PC12 Name: Key (for all questions) Date: ____________

Polynomials Key Skills Review

A. FRACTIONS

Multiplying Fractions

1) Multiply the numerators (tops)
2) Multiply the denominators (bottoms)
3) Simplify/reduce the final fraction if possible.

Examples:

1. $\frac{10}{3} \times \frac{6}{5}$

$= \frac{60}{15}$ $\div 15$ $\div 15$

$= \boxed{\frac{4}{1} \text{ or } 4}$

2. $\left(\frac{1}{2}\right)\left(\frac{10}{1}\right)$

$= \frac{10}{2}$

$= \boxed{5}$

3. $\frac{7}{2} \times \frac{3}{4}$

$= \boxed{\frac{21}{8}}$

Your turn!

1. $\frac{9}{2} \times \frac{4}{3}$

$= \frac{36}{6}$

$= 6$

2. $\left(\frac{12}{1}\right)\left(\frac{1}{3}\right)$

$= \frac{12}{3}$

$= 4$

3. $\frac{1}{2} \times \frac{1}{3}$

$= \frac{1}{6}$

4. $\frac{1}{2} \times \frac{5}{1}$

$= \frac{5}{2}$

5. $\frac{1}{2} \times \frac{5}{2}$

$= \frac{5}{4}$

6. $\frac{1}{2} \times 11$

$= \frac{11}{2}$

Adding and Subtracting Fractions

1) In order to add or subtract fractions, you must have a common denominator.
   a. If needed, multiply the top AND bottom of the fraction by the same number so that your denominators match.
2) Add (or subtract) the numerators (leave the denominators alone)
3) Simplify/reduce the final fraction if possible.

Examples:

1. $\frac{2\times 1}{2\times 3}+\frac{1}{6}$

$\frac{2}{6}+\frac{1}{6}$

$=\frac{3}{6}\,\frac{\div 3}{\div 3}$

$=\boxed{\frac{1}{2}}$

2. $\frac{4\times 2}{4\times 5}-\frac{3\times 5}{4\times 5}$

$=\frac{8}{20}-\frac{15}{20}$

$=\boxed{\frac{-7}{20}}$

3. $\frac{4\times 6}{4\times 1}+\frac{3}{4}$

$=\frac{24}{4}+\frac{3}{4}$

$=\boxed{\frac{27}{4}}$

Your turn!

1. $\frac{7\cdot 1}{7\cdot 4}+\frac{1\cdot 4}{7\cdot 4}$

$=\frac{7}{28}+\frac{4}{28}$

$=\frac{11}{28}$

2. $\frac{3\cdot 2}{3\cdot 3}-\frac{1}{9}$

$=\frac{6}{9}-\frac{1}{9}$

$=\frac{5}{9}$

3. $\frac{8\cdot 1}{8\cdot 5}+\frac{3\cdot 5}{8\cdot 5}$

$=\frac{8}{40}+\frac{15}{40}$

$=\frac{23}{40}$

4. $\frac{2\cdot 1}{2\cdot 2}-\frac{1}{4}$

$=\frac{2}{4}-\frac{1}{4}$

$=\frac{1}{4}$

5. $\frac{17}{11}+\frac{3\cdot 11}{1\cdot 11}$

$=\frac{17}{11}+\frac{33}{11}$

$=\frac{50}{11}$

6. $\frac{9\cdot 5}{9\cdot 1}-\frac{4}{9}$

$=\frac{45}{9}-\frac{4}{9}$

$=\frac{44}{9}$

B. SOLVING LINEAR EQUATIONS

1) Expand brackets and clear fractions → to "clear fractions", multiply all TERMS by each denominator.
2) Move all variable terms to one side and all other terms to the other side. Terms are separated by add/subtract.
3) Collect like terms and divide to isolate variable
↳ same variable, same exponent

Examples:

1. $4x - 1 = 9$

$+1 \quad +1$

$\frac{4x}{4} = \frac{10}{4}$

$x = \frac{10 \div 2}{4 \div 2}$

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

fraction answers are better than decimals

2. $3(x+2) - 24 = 2(4x-3) + x$

$3x + 6 - 24 = 8x - 6 + x$

$3x - 18 = 9x - 6$

$-9x \quad +18 \quad -9x \quad +18$

$\frac{-6x}{-6} = \frac{12}{-6}$

$\boxed{x = -2}$

3. $\frac{1}{2}(x+18) = \frac{4x}{5} - 3$ — $\underbrace{\frac{1}{2}(x+18)}_{\text{term}} = \underbrace{\frac{4x}{5}}_{\text{term}} - \underbrace{3}_{\text{term}}$

$5(x+18) = 4(2)x - 3(2)(5)$

$5x + 90 = 8x - 30$

$-8x \quad -90 \quad -8x \quad -90$

$\frac{-3x}{-3} = \frac{-120}{-3}$

$\boxed{x = 40}$

Your turn!

