Synthetic Division

Ex. 1 $(3x^3 + 5x^2 - 17x - 15) \div (x + 3)$

$x+3=0$

$x=\boxed{-3}$

$$\begin{array}{r|rrrr} -3 & 3 & 5 & -17 & -15 \\ & \downarrow & -9 & 12 & 15 \\ \hline & 3 & -4 & -5 & 0 \end{array}$$

$\boxed{3x^2-4x-5}$

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

put in standard form

$x-1=0$

$x=1$

Careful!

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

$$\begin{array}{r|rrrr} 1 & 2 & 1 & 2 & -3 \\ & \downarrow & 2 & 3 & 5 \\ \hline & 2 & 3 & 5 & 2 \end{array}$$

$\boxed{2x^2+3x+5+\frac{2}{x-1}}$

Synthetic Division

Ex.3 $(x^4 - 2x^2 - 22x + 36) \div (x - 2)$

$0x^3$

$x-2=0$

$x=2$

$$\begin{array}{r|rrrrr} 2 & 1 & 0 & -2 & -22 & 36 \\ & \downarrow & 2 & 4 & 4 & -36 \\ \hline & 1 & 2 & 2 & -18 & 0 \end{array}$$

$\boxed{x^3+2x^2+2x-18}$

Ex. 4 $(x^2 - 6) \div (x + 4)$

$x=-4$

x^2+0x-6

$$\begin{array}{r|rrr} -4 & 1 & 0 & -6 \\ & \downarrow & -4 & 16 \\ \hline & 1 & -4 & 10 \end{array}$$

$\boxed{x-4+\frac{10}{x+4}}$

Use synthetic division to determine whether the given linear expression is a factor of the polynomial.

$x - 3 = 0$

$x = 3$

Ex. 5 $x^4 - 2x^3 + 0x^2 + 2x - 4;\ x - 3$

If 0 is remainder then it is a factor.

$$\begin{array}{r|rrrrr} 3 & 1 & -2 & 0 & 2 & -4 \\ & \downarrow & 3 & 3 & 9 & 33 \\ \hline & 1 & 1 & 3 & 11 & 29 \end{array}$$

NO it is not a factor. since remainder is 29.

The **Remainder Theorem** provides a quick way to find the remainder of a polynomial long-division problem.

take note

Theorem The Remainder Theorem

If you divide a polynomial $P(x)$ of degree $n \geq 1$ by $x - a$, then the remainder is $P(a)$.

Use synthetic division and the Remainder Theorem to find P(a).

Ex.6 $P(x) = 2x^3 + 7x^2 + 2x + 1; a = \boxed{-2}$ $\quad P(-2)$

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

$16 + 28 - 4 + 1$

Synthetic Division

$$\begin{array}{r|rrrr} -2 & 2 & 7 & 2 & 1 \\ & \downarrow & -4 & -6 & 8 \\ \hline & 2 & 3 & -4 & 9 \end{array}$$

Remainder Theorem

$P(-2) = 9$

Ex.7 $P(x) = 3x^4 + x - 2; a = -1$

Synthetic Division

$$\begin{array}{r|rrrrr} -1 & 3 & 0 & 0 & 1 & -2 \\ & \downarrow & -3 & 3 & -3 & 2 \\ \hline & 3 & -3 & 3 & -2 & 0 \end{array}$$

Remainder Theorem

$P(-1) = 0$