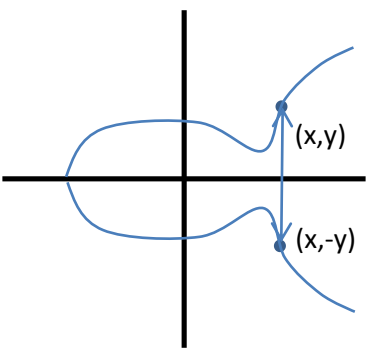
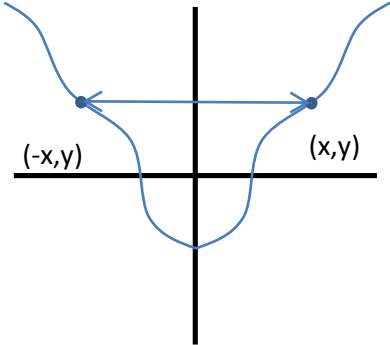
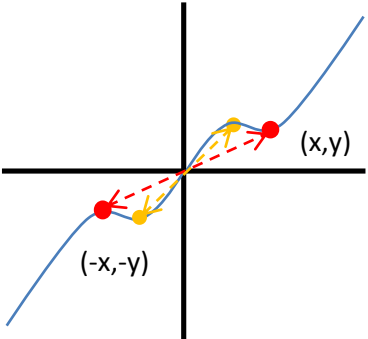


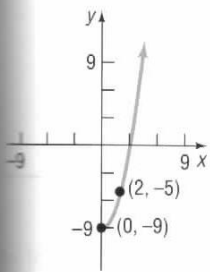
SYMMETRY

	Illustration	Coordinates	Testing an equation
x-axis		(x, y) $\leftrightarrow (x, -y)$	Replace y by $-y$ in the equation – is the result equivalent?
y-axis		(x, y) $\leftrightarrow (-x, y)$	Replace x by $-x$ in the equation – is the result equivalent?
origin		(x, y) $\leftrightarrow (-x, -y)$	Replace x by $-x$ and replace y by $-y$ in the equation – is the result equivalent?

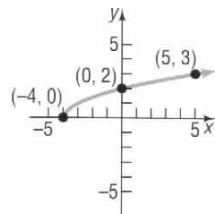
Try p. 203 #17-24

Problems 25–28, draw a complete graph so that it has the type of symmetry indicated.

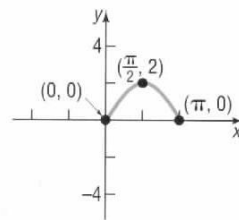
25. y-axis



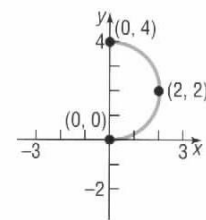
26. x-axis



27. Origin



28. y-axis



Equation	Algebraic test	Sample values	Graph												
$y = x^2$	x-axis: $y \leftarrow -y$ Result: $-y = x^2$ NO y-axis: $x \leftarrow -x$ Result: $y = (-x)^2 = x^2$ YES Origin: $x \leftarrow -x, y \leftarrow -y$ Result:	<table border="1"> <thead> <tr> <th>x</th> <th>y=x^2</th> </tr> </thead> <tbody> <tr><td>-2</td><td>4</td></tr> <tr><td>-1</td><td>1</td></tr> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>4</td></tr> </tbody> </table>	x	y=x^2	-2	4	-1	1	0	0	1	1	2	4	
x	y=x^2														
-2	4														
-1	1														
0	0														
1	1														
2	4														
$x = y^2$															
$y = x$															

Equation	Algebraic test	Sample values	Graph
$y = x^3$			
$y = \frac{1}{x}$			
$y = \sqrt{x}$			

