Elementary Algebra
Skill-Builder # PF – 3A
Factoring Quadratic Trinomials with Leading Coefficient of 1: One Variable Case

<u>Quadratic trinomials</u> are trinomials of the form $ax^2 + bx + c$, where *a, b,* and *c* are real numbers and $a \neq 0$. Note that the first term has a degree of 2, the middle term has degree 1, and the third term (sometimes called the **<u>constant term</u>**) has degree 0. The coefficient *a* of the second-degree term is called the **<u>leading coefficient</u>**. We shall first consider the case where this leading coefficient *a* is equal to 1; thus, the quadratic trinomial will look like $x^2 + bx + c$.

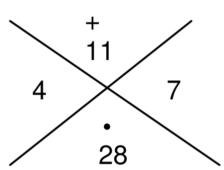
Recall that when multiplying two binomials we applied FOIL which was really nothing but distributing each term of the first binomial to each term of the second binomial. For instance,

$$(x+4)(x+7) = \underbrace{x^2}_{\text{F}} + \underbrace{7x}_{\text{O}} + \underbrace{4x}_{\text{I}} + \underbrace{28}_{\text{L}}$$

and we simplify by combining the two middle terms to get $x^2 + 11x + 28$. Now, in factoring, we will be given the "answer" $x^2 + 11x + 28$ and we need to figure out the "question" $(x+4)(x+7)$. The key in doing this lies in noting the following:

1. The middle coefficient 11 is the ***sum*** of 4 and 7.
2. The last term or constant term is the ***product*** of 4 and 7.

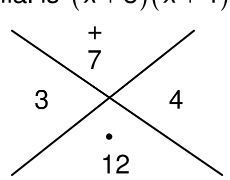
Now, both should be satisfied in order to get the correct factored form. In other words, any other pair will not work. For instance, 6 + 5 =11 but $6 \cdot 5 = 30$, so we cannot use this pair. Likewise, although $2 \cdot 14 = 28$, we cannot use these two numbers since 2 + 14 is not 11. We can use the following diagram to summarize these ***sum-product requirements***:



The above should probably really be called a ***product-sum*** diagram and maybe the positions for the numbers should switch to the product being on top and the sum being below because what one has to figure out first are the ***factors*** of the last term that add up to the middle coefficient.

Examples Factor the following.

1. $x^2 + 7x + 12$
Solution: We can use the diagram (you don't have to) to help us figure out the correct sum-product combination. We see that 3 and 4 are the factors of 12 that give the sum 7 and the factored form of the polynomial is $(x+3)(x+4)$.



2. $y^2 - 3y - 28$
Solution: For those who don't like the 'X' diagram, you can argue as follows: we want the sum of the two numbers to be -3 and the product to be -28 and we see that the numbers we need are 4 and -7. Thus, the quadratic trinomial factors into $(y-7)(y+4)$.

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Factor completely:

1. $x^2 + 9x + 20$	**2.** $x^2 - 8x + 15$
3. $y^2 + 5y - 14$	**4.** $y^2 - 4y - 32$
5. $n^2 - n - 30$	**6.** $n^2 + n - 56$
7. $w^2 - 12w + 35$	**8.** $w^2 + 6w - 55$

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Answers

1. $(x+4)(x+5)$	**2.** $(x-3)(x-5)$
3. $(y-2)(y+7)$	**4.** $(y-8)(y+4)$
5. $(n-6)(n+5)$	**6.** $(n+8)(n-7)$
7. $(w-5)(w-7)$	**8.** $(w+11)(w-5)$

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