

## TRANSFORMATIONS

### Coordinate Notation

#### Translations (slide)

$$(x,y) \rightarrow (x+a,y+b) \quad a = \text{horizontal shift, } b = \text{vertical shift}$$

#### Reflections (flip)

$$(x,y) \rightarrow (x,-y) \quad \text{in the x-axis}$$

$$(x,y) \rightarrow (-x,y) \quad \text{in the y-axis}$$

#### Rotations (turn)

$$(x,y) \rightarrow (y,-x) \quad 90^\circ \text{ clockwise}$$

$$(x,y) \rightarrow (-y,x) \quad 90^\circ \text{ counterclockwise}$$

$$(x,y) \rightarrow (-x,-y) \quad 180^\circ \text{ rotation}$$

#### Dilations (enlarge/reduce)

$$(x,y) \rightarrow (kx,ky) \quad k = \text{scale factor}$$

Before beginning any of these activities on the TI-84 Plus graphing calculator, you will need to hit 2<sup>nd</sup> MEM (above +) and 4:ClrAllLists then ENTER. Hit 2<sup>nd</sup> STATPLOT and 4:PlotsOff then ENTER. This will clear any data previously stored in the lists and turn off any plots previously used.

The names of the lists are written in blue above the number keys so they are accessed by pressing 2<sup>nd</sup> and then the number of the list you need.

## Graphing a Broken Heart

Using a TI-84 Plus Silver Edition graphing calculator, hit STAT and 1:Edit to enter the following data into L1 and L2. These data points will form half a heart.

| <u>L1</u> | <u>L2</u> |
|-----------|-----------|
| 0         | 10        |
| 2         | 13        |
| 4         | 14        |
| 6         | 14.5      |
| 8         | 14        |
| 9         | 13        |
| 9.5       | 12        |
| 9.75      | 10        |
| 9.5       | 8         |
| 8         | 6         |
| 6         | 4         |
| 0         | 0         |

To see it's graph, turn on Plot1.

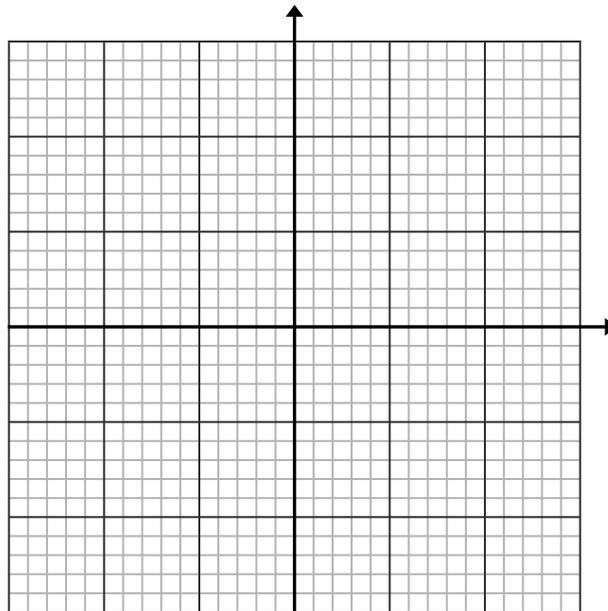
Hit 2<sup>nd</sup> STATPLOT and select Plot1. Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L1 and the Ylist to L2. Use the third mark (the small dot). To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

```

2nd [STAT] Plot2 Plot3
Off Off
Type: [L1] [L2] [L3]
      [M1] [M2] [M3]
Xlist:L1
Ylist:L2
Mark:  [ ] + [ ]

```

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.



