MATH 0031

In Class Activity – Integrating the Graphing Calculator

Part 1: The Graph of $f(x) = |x|$ and its Translations

1) Graph $f(x) = |x|$, first press $< y =>$ to enter the function. Next, display the MATH NUM menu, by pressing **<MATH>** and using the arrow to highlight **<NUM>.** Choose #1**,** *abs(* Type x and close parentheses. Enter the following window size: $-6,6,1,-6,6,1$. Graph.

2) a) Next, in y_2 enter $abs(x+3)$. Graph both that and y_1 in the same window.

How was the graph of $y = |x|$ shifted (translated) when you added 3 to x?

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   b) Repeat for $y = |x+4|$

How was the graph of $y = |x|$ shifted (translated)?

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3) a) Now in y_2 enter $abs(x-4)$. Graph both y_1 and y_2 in the same window.

How was the graph of $y = |x|$ translated when you subtracted 4 from x?

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   b) Repeat for $y = |x-5|$

How was the graph of $y = |x|$ translated?

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Conclusion: Given any absolute value equation in the form $y = |x - b|$, where "*b*" represents any constant numeric value, generalize the two possible horizontal translations which will occur (one if $b > 0$ and one if $b < 0$).

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4) a) Again consider the equation $y_1 = abs(x)$. In y_2 enter $abs(x) - 3$ and graph both that and y_1 in the same window.

How was the graph of $y = |x|$ translated when you subtracted 3 from y?

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b) Repeat for $y = |x| - 2$.

How was the graph of $y = |x|$ translated when you subtracted 2 from y?

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5) a) Enter in y_3 the following: $abs(x) + 2$. Then graph that in addition to the other two equations.

How was the graph of $y = |x|$ translated when 2 was added to the function?

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b) Repeat for $y = |x| + 3$.

How was the graph of $y = |x|$ translated when 3 was added to the function?

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Conclusion: Given any absolute value equation in the form $y = |x| + c$, where "c" represents any constant numeric value, generalize the two possible vertical translations which will occur (one if $c > 0$ and one if $c < 0$).

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Suppose we combine both shifts. How will that effect the placement of the graph's vertex?

6) a) Where will the vertex of $y = |x + 1| + 2$ be? Using what you have learned, in the space below draw a rough sketch of the graph. At this point, don't worry about correctly plotting the x-intercepts. However, you should plot the y-intercept (remember $x = 0$ there). When you are done, you should have located and plotted <u>two</u> points: the vertex and the y-intercept. Check using your graphing calculator.
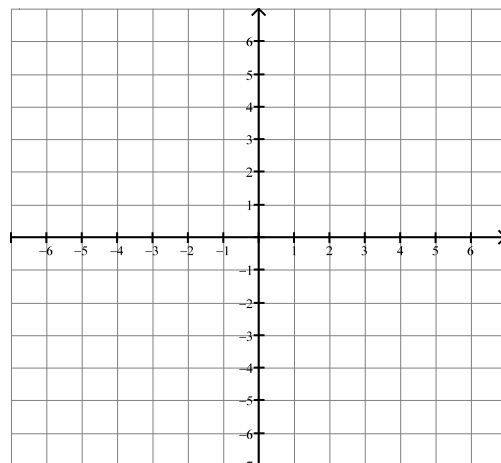
b) Repeat the above for $y = |x - 2| - 2$ and check your work with the graphing calculator.
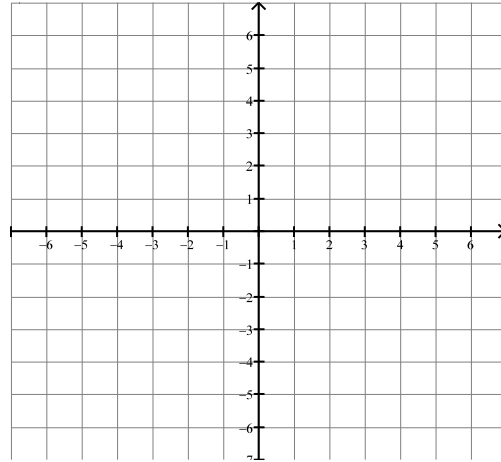
Part 2: Solving Absolute Value Equations Using Graphs

7) To solve $|x| = 4$ by graphing, go to your equation screen and in y_1 enter $abs(x)$ and in y_2 enter 4. Enter the following window size: -6,6,1,-6,6,1. Graph these equations.