1. $3x + 6 = 12$

$-6 \quad -6$

$\frac{3x}{3} = \frac{6}{3}$

$x = 2$

2. $7x - 3 = 18$

$+3 \quad +3$

$\frac{7x}{7} = \frac{21}{7}$

$x = 3$

3. $2x + 100 = 200$

$-100 \quad -100$

$\frac{2x}{2} = \frac{100}{2}$

$x = 50$

4. $5(x+2) = x + 2(x-3)$

$5x + 10 = x + 2x - 6$

$5x + 10 = 3x - 6$

$-3x \quad -10 \quad -3x \quad -10$

$\frac{2x}{2} = \frac{-16}{2}$

$x = -8$

5. $\frac{3x}{2} - 3 = \frac{1}{3}(x+5)$

$(3)(3x) - 3(2)(3) = 2(x+5)$

$9x - 18 = 2x + 10$

$-2x \quad +18 \quad -2x \quad +18$

$\frac{7x}{7} = \frac{28}{7}$

$x = 4$

C. GRAPHING LINEAR RELATIONS

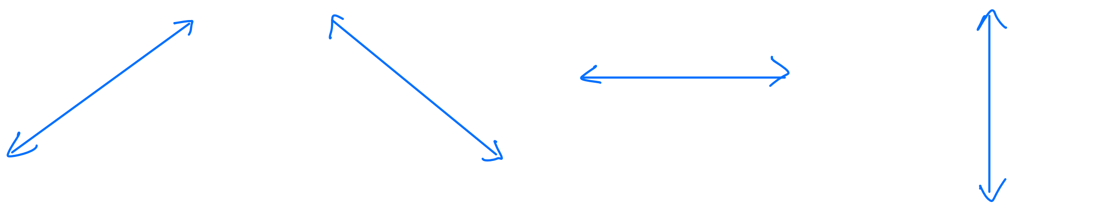
Finding Slope of a Line

Slope is the steepness of the graph. We think of "rise over run."

$$slope = m = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1}$$

Example: Sketch a line with a…

Positive Slope Negative Slope Slope of Zero Undefined Slope



Finding x- and y- intercepts

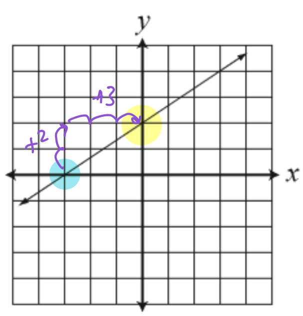
x-intercepts are where the graph crosses the x-axis (where height = 0, or $\boxed{y = 0}$).

y-intercepts are where the graph crosses the y-axis (where you are "zero over" or $\boxed{x = 0}$).

Examples:

Find and label the x- and y-intercepts and the slopes of the following graphs:

1.



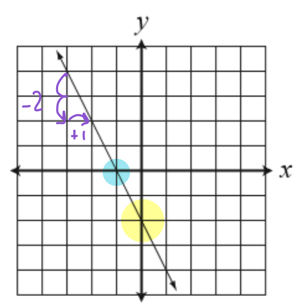
x-intercept: (-3, 0)

y-intercept: (0, 2)

Slope (m): $\frac{2}{3}$

up 2
right 3

2.



x-intercept: (-1, 0)

y-intercept: (0, -2)

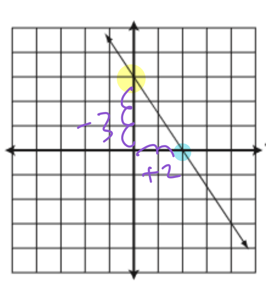
Slope (m): $-\frac{2}{1}$

down 2
right 1

Your turn!

Find and label the x- and y-intercepts and slopes of the following graphs:

1.

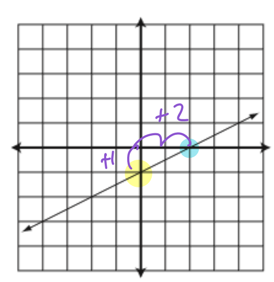


x-intercept: (2, 0)

y-intercept: (0, 3)

Slope (m): $\frac{-3}{2}$

2.



x-intercept: (2, 0)

y-intercept: (0, -1)

Slope (m): $+\frac{1}{2}$

Graphing Linear Relations (y = mx + b)

If your Linear Relation is in y = mx + b form (also called "slope-intercept" form), then

