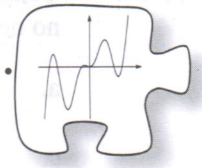
11.1.2 What's the relationship?



Relation Machines

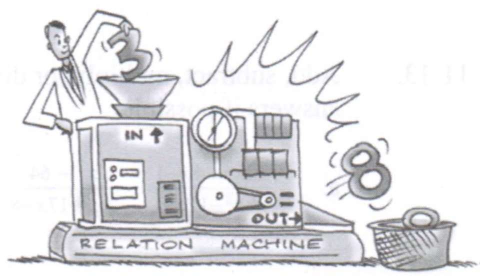
In the next few lessons you will add to your list of what you can ask about a graph of a rule. Throughout this course, you have used rules that relate two variables (like $y=-2x^2+11x+1$) to make graphs and find information. Today you will look more closely at how rules that relate two variables help establish a relationship between the variables. You will also learn a new notation to help represent these relationships.

11-16. ARE WE RELATED?

Examine the table of input (x) and output (y) values below. Is there a relationship between the input and output values? If so, state the relationship.

x	-3	-2	-1	0	1	2	3
y	8	3	0	-1	0	3	8

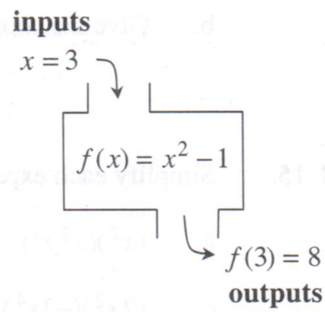
11-17. RELATION MACHINES



Each equation that relates inputs to outputs is called a **relation**. This is easy to remember because the equation helps you know how all the y-values (outputs) on your graph are **related** to their corresponding x-values (inputs).

A relation works like a machine, as shown in the diagram below. A relation is given a name that can be a letter, such as f or g. The notation $f(x)$ represents the output when x is processed by the machine. (Note: $f(x)$ is read, "f of x.") When x is put into the machine, $f(x)$, the value of a function for a specific x-value, comes out.

Numbers are put into the relation machine (in this case, $f(x)=x^2-1$) one at a time, and then the relation performs the operation(s) on each input to determine each output. For example, when $x=3$ is put into the relation $f(x)=x^2-1$, the relation squares it and then subtracts 1 to get the output, which is 8. The notation $f(3)=8$ shows that the relation named f connects the input (3) with the output (8).



a. Find the output for $f(x)=x^2-1$ when the input is $x=4$; that is, find $f(4)$.

b. Likewise, find $f(-1)$ and $f(10)$.

c. If the output of this relation is 24, what was the input? That is, if $f(x)=24$, then what is x? Is there more than one possible input?

11-18. Find the relationship between x and $f(x)$ in the table below and complete the rule of the relation.

x	9	1	100	4	49		0	25	20
$f(x)$		1			7	4		5	

Relation: $f(x) =$ ______________

11-19. Find the corresponding outputs or inputs for the following relations. If there is no possible output for the given input, explain why not.

a. $x=-3$ → $f(x)=-2x+4$ → $f(x)=?$

b. $x=-2$ → $f(x)=\sqrt{x+3}$ → $f(x)=?$

c. $x=5$ → $f(x)=x^3$ → $f(x)=?$

d. $x=-2$ → $f(x)=\sqrt{x}+1$ → $f(x)=?$

e. $x=2$ → $f(x)=\frac{x+3}{2x-5}$ → $f(x)=?$

f. $x=?$ → $f(x)=x^2-1$ → $f(x)=99$

g. $x=?$ → $f(x)=|x|$ → $f(x)=-3$

h. $x=-4$ → $f(x)=|x-2|$ → $f(x)=?$

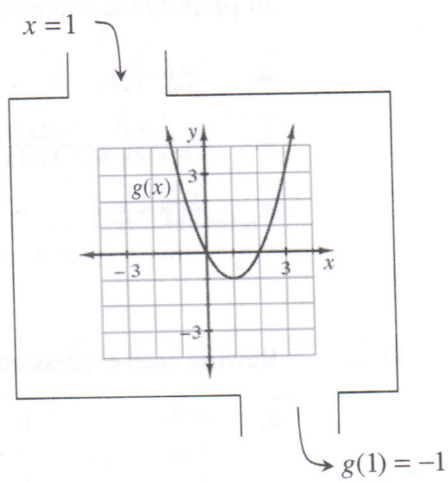
i. $x=-4$ → $f(x)=|x|-2$ → $f(x)=?$

11-20. Examine the relation defined at right. Notice that $g(1)=-1$; that is, when x is 1, the output (y or $g(1)$) is -1.

a. What is the output of the relation when the input is 2? That is, find $g(2)$.

b. Likewise, what are $g(-1)$ and $g(0)$?

c. What is the input of this relation when the output is 1? In other words, find x when $g(x)=1$. Is there more than one possible solution?



Review & Preview

11-21. If $f(x)=x^2$, then $f(4)=4^2=16$. Find:

a. $f(1)$ b. $f(-3)$ c. $f(t)$

11-22. Find the equation of the line with slope $m=-\frac{4}{3}$ that passes through the point (12, – 4).

11-23. Marley thinks that the two lines below are perpendicular, but Bob thinks they are not. Who is correct and how do you know?

$$2x-7y=16$$
$$7x+2y=3$$

11-24. Ten minutes after he left his home, Gerald was 40 miles from his grandmother's house. Then, 22 minutes after he left, he was 34 miles from her house. If he was traveling toward his grandmother's home at a constant rate and reached her house after 90 minutes, how far away from her house does he live?

11-25. Use your method for multiplying and dividing fractions to simplify the expressions below.

a. $\frac{x+2}{x-1}\cdot\frac{x-1}{x-6}$

b. $\frac{(4x-3)(x+2)}{(x-5)(x-3)}\div\frac{(x-1)(x+2)}{(x-1)(x-3)}$

c. $\frac{(x-6)^2}{(2x+1)(x-6)}\cdot\frac{x(2x+1)(x+7)}{(x-1)(x+7)}$

d. $\frac{(x+3)(2x-5)}{(3x-4)(x-7)}\div\frac{(2x-5)}{(3x-4)}$

e. $\frac{3x-1}{x+4}\div\frac{x-5}{x+4}$

f. $\frac{x-3}{x+4}\cdot\frac{3x-10}{x+11}\cdot\frac{x+4}{3x-10}$

11-26. Rewrite each expression below without negative or zero exponents.

a. 4^{-1} b. 7^0 c. 5^{-2} d. x^{-2}