Pre Calculus

Date:

Items Needed: .Book, Assignment Specs for #65

Objective: The students will be able to use shifting, reflecting, and stretching to sketch graphs of the basic functions.

PA Common Core: cc.2.2.hs.c.4

Lesson:

- Go over the parent functions again and talk about the square root and the quadratic function and all of their properties.
- On the calculator, graph two functions that have a shift from the parent function.

- Summarize the following results
- Let c be a positive real number. The following changes in the function $y = f(x)$ will produce the stated shifts in the graph of $y = f(x)$.
  1. $h(x) = f(x - c)$ Horizontal shift c units to the right
  2. $h(x) = f(x + c)$ Horizontal shift c units to the left
  3. $h(x) = f(x) - c$ Vertical shift c units downward
  4. $h(x) = f(x) + c$ Vertical shift c units upward
- If you are having problems determining which way to move the graph just set what is inside of the parentheses equal to zero and that is the direction you must move the graph.

- On the calculator graph:
  1. $Y1 = f(x) = (x - 2)^3$
  2. Then, on the same viewing screen, graph $Y2 = -(x - 2)^3$. Note that this is $-f(x)$.
  3. Repeat for $Y3 = (-x - 2)^3$
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- The following changes in the function $y = f(x)$ will produce the stated reflections in the graph of $y = f(x)$.
  1. $h(x) = -f(x)$: reflection in the x-axis
  2. $h(x) = f(-x)$: reflection in the y-axis
- Look at example 4 and refer to part b's notes.
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- **Nonrigid transformations** actually *distort* the shape of a graph, instead of just shifting or reflecting it.
- Graph $f(x)=x^2$ and $f(x)=2x^2$
- How can you describe the graphs? On the board, put up the coordinates for a graph of $f(x)=x^2$ and $f(x)=2x^2$

- Now graph $f(x)=1/2x^2$ in the same window.
- One nonrigid transformation of $y = f(x)$ comes from equations of the form $g(x) = cf(x)$. If $c > 1$, there is a **vertical stretch** of the graph of $y = f(x)$. If $0 < c < 1$, there is a **vertical shrink** of $y = f(x)$.
- **Vertical shrink or stretch is because you are keeping the same x value but multiplying the y value by the factor of multiplication.**

- Do #19, p. 47. Do examples a-f on a sheet of graph paper with the students using the smart board.
- When you get to the last example, explain that this is the toughest transformation to see.
- Do the first part of example 6.
- Illustrate given $f(x)=2-x^3$
- Then $h(x)=f((1/2)x)=2-(1/2x)^3=2-(1/8)x^3$.
- Graph f(x) and h(x) in the same window and look at the table.
- Illustrate the match up with the y values and the relationship of the new x values. (New x values are doubled)
- See whether the statement holds true for f((1/3)x). (New x values are tripled)
- What happens when we do f((2/3)x)? (Technically the new x values are multiplied by the reciprocal.
- So what happens when we have f(3x)? (New x values are multiplied by the reciprocal.)

- Another nonrigid transformation of $y = f(x)$ comes from equations of the form $h(x) = f(cx)$. If $c > 1$, there is a **horizontal shrink** of the graph of $y = f(x)$. If $0 < c < 1$, there is a **horizontal stretch** of $y = f(x)$.

Can use the next graph if needed

- Graph ***g(x)=f(2x)*** on calc using $f(x)=2-x^3$.
- Can you see what changed? Lets look at the points to determine what happened.

x	2-x^3	x2	2-8x^3
0	0	0	0
1	1	0.5	1
-1	3	-0.5	3
2	-6	1	-6
-2	10	-1	3
3	-25	2	-62
-3	29	-2	66
4	-62	3	
-4	66	-3	
		4	

- Since we multiplied by 2 inside of the parentheses looking at the table, the y values are the same when the x values are cut in half.

- Likewise if we graph *h(x)=f(1/2x)* using the same function as above we would find that in this case are x value is doubled because of the factor of ½ when the y value is the same.
- Vertical shifts deal with the scale factors multiplied times the function and the horizontal shift deals with scale factor multiplied by the x.

Assignment: .Have students do 10, 12, 20, 29-34, 43-46, 52-64 (even), 66, 73, 74, p. 47.
Have students do 65, p. 48

Evaluation: (Could be from any one/several of the following)

Responses from classroom questions
Results of classroom sample problems
Homework responses
Check answer with Calculator
End of the section exam

Enrichment: