5.1 Intro to Polynomial Functions

- I can identify and classify polynomials
- I can state the degree and leading coefficient of polynomials
- I can describe the end behavior of a polynomial

VOCABULARY

Polynomial: A monomial or a sum of monomials

- **Monomial:** A number, a variable, or product of a number and/or variable(s). Also referred to as a TERM
- **Binomial:** The sum of 2 monomials that are NOT like - terms
- **Trinomial:** The sum of 3 monomials that are NOT like - terms
- Polynomials that are larger than 3 terms are just called polynomials

Polynomials DO NOT have:

1. Variables in the denominator (division by a variable when simplified)
2. Variables with negative exponents (in the numerator when simplified)
3. Radicals or rational exponents on variables

Degree: The highest exponent of a polynomial in one variable or the highest sum of exponents of any term with multiple variables

Leading Coefficient: The numeric part of the term with highest degree

Standard Form of a Polynomials in ONE Variable: *n* is the degree and a_n is the leading coefficient

$$a_nx^n + a_{n-1}x^{n-1} + \cdots + a_3x^3 + a_2x^2 + a_1x + a_0$$

Quick Check:

1. X the expressions that are NOT polynomials
2. State the degree of all the polynomials
3. ◯ the monomials
4. ☐ the binomials
5. ⏢ the trinomials

$\boxed{\frac{2}{3}x + 5x^4}$ 4

$6x - \frac{4}{5}x^5 + \frac{2x^2}{3}$ 5

$\frac{4x^2y^6}{5x} = \frac{4x^1y^6}{5}$ 7

$\boxed{3x - 7 + 8x}$ $11x - 7$ 1

$\cancel{5x^3 + 3x^{-2} + 6x}$

$\cancel{3x^{2/3} - 5 + 4x}$

$2x^1y^3z^1 - x^2y^1z^5 - 7x^1y^1 + 5z^1$ 8
5 8 2 1

$\cancel{5x^2 + \frac{2}{x}}$

$\cancel{2\sqrt{x} + 3}$

Rewrite the following polynomials in standard form. Then complete the table. (LC = Leading Coefficient)

Example	Standard Form	Type	Degree	LC	Constant
$f(x)=-14$	$f(x) = -14$	monomial	0	-14	-14
$f(x)=-7+5x$	$f(x)= 5x-7$	binomial	1	5	-7
$f(x)=x-9+2x^2$	$f(x)= 2x^2+x-9$	trinomial	2	2	-9
$f(x)=x^3+3x-x^2$	$f(x)= x^3-x^2+3x$	trinomial	3	1	0
$f(x)=2x+x^4-5x^3-1$	$f(x)= x^4-5x^3+2x-1$	polynomial	4	1	-1

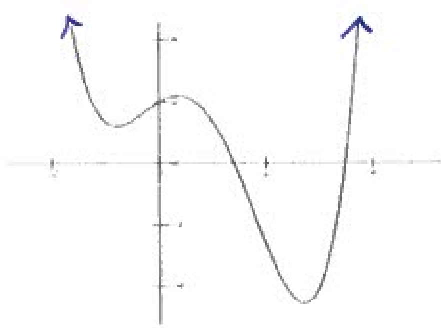
Degree and Leading Coefficient help us determine a functions END BEHAVIOR

END BEHAVIOR: Describes what the right and left ends of the graph do.
What does f(x) do (the y values) as x approaches its extremes +∞ and -∞?

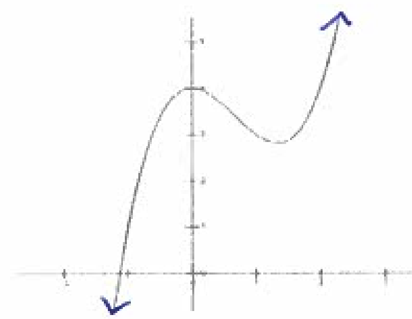
Notation:

LEFT END	RIGHT END	Graph goes UP	Graph goes DOWN
$x \to -\infty$	$x \to +\infty$	$f(x) \to +\infty$	$f(x) \to -\infty$

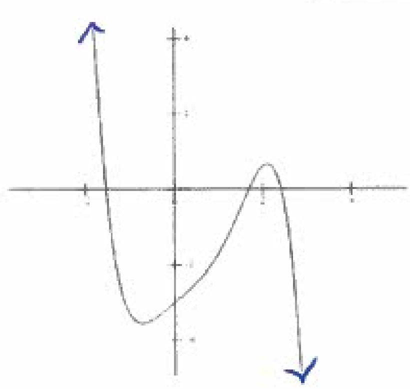
Ex1: $as\ x \to -\infty, f(x) \to$ $+\infty$ left ↑
$as\ x \to +\infty, f(x) \to$ $+\infty$ right ↑



