2016-2017 LC Math I
Final Exam Review Day 1

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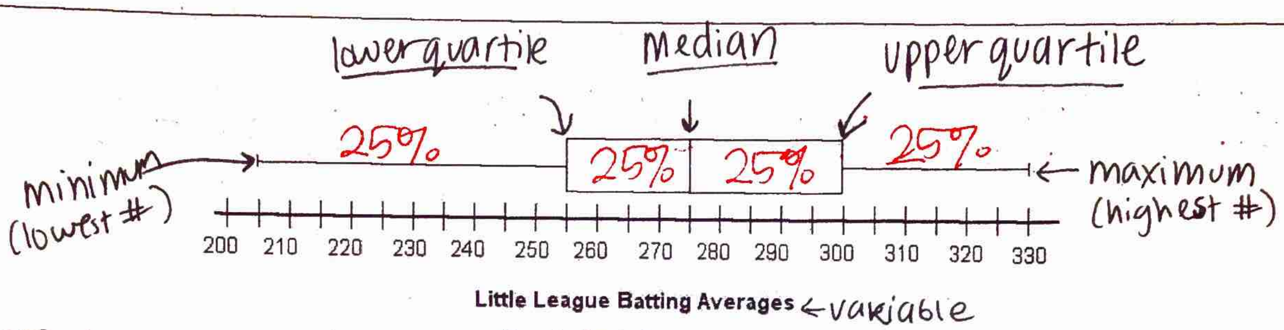
Unit 0 - Statistics

"Univariate" – Only one variable is measured

A. Box Plot



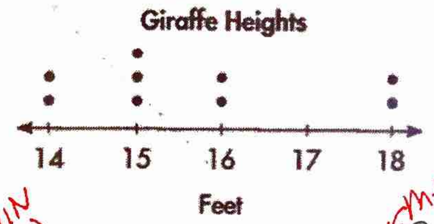
HALF of the players have a B.A. btwn...

- 205 and 275 } median & max/min
- 275 and 330
- 255 and 300 - UQ & LQ

WARNING: A bigger box/whisker doesn't mean more people. It just means that the data is more spread out.

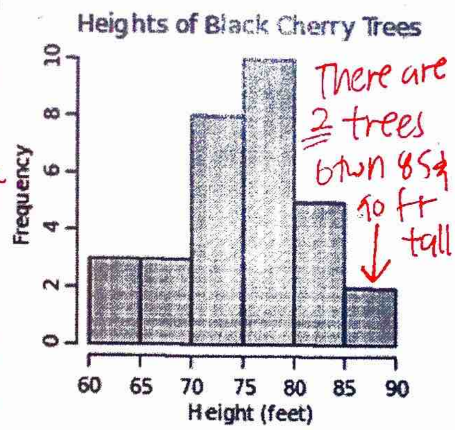
B. Frequency Plots: x-axis is variable, y-axis is frequency

