Factoring trinomials NAME:
Part 4: Upside Down method

This is a method that takes six steps. You are not done until you get to the final step.

This method starts off like the A-C method but diverges pretty quickly. We will show off the procedure by factoring $6x^2 + 11x - 10$.

Step 1: If there is a common factor in all terms, you *must* pull it out in front before you begin. Neglecting to do so will cause your final answer to be wrong by that factor. There are no common factors among all terms of $6x^2 + 11x - 10$ so we do not need to worry about that here.

Step 2: First, like the A-C method, multiply *a* and *c* of our expression. Remember this *a* and *c* refer to the generic form of a trinomial, $ax^2 + bx + c$. For $6x^2 + 11x - 10$, *a* times *c* is -60. Why is it negative?

Step 3: We now find two factors of -60 that add to 11 (of 11*x* in our trinomial). Below I have listed the possible factors of -60.

Possible factors of -60					
-1 and 60	-2 and 30	-3 and 20	-4 and 15	-5 and 12	-6 and 10
-60 and 1	-30 and 2	-20 and 3	-15 and 4	-12 and 5	-10 and 6

The only pair of factors that adds to 11 are 15 and -4.

Step 4: Now divide these factors by the leading coefficient of the trinomial. So we get $15/6$ and $-4/6$. We must reduce these if possible. We reduce $15/6$ to get $5/2$. We reduce $-4/6$ to get $-2/3$.

Step 5: We then write two basic factors using these reduced fractions.

$$6x^2 + 11x - 10 \quad \Rightarrow \quad \left(x + \frac{5}{2}\right)\left(x - \frac{2}{3}\right)$$

Notice I used an arrow, not an equal sign. This $\left(x + \frac{5}{2}\right)\left(x - \frac{2}{3}\right)$ is NOT equal to our original trinomial. We have one more step before it is. Also, notice how the minus sign came into play because of the $-2/3$.

Step 6: Now, to get the completed factorization, simply move the 2 and the 3 in the bottoms of those fractions to the front of each *x*. This makes $(2x+5)(3x-2)$. Check that this is indeed equal to the original $6x^2 + 11x - 10$ by multiplying it out.

As a second example, let's factor $6x^2+10x+4$. Notice this time we have a common factor among all terms. It *must* be taken out first. We will have to remember it when we are writing our final answer.

Step 1: If there is a common factor in all terms, you *must* pull it out in front before you begin. The common factor within $6x^2+10x+4$ is 2 so we pull it out to write $2\left(3x^2+5x+2\right)$. The rest of the procedure will be done with the $3x^2+5x+2$ inside the parentheses. But we cannot forget to write the 2 in our final answer.

Step 2: Multiply *a* and *c* of $3x^2+5x+2$ which gives us 6.

Step 3: We now find two factors of 6 that add to 5 (of 5*x* in our trinomial). The only pair of factors that adds to 5 are 2 and 3.

Step 4: Now divide these factors by the leading coefficient of the trinomial. Remember the trinomial I am now working with is $3x^2+5x+2$, so we divide our factors by 3. This gives us ${}^{2}\!/_{3}$ and ${}^{3}\!/_{3}$. When we reduce ${}^{3}\!/_{3}$, let's write it as ${}^{1}\!/_{1}$. The reason we want to leave it in fraction form is that step 6 refers to the bottoms of the fractions.

Step 5: We then write two basic factors using these reduced fractions.

$$3x^2+5x+2 \quad \Rightarrow \quad \left(x+\frac{2}{3}\right)\left(x+\frac{1}{1}\right)$$

Notice I used an arrow, not an equal sign. This $\left(x+\frac{2}{3}\right)\left(x+\frac{1}{1}\right)$ is NOT equal to our trinomial. We have one more step before it is.

Step 6: Now, to get the completed factorization, simply move the 3 and the 1 in the bottoms of those fractions to the front of each *x*. This makes $\left(3x+2\right)\left(1x+1\right)$. Check that this is indeed equal to $3x^2+5x+2$ by multiplying it out.

But remember the 2 we took out at the beginning of this process? To get the original trinomial $6x^2+10x+4$, we need to tack our 2 back onto the factorization gotten in step 6. So $6x^2+10x+4 = 2\left(3x+2\right)\left(1x+1\right)$.

Try this guided example on your own.
Factor $6x^2 + 7x + 2$.

Steps 1 - 3: There are no common factors among all three terms. So we'll start by finding the possible factors of $6 \cdot 2$ or 12.

Possible factors of 12		

Choose the pair that adds to 7 (of 7*x* from our trinomial).

Step 4: Divide your factors by 6, the leading coefficient. Be sure to reduce these fractions if possible. Write down your reduced fractions here.

Step 5: Now write the factors $(x+ \quad)(x+ \quad)$ putting your reduced fractions in the blanks.

Step 6: Whatever the bottoms of your fractions are, move them to the front of the *x*'s inside each set of parentheses. This should be your completed factorization. Write it below. Be sure to FOIL it out in your head or on scratch paper to check your answer.

Use the Upside Down method to factor the following. It is absolutely necessary to first factor out a GCF from **all** terms if one exists. Do not forget to tack it back onto the final answer.

a.) $5x^2 - 14x - 3$ (Hint: When you divide the appropriate factors by the 5, you'll find one of them will be ${}^{-15}\!/_{5}$ which reduces to -3. Write it as ${}^{-3}\!/_{1}$ to help make sense of step 6. It is also important that the negative sign stays on top. It will mess things up if you think of it as ${}^{3}\!/_{-1}$ as you go into step 6.)

b.) $-3x^2 - 10x + 8$ (Hint: Even though it does not look like there is a common factor among all three terms, we want to factor the -1 out or our factorization will be the negative of what it should be. And, you have to remember to attach that -1 in your final answer. Also, be sure to take heed of the hint from letter *a*.)

c.) $10x^2 + 4x - 6$ (Hint: There is a common factor here. Make sure you pull it out first.)

d.) $3x^2 - 26x + 35$

e.) $9x^3 + 3x^2 - 6x$ (Hint: What is the common factor here? It is not just 3.)