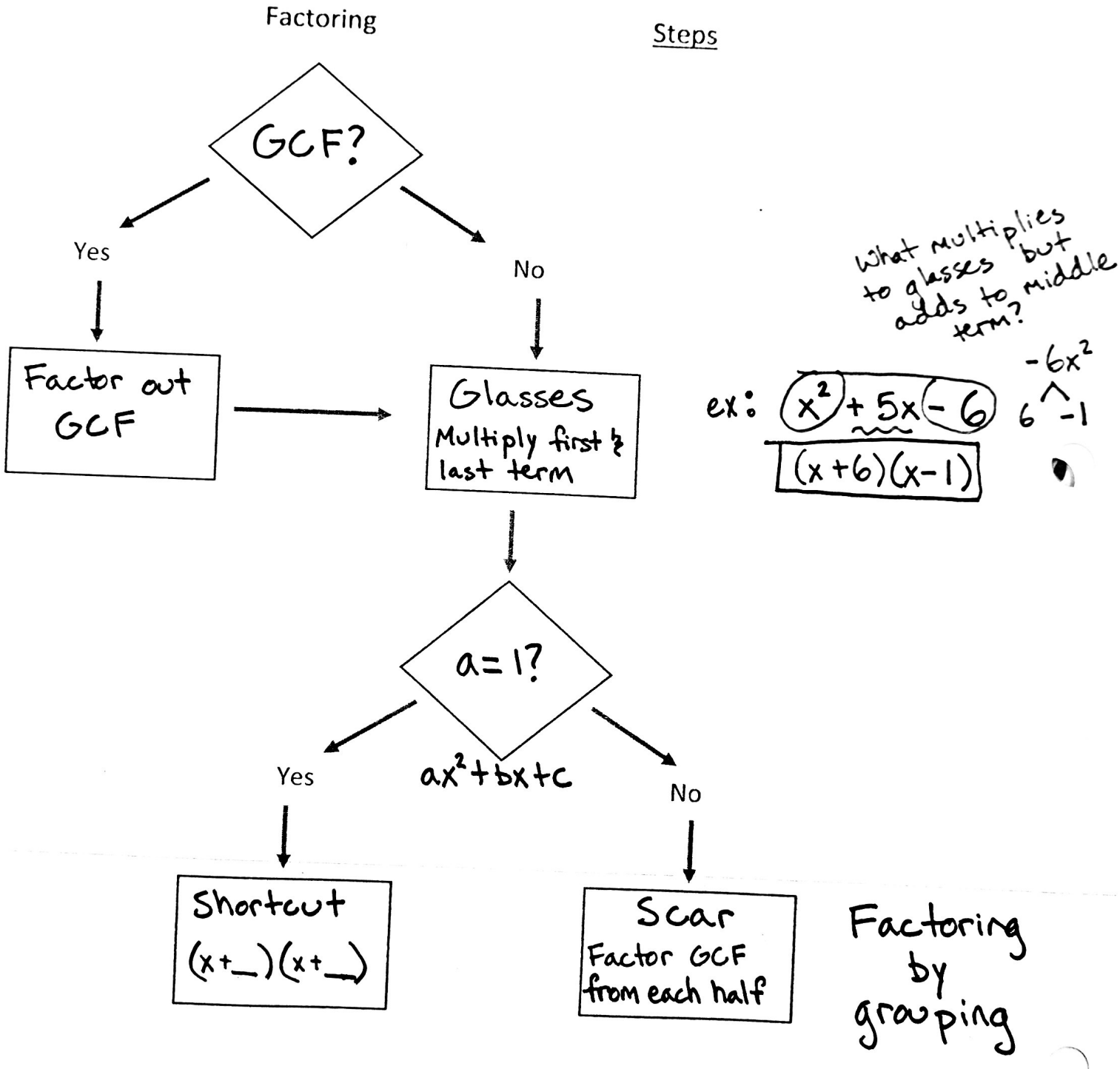
Unit 1.2: Factoring

FACTORING polynomials involves breaking up a polynomial into simpler terms (the factors) such that when the terms are multiplied together they equal the original polynomial. Factoring helps solve complex equations so they are easier to work with.



