{TikZ/PGFplots 常用图形绘制合集}

TikZ & PGF 那些年，我们一直没画好的图像

Version N/A from N/A

Contents

1 内容说明

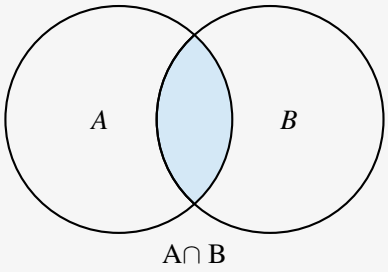
这部分内容是我收集的在中学学习阶段教师用到的常见的作图。资源来源于诸多作者如向禹老师、Banach Spaces、latexstudio等。

2 集合部分的常用图形（Venn 图）的 TikZ 实现

2.1 集合关系的 Venn 图

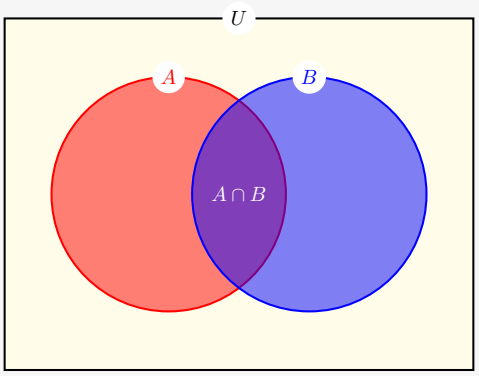
1. 两个集合的交集

```
\begin{tikzpicture}
   \begin{scope}
      \clip \firstcircle;
      \fill[filled] \secondcircle;
   \end{scope}
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
\end{tikzpicture}
```



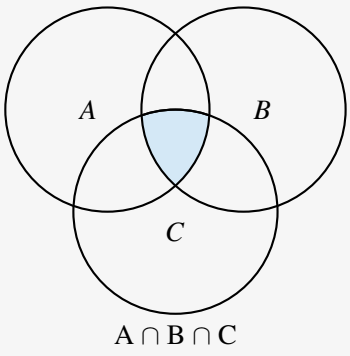
A∩ B

```
\begin{tikzpicture}
\coordinate (O) at (0,0);\coordinate (NE) at (4,3);\coordinate (SW) at ($(O
    )!-1!(NE)$);
\filldraw[draw=black,fill=yellow!10!white,line width=1pt](SW)rectangle(NE);
\filldraw[draw=red,fill=red, fill opacity=0.5, line width=1pt] \circleA;
\filldraw[draw=blue,fill=blue, fill opacity=0.5, line width=1pt] \circleB;
\node[set label] at (O |- NE) {$U$};
\node[set label,text=red] at ($(\centerA) + (90:\radius)$) {$A$};
\node[set label,text=blue] at ($(\centerB) + (90:\radius)$) {$B$};
\node[color=white] at (O) {$A\cap B$};
\end{tikzpicture}
```



2. 三个集合的交集

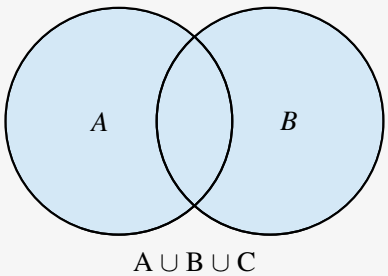
```
\begin{tikzpicture}
   \begin{scope}
      \clip \firstcircle;
      \clip \secondcircle;
      \fill[filled] \thirdcircle ;
   \end{scope}
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
   \draw[outline] \thirdcircle node[below] {$C$};
   \node[anchor=north] at (current bounding box.south) {A $\cap$ B $\cap$
       C};
\end{tikzpicture}
```



A ∩ B ∩ C

3. 两个集合的并集

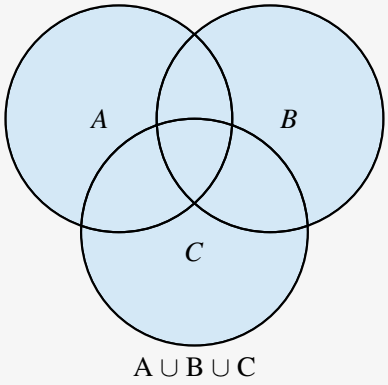
```
\begin{tikzpicture}
   \begin{scope}
      \clip \firstcircle \secondcircle \thirdcircle;
      \fill[filled] \firstcircle \secondcircle;
   \end{scope}
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
   \draw[outline] \thirdcircle node[below] {$C$};
   \node[anchor=north] at (current bounding box.south) {A $\cup$ B $\cup$
       C};
\end{tikzpicture}
```



A ∪ B ∪ C

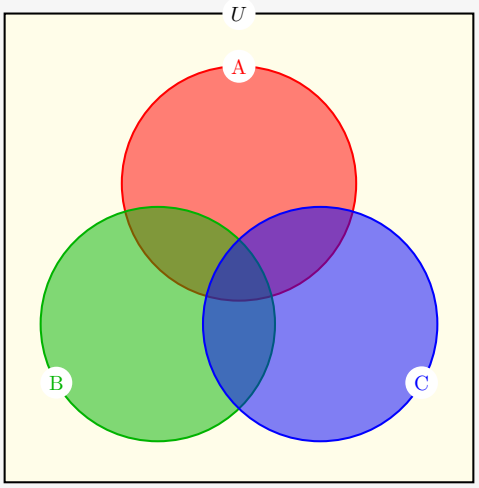
4. 三个集合的并集

```
\begin{tikzpicture}
   \begin{scope}
      \clip \firstcircle \secondcircle \thirdcircle;
      \fill[filled] \firstcircle \secondcircle \thirdcircle;
   \end{scope}
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
   \draw[outline] \thirdcircle node[below] {$C$};
   \node[anchor=north] at (current bounding box.south) {A $\cup$ B $\cup$
       C};
\end{tikzpicture}
```



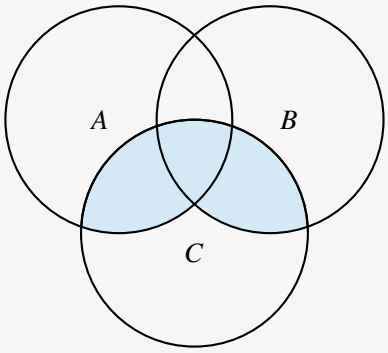
A ∪ B ∪ C

```
\begin{tikzpicture}
\coordinate (O) at (0,0);
\coordinate (NE) at (4,4.5);
\coordinate (SW) at (-4,-3.5);
\filldraw[draw=black, fill=yellow!10!white,line width=1pt] (SW) rectangle (
    NE);
\filldraw[draw=\colorA,fill=\colorA,fill opacity=0.5,line width=1pt] \
    circleA;
\filldraw[draw=\colorB,fill=\colorB,fill opacity=0.5,line width=1pt] \
    circleB;
\filldraw[draw=\colorC,fill=\colorC,fill opacity=0.5,line width=1pt] \
    circleC;
\drawLabels
\end{tikzpicture}%
```



5. 两个集合的并集与第三个集合的交集

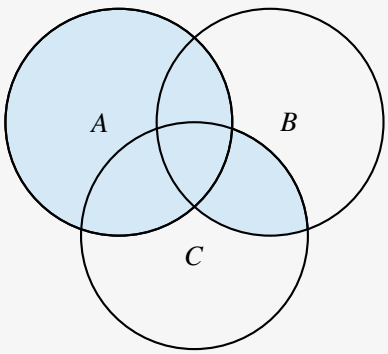
```
\begin{tikzpicture}
    \begin{scope}
      \clip \firstcircle \secondcircle;
      \fill[filled] \thirdcircle;
   \end{scope}
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
   \draw[outline] \thirdcircle node[below] {$C$};
   \node[anchor=north] at (current bounding box.south)
    {(A $\cup$ B) $\cap$ C};
\end{tikzpicture}
```



(A ∪ B) ∩ C

6. 两个集合的交集并上第三个集合

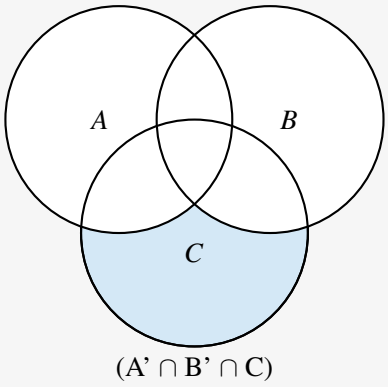
```
\begin{tikzpicture}
    \begin{scope}
      \clip \secondcircle;
      \fill[filled] \thirdcircle;
   \end{scope}
   \fill[filled] \firstcircle;
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
   \draw[outline] \thirdcircle node[below] {$C$};
   \node[anchor=north] at (current bounding box.south)
    {A $\cup$ (B $\cap$ C)};
\end{tikzpicture}
```



A ∪ (B ∩ C)

7. 两个集合的补集的交交上第三个集合

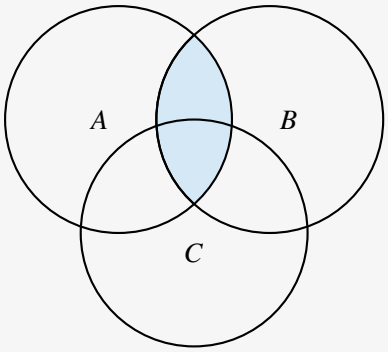
```
\begin{tikzpicture}
   \begin{scope}
      \fill[filled] \thirdcircle;
      \fill[white] \firstcircle;
      \fill[white] \secondcircle;
   \end{scope}
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
   \draw[outline] \thirdcircle node[below] {$C$};
   \node[anchor=north] at (current bounding box.south)
    {(A' $\cap$ B' $\cap$ C)};
    \end{tikzpicture}
```



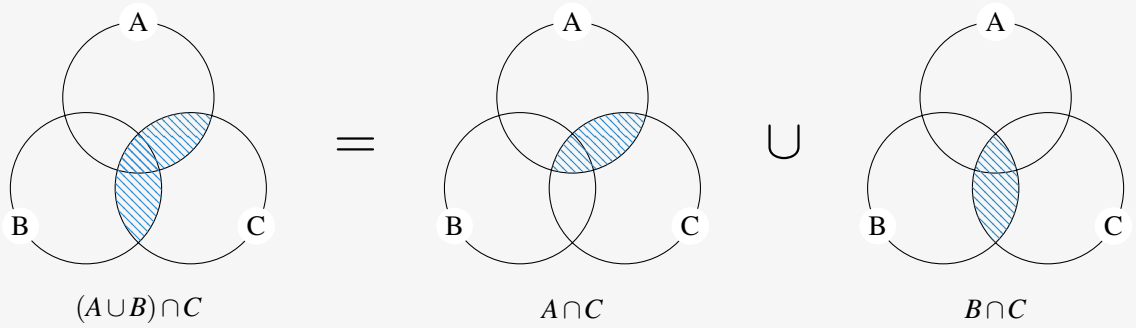
(A' ∩ B' ∩ C)

2.2 集合运算的 Venn 图表示

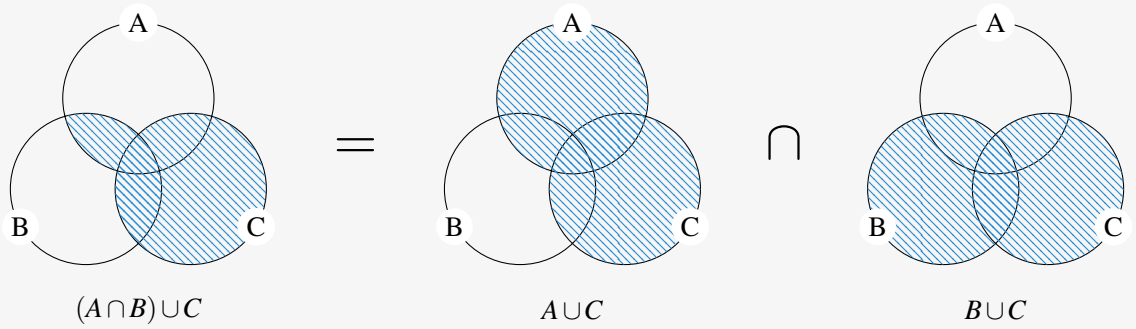
```
\begin{tikzpicture}
   \begin{scope}
      \clip \firstcircle;
      \fill[filled] \secondcircle;
   \end{scope}
   \draw[outline] \firstcircle node[left] {$A$};
   \draw[outline] \secondcircle node[right] {$B$};
   \draw[outline] \thirdcircle node[below] {$C$};
   \node[anchor=north,align=center] at (current bounding box.south)
    {(A$\cap$ B)=\\(A $\cap$ B $\cap$ C) + (A $\cap$ B $\cap$ C')};
\end{tikzpicture}
```



(A∩ B)=
(A ∩ B ∩ C) + (A ∩ B ∩ C')



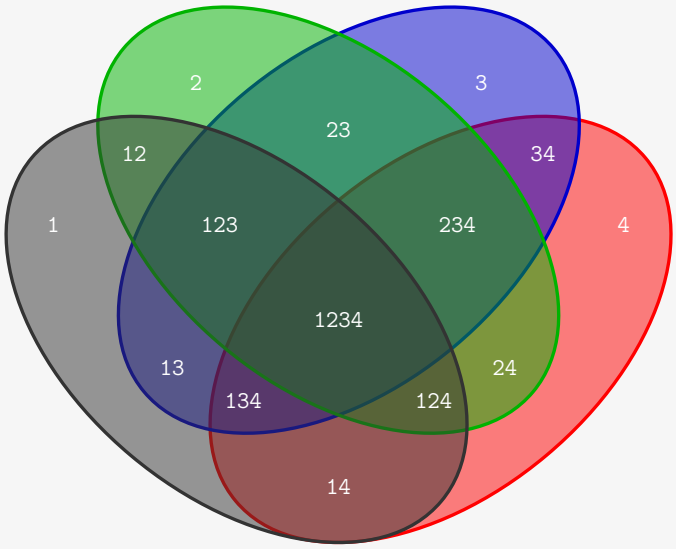
$(A \cup B) \cap C$ $A \cap C$ $B \cap C$

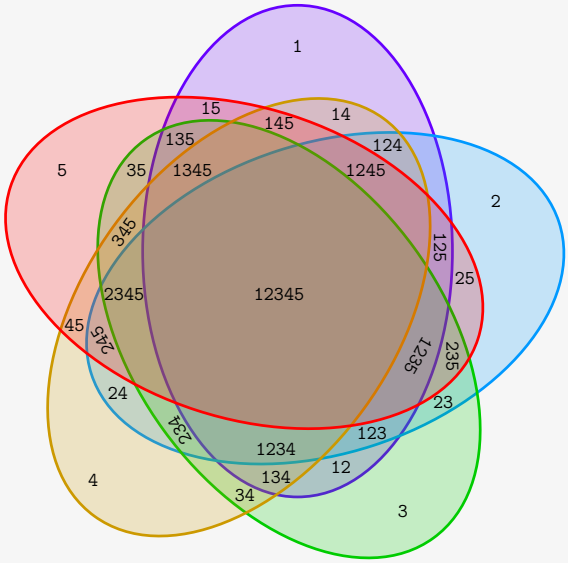


$(A \cap B) \cup C$ $A \cup C$ $B \cup C$

```
\documentclass[border=0mm]{standalone}
\usepackage{amsmath}
\usepackage{tikz}
\def\drawEllipse#1#2{\draw[draw=#1,fill=#1,fill opacity=0.5,line width=2pt] #2 circle [x radius=5.62, y radius=3.46];}
\def\xshift{2.8}
\def\yshift{3}
\begin{document}
```

```
\begin{tikzpicture}
\begin{scope}[rotate=40]
\drawEllipse{red}{(\xshift,0)}
\end{scope}
\begin{scope}[rotate=40]
\drawEllipse{blue!80!black}{(\xshift,\yshift)}
\end{scope}
\begin{scope}[rotate=-40]
\drawEllipse{green!70!black}{(-\xshift,\yshift)}
\end{scope}
\begin{scope}[rotate=-40]
\drawEllipse{black!80!white}{(-\xshift,0)}
\end{scope}
\begin{scope}[color=white,font=\ttfamily\Large]
\node at (0, 2) {1234};
\node at (0, -1.5) {14};
\node at (0, 6) {23};
\node at (-6, 4) {1};
\node at (6, 4) {4};
\node at (-3, 7) {2};
\node at (3, 7) {3};
\node at (-4.3, 5.5) {12};
\node at (4.3, 5.5) {34};
\node at (2.5, 4) {234};
\node at (-2.5, 4) {123};
\node at (-3.5, 1) {13};
\node at (3.5, 1) {24};
\node at (-2, 0.3) {134};
\node at (2, 0.3) {124};
\end{scope}
\end{tikzpicture}

\end{document}
```



