Section 2.1 Relations and Functions

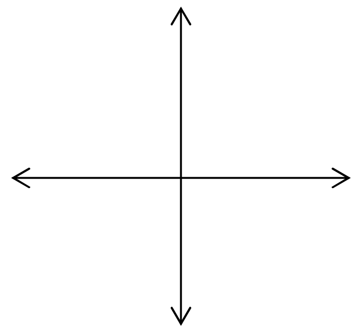
Goals:

1. To graph a relation, state the domain and range, and determine if the relation is a function.
2. To find the values of a function for the given element of the domain.

I. Relations

A. Definitions

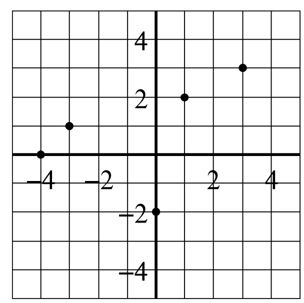
1. Relation –
2. Cartesian Coordinate System
   a)
   b)
   c)
   d)
   e)



3. Domain – the ____________ variable (   )
4. Range – the ____________ variable (   )
5. Function
   a) A relationship between __________ (___________) and __________ (___________).
   b) The output (___________) depends on the input (___________).
   a) A ____________ in which each element in the ______________ is mapped to _____ and only _____ element in the _____________.

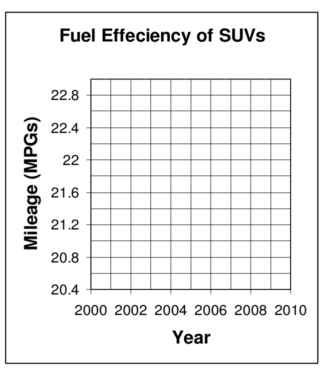
B. Examples

1. State the domain and range of the relation shown in the graph. Is the relation a function?



2. The table shows the average fuel efficiency in miles per gallon for SUVs for several years. Graph this information and determine whether it represents a function. Is this relation discrete or continuous?

Year	Fuel Efficiency (mi/gal)
2001	20.8
2002	20.6
2003	20.8
2004	20.9
2005	21.6
2006	22.3
2007	22.6

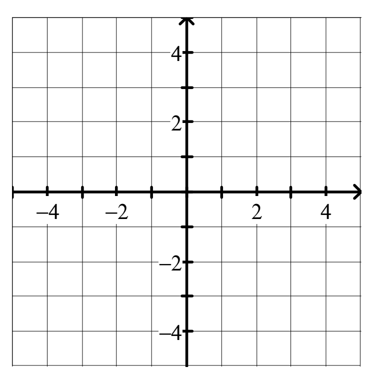


3. Graph the relation represented by $y = 3x - 1$

Find the domain and range.

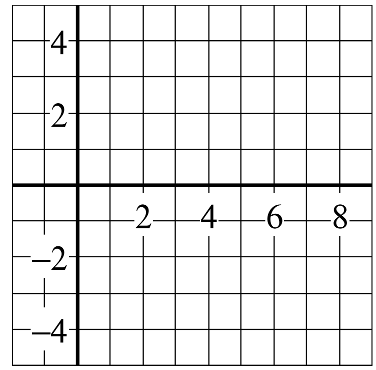
Determine whether the relation is a function.

x	y
-1	
0	
1	
2	



4. Graph the relation represented by $x = y^2 + 1$

x	y
	-2
	-1
	0
	1
	2

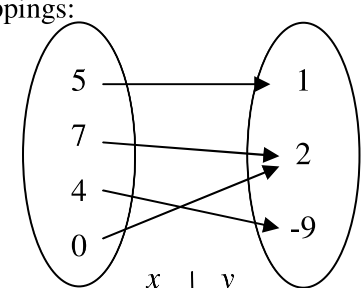


Find the domain and range.

Determine whether the relation is a function.