Dot Plot - details

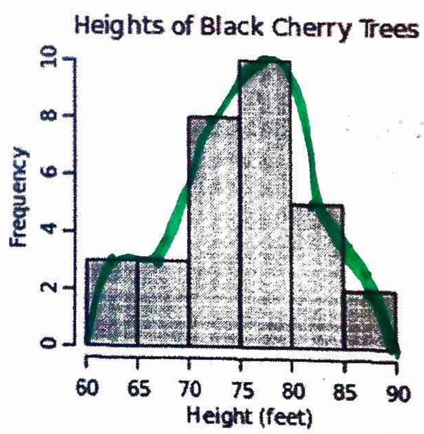


MIN {14, 14, 15, 15, 15, 16, 16, 18, 18} MAX
LQ median UQ

Histogram - generalizations

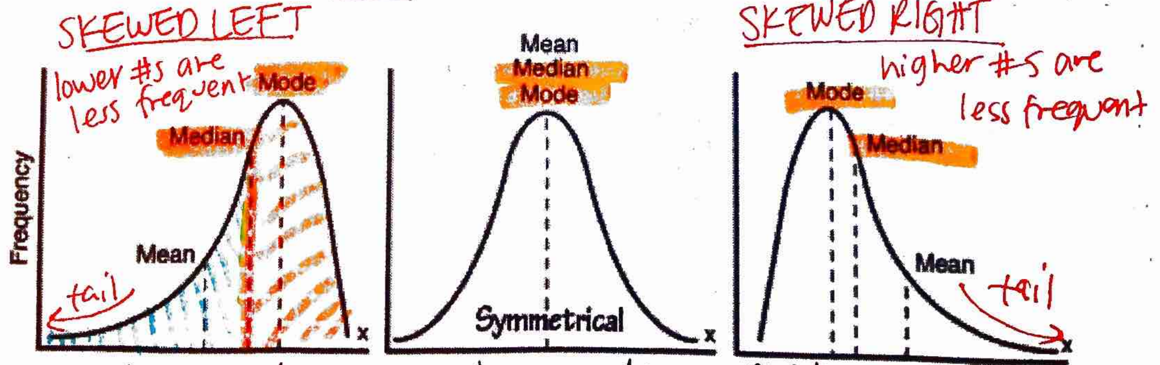


Frequency Curve



mode: where the curve is tallest
median: split the curve into two equal areas

C. Skew:



median < mode   median = mode   median > mode

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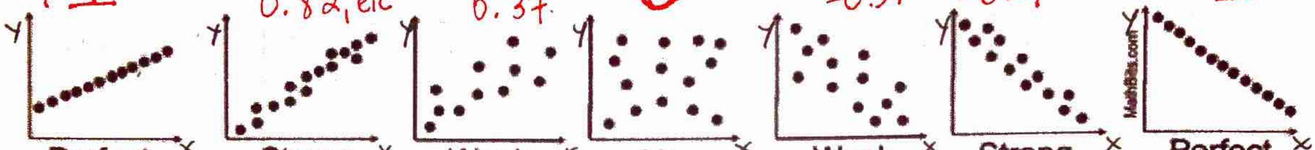
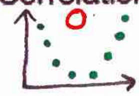
"Bivariate" – Relationship between two variables, x and y.

A. Correlation Coefficient
Tells you: ① How close to a linear relationship the data has = form & strength
② Whether the linear relationship has a positive or negative slope.
Example: Estimate the correlation coefficient for the following.

+1 | 0.9, 0.8, 0.82, etc | 0.5, 0.4, 0.37 | 0 | −0.5, −0.4, −0.37 | −0.9, −0.8, −0.82 | −1

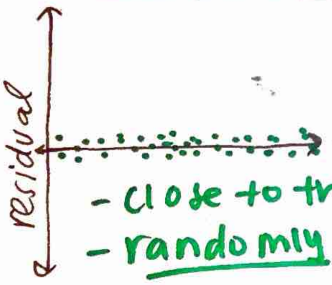


Perfect Positive Correlation | Strong Positive Correlation | Weak Positive Correlation | No Correlation | Weak Negative Correlation | Strong Negative Correlation | Perfect Negative Correlation



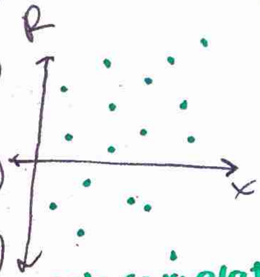
B. Residuals – distance btwn the point on the scatterplot and the linear regression
Tells you: How good of a "fit" the model/regression is.

Residual plot for good fit:



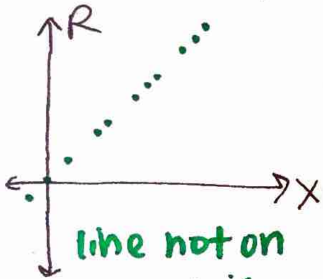
- close to the x-axis
- randomly scattered

Residual plots for bad fit: BAD



weak correlation, BUT the line is an okay model

clear shape ⇒ NOT LINEAR



line not on x-axis ⇒ linear form, BUT your regression line needs to be fixed.

C. The linear regression equation
- "line of best fit"
- $y_1 \sim mx_1 + b$

SLOPE
$= m = \frac{m}{1} = \frac{\Delta y}{\Delta x}$

x = # of tickets sold in a day
y = amt of \$ earned

$y = 10.2x - 50$

"For every 1 ticket sold, the theater profit increases by \$10.20."

$\frac{m \leftarrow \Delta y}{1 \leftarrow \Delta x}$

$\boxed{\text{y-int}}$ (0, b)
"When 0 tickets are sold, the theater makes −\$50 (loses \$50)."

$\boxed{\text{x-int}}$ have to solve for this
"When the theater makes \$0, they sell ____ tickets."

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Unit 1 – Linear Functions and Equations

Functions

equation w/ x & y

A ~~relation~~ is a function if:

every x-value (input) produces only one y-value (output).

EQUATION

f(12) can't equal two different #s

TABLE

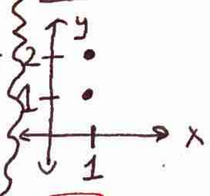
x	y
1	3
2	5
2	10

NO

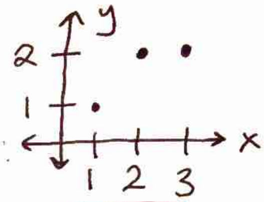
x	y
1	5
2	5
3	7

OK

GRAPH



NO

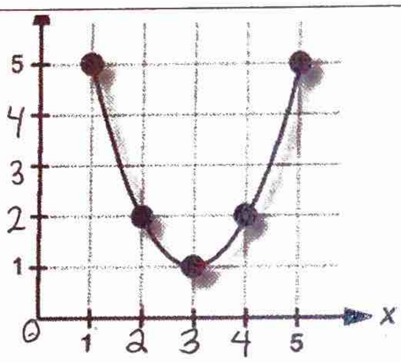


OKAY

Notation: $f(x) = y$

$f(\text{input}) = \text{output}$

Graphically



1. What is $f(2)$?

f(2) = ?
x = 2, y = ?
(2, 2)
$\boxed{f(2) = 2}$

2. What is $f(1)$?

f(1) = ?
x = 1, y = ?
(1, 5)
$\boxed{f(1) = 5}$

3. What is x when $f(x) = 1$?

f(?) = 1
y = 1, x = ?
(3, 1)
$f(3) = 1 \rightarrow \boxed{x = 3}$

Algebraically

Let $f(x) = 3(x - 4) + 10$

4. What is $f(8)$? x = 8, y = ?

$f(x) = 3(x-4)+10$ ← replace all x w/ 8
$f(8) = 3(8-4)+10$
$f(8) = 3(4)+10$
$f(8) = 12 + 10$
$\boxed{f(8) = 22}$ ← (8, 22) is on the graph