- ***m*** (the coefficient of x) is the slope

and

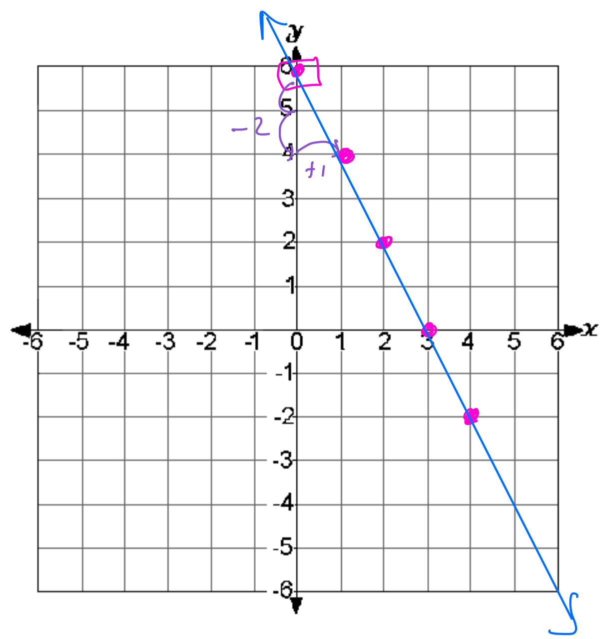
- ***b*** (the constant term) is the y-intercept

To graph:

1) Rearrange into y = mx + b if needed (make sure "y" is by itself on its own side of the equation)
2) Start on the y-axis at "b" -- plot the y-intercept, which is at (0, b)
3) Use the slope to "travel" (rise/run) to the next point and plot it
4) Plot a few points and connect the dots with a ruler!

Examples:

1. $y = -2x + 6$



y-intercept: 6 or (0, 6)

Slope (m): -2 or $\frac{-2}{1}$

Plot (0, 6) $\boxed{\cdot}$

travel $\frac{-2}{1}$ ← down 2 ← right 1

until next point

connect the dots (remember arrows)

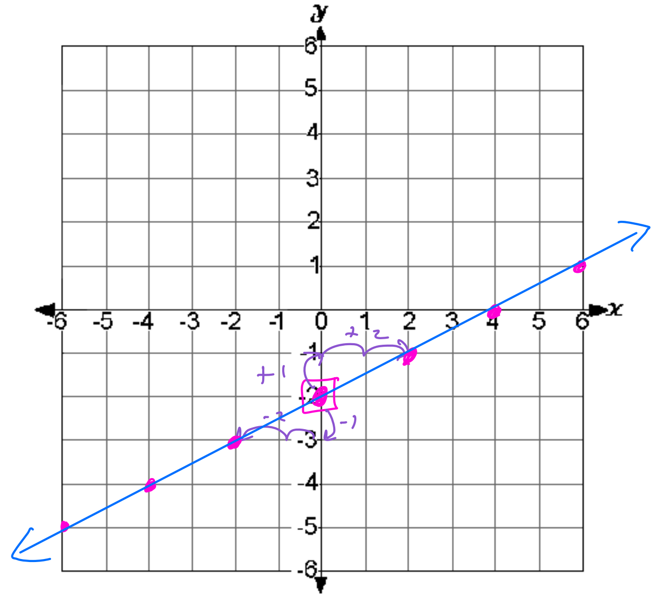
*rearrange first! $y = mx + b$

2. $x - 2y = 4$

$-x \qquad -x$

$\frac{-2y}{-2} = \frac{-x}{-2} + \frac{4}{-2}$

$y = +\frac{1}{2}x - 2$



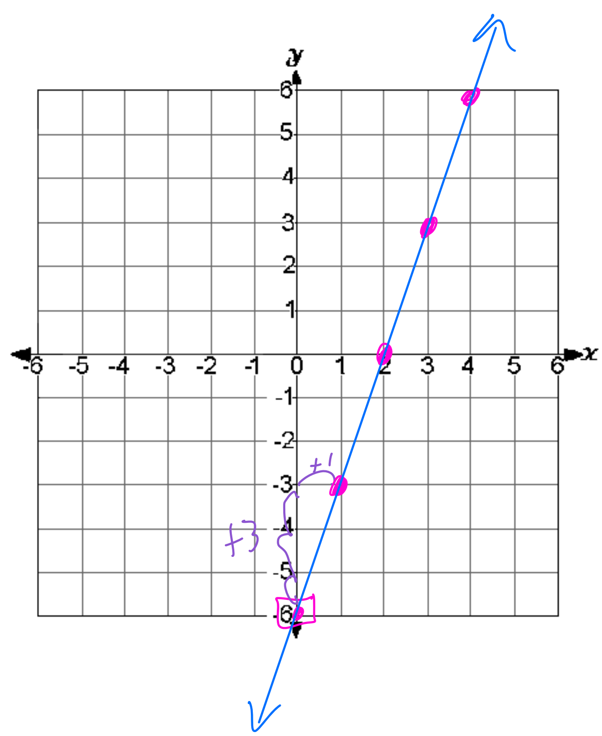
y-intercept: -2

Slope (m): $\frac{1}{2}$ ← up 1, ← right 2

(or $\frac{-1}{-2}$ ← dn 1, ← left 2)

Your turn!