5. Determine whether each relation is a function.

a) Mappings:



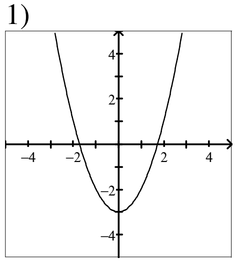
b) Tables:

x	y
-7	-12
-4	-9
2	-3
5	0

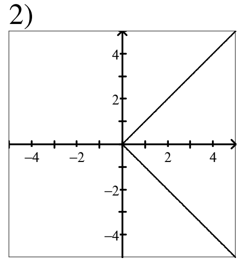
c) Ordered Pairs: $\{(-5,2),(-2,5),(0,7),(0,9)\}$

d) Graphs:

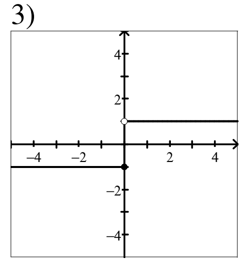
1)



2)



3)



Note: Vertical Line Test –

II. Function Values and Notation

A. Function Notation

1. $y = 3x - 8$ vs. $f(x) = 3x - 8$
2. Function notation has the advantage of clearly identifying the dependent variable $f(x)$, formerly known as *y*, while at the same time telling you *x* is the independent variable and that the function itself is called "*f*."
3. Function notation allows you to be less wordy. Instead of asking "What is the value of y that corresponds to $x = -2$?" you can ask "What is $f(-2)$?":

B. Examples

1. If $f(x) = x^3 - 3$, find $f(2)$.
2. If $h(x) = 0.3x^2 - 3x - 2.7$, find $h(1.6)$.
3. If $f(x) = x^3 - 3$, find $f\left(2t\right)$.
4. If $g(a) = a^2 + 5$, find $g\left(-1\right)$.

Homework: p. 64 – 1-10 all, 21, 27, 28, 33, 35, 45-55 all, 60

Section 2.2 Linear Equations

Goals:

1. To identify equations that are linear and graph them.
2. To write linear equations in standard form.
3. To determine intercepts of a line and use them to graph an equation.

Definitions

- Linear equation – an ________________ whose graph is a ______________ line.
  Note:
  1. _______________ Variable – (__________ variable) graphed on the ________________ axis.
  2. _______________ Variable – (__________ variable) graphed on the ________________ axis.

- Standard Form – __________________ where *A, B,* and *C* are integers.

- Function Form –

- Intercepts
  1. *x*-intercept
     - Occurs when the line crosses the ________________.
     - The _______________ equals 0
  2. *y*-intercept
     - Occurs when the line crosses the ________________.
     - The _______________ equals 0

Characteristics of a Linear Expression

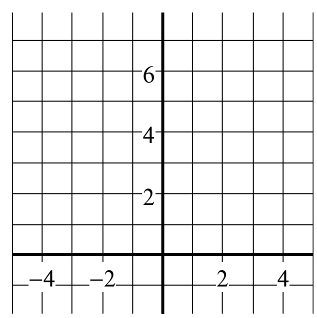
- .
-
-
-

- Examples:
  1. Linear or Not?
     a. $h(x)=3x-2$ b. $f(x)=x^2-4$ c. $g(x,y)=3xy$ d. $f(x)=3(x^2-1)+x-3x^2$

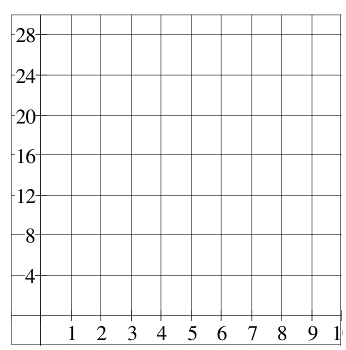
  2. Write in standard form: $-\frac{2}{3}x=2y-1$. Identify A, B, and C.

  3. Find the *x*- and *y*-intercepts of the line whose equation is given by $-2x+y-4=0$

  4. Graph using intercepts: $3x-y+6=0$



  5. Alan rides his bike to the store. If Alan stops at a red light along the way it takes him longer to the reach the store. The time it takes in minutes for Alan to get to the store can be figured by the function $t(s)=\frac{1}{2}s+15$ where *s* is the number of stops for red lights.
     Complete a table and graph.



     How long would it take Alan if he stops at 10 red lights?

Homework: p. 71 – 1-15 all, 31, 39, 41, 47, 57-68 all

Section 2.3 Slope

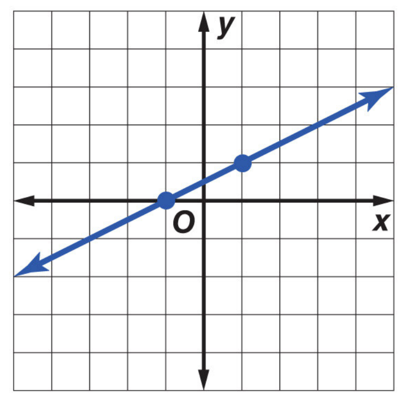
Goals:
1. To determine the slope of a line.
2. To use the slope and a point to graph a linear equation.
3. To determine if two lines are perpendicular, parallel, or neither.