5. What is $f(-5)$? ← x = -5, y = ?

$f(x) = 3(x-4)+10$
$f(-5) = 3(-5-4) + 10$
$f(-5) = 3(-9)+10$
$f(-5) = -27+10$
$\boxed{f(-5) = -17}$ ← (-5, -17) is on the graph

6. What is x when $f(x) = 4$? y = 4, x = ?

$f(x) = 3(x-4)+10$ ← replace f(x) with 4

$4 = 3(x-4)+10$
$-10 \qquad -10$
$\frac{-6}{3} = \frac{3(x-4)}{3}$
$-2 = x - 4$
$+4 \qquad +4$
$\boxed{2 = x}$ ← (2, 4) is on the graph

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Read from left to right $\longleftrightarrow x$

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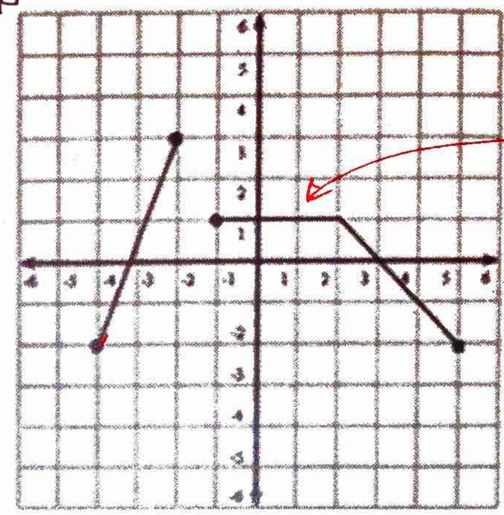
Analyzing a Function

Domain– The set of all x-values/inputs in a function

$-4 \leq x \leq 2$, $-1 \leq x \leq 5$

Range–: The set of all y-values/outputs in a function.

$-2 \leq y \leq 3$



constant

no endpoints

Increasing on: – intervals where the y-values are going up.

$-4 < x < -2$

Decreasing on: – intervals where the y-values are going down.

$2 < x < 5$

Positive on:– Intervals where $y > 0$ (ABOVE X-AXIS)

$-\frac{16}{5} < x \leq 2$, $-1 \leq x < 3$

Negative on:– intervals where $y < 0$ (BELOW X-AXIS)

$-4 \leq x < -\frac{16}{5}$, $3 < x \leq 5$

Finding intercepts:

X-intercept

Graph: point where f crosses x-axis $\boxed{(3,0)}$

Equation: point where $y=0$

write line equation: $m = \frac{5}{2}$ $(\overset{x_1}{-2}, \overset{y_1}{3})$

$y - y_1 = m(x - x_1)$

$y - 3 = \frac{5}{2}(x - (-2))$

$y - 3 = \frac{5}{2}(x + 2)$ ← point-slope form

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

$y = 0$, find $x = ?$

$0 - 3 = \frac{5}{2}(x+2)$

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

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

$-6 = 5(x+2)$

$-6 = 5x + 10$

$-16 = 5x$

$-\frac{16}{5} = x$

$\boxed{(-\frac{16}{5}, 0)}$

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Unit 1 – Linear Functions and Equations

Linear Function Graphs

A "linear" function has a graph that is a line. It has a constant rate of change/slope

Slope Equation: A line that passes through (x_1, y_1) and (x_2, y_2) has slope $\left\{ m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} \right\}$

Slope-Intercept Form

$y = mx + b$

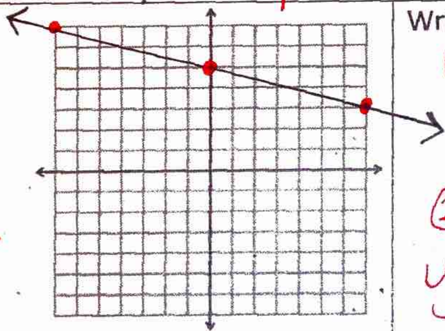
m = slope

(0, b) y-intercept

Graph

$y = -\frac{2}{7}x + 5$

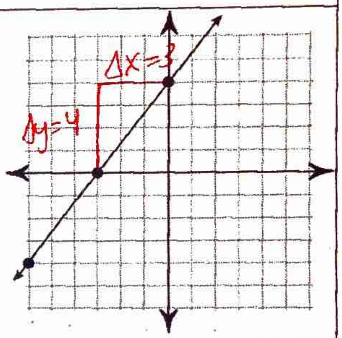
① plot (0,5)
② use slope to plot others



Write

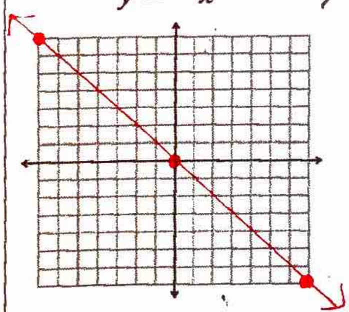
① Find slope by using $\frac{\Delta y}{\Delta x}$
② add y-int