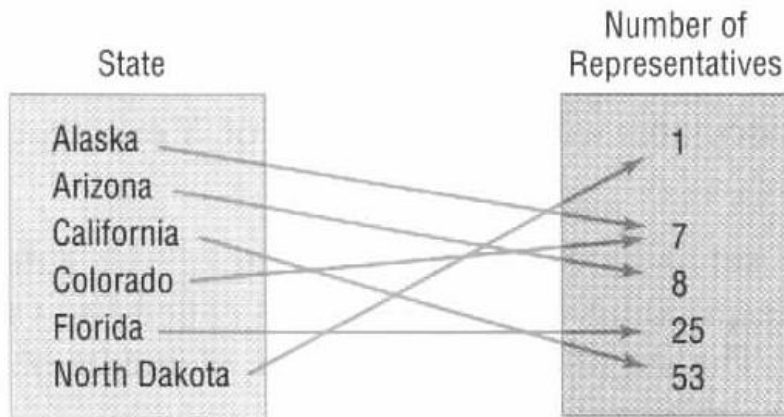
Equation	Algebraic test	Sample values	Graph
$y = x $			
$y = x^{2k}$ (even exponent)			
$y = x^{2k+1}$ (odd exponent)			
$y = \frac{1}{x^2}$			

Equation	Algebraic test	Sample values	Graph
$x^2 + y^2 = 1$			

FUNCTIONS

A *function* starts with an input set – called the *domain*- and for each member assigns *exactly one* member of an output set – called the *range*.

Example:



Domain: the set of states in the list

Range: {1,7,8,25,53}

Function: “the number of representatives for the given state”

$f(\text{state}) = \# \text{representatives for the state}$

$f(\text{Colorado}) = ?$

Ordered-pair description of a function:

{(Alaska,7), (Arizona,8), (California,53),(Colorado,7),(Florida,25),(North Dakota,1)}

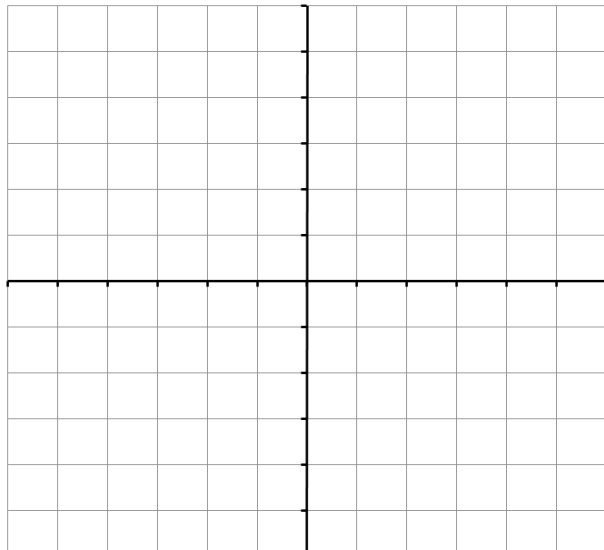
Or

{(1,3),(2,-1),(3,0),(5,3)}

Form: {(member of domain, member of range)}

Description by equation

Example: square the input

<p>Function: $f(x) =$ Domain: Range:</p> <p>Graph the function: Put the input on the x-axis put the output value of $f(x)$ on the y-axis</p> <p>$y = f(x) =$</p>	
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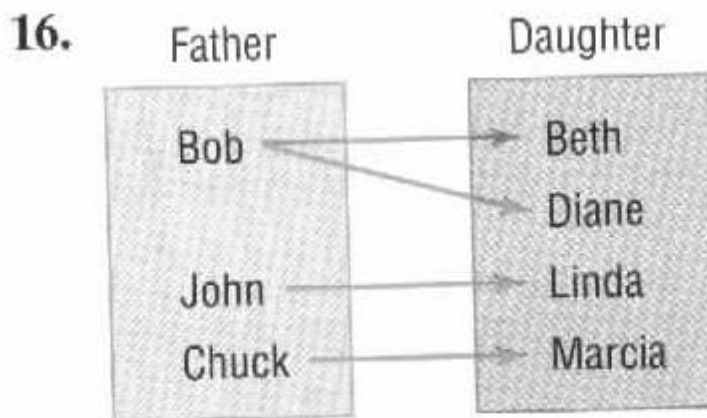
Ordered-pair description of a function:

{(Alaska,7), (Arizona,8), (California,53),(Colorado,7),(Florida,25),(North Dakota,1)}

Or

{(1,3),(2,-1),(3,0),(5,3)}

Here is a relation that is NOT a function. Why not?

