1 预备事项

这是份 Tikz tkz-eculid 的上手文件，请参照 latex 原档来比对此文件。tkz-eculide 的官方手册有更完整的介绍, 但此手册已法文书写，可参考其中的范例阅读即可。

- http://mirror.hmc.edu/ctan/macros/latex/contrib/tkz/tkz-euclide/doc/tkz-euclide-screen.pdf
- http://mirrors.concertpass.com/tex-archive/graphics/pgf/base/doc/pgfmanual.pdf
- http://www.texample.net/tikz/examples/

1.1 中文环境

以下为中文环境的设置，可以指定系统字形，要用 xelatex 来编译。

```latex
\usepackage{xeCJK}
\setCJKmainfont{AR PL UKai CN}
\setmainfont{Linux Libertine O}
```

1.2 tkz 环境

在使用 tkz-euclide 套件前，先在文档前置区加入以下内容。

```latex
\usepackage{xeCJK}
\usepackage{tikz}
\usepackage{tkz-euclide}
```

1.3 程示码模式

本文范例以 minted 套件来实现，并用 minipage 来程现左右画面。

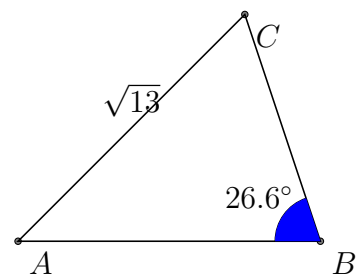
```latex
\usepackage{minted}
...
\begin{minipage}[t][][t]{.6\textwidth}
...
...
\end{minipage}
\quad
\begin{minipage}[t][][b]{.35\textwidth}
...
...
\end{minipage}
```

1.4 基本范例

以下为基本的点线绘制，利用 tkzDefPoints 定义点的位置，接着便可连线，加入标签。

绘制三角形：

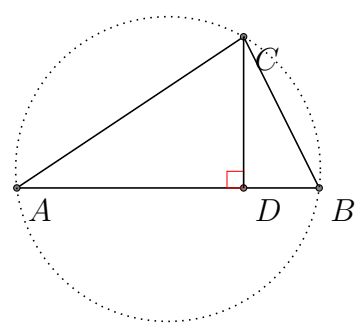
```latex
\begin{tikzpicture}
% 由坐标定义点 A,B,C
  \tkzDefPoints{0/0/A,4/0/B,3/2/C}
  \tkzDrawPoints(A,B,C)
  \tkzLabelPoints(A,B,C)
% 绘制三角形的边、角资讯
  \tkzDrawPolygon(A,B,C)
  \tkzLabelSegment(A,C){$\sqrt{13}$}
  \tkzMarkAngle[fill=red,size=0.5](C,B,A)
  \tkzLabelAngle[pos=1](C,B,A){$26.6^\circ$}
\end{tikzpicture}
```



skip

外接圆圆心：

```latex
\begin{tikzpicture}
% 绘制三角形 ABC
  \tkzDefPoints{0/0/A,4/0/B,3/2/C}
  \tkzDrawPolygon(A,B,C)
% 投影点 projection = onto A--B
  \tkzDefPointBy[projection = onto A--B](C)
    \tkzGetPoint{D}
  \tkzLabelPoints(A,B,C,D)
  \tkzDrawPoints(A,B,C,D)
% 作高与直角
  \tkzMarkRightAngle[color=red](C,D,A)
  \tkzDrawSegment(C,D)
% 作外接圆圆心、并且画圆
  \tkzCircumCenter(A,B,C)\tkzGetPoint{O}
  \tkzDrawCircle[dotted,red,line =3pt](O,A)
\end{tikzpicture}
```

