Inequalities – Introduction

Equality (Equivalence) & Inequality (Non-Equality)

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1. Equality

The word equality comes from the word equal which states that two (2) items are the same. We use the sign = to denote equality (& equivalence):

Right Hand Side = Left and Side [RHS = LHS]

Denote **equality**

$$3 = 3$$

or

equivalence

$$3 = \frac{3}{1}$$
$$3 = \frac{12}{4}$$
$$3 = \sqrt{9}$$
$$3 = \sqrt[3]{27}$$
$$3 = \left|-3\right|$$
$$3 = 3.00$$

.

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Note: With an equivalence, the values are the same but the forms are different. Different forms are used for different purposes.

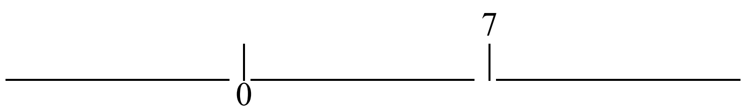
Frequently in Mathematics, we are asked to **solve** an equality (called an **equation**) for a letter, say “x”, which means that we are looking for a number or numbers, that make(s) the equation true:

$$2(\mathbf{x}-4)=13-\mathbf{x}$$
$$2([?]-4)=13-[?]$$

The solution is $\mathbf{x}=7$ since

$$2([\color{red}{7}]-4)=13-[\color{red}{7}]$$
$$6=6$$

Graph:



Note that sometimes in Mathematics, we must change the form but not the value in order “to do the math”:

$$\begin{aligned}\frac{1}{6}+\frac{8}{3}&=\frac{1}{6}+\frac{8}{3}*1\\&=\frac{1}{6}+\frac{8}{3}*\frac{2}{2}\\&=\frac{1}{6}+\frac{16}{6}\\&=\frac{17}{6}\end{aligned}$$

For Your Information (FYI): The above “form changer” comes from the identity $a=a*1$. Another “form changer” is $a=a+0$

2. Inequality

If two (2) items are NOT equal or equivalent, we use the symbol $\neq$.
Consider two (2) numbers a and b on the number line (think fancy “ruler”):

If they are equal (a = b), they reside at the same location on the number line:

```
_________________________|_________________________ Number Line
                       a = b
```

If not, we write $\mathbf{a} \neq \mathbf{b}$ and one number must be to the left of the other one:

```
_______________|____________________|_______________ Number Line
               a                    b
```

In this case, we write

a < b (or b > a)

and say that "a" is *less than* "b" (or "b" is *greater than* "a") If "b" is to the left of "a",

```
_______________|____________________|_______________ Number Line
               b                    a
```

we write b < a (or a > b) and say that "a" is *greater than* "b" (or "b" is *less than* "a"). Hence,

$3 < 5$ (or $5 > 3$)

$7 > 4$ (or $4 < 7$)

Writing x < 6 means that "x" represents *any* number less than 6:

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//////////////////////)_______________
                      6
```

Note: ")" means excluded

For example

$$-62 < 6\ ;\ -\frac{3}{4} < 6\ ;\ 0 < 6\ ;\ 2\frac{1}{2} < 6$$

The statement 11 < 6 is FALSE which we write as $11 \nless 6$.

Writing -2 < x means that "x" represents *any* number greater than -2:

$$\underline{\qquad\qquad\qquad}\underset{-2}{(}/ /$$

For example

$$-2 < -1\frac{3}{5}\ ;\ -2 < 0\ ;\ -2 < 3\frac{2}{7}\ ;\ -2 < 73$$

Sometimes we want to allow equality so we write $\mathbf{a} \le \mathbf{b}$ (or $\mathbf{b} \ge \mathbf{a}$) which means a < b **OR** a = b:

$$\overbrace{/ / / / / / / / / / / / / / / / / / / /}^{\mathbf{a}}\underset{\mathbf{b}}{]}\underline{\qquad\qquad\qquad}$$

Note: "]" means inclusion

We write $\mathbf{a} \ge \mathbf{b}$ (or $\mathbf{b} \le \mathbf{a}$) which means a > b **OR** a = b:

$$\underline{\qquad\qquad\qquad}\underset{\mathbf{b}}{[}\overbrace{/ / / / / / / / / / / / / / / / / / / /}^{\mathbf{a}}$$

So

$$7 \le 13$$

since

$$7 < 13$$

and

$$7 \le 7$$

since

$$7 = 7$$