SM 2

Date: **Section:** 1.2

Objective: Use interval notation to describe inequalities. Determine whether or not a relation is a function and find its domain and range based on a graph.

Domain: The set of all _____ (the *x*-values) of a relation.

- If a relation is represented by a graph, the domain is the set of all _____ of points on the graph. You can think of it as the graph's shadow on the *x*-axis.

Range: The set of all _____ (the *y*-values) of a relation.

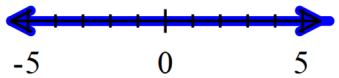
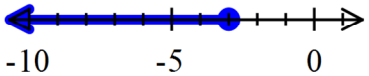
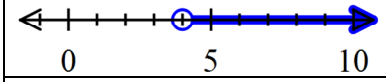
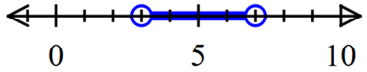
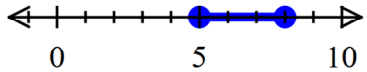
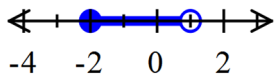
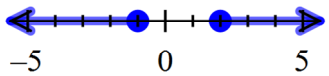
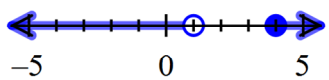
- If a relation is represented by a graph, the range is the set of all _____ of points on the graph. You can think of it as the graph's shadow on the *y*-axis.

If the graph is a set of unconnected points, the domain and range are just lists of the *x* and *y* coordinates, respectively. However, if the graphs contain connected points, they contain an infinite number of points, so we can't list the coordinates. One way we solve this is to use ***interval notation.***

Interval Notation

Domain and range are often written in ***interval notation*.**

- The numbers in the parentheses are the endpoints – the points where the interval starts and stops.
- If an endpoint is *included* in the interval, put it in a bracket [or].
- If an endpoint is *not included* in the interval, put it in a parenthesis (or).
- If the interval goes on forever, use $-\infty$ or ∞. Infinity symbols always get put in parentheses (or).
- Multiple intervals are connected with the union sign $\cup$, which is the math symbol for "or".

Graph	Interval Notation	Inequality Notation	Meaning
		$\mathbb{R}$	All real numbers
	$(-\infty,-3]$		Everything less than or equal to -3
		$x > 4$	Everything greater than 4
	$(3,7)$		Everything between 3 and 7, not including either 3 or 7
		$5 \le x \le 8$ $x \ge 5$ and $x \le 8$	Everything between 5 and 8, including both 5 and 8
	$[-2,1)$		Everything between –2 and 1, including –2, but not including 1
		$x \le -1$ or $x \ge 2$	Everything that is *either* less than *or* equal to -1 or greater than or equal to 2
	$(-\infty,1)\cup[4,\infty)$		Everything that is *either* less than 1 *or* greater than or equal to 4

Tips for domain and range

- ***Read the domain from left to right and look at the numbers on the x-axis.***
  Read the range from down to up and look at the numbers on the y-axis.
  - Write the lower value or $-\infty$ first and the higher value or ∞ last.

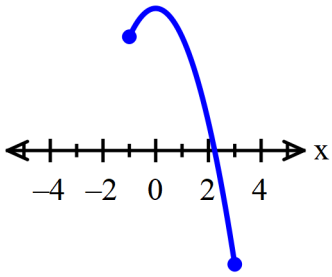
- If the graph *goes on forever without a boundary* in some direction, the domain or range will involve $-\infty$ or ∞.
  - Always use parentheses around $-\infty$ or ∞.

- Use a bracket [or] if the domain or range starts or ends at a number – there is a point at that number on the graph with that x- or y-coordinate.
  - This happens if the graph *has a* ***vertex*** (a point where the graph changes direction) or an ***endpoint*** (a point where the graph starts or stops – represented by a filled-in circle).

