# 5.6: Muliplication of Polynomials (cont'd)

Note Title 6/21/2017

Multiply.

1) $(4x+7)(5x-3)$

2) $(-x-y)(3x-2y)$

3) $(3y-7)(2y^3-5y^2+2y-1)$

4) $(3p-2)(4p+1)$

5) $(x-5)(x+5)$

6) $(x-4)^2$

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1) $(4x+7)(5x-3)$

$= 4x(5x-3)+7(5x-3)$

$= 20x^2-12x+35x-21$

$= \boxed{20x^2+23x-21}$

## The "FOIL" Method (for multiplying 2 binomials)

F: First

O: Outer

I: Inner

L: Last

Ex: $(2x+3)(3x-4)$

F L I O

$6x^2-8x+9x-12$

$= \boxed{6x^2+x-12}$

## Perfect Square pattern

$$(a+b)^2 = a^2 + 2ab + b^2$$
$$(a-b)^2 = a^2 - 2ab + b^2$$

no need to memorize.

**Ex:** $(2x+1)^2$

$$= (2x+1)(2x+1)$$
$$= 4x^2 + 2x + 2x + 1$$
$$= \boxed{4x^2 + 4x + 1}$$

**Ex:** $(x-5)^2$

$$x^2 - 10x + 25$$
$$(x-5)(x-5)$$
$$= x^2 - 5x - 5x + 25$$
$$= \boxed{x^2 - 10x + 25}$$

## Difference of 2 squares pattern

$$(a+b)(a-b) = a^2 - b^2$$

$$(a+b)(a-b)$$
$$= a^2 - \cancel{ab} + \cancel{ab} - b^2$$
$$= \boxed{a^2 - b^2}$$

**Ex:** $(x+4)(x-4)$

$$= x^2 - 4x + 4x - 16$$
$$= \boxed{x^2 - 16}$$

# 5.7: Division of Polynomials

## Dividing a polynomial by a monomial

**Ex:** Divide.

$$\frac{6x^4 - 8x^3 + 12x^2 - 9}{2x^2}$$

Split into separate fractions:

$$\frac{6x^4 - 8x^3 + 12x^2 - 9}{2x^2} = \frac{\overset{3}{\cancel{6}}x^4}{\underset{1}{\cancel{2}}x^2} - \frac{\overset{4}{\cancel{8}}x^3}{\underset{1}{\cancel{2}}x^2} + \frac{\overset{6}{\cancel{12}}x^2}{\underset{1}{\cancel{2}}x^2} - \frac{9}{2x^2}$$

$$= \frac{3x^2}{1} - \frac{4x}{1} + \frac{6}{1} - \frac{9}{2x^2}$$

$$= \boxed{3x^2 - 4x + 6 - \frac{9}{2x^2}}$$

**Note:**

$$\frac{2}{7} + \frac{3}{7}$$

$$= \frac{2+3}{7} = \frac{5}{7}$$

# Dividing a Polynomial by a Polynomial

(where divisor has 2 or more terms)

## Polynomial Long Division

Ex: Divide $\frac{379}{12}$.

$$\begin{array}{r} 31 \\ 12\overline{)379} \\ -36\phantom{9} \\ \hline 19 \\ -12 \\ \hline 7 \end{array}$$

So, $\frac{379}{12} = \boxed{31 + \frac{7}{12}}$

(we usually write this as $31\frac{7}{12}$)

## Terminology

$$\begin{array}{r} \text{Quotient} \\ \text{Divisor}\overline{)\text{Dividend}} \\ \hline \text{Remainder} \end{array}$$

$$\frac{\text{Dividend}}{\text{Divisor}} = \text{Quotient} + \frac{\text{Remainder}}{\text{Divisor}}$$

$$\text{Dividend} = (\text{Quotient})(\text{Divisor}) + \text{Remainder}$$

our example: $\frac{379}{12} = 31 + \frac{7}{12}$ Check: $(31)(12) + 7 = 379$

Ex: Divide

$$\frac{3x^2+7x+9}{x+2}$$

Note: could write

$$\frac{3x^2}{x+2} + \frac{7x}{x+2} + \frac{9}{x+2}$$

but they don't reduce

Need long division!

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

$$\begin{array}{r|l} & 3x + 1 \\ x+2 & 3x^2 + 7x + 9 \\ & -(3x^2 + 6x) \\ & \quad x + 9 \\ & -(x + 2) \\ & \quad 7 \end{array}$$

$x(?) = 3x^2$

answer: $3x$

$3x(x+2) = 3x^2+6x$

$x(?) = x$

answer: 1

Write answer:

$$\frac{3x^2+7x+9}{x+2} = \boxed{3x+1+\frac{7}{x+2}}$$

Example: Divide. $\dfrac{x^3-6x^2+x+14}{x-5}$

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

$$
\begin{array}{r}
x^2 - x - 4 \\
x-5\,\overline{)\,x^3 - 6x^2 + x + 14} \\
\underline{-(x^3 - 5x^2)} \\
-x^2 + x \\
\underline{-(-x^2 + 5x)} \\
-4x + 14 \\
\underline{-(-4x + 20)} \\
-6
\end{array}
$$

write answer:

$$\frac{x^3-6x^2+x+14}{x-5} = \boxed{x^2-x-4+\frac{-6}{x-5}}$$

or $\boxed{x^2-x-4-\frac{6}{x-5}}$

Check by multiplying:
(Quotient)(Divisor) + Remainder = Dividend

$$(x^2-x-4)(x-5)-6$$
$$=(x-5)(x^2-x-4)-6$$
$$= x^3-x^2-4x$$
$$\quad -5x^2+5x+20-6$$
$$= x^3-6x^2+x+14 \checkmark$$