

**Login your clickers & NO calculators**

**Do the 3.1 checkpoint from the brown table.**

**Portfolios are due FRIDAY!!**

Mar 19-7:37 AM

## **Algebra 2 Section 3-2**

Translating the Graph of  $f(x) = x^n$

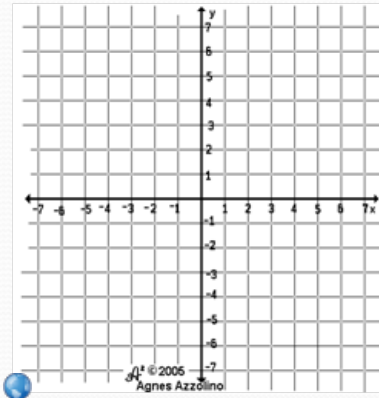
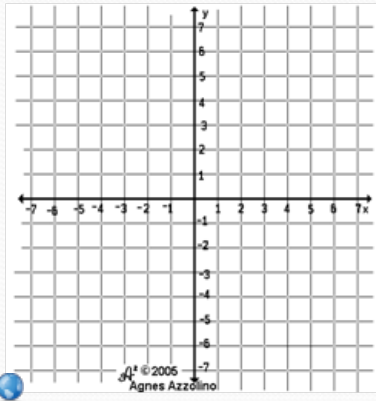
Essential Question:

How do the values of the constants  $h$  and  $k$  in  $f(x) = (x - h)^2 + k$  affect the graph of the function?

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# The Parent Graphs of $f(x) = x^n$

- Even exponents
  - The Vertex is at  $(0,0)$
- Odd Exponents
- The Graph crosses and turns at  $(0,0)$



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## Graph the functions on page 75

- Use your calculator and its table function to complete pg 75
- How is the graph of  $g(x) = x^4 - 1$  related to its parent function?
- How is the graph of  $h(x) = x^3 + 2$  related to its parent function?
- In general, how do you think  $f(x) = x^n + k$  relates to its parent function?

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Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**3-2**  
COMMON CORE  
CC.9-12.F.IF.7\*  
CC.9-12.F.IF.7c+  
CC.9-12.F.BF.3

### Translating the Graph of $f(x) = x^n$

**Essential question** How do the values of the constants  $h$  and  $k$  in  $f(x) = (x - h)^n + k$  affect the graph of the function?

In this lesson and the next, you will explore transformations of the graph of  $f(x) = x^n$ . In this lesson, the focus is on translations.

**1 EXAMPLE** Graphing  $f(x) = x^2 + k$

**Graph each function.**

**A**  $g(x) = x^2 - 1$

Complete the table of values and use it to help you graph the function. The graph of the parent function  $f(x) = x^2$  is shown.

x	g(x)
-2	
-1	
0	
1	
2	

**B**  $h(x) = x^3 + 2$

Complete the table of values and use it to help you graph the function. The graph of the parent function  $f(x) = x^3$  is shown.

x	h(x)
-2	
-1	
0	
1	
2	

**REFLECT**

1a. How is the graph of  $g(x)$  related to the graph of its parent function?  
\_\_\_\_\_

1b. How is the graph of  $h(x)$  related to the graph of its parent function?  
\_\_\_\_\_

1c. In general, how do you think the graph of  $f(x) = x^n + k$  is related to the graph of its parent function?  
\_\_\_\_\_  
\_\_\_\_\_

**2 EXAMPLE** Graphing  $f(x) = (x - h)^n$

**Graph each function.**

**A**  $g(x) = (x - 3)^4$

1 of

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## Reflect Questions

- What is the domain of the graph of  $g(x)$ ?
- What is the range of the graph of  $g(x)$ ?
- Is the graph symmetric?
- What is the domain of the graph of  $h(x)$ ?
- What is the range of the graph of  $h(x)$ ?
- Is the graph symmetric?

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# Graph the functions on page 76

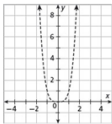
- Use your calculator and its table function to complete pg 76
- How is the graph of  $g(x) = (x - 3)^4$  related to its parent function?
- How is the graph of  $h(x) = (x + 1)^3$  related to its parent function?
- In general, how do you think  $f(x) = (x - h)^n$  relates to its parent function?

