Lesson Focus: To solve problems by modelling linear inequalities in two variables.

- a ***solution set*** is the set of all possible solutions
- a ***continuous solution set*** is a connected set of numbers
  - in a continuous set, there is always another number between any two given numbers
  - continuous variables represent things that can be measured, such as time

e.g. Graph the solution set for the following inequalities.

1. Rearrange equation into $y = mx + b$
2. Sketch Line
3. Shade

Sketch Line	Shade
Solid line $\leq$ or $\geq$	Above / Right $\geq$ or $>$
Dashed line $<$ or $>$	Below / Left $\leq$ or $<$

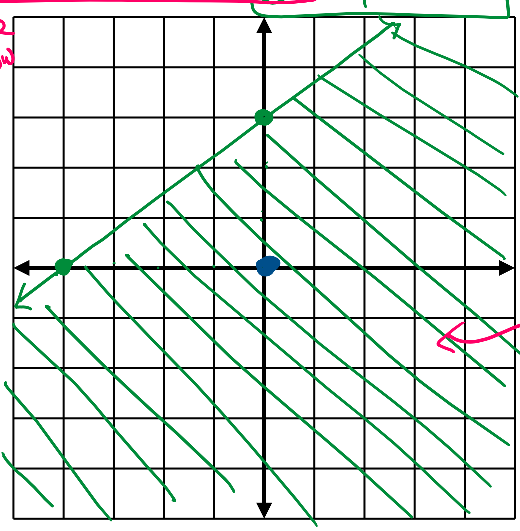
a) $-3x + 4y \leq 12$

Less than $\leq$

$\frac{4y}{4} \leq \frac{3x}{4} + \frac{12}{4}$

$\boxed{y \leq \frac{3}{4}x + 3}$

SOLID line
Shade Below



choose a point in shaded area to test: $(0,0)$

$-3x + 4y \leq 12$

$-3(0) + 4(0) \leq 12$

$0 \leq 12$ ✓

b) $y > \frac{1}{2}x - 2$

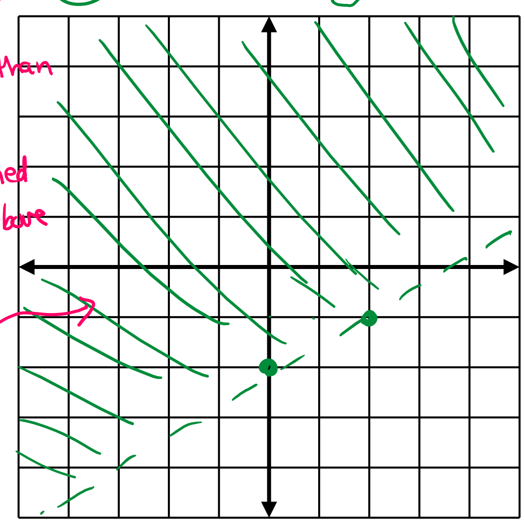
already in $y = mx + b$ form,

greater than $>$

Dashed Lined
Shade Above

y-intercept -2

slope $\frac{1}{2}$ $\frac{\text{rise}}{\text{run}}$



Solutions are in shaded area.

Test: $(0,0)$

$y > \frac{1}{2}x - 2$

$0 > \frac{1}{2}(0) - 2$

$0 > 0 - 2$

$0 > -2$ ✓

- a ***solution region*** is the part of the graph of a linear inequality that represents the solution set; the solution region includes points on its boundary if the inequality has the possibility of equality
- a ***half plane*** is the region on one side of the graph of a linear relation on a Cartesian plane

e.g. Graph the solution set for each linear inequality on a Cartesian plane.

