Factoring Study Guide ☺

- Factoring means *to write as a product*
- A polynomial can often be factored *MORE THAN ONCE*
- When we factor, our **final answer should be equivalent to the polynomial we were given** in the first place. There are two ways you can check your answer when factoring:
    - If you plug the same value in for x for both versions, your answer should be the same
    - You can go backwards and distribute. If you have done so correctly and have combined like terms (if possible) you should end up with the original polynomial

① FIRST, look to <u>see if there is a GCF</u> of the variables and/or of the numbers → if there is one, write the GCF outside of a set of parentheses, then factor out the GCF from each term, leaving the remnants in the parentheses

Ex) $Factor\ \ 10x^2 - 35x$ → $\boxed{5x(2x-7)}$

- After you've factored out a GCF, try to factor again. Factor as many times as possible so that you have "factored completely"

Ex) $2x^2 - 10x + 8$ → $2(x^2 - 5x + 4)$ what is inside of parentheses can be factored further…

→ $\boxed{2(x-4)(x-1)}$

② If there is no GCF:

- For a **TRINOMIAL with a leading coefficient of 1**→ you will have to find factor pairs of the constant, and figure out which pair have a sum which equals the middle term of the trinomial

  Ex) $Factor\ \ x^2 + 8x + 12$

  Factor pairs of 12 → 1, 12 2,6 3,4

  The pair 2,6 can be added together to = 8 → $2 + 6 = 8$

  So, we can factor using the pair → $(x+2)(x+6)$

- For a **TRINOMIAL with a leading coefficient greater than 1**→ multiply the first number (leading coefficient) and the last number (the constant). List factor pairs for this number. Choose the pair that ALSO can be added to get the coefficient on the 2nd term. Rewrite the polynomial, keeping the first and last term the same, and replace the 2nd term with 2 new terms with the same variable, whose coefficients are the 2 numbers you chose. Now, factor by grouping.

  Ex) $Factor\ \ 2x^2 - 12x + 10$

  2 • 10 =20

  Factors of 20 → 1&20, -1 & -20, 2 & 10, -2 & -10, 4 & 5, -4 & -5

  Choose -2 & -10 because they also add up to -12, which is the coefficient on the second term

  Rewrite the polynomial → $2x^2 - 2x - 10x + 10$

  Answer: $(2x-10)(x-1)$

- For a **BINOMIAL**→ rewrite the binomial so that each term is written as w "squared" term. Then, place on of each squared term into 2 sets of parentheses- one set will be adding and one will be subtracting

  Ex) $Factor\ \ 36x^2 - 16$

  Rewrite so each term is a "squared term" → $(6x)^2 - 4^2$

  Write each term once in each set of ( ), adding once and subtracting once → $\boxed{(6x-4)(6x+4)}$

- For a **4 TERM POLYNOMIAL**→ factor by grouping terms, pulling out the GCF of each group, and simplifying your work

  Ex) $Factor\ \ x^2 - x + 2x - 2$

  Group using parentheses → $(x^2 - x) + (2x - 2)$ factor out GCF→$x(x-1) + 2(x-1)$

  Finally, simplify: $\boxed{(x+2)(x-1)}$

Factoring Completely

Whenever you factor a polynomial, no matter *how* you factor, you need to be sure that you have factored it as many times as possible. This is called **factoring completely.**

How do we make sure that a polynomial is factored completely?

1.) Factor the polynomial following the steps on the reverse side
2.) Look at both of the factored pieces – see if you can factor one of them again, using the steps on the reverse side

Let's try some on our own! Factor the following completely.

a.) $2x^3 + 6x^2 - 8x$

b.) $5x^2 - 5$

c.) $4x^5 - 16x$

d.) $6x^2 + 16x + 8$

e.) $2x^3 - 3x^2 - 2x + 3$

Factoring and then Solve

1.) Move all terms to be on one side of the $=$ sign, leaving only 0 on the other side
2.) Factor the polynomial part of the equation, essentially ignoring the $=0$
3.) Set each set of parentheses $=$ to 0, and solve for the variable