**Activity 3.1.3 Polynomial TI-84 Investigation – Odd and Even Functions**

In this investigation, you will look at the effects of the transformations *f* (*–x*), *–f* (*x*) and *–f* (*–x*) on *f* (*x*). A chart is found at the end of the investigation where your results can be recorded to help you identify the relationships between the different functions.

I. On the TI-84, enter the function *f* (*x*) = *x* into Y1 and graph the function in the ZOOM DECIMAL window.

1. Describe the graph you see including the degree of the function.

 2. In Y2, enter *f* (*–x*). To do this:

 a. Go to Y=, and put your curser at Y2

 b. Select VARS (next to the CLEAR button)

 c. Arrow over to Y-VARS

 d. Select #1 (Function)

 e. Select #1 (Y1)

 f. This will bring you back to the Y= home screen with Y2 = Y1. Continue to type to get: Y2 = Y1(*–x*)

 3. Predict what this graph will look like. Make a sketch below:



 4. Compare the new graph to the original one you graphed. What has changed? What has stayed the same?

 5. Deactivate the Y2 function by using the arrow keys to highlight the equal sign in the Y= Menu and hit ENTER. Now, in Y3, enter *–f* (*x*), the opposite of the Y1 function, by following the same procedure as in step 2 to get: Y3 = –Y1

 6. Predict what this graph will look like. Make a sketch below:



7 a. Compare the graph of Y3 to the graph of Y1. Are the graphs the same? If not, how are the graphs related?

 b. Reactivate the Y2 function. Compare the graphs of Y1, Y2, and Y3. Are any of the graphs are the same? Which are reflections of each other, and if so, over what line are they reflected?

 8. Deactivate functions Y2 and Y3. Now, in Y4, enter *–f* (*–x*) by following the same procedure as in step 2 to get: Y4 = –Y1(*–x*)

 9. Predict what this graph will look like. Make a sketch below:



10 a. Compare the graph of Y4 to the graph of Y1. Are the graphs the same? If not, how are the graphs related?

 b. Reactivate the Y2 and Y3 functions, and compare all four functions. Are any of the graphs the same? Which graphs are reflections of each other? What line are they reflected over.

II. Repeat part I for the graphs *f* (*x*) = *x*2, *f* (*x*) = *x*3, *f* (*x*) = *x*4, and *f* (*x*) = *x*5

 Note: All you need to do is change Y1. The rest of the functions are based on that. Just turn on and off the graphs you want to see at once. There are extra graphs at the end of the investigation for you sketch on.

III. Based on your observation in parts I and II, answer the following:

 1. What is/are the degree(s) of the functions when *f* (*x*) and *f* (*–x*) match? (When Y1 = Y2)

 2. What is/are the degree(s) of the functions when *f* (*x*) and *–f* (*x*) match? (When Y1 = Y3)

 3. What is/are the degree(s) of the functions when *f* (*x*) and *–f* (*–x*) match? (When Y1 = Y4)

 4. Are there any functions where *f* (*–x*) and *–f* (*x*) match? (When Y2 = Y3) If so, what is/are the degrees of those functions?

 5. Are there any functions where *f* (*–x*) and *–f* (*–x*) match? (When Y2 = Y4) If so, what is/are the degrees of those functions?

 6. Are there any functions where *–f* (*x*) and *–f* (*–x*) match? (when Y3 = Y4) If so, what is/are the degrees of those functions?

 7. Given any function *f* (*x*) = *xn* where *n* is any integer ≥ 1, make a conjecture as to when:

 a. *f* (*x*) will be equal to (will match) *f* (*–x*)

 b. *f* (*–x*) will be equal to (will match) *–f* (*x*)

 8. Test your conjecture by testing larger values of *n* on your calculator (in Y1).

IV. We saw that for functions of the form *f* (*x*) = *xn*, where *n* is even, *f* (*x*) = *f* (–*x*), that is, opposite inputs have the same output. We also saw that for function of the form *f* (*x*) = *xn* , where *n* is odd, –*f* (*x*) = *f* (–*x*), that is, opposite inputs have opposite outputs.

 Investigate what will happen if you change your original functions by adding or subtracting polynomial terms of varying degrees.

 1. Enter the following functions into Y1 (one at a time) and compare functions Y1, Y2, Y3, and Y4 as before to see if your conjectures in 7a or 7b ever hold.

 a. *f* (*x*) = *x*4 – *x*2

 b. *f* (*x*) = *x*5 + *x*3 + *x*

 c. *f* (*x*) = *x*4 + *x*3 – 2*x*

d. *f* (*x*) = 5*x*6 – 3*x*2

 e. *f* (*x*) = 3*x*3 – 2*x*

 f. *f* (*x*) = *x*3 – 4*x*2 – 5*x*

 g. *f* (*x*) = *x*2 – 2

 h. *f* (*x*) = *x*3 + 1

 2. For which functions did the conjectures you made in part III always hold? In general, when does it look like *f* (*x*) = *f* (–*x*) and when does it look like *f* (–*x*) = –*f* (*x*)?

**Use the charts below to record your findings Sections III**

***f* (*x*) = *x***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

***f* (*x*) = *x*2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

***f* (*x*) = *x*3**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

***f* (*x*) = *x*4**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

***f* (*x*) = *x*5**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

***f* (*x*) = *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

***f* (*x*) = *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

***f* (*x*) = *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Y1 = *f* (*x*) | Y2 = *f* (*–x*) | Y3 = *–f* (*x*) | Y4 = *–f* (*–x*) |
| Y1 = *f* (*x*) |  |  |  |  |
| Y2 = *f* (*–x*) |  |  |  |  |
| Y3 = *–f* (*x*) |  |  |  |  |
| Y4 = *–f* (*–x*) |  |  |  |  |

 





 