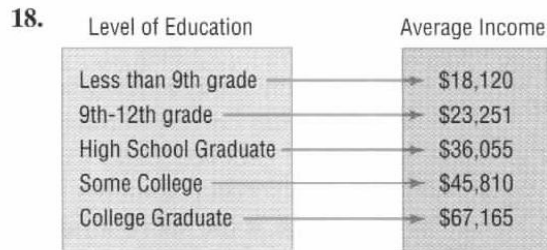
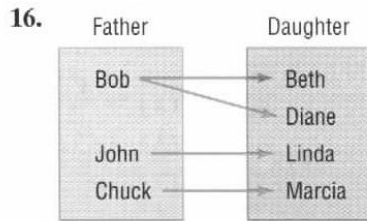


A function must produce no more than 1 output for each input

How to check:

- List or ordered pair: see if any input is associated with 2 or more outputs

Which of the following are functions?



20. $\{(-2, 5), (-1, 3), (3, 7), (4, 12)\}$
 22. $\{(0, -2), (1, 3), (2, 3), (3, 7)\}$
 24. $\{(-4, 4), (-3, 3), (-2, 2), (-1, 1), (-4, 0)\}$
 26. $\{(-2, 16), (-1, 4), (0, 3), (1, 4)\}$

- Equation – solve for y and see if 2 or more values are possible for any value of x

Equation	Solve for y	Graph
$y = x $		
$x = y^2$		
$y = \frac{3x - 1}{x + 2}$		

Evaluating functions: you are given a formula for $f(x)$ and asked to evaluate $f(\textit{something})$.

Substitute the *something* in the formula and carry out the formula.

Example:

P. 217, #40: $f(x) = -2x^2 + x - 1$

Evaluate

$f(0), f(1), f(-1), f(-x), -f(x), f(x + 1), f(2x), f(x + h)$

$f(x) = -2x^2 + x - 1$	
$f(0)$	
$f(1)$	
$f(-1)$	
$f(-x)$	
$-f(x)$	
$f(x + 1)$	
$f(2x)$	

$f(x) = -2x^2 + x - 1$	
$f(x + h)$	

Domain of a function $f(x)$

- Usually, the set of x values, among the real numbers for which the formula or other definition of $f(x)$ can be evaluated
- Sometimes, the set of x values listed in the description of $f(x)$
- Sometimes, the set of x values for which $f(x)$ makes “real-world” sense.

You may have to decide from context which questions are being asked.

If it is about “Can be evaluated” then ask yourself “What can go wrong?” (Often the problem assumes we are talking about the real numbers)

- Divide by 0
- Square root of a negative number

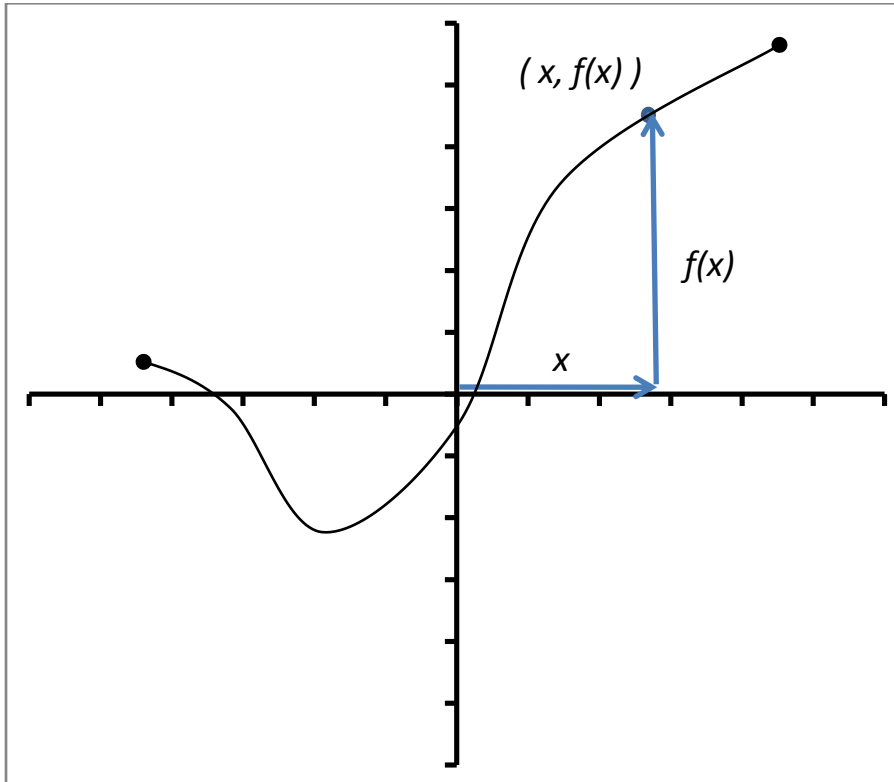
Exclude the values of x that can cause these things to go wrong.

