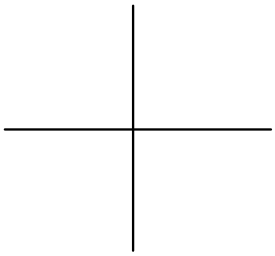
Quiz 3.1



Oct 15-10:14 AM

2.4A Real Zeros of a Polynomial

Objective: 6) I can divide a polynomial using long division.

7) I can divide a polynomial using synthetic division.

8) I can use the Remainder Theorem to find the remainders.

9) I can use the Factor Theorem to determine if something is a factor of a polynomial.

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Dividing Polynomials

Long Division

Divisor 23 ← Quotient
12 | 277 ← Dividend
− 24
37
36
1 ← Remainder

$23\frac{1}{23}$

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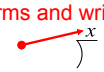
Dividing Polynomials - Long Division

Steps: 1. Write as a division problem w/ dividends & divisor in descending order, leaving spaces for missing terms in the dividend (0x)

2. Divide leading terms and write the result above the 1st term in the dividend




3. Multiply the result from #2 by the divisor & write the product under the dividend

4. Put ( ) around result from #3, distribute the subtraction sign & then add

5. Bring down remaining terms & repeat until there are no remaining terms in the dividend

6. Answer can be written in several ways

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Ex. $3x^2+7x-20 \div x+4$

$3x-5$

$x+4 \overline{)\,3x^2+7x-20}$

$-(3x^2+12x)$

$-5x-20$

$-(-5x-20)$

$3x-5$

$2x^4-x^3-2 \div 2x^2+x+1$

$x^2-x$

$2x^2+x+1 \overline{)\,2x^4-x^3+0x^2+0x-2}$

$-(2x^4+x^3+x^2)$

$-2x^3-x^2+0x-2$

$-(-2x^3-x^2-x)$

$x-2$

$x^2-x+\frac{x-2}{2x^2+x+1}$

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Dividing Polynomials - Synthetic division:

Can only be used to divide by a linear function

steps:

1. Write the terms of the dividend in descending order. Write the coeff. of the dividend in the first row using zeros for any missing terms not found in the dividend.
2. Write the zero, r, of the divisor (x-r),in the box.
3. Drop the 1st coeff. to the last row.
4. Multiply 1st coeff. by r & put product under the 2nd coeff.
5. Add product from #4 to 2nd coeff. & write the sum in the last row.
6. Repeat #4 & #5 until all coeff. have been used.
7. Write answer by putting variables behind the #'s in the last row. Start with 1 degree less than the dividend polynomial.

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$\frac{2x^3-3x^2-5x-12}{x-3=0}$ $\quad x=3$

$\frac{x^3-8x+7}{x+2=0}$ $\quad x=-2$

$3 \mid 2 \quad -3 \quad -5 \quad -12$

$\quad\quad\quad 6 \quad 9 \quad 12$

$\quad\quad 2 \quad 3 \quad 4 \mid 0$

$2x^2+3x+4$

$-2 \mid 1 \quad 0 \quad -8 \quad 7$

$\quad\quad\quad -2 \quad 4 \quad 8$

$\quad 1 \quad -2 \quad -4 \mid 15$

$x^2-2x-4+\frac{15}{x+2}$

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## Remainder Theorem

If a polynomial f(x) is divided by x - k, then the remainder is r = f(k).

a.k.a. evaluate the function for k and the result is the remainder.

Find the remainder when $f(x)=3x^2+7x-20$ is divided by: $x-2$ $\quad x+1$ $\quad x+4$

$x-2=0 \quad x=2$

$f(2)=3(2)^2+7(2)-20$

$=12+14-20$

$=6$

$x+1=0 \quad x=-1$

$f(-1)=3(-1)^2+7(-1)-20$

$=3-7-20$

$=-24$

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## Factor Theorem

A polynomial function f(x) has a factor x - k if and only if f(k) = 0.

a.k.a if the result is 0 (no remainder) then x - k is a factor.

$$\frac{3x^2+7x-20}{x+4}$$

$f(-4) = 3(-4)^2 + 7(-4) - 20$

$= 48 - 28 - 20$

$= 0$

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## Connecting Concepts

1) x = k is a solution (root, zero) of the equation f(x) = 0.

2) k is a zero of the function.

3) k is an x-interept of the graph of f(x).

4) x - k is a factor of f(x).

Oct 28-9:44 AM

## Fundamental Theorem of Algebra

Every non-constant single-variable polynomial with complex coefficients has at least one complex root.

In other words, every variable has one zero.

In other other words, the number of zeros (roots) matches the degree of the polynomial.

Ex. $f(x) = 3x^6 - 5x^3 + 2$ has 6 zeros.

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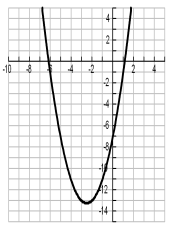
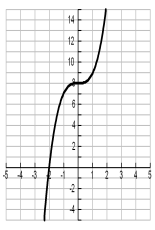
There are real zeros and complex zeros (imaginary numbers)

Complex zeros always come in pairs and do not appear on a graph.

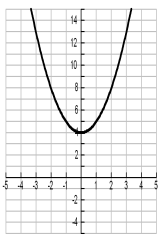
$x^2 + 5x - 7$



$x^3 + 8$



$x^2 + 4$



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