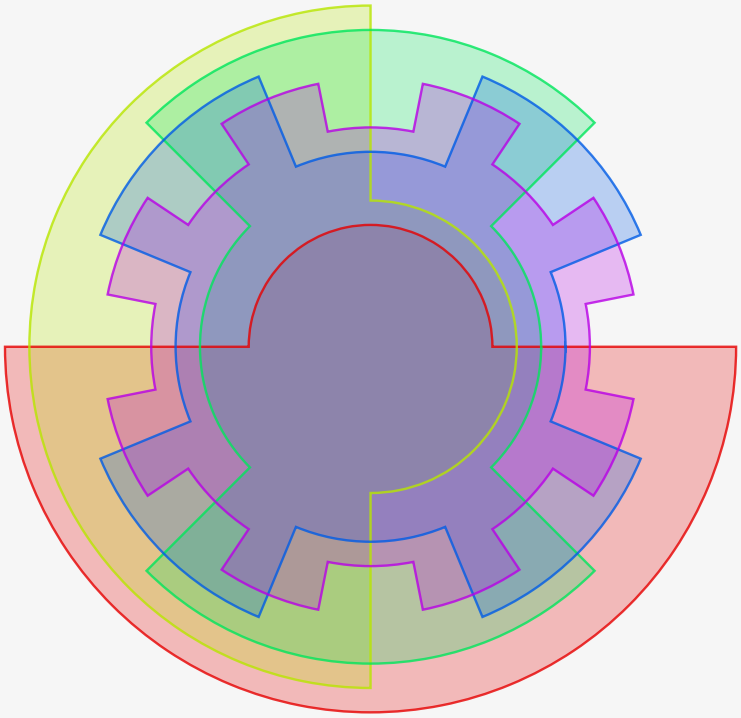


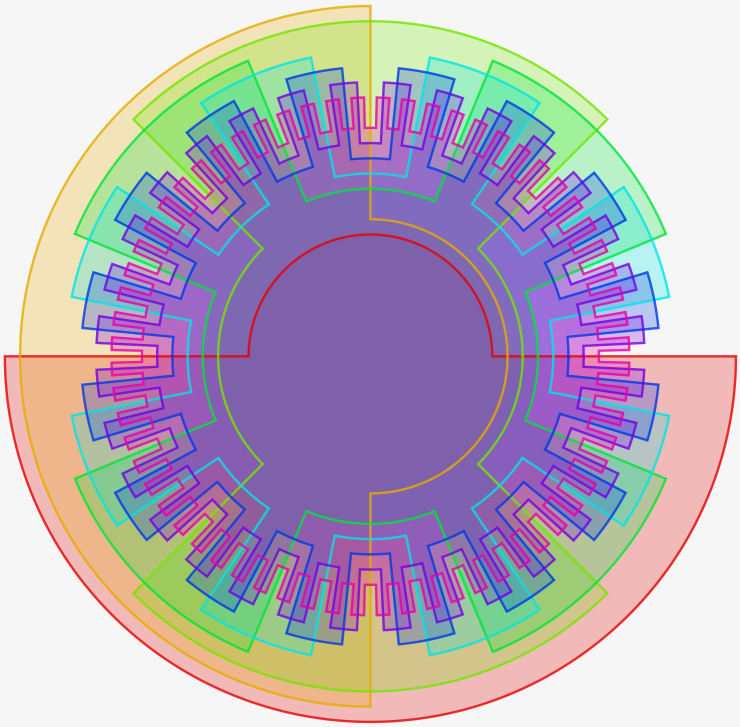

```
\documentclass[border=0.1mm]{standalone}
\usepackage{tikz}

\definecolor{colorA}{HTML}{6600FF}
\definecolor{colorB}{HTML}{0099FF}
\definecolor{colorC}{HTML}{00CC00}
\definecolor{colorD}{HTML}{CC9900}
\definecolor{colorE}{HTML}{FF0000}

\def\centerPoint{}

\def\drawEllipse#1{\draw[draw=#1,fill=#1,fill opacity=0.2,line width=2pt] (0.6,1.375) circle [x radius=5, y radius=7.935];}
```

```
\begin{document}

\begin{tikzpicture}[x=8mm,y=8mm]
\drawEllipse{colorA}
\begin{scope}[rotate=-72]
\drawEllipse{colorB}
\end{scope}
\begin{scope}[rotate=-144]
\drawEllipse{colorC}
\end{scope}
\begin{scope}[rotate=144]
\drawEllipse{colorD}
\end{scope}
\begin{scope}[rotate=72]
\drawEllipse{colorE}
\end{scope}
\begin{scope}[,font=\ttfamily\Large]
\node at (0, 0) {12345};
\node at (0.6, 8) {1};
\node at (7, 3) {2};
\node at (4, -7) {3};
\node at (-6, -6) {4};
\node at (-7, 4) {5};
\node at (-2.2, 6) {15};
\node at (0, 5.5) {145};
\node at (2, 5.8) {14};
\node at (3.5, 4.8) {124};
\node at (2.8, 4) {1245};
\node[rotate=-90] at (5.2, 1.5) {125};
\node at (6, 0.5) {25};
\node[rotate=-90] at (5.6, -2) {235};
\node[rotate=-120] at (4.5, -2) {1235};
\node at (3, -4.5) {123};
\node at (2, -5.6) {12};
\node at (-0.1, -5.9) {134};
\node at (-1.1, -6.5) {34};
\node[rotate=120] at (-3.2, -4.4) {234};
\node at (-5.2, -3.2) {24};
\node[rotate=120] at (-5.7, -1.5) {245};
\node at (-5, 0) {2345};
\node at (-6.6, -1) {45};
\node[rotate=55] at (-5, 2) {345};
\node at (-0.1, -5) {1234};
\node at (5.3, -3.5) {23};
\node at (-3.2, 5) {135};
\node at (-4.6, 4) {35};
\node at (-2.8, 4) {1345};
\end{scope}
\end{tikzpicture}

\end{document}
```

```
\documentclass[border=0mm]{standalone}
\usepackage[rgb]{xcolor}
\usepackage{tikz}
\usepackage{bitset}
\usepackage{xstring}
\usepackage{ifthen}
\usepackage{xparse}
\ExplSyntaxOn
\NewDocumentCommand\intevaldef{mm}{\tl_set:Nx {#1} {\fp_to_int:n {#2}}}
\NewDocumentCommand\realevaldef{mm}{\tl_set:Nx {#1} {\fp_eval:n {#2}}}
\ExplSyntaxOff
%
\makeatletter
\def\prepareGray#1{
  \def\num{#1}%
```

```
  \intevaldef\mesh{2^\num}%
  \intevaldef\meshminusone{\mesh-1}%
  %
  \foreach \i in {0,...,\meshminusone}{
    \bitsetSetDec{gray}{\i}%
    \bitsetLet{gray2}{gray}%
    \bitsetShiftRight{gray2}{1}%
    \bitsetXor{gray}{gray2}%
    \edef\@graystr{\bitsetGetBin{gray}{\num}}%
    \foreach \j in {1,...,\num} {%
      \StrChar{\@graystr}{\j}[\@graychar]%
      \expandafter\xdef\csname gray\i,\j\endcsname{\@graychar}%
    }
  }
}
\def\gray#1#2{\csname gray\the\numexpr#1\relax,\the\numexpr#2\relax\endcsname}%
\def\mainR{1}%
\def\@prepareVenn#1{%
  \realevaldef\subR{(\num+1-#1)/(2*\num)}%
  \realevaldef\prevR{\mainR-\subR}%
  \def\prevAngle{0}%
  \def\prevGrayChar{0}%
  \edef\pathstring{(\prevAngle:\prevR)}%
  %
  \foreach \t in {1,...,\meshminusone,0} {%
    \edef\currentGrayChar{\gray{\t}{#1}}%
    \ifthenelse{\equal{\t}{0}}{\edef\t{\mesh}}{}%
    %
    \realevaldef\currentAngle{360*\t/\mesh}%
    \ifthenelse{\equal{\currentGrayChar}{1}}{%
      \realevaldef\currentR{\mainR+\subR}%
    }{
      \realevaldef\currentR{\mainR-\subR}%
    }
    \ifthenelse{\equal{\prevGrayChar}{\currentGrayChar}}{%
      \xdef\pathstring{\pathstring\space arc (\prevAngle:\currentAngle:\currentR)}
    }{
      \xdef\pathstring{\pathstring\space arc (\prevAngle:\currentAngle:\prevR) -- (\currentAngle:\currentR)}
    }%
    \global\let\prevR\currentR
    \global\let\prevAngle\currentAngle
    \global\let\prevGrayChar\currentGrayChar
  }%
  \expandafter\xdef\csname vennPath#1\endcsname{\pathstring}
  \realevaldef\hue{round((#1-1)/\num, 4)}
  \xglobal\definecolor{vennColor#1}{hsb}{\hue,1,0.9}
}
\def\@fillVenn#1{\fill[fill=vennColor#1,fill opacity=0.25]\@nameuse{vennPath#1} -- cycle;}
\def\@drawVenn#1{\draw[draw=vennColor#1,line width=1.4pt,draw opacity=0.8]\@nameuse{vennPath#1} -- cycle;}
\def\drawVenn#1{
  \prepareGray{#1}
  \foreach \x in {1,...,#1} {
    \@prepareVenn{\x}
    \@fillVenn{\x}
  }
  \foreach \x in {1,...,#1} {
    \@drawVenn{\x}
  }
}
\makeatother
\def\NumberOfSets{8}
\begin{document}
\begin{tikzpicture}[x=5cm,y=5cm,font=\Huge\ttfamily]
\drawVenn{\NumberOfSets}
\end{tikzpicture}
\end{document}
```



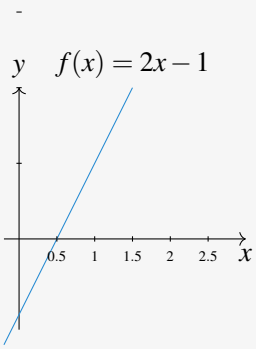


3 常见函数图像的 TikZ 实现

3.1 常用函数的 TikZ 绘制

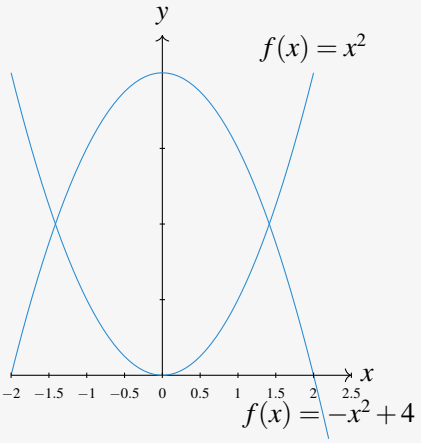
1. 一次函数

```
\begin{tikzpicture}
  \draw[->](-0.2,0)--(3,0) node[below] {$x$};
  \draw[->](0,-1.2)--(0,2) node[above] {$y$};
  \draw[domain=-0.2:1.5,draw=blue] plot (\x,{2*\x-1}) node[above] {$f(x)
      =2x-1$};
  \foreach \x in {0.5,1,...,2.5}
  \draw (\x cm,1pt) -- (\x cm,-1pt) node[anchor=north] {\tiny $\x $};
\foreach \y in {1,2,3}
\draw (1pt,\y cm) -- (-1pt,\y cm);
\end{tikzpicture}
```



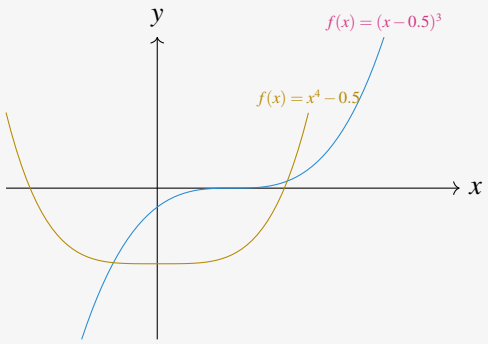
2. 二次函数

```
\begin{tikzpicture}
  \draw[->](-2,0)--(2.5,0) node[right] {$x$};
  \draw[->](0,0)--(0,4.5) node[above] {$y$};
  \draw[domain=-2:2,draw=blue,samples=60] plot (\x,{(\x)^2}) node[above]
      {$f(x)=x^2$};
  \draw[domain=-2:2.2,draw=blue,samples=60] plot (\x,{-(\x)^2+4}) node[
      above] {$f(x)=-x^2+4$};
  \foreach \x in {-2,-1.5,...,2.5}
  \draw (\x cm,1pt) -- (\x cm,-1pt) node[anchor=north] {\tiny $\x $};
\foreach \y in {1,2,3}
\draw (1pt,\y cm) -- (-1pt,\y cm);
\end{tikzpicture}
```

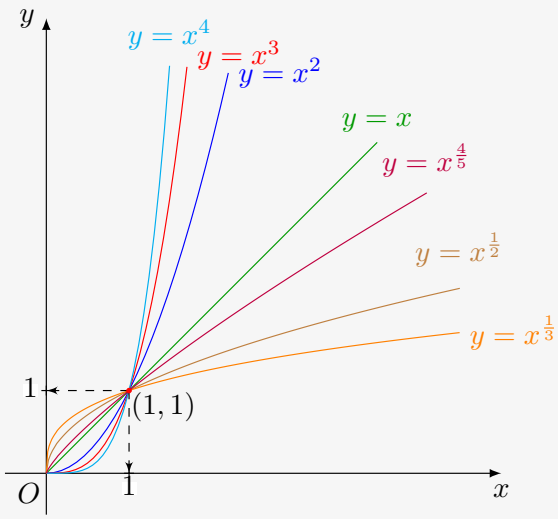


3. 多次函数

```
\begin{tikzpicture}
  \draw[->](-1.2,0)--(1.2,0) node[right] {$x$};
  \draw[->](0,-1)--(0,1) node[above] {$y$};
  \draw[domain=-1:1,draw=blue,samples=60] plot (\x,{(\x)^3}) node[above,
      scale=0.6,color=magenta] {$f(x)=x^3$};
\end{tikzpicture}
```

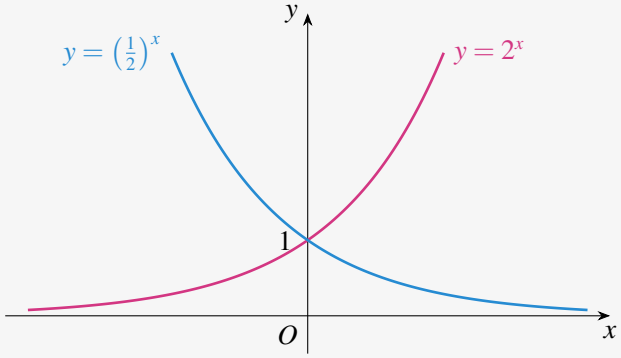



```
\begin{tikzpicture}[fun/.style={domain=0:5,samples=200}]
\tkzInit[xmin=-0.5,xmax=5,ymin=-0.5,ymax=5]
\tkzDrawXY[noticks,>=latex]
   \draw[domain=0:4,green!60!black] plot(\x,\x)node[above]{$y=x$};
   \draw[domain=0:2.2,blue] plot(\x,\x^2)node[right]{$y=x^2$};
   \draw[domain=0:1.7,red] plot(\x,\x^3)node[above=4pt,right]{$y=x^3$};
    \draw[domain=0:1.49,cyan] plot(\x,\x^4)node[above=2pt]{$y=x^4$};
   \draw[fun,brown] plot(\x,\x^0.5)node[above=4pt]{$y=x^{\frac{1}{2}}$};
    \draw[fun,orange,samples=300] plot(\x,\x^0.33)node[right]{$y=x^{\frac{1}{3}}$};
     \draw[fun,purple,domain=0:4.6,samples=300] plot(\x,\x^0.8)node[above=2pt]{$y=x^{\frac{4}{5}}$};
     \tkzDefPoints{0/0/O,1/1/A,1/0/I,0/1/J}
     \tkzLabelPoints[left=6pt,below](O)
     \tkzDrawPoints[shape=cross](I,J)
     \tkzShowPointCoord[xlabel=$1$,
         ylabel=$1$](A)
     \tkzDrawPoint[fill=red,size=1.5pt,color=red](A)
     \node at(0.9,0.8)[below,right]{$(1,1)$};
\end{tikzpicture}
```



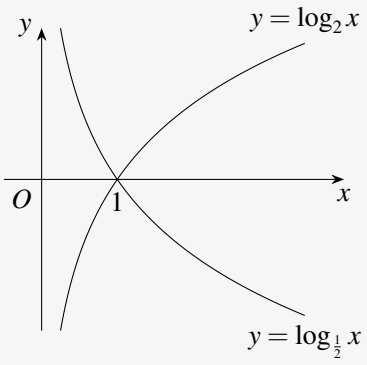
3.2 指数函数图像的 TikZ 绘制

```
\begin{tikzpicture}[samples=100]
\draw[-Stealth](-4,0)--(0,0)node[below left]{$O$}--(4,0)node[below]{
    $x$};
\draw[-Stealth](0,-0.5)--(0,4)node[left]{$y$};
\draw[domain=-3.7:1.8,line width=1pt,draw=magenta]plot(\x,{2^(\x)})
    node[right,color=magenta]{$y=2^x$};
\draw[domain=3.7:-1.8,line width=1pt,draw=blue]plot(\x,{2^(-\x)})node[
    left,color=blue]{$y=\left(\frac12\right)^x$};
\node at(-0.3,1){$1$};
\end{tikzpicture}
```



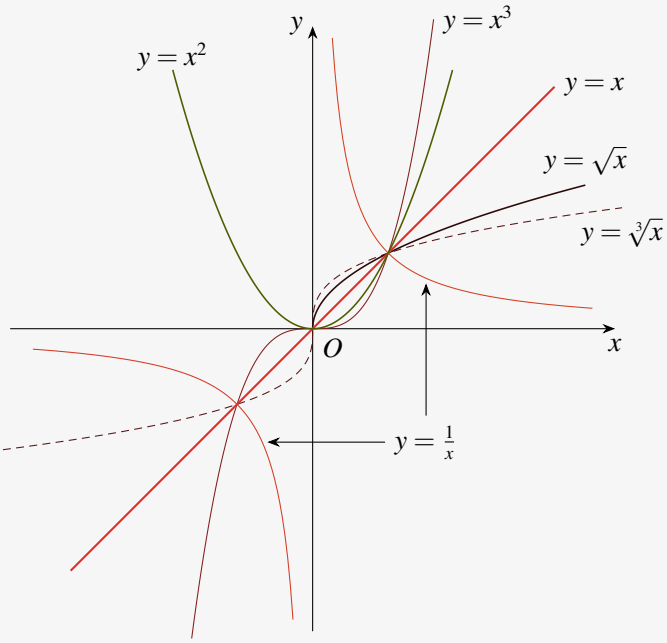
3.3 对数函数的 TikZ 图像绘制

```
\begin{tikzpicture}[samples=100]
\draw[-Stealth](-0.5,0)--(0,0)node[below left]{$O$}
--(4,0)node[below]{$x$};
\draw[-Stealth](0,-2)
--(0,2)node[left]{$y$};
\node at(1,-0.3){$1$};
\draw[domain=-2:1.8]plot({2^(\x)},\x)
node[above]{$y=\log_2x$};
\draw[domain=2:-1.8]plot({2^(-\x)},\x)
node[below]{$y=\log_{\frac12}x$};
\end{tikzpicture}
```



