

1. Factoring: Grouping
2. You should be familiar with the distributive property and with expanding binomials. We will combine this factoring technique with other factoring techniques, including greatest common factor and difference of squares.

In this lesson, we will factor polynomials with four terms by grouping..

3.
  - (a) Recall the FOIL process for expanding binomials. We begin by multiplying the first terms, then the outside terms, then the inside terms, and finally the last terms. This produces a four part answer.
  - (b) To factor, we begin with the expanded polynomial and wish to produce the factors. Recall that each term in the initial factors gets multiplied twice in the expansion and therefore will be a common factor in two terms. The  $x^2$  gets multiplied to both the  $x$  and the  $-2$ . The same is true for the 9. Similarly the  $x$  is multiplied by both  $x^2$  and 9, as is the  $-2$ . In order to factor, we merely need to split apart these common factors.
  - (c) If we arrange the terms in a grid, starting with the term with the largest degree and proceeding across the top row, then move to the bottom row, then each row and each column corresponds to the two terms in the expansion containing a common factor. The top row contains the first and outer terms, which both came from the  $x^2$ . The bottom row corresponds to the 9. The left column corresponds to the  $x$  and the right column to the  $-2$ .
  - (d) To reverse the process, we need to find the common factor in each row and column. You may begin anywhere you wish. The common factor in the top row is  $x^2$ . We can then find what we multiply  $x^2$  by to get  $x^3$ , which is  $x$ . Likewise, we find what we can multiply  $x^2$  by to get  $-2x^2$ , which is  $-2$ . We can then find what we multiply  $x$  by to get  $9x$ , which is 9, and as a double-check, we verify that 9 times  $-2$  is  $-18$
  - (e) The factors are the row and column outside the grid.
4.
  - (a) Here is another example. You may wish to pause the video here to work out the first step.
  - (b) After the initial factoring, one of the factors is a difference of squares, so we can factor further.
  - (c) The final answer has three factors.
5.
  - (a) If the initial polynomial has a common factor, then care must be taken to remove this factor at the beginning. Every term has a factor of  $3x$ , so we remove this common factor first.
  - (b) Once the common factor has been removed, the remaining polynomial can be factored by grouping.
  - (c) The final answer has three factors.

6. Here are some exercises for you to try. You may wish to pause the video now to work out these problems.
7. To recap: A four term polynomial which has been produced by expanding two binomials can be groups into rows and columns so that the common factors can found to produce the factors. Take care to remove any common factors at the beginning. After factoring by grouping, there may be other types of factoring.