To determine the *x*-coordinates of the points where the graphs intersect, use 2^{nd}, TRACE, Option 5, then move the cursor to the left intersection and hit ENTER three times.

a) Where do these two graphs intersect? _____

As you saw at the start of class, the absolute- value equation $y = |x|$ is represented by two separate linear equations: $y = -x$ (the left side of the V) and $y = x$ (the right side of the V). In our example, $|x| = 4$, the y variable is replaced by the number 4 so the two linear equations generated by the absolute value equation will be $4 = -x$ (or, if we multiply both sides by -1, $x = -4$) and $4 = x$. These two *linear* equations are the **solutions** to the absolute value equation, $|x| = 4$.

b) Repeat this graphing process for $|x - 4| = 7$. Where do the two graphs intersect?

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c) Solve graphically: $|2x + 4| = 6$. Where do the two graphs intersect?

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How does this help us understand how to solve absolute value equations *algebraically?*

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c) If you are given an absolute-value equation, $|x-b|=k$, what will be the two linear equations that are generated from it?

Part 3: Solving Absolute Value Equations Using Tables

8) To Solve $|x|=3$ using the Table option on your graphing calculator, enter *abs (x)* for Y1. Enter 3 for Y2. Using 2^{ND} , TBLSET, set the TBL START at 0 and the Δ TBL at 1. Produce the table by hitting 2^{ND} TABLE.

a) Y1, which is $|x|$, is the left side of the absolute- value equation and Y2, which is 3, is the right side. What value(s) of x make Y1 = Y2? ⸻⸻⸻⸻⸻⸻⸻⸻

Note: As you have already learned, absolute value equations usually have <u>*two*</u> solutions**.** If you place your cursor in the X column and begin scrolling downward, you will see that the values of Y1 and Y2 get further apart. That is clearly not the direction to go. Try scrolling upward in the X column. You will see that as the values of x decrease below 0, Y1 and Y2 values move closer together until they match each other at $x=-3$. You have just discovered the second solution to the equation.

b) Solve $|x-4|=7$ using a Table. ⸻⸻⸻⸻⸻⸻⸻⸻

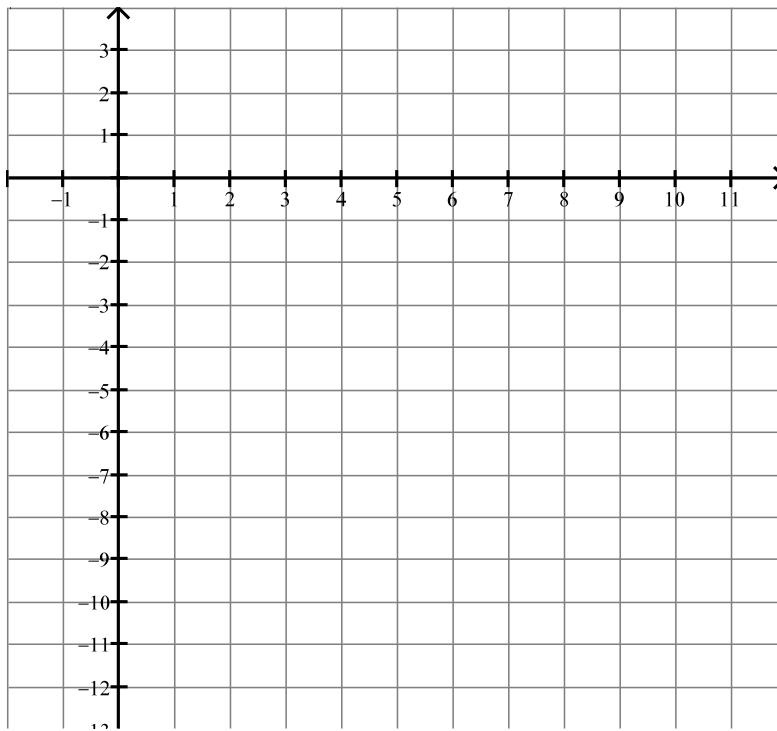**c)** Solve $|2x+4|=6$ using a Table.⸻⸻⸻⸻⸻⸻⸻⸻

Part 4: An Absolute Value Application

9) Below is the numeric representation of the temperature y at a time x in Cleveland, Ohio as a quickly moving " Alberta Clipper" cold front goes through the city.

x	0 (midnight)	1	2	3	4	5	6	7	8	9	10
y	2	0	- 2	- 4	- 6	- 8	- 6	- 4	- 2	0	2

a) Graph these ordered pairs below. How would you describe the graph? ——————————

b) What do you think the temperature was at 1: 30 AM? Explain your reasoning.

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c) What do you think the temperature was at 1: 59 AM? Explain your reasoning.

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