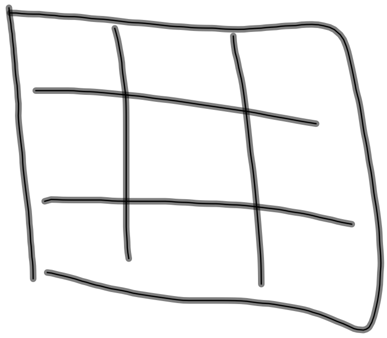
## Warm Up:

**Find each product.**

**1.** $5jk(k - 2j)$

$5jk^2 - 10j^2k$

**2.** $(2a^3 - a + 3)(a^2 + 3a - 5)$



# 6-3 Dividing Polynomials

## *Objective*

Use long division and synthetic division to divide polynomials.

6-3 Dividing Polynomials

*Vocabulary*

synthetic division




Steps for division of polynomials:
1) Write the dividend in standard form, including zeros for terms that are missing.

2) Write a division problem the same way as if you were dividing numbers.

3) Divide

4) Write your final answer, including the remainder

# 6-3 Dividing Polynomials

**Synthetic division** is a shorthand method of dividing a polynomial by a linear binomial by using only the coefficients. For synthetic division to work, the polynomial must be written in standard form, using 0 and a coefficient for any missing terms, and the divisor must be in the form $(x - a)$.



# 6-3 Dividing Polynomials

**Synthetic Division Method**

Divide $(2x^2 + 7x + 9) \div (x + 2)$ by using synthetic division.

| WORDS | NUMBERS |
|---|---|
| Step 1 Write the coefficients of the dividend, 2, 7, and 9. In the upper left corner, write the value of $a$ for the divisor $(x - a)$. So $a = -2$. Copy the first coefficient in the dividend below the horizontal bar. | $\begin{array}{r\|rrr} -2 & 2 & 7 & 9 \\ & & & \\ \hline & 2 & & \end{array}$ |
| Step 2 Multiply the first coefficient by the divisor, and write the product under the next coefficient. Add the numbers in the new column. | $\begin{array}{r\|rrr} -2 & 2 & 7 & 9 \\ & & -4 & \\ \hline & 2 & 3 & \end{array}$ |
| Repeat Step 2 until additions have been completed in all columns. Draw a box around the last sum. | $\begin{array}{r\|rrr} -2 & 2 & 7 & 9 \\ & & -4 & -6 \\ \hline & 2 & 3 & \boxed{3} \end{array}$ |
| Step 3 The quotient is represented by the numbers below the horizontal bar. The boxed number is the remainder. The others are the coefficients of the polynomial quotient, in order of decreasing degree. | $= 2x + 3 + \frac{3}{x + 2}$ |

**Divide using synthetic division.**

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

$+ 0x^2$

$$\begin{array}{r|rrrrr} -2 & 3 & -1 & 0 & 5 & -1 \\ & & -6 & 14 & -28 & 46 \\ \hline & 3 & -7 & 14 & -23 & \boxed{45} \end{array}$$

$x^3$ $x^2$ $x$ Constant

$3x^3 - 7x^2 + 14x - 23 + \frac{45}{x+2}$

**Divide using synthetic division.**

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

$$\begin{array}{r|rrr} -3 & 6 & -5 & -6 \\ & & -18 & 69 \\ \hline & 6 & -23 & \boxed{63} \end{array}$$

$6x - 23 + \frac{63}{x+3}$

**Divide using synthetic division.**

$(x^2 - 3x - 18) \div (x - 6)$

$$
\begin{array}{r|rrr}
6 & 1 & -3 & -18 \\
 & & 6 & 18 \\
\hline
 & 1 & 3 & \boxed{0}
\end{array}
$$

$x+3$

# 6-3 Dividing Polynomials

You can use synthetic division to evaluate polynomials. This process is called synthetic substitution. The process of synthetic substitution is exactly the same as the process of synthetic division, but the final answer is interpreted differently, as described by the Remainder Theorem.

**Remainder Theorem**

| THEOREM | EXAMPLE |
|---|---|
| If the polynomial function $P(x)$ is divided by $x - a$, then the remainder $r$ is $P(a)$. | Divide $x^3 - 4x^2 + 5x + 1$ by $x - 3$. $\begin{array}{r\|rrrr} 3 & 1 & -4 & 5 & 1 \\ & & 3 & -3 & 6 \\ \hline & 1 & -1 & 2 & 7 \end{array}$ $P(3) = 7$ |

**Use synthetic substitution to evaluate the polynomial for the given value.**

**$P(x) = 2x^3 + 5x^2 - x + 7$ for $x = 2$.**

$$\begin{array}{r|rrrr} 2 & 2 & 5 & -1 & 7 \\ & & 4 & 18 & 34 \\ \hline & 2 & 9 & 17 & \boxed{41} \end{array}$$

$P(2) = 41$

**Use synthetic substitution to evaluate the polynomial for the given value.**

**$P(x) = 6x^4 - 25x^3 - 3x + 5$ for $x = -\frac{1}{3}$.**

**Use synthetic substitution to evaluate the polynomial for the given value.**

**$P(x) = x^3 + 3x^2 + 4$ for $x = -3$.**

$+0x$

$$\begin{array}{r|rrrr} -3 & 1 & 3 & 0 & 4 \\ & & -3 & 0 & 0 \\ \hline & 1 & 0 & 0 & 4 \end{array}$$

$P(-3)=4$

**Use synthetic substitution to evaluate the polynomial for the given value.**

**$P(x) = 5x^2 + 9x + 3$ for $x = \frac{1}{5}$.**

$$\begin{array}{r|rrr} \frac{1}{5} & 5 & 9 & 3 \\ & & 1 & 2 \\ \hline & 5 & 10 & \boxed{5} \end{array}$$

$P(\frac{1}{5})=5$

Homework:

p. 426 #~~13-16~~, 19-28, 31-33, 49, 53-56