What does each term have in common? What are they all divisible by?

1. The first step in factoring is to check to see if any of the terms have anything in common. This is called the **GREATEST COMMON FACTOR.** (Note: If the leading coefficient is negative, you will factor out a negative as well.) * Factor out negative

a) $8xy + 4xy^2$

$4xy(2+y)$

b) $-14x^2y^2z + 21xy^2z^2$

$-7xy^2z(2x + 3z)$

c) $8x - x^2$

$x(8-x)$

d) $6x^2 - 2x + 4$

$2(3x^2-x+2)$

2. Factoring Trinomials when the leading coefficient is 1:

a) $n^2 - 7n + 6$ $\quad 6n^2$

$(n-6)(n-1)$ $\quad -6 \quad -1$

b) $m^2 - m - 56$ $\quad -56m^2$

$(m-8)(m+7)$ $\quad -8 \quad 7$

c) $r^2 - 16r + 64$ $\quad 64r^2$

$(r-8)(r-8)$ $\quad -8 \quad -8$

or $(r-8)^2$

d) $v^2 + 9v + 20$

e) $x^2 - 15x + 50$

f) $n^2 + 11n + 30$

3. If you are given 4 terms and you are asked to factor it, you may consider factoring by grouping. Factoring by grouping creates smaller groups within the problem.

Steps to factoring by grouping:
i. Group the first two terms together and the last two together. ii. Factor the GCF from each of the two groups. Notice that what is left inside the parenthesis is a perfect match. This is now the GCF of the two remaining terms. iii. Factor the "match" out of the two remaining terms. Your polynomial is now factored!

$a^2 + ab - ax - bx$

a) $4x^2 + 20x - 3xy - 15y$

$4x(x+5) - 3y(x+5)$

$\boxed{(x+5)(4x-3y)}$

b) $3x^3 - 6x^2 + 15x - 30$

$3x^2(x-2) + 15(x-2)$

$\boxed{(x-2)(3x^2+15)}$

d) $x^3 + 2x^2 - 9x - 18$

$x^2(x+2) - 9(x+2)$

$\boxed{(x+2)(x^2-9)}$

Factoring by grouping: cut in half, take GCF from each half

4. Factoring Trinomials when the leading coefficient is not 1:

Steps
i. Find two numbers that multiply to $a \cdot c$ (the outside) and add to b (the middle).
ii. Split the middle term into two pieces using the numbers from part (i).
iii. Factor by Grouping

a) $5b^2 + 16b + 3$

$15b^2$

$15b \quad 1b$

$5b^2 + 15b + 1b + 3$

$5b(b+3) + 1(b+3)$

$(b+3)(5b+1)$

b) $3n^2 - 20n + 12$

$36n^2$

$-18n \quad -2n$

$3n^2 - 18n - 2n + 12$

$3n(n-6) - 2(n-6)$

$(n-6)(3n-2)$

c) $6p^2 + 13p - 15$

d) $8x^2 - 15x - 2$

$-16x^2$

$-16x \quad 1x$

$8x^2 - 16x + 1x - 2$

$8x(x-2) + 1(x-2)$

$(x-2)(8x+1)$

e) $6r^2 + 7r - 90$

5. **Difference of Squares:** If your polynomial has two terms that are both perfect squares separated by a subtraction sign: $a^2 - b^2$ then it will always factor out to be: $(a-b)(a+b)$.

a) $z^2 - 9$

$(z+3)(z-3)$

b) $2y^2 - 32$

$2(y^2 - 16)$

$2(y+4)(y-4)$

c) $4g^2 - 64$

$4(g^2 - 16)$

$4(g+4)(g-4)$

When you factor out a GCF, it stays out front of the rest of your factoring