Your Name
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Notes

Dividing Polynomials by Synthetic Division

Day 5

7. $$\frac{x^3+x^2+x+2}{x^2-1}$$

$$x^1 + 1 + \frac{2x+3}{x^2-1}$$

$$x^2+0x-1 \overline{\big)\, x^3+1x^2+x^1+2}$$
$$-(x^3+0x^2-x)$$
$$1x^2+2x+2$$
$$-(\cancel{x^2}+0x-1)$$
$$2x+3$$

Division Algorithm

Factored Form 1:

$f(x) = d(x) \cdot q(x) + r(x)$

Divisor
Divided by $\bullet$

Quotient
ending factor
what you get
after division

$+$

Remainder
left over polynomial

Divided Form 2:

$$\frac{f(x)}{d(x)} = \frac{\cancel{d(x)}\, q(x)}{\cancel{d(x)}} + \frac{r(x)}{d(x)}$$

$$\boxed{\frac{f(x)}{d(x)} = q(x) + \frac{r(x)}{d(x)}}$$

Synthetic Division

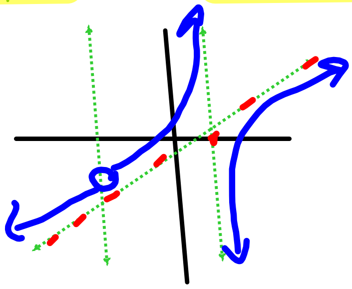
Uses

Can only be used when dividing by a linear binomial like:

$x^1 - a$ or $x^1 + a$ *(coefficient for x must be 1)

Uses:

1. To factor a polynomial into a linear binomial factor and a polynomial factor
2. To check if a number is a root/factor/solution for x, if the remainder is 0, then it is
3. To evaluate the polynomial function for a given x value, the remainder value is the y-value paired with the x factor you checked
4. To divide two functions and get the slant asymptote for the new rational function



What method would you use for each of the following?

A. $(2x^3 - 4x + 5) \div (x^2 - 4)$ long

B. $(3x^3 - 4x^2 + 5x) \div (x^1 - 4)$ synthetic

C. $(40x^{21} - 4x^{20} + 5) \div (3x + 7)$ long division

D. $(40x^{21} - 4x^{20} + 5) \div (x^3 + 7x + 10)$ long

How to Syntheticly Divide

1. Set it up:
   A. Only write the coefficients of the top polynomial, making sure to put 0 as a place holder for missing terms.
   B. You will be dividing by the zero/ solution of the factor: if divisor is x-3, then x = 3, you will write 3 on the left
2. Synthetic Division to find the left over factor after "factoring out the linear factor":
   A. Bring down the first constant to the third row
   B. Multiply the divisor by the number in the third row
   C. Write product in the second row of the next column
   D. Add the first and second row, put sum in same column third row
   E. Repeat steps #3,4,5 until finished
3. The bottom row:
   A. The first numbers are the coefficients for the left over factor starting with one degree less than you started with
   B. The last number if 0, means that the original linear binomial is a factor and a zero of the polynomial, if not, it is the remainder and is the fraction over the linear binomial that is added to the quotient

ex. $2x^3 - 7x^2 + 5 \div x-3$

$2x^3 - 7x^2 + 0x + 5$

$x - 3 = 0$
$+3 \quad +3$
$x = 3$

$$\begin{array}{r|rrrr} 3 & 2 & -7 & 0 & 5 \\ & & 6 & -3 & -9 \\ \hline & 2 & -1 & -3 & \boxed{-4} \end{array}$$

box off last number
this is the remainder

$2x^2 - 1x^1 - 3 + \frac{-4}{x-3}$

$\frac{f(x)}{d(x)} = 2x^2 - x - 3 - \frac{4}{x-3}$

$f(x) = (x-3)(2x^2 - x - 3) - 4$

Synthetic Division

1. Set it up:
   A. Only write the coefficients of the top polynomial, making sure to put 0 as a place holder for missing terms.
   B. You will be dividing by the zero/solution of the factor: if divisor is x-3, then x = 3, you will write 3 on the left
2. Synthetic Division:
   A. Bring down the first constant to the third row
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$$(x^3 + 2x^2 - 3x + 1) \div (x + 2)$$

$$\begin{array}{r|rrrr} -2 & 1 & 2 & -3 & 1 \\ & \downarrow & +\,-2 & +\,0 & +\,6 \\ \hline & 1 & 0 & -3 & \boxed{7} \end{array}$$

$$\frac{f(x)}{d(x)} = 1x^2 + 0x - 3 + \frac{7}{x+2}$$

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

Assignment

Textbook: pg. 177 #13-18

write f(x) and f(x)/d(x) form

13. $2x - 11 + \frac{62}{x+5}$

14. $x^2 - 3x + 5 - \frac{9}{x+3}$

15. $x + 3 + \frac{18}{x-3}$

16. $3x^2 - 2x - 2 - \frac{4}{x-1}$

17. $x^3 + x^2 - 2x + 1 - \frac{6}{x-6}$

18. $x^3 - x^2 + 5x - 9 + \frac{10}{x+5}$