1. $y = 3x - 6$



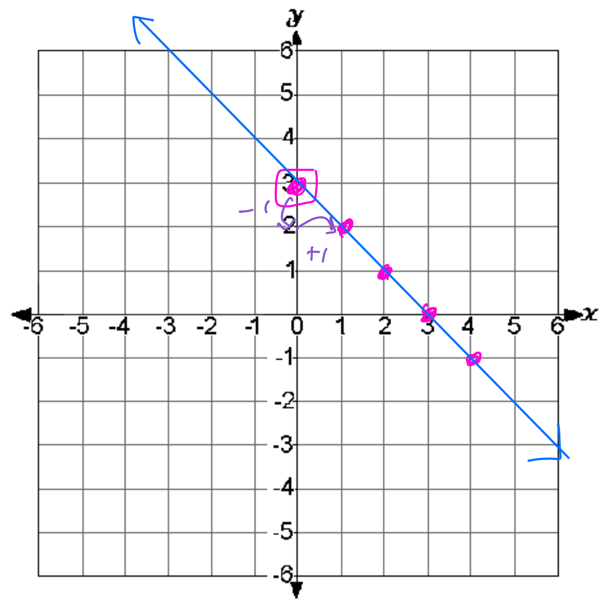
y-intercept: -6

Slope (m): $\frac{+3}{1}$

2. $x + y = 3$

$-x \quad -x$

$y = -x + 3$



y-intercept: 3

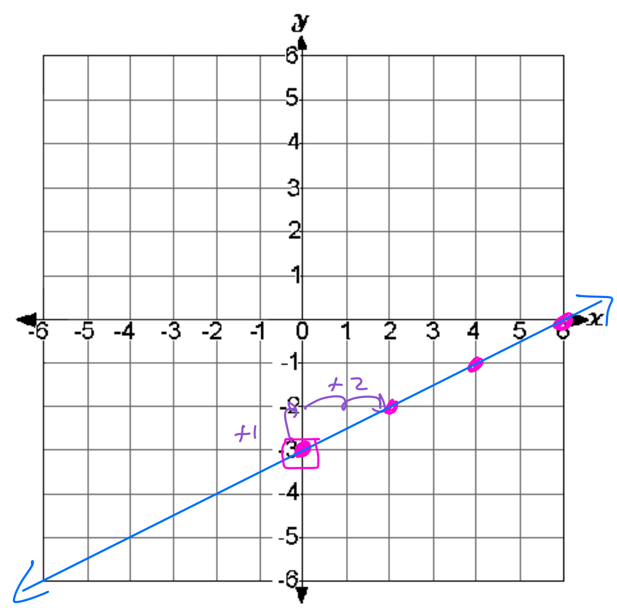
Slope (m): $\frac{-1}{1}$ dn 1 rt 1

3. $x - 2y = 6$

$-x \quad -x$

$\frac{-2y}{-2} = \frac{-x}{-2} + \frac{6}{-2}$

$y = \frac{1}{2}x - 3$



y-intercept: -3

Slope (m): $+\frac{1}{2}$ up 1 rt 2

D. FACTORING

1) Check for a Greatest Common Factor (GCF)
2) How many terms are there? If there are TWO terms, check if it's a DIFFERENCE of SQUARES
3) If there are THREE terms in the form $ax^2 + bx + c$, check if $a = 1$
4) If there are THREE terms in the form $ax^2 + bx + c$, and $a \neq 1$, you'll need a few extra steps
5) Check at the end to see if anything factors further
6) Optional: Expand out again (distribute/FOIL) to check that it's correct

Factoring a GCF

Look for numbers and/or variables that can "divide out" of EVERY term. (Terms are separated by add/subtract/equals signs).

Divide the common factor out of every term, write the common factor out front, and write the "leftovers" in a bracket.

Think: ÷ out x^2

$\frac{6x^{\cancel{3}1}}{\cancel{x^2}} + \frac{5\cancel{x^2}}{\cancel{x^2}}$

$6x + 5$

TIP: always divide out a negative as well if your highest power of x is negative!

Examples: Factor

1. $4x^2 + 12$

Think: both ÷ by 4

GCF = 4 write out front → $\boxed{4(x^2+3)}$

Check: $4(x^2+3)$
$4x^2+12$ ✓

2. $6x^3 + 5x^2$

GCF: x^2

$\boxed{x^2(6x+5)}$

Check: $x^2(6x+5)$
$6x^3+5x^2$ ✓

3. $-9x^2 + 12x + 3$

gcf: −3 ÷ out of all terms and write out front!

$\boxed{-3(3x^2-4x-1)}$

Check: $-3(3x^2-4x-1)$
$-9x^2+12x+3$ ✓

Your turn! Factor

1. $-5x^2 + 10$

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

2. $4x^2 + 9x$

$= x(4x+9)$

3. $12x^3y^2 + 6x^2y^5 - 21xy^3$

$= 3xy^2(4x^2+2xy^3-7y)$

Factoring a Difference of Squares

If you have TWO terms, check if it's a "Difference of Squares" (a perfect square with a SUBTRACT and another perfect square). Something of the form:

$$a^2 - b^2$$

Which will always factor into $(a + b)(a - b)$

(these brackets are called "conjugates")

*Remember to check for a GCF first, and remember that you can always check by expanding out! Also, check if anything factors FURTHER.