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UNIT 3: Polynomial Functions

Complete the table of values and use it to help you graph the function. The graph of the parent function  $x^4$  is shown.

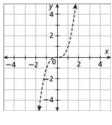
x	$g(x)$
1	
2	
3	
4	
5	



**B**  $h(x) = (x + 1)^3$

Complete the table of values and use it to help you graph the function. The graph of the parent function  $x^3$  is shown.

x	$h(x)$
-3	
-2	
-1	
0	
1	



**REFLECT**

2a. How is the graph of  $g(x)$  related to the graph of its parent function?

2b. How is the graph of  $h(x)$  related to the graph of its parent function?

2c. In general, how do you think the graph of  $f(x) = (x - h)^n$  is related to the graph of its parent function?

**3 EXAMPLE** Graphing  $f(x) = (x - h)^n + k$

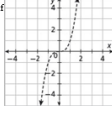
Graph  $g(x) = (x - 2)^3 + 1$ .

**A** The graph of the parent function  $g(x) = x^3$  is shown. Determine how the graph of  $f(x)$  is related to the graph of  $g(x)$ .

Since  $g(x) = (x - 2)^3 + 1$ ,  $h =$  and  $k =$

Complete the table to describe how the graph of the parent function must be translated to obtain the graph of  $f(x)$ .

Type of Translation	Number of Units	Direction
Horizontal		
Vertical		



**B** Use the translations you identified to help you draw the graph of  $f(x)$ .

**REFLECT**

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## Reflect Questions

- What is the domain of the graph of  $g(x)$ ?
- What is the range of the graph of  $g(x)$ ?
- Is the graph symmetric?
- What is the domain of the graph of  $h(x)$ ?
- What is the range of the graph of  $h(x)$ ?
- Is the graph symmetric?

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## Graphing $y = (x - h)^n + k$ on the Calculator

- Type the following functions and write down where the vertex or turning point appears to be

1)  $f(x) = (x-2)^3$     2)  $f(x) = x^4 + 2$     3)  $f(x) = (x+2)^5 - 1$

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## Summarize your thinking

- How is the graph of  $f(x) = (x - h)^n + k$  related to the parent graph of  $f(x) = x^n$  if  $n$  is even?

- How is the domain related to the above equation?

- How is the range related?

- Without graphing, tell me where the vertex of the function would be

1)  $f(x) = (x - 1)^4$       2)  $f(x) = x^6 + 2$       3)  $f(x) = (x + 3)^8 - 4$

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## Summarize your thinking

- How is the graph of  $f(x) = (x - h)^n + k$  related to the parent graph of  $f(x) = x^n$  if  $n$  is odd?

- How is the domain related to the above equation?

- How is the range related?

- Without graphing, tell me where the vertex of the function would be

1)  $f(x) = (x + 2)^5$       2)  $f(x) = x^3 + 3$       3)  $f(x) = (x - 4)^7 - 2$

\*\*Complete page 77 with your partner.

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NO CLICKERS or CALCULATORS!

Have out the 3.2 notes on translating Even/Odd polynomials.

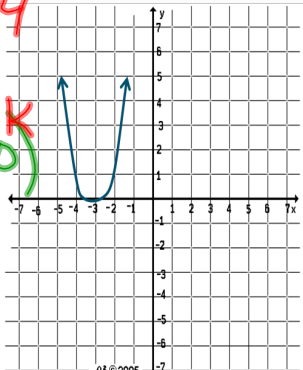
Be ready to begin, PLEASE.

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Writing Equations for  $f(x) = (x - h)^n + k$

- Use what you know about the vertex to write an equation for each graph. State the domain and range of each.
- 1) Shows a transformation of  $f(x) = x^4$  2) Shows a transformation of  $f(x) = x^6$

