Algebra 2
Ch. 1 Handout 1.1
Properties of Real Numbers

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Digits:

$$\{0,1,2,3,4,5,6,7,8,9\}$$

https://www.youtube.com/watch?v=0Z3Nii1oqMs

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Subsets of Real Numbers

Natural Numbers:

$$\{1,2,3,4,...\}$$

Natural Numbers are the numbers used for counting.

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Whole Numbers:

$$\{0,1,2,3,4,...\}$$

Whole Numbers are the natural numbers and 0.

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Integers:

$$\{...,-3,-2,-1,0,1,2,3,4,...\}$$

The integers are the natural numbers (positive integers), their opposites (negative numbers), and 0.
Each negative integer is the _opposite__, or additive __inverse_, of a positive integer

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Rational Numbers
are all the numbers that can be written as a quotients of integers
den $\neq 0$
Each quotient must have a _non-zero_ denominator.
Some rational numbers can be written as _terminating decimals_.
All other rational numbers can be written as_repeating decimal_.

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Irrational Numbers

are numbers that can't be written as a quotient of integers. Their decimal representations neither ___terminating___ nor ___repeating___.

If a positive rational number is not a perfect square such as 25 or $\frac{4}{9}$, then its square root is irrational number

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The opposite or additive inverse of any number a is ___$-a$___.

The reciprocal or multiplicative inverse of any nonzero number a is ___$\frac{1}{a}$___.

The absolute value of a real number is its ___distance from zero___.

*Real numbers are graphed as points on a number line.

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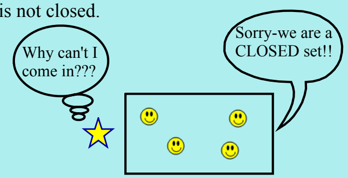
Closure Property--when you combined any two elements of the set, the result is also included in the set. If the element outside the set is produced, then the operation is not closed.



The round smiley faces are a closed set. No matter what operation is performed on round smiley faces, another round smiley face will be created Thus, there are always only round smiley faces in the box.

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Example:

If you multiply two *real numbers*, you will get another real number. Since this process is always true, it is said that the real numbers are "closed und the operation of multiplication". There is simply no way to escape the set real numbers when multiplying.

Closure: When you combine any two elements of the set, the result is also included in the set

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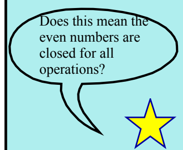
Question: If you add two even numbers (from the set of even numbers), is the sum even?

Checking: $10 + 12 = 22$ Yes, 22 is even.
$6 + 10 = 16$ Yes, 16 is even.
$2 + 102 = 104$ Yes, 104 is even.

Since the sum (the answer) is always even, the set of even numbers is closed under the operation of addition.



Let's check out this question. If you divide two even numbers (from the set of even numbers), is the quotient (the answer) even?

Checking: $16 \div 8 = 2$
$36 \div 6 = 6$
$24 \div 8 = 3$

When you find even ONE example that does not work, the set is not closed under that operation. The even numbers are not closed under division.

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If you change the order you will still get the same sum.
example: $9 + 4 = 13$ $4 + 9 = 13$

If you change the order you will still get the same product.
example: $(9)(4) = 36$ $(4)(9) = 36$

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Associative property of Addition:

22 + 8 = 30
$(12+10)+8=30$
12 + 18 = 30
$12+(10+8)=30$

You can group the same numbers in different ways to add and still get the same sum

"regrouping"

Associative property of Multiplication:

24 · 3 = 72
$(12\cdot2)3=72$
12 · 6 = 72
$12(2\cdot3)=72$

You can group the same numbers in different ways to multiply and still get the same product

"regrouping"

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example: $12+0=12$ Identity prop.

example: $(12)(1)=12$ Identity prop.

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example: $9+(-9)=0$ Inverse prop + "prop of opp"

example: $(4)\left(\frac{1}{4}\right)=1$ Inverse prop × "prop of Reciprocals"

example: $3(x+4)=3(x)+3(4)=3x+12$

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Property	Addition	Multiplication
Closure	a + b is a real number	ab is a real number
Comm. (order)	a + b = b + a	ab = ba
Assc. (Regrouping)	(a + b) + c = a + (b + c)	(ab)c = a(bc)
Identity	a + 0 = a, 0 + a = a	$a\cdot1=a; 1\cdot a=a$
Inverse	$a+(-a)=0$	$a\cdot\frac{1}{a}=1$
Dist.	$a(b+c)=ab+ac$	

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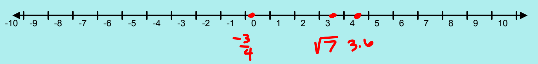
1. Graph the numbers $-\frac{3}{4}, \sqrt{7},$ and 3.6 on a number line.



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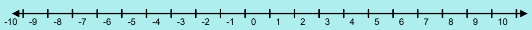
2. Graph the numbers $-\sqrt{2}$, 0.3, and $-2\frac{1}{4}$.



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3. Compare -9 and $-\sqrt{9}$. Use the symbols < and >.

$-9 \; \boxed{<} \; -\sqrt{9}$

$-9 \; \boxed{<} \; -3$

< "less than"

> "greater than"

4. Compare $-\sqrt{0.08}$ and $-\sqrt{0.1}$ using the symbols < an >.

$-\sqrt{.08} \; \boxed{>} \; -\sqrt{.1}$

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5. Find the opposite and the reciprocal of each number.

a) $-3\frac{1}{7}$ $-\frac{22}{7}$

opp. → $3\frac{1}{7}$

Reciprocal → $-\frac{7}{22}$

b) 4

opp. → -4

Reciprocal → $\frac{1}{4}$

c) -0.002 $\frac{2}{1000} = \frac{1}{500}$

opp. → .002

Reciprocal → 500

d) $-\frac{4}{9}$

opp. → $\frac{4}{9}$

Reciprocal → $-\frac{9}{4}$

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6. Which property is illustrated?

a) $(-7)(2\cdot5)=(-7)(5\cdot2)$

Comm. prop ×

b) $3\cdot(8+0)=3\cdot8$

Identity prop +

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6. Which property is illustrated?

c) $(3+0)-5=3-5$

Identity prop +

d) $-5+[2+(-3)]=(-5+2)+(-3)$

Assc. prop +

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7. Simplify:

a) $\left|4\frac{1}{3}\right| = 4\frac{1}{3}$

b) $|-9.2| = 9.2$

c) $|2(3)-4(8)|$

$|6-32|$

$|-26| = 26$

d) $|-10| = 10$

e) $|1.5| = 1.5$

f) $|0-3| = |-3| = 3$

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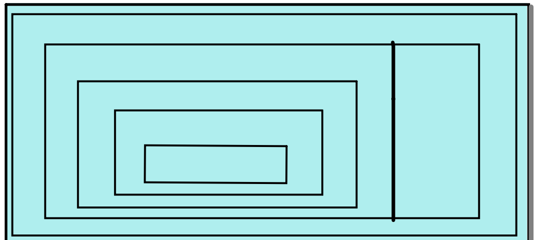

Whole Numbers

Irrational Numbers

Real Numbers

Integers

Natural Numbers

Rational Numbers

Some things the diagram shows:

*The set of whole numbers is a subset of the set of integers, the set of rational numbers, and the set of real numbers.

*The set of rational numbers and the set of irrational numbers do not intersect.

*Integers are not irrational numbers.

*The rational numbers and irrational numbers form the set of real numbers.

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