3.4 幂函数图像的 TikZ 绘制

```
\begin{tikzpicture}[samples=100]
\draw[-Stealth](-4,0)--(0,0)node[below right]{$O$}--(4,0)node[below]{
    $x$};
\draw[-Stealth](0,-4)--(0,4)node[left]{$y$};
\draw[domain=-1.6:1.6,draw=red!60!black]plot(\x,{(\x)^3})node[right]{
    $y=x^3$};
\draw[densely dashed,domain=-1.6:1.6,draw=red!40!black]plot({(\x)^3},
    \x)node[below]{$y=\sqrt[3]x$};
\draw[semithick,domain=0:1.9,draw=red!20!black]plot({(\x)^2},\x)node[
    above]{$y=\sqrt x$};
\draw[thick,domain=-3.2:3.2,draw=red]plot(\x,\x)node[right]{$y=x$};
\draw[domain=0.26:3.7,draw=orange!60!red]plot(\x,{1/(\x)});
\draw[domain=-0.26:-3.7,draw=orange!40!red]plot(\x,{1/(\x)});
\node(a)at(1.5,-1.5){$y=\frac1x$};
\draw[-Stealth](a.west)--(-0.6,-1.5);
\draw[-Stealth](a.north)--(1.5,0.6);
\draw[semithick,domain=-1.85:1.85,draw=green!60!black]plot(\x,{(\x)
    ^2});
\node at(-1.85,3.6){$y=x^2$};
\end{tikzpicture}
```



3.5 周期函数的 TikZ 绘制

3.6 其他函数图像的 TikZ 绘制

3.7 三角函数的 TikZ 绘制

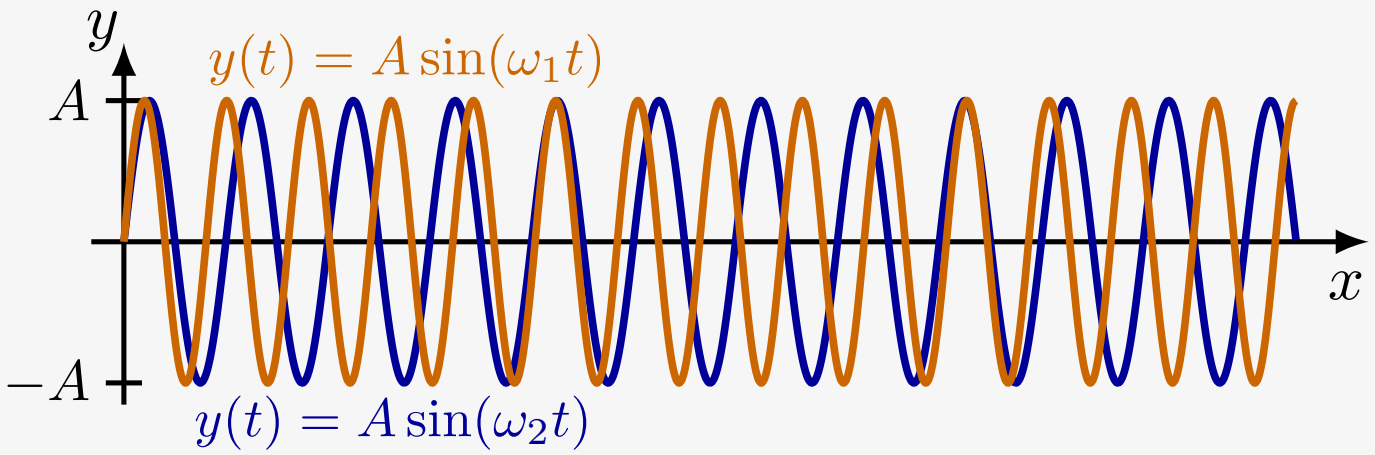
3.7.1 正、余弦和正切函数

1. 正弦函数

   平移

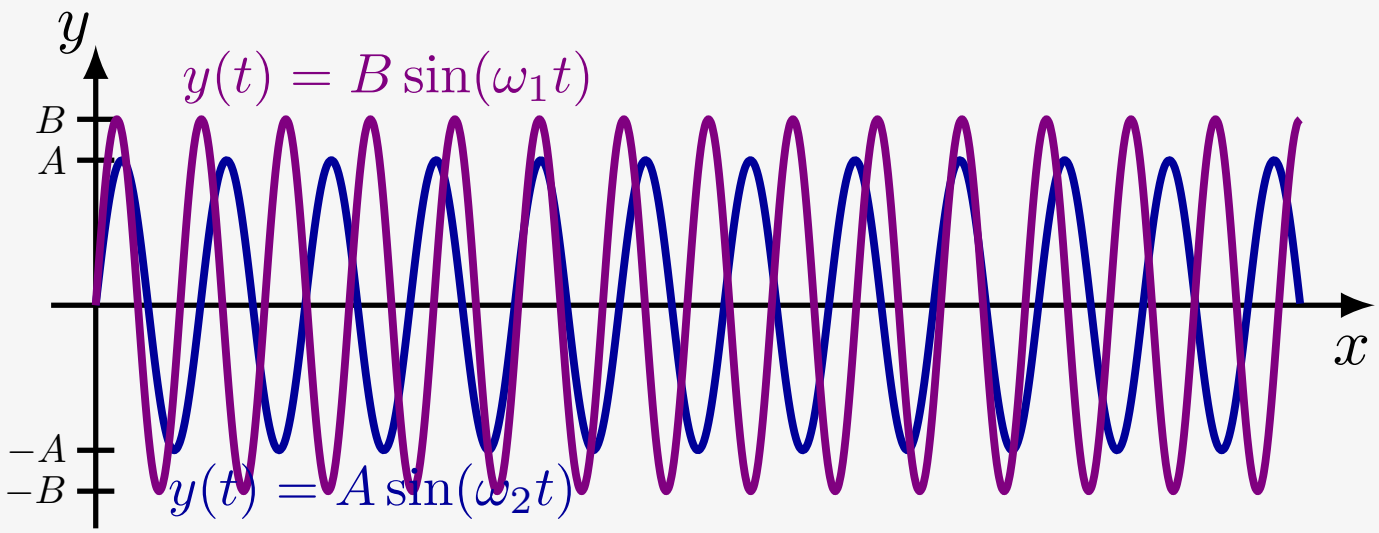
```
\colorlet{mypurple}{blue!50!red!80}
\colorlet{metalcol}{blue!25!black!30!white}

\def\tick#1#2{\draw[thick] (#1) ++ (#2:0.1) --++ (#2-180:0.2)}

\def\xmax{6.48}
```

```
\def\ymax{0.9}
\def\A{0.78}
\def\s{4.7*\A}
\def\N{400}
\def\fa{1.775}
\def\fb{2.20}

\begin{document}

\begin{tikzpicture}
  \draw[->,thick] (-0.2*\ymax,0) -- (0.4+\xmax,0) node[right=4,below left=1] {$x$};
  \draw[->,thick] (0,-\ymax) -- (0,0.2+\ymax) node[below=2,above left=-3] {$y$};
  \tick{0,\A}{0} node[scale=0.9,left=-1] {$A$};
  \tick{0,-\A}{0} node[scale=0.9,left=-1] {$-A$};
  \draw[myblue,very thick,samples=\N,smooth,variable=\x,domain=0:\xmax]
    plot(\x,{\A*sin(360*\fa*\x)});
  \draw[myred,very thick,samples=\N,smooth,variable=\x,domain=0:\xmax]
    plot(\x,{\A*sin(360*\fb*\x)});
  \node[above right=-1,myred,scale=0.85] at (0.7/\fa,\A) {$y(t)=A\sin(\omega_1 t)$};
\node[below right=-1,myblue,scale=0.85] at (0.7/\fb,-\A) {$y(t)=A\sin(\omega_2 t)$};
\end{tikzpicture}

\end{document}
```

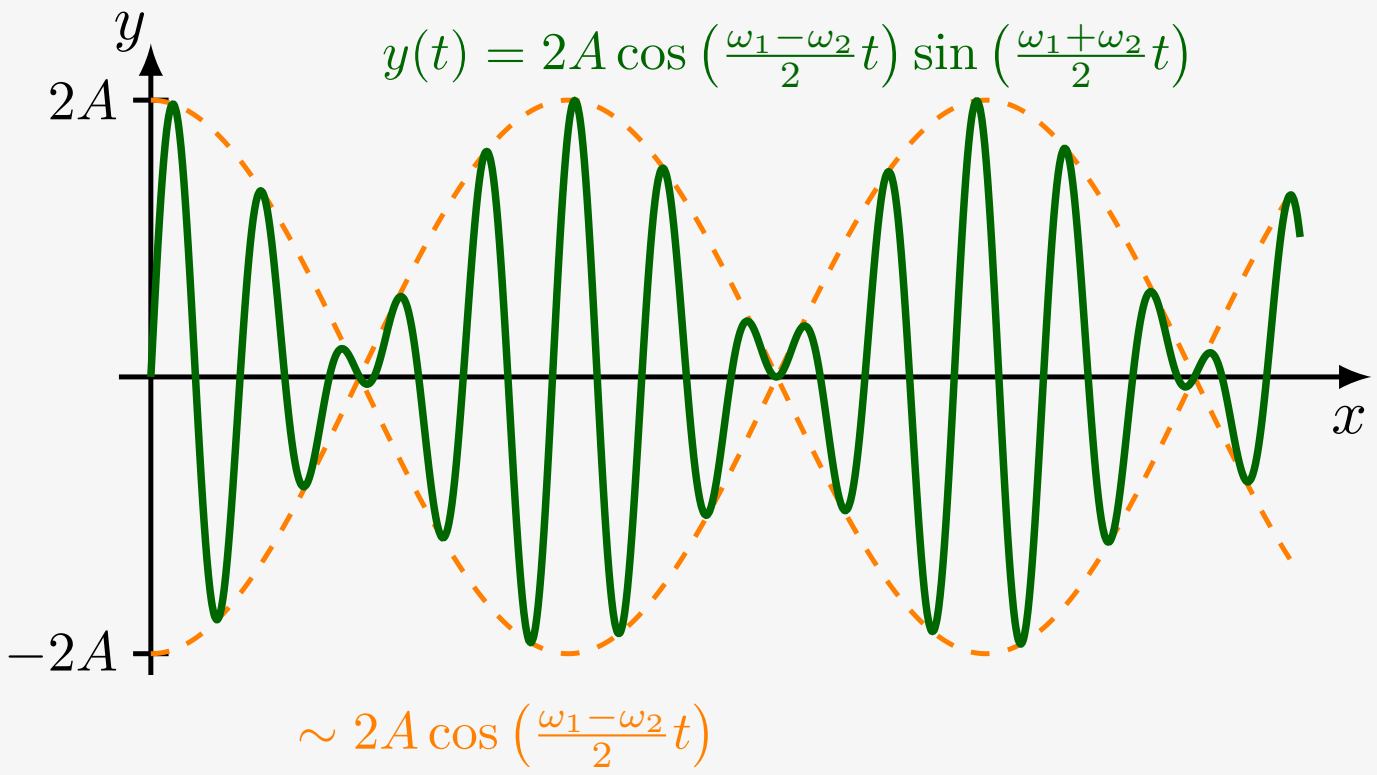



```
\colorlet{mypurple}{blue!50!red!80}
\colorlet{metalcol}{blue!25!black!30!white}

\def\tick#1#2{\draw[thick] (#1) ++ (#2:0.1) --++ (#2-180:0.2)}

\def\xmax{6.48}
\def\ymax{1.2}
\def\A{0.78}
\def\B{1}
\def\s{4.7*\A}
\def\N{400}
\def\fa{1.775}
\def\fb{2.20}

\begin{document}

\begin{tikzpicture}
  \draw[->,thick] (-0.2*\ymax,0) -- (0.4+\xmax,0) node[right=4,below left=1] {$x$};
  \draw[->,thick] (0,-\ymax) -- (0,0.2+\ymax) node[below=2,above left=-3] {$y$};
  \tick{0,\A}{0} node[scale=0.6,left=-1] {$A$};
  \tick{0,-\A}{0} node[scale=0.6,left=-1] {$-A$};
    \tick{0,\B}{0} node[scale=0.6,left=-1] {$B$};
  \tick{0,-\B}{0} node[scale=0.6,left=-1] {$-B$};
  \draw[myblue,very thick,samples=\N,smooth,variable=\x,domain=0:\xmax]
    plot(\x,{\A*sin(360*\fa*\x)});
```

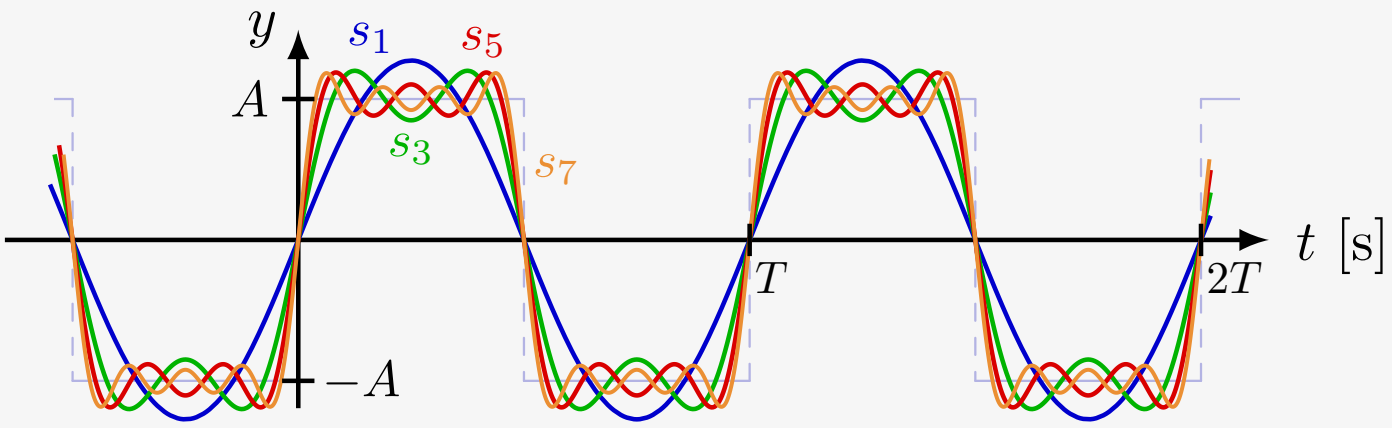
```
  \draw[violet,very thick,samples=\N,smooth,variable=\x,domain=0:\xmax]
    plot(\x,{\B*sin(360*\fb*\x)});
  \node[above right=-1,violet,scale=0.85] at (0.7/\fa,\B) {$y(t)=B\sin(\omega_1 t)$};
\node[below right=-1,myblue,scale=0.85] at (0.7/\fb,-\A) {$y(t)=A\sin(\omega_2 t)$};
\end{tikzpicture}

\end{document}
```



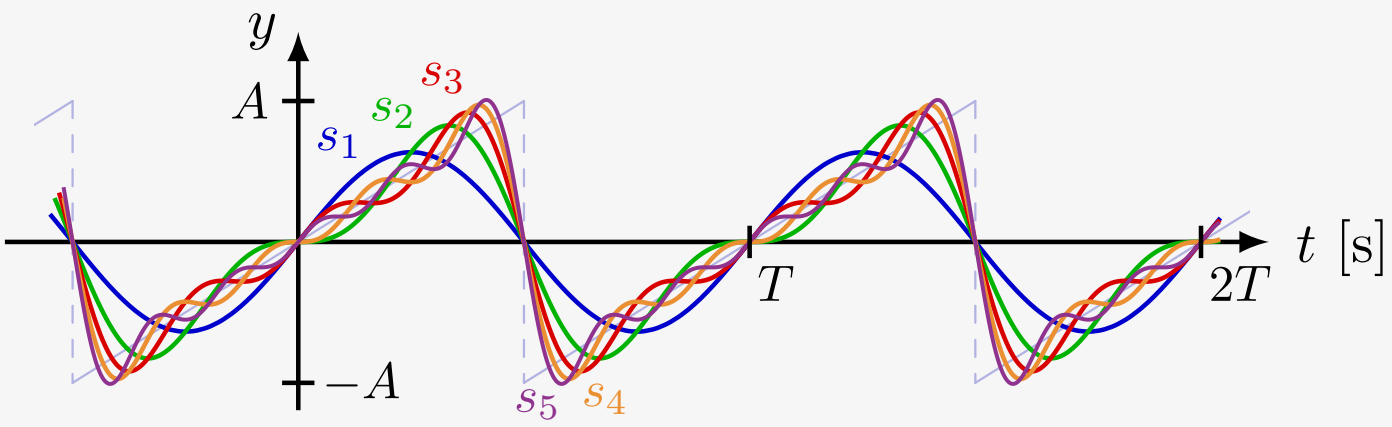

```
\colorlet{mypurple}{blue!50!red!80}
\colorlet{metalcol}{blue!25!black!30!white}
\tikzstyle{vvec}=[->,vcol,very thick,line cap=round]
\tikzstyle{node}=[xcol,scale=0.8]
\tikzstyle{metal}=[draw=metalcol!10!black,rounded corners=0.1,
  top color=metalcol,bottom color=metalcol!80!black,shading angle=10]
\tikzstyle{ring}=[metalcol!20!black,double=metalcol!70!black,double distance=1.2,line width=0.3]
\tikzstyle{rope}=[brown!20!black,double=brown!70!black,
  double distance=1.2,line width=0.6]
\tikzstyle{wood}=[draw=brown!80!black,rounded corners=0.1,
  top color=brown!80,bottom color=brown!80!black!80,shading angle=10]
\def\tick#1#2{\draw[thick] (#1) ++ (#2:0.1) --++ (#2-180:0.2)}

\def\xmax{6.48}
\def\ymax{0.9}
\def\A{0.78}
\def\s{4.7*\A}
\def\N{400}
\def\fa{1.775}
\def\fb{2.20}

\begin{document}

\begin{tikzpicture}
 \draw[->,thick] (-0.2*\ymax,0) -- (0.4+\xmax,0) node[right=4,below left=1] {$x$};
    \draw[->,thick] (0,-\ymax-\A) -- (0,0.2+\ymax+\A) node[below=2,above left=-3] {$y$};
    \tick{0,2*\A}{0} node[scale=0.9,left=-1] {$2A$};
    \tick{0,-2*\A}{0} node[scale=0.9,left=-1] {$-2A$};
    \draw[orange,thick,dashed,samples=2*\N,smooth,variable=\x,domain=0:\xmax]
      plot(\x,{ 2*\A*cos(180*(\fa-\fb)*\x)})
      plot(\x,{-2*\A*cos(180*(\fa-\fb)*\x)});
    \draw[green!40!black,very thick,samples=\N,smooth,variable=\x,domain=0:\xmax]
      plot(\x,{ 2*\A*sin(180*(\fa+\fb)*\x)*cos(180*(\fa-\fb)*\x)});
      \node[above right=-1,green!40!black,scale=0.85] at ({4.9/(\fa+\fb)},2*\A)
      {$y(t)=2A\cos\left(\frac{\omega_1-\omega_2}{2}t\right)\sin\left(\frac{\omega_1+\omega_2}{2}t\right)$};
    \node[below right=5,orange,scale=0.85] at ({0.23/(\fb-\fa)},-2*\A)
      {$\sim2A\cos\left(\frac{\omega_1-\omega_2}{2}t\right)$};
\end{tikzpicture}
\end{document}
```