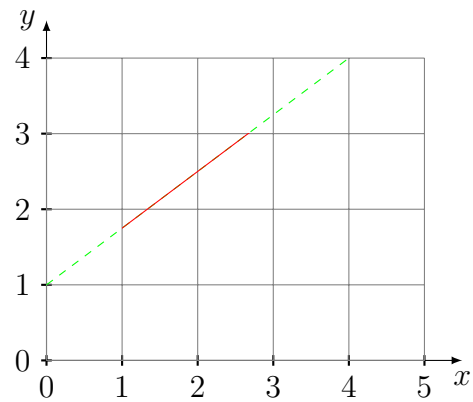


2 基本图形

2.1 基本坐标轴

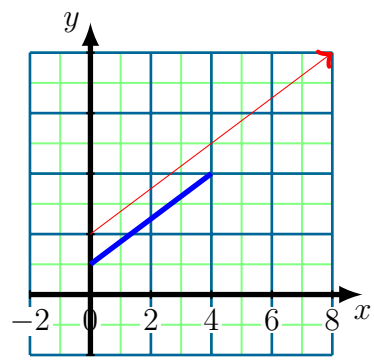
以下内容参考 tkz-Euclide 第 5 节，利用 tkzInit, tkzAxeXY 来建立坐标轴

```
\begin{tikzpicture}
% 建立坐标轴
  \tkzInit[xmax=5,ymax=4]
  \tkzAxeXY
  \tkzGrid
  \draw[green,dashed] (0,1) -- (4,4);
% 剪裁
  \tkzClip[space=-1]
  \draw[red] (0,1) -- (4,4);
\end{tikzpicture}
```



坐标轴的微调

```
\begin{tikzpicture}[scale=.8]
% 建立坐标轴
  \tkzInit[xmax=8,ymax=8,xmin=-2,ymin=-2,xstep=2,ystep=2]
  \tkzGrid[sub,subxstep=1,subystep=1,color=green]
  %% color 设定颜色 可用 green!30!blue 调色
  \tkzGrid[line width=1pt,color=green!40!blue]
  \tkzAxeX[line width=2pt] %% 显示 step 标号
  \tkzDrawY[line width=2pt] %% 只显示轴，但无标号
  %% draw 的位置不随 step 而变
  \draw[red,->] (0,1) -- (4,4);
% 利用 DefPoint 标点
  \tkzDefPoints{0/1/A, 4/4/B}
  % 连接两点连线
  \tkzDrawSegment[blue,line width=2pt](A,B)
\end{tikzpicture}
```



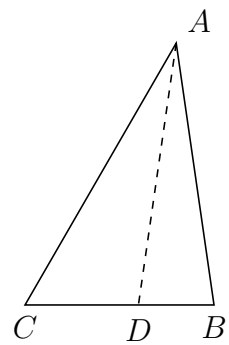
2.2 点、线与坐标

tkz-Euclide 第 6 节，主要内容：

```
% 点的定义
\tkzDefPoint[label=-60:$A_n$](2,3){A}
\tkzDefPoint({4*sin(FPpi/6)},{4*cos(FPpi/6)}){B}
\tkzDefPoints{0/0/A,2/0/B}
% 点的相对坐标
\tkzDefShiftPoint[A](30:4){C}
\tkzDefShiftPointCoord[2,3](30:4){B}
% 点的绘制与标号
\tkzDrawPoint[shape=cross,size=12,color=blue](B)
\tkzDefPoint[label=below:$\mathcal{C}$,shift={(2,3)}](-30:5.5){E}
\tkzLabelPoint[right,blue](B){$B$}
% 点的绘制与标号
\tkzSetUpPoint[shape=cross out,size=10,color=red]
```

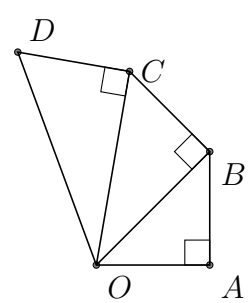
基本的坐标与连线

```
\begin{tikzpicture}[scale=.5]
  \tkzDefPoint[label=180:$C$](0,0){C}
  %% 可用 (60:8) 来用极坐标
  \tkzDefPoint[label=60:$A$](60:8){A}
  \tkzDefPoint[label=0:$B$](0:5){B}
  \tkzDefPoint(3,0){D}
  %% 微调标号的位置
  \tkzLabelPoint[below left=1pt](D){$D$}
  \tkzDrawPolygon(A,B,C)
  \tkzDrawSegment[style=dashed](A,D)
\end{tikzpicture}
```



