5
47 div)(!4.5 1 4.5 div)(4.5,0)
48
49 \NormalCoor
50
51
52 \end{pspicture}

```

(c) Plotting Data from a File

Suppose that you wish to plot the following data.

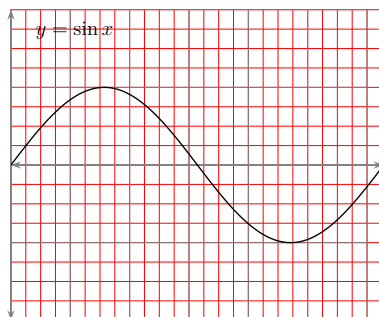
0,	0
0.0628,	0.06279
0.1256,	0.12533
...	...

The following code does the trick.

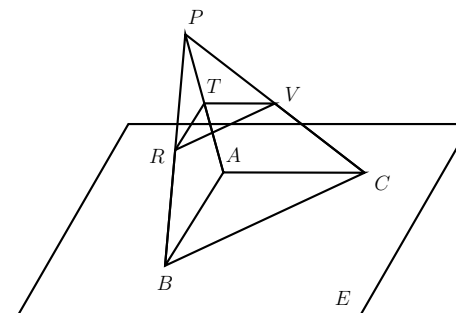
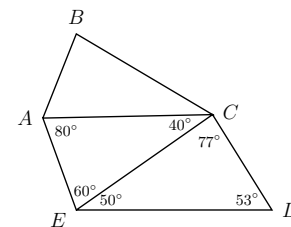
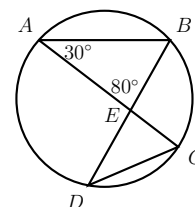
```

1 %\begin{pspicture}(\xmin,\ymin)(\xmax,\ymax)
2 \showgrid
3 %% Axes and Ticks %%
4 \myaxes{<->}(0,0)(\xmin,\ymin)(\xmax,\ymax)
5 %% Graphical Objects %%
6 \psclip{myframe(\xmin,\ymin)(\xmax,\ymax)}
7 \fileplot{plotData.txt}
8 \endpsclip
9 \SpecialCoor
10 \rput[lt](!\xmax\space\xmin\space sub 15 div
11 \ymax\space\ymax\space\ymin\space sub 25 div sub){$y=\sin x$}
12 \NormalCoor
13 %\end{pspicture}

```

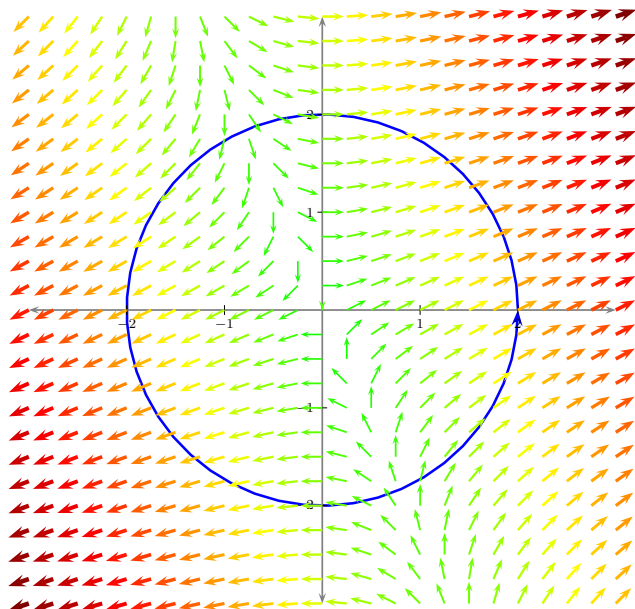


4. Several examples from geometry.

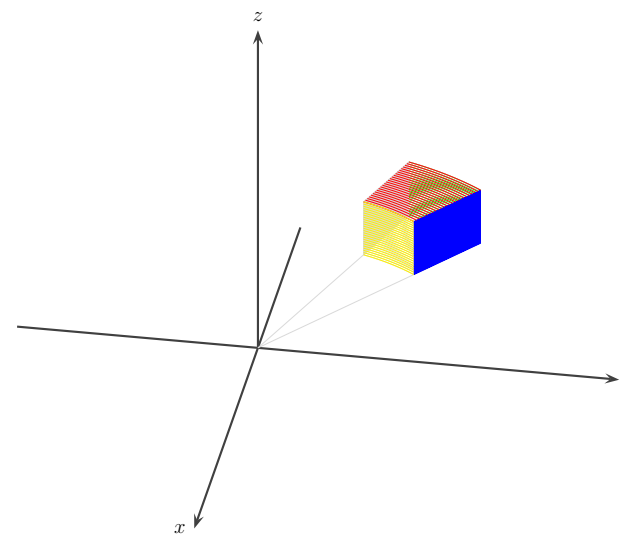


5. A few exotic tricks.

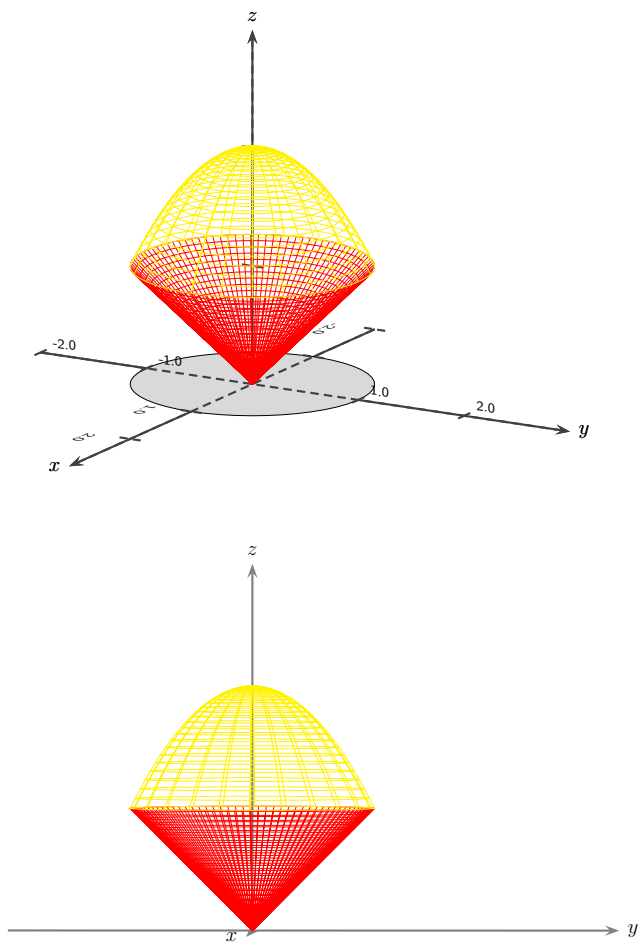
(a) A vector field.



(b) A three dimensional wedge.



(c) An ice-cream cone.



(d) A level surface.