### Reflection in the y-axis $(x,y) \rightarrow (-x,y)$

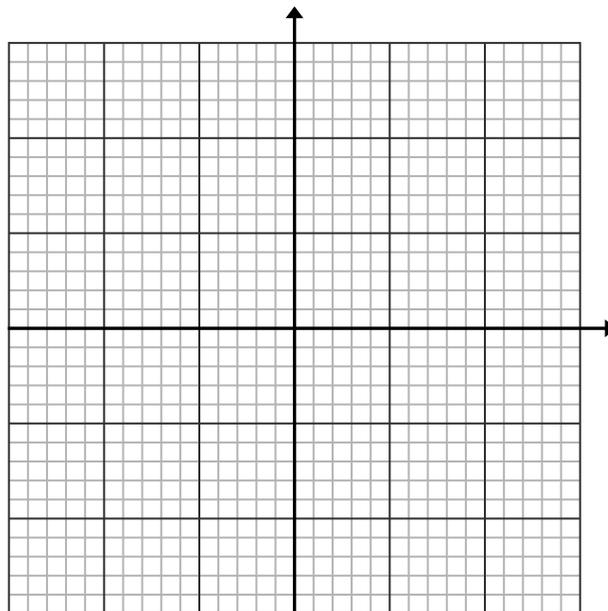
To draw the other half of the heart, you will need to reflect your data points in the y-axis. Since the y-values remain the same, you can still use List 2, but all the values in List 1 will need to be the opposite. You will use List 3. Hit STAT and 1:Edit then arrow right to L3 and up to highlight L3. Enter (-) L1 and hit ENTER. You should see all the opposites of List 1 appear in List 3. To see the whole heart you will need to have Plot 1 and Plot 2 turned on.

Hit 2<sup>nd</sup> STATPLOT and select Plot2.

Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L3 and the Ylist to L2. Use the third mark (the small dot). To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

```
Plot1  Plot3
Off
Type: L1  L2  L3 
Xlist: L3
Ylist: L2
Mark:   
```

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.



## Reflection in the x-axis $(x,y) \rightarrow (x,-y)$

To draw another heart upside down from this heart, you will need to reflect all these data points in the x-axis. You will need both sets of x-values from List 1 and List 3 and you will need the opposite of all the y-values.

To do this you will combine List 1 and List 3 together into one List 4. Since this list will have twice as many values and the lists must match, you will use List 5 to enter the opposite of List 2 twice.

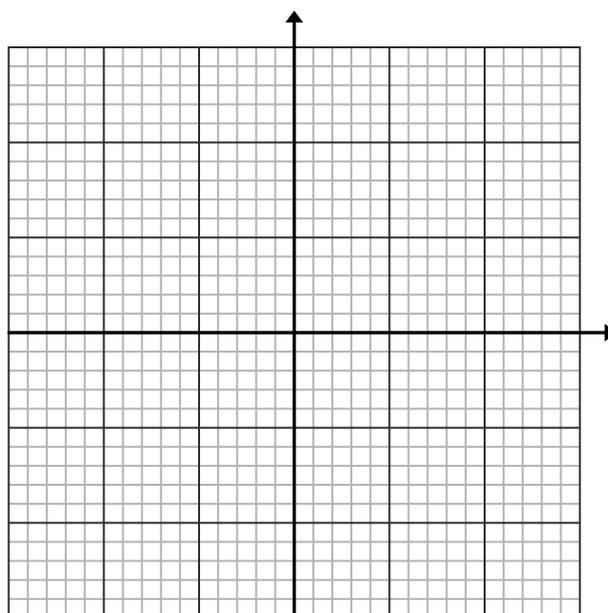
To begin, hit STAT and 1:Edit to get to the list editor. Arrow right to L4 and up to highlight L4. While it is highlighted, hit 2<sup>nd</sup> STAT, arrow right to OPS, and select 9:augment and then hit ENTER. Tell the calculator which lists you wish to combine by entering L1, L3) and then hit ENTER. [Remember to use the comma key located above the 7 and a closing parenthesis.] Now arrow over to L5 and repeat the above steps to enter - L2, - L2. Be sure to enter it twice so you have matching data.

To see the whole heart and its reflection you will need to have Plot 1, Plot 2, and Plot 3 turned on.

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.

Hit 2<sup>nd</sup> STATPLOT and select Plot3. Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L4 and the Ylist to L5. Use the third mark (the small dot). To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

```
Plot1 Plot2 Plot3
Off Off On
Type: L1 L2 L3 L4 L5
Xlist: L4
Ylist: L5
Mark: . + ■
```



When you are finished sketching your graph, hit 2<sup>nd</sup> MEM (above +) and 4:ClrAllLists then ENTER. Hit 2<sup>nd</sup> STATPLOT and 4:PlotsOff then ENTER.

