Math 3 # 4.4 Polynomial Rates of Change Unit 4

SWBAT explore how quickly polynomial functions increase and decrease.

In as many ways as possible, compare and contrast linear, quadratic, and exponential functions.

Answers will vary

Example 1: Use the following functions to help answer the statements below.

2^x	$x^2 - 20$	$x^5 - 4x^2 + 1$	$x + 30$	$x^4 - 1$	$x^3 + x^2 - 4$	$-x^2 + x$

a) Write the following expressions in order from **least to greatest** when the value of x is zero.

(x^2-20) (x^3-x^2-4) (x^4-1) $(-x^2+3x)$ $(2^x$ or $x^5-4x^2+1)$ $(x+30)$

-20 -4 -1 0 1 30

b) Do you think this order would change when x represents other numbers?

yes b/c the values all grow at different rates.

c) Write the same expressions from **least to greatest** when x represents a very large number (this number is so large it is close to or approaching positive infinity).

Least Greatest

$(-x^2+3x)$ $(x+30)$ (x^2-20) (x^3+x^2-4) (x^4-1) (x^5-4x^2+1) (2^x)

d) Write the same expressions in order from **least to greatest** when x represents a number that is approaching negative infinity.

Least Greatest

(x^5-4x^2+1) (x^3+x^2-4) $(-x^2+x)$ $(x+30)$ (2^x) (x^2-20) (x^4-1)

e) When comparing expressions, how does the order change depending on the values of x (close to negative infinity, zero, and positive infinity)?

When x is a large #, functions are ordered based on exponents

When x is a small #, functions are ordered from largest odd to largest even.

f) Determine where you would insert the following expression in question c.

$\left(\frac{1}{2}\right)^x$	x^7	$-x^5$	x^6	x^5

Least Greatest

$(-x^5)$ $(-x^2+3x)$ $(1/2)^x$ $(x+30)$ (x^2-20) (x^3+x^2-4) (x^4-1) (x^5) (x^5-4x^2+1) (x^6) (x^7) (2^x)

