

# Synthetic Divn handout.notebook

## Synthetic Division

1) Write the coefficients of the dividend and write the opposite of the constant from the divisor in the box.

Ex.  $(2x^3 - x^2 + x - 4) \div (x - 1)$

Write:  $\underline{1} \mid 2 \quad -1 \quad 1 \quad -4$

2) Bring down the first coefficient.

Write:  $\underline{1} \mid 2 \quad -1 \quad 1 \quad -4$

$$\begin{array}{r|rrrr} & & & & \\ \hline & 2 & -1 & 1 & -4 \end{array}$$

3) Multiply by the constant in the box and write the product above the line.

Write:  $\underline{1} \mid 2 \quad -1 \quad 1 \quad -4$

$$\begin{array}{r|rrrr} & & & & \\ \hline & 2 & -1 & 1 & -4 \\ & & 2 & & \end{array}$$

4) Add and then repeat from step 2 multiplying

Write:  $\underline{1} \mid 2 \quad -1 \quad 1 \quad -4$

$$\begin{array}{r|rrrr} & & & & \\ \hline & 2 & -1 & 1 & -4 \\ & & 2 & 1 & 2 \\ \hline & 2 & 1 & 2 & -2 \end{array}$$

5) The answer to the division is the bottom row of numbers. The last number is the remainder and the other numbers are coefficients.

Answer:  $2x^2 + 1x + 2$  remainder  $-2$

This answer can also be written  $2x^2 + 1x + 2 - \frac{2}{x-1}$ .

Example 2:  $(x^4 - 2x^2 - 1) \div (x - 3)$

Solution:  $\underline{3} \mid 1 \quad 0 \quad -2 \quad 0 \quad -1$  Notice that you must make a column for every power of  $x$ .

$$\begin{array}{r|rrrrr} & & & & & \\ \hline & 1 & 0 & -2 & 0 & -1 \\ & \downarrow & & & & \\ & 3 & 9 & 21 & 63 & \\ \hline & 1 & 3 & 7 & 21 & 62 \end{array}$$

$x^3 + 3x^2 + 7x + 21 + \frac{62}{x-3}$

*placeholders*

$x^4 + 0x^3 - 2x^2 + 0x - 1$

$$(x-a) \frac{P(x)}{x-a} = \frac{(x-a)Q(x)}{x-a} + \frac{R}{x-a} \quad (x-a)$$

*or*

$$P(x) = (x-a)Q(x) + R$$

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## EXTRA PRACTICE Synthetic Division

Examples:

a)  $(x^3 - 2x^2 + x - 15) \div (x + 5)$

$$\begin{array}{r|rrrr} -5 & 1 & -2 & 1 & -15 \\ & & -5 & 35 & -180 \\ \hline & 1 & -7 & 36 & -195 \end{array}$$

The quotient is  $x^2 - 7x + 36$ .  
The remainder is  $-195$ .

b)  $(x^4 - x^2 + 3) \div x(x - 1)$

$$\begin{array}{r|rrrrr} 1 & 1 & 0 & -1 & 0 & 3 \\ & & 1 & 1 & 0 & 0 \\ \hline & 1 & 1 & 0 & 0 & 3 \end{array}$$

The quotient is  $x^3 + x^2$ .  
The remainder is 3.

c) Let  $f(x) = 4x^5 - 2x^3 + x - 9$ .  
Use synthetic division to find  $f(3)$ .

$$\begin{array}{r|rrrrrr} 3 & 4 & 0 & -2 & 0 & 1 & -9 \\ & & 12 & 36 & 102 & 306 & 921 \\ \hline & 4 & 12 & 34 & 102 & 307 & 912 \end{array}$$

The remainder tells us that  $f(3) = 912$ .

Use synthetic division to divide.

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

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

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3.  $(x^3 - 10x^2 + x + 120) \div (x - 5)$

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4.  $(2x^3 - 7x^2 - 19x + 60) \div (x + 3)$

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5.  $(2x^3 + 9x^2 - 53x + 27) \div (x + 8)$

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6.  $(x^3 - 3x^2 - 10x + 29) \div (x - 4)$

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7.  $(3x^3 + 5x^2 + 2x - 3) \div (x + 6)$

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8.  $(2x^3 - 4x + 3)(x - 3)$

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9.  $(x^4 - 16) \div (x - 2)$

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10.  $(x^3 - 2x^2 + 3) \div (x + 4)$

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11.  $(x^4 + 4x^2 + 3x + 4) \div (x - 2)$

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12.  $(x^3 + 3x^2 + 2x - 4) \div (x + 1)$

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