$y = \frac{4}{3}x + 4$



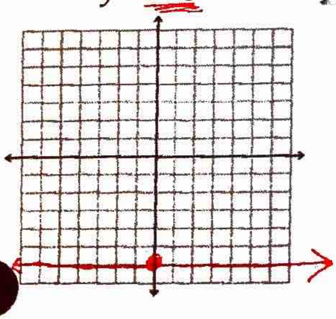
Graph special cases

$y = -x \longrightarrow y = \underset{\text{slope}}{-1} \cdot x + \underset{\text{y-int}}{0}$

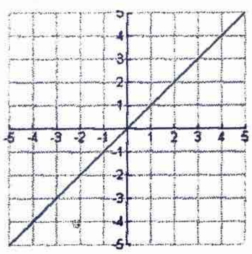


"CONSTANT"

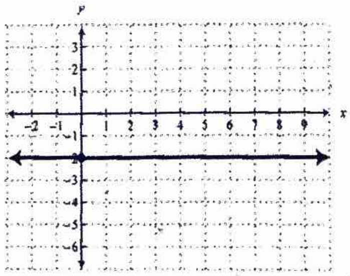
$y = -6 \longrightarrow y = \underset{\text{slope}}{0} \cdot x \underset{\text{y-int}}{-6}$



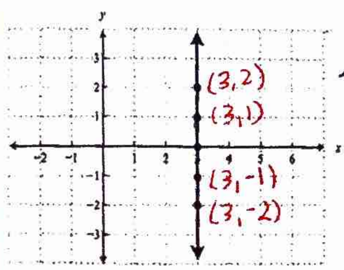
Write special cases



y-int = 0
m = 1
y = mx + b
y = 1x + 0
$\boxed{y = x}$



y-int = -2
$m = \frac{0}{1} = 0$
y = mx + b
y = 0x − 2
$\boxed{y = -2}$



no y-int
$m = \frac{1}{0}$ = "undefined"
$\boxed{x = 3}$

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Point-Slope Form

WARNING Notice that the form has minus signs
⇒ the x & y-coordinates will be opposite sign of what you see

$$y - y_1 = m(x - x_1)$$

slope

coordinates of a point on the graph (x_1, y_1)

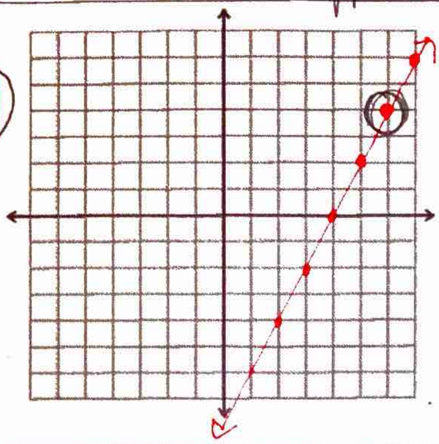
Graph

slope

$y - 4 = 2(x - 6)$

y_1 x_1

slope = 2
point (6, 4)



Write

$m = \frac{-4}{5}$

using (-2, 3):

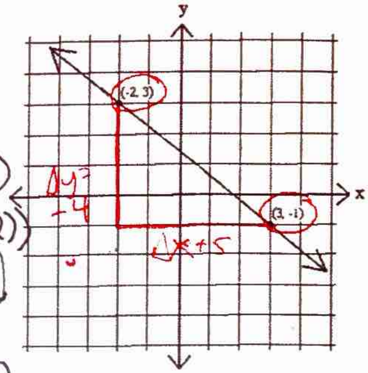
$y - y_1 = m(x - x_1)$

$y - 3 = -\frac{4}{5}(x - (-2))$

$\boxed{y - 3 = -\frac{4}{5}(x + 2)}$

using (3, -1)

$\boxed{y + 1 = -\frac{4}{5}(x - 3)}$



Rewrite in slope-intercept form

① $y - 4 = 2(x - 6)$

$y - 4 = 2x - 12$

$+4 \quad +4$

$\boxed{y = 2x - 8}$

② $y - 3 = -\frac{4}{5}(x + 2)$

$y - 3 = -\frac{4}{5}x - \frac{4}{5} \cdot \frac{2}{1}$

$y - 3 = -\frac{4}{5}x - \frac{8}{5}$

$+3 \quad +3$

$y = -\frac{4}{5}x - \frac{8}{5} + \frac{3}{1}\left(\frac{5}{5}\right)$

$y = -\frac{4}{5}x - \frac{8}{5} + \frac{15}{5}$ ⇒ $y = -\frac{4}{5}x + \frac{7}{5}$