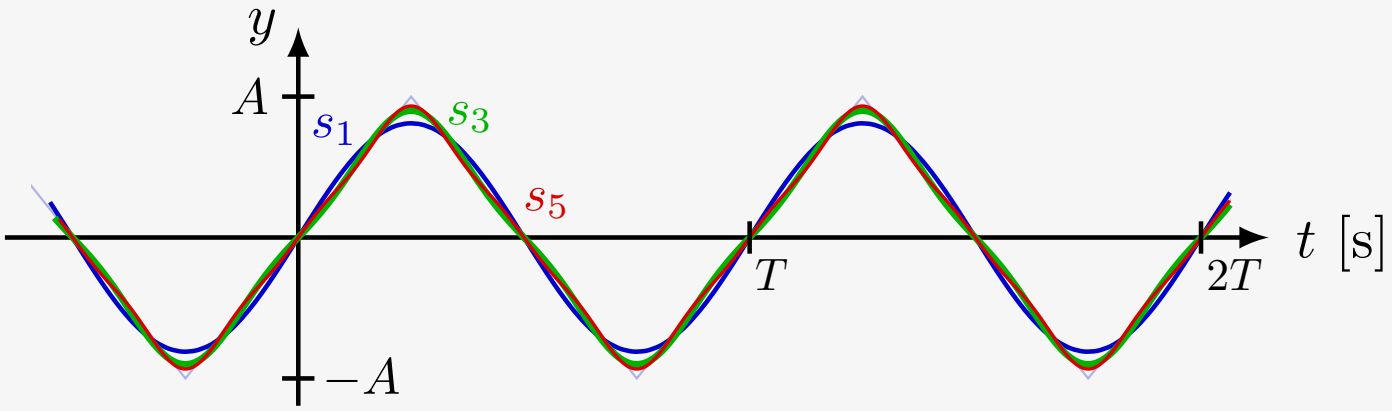

```
\begin{tikzpicture}
   \message{^^JSquare wave synthesis - time}
   \def\xmin{-0.65*\T}
   \def\T{(0.465*\xmax)}
  \begin{scope}
    \clip ({-0.54*\T},-1.1*\A) rectangle (0.97*\xmax,1.1*\A);
    \foreach \i [evaluate={\x=\i*\T/2;}] in {-2,...,4}{
      \ifodd\i
        \draw[myblue!80!black!30,line cap=round] (\x,{-\A}) --++ ({\T/2},0);
        \draw[myblue!80!black!30,dashed,thin,line cap=round]
          ({\x+\T/2},{-\A}) --++ (0,2*\A);
      \else
        \draw[myblue!80!black!30,line cap=round] (\x,{\A}) --++ ({\T/2},0);
        \draw[myblue!80!black!30,dashed,thin,line cap=round]
          ({\x+\T/2},{\A}) --++ (0,-2*\A);
      \fi
    }
  \end{scope}
  \draw[->,thick] (0,\ymin) -- (0,\ymax) node[left] {$y$};
  \draw[->,thick] ({\xmin},0) -- (\xmax,0) node[below=1,right=1] {$t$ [s]};
  \draw[xline,samples=\N,smooth,variable=\t,domain=-0.55*\T:0.94*\xmax]
    plot(\t,{\f{1}});% node[pos=0.3,above] {$n=1$};
  \draw[xline,mygreen,samples=3*\N,smooth,variable=\t,domain=-0.54*\T:0.94*\xmax]
    plot(\t,{\f{1}+\f{3}});
  \draw[xline,myred,samples=5*\N,smooth,variable=\t,domain=-0.53*\T:0.94*\xmax]
    plot(\t,{\f{1}+\f{3}+\f{5}});
  \draw[xline,myorange,line width=0.7,samples=7*\N,smooth,variable=\t,domain=-0.52*\T:0.94*\xmax]
    plot(\t,{\f{1}+\f{3}+\f{5}+\f{7}});
  \node[myblue,  above,scale=0.9] at ({0.16*\T},1.20*\A) {$s_1$};
  \node[mygreen, below,scale=0.9] at ({0.25*\T},0.88*\A) {$s_3$};
  \node[myred,   above,scale=0.9] at ({0.41*\T},1.17*\A) {$s_5$};
  \node[myorange,right,scale=0.9] at ({0.48*\T},0.50*\A) {$s_7$};
  \tick{{\T},0}{90} node[below right=-2,scale=0.8] {$T$};
  \tick{{2*\T},0}{90} node[below right=-2,scale=0.8] {$2T$};
  \tick{0,{ \A}}{  0} node[left=-1,scale=0.9] {$A$};
  \tick{0,{-\A}}{180} node[right=-2,scale=0.9] {$-A$};
\end{tikzpicture}
```




```
\begin{tikzpicture}
   \message{^^JSawtooth wave synthesis - time}
   \def\xmin{-0.65*\T}  % max x axis
   \def\T{(0.465*\xmax)} % period
   \def\f#1{\A*2/pi/(#1)*(-1)^(#1-1)*sin(360/\T*#1*Mod(\t,\T))} %Mod(360*#1*\t/\T,360)
  \begin{scope}
    \clip ({0.9*\xmin},-1.1*\A) rectangle (0.98*\xmax,1.1*\A);
    \foreach \i [evaluate={\x=\i*\T-\T/2;}] in {-2,...,4}{
      \draw[myblue!80!black!30,line cap=round]
        (\x,-\A) --++ ({\T},2*\A);
      \draw[myblue!80!black!30,dashed,thin,line cap=round]
        ({\x+\T},\A) --++ (0,-2*\A);
    }
  \end{scope}
  \draw[->,thick] (0,\ymin) -- (0,\ymax) node[left] {$y$};
  \draw[->,thick] ({\xmin},0) -- (\xmax,0) node[below=1,right=1] {$t$ [s]};
  \draw[xline,samples=\N,smooth,variable=\t,domain=-0.55*\T:0.95*\xmax]
    plot(\t,{\f{1}});
  \draw[xline,mygreen,samples=2*\N,smooth,variable=\t,domain=-0.54*\T:0.95*\xmax]
    plot(\t,{\f{1}+\f{2}});
  \draw[xline,myred,samples=3*\N,smooth,variable=\t,domain=-0.53*\T:0.95*\xmax]
    plot(\t,{\f{1}+\f{2}+\f{3}});
  \draw[xline,myorange,samples=4*\N,smooth,variable=\t,domain=-0.52*\T:0.95*\xmax]
    plot(\t,{\f{1}+\f{2}+\f{3}+\f{4}});
  \draw[xline,mypurple,line width=0.7,samples=5*\N,smooth,variable=\t,domain=-0.52*\T:0.95*\xmax]
    plot(\t,{\f{1}+\f{2}+\f{3}+\f{4}+\f{5}});
  \node[myblue,  above,scale=0.9] at ({0.09*\T}, 0.47*\A) {$s_1$};
  \node[mygreen, above,scale=0.9] at ({0.21*\T}, 0.68*\A) {$s_2$};
  \node[myred,   above,scale=0.9] at ({0.32*\T}, 0.93*\A) {$s_3$};
  \node[myorange,below,scale=0.9] at ({0.68*\T},-0.88*\A) {$s_4$};
  \node[mypurple,below,scale=0.9] at ({0.53*\T},-0.92*\A) {$s_5$};
  \tick{{\T},0}{90} node[below right=-2,scale=0.9] {$T$};
  \tick{{2*\T},0}{90} node[below right=-2,scale=0.9] {$2T$};
  \tick{0,{\A}}{  0} node[left=-1,scale=0.9] {$A$};
  \tick{0,{-\A}}{180} node[right=-2,scale=0.9] {$-A$};
\end{tikzpicture}
```

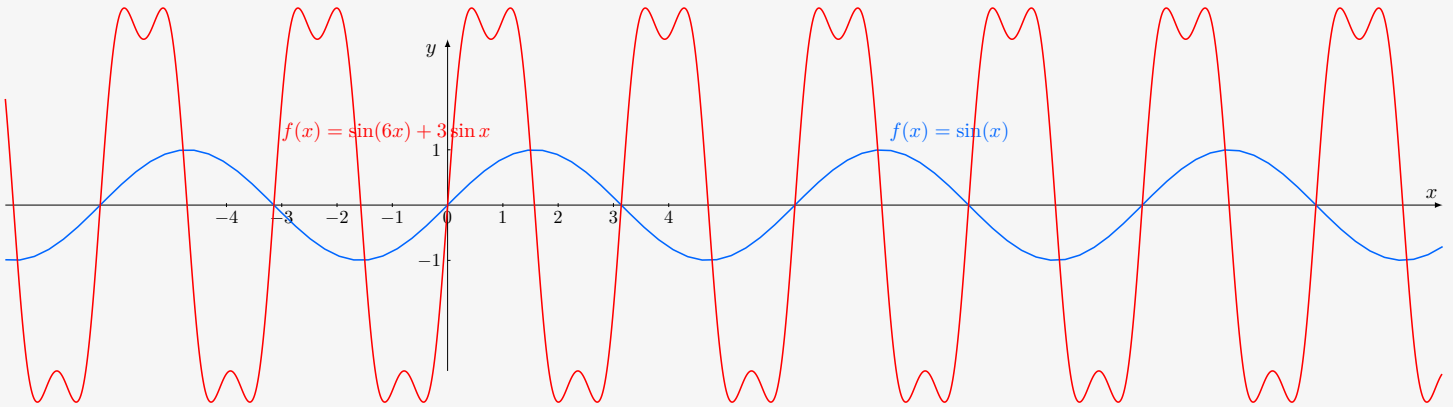



```
\begin{tikzpicture}
  \message{^^JTriangle wave synthesis - time}
   \def\xmin{-0.65*\T}  % max x axis
   \def\T{(0.465*\xmax)} % period
   \def\f#1{\A*8/pi^2/(#1)^2*(-1)^((#1-1)/2)*sin(360/\T*#1*Mod(\t,\T))} %Mod(360*#1*\t/\T,360)
  \begin{scope}
    \clip ({-0.59*\T},-1.1*\A) rectangle (0.96*\xmax,1.1*\A);
    \draw[myblue!80!black!30,line cap=round]
      \foreach \i [evaluate={\x=\i*\T;}] in {-2,...,4}{
        (\x,0) --++ ({0.25*\T},\A) --++ ({\T/2},-2*\A) --++ ({0.25*\T},\A)};
  \end{scope}
  \draw[->,thick] (0,\ymin) -- (0,\ymax) node[left] {$y$};
  \draw[->,thick] ({\xmin},0) -- (\xmax,0) node[below=1,right=1] {$t$ [s]};
  \draw[xline,samples=\N,smooth,variable=\t,domain=-0.55*\T:0.96*\xmax]
    plot(\t,{\f{1}});% node[pos=0.3,above] {$n=1$};
  \draw[xline,mygreen,line width=1.2,samples=2*\N,smooth,variable=\t,domain=-0.54*\T:0.96*\xmax]
    plot(\t,{\f{1}+\f{3}});
  \draw[xline,myred,line width=0.6,samples=3*\N,smooth,variable=\t,domain=-0.53*\T:0.96*\xmax]
    plot(\t,{\f{1}+\f{3}+\f{5}});
  \node[myblue,  above,scale=0.9] at ({0.08*\T},0.53*\A) {$s_1$};
  \node[mygreen, above,scale=0.9] at ({0.38*\T},0.62*\A) {$s_3$};
  \node[myred,   above,scale=0.9] at ({0.55*\T},0.01*\A) {$s_5$};
  \tick{{  \T},0}{90} node[below right=-2,scale=0.8] {$T$};
  \tick{{2*\T},0}{90} node[below right=-2,scale=0.8] {$2T$};
  \tick{0,{ \A}}{  0} node[left=-1,scale=0.9] {$A$};
  \tick{0,{-\A}}{180} node[right=-2,scale=0.9] {$-A$};
\end{tikzpicture}
```



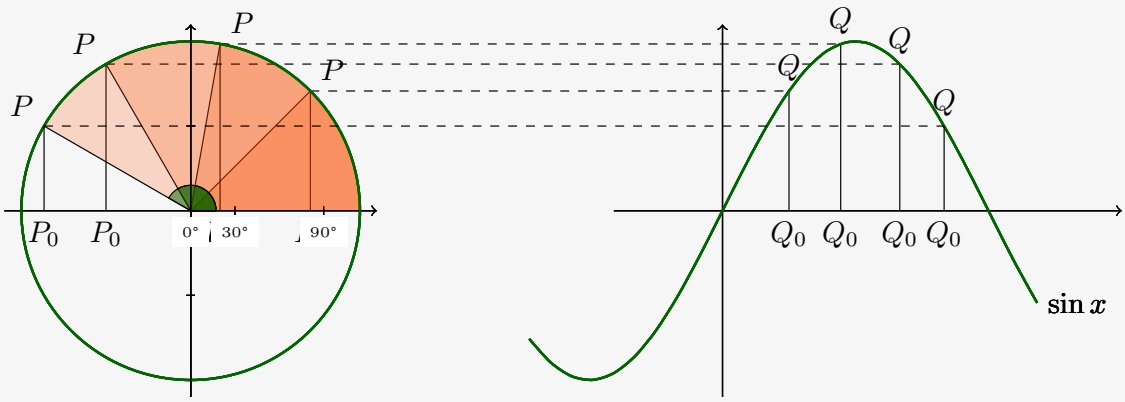

```
\documentclass{ctexart}
\usepackage{ctex}
\usepackage{amsmath} % for \dfrac
\usepackage{tikz}
\tikzset{>=latex} % for LaTeX arrow head
```

```
\usepackage{pgfplots} % for the axis environment

% split figures into pages
\usepackage[active,tightpage]{preview}
\PreviewEnvironment{tikzpicture}
\setlength\PreviewBorder{0pt}%
  \def\xa{-8}
  \def\xb{18}
  \def\ya{-3}
  \def\yb{3}
  \def\N{100}
\begin{document}
\begin{tikzpicture}
  \draw[->](\xa,0) -- (\xb,0) node[above=6pt,left=-1pt] {$x$};
  \draw[->](0,\ya) -- (0,\yb) node[below=6pt,left=2pt] {$y$};
  \foreach \X in {-4,-3,...,4}
 \draw (\X cm,1pt) -- (\X cm,-1pt)
node[below,scale=0.9] at (\X,0) {$\X$};
\foreach \Y in {-1,1}
\draw (0pt,\Y cm) -- (1.5pt,\Y cm) node[left,scale=0.9] at (0,\Y) {$\Y$};
  \def\ea{0.28}
  \def\eb{0.26}
  \draw[color=blue!60!cyan,thick,samples=\N,domain=\xa:\xb]
    plot(\x,{sin(\x r)})
    node[above right] at (5*pi/2,1) {$f(x)=\sin(x)$};
\draw[color=red,thick,samples=2000,domain=\xa:\xb]
    plot(\x,{sin(6*\x r)+4*sin(2*\x r)})
    node[above right] at (-2*pi/2,1) {$f(x)=\sin(6x)+3\sin x$};
    \end{tikzpicture}
\end{document}
```