- Use a parenthesis (or) if a number *is not included* in the domain or range (the graph gets really, really close to that x- or y-coordinate, but never actually gets there).
  - This happens when there is an ***asymptote*** (a line that the graph gets really close to, but never actually touches). It can also happen if there are holes or gaps in the graph.

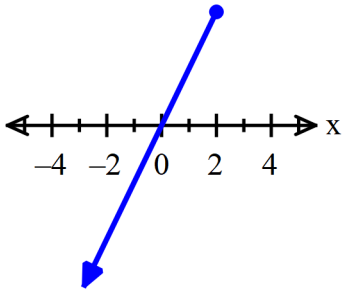
Example: State the domain in interval notation.

a)



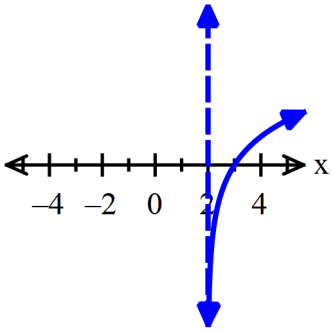
Domain:

b)



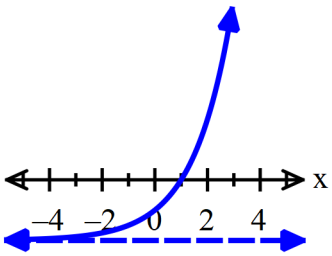
Domain:

c)



Domain:

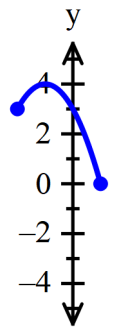
d)



Domain:

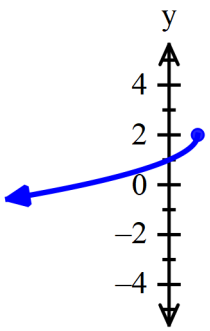
Example: State the range in interval notation.

a)



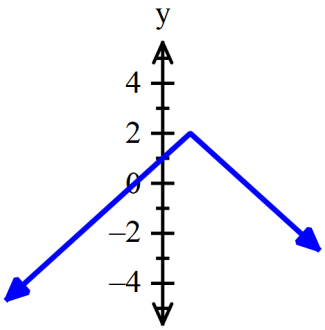
Range:

b)



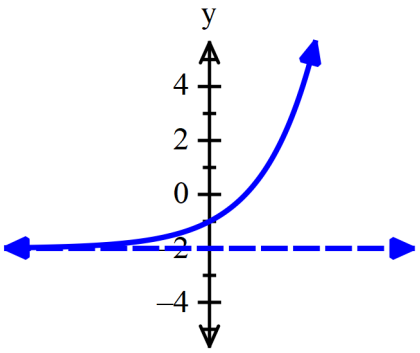
Range:

c)



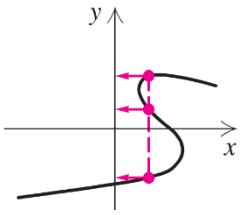
Range:

d)



Range:

Vertical Line Test

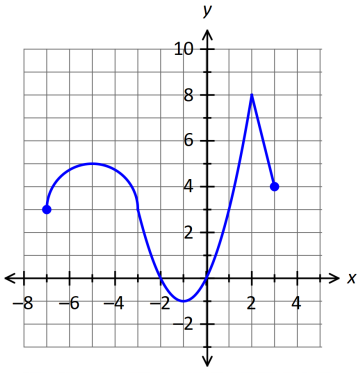


If it is possible for a vertical line to cross a graph more than once, then the graph is not the graph of a function.

The graph at left is not a function because one x-value has 3 different y-values.