## Graphing a Flower Petal or Feather

Using a TI-84 Plus Silver Edition graphing calculator, hit STAT and 1:Edit to enter the following data into L1 and L2. These data points will form a flower petal or feather.

| <u>L1</u> | <u>L2</u> |
|-----------|-----------|
| 0         | 0         |
| 4         | 12        |
| 12        | 20        |
| 16        | 22        |
| 22        | 22        |
| 22        | 16        |
| 20        | 12        |
| 12        | 4         |
| 0         | 0         |

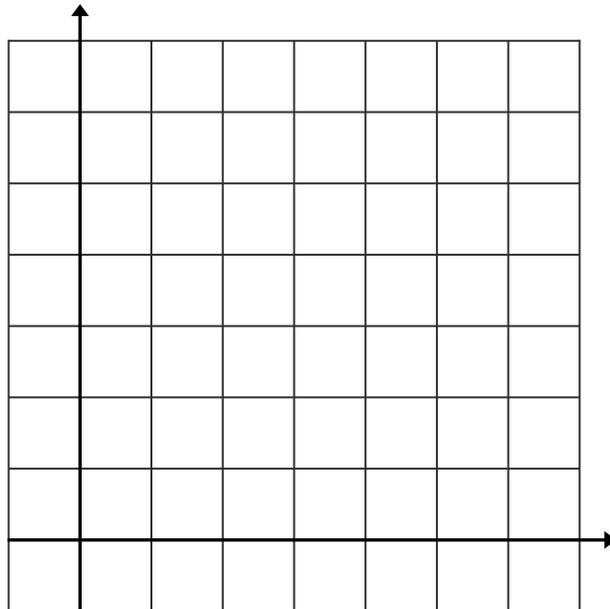
To see it's graph, turn on Plot1.

Hit 2<sup>nd</sup> STATPLOT and select Plot1. Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L1 and the Ylist to L2. Use the third mark (the small dot). To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

```

Plot1 Plot2 Plot3
On Off
Type: L1 [ ] [ ]
      [ ] [ ] [ ]
Xlist:L1
Ylist:L2
Mark:  . + ■
    
```

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.



**Translations**       $(x,y) \rightarrow(x+a,y+b)$

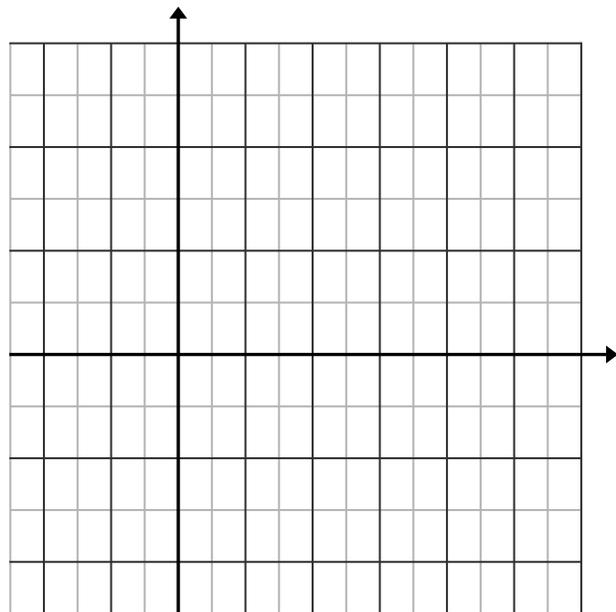
To draw another flower petal or feather on the same coordinate plane, you will need to change the all the values in List 1 by the same amount and all the values in List 2 by another amount.

To begin, hit STAT and 1:Edit to get to the list editor. Arrow right to L3 and up to highlight L3. Enter L1 + 10 and hit ENTER. Arrow right to L4 and up to highlight L4. Enter L2 - 18 and hit ENTER.

To see your new graph of both flower petals or feathers, hit 2<sup>nd</sup> STATPLOT and select Plot2. Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L3 and the Ylist to L4. Use the third mark (the small dot). To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

```
Plot1  Plot2  Plot3   
 Off  
Type: L1  L2  L3   
Xlist:L3  
Ylist:L4  
Mark:   
```

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.



When you are finished sketching your graph, hit STAT and 4:ClrList then L3, L4 and ENTER. [Remember to use the comma key above the 7.] Hit 2<sup>nd</sup> STATPLOT and turn OFF Plot 2.

