# Factoring by Grouping

In some cases there is not a GCF for ALL the terms in a polynomial. If you have four terms with no GCF, then try factoring by grouping.

To factor a four term polynomial using grouping, follow the steps listed below:
**Step 1:** Group the first two terms together and then the last two terms together.
**Step 2:** Factor out a GCF from each separate binomial.
**Step 3:** Factor out the common binomial.

Let us apply the steps to factor the polynomial $x^3 + 7x^2 + 2x + 14$
There is not a GCF for ALL the terms. So let's go ahead and factor this by grouping.

**Step 1:** Group the first two terms together and then the last two terms together.

$x^3 + 7x^2 + 2x + 14$

$= \left(x^3 + 7x^2\right) + \left(2x + 14\right)$

**Step 2:** Factor out a GCF from each separate binomial.

$\left(x^3 + 7x^2\right) + \left(2x + 14\right)$

$= x^2\left(x + 7\right) + 2\left(x + 7\right)$

**Step 3:** Factor out the common binomial.

$x^2\left(x + 7\right) + 2\left(x + 7\right)$

$= \left(x^2 + 2\right)\left(x + 7\right)$

Note that if we multiply our answer out, we do get the original polynomial.

Example 1 : Factor:

1) $x^3 + 3x^2 - 4x - 12$.

$x^3 + 3x^2 - 4x - 12$
$= x^2 (x + 3) - 4 (x + 3)$
$= (x + 3) (x^2 - 4)$
$= (x + 3) (x - 2) (x + 2)$

A difference of squares can have more than two terms. For example, one of the squares may be a trinomial. We can factor by a type of grouping.

2) $x^2 + 6x + 9 - y^2$.
$x^2 + 6x + 9 - y^2$
$= (x^2 + 6x + 9) - y^2$ , grouping as a trinomial minus $y^2$ to show a difference of squares.
$= (x + 3)^2 - y^2$
$= (x + 3 + y) (x + 3 - y)$