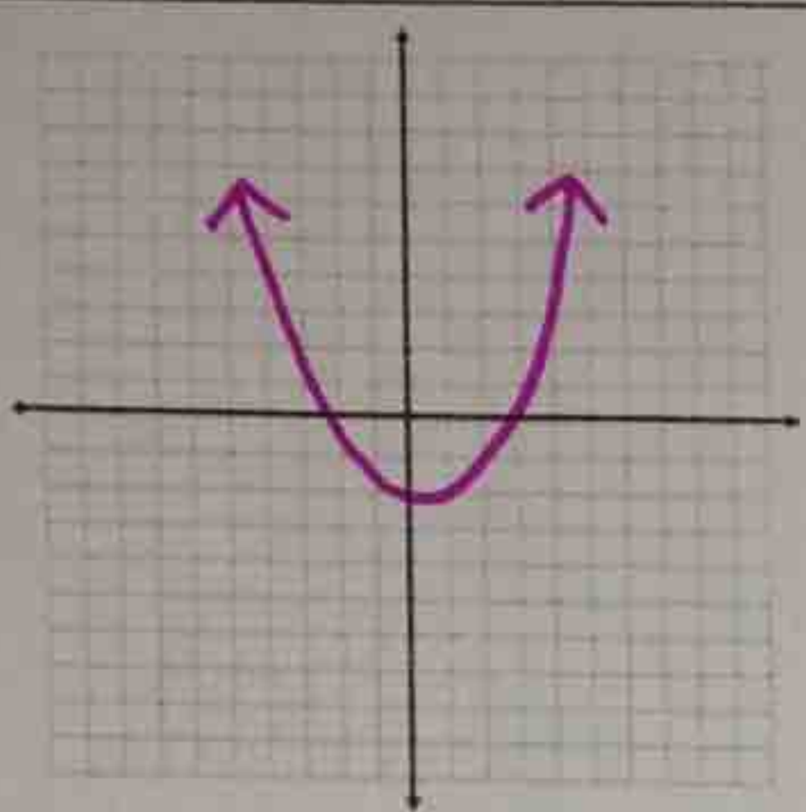
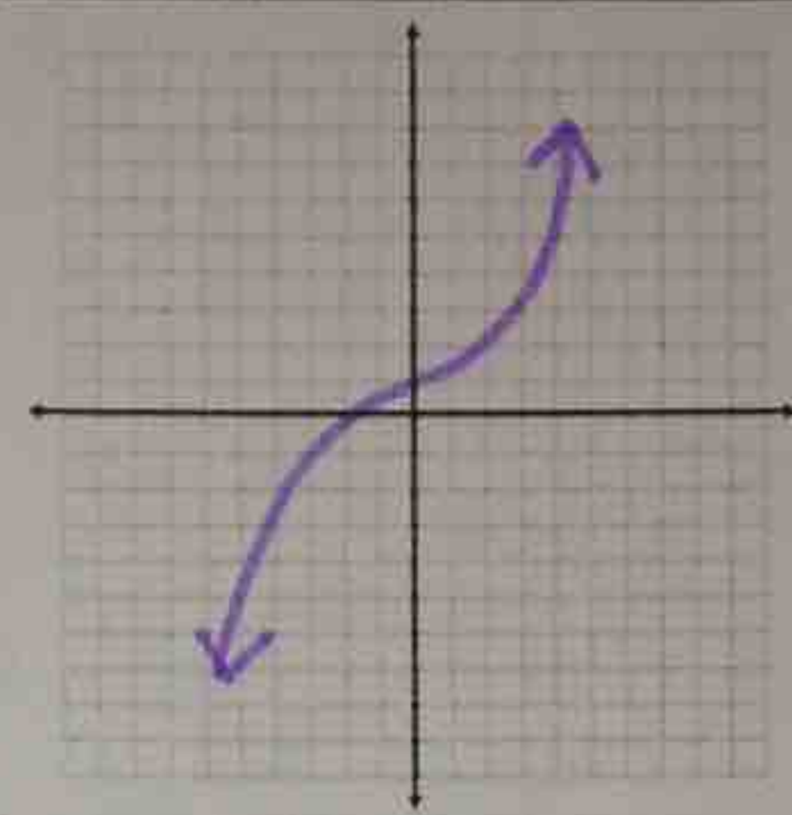
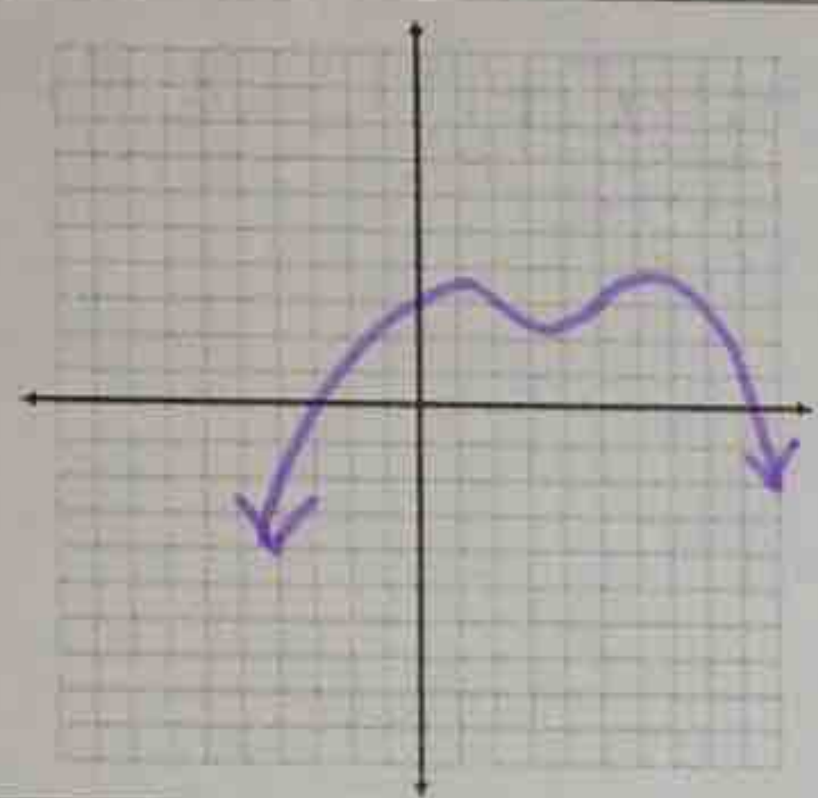
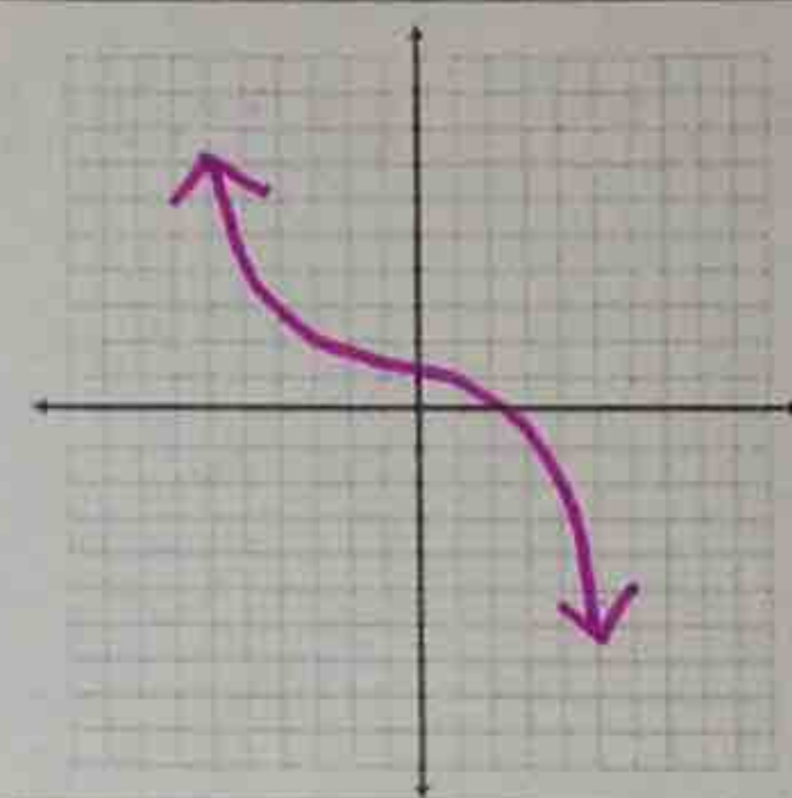
Least g) Now insert these same expressions into your list in question d. Greatest