Examples: Factor

1. $4x^2 - 25$

set-up: $(\quad + \quad)(\quad - \quad)$

$\boxed{(2x + 5)(2x - 5)}$

$\sqrt{4x^2} = 2x$ $\sqrt{25} = 5$ same bracket, except with opposite sign!

2. $2t^5 - 162t$ gcf $= 2t$

$2t(t^4 - 81)$

$2t(t^2 + 9)(t^2 - 9)$ factors more!

$\boxed{2t(t^2+9)(t+3)(t-3)}$

3. $x^4 - 1$

$(x^2 + 1)(x^2 - 1)$ factors more!

$\boxed{(x^2+1)(x+1)(x-1)}$

Your turn! Factor

1. $x^2 - 9$

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

2. $8x^2 - 72$

$= 8(x^2 - 9)$

$= 8(x+3)(x-3)$

3. $25x^4 - 16$

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

Factoring a Trinomial when a = 1

If you have a trinomial of the form $x^2 + bx + c$, then

1) check to see if you can find the two numbers that

   ___ x ___ = c (multiply to the outside)

   ___ + ___ = b (add to the middle)

2) If those numbers exist, then the trinomial factors into two brackets with those numbers "dropped in". Remember the + or – sign.

$$(x\_\_\_\_)(x\_\_\_\_)$$

*Remember to check for a GCF first, and remember that you can always check by expanding out!

Examples: Factor

1. $x^2 + 9x + 20$

$4 \times 5 = 20$

$4 + 5 = 9$

set-up → $(x \quad)(x \quad)$

$= \boxed{(x+4)(x+5)}$

2. $x^2 + 3x - 28$

$7 \times -4 = -28$

$7 + -4 = 3$

$(x \quad)(x \quad)$

$\boxed{(x+7)(x-4)}$

3. $z^2 - 12z + 32$

$-8 \times -4 = 32$

$-8 + -4 = -12$

$\boxed{(z-8)(z-4)}$

4. $a^2 - 5a - 66$

$-11 \times 6 = -66$

$-11 + 6 = -5$

$\boxed{(a-11)(a+6)}$

Your turn! Factor

1. $x^2 + 7x + 12$

$3 \times 4 = 12$

$3 + 4 = 7$

$= (x+3)(x+4)$

2. $x^2 - 9x + 8$

$-1 \times -8 = 8$

$-1 + -8 = -9$

$= (x-1)(x-8)$

3. $x^2 + 5x - 66$

$+11 \times -6 = -66$

$+11 + -6 = 5$

$= (x+11)(x-6)$

4. $x^2 - 6x - 27$

$-9 \times 3 = -27$

$-9 + 3 = -6$

$= (x-9)(x+3)$

Factoring a Trinomial when a ≠ 1

If you have a trinomial of the form $ax^2 + bx + c$, and **a ≠ 1,** then you can use EITHER the "ac method" or "decomposition".

$a \times c = 3 \times 5 = 15$

$b = 16$

Example: Factor $\underset{a}{3x^2} + \underset{b}{16x} + \underset{c}{5}$

use 1 and 15 below

<table>
<tr><th>ac method</th><th>Decomposition</th></tr>
<tr><td colspan="2">1) check to see if you can find the two numbers that

1 x 15 = 15 ac (multiply to the outside numbers multiplied together, a times c)
1 + 15 = 16 b (add to the middle)

If those numbers exist, then you can use them for EITHER the "ac method" or "decomposition".</td></tr>
<tr><td>2) Write two helper brackets set up with x in each bracket and a fraction over "a", like this:
$\left(x \quad \frac{\ }{a}\right)\left(x \quad \frac{\ }{a}\right)$

Here, a = 3, so the helper brackets are

$\left(x \quad \frac{\ }{3}\right)\left(x \quad \frac{\ }{3}\right)$</td><td>2) "split" the middle (b) term into two terms using the numbers you found in step 1 (that multiply to ac and add to b)
$ax^2 + \_\_x + \_\_x + c$

Here, we would get

$\underbrace{3x^2 + 1x}_{\text{gcf: } x} + \underbrace{15x + 5}_{\text{gcf: } 5}$</td></tr>
<tr><td>3) Drop the numbers you found in step 1 (that multiply to ac and add to b) into the brackets "over a"

$\left(x + \frac{1}{3}\right)\left(x + \frac{15}{3}\right)$
Reduce</td><td>3) Group the first two terms together, and the last two terms, and take out a GCF from each pair:

$x(3x+1) + 5(3x+1)$
✓match!</td></tr>
<tr><td>4) Reduce the fractions (if they reduce), and any fractions that do not reduce, take the bottom of the fraction and make it the coefficient of x:

$(3x+1)(x+5)$</td><td>4) The brackets should match. They are a "common bracket" and can be factored out. Write the matching bracket once, and the "leftovers" in their own bracket:

$(3x+1)(x+5)$
(matching bracket) (leftovers)</td></tr>
</table>

Same answer!

