

WorkBook

INTEGERS and NUMBER LINES

WorkNotes

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INTEGERS

Definitions

There are several sets (groups) of whole numbers. They include

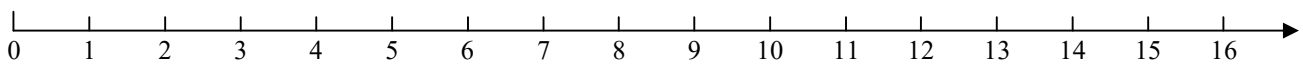
Counting numbers	whole numbers starting at 1.
Cardinal numbers	whole numbers starting at 0.
Integers	all whole numbers (real).

Counting numbers

Counting numbers are whole numbers that, as their name implies, are used for counting. You will always get a counting number as a result of adding or multiplying counting numbers. This is not always true for subtraction or division. A Counting Number Line is drawn below. Notice that the numbers start at 1 and increase infinitely.

Cardinal numbers

Cardinal numbers are whole numbers that, as their name implies, are the main numbers. You will always get a Cardinal number as a result of adding or multiplying Cardinal numbers. This is not always true for subtraction or division. A Cardinal Number Line is drawn below. Notice that the numbers start at 0 and increase infinitely.



Greater Than and Less Than

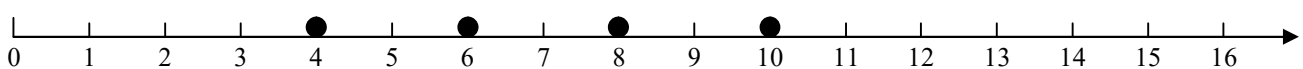
- Numbers that are to the left of other numbers on a number line are said to be Less Than the other numbers.
- Numbers that are to the right of other numbers on a number line are said to be Greater Than the other numbers.

Example	Notation
2 is less than 8	$2 < 8$
8 is greater than 2	$8 > 2$
8 is less than 13	$8 < 13$
12 is greater than 7	$12 > 7$

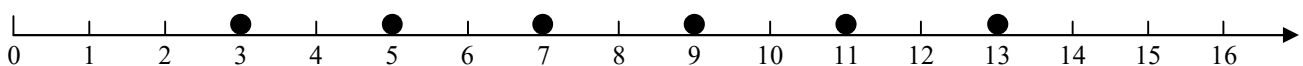
Graphing sets of numbers on a number line.

Sets of numbers can be graphed on a number line. This is a very useful visual representation.

Example. Graph the set of even numbers between 3 and 12.



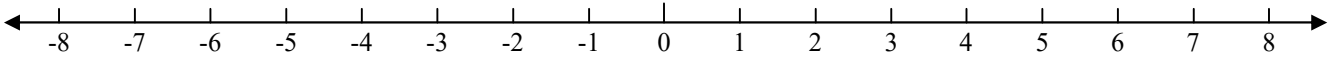
Example. Graph the set of odd numbers from 3 to 13.



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Integers

Integers numbers are whole numbers that extends the cardinals numbers backwards. That is, when counting backwards towards zero, they include the numbers past zero. The numbers that are less than zero are negative numbers. You will always get an integer as a result of adding, subtracting or multiplying integers. This is not always true for division. An Integer Number Line is drawn below. Notice that the numbers are both side of 0 and increase infinitely in both directions.

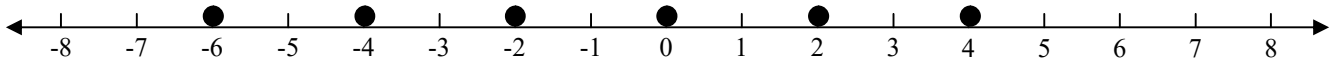


When integers are compared, both their size and direction must be considered. For example, 8 is bigger than 3. Also, 8 is greater than 3. However, -8 is bigger than 3, although -8 is less than 3. Here, the word 'bigger' describes the size while greater than describes the direction. All negative numbers are less than zero, and hence all negative numbers are less than all positive numbers. Conversely, all positive numbers are greater than all negative numbers.

Example	Notation
-2 is less than 8	$-2 < 8$
-8 is less than -2	$-8 < -2$
8 is greater than -13	$8 > -13$
2 is greater than -7	$2 > -7$

Graphing sets of integers on a number line.

Example. Graph the set of integers between -8 and 6 that are divisible by two.



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Addition of integers

Rules

Same sign	ADD, and use the same sign
Different signs	SUBTRACT, and use the 'biggest' sign

Example	Explanations
$3 + 5 = 8$	<ul style="list-style-type: none"> • Same signs. • Both numbers are positive. • Add and use the positive sign (no sign required).
$-3 + 5 = 2$	<ul style="list-style-type: none"> • Different signs. • A negative and a positive number. • Subtract and use the 'biggest' sign (positive).
$3 + -5 = -2$	<ul style="list-style-type: none"> • Different signs. • A positive and a negative number. • Subtract and use the 'biggest' sign (negative).
$-3 + -5 = -8$	<ul style="list-style-type: none"> • Same signs. • Both numbers are negative • Add and use the negative sign

Subtraction of integers

Rules

2 negatives make a positive
i.e. $-- \Rightarrow +$

Example	Explanations
$3 - 5 = -2$	<ul style="list-style-type: none"> • Different signs. (The minus is the same as a negative). • A positive and a negative number. • Subtract and use the 'biggest' sign (negative).
$-3 - 5 = -8$	<ul style="list-style-type: none"> • Same signs. • Both numbers are negative • Add and use the negative sign
$3 - -5 = 8$	<ul style="list-style-type: none"> • $-- \Rightarrow +$, i.e. $3 + 5 = 8$ • Same signs. • Both numbers are positive. • Add and use the positive sign (no sign required).
$-3 - -5 = 2$	<ul style="list-style-type: none"> • $-- \Rightarrow +$, i.e. $-3 + 5 = 2$ • Different signs. • A negative and a positive number. • Subtract and use the 'biggest' sign (positive).

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Multiplication of integers

Rules

Like signs $\Rightarrow +$
Unlike signs $\Rightarrow -$

Example	Explanations
$3 \times 5 = 15$	<ul style="list-style-type: none">• Like signs.• Both numbers are positive.• Multiply and use a positive sign (no sign required).
$-3 \times 5 = -15$	<ul style="list-style-type: none">• Unlike signs.• A negative and a positive number.• Multiply and use a negative sign
$3 \times -5 = -15$	<ul style="list-style-type: none">• Unlike signs.• A positive and a negative number.• Multiply and use a negative sign
$-3 \times -5 = 15$	<ul style="list-style-type: none">• Like signs.• Both numbers are negative• Multiply and use a positive sign (no sign required).

Division of integers

Rules

Same rules as multiplication

Example	Explanations
$15 \div 5 = 3$	<ul style="list-style-type: none">• Like signs.• Both numbers are positive.• Divide and use a positive sign (no sign required).
$-15 \div 5 = -3$	<ul style="list-style-type: none">• Unlike signs.• A negative and a positive number.• Divide and use a negative sign
$15 \div -5 = -3$	<ul style="list-style-type: none">• Unlike signs.• A positive and a negative number.• Divide and use a negative sign
$-15 \div -5 = 3$	<ul style="list-style-type: none">• Like signs.• Both numbers are negative• Divide and use a positive sign (no sign required).