(x^7) (x^5-4x^2+1) (x^5) (x^3+x^2-4) $(-x^2+x)$ $(x+30)$ (2^x) (x^2-20) (x^4-1) $(-x^5)$ (x^6) $(1/2)^x$

h) Write your process for ordering one variable polynomial expressions for both extremes (when x approaches infinity as well as when x approaches negative infinity).

See question e.

End Behavior: Defined by what is going on at the *ends* of a graph.

	Even Degree Polynomial	**Odd** Degree Polynomial
Positive Leading Coefficient	 Ex: $3x^2$ $x \to -\infty, f(x) \to \infty$ $x \to \infty, f(x) \to \infty$	 Ex: x^5 $x \to -\infty, f(x) \to -\infty$ $x \to \infty, f(x) \to \infty$
Negative Leading Coefficient	 Ex: $-4x^6$ $x \to -\infty, f(x) \to -\infty$ $x \to \infty, f(x) \to -\infty$	 Ex: $-2x^7$ $x \to -\infty, f(x) \to \infty$ $x \to \infty, f(x) \to -\infty$

Example 1: Find the end behavior based on your knowledge of the function.

1. $f(x) = 3 + 2x$

Degree: 1

LC: 2

End Behavior:

$x \to -\infty, f(x) \to -\infty$

$x \to \infty, f(x) \to \infty$

2. $f(x) = x^4 - 16$

Degree: 4

LC: +1

End Behavior:

$x \to -\infty, f(x) \to \infty$

$x \to \infty, f(x) \to \infty$

3. $f(x) = 3^x$

y = 0

~~Degree:~~ Exponential

~~LC:~~ Growth

End Behavior:

$x \to -\infty, f(x) \to 0$

$x \to \infty, f(x) \to \infty$

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

Degree: 3

LC: +1

End Behavior:

$x \to -\infty, f(x) \to -\infty$

$x \to \infty, f(x) \to \infty$

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

Degree: 3

LC: −2

End Behavior:

$x \to -\infty, f(x) \to \infty$

$x \to \infty, f(x) \to -\infty$

6. $f(x) = log_2 x$

x = 0

~~Degree:~~ Logarthim

LC: +1

End Behavior:

$x \to 0, f(x) \to -\infty$

$x \to \infty, f(x) \to \infty$

7. $f(x) = -2(x-3)(x+4)$

Degree: 2

LC: −2

End Behavior:

$x \to -\infty, f(x) \to -\infty$

$x \to \infty, f(x) \to -\infty$

8. $f(x) = \sqrt{x} - 3$

~~Degree:~~ Square root

LC: +1

End Behavior: (0, −3)

$x \to 0, f(x) \to -3$

$x \to \infty, f(x) \to \infty$

9. $f(x) = 3(x-1)(x+2)(x-4)$

Degree: 3

LC: 3

End Behavior:

$x \to -\infty, f(x) \to -\infty$

$x \to \infty, f(x) \to \infty$