What is the domain of

$f(x) = x^2 + 1?$	
$f(x) = \frac{2x}{x^2 - 4}$	
$f(x) = \sqrt{1 - x}$	

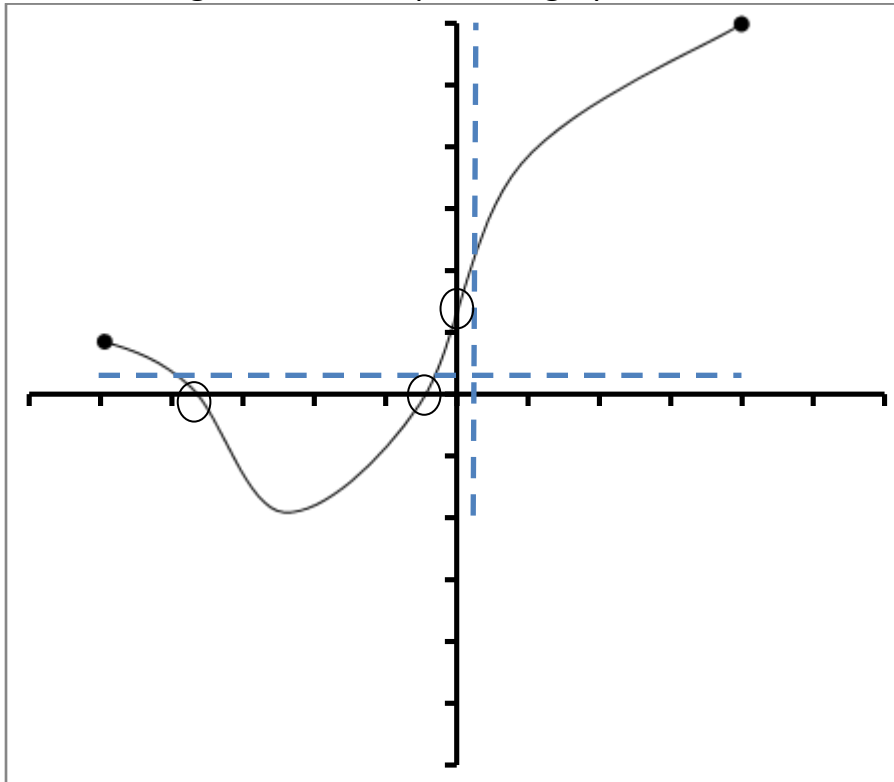
Graph of a function $f(x)$

Is the set of points $(x, f(x))$ for all x in the domain of the function. It's the same as the graph of the equation $y = f(x)$.

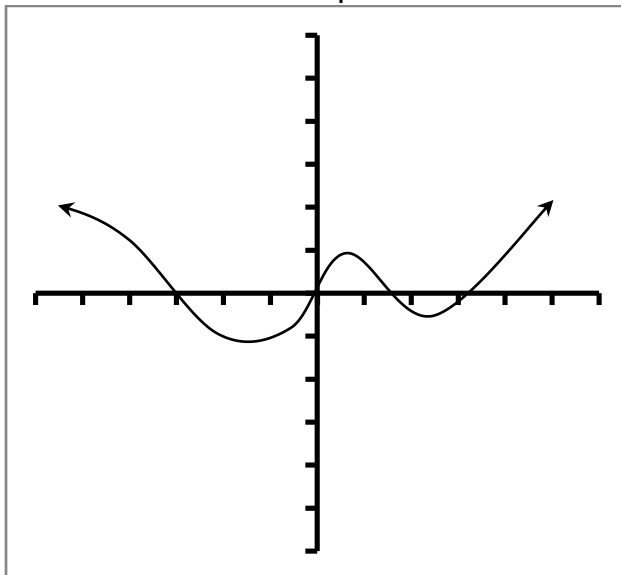


Can a vertical line cross the graph of a function more than once?

