

# *Symmetries of an Equilateral Triangle*

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*This is a first draft of a worksheet for the beginning of Abstract Algebra*

## ▼ Outline

1. Investigate the symmetries of an equilateral triangle visually using `plottools`.
2. Investigate the composition of two transformations visually using `plottools`.

## ▼ Symmetries of an Equilateral Triangle

### ▼ Define and plot an equilateral triangle

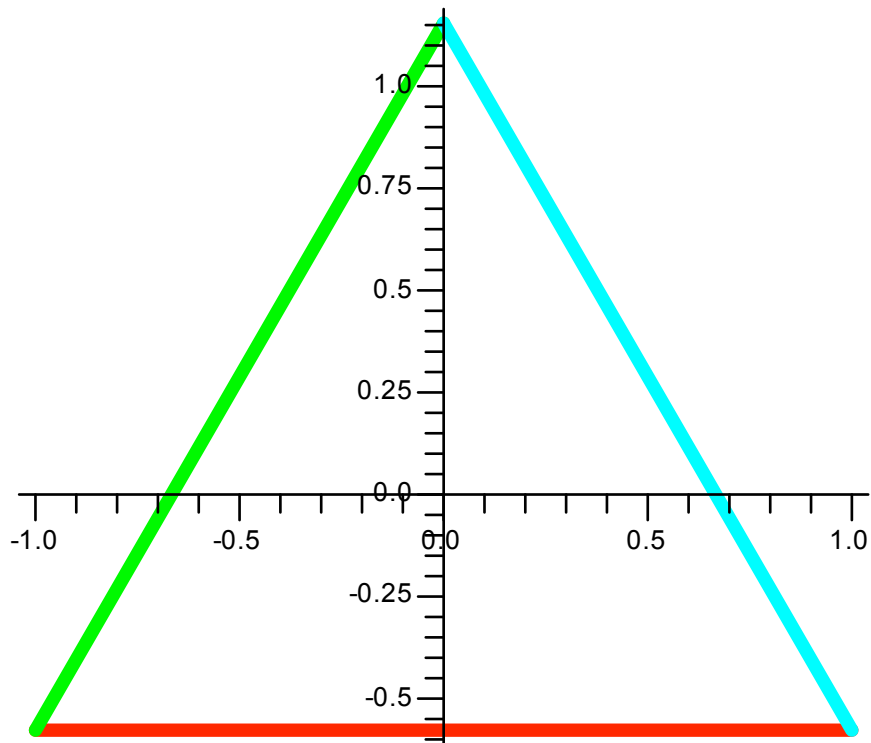
```
> restart: with(plots):with(plottools):  
Warning, the name changecoords has been redefined  
Warning, the assigned name arrow now has a global binding
```

The following define the sides of the equilateral triangle.

```
> L1 := line([1, -sqrt(3)/3], [0, 2*sqrt(3)/3], color = cyan,  
thickness = 5):  
L2 := line([0, 2*sqrt(3)/3], [-1, -sqrt(3)/3], color = green,  
thickness = 5):  
L3 := line([-1, -sqrt(3)/3], [1, -sqrt(3)/3], color = red,  
thickness = 5):
```

Next we display the triangle. (How can I get the same scale on both axes?)

```
> display(L1, L2, L3, scaling = constrained);
```

