Name: ______________________________ Date: _________________

Algebra II Lesson 1-9

Polynomial Long Division

When we divide two polynomials, we get another polynomial, $q(x)$ and a remainder, $r(x)$.
Recall the **quotient-remainder form:**

$$\frac{a(x)}{b(x)} = q(x) + \frac{r(x)}{b(x)}$$

When dividing two first degree polynomials both the quotient and remainder are constants.

Do Now: Consider the expression $\frac{x+8}{x+3}$.

a. Perform long division and write the result in quotient-remainder form.

$$\begin{array}{r} 1 \\ x+3 \overline{) x+8} \\ -(x+3) \\ \hline 5 \end{array} \qquad \frac{x}{x} = 1$$

$$1 + \frac{5}{x+3}$$

b. Re-write the expression in quotient-remainder form by simplification.

$$\frac{x+8}{x+3}$$

$$\frac{x+3+5}{x+3}$$

$$\frac{x+3}{x+3} + \frac{5}{x+3}$$

$$1 + \frac{5}{x+3}$$

*you can only do this if you are dividing polynomials of the same degree

***Exercise* #1:** Given $\frac{4x+13}{x+2}$, state the quotient and remainder.

$$\begin{array}{r} 4 \\ x+2\,\overline{)\,4x+13} \\ -(4x+8) \\ \hline 5 \end{array}$$

$$\boxed{4+\frac{5}{x+2}}$$

$$\frac{4x+13}{x+2}$$

$$\frac{4x+8+5}{x+2}$$

$$\frac{4x+8}{x+2}+\frac{5}{x+2}$$

$$\frac{4\cancel{(x+2)}}{\cancel{x+2}}+\frac{5}{x+2}$$

$$\boxed{4+\frac{5}{x+2}}$$

***Exercise* #2:** Given $f(x) = 3x^4 + 2x + x^3 - 5x^2 + 3$ and $g(x) = x^2 + 2x + 2$, state the quotient and remainder of $\frac{f(x)}{g(x)}$, in the form $q(x) + \frac{r(x)}{g(x)}$.

* Needs to be in standard form!

$$\begin{array}{r} 3x^2-5x-1 \\ x^2+2x+2\,\overline{)\,3x^4+x^3-5x^2+2x+3} \\ -(3x^4+6x^3+6x^2) \\ \hline -5x^3-11x^2+2x \\ -(-5x^3-10x^2-10x) \\ \hline -1x^2+12x+3 \\ -(-1x^2-2x-2) \\ \hline 14x+5 \end{array}$$

$$\boxed{3x^2-5x-1+\frac{14x+5}{x^2+2x+2}}$$

Need to fill in missing terms

Exercise #3: Given $f(x) = 4x^4 + 5x - 4$ and $g(x) = x^2 + 3x - 2$, state the quotient and remainder of $\frac{f(x)}{g(x)}$, in the form $q(x) + \frac{r(x)}{g(x)}$.

$$
\begin{array}{r}
4x^2 - 12x + 44 \\
x^2 + 3x - 2 \overline{)\, 4x^4 + 0x^3 + 0x^2 + 5x - 4} \\
-\left(4x^4 + 12x^3 - 8x^2\right) \\
\hline
-12x^3 + 8x^2 + 5x \\
-\left(-12x^3 - 36x^2 + 24x\right) \\
\hline
44x^2 - 19x - 4 \\
-\left(44x^2 + 132x - 88\right) \\
\hline
-151x + 84
\end{array}
$$

$$\boxed{4x^2 - 12x + 44 - \frac{151x + 84}{x^2 + 3x - 2}}$$

Reminder...

Check for standard form
& for missing terms!

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Algebra II Lesson 1-9

POLYNOMIAL LONG DIVISION PRACTICE

1. Given $\frac{3x-5}{x-4}$, state the quotient and remainder.

$$
\begin{array}{r}
3 \\
x-4\overline{)\,3x-5} \\
-(3x-12) \\
\hline
7
\end{array}
$$

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

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

← Put into standard form!

2. Given $f(x) = x^4 + 3x^3 + x - 4x^2 - 7$ and $g(x) = x^2 + 3x - 1$, state the quotient and remainder of $\frac{f(x)}{g(x)}$, in the form $q(x) + \frac{r(x)}{g(x)}$.

$$
\begin{array}{r}
x^2 \qquad -3 \\
x^2+3x-1\overline{)\,x^4+3x^3-4x^2+x-7} \\
-(x^4+3x^3-x^2) \downarrow \;\downarrow \\
\hline
-3x^2+x-7 \\
-(-3x^2-9x+3) \\
\hline
10x-10
\end{array}
$$

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

$$\boxed{x^2 - 3 + \frac{10x-10}{x^2+3x-1}}$$

Fill in missing terms

3. Given $f(x) = 2x^4 + 3x^3 + 5x - 1$ and $g(x) = x^2 + 3x + 2$, state the quotient and remainder of $\frac{f(x)}{g(x)}$, in the form $q(x) + \frac{r(x)}{g(x)}$.

$$2x^2 - 3x + 5$$

$$x^2 + 3x + 2 \,\overline{)\, \cancel{2x^4} + 3x^3 + 0x^2 + 5x - 1}$$

$$-(\cancel{2x^4} + 6x^3 + 4x^2)$$

$$\cancel{-3x^3} - 4x^2 + 5x$$

$$-(\cancel{-3x^3} - 9x^2 - 6x)$$

$$5x^2 + 11x - 1$$

$$-(5x^2 + 15x + 10)$$

$$-4x - 11$$

$$\boxed{2x^2 - 3x + 5 + \frac{-4x-11}{x^2+3x+2}}$$

ANSWERS

1. $3 + \frac{7}{x-4}$

2. $x^2 - 3 + \frac{10x-10}{x^2+3x-1}$

3. $2x^2 - 3x + 5 + \frac{-4x-11}{x^2+3x+2}$