Section P.1

Real Numbers and Intervals

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Natural = { 1, 2, 3, ... }

Whole = { 0, 1, 2, 3, ... }

Integers = { ..., -3, -2, -1, 0, 1, 2, 3, ... }

Rational = { p/q | p and q are integers }

"where"

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Rational = { p/q | p and q are integers }

{ p/q where p and q are integers}

Examples:

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Irrational = { all the numbers that are NOT rational }

Real numbers = { rational & irrationals }

Notation for the real numbers: $\mathbb{R}$

$\mathbb{R}$

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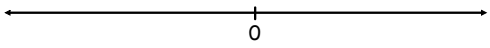
The ***real number line*** can be used to graphically represent numbers.

Every position on the line corresponds to a real number



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Converting rational numbers to decimals:

The sequence will terminate or repeat.

A line is drawn over the repeating pattern.

$\frac{1}{8} =$ $= 0.125$ number terminates

$\frac{1}{12} =$ $= 0.083333\ldots = 0.08\overline{3}$ pattern repeats

$\frac{1}{7} =$ $= 0.142857142857\ldots = 0.\overline{142857}$ pattern repeats

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Irrational numbers have a decimal sequence which never terminates or repeats:

$\pi \approx 3.1415926.....$

↑ approximately equal to

Hint: the square root of a prime number is irrational.

$\sqrt{prime} = irrational$

$\sqrt{2} = irrational$

$\sqrt{3} = irrational$

$\sqrt{5} = irrational$

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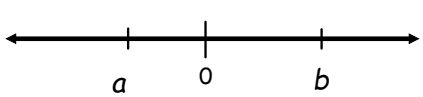
$a < b$

"a is (strictly) less than b"

a lies to the left of b on the number line.



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$a \leq b$

"a is less than or equal to b"

a lies to the left of b on the number line

or

$a = b$.

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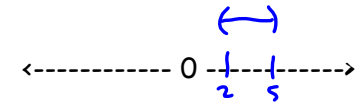
Let x be a real number.

Write the inequality in interval notation and graph it on the real number line.

a)

Inequality: $2 < x < 5$

Interval notation: $(2, 5)$

Graphically: 

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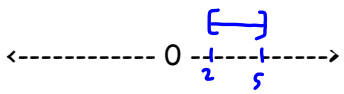
Let x be a real number.

Write the inequality in interval notation and graph it on the real number line.

b)

Inequality: $2 \leq x \leq 5$

Interval notation: $[2, 5]$

Graphically: 

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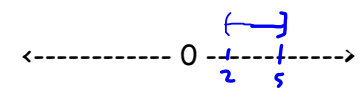
Let x be a real number.

Write the inequality in interval notation and graph it on the real number line.

c)

Inequality: $2 < x \leq 5$

Interval notation: $(2, 5]$

Graphically: 

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Let x be a real number.

Write the inequality in interval notation and graph it on the real number line.

d)

Inequality: $2 \leq x < 5$

Interval notation: $[2, 5)$

Graphically: <---------- 0 --[---)------> (2, 5)

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An interval that is contained between two real numbers is called a

BOUNDED INTERVAL.

The previous intervals are all bounded.

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An UNBOUNDED interval has no limit on its size.

We can say that is "goes to infinity."

∞ is the symbol for *infinity*.

Note: ∞ is not a number.

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Write the inequality in interval notation and graph it on the real number line.

a)

Inequality: $2 < x < \infty$

Interval notation: $(2, \infty)$

Graphically: <---------- 0 --(---------->

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Write the inequality in interval notation and graph it on the real number line.

b)

Inequality: $2 \leq x < \infty$

Interval notation: $[2, \infty)$

Graphically: <---------- 0 --[---------->

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$-\infty$ is the symbol for *negative infinity*.

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Write the inequality in interval notation and graph it on the real number line.

c)

Inequality: $-\infty < x < 2$

Interval notation: $(-\infty, 2)$

Graphically: <---------- 0 --)---------->

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Write the inequality in interval notation and graph it on the real number line.

d)

Inequality: $-\infty < x \leq 2$

Interval notation: $(-\infty, 2]$

Graphically: <---------- 0 --]---------->

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The inequality

$-\infty < x < \infty$

means "all real numbers."

This can be written as $(-\infty, \infty)$

and also as $\mathbb{R}$.

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The *magnitude* of a number is its distance from 0 on the number line.

This is also called the *absolute value*.

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Let a be a real number:

$|a|$ "the absolute value of a."

$|3| = 3$

$|-3| = 3$

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The *sign* of a number tells you if it lies to the left or right of ZERO on the number line.

A number's sign can be:

negative, zero, positive

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Evaluate the following expressions:

a) $a = 3$

$-a = -3$

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b)

$a = -3$

$-a = -(-3) = 3$

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c)

$a = -9$

$-a = -(-9) = 9$

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d)

$a = |-4|$

$a = 4$

$-a = -4$

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e)

$a = |4 - (-3)|$

$a = |4 + 3|$

$a = |7|$

$a = 7$

$-a = -7$

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Implications

A logical statement is a statement that is either TRUE or FALSE.

Letters are often used to represent statements.

$p \Rightarrow q$ is an *implication* and is read "p implies q"

This means,

IF p is true THEN q is true.

An implication can be VALID or NOT VALID.

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Example:

Let p and q be defined as follows:

p: It is raining

q: The grass is wet

Then $p \Rightarrow q$

means,

IF it is raining THEN the grass is wet.

Q: Is this VALID or NOT VALID?

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Given the implication $p \Rightarrow q$

the implication $q \Rightarrow p$ is called the ***CONVERSE***.

In this case that would correspond to:

IF the grass is wet THEN it is raining.

Q: Is this VALID or NOT VALID?

Hint: Can you find a *counter example*?

Note: A counter example is a situation where the second statement is true but the first is false.

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IF the grass is wet THEN it is raining.

This is NOT VALID.

There are many ways the grass could be wet even though it is not raining.

1. It just stopped raining.
2. Someone sprayed the grass with a hose.
3. Some drunk guys just came by.

... and more.

The End.

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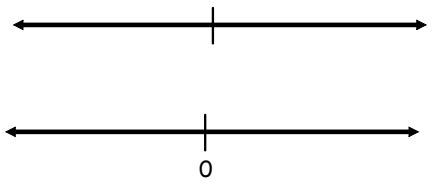

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