same

③ $y + 1 = -\frac{4}{5}(x - 3)$

$y + 1 = -\frac{4}{5}x - \frac{4}{5}\left(\frac{-3}{1}\right)$

$y + 1 = -\frac{4}{5}x + \frac{12}{5}$

$-1 \quad -1$

$y = -\frac{4}{5}x + \frac{12}{5} - \frac{1}{1}\left(\frac{5}{5}\right)$

$y = -\frac{4}{5}x + \frac{12}{5} - \frac{5}{5}$

Standard Form

$$Ax + By = C$$

x-int: $y = 0$

$Ax + B(0) = C$

$x = \frac{C}{A}$ $\left(\frac{C}{A}, 0\right)$

y-int: $x = 0$

$A(0) + By = C$

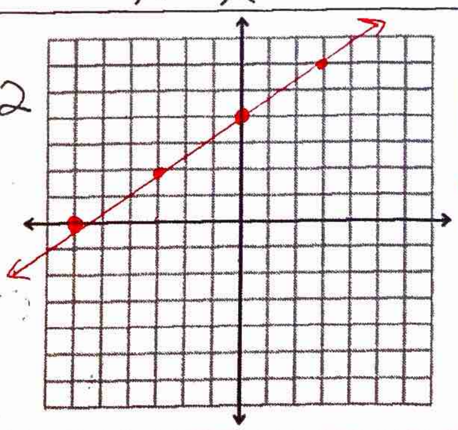
$y = \frac{C}{B}$ $\left(0, \frac{C}{B}\right)$

Graph

$-2x + 3y = 12$

x-int:
$-2x = 12$
$x = -6$

y-int:
$3y = 12$
$y = 4$



Rewrite in slope-intercept form

$-2x + 3y = 12$

$+2x \quad +2x$

$\frac{3y}{3} = \frac{2x + 12}{3}$

$\boxed{y = \frac{2}{3}x + 4}$

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Unit 1 – Linear Functions and Equations
Writing Linear Function Equations

Step 1 – Find the Slope

A) Point and Slope: COPY The line through $(2, 3)$ with a slope of $\frac{7}{2}$ $m = \frac{7}{2}$	**B) Two Points** : SLOPE EQUATION The line through the points $(\underset{x_1}{-4}, \underset{y_1}{-2})$ and $(\underset{x_2}{-2}, \underset{y_2}{5})$ $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-(-2)}{-2-(-4)} = \frac{5+2}{-2+4} = \frac{7}{2}$
C) Point and Parallel Line: SAME The line through $(-3, -2)$ that is parallel to the line $y = -x + 8$ $m = -1$	**D) Point and Perpendicular Line** $\frac{a}{b} \to \frac{-b}{a}$ The line through $(5, -4)$ that is perpendicular to the line $y = \boxed{-5}x + 3$ OPPOSITE $+ \longleftrightarrow -$ RECIPROCAL $\frac{a}{b} \longleftrightarrow \frac{b}{a}$ $m = \frac{-5}{1} \to \frac{+1}{5}$

Step 2 – Put in point-slope form $y - y_1 = m(x - x_1)$

A) $y-3 = \frac{7}{2}(x-2)$	B) $y+2 = \frac{7}{2}(x+4)$ OR $y-5 = \frac{7}{2}(x+2)$
C) $y+2 = -(x+3)$	D) $y+4 = \frac{1}{5}(x-5)$

Step 3 (optional, if requested) – Change to slope-intercept form

A) $y-3 = \frac{7}{2}(x-2)$ $y-3 = \frac{7}{2}x - 7$ $+3 \qquad +3$ $\boxed{y = \frac{7}{2}x - 4}$	B) $y+2 = \frac{7}{2}(x+4)$ $y+2 = \frac{7}{2}x + 14$ $\boxed{y = \frac{7}{2}x + 12}$ $y-5 = \frac{7}{2}(x+2)$ $y-5 = \frac{7}{2}x + 7$ $\boxed{y = \frac{7}{2}x + 12}$
C) $y+2 = -(x+3)$ $y+2 = -x-3$ $\boxed{y = -x-5}$	D) $y+4 = \frac{1}{5}(x-5)$ $y+4 = \frac{1}{5}x - 1$ $\boxed{y = \frac{1}{5}x - 5}$

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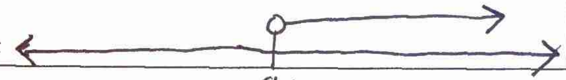
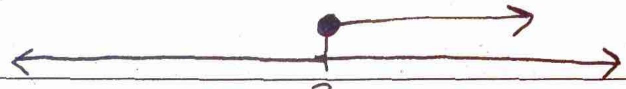
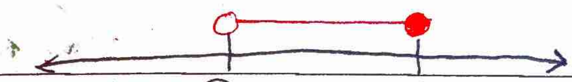
Unit 2 – Systems of Equations and Inequalities