I. Slope
   A. Definition –

   B. Examples
      1. Determine the slopes
         a) $(-2,3)$ and $(-4,4)$

         b) $(7,5)$ and $(-3,5)$

         c) $(5,7)$ and $(5,-3)$



      2. Find the slope of the line shown at the right.

II. Slope as a Rate
   A. Examples
      1. In 2004, 56,878 students applied to UCLA. In 2006, 60,291 students applied. Find the rate of change in the number of students applying for admission from 2004 to 2006.

      2. Refer to the graph to the right, which shows data on the fastest-growing restaurant chain in the U.S. during the time period of the graph. Find the rate of change of the number of stores from 2001 to 2006.

Homework: p. 79 – 1-8 all, 11, 21, 29, 36, 45-54 all

Section 2.4 Writing Linear Equations

Goals:

1. To write an equation of a line given the slope and one point or two points
2. To write an equation of a line that is parallel or perpendicular to the graph of a given equation.

A. Slope-intercept form $y = mx + b$
   1. m –
   2. b –

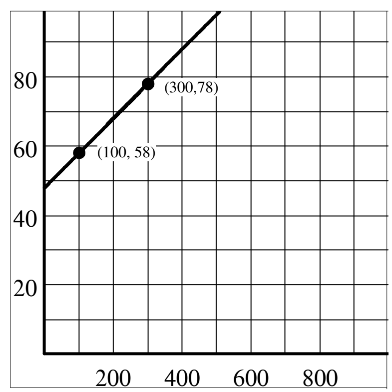
B. Examples – Find the slope-intercept form of the equation with the following givens:

   1. A line that has a slope of $-\frac{3}{5}$ and passes through the point (5, –2)

   2. A line that passes through the points (2,-3) and (-3,7)

   3. A line that passes through the points (-2,-5) and (4,-5)

   4. As a part-time salesperson, Jean Stock is paid a daily salary plus commission. When her sales are \$100, she makes \$58. When her sales are \$300, she makes \$78.



      a) Write a linear equation to model this situation.

      b) What are Ms. Stock's daily salary and commission rate?

      c) How much would Jean make in a day if her sales were \$500?

B. Parallel and Perpendicular Lines
   1. Parallel
      a) Definition –

      b) A line that passes through the point (3,5) and // $y = 3x - 2$

   2. Perpendicular
      a) Definition –

      b) A line that passes through the point (3,–2) and $\perp$ $y = -5x + 1$

Homework: p. 86 – 1-7 all, 13, 16, 17, 21, 25-28 all, 31, 35, 47-53 all

Section 2.5A Modeling Real-World Data (Manually)

Goals:
1. To draw scatter plots and find prediction equations
2. To solve problems using predictions equations

Types of correlation
1. Positive correlation –
2. Negative correlation –
3. No correlation –

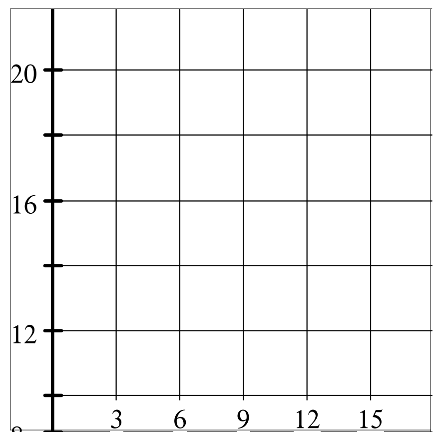
A _______________ equation can be determined by using a process ____________ to the one used to find the _____________ of a ___________.

The procedure
1.
2.
3.
4.

Examples
1. The table below shows the approximate percent of students who sent applications to two colleges in various years since 1985. Draw a scatter plot, best fit line, and find an equation that would predict the approximate percent of students who sent applications to two colleges in various years since 1985.
Predict the percent of students who will send applications to two colleges in 2010.
What is the dependent and independent variable and why?
What type of correlation does this data have?

