$$\begin{array}{c}
10 \\
2x^{4} + 7x^{3} + 5x^{2} \\
x^{2}(2x^{2} + 7x + 5) \\
x(2x + 5)(x + 1) \\
2x + 5x \\
7x
\end{array}$$

$$(8x^{4} + 8x^{3}) + (27x + 27)$$

$$(8x^{3})(x + 1)(+27)(x+1)$$

$$(x+1)(\frac{8x^{3}+27}{a^{3}+b^{3}})$$

$$a = 2x \qquad b = 3$$

$$(x+1)(2x+3)(4x^{2}-6x+9)$$

$$(18) (4x^{4} + 4x^{3})(-x+1)$$

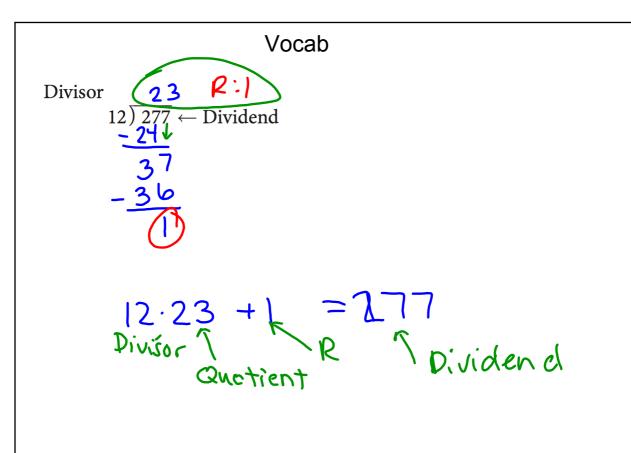
$$4x^{3}(x-1) - 1(x-1)$$

$$(x-1)(4x^{3}-1)$$

2-4 Dividing Polynomials

Objectives:

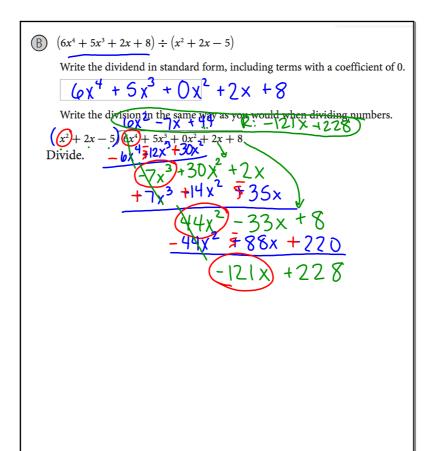
- I can divide polynomials using long division.
- -I can divide polynomials using synthetic division.



Dividing Polynomials - Long Division

Steps: 1. Write as a division problem w/ dividends & divisor in descending order, leaving spaces for missing terms in the dividend (0x)

- 2. Divide leading terms and write the result above the 1st term in the dividend $\frac{x}{\sqrt{x}}$
 - 3. Multiply the result from #2 by the divisor & write the product under the dividend
 - 4. Put () around result from #3, distribute the subtraction sign & then add
- 5. Bring down remaining terms & repeat until there are no remaining terms in the dividend
 - 6. Answer can be written in several ways



Book Example 1A

$$(4x^3 + 2x^2 + 3x + 5) \div (x^2 + 3x + 1)$$

Your Turn

Use long division to find the quotient and remainder. Write the result in the form dividend = (divisor)(qoutient) + remainder and then carry out a check.

3.
$$(15x^3 + 8x - 12) \div (3x^2 + 6x + 1)$$

Example: Divide the polynomial using long division.

$$(x^{4} - 3x^{3} + 6x^{2} - 3x + 5) \div (x^{2} + 1)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 1)(x^{4} - 3x^{3} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 10(x^{2} + 6x^{2} + 6x^{2} - 3x + 5)$$

$$(x^{2})(0x) + 10(x^{2} + 6x^{2} +$$

Dividing Polynomials - Synthetic division:

Can only be used to divide by a linear function steps:

- 1. Write the terms of the dividend in descending order. Write the coeff. of the dividend in the first row using zeros for any missing terms not found in the dividend.
- 2. Write the zero, r, of the divisor (x-r),in the box.
- 3. Drop the 1st coeff. to the last row.
- 4. Multiply 1st coeff. by r & put product under the 2nd coeff.
- 5. Add product from #4 to 2nd coeff. & write the sum in the last row.
 - 6. Repeat #4 & #5 until all coeff. have been used.
 - 7. Write answer by putting variables behind the #'s in the last row. Start with 1 degree less than the dividend polynomial.

