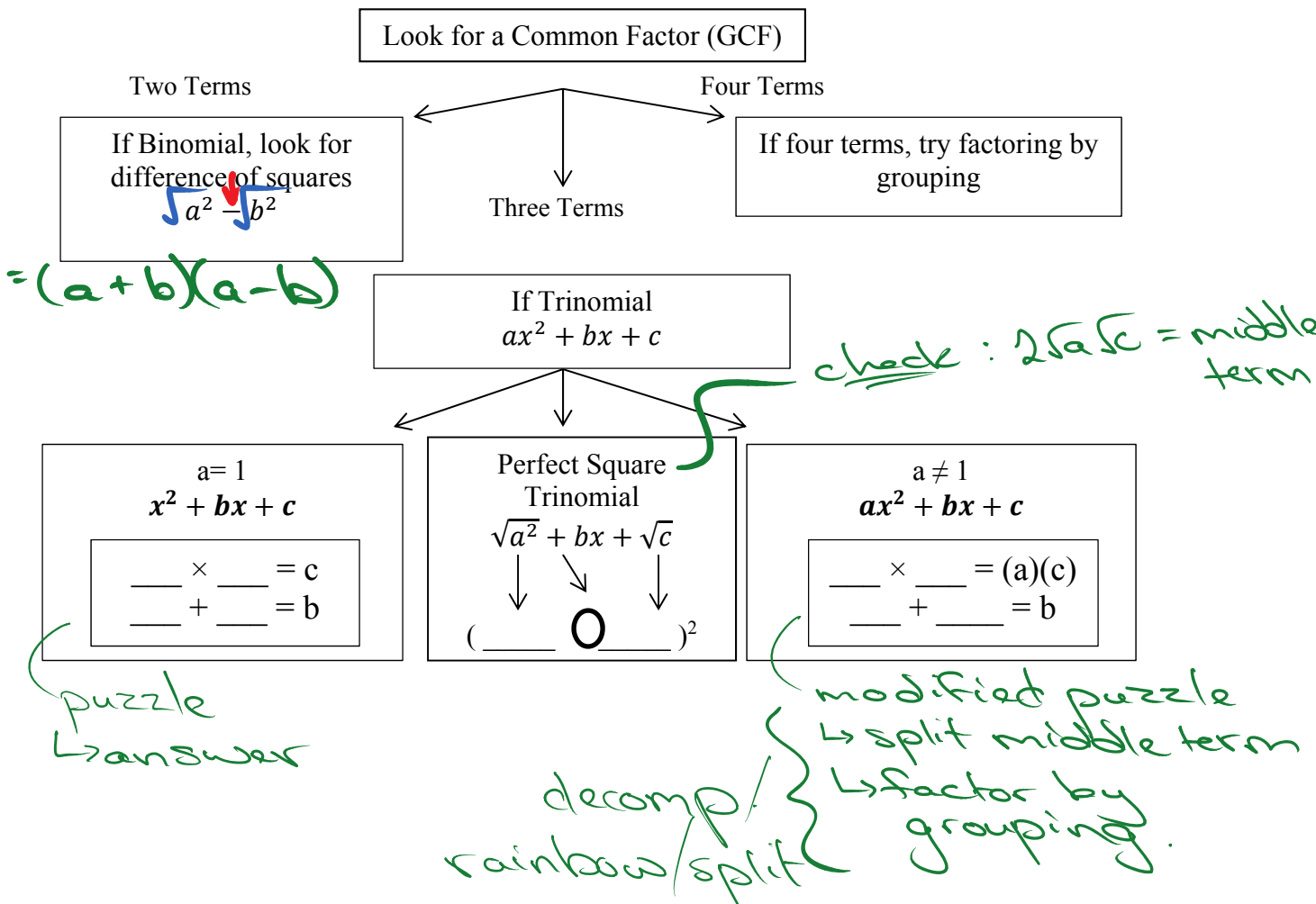# 4.2 Part 1 Factoring Polynomial Expressions

The Following are guidelines for factoring polynomials.

1. Look for a __common factor__!!! If there is one take it out and look for further __GCF's__.

2. If there is a binomial expression left look for a __difference of squares__.

3. If there is a trinomial of the form $x^2 + bx + c$, look for two numbers that __multiply__ to "c" but __add__ to "b." Then write your answer with two binomial factors.

4. If there is a trinomial of the form $ax^2 + bx + c$, look two numbers that multiply to __(a)(c)__, but adds to __b__. Then factor in ~~pairs~~ groups, and write your answer with two binomial factors.

5. If there is a trinomial which fits the perfect trinomial square pattern, then the answer is two binomial factors which are both the __same__. Square root the __first__ and __last__ terms and the sign matches the middle term sign. Always check the middle term!

$$\sqrt{a} \qquad 2(\ )(\ ) \qquad \sqrt{c}$$
$$= \text{middle term.}$$

6. Lastly, always check to see if there is any further factoring.

Look for a Common Factor (GCF)

Two Terms

If Binomial, look for difference of squares
$$\sqrt{a^2} - \sqrt{b^2}$$

$$= (a+b)(a-b)$$

Three Terms

Four Terms

If four terms, try factoring by grouping

If Trinomial
$$ax^2 + bx + c$$

check: $2\sqrt{a}\sqrt{c} = $ middle term

a= 1
$$x^2 + bx + c$$

| ___ × ___ = c |
| ___ + ___ = b |

puzzle
↳ answer

Perfect Square Trinomial
$$\sqrt{a^2} + bx + \sqrt{c}$$

$$(\underline{\quad} \; O \; \underline{\quad})^2$$

decomp/
rainbow/split

a ≠ 1
$$ax^2 + bx + c$$

| ___ × ___ = (a)(c) |
| ___ + ___ = b |

modified puzzle
↳ split middle term
↳ factor by grouping.