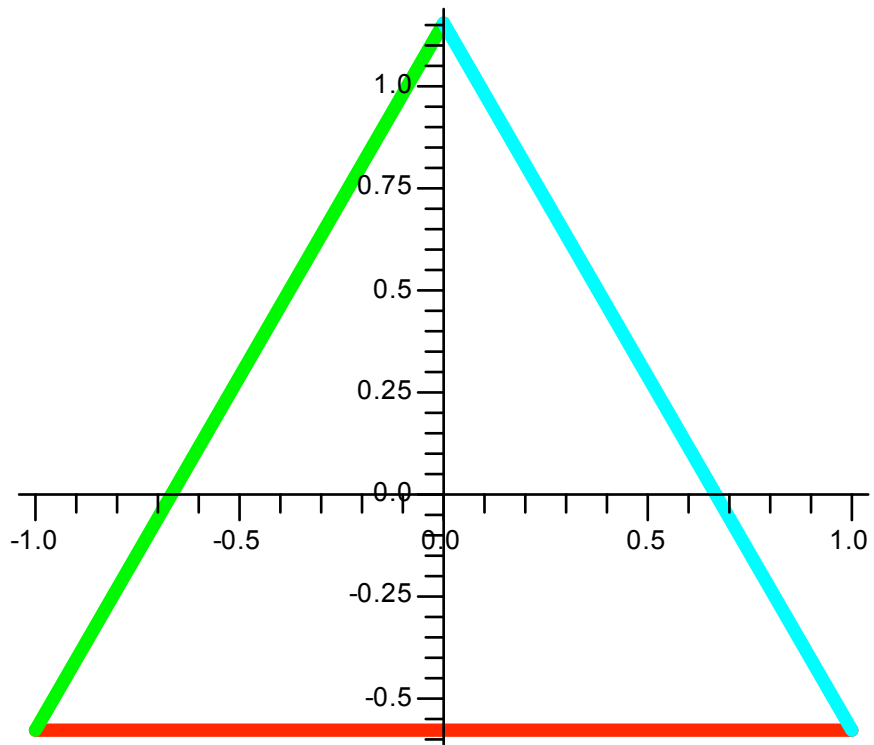


Name it so that we can deal with it as an object.

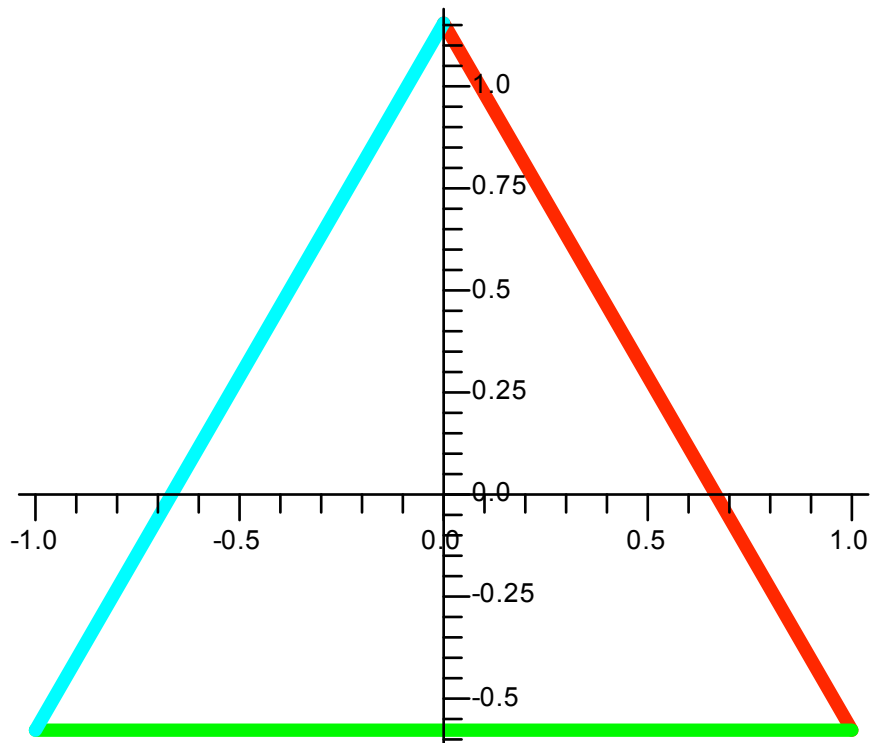
```
[ > ET := display(L1, L2, L3, scaling = constrained) :
```