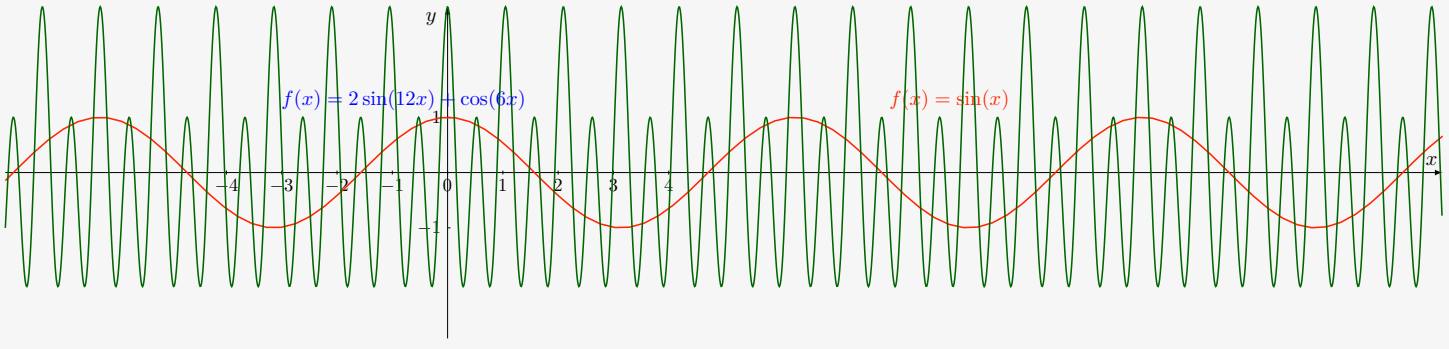

```
\begin{tikzpicture}
\foreach \iangle in {45,80,120,150}{
\fill[fill=orange!60!red,fill opacity=0.2](0,0) -- (0:2) arc (0:\iangle:2) -- cycle;
\filldraw[fill=green!40!black,fill opacity=0.5](0,0) --(0:0.3) arc (0:\iangle:0.3) -- cycle;
                \draw[->] (-2.2,0) -- (2.2,0);
                \draw[->] (0,-2.2) -- (0,2.2);
                \draw[thick,draw=green!40!black] (0,0) circle (2);
                \coordinate[label=\iangle:$P$] (P) at (\iangle:2);
                \coordinate[label=below:$P_0$] (P0) at (P |- 0,0);
                \draw (0,0) -- (P);
                \draw (P) -- (P0);
                \draw[->] (5,0) -- (11,0);
                \draw[->] (0,-2.2) -- (0,2.2);
        \draw[->] (2*pi,-2.2) -- (2*pi,2.2);
\draw[thick,domain=4:10,smooth,draw=green!40!black] plot(\x,{2*sin(\x r)}) node[right] {$\sin x$};
\foreach \t in {0,30,90} {
                        \draw ({rad(\t)},-0.05) -- ({rad(\t)},0.05);
                        \node[below,outer sep=2pt,fill=white,font=\tiny]
                        at ({rad(\t)},0) {\ang{\t}};}
\foreach \y in {-1,1} {\draw (-0.05,\y) -- (0.05,\y); }
                \coordinate[label=above:$Q$] (Q) at ({rad(\iangle+360)},{2*sin(\iangle+360)});
                \coordinate[label=below:$Q_0$] (Q0) at (Q |- 0,0);
```

```
                \draw (Q) -- (Q0);
                \draw[dashed] (P) -- (Q);
}
\end{tikzpicture}
```

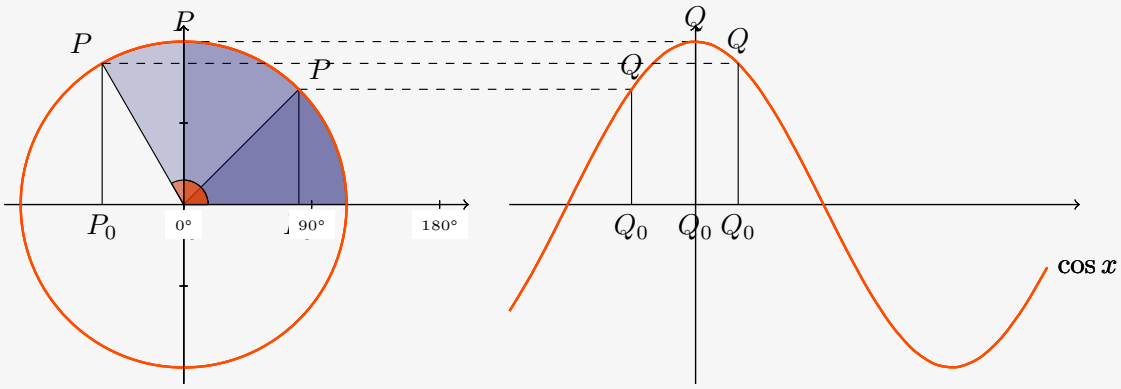


2. 余弦函数

```
\documentclass{ctexart}
\usepackage{ctex}
\usepackage{amsmath}
\usepackage{tikz}
\tikzset{>=latex}
\usepackage{pgfplots}
\usepackage[active,tightpage]{preview}
\PreviewEnvironment{tikzpicture}
\setlength\PreviewBorder{0pt}%
  \def\xa{-8}
  \def\xb{18}
  \def\ya{-3}
  \def\yb{3}
  \def\N{100}
\begin{document}
\begin{tikzpicture}
  \draw[->](\xa,0) -- (\xb,0) node[above=6pt,left=-1pt] {$x$};
  \draw[->](0,\ya) -- (0,\yb) node[below=6pt,left=2pt] {$y$};
  \foreach \X in {-4,-3,...,4}
 \draw (\X cm,1pt) -- (\X cm,-1pt)
node[below,scale=0.9] at (\X,0) {$\X$};
\foreach \Y in {-1,1}
\draw (0pt,\Y cm) -- (1.5pt,\Y cm) node[left,scale=0.9] at (0,\Y) {$\Y$};
  \def\ea{0.28}
  \def\eb{0.26}
  \draw[color=orange!30!red,thick,samples=\N,domain=\xa:\xb]
    plot(\x,{cos(\x r)})
    node[above right] at (5*pi/2,1) {$f(x)=\sin(x)$};
\draw[color=green!40!black,thick,samples=2000,domain=\xa:\xb]
    plot(\x,{2*cos(12*\x r)+cos(6*\x r)})
    node[above right,color=blue] at (-2*pi/2,1) {$f(x)=2\sin(12x)+\cos (6x)$};
    \end{tikzpicture}
\end{document}
```



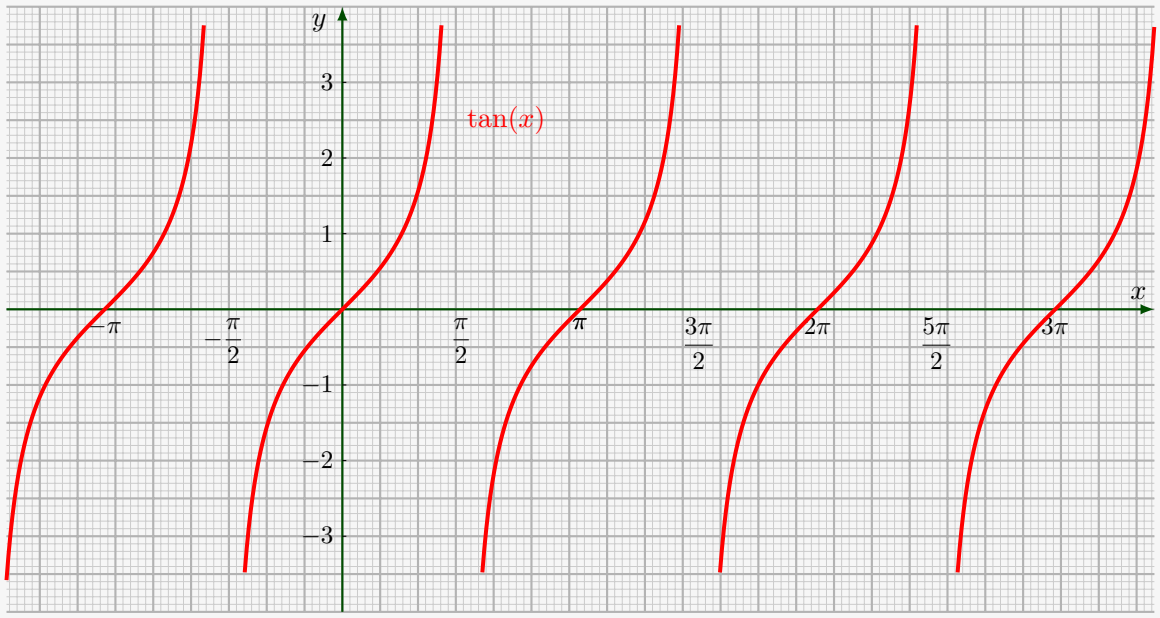
```
\begin{tikzpicture}
\foreach \iangle in {45,90,120}{
\fill[fill=blue!40!black,fill opacity=0.2](0,0) -- (0:2) arc (0:\iangle:2) -- cycle;
\filldraw[fill=orange!60!red,fill opacity=0.5](0,0) --(0:0.3) arc (0:\iangle:0.3) -- cycle;
                \draw[->] (-2.2,0) -- (3.5,0);
                \draw[->] (0,-2.2) -- (0,2.2);
                \draw[thick,draw=orange!60!red] (0,0) circle (2);
                \coordinate[label=\iangle:$P$] (P) at (\iangle:2);
                \coordinate[label=below:$P_0$] (P0) at (P |- 0,0);
                \draw (0,0) -- (P);
                \draw (P) -- (P0);
                \draw[->] (4,0) -- (11,0);
                \draw[->] (0,-2.2) -- (0,2.2);
        \draw[->] (2*pi,-2.2) -- (2*pi,2.2);
\draw[thick,domain=4:10.6,smooth,draw=orange!60!red] plot(\x,{2*cos(\x r)}) node[right] {$\cos x$};
                \foreach \t in {0,90,180} {
                \draw ({rad(\t)},-0.05) -- ({rad(\t)},0.05);
                \node[below,outer sep=2pt,fill=white,font=\tiny]
                        at ({rad(\t)},0) {\ang{\t}};}
                \foreach \y in {-1,1} {\draw (-0.05,\y) -- (0.05,\y);}
                \coordinate[label=above:$Q$] (Q) at ({rad(\iangle+270)},{2*cos(\iangle+270)});
                \coordinate[label=below:$Q_0$] (Q0) at (Q |- 0,0);
                \draw (Q) -- (Q0);
                \draw[dashed] (P) -- (Q);
}
\end{tikzpicture}
```



3. 正切函数

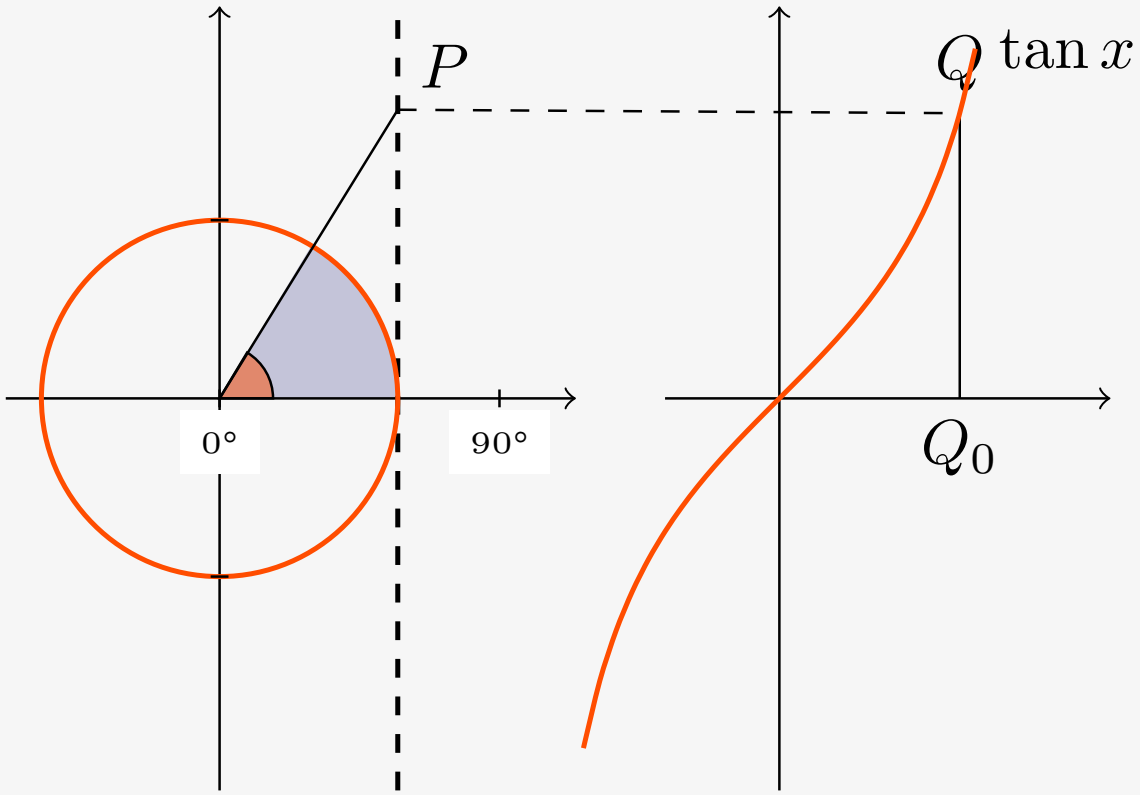
```
\documentclass{ctexart}
\usepackage{ctex}
\usepackage{amsmath} % for \dfrac
\usepackage{tikz}
\tikzset{>=latex} % for LaTeX arrow head
\usepackage{pgfplots} % for the axis environment

% split figures into pages
\usepackage[active,tightpage]{preview}
\PreviewEnvironment{tikzpicture}
\setlength\PreviewBorder{0pt}%
  \def\xa{-4.44}
  \def\xb{10.735}
  \def\ya{-4}
  \def\yb{4}
  \def\N{100}
\begin{document}
\begin{tikzpicture}
\draw[xstep=0.1,ystep=0.1,very thin, color=gray!40!white,fill=blue!5!white](\xa,\ya) grid (\xb,\yb);
  \draw[xstep=0.5,ystep=0.5,thick, color=gray!60!white,fill=blue!5!white](\xa,\ya) grid (\xb,\yb);
  \draw[->,thick,draw=green!30!black](\xa,0) -- (\xb,0) node[above=6pt,left=-1pt] {$x$};
  \draw[->,thick,draw=green!30!black](0,\ya) -- (0,\yb) node[below=6pt,left=2pt] {$y$};
```

```
  \draw[]
        node[below,scale=0.9] at ( -pi,   0) {$-\pi$}
        node[below,scale=0.9] at ( -pi/2, 0) {$-\dfrac{\pi}{2}$}
        node[below,scale=0.9] at (  pi,   0) {$\pi$}
        node[below,scale=0.9] at (  pi/2, 0) {$\dfrac{\pi}{2}$}
        node[below,scale=0.9] at (  pi,   0) {$\pi$}
        node[below,scale=0.9] at (3*pi/2, 0) {$\dfrac{3\pi}{2}$}
        node[below,scale=0.9] at (2*pi,   0) {$2\pi$}
        node[below,scale=0.9] at (5*pi/2, 0) {$\dfrac{5\pi}{2}$}
        node[below,scale=0.9] at (3*pi,0) {$3\pi$};
\foreach \Y in {-3,-2,-1,1,2,3}
\draw (0pt,\Y cm) -- (1.5pt,\Y cm) node[left,scale=0.9] at (0,\Y) {$\Y$};
  \def\ea{0.28}
  \def\eb{0.26}
  \draw[line width=1.5pt,draw=red]
    plot[samples=\N,domain=  \xa     :   -pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain=  -pi/2+\ea:   pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain=   pi/2+\ea: 3*pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain= 3*pi/2+\ea: 5*pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain= 5*pi/2+\ea:  \xb      ] (\x, {tan(\x r)})
    node[samples=\N,right=-2pt,color=red] at (pi/2,2.5) {$\tan(x)$};
    \end{tikzpicture}
\end{document}
```



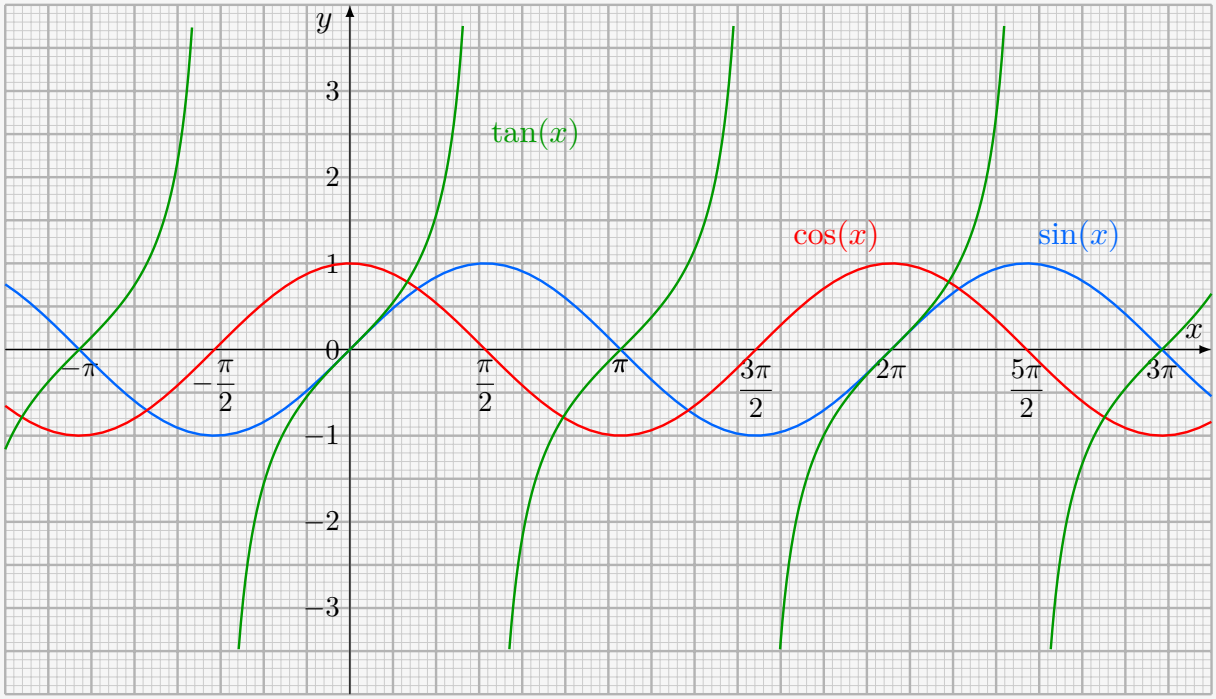

```
\documentclass[border=0pt]{standalone}
\usepackage{tikz}
\usepackage{siunitx}
%\newcommand{\iangle}{120}
\begin{document}
        \begin{tikzpicture}
\foreach \iangle in {45}{
                        \fill[fill=blue!40!black,fill opacity=0.2]
                        (0,0) -- (0:1) arc (0:\iangle+14:1) -- cycle;
                        \filldraw[fill=orange!60!red,fill opacity=0.5]
                        (0,0) --(0:0.3) arc (0:\iangle+14:0.3) -- cycle;
                        \draw[->] (-1.2,0) -- (2,0);
            \draw[->] (2.5,0) -- (5,0);
                    \draw[->] (0,-2.2) -- (0,2.2);
            \draw[thick,dashed] (1,-2.2) -- (1,2.2);
            \draw[->] (pi,-2.2) -- (pi,2.2);
                        \draw[thick,draw=orange!60!red] (0,0) circle (1);
                        \coordinate[label=\iangle:$P$] (P) at (1,{tan(\iangle r)});
            \coordinate[label=above:$Q$] (Q) at ({rad(\iangle+193)},{tan(\iangle+193)});
                    \coordinate[label=below:$Q_0$] (Q0) at (Q |- 0,0);
                    \draw (Q) -- (Q0);
                    \draw[dashed] (P) -- (Q);
                        \draw (0,0) -- (P);
```

```
                        \draw[thick,domain=0.65*pi:1.35*pi,smooth,draw=orange!60!red] plot(\x,{tan(\x r)}) node[right]
    {$\tan x$};
%% ============================================================
                \foreach \t in {0,90} {
                        \draw ({rad(\t)},-0.05) -- ({rad(\t)},0.05);
                        \node[below,outer sep=2pt,fill=white,font=\tiny]
                        at ({rad(\t)},0) {\ang{\t}};
                }
                \foreach \y in {-1,1} {
                        \draw (-0.05,\y) -- (0.05,\y);
                }
}
        \end{tikzpicture}
\end{document}
```




```

\draw[->](\xa,0) -- (\xb,0) node[above=6pt,left=-1pt] {$x$};
\draw[->](0,\ya) -- (0,\yb) node[below=6pt,left=2pt] {$y$};
\draw[]
      node[below,scale=0.9] at ( -pi,   0) {$-\pi$}
      node[below,scale=0.9] at ( -pi/2, 0) {$-\dfrac{\pi}{2}$}
      node[below,scale=0.9] at (  pi,   0) {$\pi$}
      node[below,scale=0.9] at (  pi/2, 0) {$\dfrac{\pi}{2}$}
      node[below,scale=0.9] at (  pi,   0) {$\pi$}
      node[below,scale=0.9] at (3*pi/2, 0) {$\dfrac{3\pi}{2}$}
      node[below,scale=0.9] at (2*pi,   0) {$2\pi$}
      node[below,scale=0.9] at (5*pi/2, 0) {$\dfrac{5\pi}{2}$}
      node[below,scale=0.9] at (3*pi,0) {$3\pi$};
\draw[]
      node[left,scale=0.9] at ( 0,  3) {$3$}
      node[left,scale=0.9] at ( 0,  2) {$2$}
      node[left,scale=0.9] at ( 0,  1) {$1$}
      node[left,scale=0.9] at ( 0,  0) {$0$}
      node[left,scale=0.9] at ( 0, -1) {$-1$}
      node[left,scale=0.9] at ( 0, -2) {$-2$}
      node[left,scale=0.9] at ( 0, -3) {$-3$};
\def\ea{0.28}
\def\eb{0.26}
\draw[color=blue!60!cyan,thick,samples=\N,domain=\xa:\xb]
  plot(\x,{sin(\x r)})
  node[above right] at (5*pi/2,1) {$\sin(x)$};
```