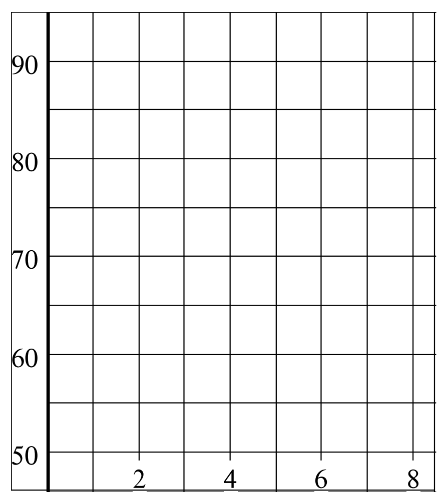
Years Since 1985	Percent
0	20
3	18
6	15
9	15
12	14
15	13

Source: U.S. News and World Report



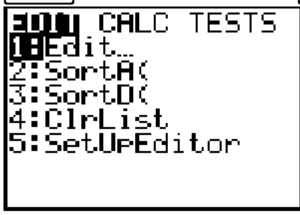
2. Safety The table below shows the approximate percent of drivers who wear seat belts in various years since 1994. What is the dependent and independent variable and why? Draw a scatter plot and a best fit line. What type of correlation does this data have? Find an equation that would predict the approximate percent of drivers who wear seatbelts since 1994. What do the slope and *y*-intercept indicate? Predict the percent of drivers who will be wearing seat belts in 2010.

Years Since 1994	Percent
0	57
3	64
6	71
9	79
12	81

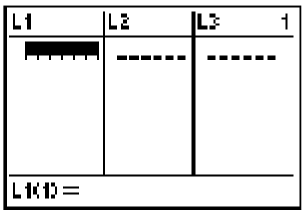


Homework: p.96 – 1-6 all, 21-28 all, 30

1. Entering Data
   a. STAT →EDIT →Edit ENTER



   b.

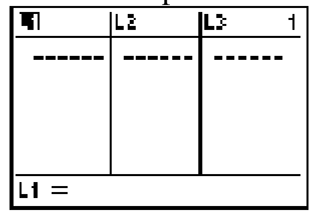


   Enter the *x*-values in L1 and *y*-values in L2

   c. 2nd QUIT

To clear a List:

1. Go to the top of list.



2. CLEAR ENTER

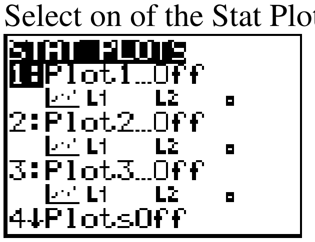
Note: Do not delete lists.

In order to get deleted lists back you must do the following:

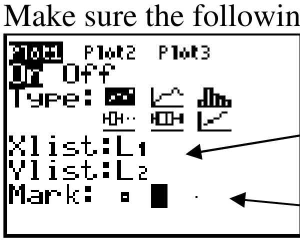
STAT → SetUpEditor ENTER ENTER

This should restore your lists.

2. Graphing Data –We do not normally do this step, unless asked to see how well the data fits.
   a. Clear all equations from Y= that do not pertain to the problem at hand.
   b. 2nd STAT PLOT
   c. Select on of the Stat Plots



   d. Make sure the following is selected.



<u>Note:</u> If your *x*- or y-values are in a different list location you can always change the XList: and YList: locations typing in the new list location.

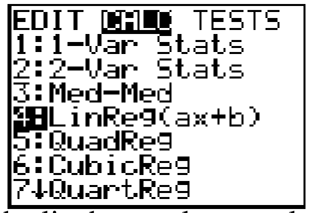
You can change your mark to your preference.

   To select put cursor on top of item and hit ENTER

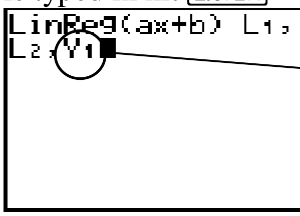
   e. 2nd QUIT
   f. ZOOM→ZoomStat

3. Finding the Prediction Line (Model)

   a. [STAT] →Calc →LinReg(ax+b) →[ENTER]

