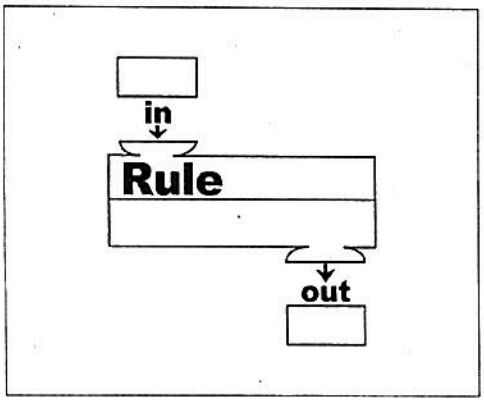
**Essential Questions:** What is a function? How can we determine if a relation is a function?

**Do Now:** Carlos needs to buy some new pencils from the school supply store at his school. Carlos asks his classmates if they know how much pencils cost. Angela says she bought 2 pencils for $0.50. Paige bought 3 pencils for $0.75, and Spencer bought 4 pencils for $1.00.

***Think about this:***
*We can think about the rule for finding the price of pencils as a machine. If Carlos puts the number of pencils he wants to buy into the machine, the machine applies the rule and tells him the total cost of that number of pencils.*




| Number of Pencils | Rule | Total Cost |
|---|---|---|
| 2 | .25(2) | .50 |
| 3 | .25(3) | .75 |
| 4 | .25(4) | 1.00 |
| x | .25(x) | .25x |

**A) Using the prices presented in the problem, complete the table above.**

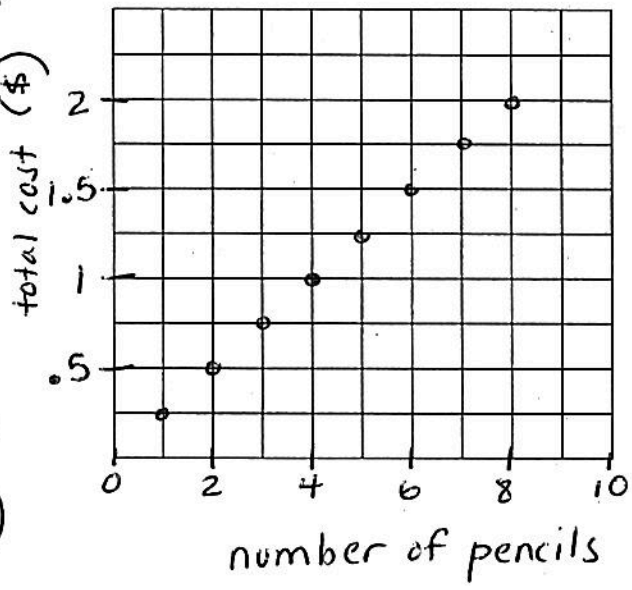
**B) How much does one pencil cost?** .25

**C) Using your rule, find the cost of 15 pencils.** .25x
.25(15)
$3.75

**D) Can this relationship (*rule*) be graphed?**

rule: $y = .25x$
(dependent variable) → cost of pencils
# of pencils (independent variable)

This is a discrete function (it does not make sense to connect all the values)



## Functions

A ***function*** is a relation (a set of ordered pairs) in which each **input** (*x*-value) is assigned to exactly one **output** (*y*-value).

**Domain:** the x values of the function (input)

**Range:** the y values of the function (output)

**Functions can be represented in multiple ways.**

**Table**

domain range

| Input | Output |
|---|---|
| 2 | 1 |
| 4 | 2 |
| 6 | 3 |

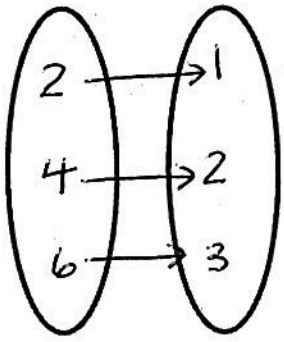
**Ordered Pairs**

(2, 1)

(4, 2)

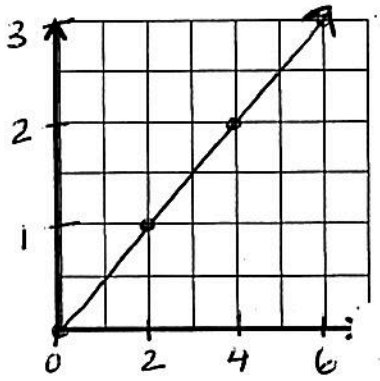
(6, 3)