坐标的平移与旋转

```
\begin{tikzpicture}[scale=1.5]
  \tkzDefPoints{0/0/O,1/0/A,1/1/B}
  % 定个以 B 为原点，坐标轴转 90 度的坐标
  \begin{scope}[shift={(B)},rotate=45]
    \tkzDefPoints{0/1/C}
    % 定个以 C 为原点，坐标轴转再转 26.6 度的坐标
    \begin{scope}[shift={(C)},rotate=26.6]
      \tkzDefPoints{0/1/D}
    \end{scope}
  \end{scope}
  \tkzDrawPoints(A,B,O,C,D)
  \tkzLabelPoints(O,A,B)
  \tkzLabelPoint[right=0](C){$C$}
  \tkzLabelPoint[above right=0](D){$D$}
  \tkzDrawPolygon(O,A,B,C,D)
  \tkzDrawSegments(O,B O,C)
\end{tikzpicture}
```

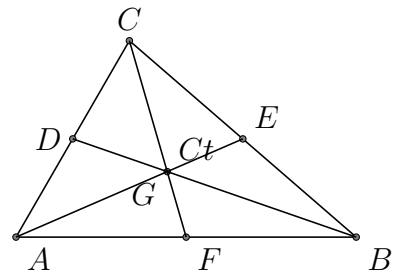


2.3 点、线与坐标

以下内容参考 tkz-Euclide 第 7 节：

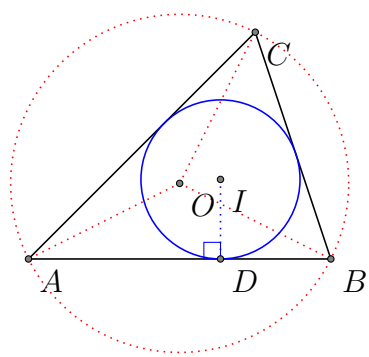
点作标的加权：

```latex
\begin{tikzpicture}[scale=1.5]
  % 绘制三角形 A,B,C, C 点用平移来定义
  \tkzDefPoints{0/0/A,3/0/B}
  \tkzDefShiftPointCoord[0,0](60:2){C}
  \tkzDrawPolygon(A,B,C)
  %tkzDefMidPoint 取得 A,B 中点 F
  \tkzDefMidPoint(A,B) \tkzGetPoint{F}
  %BarycentricPoint 可对每个点取不同加权
  \tkzDefBarycentricPoint(C=1,B=1)
    \tkzGetPoint{E}
  % 对三个点加权可得重心
  \tkzDefBarycentricPoint(A=1,B=1,C=1)
    \tkzGetPoint{G}
  \tkzCentroid(A,B,C) \tkzGetPoint{Ct}
  % 可得外分点
  \tkzDefBarycentricPoint(G=3,B=-1)
    \tkzGetPoint{D}
  % 标示点
... 省略 ...
\end{tikzpicture}
```



外接圆与内切圆：

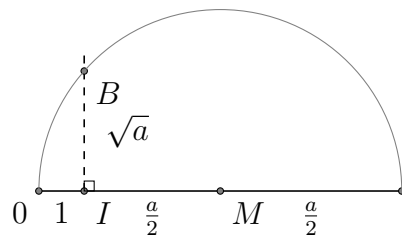
```latex
\begin{tikzpicture}
% 绘制三角形 ABC
  \tkzDefPoints{0/0/A,4/0/B,3/3/C}
  \tkzDrawPolygon(A,B,C)
% 作外接圆圆心、并且画圆
  \tkzCircumCenter(A,B,C)\tkzGetPoint{O}
  \tkzDrawSegments[dotted,color=red](O,A O,C O,B)
  \tkzDrawCircle[dotted,color=red](O,A)
% 作内切圆圆心、并且画圆
  \tkzInCenter(A,B,C)\tkzGetPoint{I}
  \tkzDefPointBy[projection = onto A--B](I)
    \tkzGetPoint{D}
  \tkzDrawCircle[color=blue](I,D)
% 作高与直角
  \tkzMarkRightAngle[color=blue](I,D,A)
  \tkzDrawSegment[color=blue,dotted](I,D)
% 标点
  \tkzLabelPoints(A,B,C,D,I,O)
  \tkzDrawPoints(A,B,C,D,I,O)
\end{tikzpicture}
```