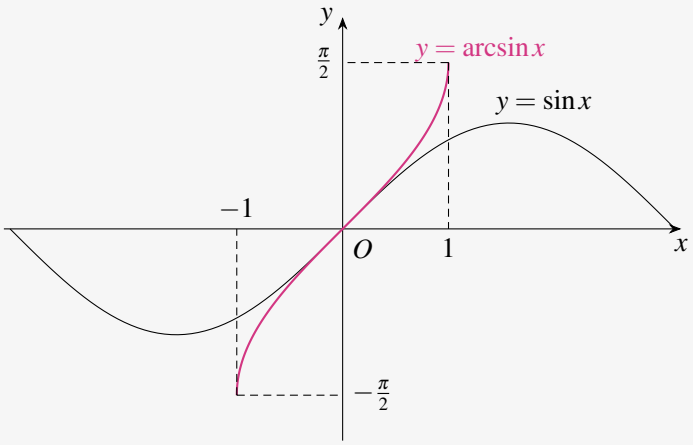
```
  \draw[thick,color=red,samples=\N,domain=\xa:\xb]
    plot(\x,{cos(\x r)})
    node[above left] at (2*pi,1) {$\cos(x)$};
  \draw[thick,draw=green!60!black]
    plot[samples=\N,domain=  \xa     :   -pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain=  -pi/2+\ea:   pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain=   pi/2+\ea: 3*pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain= 3*pi/2+\ea: 5*pi/2-\eb] (\x, {tan(\x r)})
    plot[samples=\N,domain= 5*pi/2+\ea:  \xb      ] (\x, {tan(\x r)})
    node[samples=\N,right=-2pt,color=green!60!black] at (pi/2,2.5) {$\tan(x)$};
    \end{tikzpicture}
\end{document}
```



3.7.2 三角函数的反函数

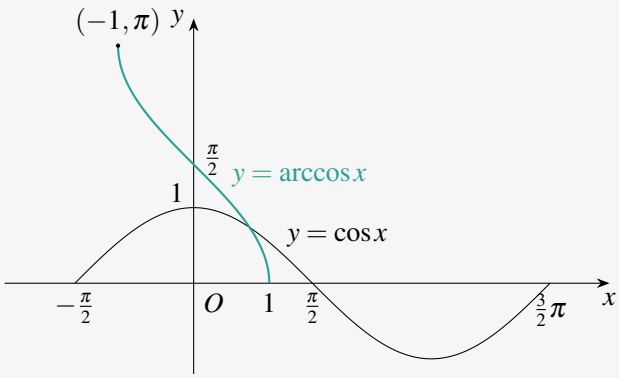
1. 反正弦函数

```
\begin{tikzpicture}[samples=100,scale=1.4]
\draw[-Stealth](-3.2,0)--(0,0)node[below right]{$O$}--(3.2,0)node[
    below]{$x$};
\draw[-Stealth](0,-2)--(0,2)node[left]{$y$};
\draw[domain=-pi:pi]plot(\x,{sin(\x r)});
\draw[semithick,domain=-pi/2:pi/2,draw=magenta,thick]plot({sin(\x r)},
    \x);
\node at(1.9,1.2){$y=\sin x$};\node[color=magenta] at(1.3,1.7){$y=
    \arcsin x$};
\draw[densely dashed](1,pi/2)--(1,0)node[below]{$1$}
(1,pi/2)--(0,pi/2)node[left]{$\frac\pi2$};
\draw[densely dashed](-1,-pi/2)--(-1,0)node[above]{$-1$}
(-1,-pi/2)--(0,-pi/2)node[right]{$-\frac\pi2$};
\end{tikzpicture}
```



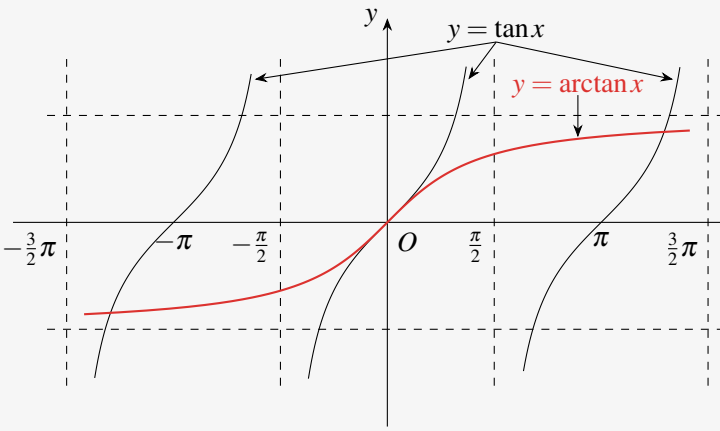
2. 反余弦函数

```
\begin{tikzpicture}[samples=100]
\draw[-Stealth](-2.5,0)--(0,0)node[below right]{$O$}--(5.5,0)node[
    below]{$x$};
\draw[-Stealth](0,-1.2)--(0,3.5)node[left]{$y$};
\draw[domain=-pi/2:3*pi/2]plot(\x,{cos(\x r)});\node[color=cyan] at
    (1.4,1.4){$y=\arccos x$};
\draw[semithick,domain=0:pi,thick,draw=cyan]plot({cos(\x r)},\x);
\node at(1.9,0.6){$y=\cos x$};
\node[left]at(0,1.2){$1$};\
\node[below] at(-pi/2,0){$-\frac\pi2$};
\node[below]at(pi/2,0){$\frac\pi2$};
\node[below]at(1,0){$1$};\node[right]at(0,1.63){$\frac\pi2$};
\node[below]at(3*pi/2,0){$\frac32\pi$};
\fill(-1,pi)circle(0.8pt)node[above]{$(-1,\pi)$};
\end{tikzpicture}
```



3. 反正切函数

```
\begin{tikzpicture}[samples=100,scale=0.9]
\draw[-Stealth](-5.5,0)--(0,0)node[below right]{$O$}--(5.5,0)node[
    below]{$x$};
\draw[-Stealth](0,-3)--(0,3)node[left]{$y$};
\draw[domain=-4.3:-2]plot(\x,{tan(\x r)});
\draw[dashed](-3*pi/2,-2.4)--(-3*pi/2,2.4);
\draw[dashed](-pi/2,-2.4)--(-pi/2,2.4);
\draw[dashed](pi/2,-2.4)--(pi/2,2.4);
\draw[dashed](3*pi/2,-2.4)--(3*pi/2,2.4);
\draw[domain=-1.16:1.16]plot(\x,{tan(\x r)});
\draw[domain=2:4.3]plot(\x,{tan(\x r)});
\node[below left]at(-3*pi/2,0){$-\frac32\pi$};
\node[below left]at(3*pi/2,0){$\frac32\pi$};
\node[below left]at(pi/2,0){$\frac\pi2$};\node[below left]at(-pi/2,0){
    $-\frac\pi2$};
\node[below]at(pi,0){$\pi$};\node[below]at(-pi,0){$-\pi$};
\node(a)at(1.6,2.8){$y=\tan x$};\node[color=red](b) at(2.8,2){$y=
    \arctan x$};
\draw[semithick,domain=-1.35:1.35,thick,draw=red]plot({tan(\x r)},\x);
\draw[dashed](-5,pi/2)--(5,pi/2)(-5,-pi/2)--(5,-pi/2);
\draw[-Stealth](2.8,1.87)--(2.8,1.25);
\draw[-Stealth](1.6,2.65)--(-1.95,2.1);
\draw[-Stealth](1.6,2.65)--(1.19,2.1);\draw[-Stealth](1.6,2.65)
    --(4.2,2.1);
\end{tikzpicture}
```



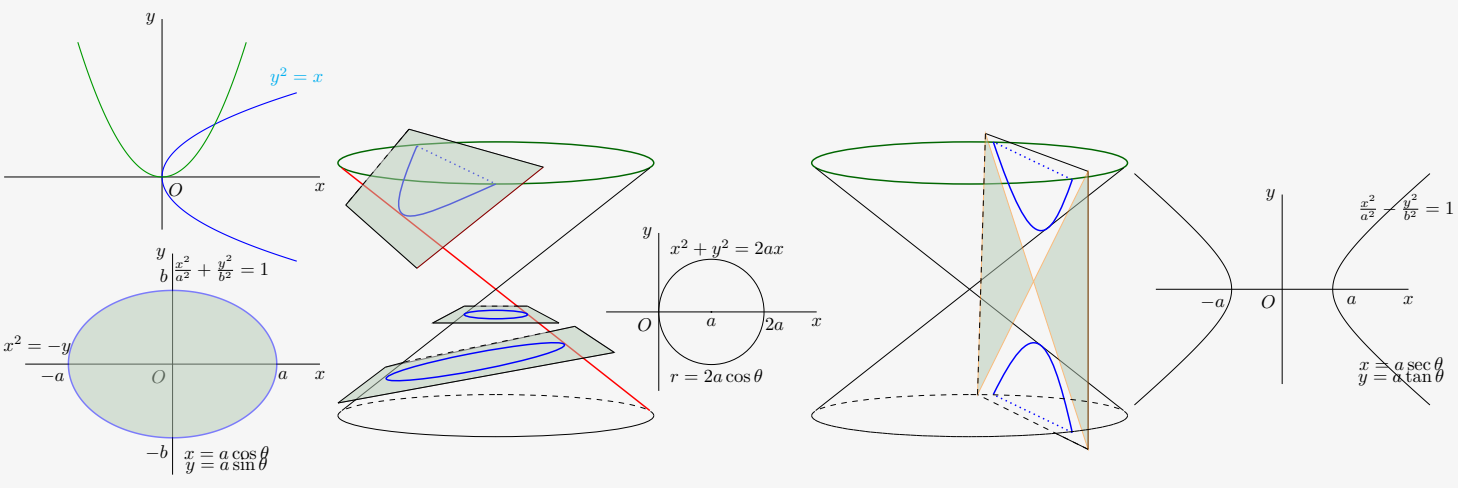
3.8 圆锥曲线的 TikZ 绘制

圆锥曲线的产生

```
\documentclass[border=0mm]{standalone}
\usepackage{tikz,times}
\usepackage{verbatim}
\usepackage[active,tightpage]{preview}
\PreviewEnvironment{tikzpicture}
\setlength\PreviewBorder{10pt}
\tikzset{fontscale/.style = {font=\relsize{#1}}}
\usetikzlibrary{arrows}
\usetikzlibrary{decorations.markings}
\tikzset{->-/.style={decoration={
  markings,
  mark=at position #1 with {\arrow{triangle 45}}},postaction={decorate}}}

\begin{document}
\begin{tikzpicture}[xscale=1.5,yscale=0.8]
\draw[green!40!black,thick] (-3,3) ellipse (2 and 0.5);
```

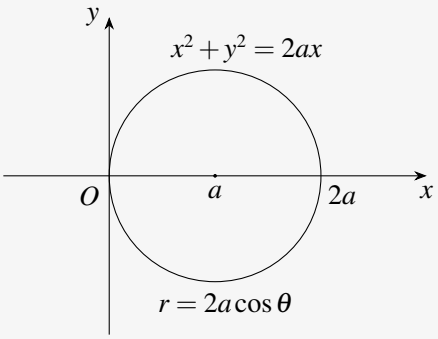
```
\draw[green!40!black,thick] (3,3) ellipse (2 and 0.5);
\draw[red,thick] (-4.95,2.88) -- (-1.05,-2.88);
\draw[] (-4.95,-2.88) -- (-1.05,2.88);
\draw[] (4.95,2.88) -- (1.05,-2.88);
\draw[] (4.95,-2.88) -- (1.05,2.88);

\draw[fill=green!30!black!30!white,opacity=0.5] (-2.6,-0.4) -- (-3.4,-0.4)--(-3.8,-0.8)--(-2.2,-0.8);
\draw[blue, thick] (-3,-0.6) ellipse (0.4 and 0.1);
\draw[] (-3.8,-0.8) -- (-2.2,-0.8);
\draw[] (-3.8,-0.8) -- (-3.4,-0.4);
\draw[] (-2.2,-0.8) -- (-2.6,-0.4);
\draw[] (-3.4,-0.4) -- (-3.3,-0.4);
\draw[] (-2.6,-0.4) -- (-2.7,-0.4);
\draw[dashed] (-2.7,-0.4) -- (-3.3,-0.4);
\node[] at (-.2,-0.4) {
\begin{tikzpicture}[samples=100]
\draw[smooth](-1,0)--(0,0)node[below left]{$O$}--(3,0)node[below]{$x$};
\draw[smooth](0,-1.5)--(0,1.5)node[left]{$y$};
\draw plot[tension=1,smooth cycle]coordinates{(0,0)(1,1)(2,0)(1,-1)};
\node [below]at(2.2,0){$2a$};\node [below]at(1,0){$a$};
\fill(1,0)circle(0.5pt);
\node at(1.1,-1.2){$r=2a\cos\theta$};
\node at(1.3,1.2){$x^2+y^2=2ax$};
\end{tikzpicture}};

\draw[fill=green!30!black!30!white,opacity=0.5] (-5,-2.7) -- (-1.5,-1.5)-- (-2,-0.88)--(-4.4,-1.85);
\draw[rotate around={20:(-3.26,-1.72)}, blue, thick] (-3.26,-1.72) ellipse (1.2 and 0.2);
\draw[] (-5,-2.7) -- (-1.5,-1.5);
\draw[] (-5,-2.7) -- (-4.4,-1.85);
\draw[] (-4.4,-1.85) -- (-4.1,-1.7);
\draw[] (-1.5,-1.5) -- (-2,-0.88);
\draw[] (-2,-0.88) -- (-2.3,-1);
\draw[dashed] (-2.3,-1) -- (-4.1,-1.7);
\node[left] at (-5,-1.7) {
\begin{tikzpicture}[samples=200,scale=1.4]
\draw[smooth](-2,0)--(0,0)node[below left]{$O$}--(2,0)node[below]{$x$};
\draw[smooth](0,-1.5)--(0,1.5)node[left]{$y$};
\draw[domain=0:2*pi,thick,draw=blue,fill=green!30!black!30!white,opacity=0.5]plot({1.414*cos(\x r)},{sin(\x r)});
\node[left=-1pt] at(0,1.2){$b$};\node[left=-1pt] at(0,-1.2){$-b$};
\node[below] at(-1.63,0){$-a$};\node[below] at(1.5,0){$a$};
\node at(1.4,1.3){$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$};
\node[align=flush center] at(1.4,-1.3){$x=a\cos\theta$\\[-2mm]
$y=a\sin\theta$};
\end{tikzpicture}
};

%% ======================================
\draw[blue,thick] (-4,3.4) .. controls (-4.5,1.2)
and (-4.2,1.5) .. (-3,2.5);
\draw[dotted, blue, thick] (-4,3.4) -- (-3,2.5);
\draw[red] (-2.4,2.9) -- (-4,0.5);
\draw[] (-2.4,2.9) -- (-4.1,3.8) coordinate (A);
\draw[] (-4,0.5) -- (-4.9,2) coordinate (B);
\draw[dashed] (A) -- (B);
\draw[] (A) -- (-4.28,3.4);
\draw[] (B) -- (-4.7,2.45);
\draw[fill=green!30!black!30!white,opacity=0.5] (-2.4,2.9) -- (-4,0.5)--(-4.9,2)--(-4.1,3.8)--cycle;
\node[left] at (-5,2.5) {
\begin{tikzpicture}[samples=100]
\draw[smooth](-3,0)--(0,0)node[below right]{$O$}--(3,0)node[below]{$x$};
\draw[smooth](0,-1)--(0,3)node[left]{$y$};
\draw[semithick,domain=0:1.6,draw=blue]plot({(\x)^2},\x)
node[above,color=cyan]{$y^2=x$};
\draw[semithick,domain=0:1.6,draw=blue]plot({(\x)^2},-\x);
\draw[semithick,domain=-1.6:1.6,draw=green!60!black]plot(\x,{(\x)^2});
\node at(-1.6,-3.2){$x^2=-y$};
\end{tikzpicture}};
```

```
\draw[] (4.5,-3.8) coordinate (A) -- (4.5,2.8) coordinate (B);
\draw[dashed] (A) -- (3.1,-2.5) coordinate (C);
\draw[] (B) -- (3.2,3.7) coordinate (D);
\draw[draw=orange,fill=green!30!black!30!white,opacity=0.5] (A) -- (B)--(C)--(D)--cycle;
\draw[dashed] (C) -- (D);
\draw[blue, thick] (4.3,-3.4) coordinate (E) .. controls (4,-0.9) and (3.8,-0.6) .. (3.3,-2.5) coordinate (F);
\draw[dotted, blue, thick] (E) -- (F);
\draw[blue, thick] (4.3,2.6) coordinate (G) .. controls (4,1) and (3.8,0.7) .. (3.3,3.5) coordinate (H);
\draw[dotted, blue, thick] (G) -- (H);
\draw[] (A) -- (4.1,-3.43);
\node[right] at (5,0) {\begin{tikzpicture}[samples=200,scale=1.2]
\def\a{0.8}
\def\b{2/3}
\draw[smooth](-2,0)--(0,0)node[below left]{$O$}--(2,0)node[below]{$x$};
\draw[smooth](0,-1.5)--(0,1.5)node[left]{$y$};
\draw[domain=-70:70] plot ({\a*sec(\x)},{\b*tan(\x)});
\draw[domain=110:250] plot ({\a*sec(\x)},{\b*tan(\x)});
\node[below] at(-1.1,0){$-a$};\node[below] at(1.1,0){$a$};
\node at(1.1,1.3){$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$};
\node[align=flush center] at(1.1,-1.3){$x=a\sec\theta$\\[-2mm]
$y=a\tan\theta$};
\end{tikzpicture}};

\pgfpathmoveto{\pgfpoint{-1cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{0}{\pgfpoint{-3cm}{-3.5cm}}
\pgfpathmoveto{\pgfpoint{-5cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{-1}{\pgfpoint{-3cm}{-3.5cm}}
\pgfstroke

\pgfsetdash{{3pt}{3pt}}{0pt}
\pgfpathmoveto{\pgfpoint{-1cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{-1}{\pgfpoint{-3cm}{-2.5cm}}
\pgfpathmoveto{\pgfpoint{-5cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{0}{\pgfpoint{-3cm}{-2.5cm}}
\pgfstroke

\pgfsetdash{{3pt}{0pt}}{0pt}
\pgfpathmoveto{\pgfpoint{1cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{-1}{\pgfpoint{3cm}{-3.5cm}}
\pgfpathmoveto{\pgfpoint{5cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{0}{\pgfpoint{3cm}{-3.5cm}}
\pgfstroke

\pgfsetdash{{3pt}{3pt}}{0pt}
\pgfpathmoveto{\pgfpoint{1cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{0}{\pgfpoint{3cm}{-2.5cm}}
\pgfpathmoveto{\pgfpoint{5cm}{-3cm}}
\pgfpatharcto{2cm}{0.5cm}{0}{0}{-1}{\pgfpoint{3cm}{-2.5cm}}
\pgfstroke
\end{tikzpicture}
\end{document}
```