$\underline{10} \times \underline{-5} = -50$
$\underline{10} + \underline{-5} = 5$

$\underline{-4} \times \underline{-3} = 12$
$\underline{-4} + \underline{-3} = -7$

* always take out a negative from the highest power of x!

Examples: Factor

1. $2x^2 + 5x - 25$

helper brackets: $\left(x \quad \frac{}{2}\right)\left(x \quad \frac{}{2}\right)$

$\left(x + \frac{10}{2}\right)\left(x - \frac{5}{2}\right)$

reduce! move denom!

$= \boxed{(x+5)(2x-5)}$

Decomp: **2.** $6y^2 - 7y + 2$

$\underbrace{6y^2 - 4y}_{\text{gcf: } 2y} \underbrace{- 3y + 2}_{\text{gcf: } -1}$

$2y(3y-2) - 1(3y-2)$

$\boxed{(3y-2)(2y-1)}$

Your turn! Factor

1. $3x^2 - 13x + 12$

$\underline{-9} \times \underline{-4} = 36$
$\underline{-9} + \underline{-4} = -13$

ac

$\left(x - \frac{9}{3}\right)\left(x - \frac{4}{3}\right)$

$= \boxed{(x-3)(3x-4)}$

decomp

$3x^2 - 13x + 12$

$= \underbrace{3x^2 - 9x}_{\text{gcf: } 3x} \underbrace{- 4x + 12}_{\text{gcf: } -4}$

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

$= \boxed{(x-3)(3x-4)}$

2. $2x^2 + 3x - 14$

$\underline{+7} \times \underline{-4} = -28$
$\underline{7} + \underline{-4} = 3$

ac

$\left(x + \frac{7}{2}\right)\left(x - \frac{4}{2}\right)$

$= \boxed{(2x+7)(x-2)}$

decomp

$2x^2 + 3x - 14$

$= \underbrace{2x^2 + 7x}_{\text{gcf: } x} \underbrace{- 4x - 14}_{\text{gcf: } -2}$

$= x(2x+7) - 2(2x+7)$

$= \boxed{(2x+7)(x-2)}$

E. SOLVING QUADRATIC EQUATIONS

Quadratic Equations can have 0, 1, or 2 solutions.

Get organized! →
1) Move all terms to one side of the equation, leaving zero on the other side
2) If you can factor, factor! The SOLUTIONS are the "zeros of the brackets."
3) If you can't factor, use the quadratic formula:

For $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Solving Quadratic Equations by Factoring

Examples: Solve by factoring

1. $x^2 = 13x + 48$

$-13x-48 \quad -13x \quad -48$

$x^2 - 13x - 48 = 0$

$-16 \times 3 = -48$
$-16 + 3 = -13$

$(x - 16)(x + 3) = 0$

the "zero" is the x-value that makes this bracket $= 0$

$x - 16 = 0$
$x = 16$

$x + 3 = 0$
$x = -3$

$\therefore \boxed{x = -3, 16}$

2. $6x^2 + 4x = 0$

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

Think:

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

$x = 0$

$3x + 2 = 0$
$3x = -2$
$x = -\frac{2}{3}$

$\therefore \boxed{x = 0, -\frac{2}{3}}$

3. Clear fractions! × all terms by 8

$4(8)\ \frac{1}{2}x^2 + \frac{3}{8}(8) = x(8)$

$4x^2 + 3 = 8x$

$-8x \quad -8x$

$4x^2 - 8x + 3 = 0$

$-6 \times -2 = 12$
$-6 + -2 = -8$

$a \neq 1$
ac method.
use decomp if you prefer!

$(x \quad \overline{4})(x \quad \overline{4})$
$(x - \frac{6}{4})(x - \frac{2}{4})$
$(x - \frac{3}{2})(x - \frac{1}{2})$

$(2x - 3)(2x - 1) = 0$

$\therefore \boxed{x = \frac{3}{2}, \frac{1}{2}}$

Your turn! Solve by factoring:

1. $x^2 - 5x + 6 = 0$

$-2 \times -3 = 6$
$-2 + -3 = -5$

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

$\boxed{x = 2, x = 3}$

2. $x^2 + 7x = -10$

$+10 \quad +10$

$x^2 + 7x + 10 = 0$

$2 \times 5 = 10$
$2 + 5 = 7$

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

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

3. $2x^2 = 27 - 15x$

$-27 + 15x \quad -27 \quad +15x$

$18 \times -3 = -54$
$18 + -3 = +15$

$2x^2 + 15x - 27 = 0$

$(2x - 3)(x + 9) = 0$

$\boxed{x = \frac{3}{2}, x = -9}$

ac

$(x + \frac{18}{2})(x - \frac{3}{2})$

$(x + 9)(2x - 3)$

decomp

$2x^2 + 18x - 3x - 27$

$2x(x + 9) - 3(x + 9)$

$(x + 9)(2x - 3)$

need $ax^2+bx+c=0$ first!