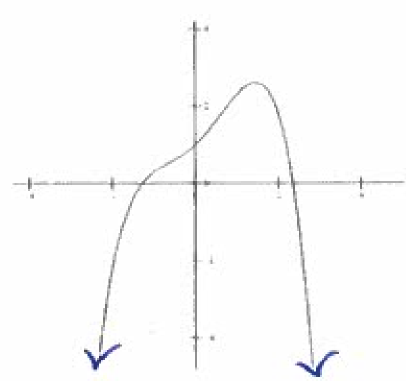
Ex2: $as\ x \to -\infty, f(x) \to$ $-\infty$ left ↓
$as\ x \to +\infty, f(x) \to$ $+\infty$ right ↑



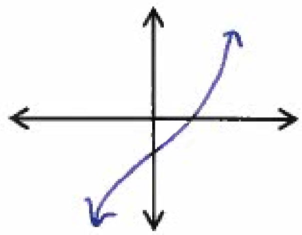
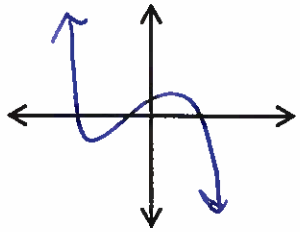
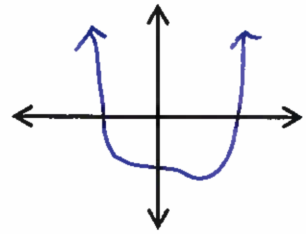
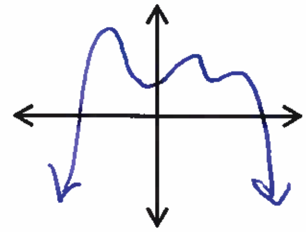
Ex3: $as\ x \to -\infty, f(x) \to$ $+\infty$ Left ↑
$as\ x \to +\infty, f(x) \to$ $-\infty$ right ↓



Ex4: $as\ x \to -\infty, f(x) \to$ $-\infty$ left ↓
$as\ x \to +\infty, f(x) \to$ $-\infty$ right ↓



Degree and Leading Coefficient determine the end behavior of a function.

Degree: **ODD** Leading Coefficient: **+**	Degree: **ODD** Leading Coefficient: **-**	Degree: **EVEN** Leading Coefficien: **+**	Degree: **Even** Leading Coefficient: **-**
			

- ODD degree ends are opposite and similar to lines 
- EVEN degree ends are the same and similar to parabolas 

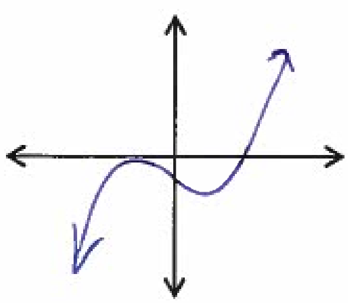
Do & Discuss

Make a rough sketch to describe the end behavior. Do NOT use a graphing utility

Ex5: $8 - x^4 + x^5$

Degree: 5

LC: 1



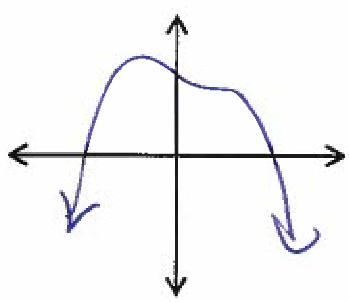
$as\ x \to -\infty, f(x) \to$ $-\infty$

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

Ex6: $5x - 2x^2 + 1$

Degree: 2

LC: -2



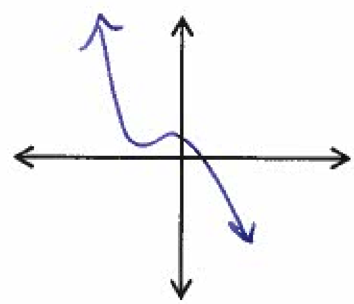
$as\ x \to -\infty, f(x) \to$ $-\infty$

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

Ex7: $3 - 2x^{39}$

Degree: 39

LC: -2



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

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

- *Additional Resources:* Textbook Chapter 5.2 pg.337