B. Synthetic Division

This method can only be used when dividing by a linear binomial whose leading coefficient is 1. In other words, this method can only be used when dividing by a polynomial of the form (x - k).

Let's see how it works.

Divide the following using synthetic division.

k **(1)** $(x^3+2x^2-6x-9)\div\underbrace{(x+3)}_{}$ $(x-k)$ $= \boxed{x^2-x-3}$

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

← coefficients of dividend

multiply, add, add, add

← remainder

coefficients of answer

MUST insert placeholder

Divide the following using synthetic division.

(2) $(x^3 + 0x^2 - 7x - 6)\div(x-2) = x^2+2x-3 - \frac{12}{x-2}$

$$\begin{array}{r|rrrr} 2 & 1 & 0 & -7 & -6 \\ & \downarrow & 2 & 4 & -6 \\ \hline & 1 & 2 & -3 & -12 \end{array}$$

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

$$\begin{array}{r|rrr} -1 & 4 & 5 & -4 \\ & & -4 & -1 \\ \hline & 4 & 1 & -5 \end{array}$$

$4x+1-\frac{5}{x+1}$

Remainder Theorem

If the polynomial function $P(x)$ is divided by $x - a$, then the remainder r is $P(a)$.

Example:

If your last name begins with A - L, find the value of $P(3)$ if

$P(x) = x^3 - 4x^2 + 5x + 1$.

$P(3) = 3^3 - 4(3)^2 + 5(3) + 1 = 7$

If your last name begins with M - Z, use synthetic division to divide $x^3 - 4x^2 + 5x + 1$ by $x - 3$.

3	1	-4	5	1
		3	-3	6
	1	-1	2	7

Use synthetic substitution to evaluate the polynomial for the given value.

(1) $P(x) = x^3 - 4x^2 + 3x - 5$ for $x = 4$ K

$P(4) = 7$

4	1	-4	3	-5
	↓	4	0	12
	1	0	3	7

(2) $P(x) = 4x^4 + 2x^3 + 0x^2 + 3x + 5$ for $x = -½$

$P(-1/2) = 7/2$

-1/2	4	2	0	3	5
	↓	-2	0	0	-3/2
	4	0	0	3	7/2