<u>4.2 Part2 Factoring Quadratic Equations</u>

Once a Quadratic Equation is Factored and is equated to zero, we can find the

<u>x-intercepts</u>. This is done by equating each bracket to zero and solving for x.

Ex) $(x - 3)(x + 5) = 0$

$$x - 3 = 0 \qquad x + 5 = 0$$
$$+3 \quad +3 \qquad -5 \quad -5$$
$$\boxed{x = 3} \qquad \boxed{x = -5}$$

For this product to equal zero
Either one or <u>both</u> brackets must equal zero

These are the x-intercepts.

GCF	
$0 = 6x^2 + 3x$ $$0 = 3x(2x+1)$$ $$3x = 0 \qquad 2x + 1 = 0$$ $$\frac{3x}{3} \qquad \qquad -1 \quad -1$$ $$\boxed{x = 0} \quad \frac{2x}{2} = \frac{-1}{2}$$ $$\boxed{x = -\frac{1}{2}}$$	$0 = 4x^2 - 2x$ $$0 = 2x(2x - 1)$$ $$\frac{2x}{2} = \frac{0}{2} \qquad 2x - 1 = 0$$ $$\boxed{x = 0} \qquad +1 \quad +1$$ $$\frac{2x}{2} = \frac{1}{2}$$ $$\boxed{x = \frac{1}{2}}$$
Simple Trinomials	
$x^2 + 8x + 12 = 0$ $$(x + 6)(x + 2) = 0$$ $$x + 6 = 0 \qquad x + 2 = 0$$ $$-6 \quad -6 \qquad -2 \quad -2$$ $$\boxed{x = -6} \qquad \boxed{x = -2}$$	$x^2 + 3x - 10 = 0$ $$(x + 5)(x - 2) = 0$$ $$x + 5 = 0 \qquad x - 2 = 0$$ $$-5 \quad -5 \qquad +2 \quad +2$$ $$\boxed{x = -5} \qquad \boxed{x = 2}$$
$x^2 - 15x + 36 = 0$ $$(x - 12)(x - 3) = 0$$ $$x - 12 = 0 \qquad x - 3 = 0$$ $$+12 \quad +12 \qquad +3 \quad +3$$ $$\boxed{x = 12} \qquad \boxed{x = 3}$$	$x^2 + x - 6 = 0$ $$(x - 3)(x + 2) = 0$$ $$x - 3 = 0 \qquad x + 2 = 0$$ $$+3 \quad +3 \qquad -2 \quad -2$$ $$\boxed{x = 3} \qquad \boxed{x = -2}$$

Decomposition

$$-+-=-3$$
$$-\times-=-40$$

$3x^2 + 4x - 7 = 0$

$-+-=4$
$-\times-=-21$

$(3x^2 - 3x)(+7x - 7) = 0$

$[3x(x-1) + 7(x-1)] = 0$

$(3x+7)(x-1) = 0$

$3x + 7 = 0 \qquad\qquad x - 1 = 0$
$\quad -7 \;\; -7 \qquad\qquad\qquad +1 \quad +1$
$\dfrac{3x}{3} = \dfrac{-7}{3} \qquad\qquad \boxed{x = 1}$

$\boxed{x = -\dfrac{7}{3}}$

$4x^2 - 6x - 40 = 0$

$2(2x^2 - 3x - 20) = 0$

$2[(2x^2 - 8x)(+5x - 20)] = 0$

$2[2x(x-4) + 5(x-4)] = 0$

$2(2x+5)(x-4) = 0$

no x term

$2x + 5 = 0 \qquad\qquad x - 4 = 0$
$\dfrac{2x}{2} = \dfrac{-5}{2} \qquad\qquad \boxed{x = 4}$

$\boxed{x = -\dfrac{5}{2}}$

$9x^2 - 24x = -16$

$\sqrt{9x^2}\,\sqrt{16} = 24x$

$+16 \qquad +16$

$9x^2 - 24x + 16 = 0$

$(3x - 4)(3x - 4) = 0$

$3x - 4 = 0 \qquad$ same

$\dfrac{3x}{3} = \dfrac{4}{3}$

$\boxed{x = \dfrac{4}{3}}$

means only one x-intercept!

$4x^2 - 20x = -25$

$\sqrt{4x^2}\,\sqrt{25} = 20x$

$+25 \qquad +25$

$4x^2 - 20x + 25 = 0$

$(2x - 5)(2x - 5) = 0$

$2x - 5 = 0 \qquad$ same

$\dfrac{2x}{2} = \dfrac{5}{2}$

$\boxed{x = \dfrac{5}{2}}$

Difference of Squares

$x^2 - 25 = 0$

$(x + 5)(x - 5) = 0$

$x + 5 = 0 \qquad\qquad x - 5 = 0$
$x = -5 \qquad\qquad\quad x = 5$

$\boxed{x = \pm 5}$

2 x-int!

$4x^2 - 9 = 0$

$(2x + 3)(2x - 3) = 0$

$2x + 3 = 0 \qquad \boxed{x = \pm\dfrac{3}{2}}$
$\dfrac{2x}{2} = \dfrac{-3}{2}$

$2x^2 - 8 = 0$

$2(x^2 - 4) = 0$

$2(x + 2)(x - 2) = 0$

$\boxed{x = \pm 2}$

$x^2 + 4 = 0$

not a difference of squares!

Practice: p.229 # 3ad, 4a, 8acdf, 9abef