

## Section 3.3 Polynomial Functions

A polynomial function has the form

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

where  $a_n, a_{n-1}, \dots, a_1, a_0$  are real numbers. degree = 3  
coefficients

ex:  $f(x) = 8x^3 - 2x^2 + 6$

↑  
leading coefficient = 8

$a_n$  is the leading coefficient

$n$  is a nonnegative integer.

(exponents on the  $x$ 's are whole numbers)

$n$  is called the degree. The graph is smooth and continuous



not a  
polynomial

ex:  $f(x) = 7x^4 - 13x^2 + 10x - 5$

↑ no  $x^3$  term, it's like  $0x^3$

is a polynomial, degree = 4

leading coefficient = 7

-5 is the constant term

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ex:  $f(x) = 13x^4 - 7\sqrt{x} + 5$  is not a polynomial

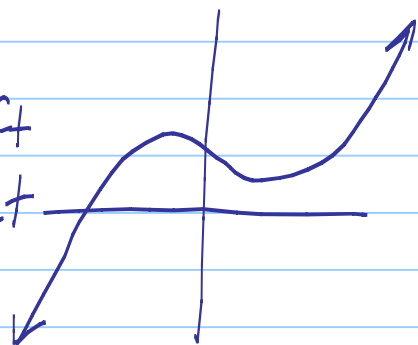
because  $\sqrt{x} = x^{1/2}$  and all exponents in a polynomial are whole numbers.

## End Behavior

### Degree is Odd

i)  $a_n > 0$

graph falls left  
and rises right

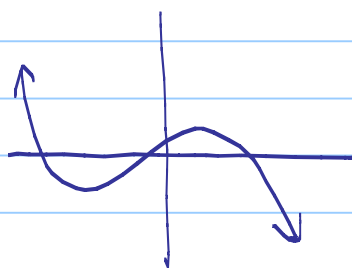


as  $x \rightarrow -\infty$ ,  $f(x) \rightarrow -\infty$

as  $x \rightarrow \infty$ ,  $f(x) \rightarrow \infty$

ii)  $a_n < 0$

graph rises left  
and falls right



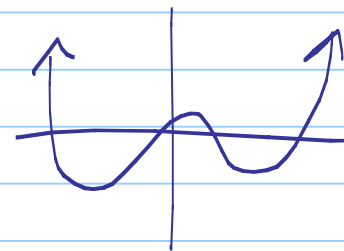
as  $x \rightarrow -\infty$ ,  $f(x) \rightarrow \infty$

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

### Degree is Even

i)  $a_n > 0$

graph rises left  
and rises right

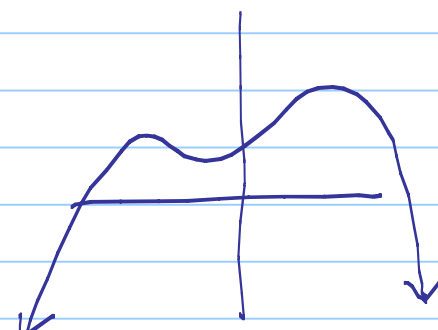


as  $x \rightarrow -\infty$ ,  $f(x) \rightarrow \infty$

as  $x \rightarrow \infty$ ,  $f(x) \rightarrow \infty$

ii)  $a_n < 0$

graph falls left  
and falls right



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

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

ex: Discuss end behavior of  $f(x) = -3 \underbrace{(x+4)^5}_{x^5} \underbrace{(x-3)^4}_{x^4}$

$a_n < 0$   
odd degree

rises left, falls right

$-3x^9$   
↑  
leading coefficient = -3  
degree = 9

HW p 211

1-9 odd,  
19-27 odd (just discuss end behavior)