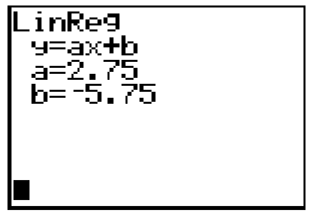


   b. After LinReg(ax+b) you will need to type the list he *x*-values are located (usually L1) flowed by a comma and the list where the *y*-values are located (usually L2) followed by another comma and then the location you want to store the equation (usually Y1). After all is typed in hit [ENTER]



Y1 thru Y9 can be located by doing the following:
[VARS]→Y-VARS→Function

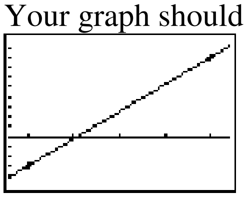
   c. You should get the following.
   a is your slope and *b* is your *y*-intercept.
   Thus your equation is $y = 2.75x - 5.75$.



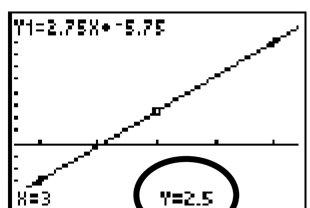
4. Using the model to predict

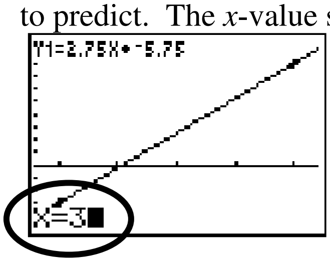
   a. Turn STAT PLOT off and clear all equations from [Y=] that do not pertain to the problem at hand.

   b. To see your graph. You must use your data to set up an appropriate window.
   Once you have your window set up the hit [GRAPH].
   Your graph should appear with data points and the model.



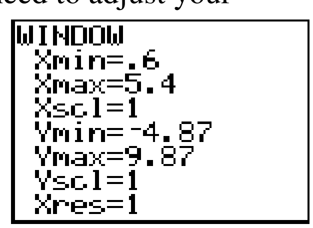
   c. To predict. Hit [TRACE].
   You should now see the following.
   Once you have model selected type in the *x*-value you want to predict. The *x*-value should appear at the bottom of the screen.

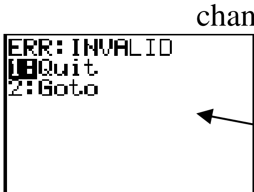




Next hit [ENTER]. You should get the corresponding *y*-value.
Now you have your answer.

   d. When you predict out side you data range (extrapolate) you may need to adjust your window. Go to [WINDOW] and adjust.
   If I needed to predict a *y*-value when *x* was 7 I would need to change my Xmax to at least 7. Then I would go back and predict.





This is the error you might get if you try to extrapolate before adjusting the window.

Section 2.5B Modeling Real-World Data (Using a Calculator)

Goals:
1. To draw scatter plots and find prediction equations
2. To solve problems using predictions equations

Correlation Coefficient (r): Shows how well data are modeled by a function.
Measures:
- When r is close to –1,
- When $r = 0$,
- When r

Examples
1. The table shows the median income of U.S. families for the period 1970–2002. Use a graphing calculator to make a scatter plot of the data. Find an equation for and graph a line of regression. Then use the equation to predict the median income in 2015. Use a graphing calculator to make a scatter plot of the data. Find an equation for and graph a line of regression. Then use the equation to predict the attendance in 2015. What is the correlation coefficient? What does this value tell us about our model?

Year	Income($)
1970	9867
1980	21,023
1985	27,735
1990	35,353
1995	40,611
1998	46,737
2000	50,732
2002	51,680

2. The table shows the winning times for an annual dirt bike race for the period 2000–2008. Use a graphing calculator to make a scatter plot of the data. Find and graph a line of regression. Then use the function to predict the winning time in 2015.

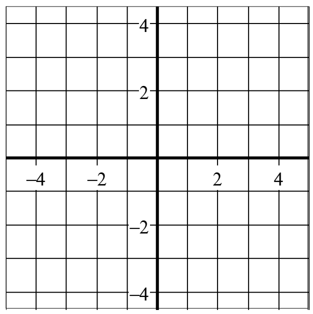
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Time(s)	320	290	310	300	270	260	230	215	205

Homework: p. 96 – 7-11 all

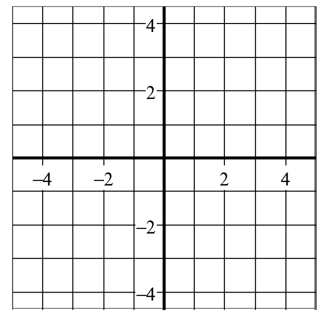
Section 2.6 Special Functions
Goals:
1. To identify and graph special functions

