Division of Polynomials by …

Long Division (works EVERYTIME)

Steps:

1) Write as a regular long division problem, **in standard form, including all place holders**
2) Divide the leading term of the divisor into the leading term of the dividend and write result above the dividend.
3) Multiply the result by each term in the divisor and write below the dividend, aligning the like terms.
4) SUBTRACT **(distribute the negative to all terms of the previous product).**
5) Bring down next term.
6) Repeat steps 2 thru 5 until there are no remaining values in the dividend.

Ex 1: $\dfrac{x^3-2x^2-9}{x-3}$ x+

$$\frac{x^3}{x}=x^2 \qquad x^2(x-3)$$

$$\frac{x^2}{x}=x \qquad x(x-3)$$

$$\frac{3x}{x} \qquad 3(x-3)$$

$$\begin{array}{r|l} & x^2+x+3+{}^{18}/_{x-3} \\ x-3 & x^3-2x^2+0x-9 \\ & -(x^3-3x^2) \\ \hline & x^2+0x \\ & -(x^2-3x) \\ \hline & 3x+9 \\ & -(3x-9) \\ \hline & 18 \end{array}$$

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

Ex 2: $(6x^2+17x+20)\div(3x+4)$

$$\frac{6x^2}{3x}=2x \qquad 2x(3x+4)$$

$$\frac{9x}{3x}=3 \qquad 3(3x+4)$$

$$\begin{array}{r|l} & 2x+3+{}^{8}/_{3x+4} \\ 3x+4 & 6x^2+17x+20 \\ & -(6x^2+8x) \\ \hline & 9x+20 \\ & -(9x+12) \\ \hline & 8 \end{array}$$

$$\boxed{2x+3+{}^{8}/_{3x+4}}$$

Synthetic Division (only works when divisor is LINEAR)

Steps:

1) Find the **"zero"** of the divisor(**set divisor equal to 0 and solve)**
2) List coefficients of dividend, **in standard form, with place holders**
3) Bring Leading Coefficient (first #) straight down
4) Multiply "zero" with the number you brought down and write the product under the next coefficient
5) Add two numbers together and write the sum in bottom row.
6) Repeat steps 4 and 5 until all columns are completed.

Ex 3: $\dfrac{3x^3-8x^2\overset{0x}{\wedge}+4}{x-2}$ $x-2=0$ $x=2$

$$\begin{array}{c|cccc} 2 & 3 & -8 & 0 & 4 \\ & & 6 & -4 & -8 \\ \hline & 3_{x^2} & -2_x & -4 & -4 \end{array}$$

remainder

constant

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

Ex 4: $(x^4-2x^3\overset{0x^2}{\wedge}+3x+1)\div(x-2)$ $x-2=0$ $x=2$

$$\begin{array}{c|ccccc} 2 & 1 & -2 & 0 & 3 & 1 \\ & & 2 & 0 & 0 & 6 \\ \hline & 1_{x^3} & 0_{x^2} & 0_x & 3 & 7 \end{array}$$

remainder

constant

$$\boxed{x^4+3+{}^{7}/_{x-2}}$$

Notes: Multiplying Special Products

The **square of a binomial** is the sum of: the square of the first terms, twice the product of the two terms, and the square of the last term.

$$(x+y)^2 = \underset{\substack{\uparrow \\ \text{Square 1st} \\ \text{Term} \\ \downarrow}}{x^2} + \underset{\substack{\uparrow \\ \text{Twice the} \\ \text{product of} \\ \text{the two terms.} \\ \downarrow}}{2xy} + \underset{\substack{\uparrow \\ \text{Square the} \\ \text{last term.} \\ \downarrow}}{y^2}$$

$$(x-y)^2 = x^2 - 2xy + y^2$$

$(x+3)^2$	$(x-5)^2$	$(2x-4)^2$	$(10-x)^2$
$(x)^2 + 2(x)(3) + (3)^2$ $x^2 + 6x + 9$	$(x)^2 - 2(x)(5) + (5)^2$ $x^2 - 10x + 25$	$(2x)^2 + 2(2x)(4) + (4)^2$ $4x^2 + 16x + 16$	$(10)^2 + 2(10)(x) + (x)^2$ $100 - 20x + x^2$ $x^2 - 20x + 100$

Difference of Two Squares

When multiplying binomials whose only difference is the sign between the two terms, square the first term, square the second term, and subtract.

$$(x+y)(x-y) = \underset{\substack{\uparrow \\ \text{Square 1st} \\ \text{Term}}}{x^2} - \underset{\substack{\uparrow \\ \text{Square 2nd} \\ \text{term}}}{y^2}$$

$(x+3)(x-3)$	$(x-5)(x+5)$	$(2x-4)(2x+4)$	$(10-x)(10+x)$
$x^2+3x-3x-9$ x^2-9	$x^2-5x+5x-25$ x^2-25	$4x^2-16$	$100-x^2$