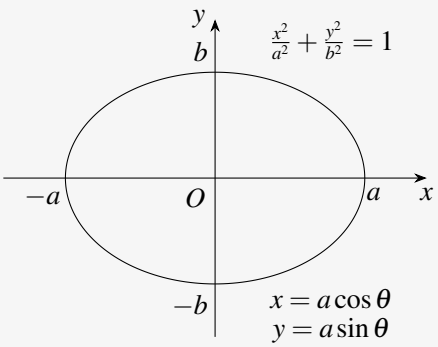
1. 在坐标系中的圆

```
\begin{tikzpicture}[samples=100]
\draw[-Stealth](-1,0)--(0,0)node[below left]{$O$}--(3,0)node[below]{
    $x$};
\draw[-Stealth](0,-1.5)--(0,1.5)node[left]{$y$};
\draw plot[tension=1,smooth cycle]coordinates{(0,0)(1,1)(2,0)(1,-1)};
\node [below]at(2.2,0){$2a$};\node [below]at(1,0){$a$};
\fill(1,0)circle(0.5pt);
\node at(1.1,-1.2){$r=2a\cos\theta$};
\node at(1.3,1.2){$x^2+y^2=2ax$};
\end{tikzpicture}
```



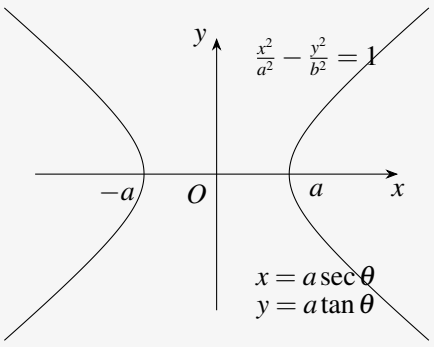
2. 椭圆的图像绘制

```
\begin{tikzpicture}[samples=200]
\draw[-Stealth](-2,0)--(0,0)node[below left]{$O$}--(2,0)node[below]{
    $x$};
\draw[-Stealth](0,-1.5)--(0,1.5)node[left]{$y$};
\draw[domain=0:2*pi]plot({1.414*cos(\x r)},{sin(\x r)});
\node[left=-1pt] at(0,1.2){$b$};\node[left=-1pt] at(0,-1.2){$-b$};
\node[below] at(-1.63,0){$-a$};\node[below] at(1.5,0){$a$};
\node at(1.1,1.3){$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$};
\node[align=flush center] at(1.1,-1.3){$x=a\cos\theta$\\[-2mm]
$y=a\sin\theta$};
\end{tikzpicture}
```



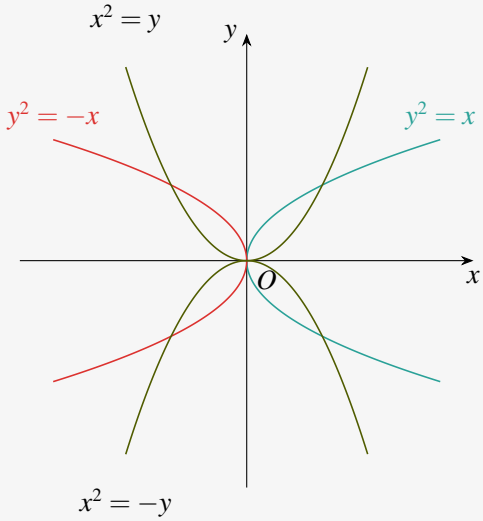
3. 双曲线的 tizk 实现

```
\begin{tikzpicture}[samples=200,scale=1.2]
\def\a{0.8}
\def\b{2/3}
\draw[-Stealth](-2,0)--(0,0)node[below left]{$O$}--(2,0)node[below]{
    $x$};
\draw[-Stealth](0,-1.5)--(0,1.5)node[left]{$y$};
\draw[domain=-70:70] plot ({\a*sec(\x)},{\b*tan(\x)});
\draw[domain=110:250] plot ({\a*sec(\x)},{\b*tan(\x)});
\node[below] at(-1.1,0){$-a$};\node[below] at(1.1,0){$a$};
\node at(1.1,1.3){$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$};
\node[align=flush center] at(1.1,-1.3){$x=a\sec\theta$\\[-2mm]
$y=a\tan\theta$};
\end{tikzpicture}
```



4. 抛物线的绘制

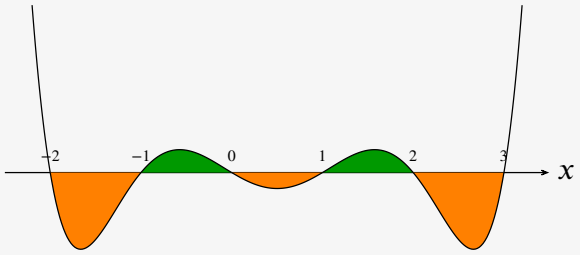
```
\begin{tikzpicture}[samples=100]
\draw[-Stealth](-3,0)--(0,0)node[below right]{$O$}--(3,0)node[below]{
    $x$};
\draw[-Stealth](0,-3)--(0,3)node[left]{$y$};
\draw[semithick,domain=0:1.6,draw=cyan]plot({(\x)^2},\x)
node[above,color=cyan]{$y^2=x$};
\draw[semithick,domain=0:1.6,draw=red]plot({-(\x)^2},\x)
node[above,color=red]{$y^2=-x$};
\draw[semithick,domain=0:1.6,draw=cyan]plot({(\x)^2},-\x);
\draw[semithick,domain=0:1.6,draw=red]plot({-(\x)^2},-\x);
\draw[semithick,domain=-1.6:1.6,draw=green!60!black]plot(\x,{(\x)^2});
\node at(-1.6,3.2){$x^2=y$};
\draw[semithick,domain=-1.6:1.6,draw=green!60!black]plot(\x,{-(\x)^2})
    ;
\node at(-1.6,-3.2){$x^2=-y$};
\end{tikzpicture}
```



3.9 图像阴影填充面积与定积分

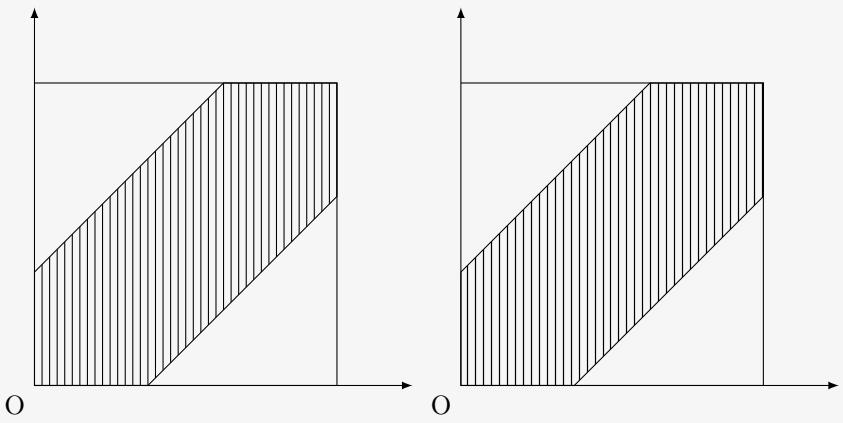
1. 不等式的“穿针引线”法

```
\begin{tikzpicture}[smooth]
\draw[arrows={-Stealth[length=5pt, inset=3.5pt]}] (-2.5,0)
     -- (3.5,0)node (xaxis) [right=-1pt] {$x$};
\foreach \D/\C in {{-2:-1}/orange,{-1:0}/green!60!black
    ,{0:1}/orange,{1:2}/green!60!black,{2:3}/orange}
\draw[color=black,domain=\D,fill=\C] plot (\x,{0.05*\x*(\x
    +2)*(\x+1)*(\x-1)*(\x-2)*(\x-3)});
\foreach \M in {{-2.2:-2},{3:3.2}}
\draw[color=black,domain=\M] plot (\x,{0.05*\x*(\x+2)*(\x
    +1)*(\x-1)*(\x-2)*(\x-3)});
\foreach \N in {-2,-1,...,3}
\node[above] at (\N,0){\tiny $\N$};
\end{tikzpicture}
```

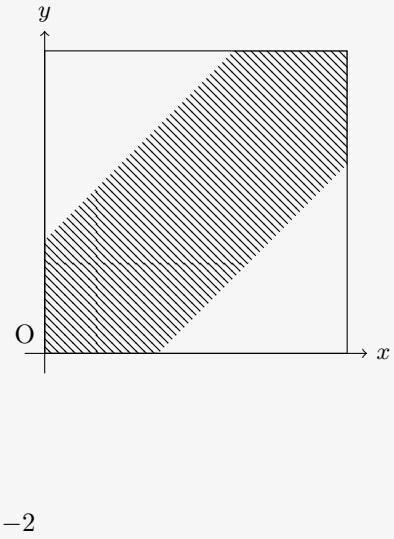


2. 线性规划

```
\documentclass{standalone}
\usepackage{tikz}
\usetikzlibrary{patterns}
\begin{document}
  \begin{tikzpicture}
    \draw[-latex] (0, 0) node[below left]{O}-- (5, 0);
    \draw[-latex] (0, 0) -- (0, 5);
    \draw (0, 0) -- (4, 0) -- (4, 4) -- (0, 4);
    \draw[clip] (1.5, 0) -- (4, 2.5) -- (4, 4) -- (2.5, 4) -- (0, 1.5) -- (0, 0) -- cycle;
    \foreach \x in {0, 0.1,...,5}{
      \draw (\x, 0) -- (\x, 5);
    }
  \end{tikzpicture}
  \begin{tikzpicture}
    \draw[-latex] (0, 0) node[below left]{O}-- (5, 0);
    \draw[-latex] (0, 0) -- (0, 5);
    \draw (0, 0) -- (4, 0) -- (4, 4) -- (0, 4);
    \path[draw, pattern=vertical lines] (1.5, 0) -- (4, 2.5) -- (4, 4) -- (2.5, 4) -- (0, 1.5) -- (0, 0) -- cycle;
  \end{tikzpicture}
\end{document}
```



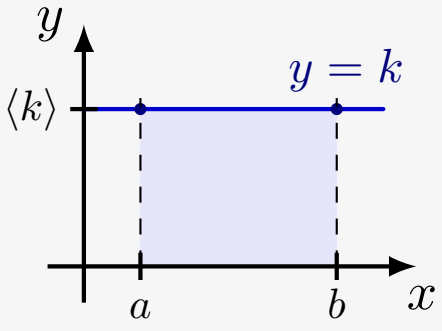
```
\documentclass{standalone}
\usepackage{tikz}
\usetikzlibrary{patterns}
\usetikzlibrary{datavisualization}
\begin{document}
\begin{tikzpicture}
\datavisualization[
school book axes,
x axis={label={$x$},ticks={major={at={}}}},
y axis={label={$y$},ticks={major={at={}}}},
]
data{
x,y
0, 0
4, 4
};
\begin{scope}
\draw [draw=black](0,0) rectangle (4,4);
\draw (0,0) node[above left]{O};
\draw (0, -2) node [below left]{$ -2$};
\clip (1.5, 0) -- (4, 2.5) -- (4, 4) -- (2.5, 4) -- (0,
    1.5) -- (0, 0);
\draw [pattern=north west lines,draw=black](0,0) rectangle
     (4,4);
\end{scope}
\end{tikzpicture}
\end{document}
```



3. 定积分

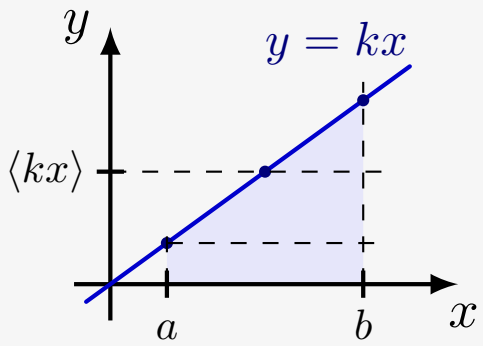
```
\begin{tikzpicture}
  \message{^^JConstant}
  \def\a{0.17*\xmax} % first limit
  \def\b{0.76*\xmax} % last limit
  \def\k{0.65*\ymax} % constant value
  \fill[myblue!10] (\a,0) rectangle (\b,\k);
  \draw[->,thick] (0,-0.15*\ymax) -- (0,\ymax) node[left] {$y$};
  \draw[->,thick] (-0.15*\ymax,0) -- (\xmax,0) node[right=1,below] {$x$};
  \draw[xline,line cap=round] (0,\k) -- (0.9*\xmax,\k)
    node[mydarkblue,left=7,above=0,scale=0.9] {$y=k$};
  \fill[mydarkblue] (\a,\k) circle(0.04) (\b,\k) circle(0.04);
  \draw[dashed] (\a,0) --++ (0,1.07*\k);
  \draw[dashed] (\b,0) --++ (0,1.07*\k);
  \tick{\a,0}{90} node[below=-2.5,scale=0.8] {\strut$a$};
  \tick{\b,0}{90} node[below=-2.5,scale=0.8] {\strut$b$};
  \tick{0,\k}{0} node[left=-1,scale=0.8] {$\expval{k}$};
  \node at (-5,0.7){$\displaystyle\int_{a}^{b}k\dif x=k(b-a)$};
\end{tikzpicture}
```

