section 1.1 Linear Relations and Functions

We begin with a set of ordered pairs, coordinates were each x value has an assigned y value. This set of ordered pairs represents a relation.

Example:

Wind speed (mph)	Wind chill Temp °F
5	19
10	3
15	-5
20	-10
25	-15
30	-18

The ordered pairs represent a relation.
(5, 19) (10, 3) (15, -5)
(20, -10) (25, -15) (30, -18)

If we add the limitation to our relation that each x-value can have only one non-repeating y-value, the relation becomes a function.

The x-values are referred to as the domain.
The y-values are referred to as the range.
A function is a relation in which each element of the domain is paired with exactly one element in the range.
Simply put, domain values <u>cannot</u> be repeated for a relation to be a function.

Linear equations take the form $y = ax + c$ where the degree (exponent) of the variables x and y are both 1. This creates a graph that is a line, hence the name <u>linear function</u>.

If any relation is to be considered a function, we can replace y in the ordered pair with the symbol $f(x)$. This $f(x)$ translates to f of x or the function f with respect to x.

$g(x)$ means the function g with respect to x.

If we are given a function, $f(x)$ and we know a given value of x, we can solve for the corresponding value of $f(x)$.

Example: $f(x) = x^2 + 3x - 4$ solve for $f(2)$

We insert the value of 2 for x and we solve for the resulting value. $f(2) = (2)^2 + 3(2) - 4 = 4 + 6 - 4 = 6$

$f(2) = 6$.

This means that we can insert any real value into our function and determine the resulting value of $f(x)$.

However, sometimes this has real limitations.

1. We cannot divide by zero
2. We cannot take the square root of a negative number

These limitations affect the domain of our function.

Ex. $f(x) = \dfrac{x+2}{x-1}$

we see that if $x = 1$, then we are dividing by 0, which is not possible. This is the only value here that causes this problem. Therefore,

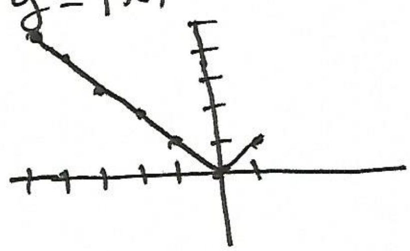
$\{x : x \in \mathbb{R}, x \neq 1\}$

Ex. $f(x) = \sqrt{5-x}$

we see that if $x > 5$ then we have a negative value under the radical. The square root of a negative value is imaginary

Page 10-11 Problems

\# 28 $y = |x|$ and $-5 \leq x \leq 1$



x	y
-5	5
-4	4
-3	3
-2	2
-1	1
0	0
1	1

\# 33 $\{(1,-2)\ (1,4)\ (1,-6)\ (1,0)\}$

Since the domain value of 1 has multiple range values, this relation is not a function.

\# 41 $f(3)$ if $f(x) = 2x+3$ $\quad f(3) = 2(3)+3 = 6+3 = 9$

\# 45 $f(n-1)$ if $f(x) = 2x^2 - x + 9$

$$\begin{aligned} f(n-1) &= 2(n-1)^2 - (n-1) + 9 \\ &= 2(n^2 - 2n + 1) - n + 1 + 9 \\ &= 2n^2 - 4n + 2 - n + 1 + 9 \\ &= 2n^2 - 5n + 12 \end{aligned}$$

51.

a) $f(x) = \dfrac{3}{x-1}$ $\quad x \neq 1$

b) $g(x) = \dfrac{3-x}{5+x}$ $\quad x \neq -5$

c) $h(x) = \dfrac{x^2-12}{x^2-4}$ $\quad x \neq 2, -2$

53. If $f(2m+1) = 24m^3 + 36m^2 + 26m$ what is $f(x)$?

Let $x = 2m+1$, then $\dfrac{x-1}{2} = m$.

$$f(2m+1) = 24\left(\frac{x-1}{2}\right)^3 + 36\left(\frac{x-1}{2}\right)^2 + 26\left(\frac{x-1}{2}\right)$$
$$= 24\frac{(x-1)^3}{8} + 36\frac{(x-1)^2}{4} + 26\frac{(x-1)}{2}$$
$$= 3(x-1)^3 + 9(x-1)^2 + 13(x-1)$$
$$= 3(x^3 - 3x^2 + 3x - 1) + 9(x^2 - 2x + 1) + 13(x-1)$$
$$= 3x^3 - 9x^2 + 9x - 3 + 9x^2 - 18x + 9 + 13x - 13$$
$$f(x) = 3x^3 + 4x - 7$$

$f(x) = 3x^3 + 4x - 7$