Solving Quadratic Equations with the Quadratic Formula

Example: Solve using the quadratic formula $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

(give exact answers AND decimal approx.)

1. $5x^2 + 2x = 6$

$-6 \quad -6$

$5x^2 + 2x - 6 = 0$

$a=5 \quad b=2 \quad c=-6$

$x = \frac{-b \pm \sqrt{(b^2-4ac)}}{2a}$

BEDMAS

$x = \frac{-(2) \pm \sqrt{(2)^2-4(5)(-6)}}{2(5)}$

$x = \frac{-2 \pm \sqrt{4+120}}{10}$

$x = \frac{-2 \pm \sqrt{124}}{10}$

simplify radicals

$\sqrt{124} = \sqrt{4 \cdot 31} = 2\sqrt{31}$

$x = \frac{(-2 \pm 2\sqrt{31}) \div 2}{(10) \div 2}$

$\boxed{x = \frac{-1 \pm \sqrt{31}}{5}}$ ← Exact answers

$x = (-1+\sqrt{31})/5 \qquad x = (-1-\sqrt{31})/5$

$\boxed{x = 0.91355 \qquad x = -1.31355}$ ← Decimal Approx:

Your turn! Solve using the quadratic formula (give exact answers AND decimal approx.)

1. $2x^2 + 3 = 7x$

$-7x \quad -7x$

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

$a=2 \quad b=-7 \quad c=3$

$x = \frac{-(-7) \pm \sqrt{(-7)^2 - 4(2)(3)}}{2(2)}$

$x = \frac{7 \pm \sqrt{49-24}}{4}$

$x = \frac{7 \pm \sqrt{25}}{4}$

$x = \frac{(7 \pm 5)}{4}$

$x = \frac{(7+5)}{4}$ or $x = \frac{(7-5)}{4}$

$x = \frac{12}{4} \qquad x = \frac{2}{4}$

$\boxed{x = 3 \qquad x = \frac{1}{2}}$

Exact value (and no need for decimal approx.)

(This one would have factored!)

2. $x^2 - 10x = 9$

$-9 \quad -9$

$x^2 - 10x - 9 = 0$

$a=1 \quad b=-10 \quad c=-9$

$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(1)(-9)}}{2(1)}$

$x = \frac{10 \pm \sqrt{100+36}}{2}$

$x = \frac{10 \pm \sqrt{136}}{2}$

$\sqrt{136} = \sqrt{4 \cdot 34} = 2\sqrt{34}$

$x = \frac{(10 \pm 2\sqrt{34}) \div 2}{(2) \div 2}$

$\boxed{x = 5 \pm \sqrt{34}}$ ← exact value

$x = 5 + \sqrt{34} = 10.83095$

or

$x = 5 - \sqrt{34} = -0.83095$

decimal approx.

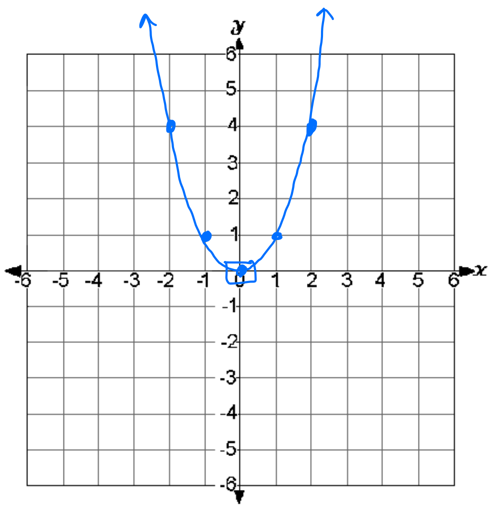
F. GRAPHING QUADRATIC FUNCTIONS $f(x) = ax^2 + bx + c$

Graphing the Basic Quadratic Function $y = x^2$

Use a table of values to generate the graph of $y = x^2$:

x	y	$= (x)^2$
-3	9	$= (-3)^2 = 9$
-2	4	$= (-2)^2 = 4$
-1	1	$= (-1)^2 = 1$
$\boxed{0}$	$\boxed{0}$	$= (0)^2 = 0$
1	1	$= (1)^2 = 1$
2	4	$= (2)^2 = 4$
3	9	$= (3)^2 = 9$

vertex



The shape generated by a quadratic function is called a PARABOLA

The VERTEX is where the graph "turns around". Here, (0, 0)

Direction of Opening: this one opens up!

f(x) means "y"

Sketching Quadratic Functions $\boldsymbol{f(x) = ax^2 + bx + c}$

In Math 11, we learned how to graph quadratic functions using the vertex and the "basic count."

