2.1 we discussed equations, which describe a math relationship. This relationship when viewed geometrically gives us a picture or graph.

This section we will talk more about some categories for math relationships.

Def: A relation or what the book refers to as a correspondence is simply a rule or map that sends inputs (x’s) to outputs (y’s)

Technically, a relation must be 1. Reflexive 2. Symmetric & 3. Transitive

Note: A relation has very little requirements.

Examples:

Domain: Car Make Range: Model

 *Relation* Camry

Toyota Corolla

Ford Escape

Honda Civic

 CRV

Domain: Predators Range: Prey

 *Relation*

Cat Dog

Fish Worm

Dog Cat

Tiger Fish

Bat mosquito

Domain: Set of Reals Range: NNon-neg. Reals

 *Relation*

1

2 1

3 4

-1 9

-2

-3

Def: A **function** is a relation/correspondence between a domain set and a range set that maps inputs to one and only one out put.

 The d**omain** is the set of all inputs for the relation, the **range** is the set of all outputs for the relation.

Which of the above relations are functions? (not the first example)

Consider the third example.

Domain: Set of Reals Range: Non-neg. Reals Another way to represent this relation is

 *Relation* with ordered pairs.

1

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

3 4

-1 9

-2

-3

What is the Domain and Range of the relation as shown in these two example?

D:{1,2,3,-1,-2,-3} R: {1,4,9}

Ex: Consider the following relations. Find the domain, range and determine if it is a function.

1. $\{\left(0,-1\right),\left(1,3\right),\left(2,-1\right),\left(-2,3\right)\}$ D: {0,1,2,-2} R: {-1,3,-1,3} Yes
2. $\{\left(1,1\right),\left(2,1\right),\left(3,1\right)\}$ D: {1,2,3} R: {1} Yes
3. $\{\left(7,5\right),\left(8,2\right),\left(5,1\right),\left(9,4\right),(7,6)\}$ D: {7,8,5,9} R: {5,2,1,4,6} No
4. $\{\left(3,8\right),\left(5,7\right),(3,8)\}$ D: {3,5} R: {8,7} Yes

Ex: Create a relation that is a function and one that is not.

## Functions and Graphs

The key to a relation being a function is that inputs must consistently go to the same outputs. You cant send an input to two different outputs, this is the central property for functions.

So if we can look at equations as a algebraic statement and as a geometric graph, and all equations are just mathematical relations, then we should be able to look at a graph and tell if it represents a function.

If a function MUST have for each input one unique output, what would this mean for a graph?

(must pass v. line test)

Ex: Which of the following graphs is a function? (Not c or f)

1. b c) d) e) f)

The 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.

Ex: Label the graphs above and ask for the domain and range of the relation based upon the graph.

## Function Notation and Equations

Function notation looks like $f(x)$ [pronounced f of x]. With this notation we are given two important pieces of information.

1. The relation IS A FUNCTION.
2. The relation is a function of the variable x.

Consider $y=x^{3}$ and $f\left(x\right)=x^{3}$

Where the first makes us assume the input variable is x, and leaves us to figure out for ourselves if it is a function,

The second tells us that the relation obeys the requirement of being a function and that this function has x as the input variable.

Note: !!!$f(x)$ does not mean $f∙(x)$ [f times x]!!!

It means where ever you see x, in the parentheses, if you replace it with a number, you have to replace all other x’s in the equation with that number too.

Ex: If $f\left(x\right)=2x^{2}+x-1$ Find $f\left(3\right),f\left(0\right),f\left(-1\right),f\left(t\right),f(poop)$.

{11,-1,0,$\left[2t^{2}+t-1\right],[2poop^{2}+poop-1]\}$

Ex: For each function determine the domain:

1. $f\left(x\right)=\left|x\right|$ D: $R$
2. $f\left(x\right)=\frac{1}{x}$ D: $R\\{0\}$
3. $f\left(x\right)=\frac{2}{3x-5}$ D: $R\\{5/3 \} $

Ex: Create a function whose Domain is $R\\{1 \} $ $f\left(x\right)=\frac{1}{x-1}$