B
$$(4x^4 - 3x^2 + 7x + 2) \div (x - \frac{1}{2}) = 4x^3 + 2x^2 - 2x + 6$$
 P: S Find a. Then write the coefficients and a in the synthetic division format.

$$4x^{4} - 3x^{2} + 7x + 2$$

$$+ \frac{1}{2} \qquad 4x^{4} + 0x^{3} - 3x^{2} + 7x + 2$$

$$+ \frac{1}{2} \qquad 1 \qquad 1 \qquad 3$$

$$+ \frac{1}{2} \qquad 4x^{3} + 2x^{2} - 2x + 6 \qquad 15 \qquad R$$

(7
$$x^3 - 6x + 9$$
) ÷ $(x + 5)$

Your Turn

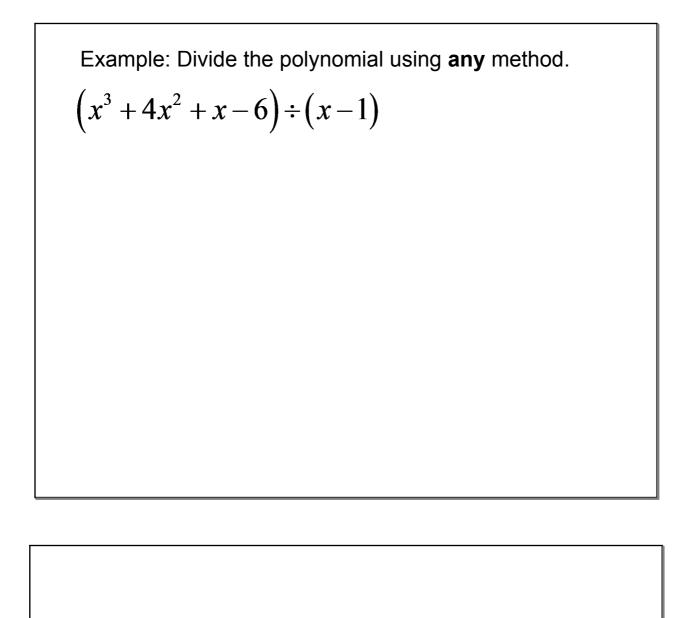
Given a polynomial p(x), use synthetic division to divide by x - a and obtain the quotient and the (nonzero) remainder. Write the result in the form p(x) = (x - a)(quotient) + p(a). You may wish to perform a check.

6.
$$(2x^3 + 5x^2 - x + 7) \div (x - 2)$$

Example: Divide the polynomial using synthetic division.

$$(x^3 + 3x^2 - 4x - 12) \div (x + 3)$$

Long Division	Synthetic Substitution
$ \begin{array}{r} 3x^{2} + 10x + 20 \\ x - 2) \overline{3x^{3} + 4x^{2} + 0x + 10} \\ \underline{-(3x^{3} - 6x^{2})} \\ 10x^{2} + 0x \\ \underline{-(10x^{2} - 20x)} \\ 20x + 10 \\ \underline{-20x - 40} \\ 50 \end{array} $	2 3 4 0 10 6 20 40 3 10 20 50



Verify the following polynomial identity

$$(a+b)(a^2-ab+b^2)=a^3+b^3$$

$$(a+b)(a^{2}-ab+b^{2}) = a^{3}+b^{3}$$

$$a(a^{2}) + a(b^{2}) + b(a^{2}) + (-ab) + b(b^{2}) = a^{3}+b^{3}$$

$$a^{3}-a^{2}b+ab^{2} + (-ab)^{2} + (-ab)^{2} + (-ab)^{2} + (-ab)^{3}$$

$$a^{3}-(-ab)^{2} + (-ab)^{2} + (-ab)^{2} + (-ab)^{3} + (-ab)^{3}$$

$$a^{3}-(-ab)^{2} + (-ab)^{2} + (-ab)^{3} + (-ab)^{3}$$

$$a^{3}-(-ab)^{2} + (-ab)^{2} + (-ab)^{3} + (-ab)^{3}$$

$$a^{3}-(-ab)^{2} + (-ab)^{3} + (-ab)^{3} + (-ab)^{3}$$

$$a^{3}-(-ab)^{3} + (-ab)^{3} + (-ab)^{3} + (-ab)^{3} + (-ab)^{3}$$

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$$a^{3}-(-ab)^{3} + (-ab)^{3} + (-ab)^{3} + (-ab)^{3} + (-ab)^{3} + (-ab)^{3} + (-ab)^{3}$$

$$a^{3}-(-ab)^{3} + (-ab)^{3} + (-ab)^{3}$$

Therefore, $(a + b)(a^2 - ab + b^2) = a^3 + b^3$ is a _____ statement.