**Mapping Diagram**

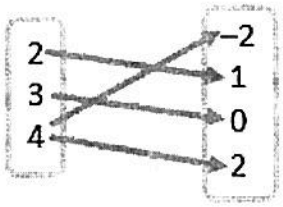
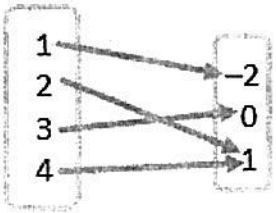



rule: $y = \frac{1}{2}x$

**Graph**



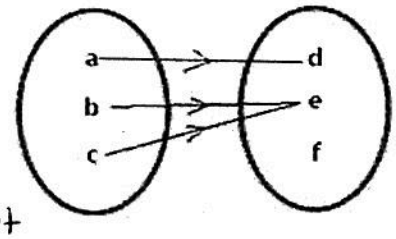

**How can I determine if a relation is a function from a set of ordered pairs?**

| Points | Mapping Diagram | Function? Yes or No |
|---|---|---|
| {(2, 1), (3, 0), (4, 2), (4, −2)} |   | No An input (4) has two distinct (different) outputs (−2 and 2) |
| {(1, −2), (2, 1), (3, 0), (4, 1)} |   | Yes every input has only one output |

**Let's apply what we've learned.**

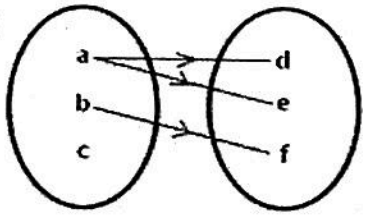
1) Determine which mapping diagram is a function. Justify your response.

(a)




Yes every input has only one output

(b)




No input "a" has two different outputs, "d" and "e"

2) Determine if the relation is a function. Be ready to justify your response.

| *domain* | 2 | 5 | 7 | 25 | 42 |
|---|---|---|---|---|---|
| *range* | 8 | 2 | 5 | 5 | 10 |

each input has only one output

Function

| *input* | 4 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|
| *output* | 4 | 5 | 6 | 7 | 8 |

input "4" has two different outputs, "4" and "5"

Not a function

| *x* | -1 | -5 | -7 | -3 | -9 |
|---|---|---|---|---|---|
| *y* | 2 | 2 | 2 | 2 | 2 |

each input has only one output

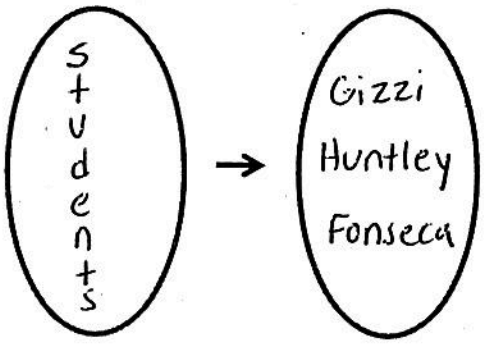
Function

3) ***Think about this...***

(teaching regular classes)

**Given:** {Mrs. Gizzi, Ms. Fonseca and Mrs. Huntley}
{All 8th grade algebra students}

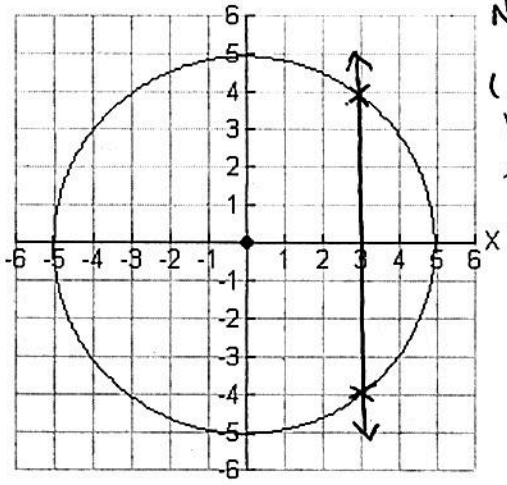
a) Which students are assigned to which teacher?



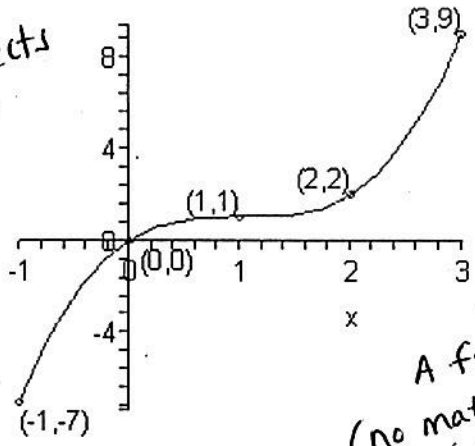

b) Is the assignment of math teachers to students a function? No, the math teachers have more than one student

c) Is the assignment of students to math teachers a function? yes, each student has only one regular math class teacher

## How can I determine if a graph is a function?



Not a function (a vertical line intersects this graph in more than one place)

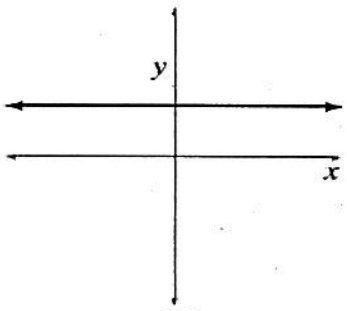



A function (no matter where a vertical line is drawn, it only intersects the graph once)

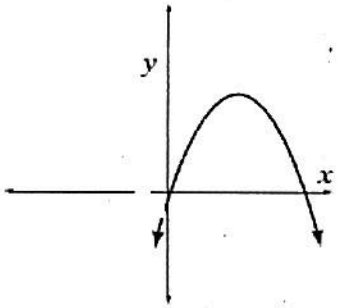
### Vertical Line Test

- Used to determine if a graph is a function.
- A vertical line must pass through exactly one point on each part of the graph for the graph to be a function.