Domain, range, and intercepts on a graph of a function

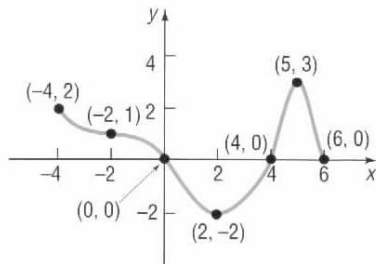


Arrows are used to depict functions with infinite domain



Examples:

10. Use the given graph of the function f to answer parts (a)–(n).

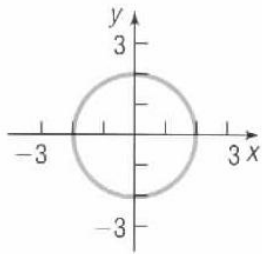


- Find $f(0)$ and $f(6)$.
- Find $f(2)$ and $f(-2)$.
- Is $f(3)$ positive or negative?
- Is $f(-1)$ positive or negative?
- For what numbers x is $f(x) = 0$?
- For what numbers x is $f(x) < 0$?
- What is the domain of f ?
- What is the range of f ?
- What are the x -intercepts?
- What is the y -intercept?
- How often does the line $y = -1$ intersect the graph?
- How often does the line $x = 1$ intersect the graph?
- For what value of x does $f(x) = 3$?
- For what value of x does $f(x) = -2$?

In Problems 11–22, determine whether the graph is that of a function by using the vertical-line test. If it is, use the graph to find:

- Its domain and range
- The intercepts, if any
- Any symmetry with respect to the x -axis, the y -axis, or the origin

<p>12.</p>	<p>Function? If so: <ul style="list-style-type: none"> • Domain • Range Intercepts Symmetries</p>
<p>14.</p>	<p>Function? If so: <ul style="list-style-type: none"> • Domain • Range Intercepts Symmetries</p>

<p>16.</p> 	<p>Function? If so:</p> <ul style="list-style-type: none"> • Domain • Range <p>Intercepts Symmetries</p>
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P. 225 #28 - Answer questions a-f

$$f(x) = \frac{2x}{x-2}$$

<p>(a) Is the point $\left(\frac{1}{2}, -\frac{2}{3}\right)$ on the graph of f?</p>	
<p>(b) If $x = 4$, what is $f(x)$? What point is on the graph of f?</p>	
<p>(c) If $f(x) = 1$, what is x? What point(s) are on the graph of f?</p>	
<p>(d) What is the domain of f?</p>	
<p>(e) List the x-intercepts, if any, of the graph of f.</p>	
<p>(f) List the y-intercept, if there is one, of the graph of f.</p>	

Applications of functions

You are given, or might derive, a function that describes a situation

Answer specific questions about a problem or situation – evaluate the function, or solve for x .

Graph the function to answer questions and understand the situation better

P. 226, #32

An object weighs m pounds at sea level

When it is h miles above sea level, its weight W is

$$W(h) = m \left(\frac{4000}{4000 + h} \right)^2$$

Questions a. to e.

- (a) If Amy weighs 120 pounds at sea level, how much will she weigh on Pike's Peak, which is 14,110 feet above sea level?
- (b) Use a graphing utility to graph the function $W = W(h)$. Use $m = 120$ pounds.
- (c) Create a Table with TblStart = 0 and Δ Tbl = 0.5 to see how the weight W varies as h changes from 0 to 5 miles.
- (d) At what height will Amy weigh 119.95 pounds?
- (e) Does your answer to part (d) seem reasonable? Explain.

Defining/sketching a function to describe information you have:

- Decide the meaning of x and $f(x)$
- Scale the axes
- Plot (x, y) points that you know
- Do you know anything about the shape of the curve between the known points?

P. 227 #40

40. Consider the following scenario: Jayne enjoys riding her bicycle through the woods. At the forest preserve, she gets on her bicycle and rides up a 2000-foot incline in 10 minutes. She then travels down the incline in 3 minutes. The next 5000 feet is level terrain and she covers the distance in 20 minutes. She rests for 15 minutes. Jayne then travels 10,000 feet in 30 minutes. Draw a graph of Jayne's distance traveled (in feet) as a function of time.

(the distance traveled is "odometer distance" – without regard to direction)

