CLASS NOTES

SYNTHETIC DIVISION

When factoring or evaluating polynomials we often find that it is convenient to divide a polynomial by a linear (first degree) binomial of the form $x-k$ where k is a real number. In certain problems we must use trial-and-error to find a particular value of k. The resulting process of repeated divisions can be tedious and time-consuming. The use of **synthetic division** (instead of long division) can save a lot of time and effort.

It must be emphasized that synthetic division may <u>only</u> be used when dividing a polynomial by a binomial of the form $x-k$.

Illustration: Suppose we wish to divide the polynomial $P(x)=5x^3-6x^2-28x-2$ by $x-3$. The *k*-value is 3 (the number subtracted from *x* in the binomial $x-3$). $P(x)$ is a polynomial of degree 3, and the four coefficients of $P(x)$ are 5, -6, -28 and -2.

The division may now be expressed as shown below. Note that there is a blank space above the horizontal line.

$$\begin{array}{r|rrrr} 3 & 5 & -6 & -28 & -2 \\ & & & & \\ \hline & & & & \end{array}$$

We "bring down" (copy) the leading coefficient below the line in the same column.

$$\begin{array}{r|rrrr} 3 & 5 & -6 & -28 & -2 \\ & \downarrow & & & \\ \hline & 5 & & & \end{array}$$

We now multiply 5 (the number below the line in the first column) by the *k*-value (3) and write the result in the next column (second column) above the line.

$$\begin{array}{r|rrrr} 3 & 5 & -6 & -28 & -2 \\ & & 15 & & \\ \hline & 5 & & & \end{array}$$

Then we add the two numbers that are above the line in the second column and write the sum below the line.

$$\begin{array}{r|rrrr} 3 & 5 & -6 & -28 & -2 \\ & & 15 & & \\ \hline & 5 & 9 & & \end{array}$$

We now multiply 9 (the number below the line in the second column) by the *k*-value (3) and write the result in the next column (third column) above the line.