**Dilation**  $(x,y) \rightarrow(kx,ky)$

To make our flower petal or feather grow (or enlarge) or shrink (or reduce) you will need to multiply all the values of List 1 and List 2 by the same scale factor. In this example the scale factor will be 2 times larger. ( $k = 2$ )

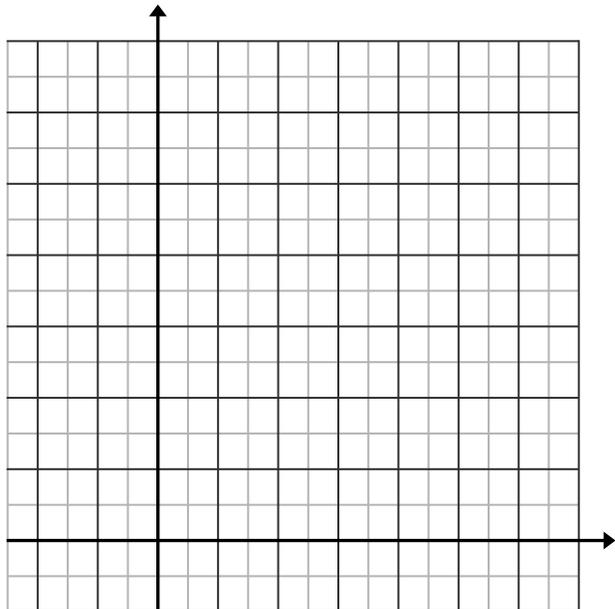
To begin, hit STAT and 1:Edit then arrow right to L3 and up to highlight L3. Enter  $L1 * 2$  and hit ENTER. Arrow right to L4 and up to highlight L4. Enter  $L2 * 2$  and hit ENTER.

To see your new graph of both flower petals or feathers, hit 2<sup>nd</sup> STATPLOT and select Plot2. Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L3 and the Ylist to L4. Use the third mark (the small dot). To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

```
Plot1 Plot2 Plot3
Off
Type: L1 L2 L3 L4
      . . .
Xlist:L3
Ylist:L4
Mark: . + ■
```

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.

When you are finished sketching your graph, hit STAT and 4:ClrList then L3, L4 and ENTER. [Remember to use the comma key above the 7.] Hit 2<sup>nd</sup> STATPLOT and turn OFF Plot 2.



### Rotations with a flower petal or feather.

Use List 1, List 2 and Plot 1 as before. In order to create the following rotations you will need List 1 to represent  $x$ , List 2 to represent  $y$ , List 3 to represent  $-x$ , and List 4 to represent  $-y$ .

To begin, hit STAT and 1:Edit then arrow right to L3 and up to highlight L3 where you will enter  $-L1$  and hit ENTER to get all the opposite values of  $x$  entered. Arrow right to L4 and up to highlight L4 where you will enter  $-L2$  and hit ENTER to get all the opposite values of  $y$  entered. [Remember: use the  $(-)$  key for the negative sign.]

#### **Rotate 90° clockwise $(x,y) \rightarrow (y,-x)$**

In order to create this rotation you must use your  $y$ -values for  $x$  and use the opposite of the  $x$ -values for  $y$ .

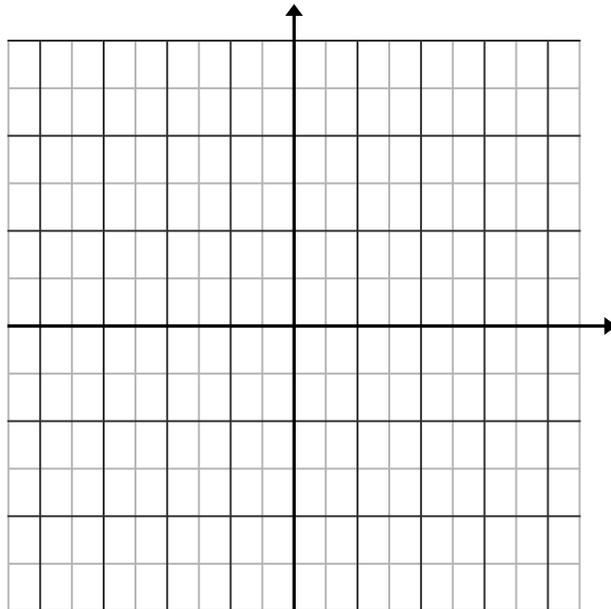
To see both the original flower petal or feather and the rotation, hit 2<sup>nd</sup> STATPLOT and select Plot 2. Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L2 and the Ylist to L3. Use the third mark (the small dot).

```
Plot1  Plot2  Plot3   
 Off  
Type:     
Xlist:L2  
Ylist:L3  
Mark:   
```

To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.

