Name: _____ Date: _____ # ____

Section 5-1 Polynomial Functions

Learning Goal: To understand how to classify polynomials; to understand how to graph polynomial functions and describe end behavior.

Essential Questions: What does the degree of a polynomial tell you about its related polynomial function?
For a polynomial function, how are factors, zeros, and x-intercepts related?
For a polynomial equation, how are factors and roots related?

Warm Up:

1. Solve equation by factoring. $x^2 - x - 20 = 0$

2. Which equation is equivalent to $x^2 + 24x + 100 = -46$?

   A. $(x+12)^2 = -2$

   B. $(x-12)^2 = -2$

   C. $(x-12)^2 = 2$

   D. $(x+12)^2 = 2$

3. What is the transformation of the graph of $y = (x+3)^2 - 2$ from its parent function $y = x^2$.

   A. 3 units left and 2 units down
   B. 3 units right and 2 units up
   C. 6 units right and 2 units up
   D. 2 units left and 3 units up

4. What is the axis of symmetry for the graph of the quadratic equation $y = -3x^2 - 12 + 12x$?

5. What is the vertex of $y = -2|x+4| - 5$

Vocabulary:

Monomial – a real number, a variable, or a product of a real number and one or more variables with whole number exponents.

Example:

Degree of a monomial - Is the sum of all exponents on variables

Example:

Polynomial – is a monomial or a sum of monomials

Example:

Degree of a polynomial – is the greatest degree among its monomial terms

Example:

Polynomial Function - a polynomial in the variable x defines a polynomial function of x

Example:

Standard form of a polynomial function- arranges the terms by degree in descending numerical order.

$$P(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0$$

where n is a nonnegative integer and $a_n,\ldots,a_0$ are real numbers

Example: $P(x) = 4x^3 + 3x^2 + 5x - 2$

Degree	Name Using Degree	Polynomial Example	Number of Terms	Name Using Number of Terms
0	constant	5	1	monomial
1	linear	$x + 4$	2	binomial
2	quadratic	$4x^2$	1	monomial
3	cubic	$4x^3 - 2x^2 + x$	3	trinomial
4	quartic	$2x^4 + 5x^2$	2	binomial
5	quintic	$-x^5 + 4x^2 + 2x + 1$	4	polynomial of 4 terms

You try:

Write each polynomial in standard form. What is the classification of each polynomial by degree? by number of terms?

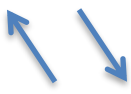
1. $3x + 9x^2 + 5$

2. $4x - 6x^2 + x^4 + 10x^2 - 12$

3. $3x^3 - x + 5x^4$

4. $3 - 4x^5 + 2x^2 + 10$

Note: The degree of a polynomial function affects the shape of its graph and determines the maximum number of **turning points**, or places where the graph changes direction. It also affects the **end behavior**, or the direction of the graph to the far left and to the far right.

There are 4 types of end behaviors			
Up and UP	Down and Down	Down and Up	Up and Down
			

take note

Key Concept Polynomial Functions

$y = 4x^4 + 6x^3 - x$

End Behavior: Up and Up

Turning Points: $(-1.07, -1.04)$, $(-0.27, 0.17)$, and $(0.22, -0.15)$

The function is decreasing when $x < -1.07$ and $-0.27 < x < 0.22$. The function increases when $-1.07 < x < -0.27$ and $x > 0.22$.

$y = -x^2 + 2x$

End Behavior: Down and Down

Turning Point: $(1, 1)$

The function is increasing when $x < 1$ and is decreasing when $x > 1$.

$y = x^3$

End Behavior: Down and Up

Zero turning points.

The function is increasing for all x.

$y = -x^3 + 2x$

End Behavior: Up and Down

Turning Points: $(-0.82, -1.09)$ and $(0.82, 1.09)$

The function is decreasing when $x < -0.82$ and when $x > 0.82$. The function is increasing when $-0.82 < x < 0.82$.

End Behavior of a Polynomial Function With Leading Term ax^n

	n Even ($n \neq 0$)	n Odd
a Positive	Up and Up	Down and Up
a Negative	Down and Down	Up and Down

You Try:

Consider the leading term of each polynomial function. What is the end behavior of the graph?

5. $y = 4x^3 - 3x$

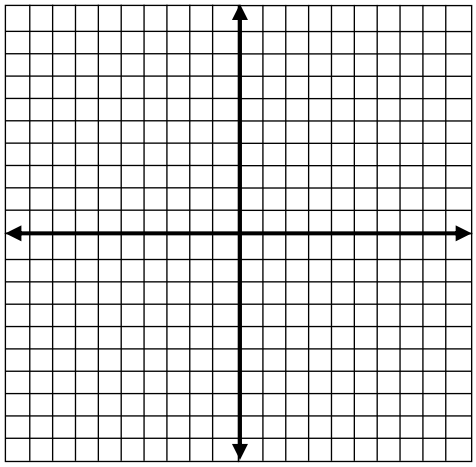
6. $y = 2x^4 + 8x^3 - 8x^2 + 2$

7. $y = -6x^5 - 4x^2 + 3$

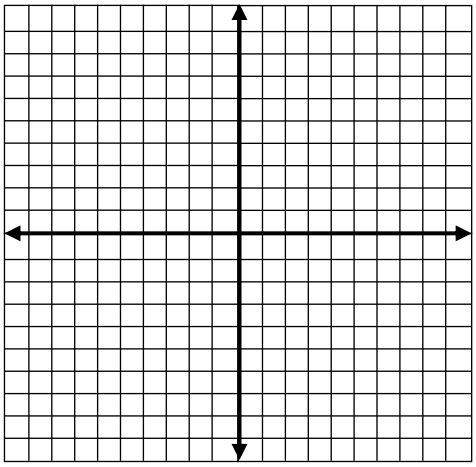
8. $y = -8x^{10} - 13$

What is the graph of each cubic function? Describe the graph, including end behavior, turning points, and increasing/decreasing intervals.

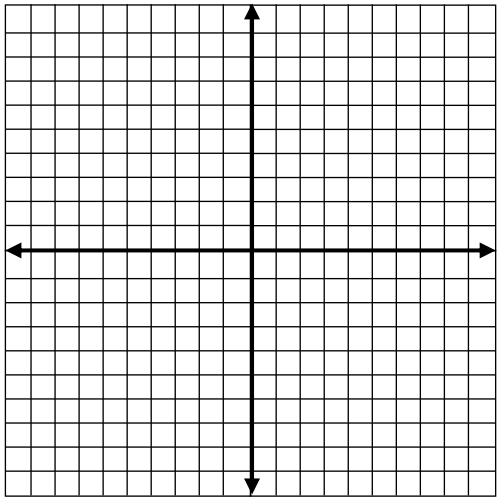
9. $y = -\frac{1}{2}x^3$



10. $y = x^3 + 2x^2 - x - 2$



11. $y = \frac{1}{4}(x+3)^3 - 4$



How do you determine the degree looking at a table?

- If your input or x-values differ by a constant, you can find the difference in the output or y-values.
- If it is constant the first time it is Linear
- If it is constant the second time it is quadratic
- If it is constant the third time it is cubic
- Etc

Try some:

What is the degree of the polynomial function that generates the data shown in the table?

12.

x	y
-2	-13
-1	-4
0	-1
1	2
2	11
3	32
4	71

13.

x	y
-3	23
-2	-16
-1	-15
0	-10
1	-13
2	-12
3	29

Closure: What does the degree of a polynomial function tell you about its graph?

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Assignment: section 5.1 # 11,14,17,19,20,22,23,26,33,39,44,45,54 (13 problems)