Dividing two numbers we use a process known as long division.

\[
\begin{array}{c|c}
1512 & 1649 \\
\hline
4 & 7 \\
\end{array}
\]

We can also polynomials:

\[
x^2 + 3x - 18 \div x - 3
\]

\[
x^2 + 2x - 30 \div x - 5
\]

1. Look at the first term in each polynomial. Here, ask, \(x\) goes into \(x^2\) how many times?
2. As with long division, multiply quotient by the divisor and simplify; drop the next term from the dividend.
3. Repeat the process of bringing down the next term followed by dividing, multiplying, and subtracting.

\[
x^3 + 7x^2 - 4 \div x + 2
\]
When there is a remainder, the proper form for the factor is:

\[
(dividend) = (divisor)(quotient) + remainder
\]

How does this dividing help us?
1. Given a factor, we can simplify by dividing to find the factor pair.
2. We can verify if a polynomial is a factor of another polynomial. If the remainder is zero then our divisor is a factor!

**Remainder Theorem**

If we have a polynomial \( P(x) \) and it is divided by \( x - a \), then:

\[ P(a) = \text{number} = \text{remainder} \]

A second type of division we can use which is quicker than long division is known as **synthetic division**. This technique works only when we have a linear binomial in the form of \( x - a \), that is \( x - \boxed{a} \).

\[
\begin{array}{c|c|c}
\quad \quad & x^3 - 7x^2 + 15x - 9 & x^3 + 4x^2 + x - 6 \\ 
\quad \quad & \div x - 3 & \div x + 1 \\
\end{array}
\]

Is \( (x + 2) \) a factor of:

\[
\begin{array}{c|c|c}
\quad \quad & 2x^2 + 7x + 6 & x^3 - 5x - 10 \\
\quad \quad & \quad & \\
\end{array}
\]
The volume in cubic feet of a workshop’s storage chest can be expressed as the product of its three dimensions by the given function: \( V(t) = t^3 + 7t^2 + 10t \). The depth of the chest is given by the function \( (x + 2) \). Find the linear expressions for the other two dimensions.

Find \( P(4) \) for \( P(x) = x^4 - 5x^2 + 4x + 12 \)

use synthetic division:

Now solve for \( P(-4) \)

Find \( P(-1) \) for \( P(x) = 2x^4 + 6x^3 - 5x^2 + 60 \)