## ▼ Rotations

```
[ > R0 := rotate(ET, 0, [0, 0]) :  
display(ET) ;
```

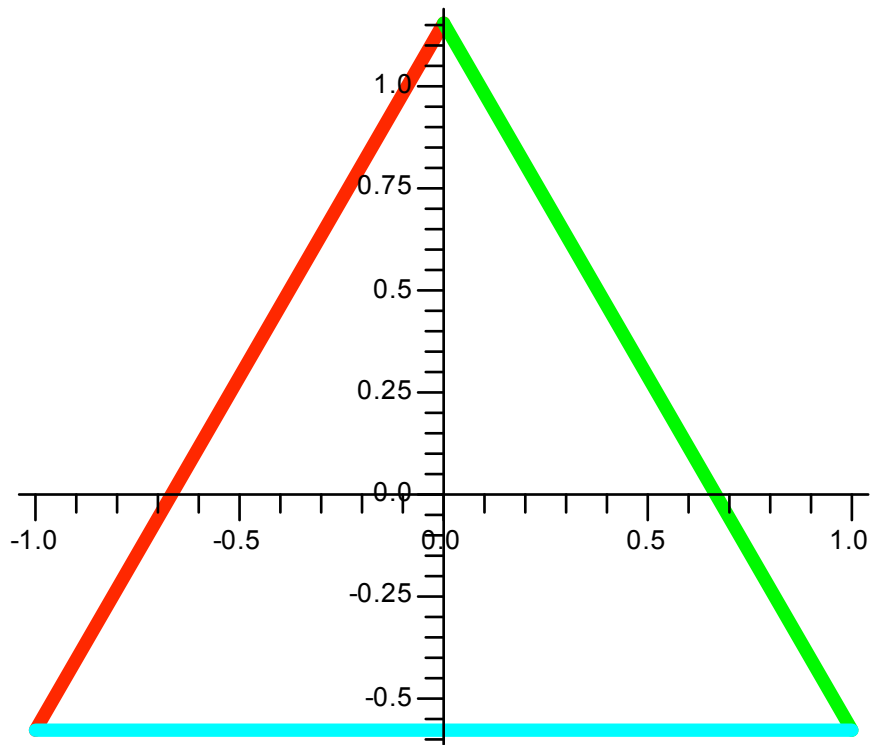


```
> R120 := rotate(ET, 2*Pi/3, [0, 0]):  
display(R120);
```

