Name______________________________ Date:________________

Algebra II Lesson 1-8

POLYNOMIAL LONG DIVISION: THE ALGORITHM

Do Now: Solve $2{,}847 \div 5$ (No calculator!)

$$\begin{array}{r} 569 \text{ R } 2 \\ 5\overline{)2847} \\ -25\downarrow \\ \hline 34 \\ 30\downarrow \\ \hline 47 \\ 45 \\ \hline 2 \end{array}$$

Check your division without the use of a calculator!

$$\begin{array}{r} {}^{3\,4} \\ 569 \\ \times \quad 5 \\ \hline 2845 \end{array} \qquad \begin{array}{r} 2845 \\ + \quad 2 \\ \hline 2847 \checkmark \end{array}$$

The result of this division can be written two ways:

$569 \text{ R } 2$ OR $569 + \frac{2}{5}$

$$\begin{array}{r} \text{quotient} \\ \text{divisor}\overline{)\text{dividend}} \end{array}$$

Dividend: 2847

Divisor: 5

Quotient: 569

Remainder: 2

- **Dividend**: that which is being divided
- **Divisor:** that by which the dividend will be divided
- **Quotient:** the expression representing how many times the divisor will go into the dividend
- **Remainder:** the leftover portion, less than the divisor, which is not evenly divisible by the dividend.

We use the same long division algorithm to divide polynomials.

D **M** **S** **B**

Divide Multiply Subtract Bring down

Steps to success
Divide the first term of the dividend by the first term of the divisor, and put that in the quotient. **Multiply** each part of the divisor by that answer, and put that product below the dividend. **Subtract** to create a new polynomial. **Bring down** the next term. And **REPEAT** the process **:)**

Example 1: Divide $4x^2 - 7x - 2$ by $x - 2$.

$$
\begin{array}{r l}
 & 4x + 1 \\
x-2 \,\big) & \cancel{4x^2} - 7x - 2 \\
 & -(\cancel{4x^2} - 8x) \quad \downarrow \\
\hline
 & \qquad\quad x - \cancel{2} \\
 & \qquad -(x - \cancel{2}) \\
\hline
 & \qquad\qquad 0
\end{array}
$$

$$\boxed{4x+1}$$

Example 2: Divide: $\frac{2x^2+15x+20}{x+6}$

$$
\begin{array}{r l}
 & 2x + 3 \\
x+6 \,\big) & \cancel{2x^2} + 15x + 20 \\
 & -(\cancel{2x^2} + 12x) \quad \downarrow \\
\hline
 & \qquad 3x + 20 \\
 & \quad -(3x + 18) \\
\hline
 & \qquad\qquad 2
\end{array}
$$

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

we usually use this way!

The result of this division can be written two ways:

$2x+3$ R2 $\qquad 2x+3+\frac{2}{x+6}$

Example 3: Write the rational expression $\frac{4x^2+4x-7}{2x+1}$ in the form: $q(x)+\frac{r}{b(x)}$.

$$\begin{array}{r}
2x+1 \\
2x+1 \overline{)\,4x^2+4x-7} \\
-(4x^2+2x) \\
\hline
2x-7 \\
-(2x+1) \\
\hline
-8
\end{array}$$

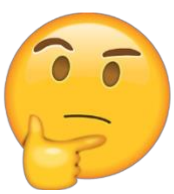
$\frac{4x^2}{2x}=2x$ $\qquad$ $\frac{2x}{2x}=1$

$$2x+1-\frac{8}{2x+1}$$

How can we check our answer?

→ multiply the quotient and divisor

→ add the remainder



$$(2x+1)(2x+1)-8$$

$$4x^2+2x+2x+1-8$$

$$4x^2+4x-7 \checkmark$$

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POLYNOMIAL LONG DIVISION: THE ALGORITHM PRACTICE

#1: Write the rational expression $\dfrac{x^2+2x-5}{x-3}$ in the form: $q(x)+\frac{r(x)}{b(x)}$

$$
\begin{array}{r|l}
 & x+5 \\
\hline
x-3 & x^2+2x-5 \\
 & -(x^2-3x) \downarrow \\
\hline
 & 5x-5 \\
 & -(5x-15) \\
\hline
 & 10
\end{array}
$$

$$\boxed{x+5+\frac{10}{x-3}}$$

SCAN ME

#2: Write the rational expression $\dfrac{2x^2-23x+17}{x-10}$ in the form: $q(x)+\frac{r}{b(x)}$

$$
\begin{array}{r|l}
 & 2x-3 \\
\hline
x-10 & 2x^2-23x+17 \\
 & -(2x^2-20x) \downarrow \\
\hline
 & -3x+17 \\
 & -(-3x+30) \\
\hline
 & -13
\end{array}
$$

$$\boxed{2x-3-\frac{13}{x-10}}$$

SCAN ME

#3: Write the expression below in $q(x)+\dfrac{r}{x-a}$. The polynomial $q(x)$ will now be a quadratic.

$$\frac{2x^3-11x^2+22x-25}{x-3}$$

$$\begin{array}{r}
2x^2-5x+7 \\
x-3\,\big)\,\overline{2x^3-11x^2+22x-25} \\
-(2x^3-6x^2)\downarrow \quad\;\; \\
-5x^2+22x \quad\;\; \\
-(-5x^2+15x)\downarrow \\
7x-25 \\
-(7x-21) \\
\hline
-4
\end{array}$$

$$\boxed{2x^2-5x+7-\frac{4}{x-3}}$$

SCAN ME

#4: State the quotient, *q(x)*, and the remainder, *r*, when $5x^3-x^2-5x+1$ is divided by $x+1$.

$$\begin{array}{r}
5x^2-6x+1 \\
x+1\,\big)\,\overline{5x^3-x^2-5x+1} \\
-(5x^3+5x^2)\downarrow \quad\;\; \\
-6x^2-5x \quad\;\; \\
-(-6x^2-6x)\downarrow \\
x+1 \\
-(x+1) \\
\hline
0
\end{array}$$

$$\boxed{5x^2-6x+1}$$

SCAN ME