○ $>$ $<$ ● $\geq$ $\leq$

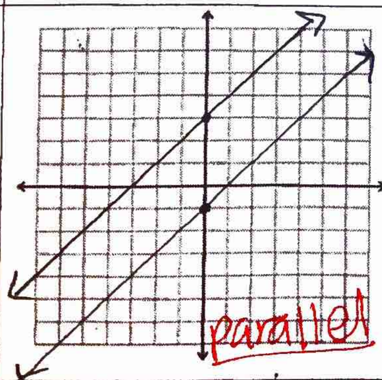
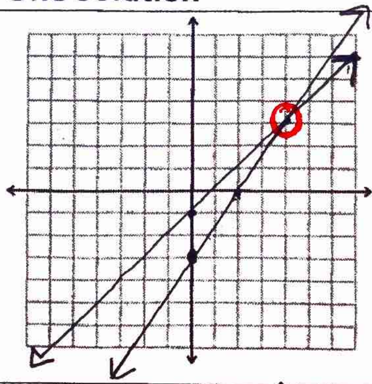
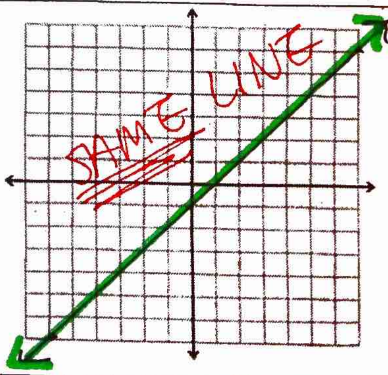
Inequalities

Solving – treat it like an equation	**Solving when multiplying or dividing by a negative number** ⟶ switch the direction of the inequality
$2(x-1)+5>12$ $2x-2+5>12$ $2x+3>12$ $2x>9$ $x>9/2$	$6-3x\leq -3$ $6-3x\leq -3$ $-3x\leq -9$ $x\geq 3$
GRAPH: 	

Compound Inequalities

AND overlap	**OR** combine the graphs
$7<3(x-1)+4\leq 25$ $7<3(x-1)+4$ AND $3(x-1)+4\leq 25$ $7<3x-3+4$ $3x-3+4\leq 25$ $7<3x+1$ $3x+1\leq 25$ $6<3x$ $3x\leq 24$ $2<x$ $x\leq 8$ $\boxed{2<x\leq 8}$	$2x+4<8$ or $2x+4>16$ $-4\ -4$ $-4\ -4$ $2x<4$ $2x>12$ $x<2$ OR $x>6$
	

Systems of Equations: No Solution, One solution, Infinitely Many Solutions

	No Solution	One Solution	Infinitely Many
Graph	 parallel		 SAME LINE
Algebra	If, when solving, you get an untrue statement ex $2=7$	If, when solving, you get a value for x or y ex $x=0$, $y=7$	If, when solving, you get a statement that is always true ex $4=4$, $0=0$, $x=x$

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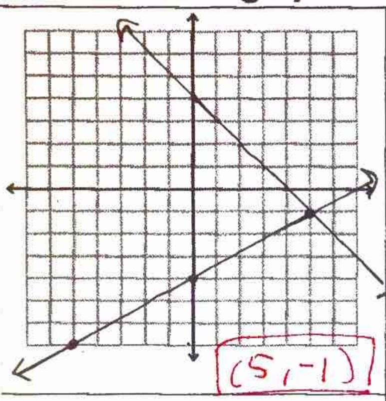
Solving Systems of Equations

By Graphing

$$\begin{cases} y = \frac{3}{5}x - 4 \end{cases}$$

y=-x+4



$\boxed{(5,-1)}$

By Substitution

$$\begin{cases} 2x + y = 9 \\ x + 3y = 2 \end{cases}$$

x+3y=2
-3y -3y
x=-3y+2

① isolate a variable

2(-3y+2)+y=9
-6y+4+y=9
-5y=5

② substitute into other eqn

$\boxed{y=-1}$
x+3(-1)=2
x-3=2
$\boxed{x=5}$

$\boxed{(5,-1)}$

① pick a variable to "eliminate" ⇒ x

$$\begin{cases} 2x + 4y = 12 \\ 5x + 3y = 2 \end{cases}$$)5)(-2)

→ {10x+20y=60
{-10x-6y=-4
0 +14y=56
14 14
$\boxed{y=4}$

② multiply one or both equations by a # so that the coefficients of the variable are opposites

$\boxed{(-2,4)}$

5x+3(4)=2
5x+12=2
5x=-10
$\boxed{x=-2}$

Word Problems

Mary and Shawn are selling plain and patterned wrapping paper. Mary sold 5 plain rolls and 14 patterned rolls for \$380. Shawn sold 10 plain and 7 patterned rolls for \$340. How much does each type of paper cost?

variables
let x=cost of plain roll (\$)
y=cost of patterned roll (\$)

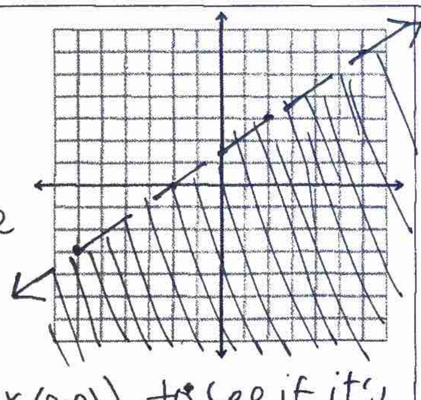
system
{5x+14y=380
{10x+7y=340

Linear Inequalities

Linear Inequality

$$y + 3 < \frac{3}{4}(x + 6)$$

① Graph the bounding line
> < ⇢ ≥ ≤ ↔



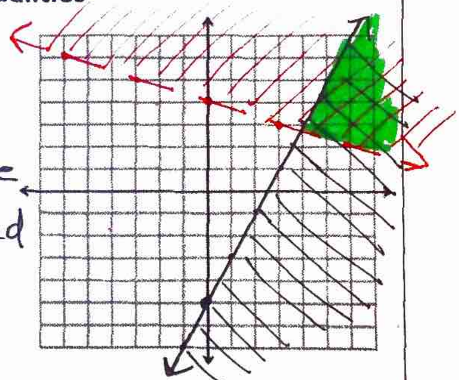
② test a point (ex (0,0)) to see if it's a solution
if yes → shade in the direction of point
if no → shade in other direction