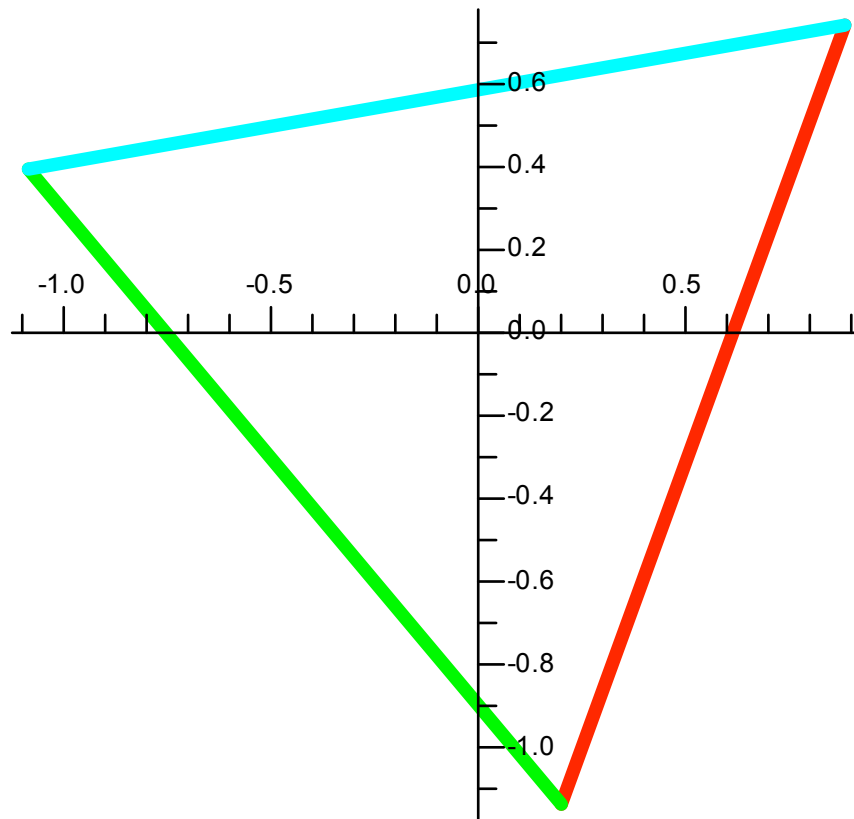


>

```
> R240 := rotate(ET, 4*Pi/3, [0,0]):  
display(R240);
```



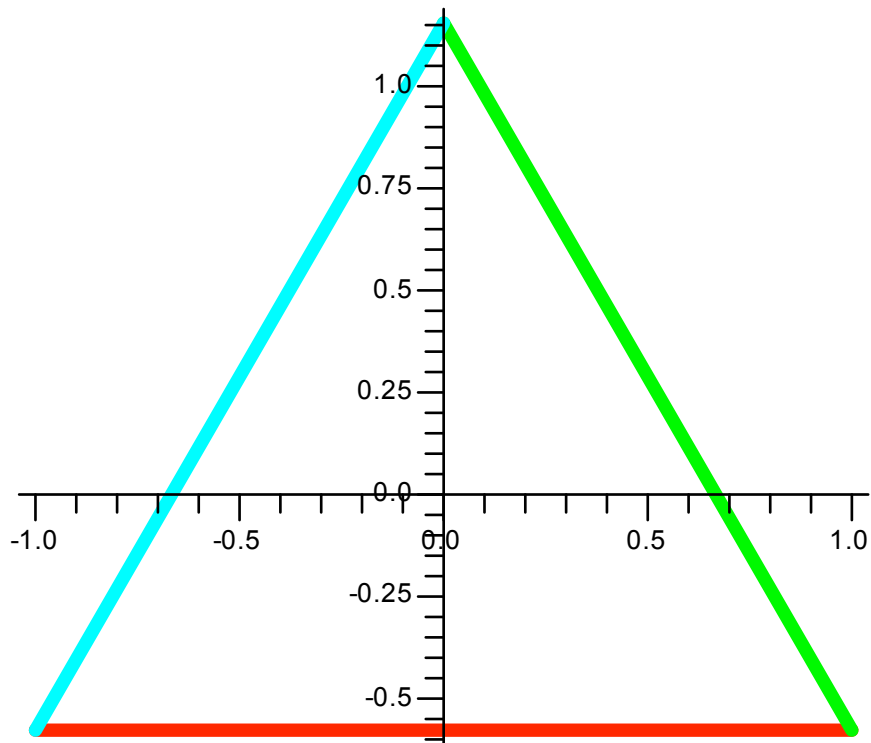
```
>  
> R70 := rotate(ET, 7*Pi/18, [0,0]):  
display(R70);
```



## ▼ Reflections

Reflect in the line containing the first altitude.

```
> A1 := reflect(ET, [[0, 2*sqrt(3)/3], [0, -sqrt(3)/3]]):  
display(A1);
```



[>

Reflect in the line containing the second altitude.

```
[> A2 := reflect(ET, [], []):
display(A2);
Error, (in plottools:-reflect) wrong type of arguments
Error, (in display) first argument must be a plot structure or
list, set or array of plot structures
```

[>

**Needs more work in controlling scale.**

```
[> A3 :=
```

[>

## ▼ Composition of Transformations