Solve for x

a) $-2x+4<0$

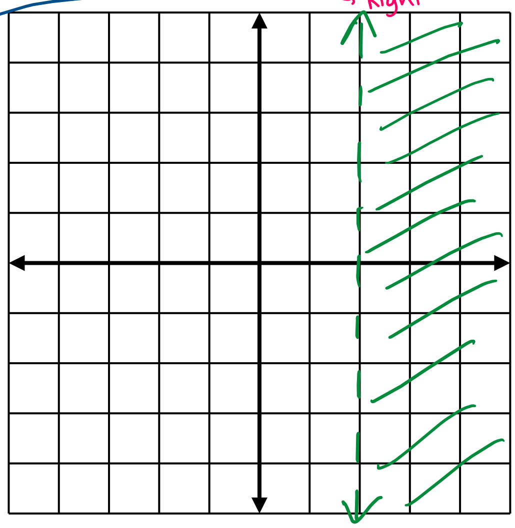
$\frac{-2x}{-2} < \frac{-4}{-2}$

$\boxed{x > 2}$

↳ Dashed
↳ Right

*When you divide by a negative in an inequality, you must flip the sign

Vertical line at $x=2$



b) $4y-8 \geq -16$

Solve for y

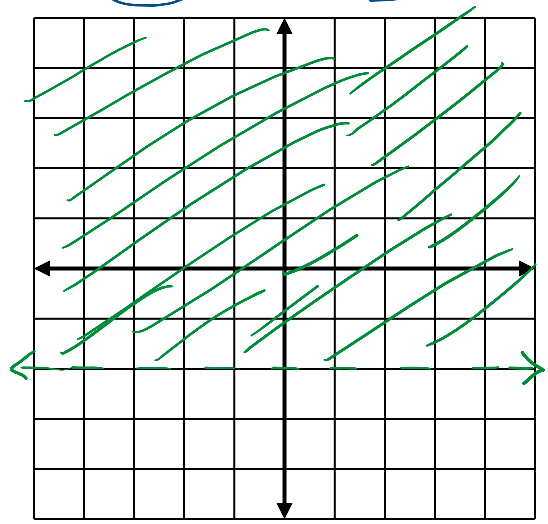
$4y \geq -16+8$

$\frac{4y}{4} \geq \frac{-8}{4}$

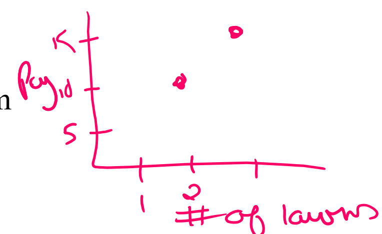
$\boxed{y \geq -2}$

solid line
shade above

Horizontal line at $y=-2$



- a ***discrete solution set*** consists of separate or distinct parts
  - discrete variables represent things that can be counted, such as people in a room



- we can use inequalities to solve word problems

e.g. Sam and Mary are competing in a spelling quiz. Mary gets a point for every word she spells correctly. Sam is younger than Mary so he gets 3 points for every word he spells correctly. Sam will also get an extra bonus point overall for being younger. What combinations of correctly spelled words for Sam and Mary will result in Mary scoring more points than Sam?

a) Let x represent the number of correctly spelled words for Sam and y the number for Mary.

Points for Sam ⇒ $3x+1$

Points for Mary ⇒ y

b) Write an inequality to represent the above problem.

Mary score more points than Sam ⇒ > greater than

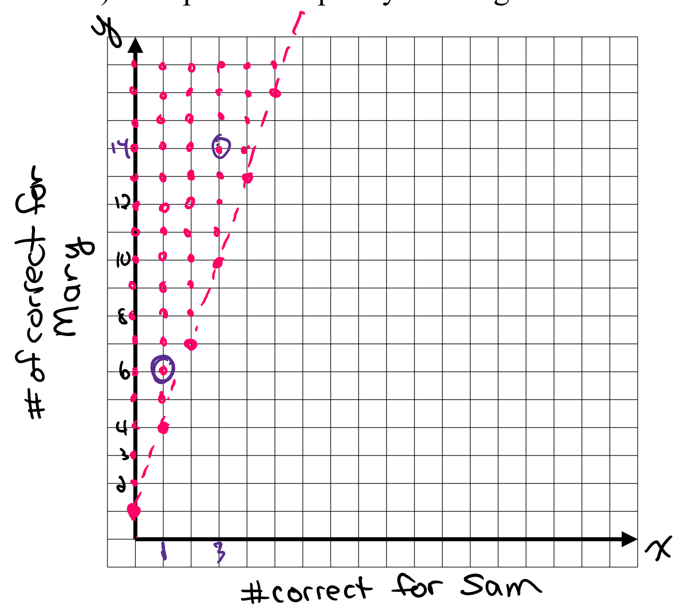
$y > 3x+1$

Dashed Line Solutions and Above

NOTE: Discrete contexts often have domain and range values $\{x \in W, y \in W\}$ (first quadrant).

$y > 3x+1$ y-intercept: +1 slope: $\frac{3}{1}$ $\frac{\text{rise}}{\text{run}}$ Whole Numbers 0, 1, 2, 3, ...

c) Graph the inequality on the grid below.



d) Choose two combinations that would work.

Any point on the line is NOT a solution.

2 Points: (1, 6) + (3, 14)

check: $y > 3x+1$ | $y > 3x+1$

$6 > 3(1)+1$ | $14 > 3(3)+1$

$6 > 4$ ✓ | $14 > 10$ ✓

KEEP IN MIND

- The boundary of an inequality in two variables is a straight line that creates two half-planes. One of these half-planes includes the solution set of the inequality. The boundary may or may not be part of the solution set.
- A continuous solution set contains all of the points in the solution region.
- A discrete solution set contains some, but not all, of the points in the solution region: the points with whole-number or integer coordinates.
- When no domain, range or context is given, assume the domain and range are the set of real numbers **i.e.** $\{(x, y) \mid x \in \Re, y \in \Re\}$ (continuous solution set)
- In real-world situations, solution sets may be restricted to specific quadrants.
- To graph the solution set of a linear inequality, first graph the boundary:
  - For < or > inequalities (strict), draw a **DASHED** line.
  - For ≤ or ≥ inequalities (weak), draw a **SOLID** line.
  - For < or ≤ shade **BELOW** the boundary line.
  - For > or ≥ shade **ABOVE** the boundary line.