

Dividing Polynomials

$$\frac{x^3 + 9x^2 + 8x}{x+1}$$

$$\boxed{x+1}$$

$$\boxed{x+1}$$

$$\begin{array}{r} x^2 + 8x \\ \hline x^3 + 9x^2 + 8x \\ \underline{-x^3 + x^2} \\ 8x^2 + 8x \\ \underline{-8x^2 + 8x} \\ 0 \end{array}$$

$$\frac{x^3}{x} = x^2$$

$$\frac{8x^2}{x} = 8x$$

$x+1$
 first degree binomial
 highest exponent on x
 $x^{\textcircled{3}} + 9x^2 + 8x$

number of terms

third degree trinomial

$$\frac{x^3 + 9x^2 + 8x}{x+1} = \boxed{x^2 + 8x}$$

you don't have to check

$$\begin{array}{r} (x+1)(x^2 + 8x) \\ \hline x^3 + 8x^2 + x^2 + 8x \\ \hline x^3 + 9x^2 + 8x \end{array}$$

Synthetic Division

$$x^3 + 9x^2 + 8 \div x+1$$

$$x+1 \overline{) x^3 + 9x^2 + 8x}$$

$$\begin{array}{r|rrr} -1 & 1 & 9 & 8 \\ & \downarrow & -1 & -8 \\ \hline & 1 & 8 & 0 \end{array} \quad \boxed{x^2 + 8x}$$

$\frac{1}{x^2}$ $\frac{8}{x}$ 0 constant

$$\begin{array}{l} x+1=0 \\ -1 -1 \\ x=-1 \end{array}$$

$$2x^2 + 7x - 15 \div x + 5$$

$$x+5$$

$$-5 \overline{) \begin{array}{r} 2x^2 - 7 - 15 \\ \underline{-10} \\ 2 - 3 \\ \times \text{ constant} \end{array}}$$

$$\boxed{2x - 3}$$

$$\boxed{x+5} \overline{) \begin{array}{r} 2x^2 + 7x - 15 \\ \underline{-2x^2 + 10x} \\ -3x - 15 \\ \underline{+3x + 15} \\ 0 \end{array}}$$

$$\frac{-3x}{x} = -3$$

$$\frac{-3x - 15}{+3x + 15} = 0$$

$$\boxed{2x - 3}$$

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

$$\frac{3x}{3} = \frac{-2}{3}$$

$$12x^3 + 20x^2 + 11x + 2 \div 3x + 2$$

$$-\frac{2}{3} \overline{) \begin{array}{r} 12 \ 20 \ 11 \ 2 \\ \underline{-8 \ -8 \ -2} \\ 12 \ 12 \ 3 \ 0 \end{array}}$$

$$\boxed{12x^2 + 12x + 3}$$

$$\boxed{3x+2} \overline{) \begin{array}{r} 4x^2 + 4x + 1 \\ 12x^3 + 20x^2 + 11x + 2 \\ \underline{-12x^3 - 8x^2} \\ 12x^2 + 11x \\ \underline{12x^2 + 8x} \\ 3x + 2 \\ \underline{-3x - 2} \\ 0 \end{array}}$$

$$\frac{12x^3}{3x}$$

$$\frac{12x^2}{3x} = 4x$$

$$12x^3 + 20x^2 + 11x + 2 = (3x+2)(4x^2 + 4x + 1)$$

$$12x^3 + 20x^2 + 11x + 2 = 3\left(x + \frac{2}{3}\right)\left(\frac{12x^2}{3} + \frac{12x}{3} + \frac{3}{3}\right)$$

$$\begin{array}{r|rrrrr}
 & x^4 & & & & \\
 7 & 1 & -1 & -35 & -47 & -15 \\
 & \downarrow & 7 & 42 & 49 & 14 \\
 \hline
 & 1 & 6 & 7 & 2 & -1 \\
 & x^3 & & & &
 \end{array}$$

$$\boxed{x^3 + 6x^2 + 7x + 2 - \cancel{1}x - 7}$$

$$f(x) = x^4 - x^3 - 35x^2 - 47x - 15$$

$$\boxed{f(7) = 1}$$