$$\int_a^b k\,\mathrm{d}x = k(b-a)$$



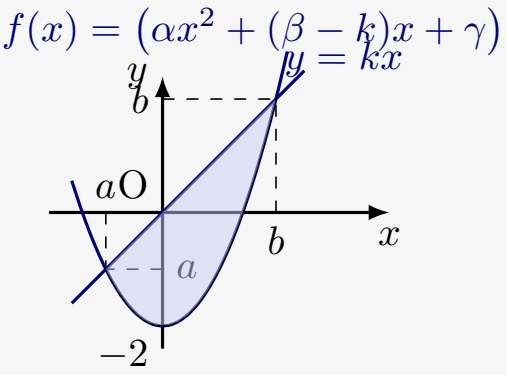
```
\begin{tikzpicture}
  \message{^^JLinear}
  \def\a{0.17*\xmax}  % first limit
  \def\b{0.76*\xmax}  % last limit
  \def\k{\ymax/\xmax} % slope coefficient
  \fill[myblue!10] (\a,0) -- (\a,\k*\a) -- (\b,\k*\b) |- cycle;
  \draw[->,thick] (0,-0.15*\ymax) -- (0,\ymax+0.1) node[left] {$y$};
  \draw[->,thick] (-0.15*\ymax,0) -- (\xmax+0.1,0) node[right=1,below] {$x$};
  \draw[xline,line cap=round]
    (-0.1*\ymax,-0.1*\k*\ymax) -- (0.9*\xmax,0.9*\k*\xmax)
    node[mydarkblue,above left=-3,scale=0.9] {$y=kx$};
  \fill[mydarkblue]
    (\a,\k*\a) circle(0.04) (\b,\k*\b) circle(0.04)
    ({(\b+\a)/2},{\k*(\b+\a)/2}) circle(0.04);
  \draw[dashed] (\a,0) --++ (0,1.25*\k*\a);
  \draw[dashed] (\b,0) --++ (0,1.10*\k*\b);
  \draw[dashed] (0,{\k*(\b+\a)/2}) --++ (1.1*\b,0);
  \draw[dashed] (\a,\k*\a) --++ ({1.1*(\b-\a)},0);
  \tick{\a,0}{90} node[below=-2,scale=0.8] {\strut$a$};
  \tick{\b,0}{90} node[below=-2,scale=0.8] {\strut$b$};
  \tick{0,{\k*(\b+\a)/2}}{0} node[left=-1,scale=0.8] {$\expval{kx}$};
  \node at (-4.55,0.7){$\displaystyle\int_{a}^{b}kx\dif x=\dfrac{k}{2}\left(b^2-a^2\right)$};
\end{tikzpicture}
```

$$\int_a^b kx\,\mathrm{d}x = \frac{k}{2}\left(b^2 - a^2\right)$$



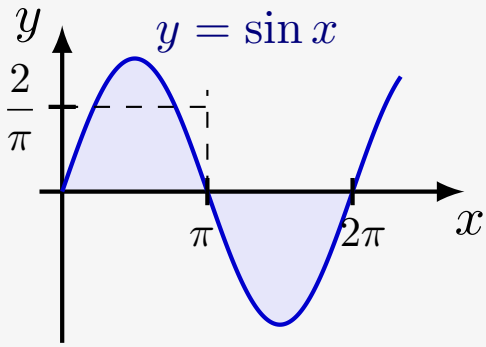

```
\begin{tikzpicture}
        \draw (0,0) node[above left]{O};
        \draw[thick,->] (-1,0) -- (2,0) node[below]{$x$};
        \draw[thick,->] (0,-1.2) -- (0,1.2) node[left]{$y$};
        \begin{scope}[scale=0.5]
         \draw[thick, color=mydarkblue,domain=-1.6:2.5] plot (\x,\x) node at(3.2,2.7) {$y = kx$};
         \draw[thick, color=mydarkblue,domain=-1.6:2.2,smooth] plot (\x,{\x * \x - 2}) node at(1.6,3.2) {$f(x)=\left(\
    alpha x^2+(\beta-k)x+\gamma\right)$};
        \draw[dashed](2,0) node [below]{$b$}--(2,2);
        \draw[thin,dashed](0,2) node [left]{$b$}--(2,2);
        \draw[thin,dashed](-1,0) node [above]{$ a$}--(-1, -1);
        \draw[thin,dashed](0, -1) node [right]{$ a$}--( -1, -1);
        \draw (0, -2) node [below left]{$ -2$};
        \clip (-2.5,-2.5) |- (0, - 2.5) -| (2.5,2.5) --cycle;
        \clip [draw,domain= -2:2.2] plot (\x,{\x * \x - 2});
        \draw [fill=myblue!20,opacity=0.5](-2, -2) rectangle (2,2);
       \end{scope}
  \node[align=left] at (-4.55,0.7){$\displaystyle\int_{a}^{b}\left(\alpha x^2+(\beta-k)x+\gamma\right)\dif x=$\\
  $\dfrac{\alpha}{3}\left( b^3-a^3 \right)-\dfrac{(\beta-k)}{2}\left(b^2-a^2 \right)+$\\
  $\gamma(b-a)$};
\end{tikzpicture}
```

$$\int_a^b \left(\alpha x^2 + (\beta - k)x + \gamma\right)\,\mathrm{d}x = \frac{\alpha}{3}\left(b^3 - a^3\right) - \frac{(\beta - k)}{2}\left(b^2 - a^2\right) + \gamma(b - a)$$



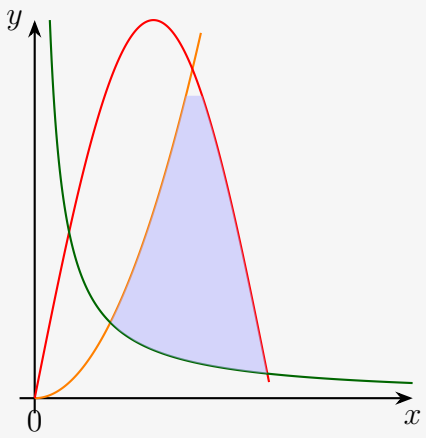

```
\def\xmax{3.2}
\begin{tikzpicture}
  \message{^^JSine}
  \def\ymax{1.0}
  \def\T{0.60*\xmax}
  \def\A{0.88*\ymax}
  \fill[myblue!10,samples=\N,smooth,variable=\x,domain=0:\T]
    plot(\x,{\A*sin(360/(\T)*\x)});
  \draw[->,thick] (0,-\ymax) -- (0,\ymax+0.1) node[left] {$y$};
  \draw[->,thick] (-0.15*\ymax,0) -- (0.80*\xmax+0.1,0) node[right=1,below] {$x$};
  \draw[xline,samples=\N,smooth,variable=\x,domain=0:0.7*\xmax]
    plot(\x,{\A*sin(360/(\T)*\x)});
  \draw[dashed] (0,2*\A/pi) --++ (0.50*\T,0);
  \draw[dashed] (0.5*\T,0) --++ (0,2.4*\A/pi);
  \tick{\T/2,0}{90} node[left=1,below=-2,scale=0.8] {\strut$\pi$};
  \tick{\T,0}{90} node[right=2,below=-2,scale=0.8] {\strut$2\pi$};
  \tick{0,2*\A/pi}{0} node[left=-1,scale=0.8] {$\dfrac{2}{\pi}$};
  \node[above right=-2,mydarkblue,scale=0.9] at (0.3*\T,\A) {$y=\sin x$};
  \node at (-4.5 ,0.3){$\displaystyle\int_{0}^{2\pi}\sin x\dif x=0$};
\end{tikzpicture}
```

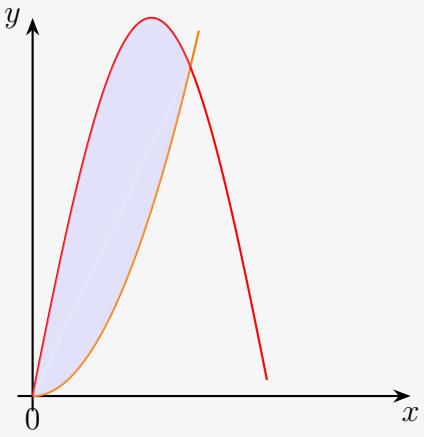
$$\int_0^{2\pi} \sin x\,\mathrm{d}x = 0$$




```
\documentclass[12pt,border=5pt]{standalone}
\usepackage{amsmath,tikz}
\usetikzlibrary {arrows.meta}
\begin{document}
\begin{tikzpicture}[thick]
    \draw[thick,->,arrows = {-Stealth[reversed, reversed]}](-0.2,0)--(0,0) node[right,below]{0}--(5,0)node[below]{$x$};
   \draw[thick,->,arrows = {-Stealth[reversed, reversed]}](0,-0.2)--(0,5)node[left]{$y$};
    \begin{scope}
        \clip plot[samples=400,domain=0:2](\x,{\x^2})--++(-3,0)--cycle;
        %\path[fill=blue!10] (0,0)--plot[domain=0:pi](\x,{5*sin(\x r)})--cycle;
    \end{scope}
    \draw[orange] plot[samples=400,domain=0:2.2](\x,{\x^2});
    \draw[red,domain=0:3.1] plot[samples=400](\x,{5*sin(\x r)});

    \begin{scope}
        \clip (0,0)plot[domain=0:2](\x,{\x^2})--(5,2)--(5,0)--cycle;
        \clip plot[domain=1:5](\x,{1/\x})--(5,0)--(0,0)--(0,5)--cycle;
```

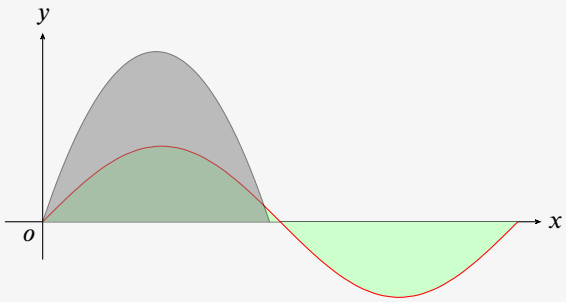
```
    \end{scope}

    \begin{scope}
       \draw[green!40!black] plot[samples=400,domain=0.2:5](\x,{1/\x});
       \clip plot[domain=0:2](\x,{\x^2})--++(2,0)--(5,0)--cycle;
        \clip plot[domain=0.1:5](\x,{1/\x})--(5,5)--cycle;
       \clip plot[domain=0:pi](\x,{5*sin(\x r)})--(0,0);
        \path[fill=blue!30,opacity=0.5] (0,0)rectangle(5,5);
    \end{scope}
\end{tikzpicture}
\end{document}
```






```
\documentclass[12pt,border=5pt]{standalone}
\usepackage{amsmath,tikz}
\usetikzlibrary {arrows.meta,intersections}
\begin{document}
\begin{tikzpicture}[thick]
    \draw[thick,->,arrows = {-Stealth[reversed, reversed]}](-0.2,0)--(0,0) node[right,below]{0}--(5,0)node[below]{$x$};
   \draw[thick,->,arrows = {-Stealth[reversed, reversed]}](0,-0.2)--(0,5)node[left]{$y$};

    \draw[name path=line1,orange] plot[samples=400,domain=0:2.2](\x,{(\x)^2});
    \draw[name path=line2,red,domain=0:3.1] plot[samples=400](\x,{5*sin(\x r)});
    %\draw[name intersections={of=line1 and line2,by={a,b}},red](a)--(b);
   \path[name intersections={of=line1 and line2,by={a,b}},fill=blue!20,opacity=0.5] plot[domain=0:2.08](\x,{5*sin(\x r)
    })--plot[samples=400,domain=0:2.1](\x,{(\x)^2})--cycle;
\end{tikzpicture}
\end{document}
```

```
\begin{tikzpicture}[smooth]
\draw[arrows={-Stealth[length=5pt, inset=3.5pt]}] (-0.5,0) --
     (2.1*pi,0)node (xaxis) [right=-1pt] {$x$};
\draw[arrows={-Stealth[length=5pt, inset=3.5pt]}] (0,-0.5) --
     (0,2.5)node (yaxis) [above=-0.6pt] {$y$};
\draw  (-0.18,-0.18) node {$o$};
\draw[color=red,domain=0:2*pi,fill=green!20] plot (\x,{sin(\x
     r)});
\draw[color=black,domain=0:3,fill=gray,opacity=0.5] plot (\x
    ,3*\x-\x^2)  ;
\end{tikzpicture}
```



4 统计图的 TikZ 绘制

4.1 折线图的 TikZ 绘制

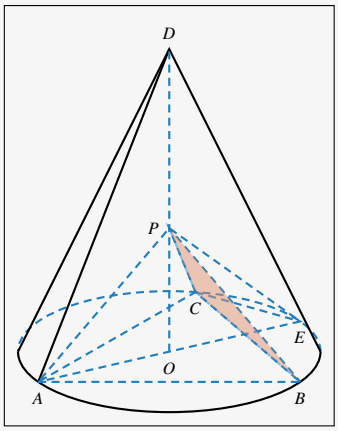
4.2 柱状图的 TikZ 绘制

4.3 饼图的 TikZ 绘制

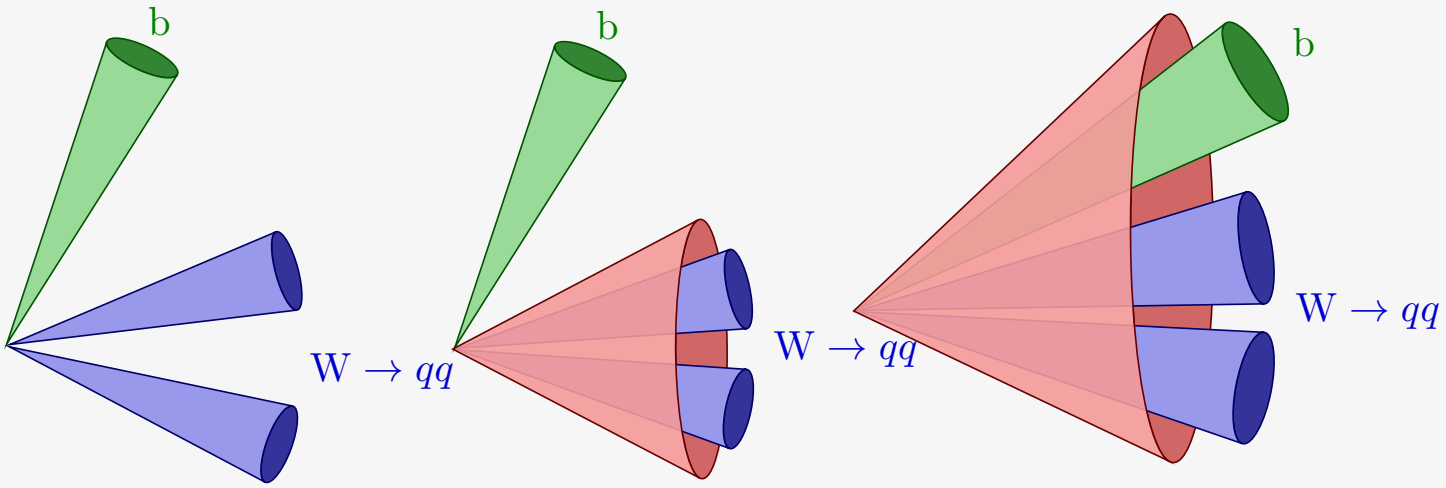
5 几何图形的 TikZ 绘制

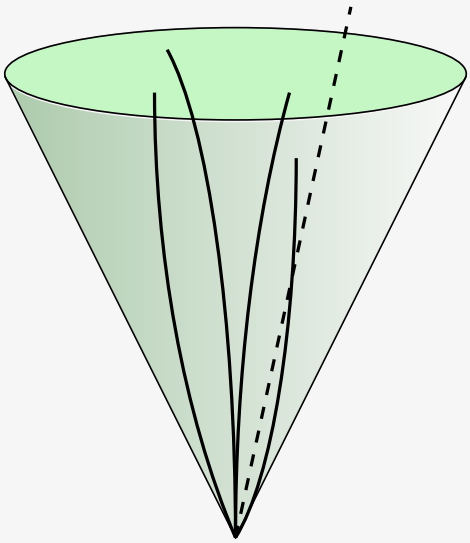
5.1 平面几何图形的 TikZ 绘制

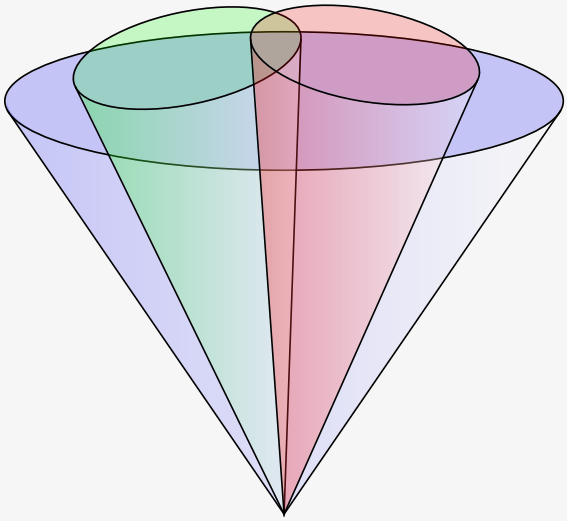
5.2 空间几何图形的 TikZ 绘制



```
\usetikzlibrary{math} % for \tikzmath
\tikzset{>=latex} % for LaTeX arrow head
\usetikzlibrary{decorations.pathreplacing} % for curly braces

\colorlet{myblue}{blue!70!black}
\colorlet{mydarkblue}{blue!40!black}
\colorlet{mygreen}{green!40!black}
\colorlet{myred}{red!65!black}
\tikzstyle{vector}=[->,very thick,myblue,line cap=round]
\tikzstyle{ptmiss}=[->,dashed,thick,myred,line cap=round]
\tikzstyle{cone}=[thin,blue!50!black,fill=blue!50!black!30] %,fill opacity=0.8
\tikzstyle{conebase}=[cone,fill=blue!50!black!50] %,fill opacity=0.8

\newcommand\jetcone[5][blue]{{
  \pgfmathanglebetweenpoints{\pgfpointanchor{#2}{center}}{\pgfpointanchor{#3}{center}}
  \edef\ang{#4/2}
  \edef\e{#5}
  \edef\vang{\pgfmathresult} % angle of vector OV
```







6 图像的大致图像的 TikZ 绘制

7 混合图形的 TikZ 绘制

8 PGFplots 实现杂例

本手册中的图像是使用Ti*k*Z-network library 或 Ti*k*Z。为每个图像指定用于此的代码。

```
\begin{tikzpicture}
 \filldraw (-.2,.2) circle (2pt)
  (.2,.2) circle (2pt);
 \draw (0,0) circle (5mm) (-.3,-.1) .. controls (0,-.3) ..(.3,-.1);
\end{tikzpicture}
```