Examples: Determine whether each graph is the graph of a function. Then state the domain and range.

a)

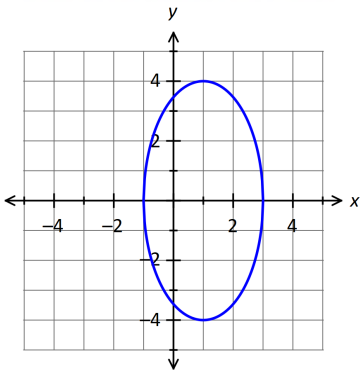


Function? Yes / No

Domain?

Range?

b)

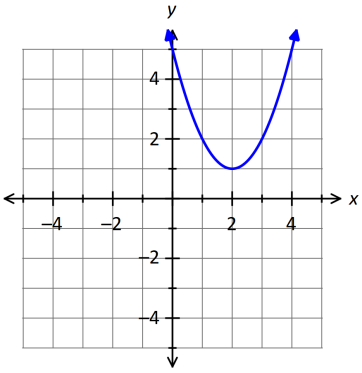


Function? Yes / No

Domain?

Range?

c)

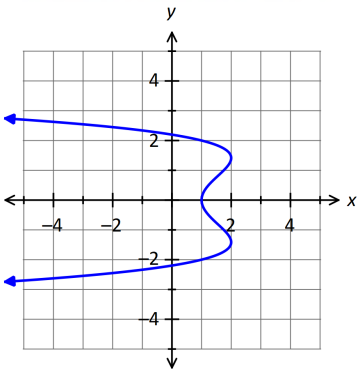


Function? Yes / No

Domain?

Range?

d)

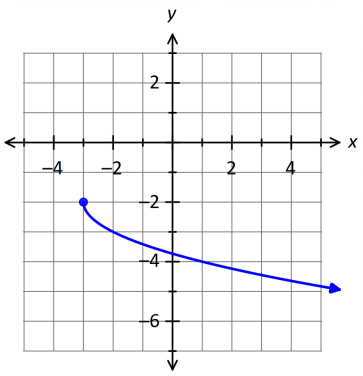


Function? Yes / No

Domain?

Range?

e)

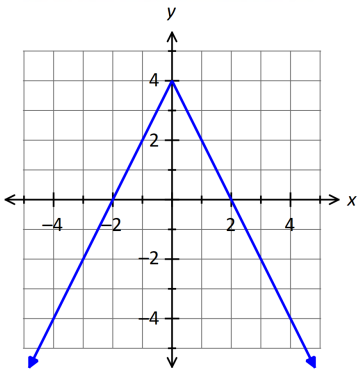


Function? Yes / No

Domain?

Range?

f)

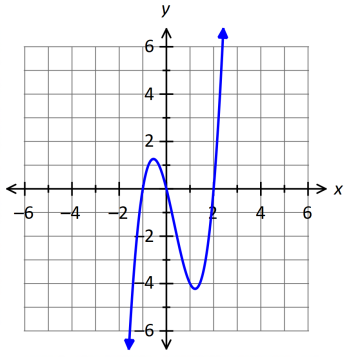


Function? Yes / No

Domain?

Range?

g)

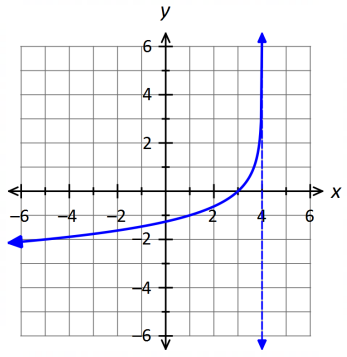


Function? Yes / No

Domain?

Range?

h)

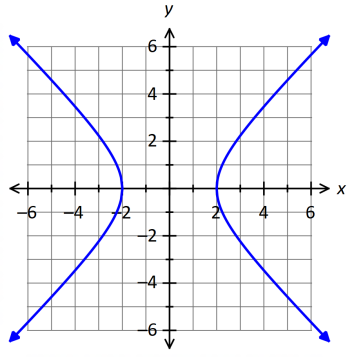


Function? Yes / No

Domain?

Range?

i)



Function? Yes / No

Domain?

Range?