3 实例展示

3.1 tkzExample：$\sqrt{a}$ 的作图

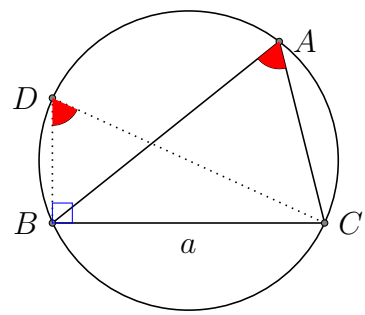
```latex
\begin{tikzpicture}[scale=.5]
% 定义范围
  \tkzInit[ymin=-5,ymax=5,xmin=-1,xmax=8]
  \tkzClip
% 定义点
  \tkzDefPoints{0/0/O,1/0/I}
  %% homothety 位似，缩放
  \tkzDefPointBy[homothety=center O ratio 8](I)
    \tkzGetPoint{A}
  \tkzDefMidPoint(O,A) \tkzGetPoint{M}
  %% orthogonal 垂直
  \tkzDefPointWith[orthogonal](I,M) \tkzGetPoint{H}
  %% tkzInterLC 直线与园的交点
  \tkzInterLC(I,H)(M,A) \tkzGetSecondPoint{B}
% 线段、弧线
  \tkzDrawSegment(O,A)
  \tkzDrawSegment[style=dashed](I,H)
  \tkzDrawPoints(O,I,A,B,M)
  \tkzDrawArc(M,A)(O)
  \tkzMarkRightAngle(A,I,B)
% 上标签
  \tkzLabelSegment[right=4pt](I,B){$\sqrt{a}$}
  \tkzLabelSegment[below](O,I){$1$}
  \tkzLabelSegment[below](I,M){$\frac{a}{2}$}
  \tkzLabelSegment[below](M,A){$\frac{a}{2}$}
  \tkzLabelPoints(I,M,B,A)
  \tkzLabelPoint[below left](O){$0$}
\end{tikzpicture}
```



3.2 圆线交点与正弦定理

在这个例子，主要展式圆线交点 tkzInterLC 的使用。

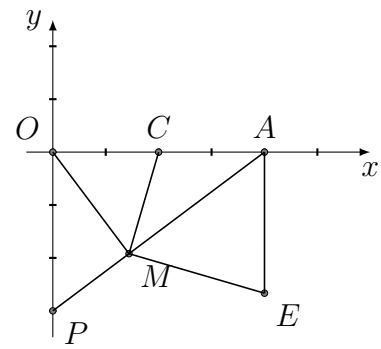
```latex
\begin{tikzpicture}[scale=1.2]
% 画三角形 A,B,C 及外接圆 O
  \tkzDefPoints{0/0/B,3/0/C, 2.5/2/A}
  \tkzCircumCenter(A,B,C) \tkzGetPoint{O}
  \tkzDrawPolygon(A,B,C)
  \tkzDrawCircle(O,A)
% 作垂直 BC 的动点 H , 并求 BH 与圆的交点 D
  \tkzDefPointWith[orthogonal](B,C) \tkzGetPoint{H}
  \tkzInterLC(B,H)(O,B) \tkzGetSecondPoint{D}
  \tkzDrawSegment[dotted](B,D)
  \tkzDrawSegment[dotted](C,D)
% 表示 A,B,C,D 四点
  \tkzDrawPoints(A,B,C,D)
  \tkzLabelPoint[right=1pt](A){$A$}
  \tkzLabelPoint[left=1pt](B){$B$}
  \tkzLabelPoint[right=1pt](C){$C$}
  \tkzLabelPoint[left=1pt](D){$D$}
% 标示角度与边长
  \tkzMarkRightAngle[color=blue](C,B,D)
  \tkzMarkAngle[size=.3cm,fill=red](B,A,C)
  \tkzMarkAngle[size=.3cm,fill=red](B,D,C)
  \tkzLabelSegment[below=2pt](B,C){$a$}
\end{tikzpicture}
```