The Special Functions
1. Piecewise Function
2. Absolute Value Function:
3. Greatest Integer Function:
   (_______________ integer not greater than x)
   Example – $[\![2.75]\!] = 2$ or $[\![1.9875]\!] = 1$ or $[\![-2.125]\!] = -3$

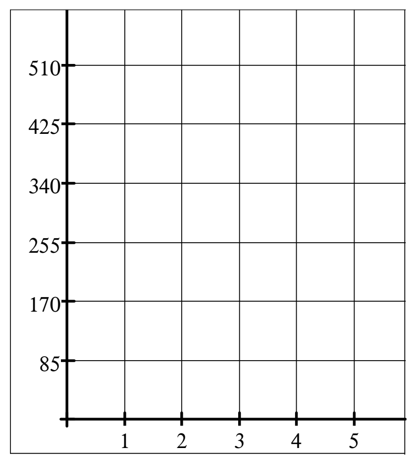
Examples:
- Graph:
  - $f(x) = \begin{cases} x-1, & \text{if } x \le 3 \\ -1, & \text{if } x > 3 \end{cases}$
    Find the Domain and Range.



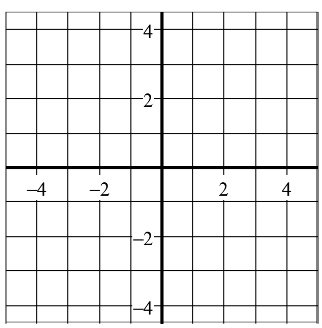
$f(x) = \begin{cases} 2x+1, & \text{if } x > -1 \\ -3, & \text{if } x \le -1 \end{cases}$
Find the Domain and Range.



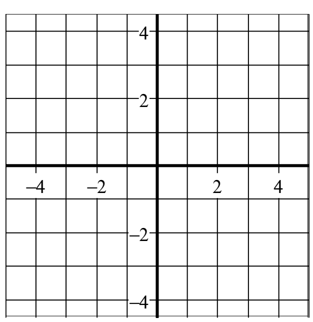
- Psychology: One psychologist charges for counseling sessions at the rate of \$85 per hour or any fraction thereof. Draw a graph that represents this solution



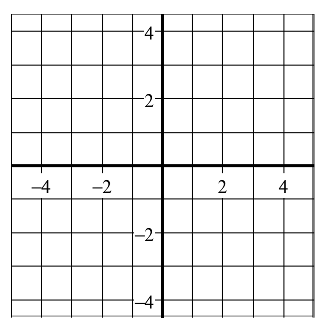
- $y = [\![x-2]\!]$



- $y = |x+2|$
  Find the Domain and Range.



$f(x) = |x-3|$
Find the Domain and Range.



Homework: p.104 – 1-4, 13, 20, 24, 28, 32, 33, 49-55 all

Section 2.7 – Parent Functions and Transformations

Goals:

1. To identify and use parent graphs.
2. To describe transformations of functions.

I. Parent Graphs

A. Constant Function:

B. Identity Function:

C. Absolute Value function:

D. Quadratic Function:

II. Transformations

A. Translation –

1. Horizontal:

2. Vertical:

B. Reflection –

1. Reflection over the *x*-axis:

2. Reflection over the *y*-axis:

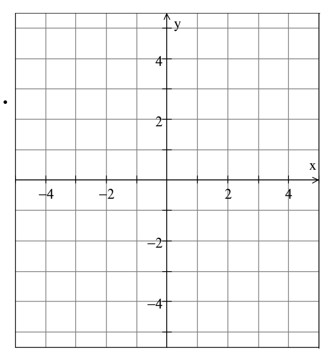
C. Dilation –

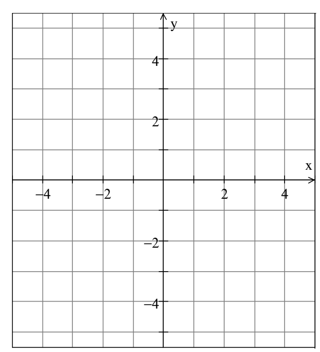
1. Stretched vertically:

2. Compressed vertically:

D. Examples

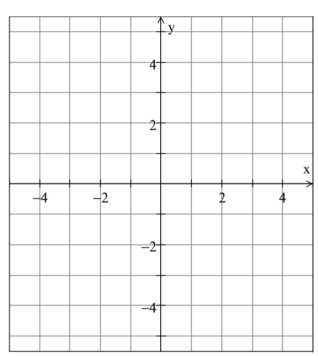
1. Describe the translation in $y=(x+1)^2$. Then graph the function.