When you are finished sketching your graph, hit 2<sup>nd</sup> STATPLOT and turn OFF Plot 2.



**Rotate 90° counterclockwise  $(x,y) \rightarrow(-y,x)$**

In order to create this rotation you must use your x-values for y and use the opposite of the y-values for x.

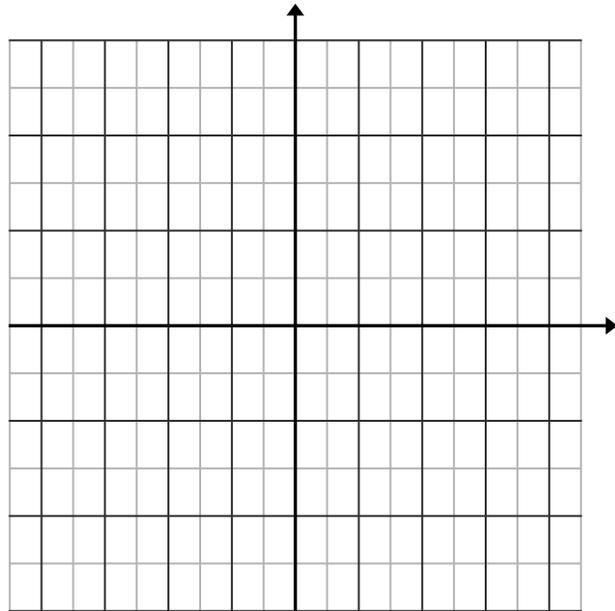
To see both the original flower petal or feather and the rotation, hit 2<sup>nd</sup> STATPLOT and select Plot 2.

Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L4 and the Ylist to L1. Use the third mark (the small dot).



To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.



When you are finished sketching your graph, hit 2<sup>nd</sup> STATPLOT and turn OFF Plot 2.

**Rotate 180°       $(x,y) \rightarrow(-x,-y)$**

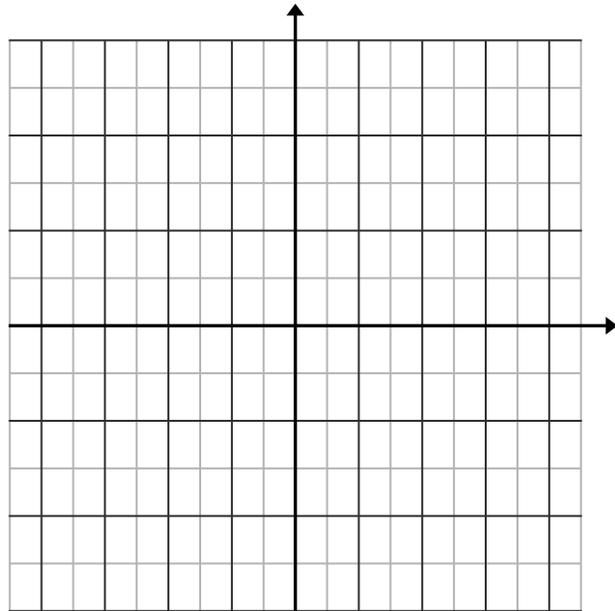
In order to create this rotation you must use the opposite of the x-values for x and the opposite of the y-values for y.

To see both the original flower petal or feather and the rotation, hit 2<sup>nd</sup> STATPLOT and select Plot 2. Turn the Plot ON by selecting ON. Use the down arrow key to select the type of graph to be a line graph (the second one) and set the Xlist to L3 and the Ylist to L4. Use the third mark (the small dot).



To see the graph properly, hit ZOOM and 9:ZoomStat and then ZOOM and 5:ZoomSquare.

On the graph provided, sketch what you see on the TI-84 Plus graph screen. Check the accuracy of your drawing against the data lists.



When you are finished sketching your graph, hit 2<sup>nd</sup> MEM (above +) and 4:ClrAllLists then ENTER. Hit 2<sup>nd</sup> STATPLOT and 4:PlotsOff then ENTER.