(0,0):
0+3 < ¾(0+6)
3 < ¾(6)
3 < 18/4
TRUE

System of Linear Inequalities

$$\begin{cases} y \le 2x - 5 \\ y > -\frac{1}{3}x + 4 \end{cases}$$

solution: where the two shaded regions overlap.



y≤2x-5
0≤2(0)-5
0≤-5
FALSE

y>-⅓x+4
0>-⅓(0)+4
0>4
FALSE

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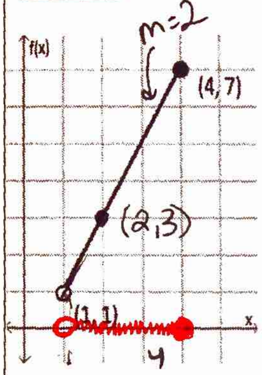
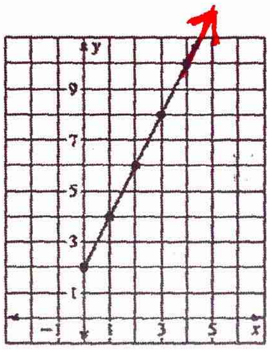
Unit 3 – Absolute Value and Piecewise Functions

$y - y_1 = m(x - x_1)$

Restricted Domain

Writing





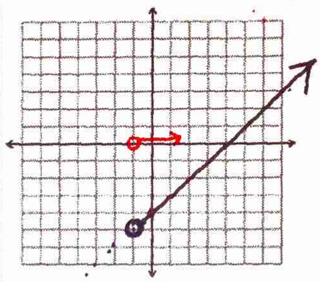
Line: $y-3=2(x-2)$

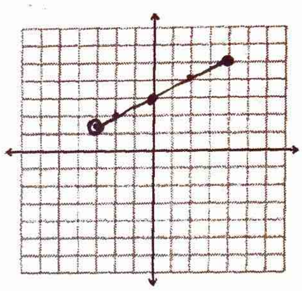
Domain: $1 < x \leq 4$

Line: $y = 2x+2$

Domain: $x \geq 0$

Graphing





Line: $y = x - 4$

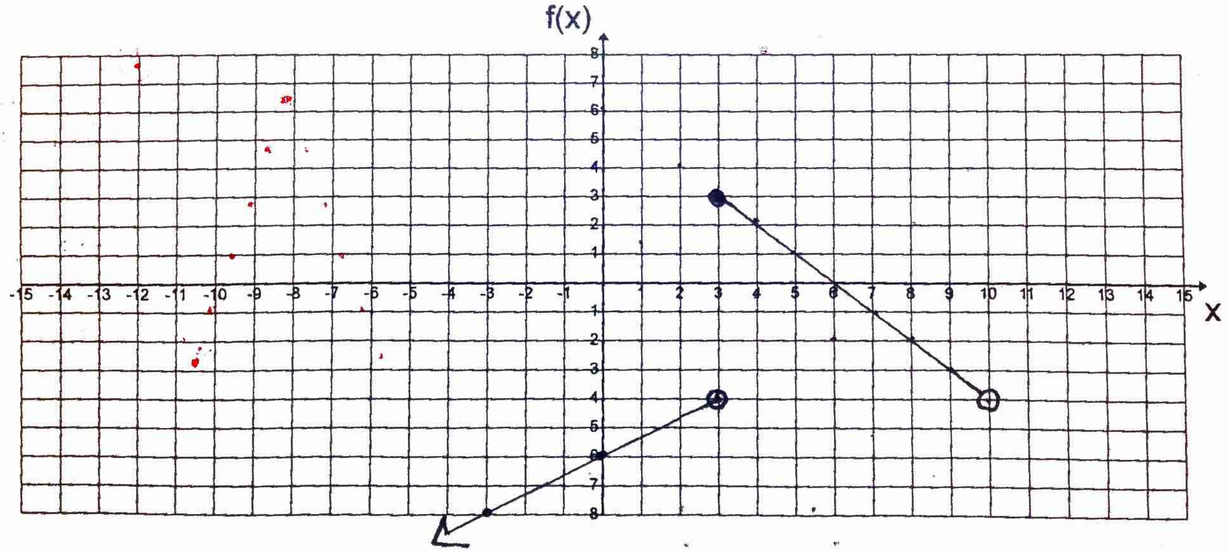
Domain: $x > -1$

Line: $y = \frac{1}{2}x + 3$

Domain: $-3 < x \leq 4$

Piecewise Functions

$$f(x) = \begin{cases} \frac{2}{3}(x-6) - 2, & x < 3 \\ -x + 6, & 3 \leq x < 10 \end{cases}$$