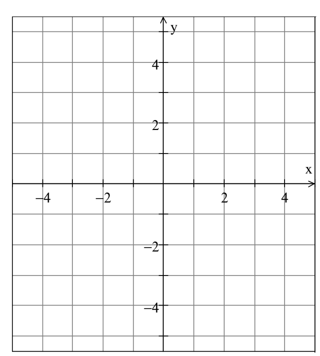




2. Describe the translation in $y=|x-4|$. Then graph the function.

3. Describe the reflection in $y=-|x|$. Then graph the function.





4. Describe what transformations to the following function $f(x)=-\frac{1}{4}|x+4|-2$. Then graph the function.

Homework: p.113 – 1-7 all, 9, 10-13 all, 14-19 all, 21, 28, 33, 36-38 all, 52-58 all, 60

Section 2.7 Linear Inequalities

Goals:

1. To draw graphs of inequalities with two variables.

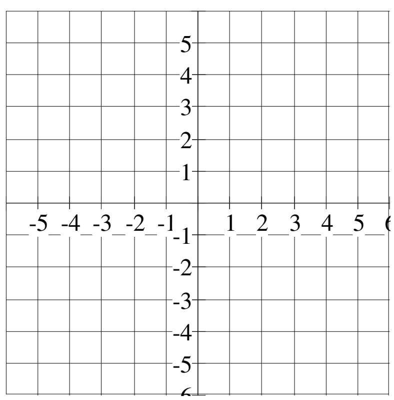
Boundary Lines

1. _______________ -- ≤ or ≥
2. _______________ -- < or >

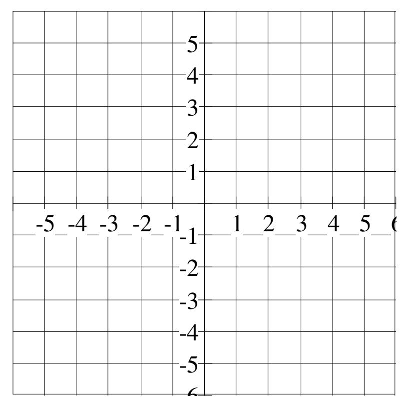
Examples:

- Is $(-2, 4)$ a solution to $2x - 3y < 6$?

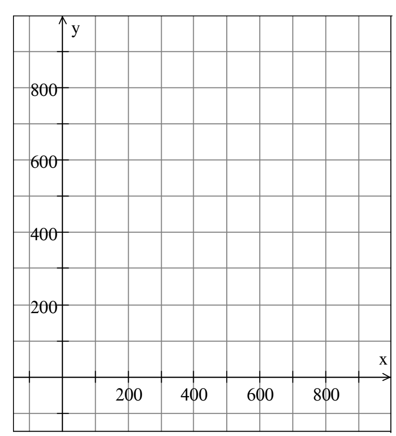
- Graph:
  - $x - 2y < 4$



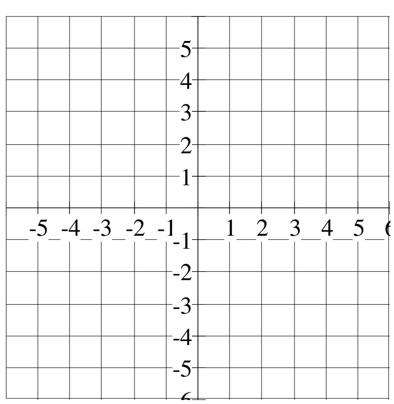
$y < 3$



- One tutoring company advertises that it specializes in helping students who have a combined score on the SAT that is 900 or less. Write an inequality to describe the combined scores of students who are prospective tutoring clients. Let *x* represent the verbal score and *y* the math score.



- $y \geq |x| - 2$



Homework: p. 119 – 1-6 all, 9-13 odds, 17, 23, 35, 42-51 all