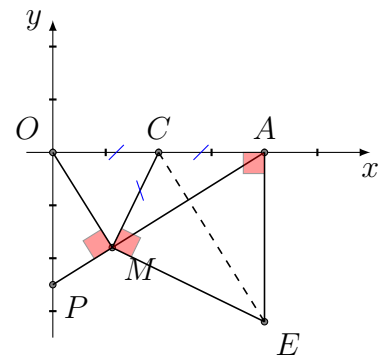


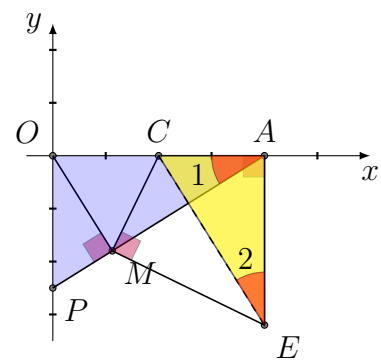
3.3 垂线：相似形题目

这列子主要展示两个垂线交点，利用 DefPointWith[orthogonal] 指令

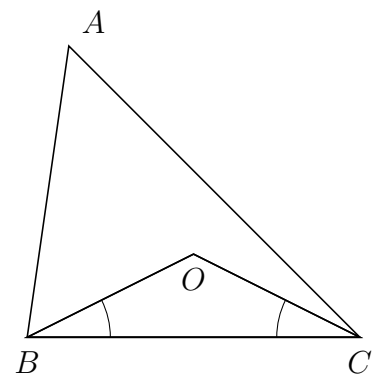
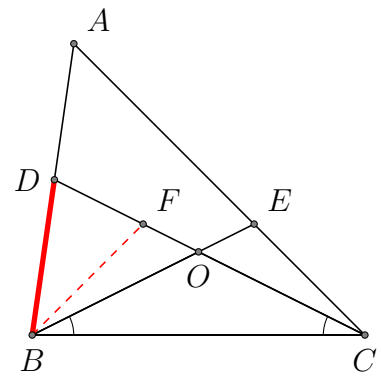
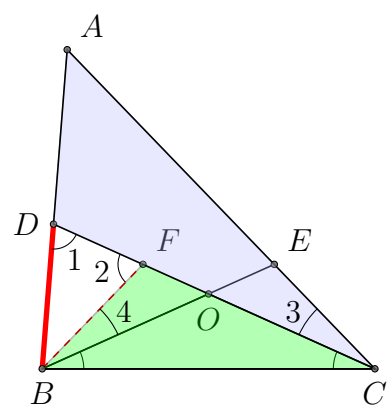
```
\begin{tikzpicture}
%\tkzGrid
  \tkzInit[xmax=5.5,xmin=-0.5,ymax=2,ymin=-3.5]
  \tkzDrawX
  \tkzDrawY
% 定义点
  \tkzDefPoints{0/0/O,4/0/A,0/-2.5/P}
  \tkzDefBarycentricPoint(A=1,O=1)
    \tkzGetPoint{C}
  \tkzDefPointBy[projection = onto A--P](O)
    \tkzGetPoint{M}
  % E 为垂直 MC 与 OA 两线的交点
  \tkzDefPointWith[orthogonal](M,C)
    \tkzGetPoint{MOC}
  \tkzDefPointWith[orthogonal](A,O)
    \tkzGetPoint{AOM}
  \tkzInterLL(M,MOC)(A,AOM)
    \tkzGetPoint{E}
% 标点与线
  \tkzDrawPoints(O,A,P,C,M,E)
  \tkzLabelPoints(P,M,E)
  \tkzLabelPoint[above left=1pt](O){$O$}
  \tkzLabelPoint[above=1pt](A){$A$}
  \tkzLabelPoint[above=1pt](C){$C$}
  \tkzDrawSegments(A,P O,M M,E M,C A,E)
%% part 2
% 标直角
  \tkzMarkRightAngles[size=0.4,fill=purple,opacity=.4]%
  (E,A,O E,M,C O,M,P)
  \tkzDrawSegment[dashed](C,E)
% 标等长边
  \tkzMarkSegment[pos=.4,mark=s|,color=blue](C,M)
  \tkzMarkSegment[pos=.4,mark=s|,color=blue](C,A)
  \tkzMarkSegment[pos=.4,mark=s|,color=blue](C,O)
%% part 3
% 多边形内部
  \tkzDrawPolygon[fill=blue,opacity=.2](O,A,P)
  \tkzDrawPolygon[fill=yellow,opacity=.6](C,A,E)
% 标角 1，角 2
  \tkzMarkAngle[fill=red,pos=.5,opacity=.5](O,A,P)
  \tkzMarkAngle[fill=red,pos=.5,opacity=.5](A,E,C)
  \tkzLabelAngle[pos=-1.2,red](O,A,P){$1$}
  \tkzLabelAngle[pos=1.2,red](A,E,C){$2$}
\end{tikzpicture}
```