Domain: $x < 10$

Range: $y \leq 3$

Increasing: $x < 3$

Decreasing: $3 < x < 10$

Positive: $3 \leq x < 6$

Negative: $x < 3,\ 6 < x < 10$

x-int: $(6, 0)$

y-int: $(0, -6)$

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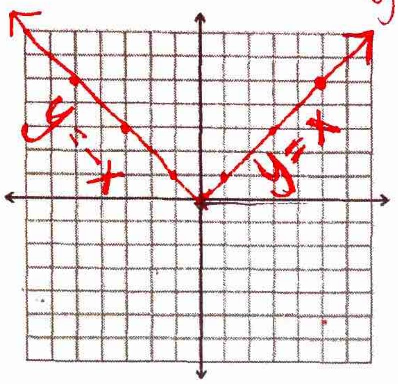
Parent Absolute Value Graph

x	$y = \lvert x \rvert$
-5	$\lvert -5 \rvert = 5$
-3	$\lvert -3 \rvert = 3$
-1	$\lvert -1 \rvert = 1$
0	$\lvert 0 \rvert = 0$
1	$\lvert 1 \rvert = 1$
3	$\lvert 2 \rvert = 3$
5	$\lvert 5 \rvert = 5$

$y = |x|$



Absolute value |x| means... the distance between x and zero (origin).

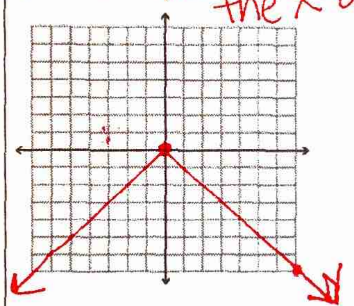
ex. $|2| = 2 \quad |-2| = 2$

Write $y = |x|$ as a piecewise function:

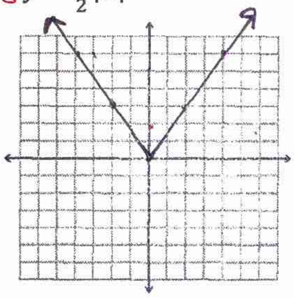
$$y = \begin{cases} -x, & x < 0 \\ x, & x \geq 0 \end{cases}$$

Absolute Value with Different Slopes

$y = -|x|$ reflect over the x-axis

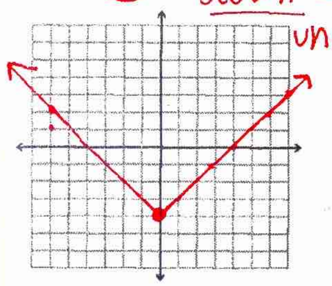


$y = \frac{3}{2}|x|$

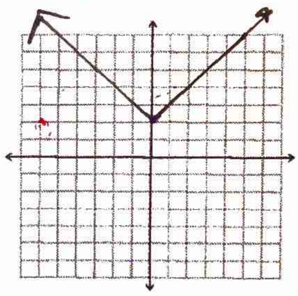


Absolute Value with Vertical Translations/Shifts

$y = |x| - 4$ ← Translate down 4 units

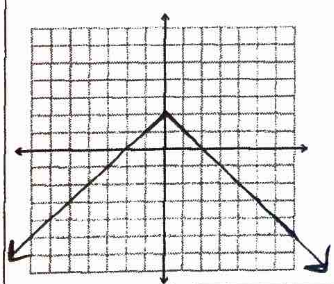


$y = |x| + 2$

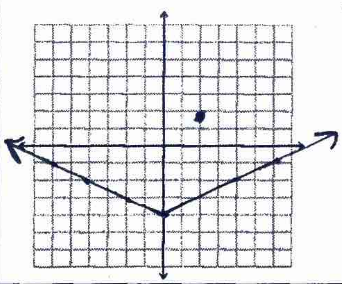


Absolute Value with Both Transformations

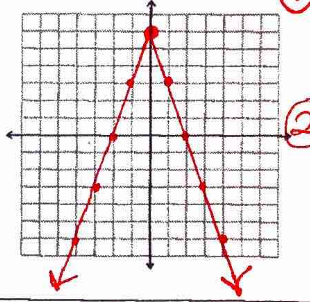
$y = -|x| + 2$



$y = \frac{1}{2}|x| - 4$

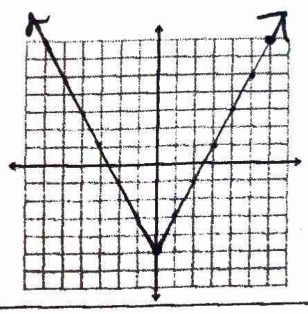


$y = -3|x| + 6$

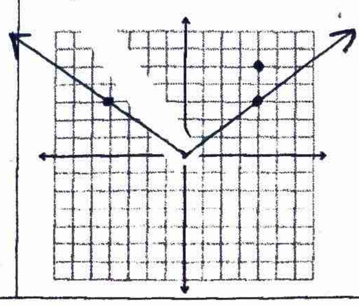


① Translate up 6 units
vertex: (0,6)
② use (-3):
−: reflect over x-axis
3: slopes are ±3

$y = 2|x| - 5$



$y = \frac{3}{4}|x| + 1$



$y = -\frac{5}{3}|x| - 1$