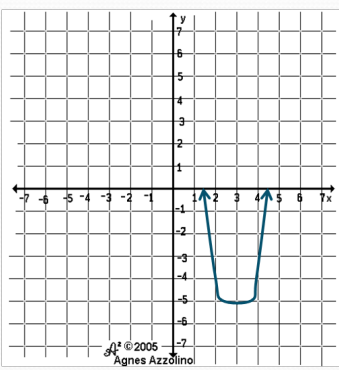
$n=4$



$f(x) = (x - -3)^4 + 0$

$f(x) = (x + 3)^4$

$n=6$

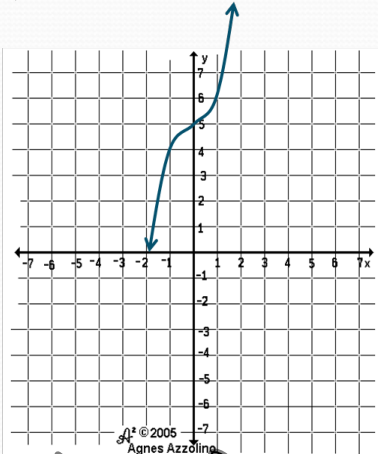


$f(x) = (x - 3)^6 - 5$

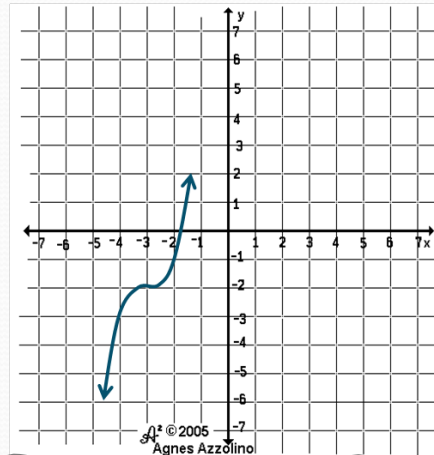
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### Writing Equations for $f(x) = (x - h)^n + k$

- Use what you know about the turning point to write an equation for each graph. State the domain and range of each.
- 1) Shows a transformation of  $f(x) = x^3$  2) Shows a transformation of  $f(x) = x^5$



$f(x) = x^3 + 5$



$f(x) = (x + 3)^5 - 2$

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### Try Example 4 on page 78 with your partner

- Compare the domain and range of  $g(x)$  to the domain and range of the parent function  $f(x) = x^4$ .

Even:  $D: x \in \mathbb{R} \quad R: y \in \mathbb{R}: y \geq k$

- Suppose the graph of  $g(x)$  is translated 3 units right and 2 units up to give the graph of  $h(x)$ . Explain how you can write the equation of  $h(x)$ .

$g(x) = (x - 2)^3 + 4$   
 $h(x) = (x - 5)^3 + 6$  (5, 6) (h, k)

- In general, do translations change the end behavior of a function of the form  $f(x) = x^n$ ? Give a specific example.

→ H. Shift  
 U. Shift

No!

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UNIT 3: Polynomial Functions

3a. Compare the domain and range of  $g(x) = (x - 2)^2 + 1$  to the domain and range of the parent function  $f(x) = x^2$ .

3b. How is the graph of  $h(x) = (x + 1)^2 - 6$  related to the graph of  $f(x) = x^2$ ?

**EXAMPLE** Writing the Equation of a Function

The graph of  $g(x)$  is the graph of  $f(x) = x^2$  after a horizontal and vertical translation. Write the equation of  $g$ .

4. Complete the table to describe how the graph of the parent function must be translated to obtain the graph of  $g$ . (Hint: Consider how the "turning point"  $(0, 0)$  on the graph of  $f(x)$  must be translated to obtain the turning point on the graph of  $g(x)$ .)

Type of Translation	Number of Units	Direction
Horizontal		
Vertical		

5. Determine the values of  $h$  and  $k$  in the equation  $g(x) = (x - h)^2 + k$ .  
Based on the translations,  $h =$  \_\_\_\_\_ and  $k =$  \_\_\_\_\_.  
So,  $g(x) =$  \_\_\_\_\_.

**REFLECT**

4a. Compare the domain and range of  $g(x)$  to the domain and range of the parent function  $f(x) = x^2$ .

4b. Suppose the graph of  $g(x)$  is translated 3 units right and 2 units up to give the graph of  $h(x)$ . Explain how you can write the equation of  $h(x)$ .

4c. In general, do translations change the end behavior of a function of the form  $f(x) = x^n$ ? Give a specific example.

**PRACTICE**

Graph each function.

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Pg. 79 - 80  
1-10 all  
& 11 or 12

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① Odd Polynomial

V. Stretch & H. Shift

② Even Polynomial  
Reflection, V. Shift &  
V. Shrink

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