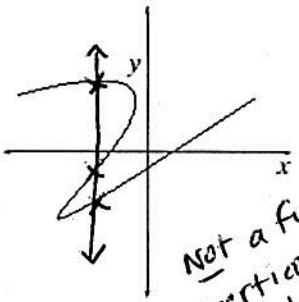
4) Which graphs represent functions?



A



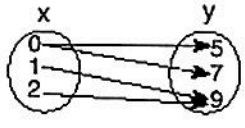
B



C

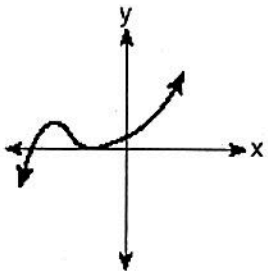
Not a function a vertical line intersects the graph in more than one place

5) Which diagram represents a relation in which each member of the domain corresponds to only one member of its range?

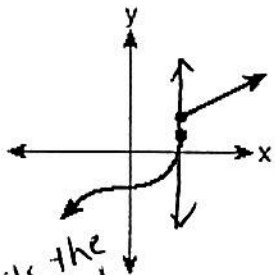



domain "0" has two distinct ranges "5" and "7"

A



B



Fails the vertical line test

C

## The Take Away...

**We can determine if relationships represent functions.**

**A mapping diagram shows a function if** only one arrow is drawn from each input value

**A table of values or a set of ordered pairs represents a function if** each input corresponds (matches) to only one output

**A graph represents a function if** it passes the vertical line test (a vertical line intersects the graph in only one place)

**TURN AND TALK**

1) Which set of ordered pairs is ***not*** a function?

(1) {(0,0), (1,1), (2,2), (3,3)}
(2) {(1,2), (3,4), (4,5), (5,6)}
(3) {(4,1), (5,1), (6,1), (7,1)}
(4) {(3,1), (2,1), (1,2), (3,2)}

input "3" has two distinct outputs "1" and "2"

2) Which relation represents a function?

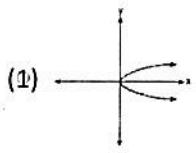
(1) {(0, 3), (2, 4), (0, 6)} input "0" has two distinct outputs
(2) {(−7, 5), (−7, 1), (−10, 3), (−4, 3)} input "−7" has two distinct outputs
(3) {(2, 0), (6, 2), (6, −2)} input 6 has two distinct outputs
(4) {(−6, 5), (−3, 2), (1, 2), (6, 5)} every input has only one output

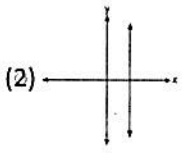
3) Given the relation. $R$ = {(-2,3), (***a***, 4), (1,9), (0,7)}Which replacement for ***a*** makes this relation a function?

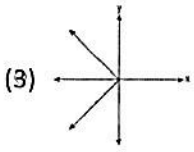
(1) 1 (2) -2 (3) 0 (4) 4

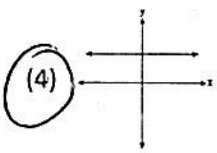
any number that has not been used as an input already

4) Which graph represents a function?

(1) 

(2) 

(3) 

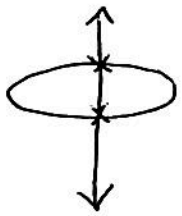
(4) 

the others fail the vertical line test

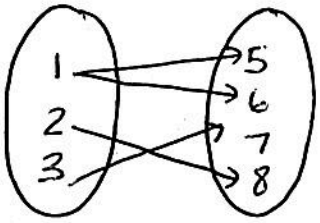
5) Using a mathematical model (*mapping diagram, table of values, ordered pairs, graph*), give an example of a relation that is a function. Give an example of a relation that is *not* a function. Explain why each of your examples is a function or *not* a function.

[answers will vary]

## not a function



not a function fails the vertical line test because it touches the graph in two places




input "1" has two distinct outputs

$\{(1,7), (-2,3), (9,2), (1,4)\}$

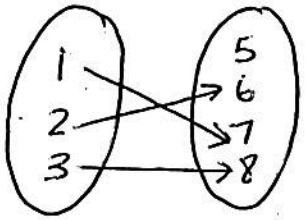
input "1" has two distinct outputs

| input (domain) | output (range) |
|---|---|
| 6 | -2 |
| 5 | 7 |
| 4 | -1 |
| 6 | 3 |
| 7 | 5 |

input "6" has two different output

## functions

passes the vertical line test
any vertical line drawn touches the graph in only one place




each input has only one output

$\{(5,0), (3,5), (2,0)\}$

| input (domain) | output (range) |
|---|---|
| 11 | 2 |
| 3 | -5 |
| 6 | 7 |
| 14 | 6 |
| 11 | 2 |