3.4 作两倍角

此例主要展示 tkzDefPointBy[refection=over B−C](O) 与 tkzDefLine[orthogonal=through Ah](B,C)

```
\begin{tikzpicture}[scale=1.1]
% 先画等腰三角形 B,C,O 并定 A 在 BC 的垂足为 Ah
  \tkzDefPoints{0/0/B,4/0/C, 2/0.9/O,0.3/0/Ah}
% 以下为作 A ，使得 A = OBC + OCB
  \tkzDefPointBy[reflection=over B--C](O)\tkzGetPoint{OR}
  \tkzDrawPolygon(B,C,O)
  \tkzCircumCenter(B,C,OR) \tkzGetPoint{OO}
  \tkzDefLine[orthogonal=through Ah](B,C)\tkzGetPoint{a}
  \tkzInterLC(Ah,a)(OO,B)\tkzGetSecondPoint{A}
% 绘制 A,B,C, 及 B,O,C
  \tkzDrawPolygon(B,C,A)
  \tkzDrawPolygon(B,C,O)
  \tkzLabelPoint[above right=1pt](A){$A$}
  \tkzLabelPoints[below=1pt](B,O,C)
% 标角
  \tkzMarkAngles[size=.5](C,B,O O,C,B)
%% ==== part 2 ====
% 作 D,E
  \tkzInterLL(C,O)(A,B)\tkzGetPoint{D}
  \tkzInterLL(B,O)(A,C)\tkzGetPoint{E}
  \tkzDrawSegment(O,D)
  \tkzDrawSegment(O,E)
  \tkzLabelPoint[left=1pt](D){$D$}
  \tkzLabelPoint[above right=1pt](E){$E$}
  \tkzDrawSegment[red,line width=2pt](B,D)
% 作 F
  \tkzInterLC(D,C)(B,D)\tkzGetSecondPoint{F}
  \tkzDrawSegment[dashed,red](B,F)
  \tkzLabelPoint[above right=1pt](F){$F$}
% 标点
  \tkzDrawPoints(A,B,C,D,E,F,O)
%% ==== part 3 ====
% 三角形
  \tkzDrawPolygon[fill=blue!30!white,opacity=0.3](A,D,C)
  \tkzDrawPolygon[fill=green,opacity=0.3](B,F,C)
% 标角 1,2,3,4
  \tkzMarkAngles[size=.3cm](B,D,F D,F,B)
  \tkzMarkAngles(E,B,F E,C,D)
  \tkzLabelAngle[pos=0.5](B,D,F){$1$}
  \tkzLabelAngle[pos=-0.5](D,F,B){$2$}
  \tkzLabelAngle[pos=1.2](E,C,O){$3$}
  \tkzLabelAngle[pos=1.2](O,B,F){$4$}
\end{tikzpicture}
```