We can also get a ***quick sketch*** of a quadratic function by finding its x-intercepts, and using the "a" value to determine whether the parabola opens up or down.

x-intercepts (when y =0)
Set y = 0 and solve the quadratic equation (by factoring or quadratic formula)

The "solutions" are the x-intercepts of your graph!

a-value

- When a is positive, the parabola Opens up
- When a is negative, the parabola opens down

y-intercept (when x =0)
Set x = 0 and evaluate for y. (Optional)

To sketch:

1) Find the x-intercepts (set y = 0 and solve for x) of the graph and plot them
2) Use "a" to decide if the parabola opens up or down
3) Sketch the parabola going through the x-intercepts and opening in the correct direction
4) (Optional – find and plot the y-intercept. Set x equal to zero and find y.)

$a = -1$ ∴ opens down

Example: Sketch $y = -x^2 - 5x + 6$ using x-intercepts.

x-int: set y = 0

$y = -x^2 - 5x + 6$

$0 = -x^2 - 5x + 6$

gcf: -1

$0 = -1(x^2 + 5x - 6)$

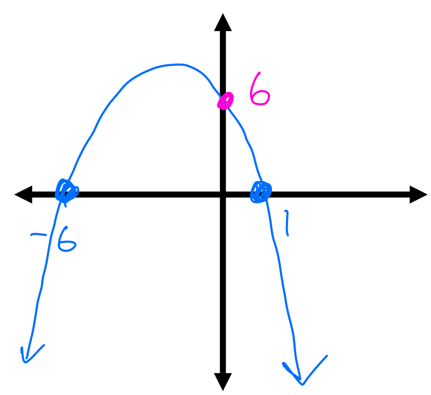
$-1 \times 6 = -6$
$-1 + 6 = 5$

$0 = -1(x - 1)(x + 6)$

$\therefore \boxed{x = 1 \quad x = -6}$ → ① plot x-intercepts! $(-6, 0)$ and $(1, 0)$

② Sketch "down" parabola

③ Label y-int $(0, 6)$ (optional)



y-int: set x = 0

$y = -x^2 - 5x + 6$

$y = -(0)^2 - 5(0) + 6$

$\boxed{y = 6}$

To sketch:

1) Find the x-intercepts (set y = 0 and solve for x) of the graph and plot them
2) Use "a" to decide if the parabola opens up or down
3) Sketch the parabola going through the x-intercepts and opening in the correct direction
4) (Optional – find and plot the y-intercept. Set x equal to zero and find y.)

Your turn!

1. Sketch $y = x^2 + 2x - 8$ using x-intercepts.

x-int: (set y=0)

$y = x^2 + 2x - 8$

$0 = x^2 + 2x - 8$

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

$\therefore x = -4 \quad x = 2$

① Plot $(-4,0)$ $(2,0)$

a=1 (positive) so parabola opens up

② Sketch parabola going up

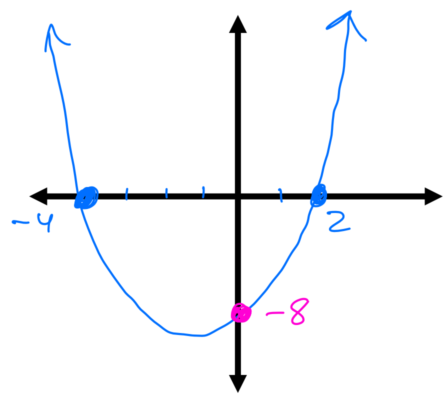
y-int (set x=0)

$y = x^2 + 2x - 8$

$y = 0^2 + 2(0) - 8$

$y = -8$

③ Label y-int at $(0,-8)$



2. Sketch $y = -2x^2 - 9x + 5$ using x-intercepts.

x-int: (set y=0)

$y = -2x^2 - 9x + 5$

$0 = -2x^2 - 9x + 5$

$0 = -(2x^2 + 9x - 5)$

$0 = -(2x-1)(x+5)$

ac: $2x^2 + 9x - 5$

$(x + \frac{10}{2})(x - \frac{1}{2})$

$(x+5)(2x-1)$

$\frac{10}{} \times \frac{-1}{} = -10$

$\frac{10}{} + \frac{-1}{} = 9$

decomp: $2x^2 + 9x - 5$

$2x^2 + 10x - 1x - 5$

$2x(x+5) - 1(x+5)$

$(x+5)(2x-1)$

$\therefore x = \frac{1}{2} \quad x = -5$

① plot $(-5,0)$ $(0.5,0)$

a=-2 (a is negative, opens down)

② Sketch down parabola

y-int (set x=0)

$y = -2\cancel{x^2} - 9\cancel{x} + 5$

$y = 5$

③ Label y int $(0,5)$