Name: _____ Per: _____

Factoring to Determine Solutions

You know how to **factor** (**when *a* = 1**)—find two numbers that **multiply to equal *c***, and **add to equal *b***.
The next step is to use factoring to solve for *x*. This is only possible under two conditions:

1. The quadratic must be set equal to 0
2. The quadratic must be factorable
   —sometimes, there is no set of numbers that multiplies to *c* and adds to *b*. It's sad, but true.
   If this is the case, you cannot factor it, so you cannot solve for *x* this way.

There is one other thing that you must remember:
If two terms **multiply to 0**, then **one of 'em must be zero**.
Example: $(5)(?) = 0$ …umm, the ? has to be 0. That's the only way to get $\boxed{0}$.
Another example: $(5)(x) = 0$ …umm, that's the same problem. *x* is still $\boxed{0}$.
Another example: $(5)(x+1) = 0$ …oooh, tricky. I still have to multiply 5 by 0.
This means that $x + 1 = 0$. So, $x = \boxed{-1}$
Yet another example: $(x-5)(x+1) = 0$ …you can't fool me. We've done this before. One of them has to be 0.
So, this means that either $x - 5 = 0$ *or* $x + 1 = 0$
$x = 5$ *or* $x = -1$
$x = \boxed{\{-1, 5\}}$ I win.

EXAMPLE Solve for *x*. $0 = x^2 - 16x + 48$ *Two numbers that multiply to c = 48 and add to b = -16…* *Guess and check:* $(-2)(-24) = 48$ $-2 + -24 = -16$ *…umm, no. NEXT!* $(-4)(-12) = 48$ $-4 + -12 = -16$ *YAHTZEE!* *Use:* -4 & -12 $0 = x^2 - 16x + 48$ $0 = (x-4)(x-12)$ $x - 4 = 0$ *or* $x - 12 = 0$ $x = 4$ *or* $x = 12$ $x = \boxed{\{4, 12\}}$	**EXAMPLE** Solve for *x*. $0 = x^2 + 9x - 14$ *Two numbers that multiply to c = -14 and add to b = +9…* *Guess and check:* $(-2)(7) = -14$ $-2 + 7 = 9$ *…nope. NEXT!* $(2)(-7) = -14$ $2 + -7 = 9$ *…still no. NEXT!* $(-1)(14) = -14$ $-1 + 14 = 9$ *…no. NEXT!* $(1)(-14) = -14$ $1 + -14 = 9$ *…no. NEXT!* *Okay, there are no other numbers that multiply to -14. I'm out of options.* *This problem is* $\boxed{NOT\ POSSIBLE}$.	**EXAMPLE** Solve for *x*. $0 = x^2 - x - 12$ *Two numbers that multiply to c = -12 and add to b = -1…* *Guess and check:* $(-3)(4) = -12$ $-3 + 4 = -1$ *…nope. NEXT!* $(3)(-4) = -12$ $3 + -4 = -1$ *Found 'em!* *Use:* 3 & -4 $0 = x^2 - x - 12$ $0 = (x+3)(x-4)$ $x + 3 = 0$ *or* $x - 4 = 0$ $x = -3$ *or* $x = 4$ $x = \boxed{\{-3, 4\}}$
1. Solve for *x*. $0 = x^2 + 9x - 36$	2. Solve for *x*. $0 = x^2 - 7x + 10$	3. Solve for *x*. $0 = x^2 + 2x + 24$
4. Solve for *x*. $0 = x^2 - 5x - 6$	5. Solve for *x*. $0 = x^2 + 8x - 15$	6. Solve for *x*. $0 = x^2 - 2x - 48$

7. Solve for x. $0 = x^2 + x - 30$	8. Solve for x. $0 = x^2 - 3x - 54$	9. Solve for x. $0 = x^2 + 12x - 20$

Now, we'll practice a skill you'll need soon. I've already shown it to you: *the magic step*. This time, I want you to do the magic step and then solve for x. Here's how you'll do it:

1. Use the Magic Step
2. Simplify the right side
3. Square root both sides (don't forget the $\pm$)
4. Get x alone.

EXAMPLE $x^2 + 12x = 13$ MAGIC→ $12 \div 2 = 6, so \ldots$ $(x+6)^2 = 13 + (6)^2$ $(x+6)^2 = 13 + 36$ $(x+6)^2 = 49$ $\sqrt{(x+6)^2} = \pm\sqrt{49}$ $x + 6 = \pm 7$ $x = -6 \pm 7$ $So,\ x = -6 - 7 = -13$ $or\ \ x = -6 + 7 = 1$ $x = \boxed{\{-13, 1\}}$	**EXAMPLE** $x^2 - 2x = -5$ MAGIC→ $-2 \div 2 = -1, so \ldots$ $(x-1)^2 = -5 + (-1)^2$ $(x-1)^2 = -5 + 1$ $(x-1)^2 = -4$ $\sqrt{(x-1)^2} = \pm\sqrt{-4}$ $x - 1 = \pm 2i$ $x = \boxed{1 \pm 2i}$	**EXAMPLE** $x^2 + 8x = -23$ MAGIC→ $8 \div 2 = 4, so \ldots$ $(x+4)^2 = -23 + (4)^2$ $(x+4)^2 = -23 + 16$ $(x+4)^2 = -7$ $\sqrt{(x+4)^2} = \pm\sqrt{-7}$ $x + 4 = \pm i\sqrt{7}$ $x = \boxed{-4 \pm i\sqrt{7}}$
10. $x^2 + 20x = -19$	11. $x^2 - 14x = 23$	12. $x^2 - 4x = -20$
13. $x^2 - 18x = -12$	14. $x^2 + 6x = -9$	15. $x^2 + 16x = -25$