2.1 Use Integers and Rational Numbers

Goal • Graph and compare positive and negative numbers.

Your Notes

VOCABULARY

Whole number are 0, 1, 2, 3, 4 . . .

Integer are whole numbers and their opposites.

$-\infty$ . . . $-3, -2, -1, 0, 1, 2, 3 \ldots + \infty$

INTEGERS - NO FRACTIONS

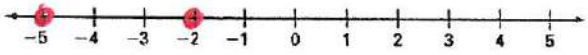
Rational number A NUMBER THAT CAN BE WRITTEN AS A FRACTION.

Example 1 ***Graph and compare integers***

Graph −2 and −5 on a number line. Then tell which number is less.

Solution

$-\infty$ $+\infty$



On the number line, −5 is to the left of −2.

So, $-5 < -2$. OR $-2 > -5$

Negative integers are integers less than 0 and positive integers are integers greater than 0. The integer 0 is neither negative nor positive.

Example 2 ***Classify numbers***

Tell whether each of the following numbers is a whole number, an integer, or a rational number:

POSITIVE

Number	Whole Number?	Integer?	Rational Number?	
3	Y	Y	Y	$\frac{3}{1}$
1.7	N	N	Y	$1\frac{7}{10} = \frac{17}{10}$
−14	N	Y	Y	$\frac{-14}{1}$
$-\frac{1}{2}$	N	N	Y	
$-5\frac{1}{3}$	N	N	Y	$\frac{16}{3}$
$-\sqrt{4}$	N	Y	Y	-2
π	N	N	N	3.14159 . . . ← NO PATTERN
$\sqrt{2}$	N	N	N	1.4142 . . . ← NO PATTERN

2 IS NOT A PERFECT SQUARE

Perfect SQUARE

NOTE: π and $\sqrt{2}$ are irrational numbers

Example 3 *Order rational numbers*

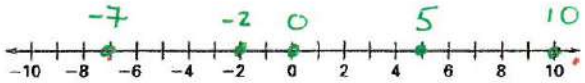
Temperature The table shows the low daily temperatures for a town over a five-day period. Order the ~~days~~ temps from warmest to coldest.

Day	1	2	3	4	5
Temperature	0°C	10°C	−2°C	5°C	−7°C

Solution

Step 1

Graph the numbers on a number line.



Step 2

Read the numbers from left to right: small → big (Coldest to warmest)

-7, -2, 0, 5, 10

From warmest to coldest the days are 10, 5, 0, -2, -7

big → small

Read RIGHT TO LEFT

Your Notes

VOCABULARY

Opposite Two numbers that are the same distance from ZERO. EXAMPLE: 2 and -2

The symbol for opposite is $-a$

Take the opposite of a.

Example 4 *Find opposites of numbers*

a. If $a = -4.8$, then $-a = -(-4.8) = 4.8$.

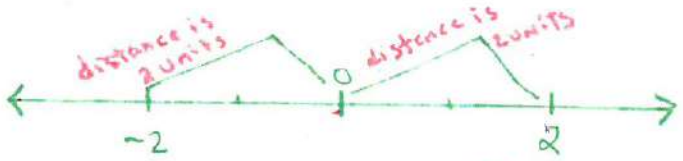
b. If $a = \frac{5}{6}$, then $-a = -\left(\frac{5}{6}\right) = -5/6$

Show substitution

VOCABULARY THINK about || symbols → mean ()'s

Absolute value IS THE DISTANCE FROM ZERO.

The absolute value symbol is | |.



$|-2| = 2$ $\quad |2| = 2$

ABSOLUTE VALUE OF A NUMBER

	Words	Numbers (EXAMPLE)
1	If x is a positive number, then $\lvert x \rvert = x$.	$\lvert 5 \rvert =$ 5
2	If x is 0, then $\lvert x \rvert = 0$.	$\lvert 0 \rvert =$ 0
3	If x is a NEGATIVE number, then $\lvert -x \rvert = x$	$\lvert -4 \rvert =$ 4

3 RULES

Think! Why are these NOT EQUAL?

$|-5| \neq -|5|$

$\downarrow \qquad \downarrow$

$5 \neq -5$

You must follow order of operations

Example 5 *Find absoute values of numbers*

a. If $a = -\frac{3}{7}$, then $|a| = \left|-\frac{3}{7}\right| = \frac{3}{7}$

b. If $a = 2.9$, then $|a| = |2.9| = 2.9$.

"EVALUATE" EXPRESSION

Show substitution

Checkpoint For the given value of a, find $-a$ and $|a|$.

2. $a = 6$	3. $a = -9.5$	4. $a = -\frac{3}{8}$
$-a$ → $-(6) = -6$	$-a = 9.5$	$-a = \frac{3}{8}$
$\lvert a \rvert$ → $\lvert 6 \rvert = 6$	$\lvert a \rvert = 9.5$	$\lvert a \rvert = \frac{3}{8}$

$-a$ means ? take the opposite of a

$|a|$ means ? take the absolute value of a

2.2 Add Real Numbers

Goal • Add positive and negative numbers.

Your Notes

VOCABULARY

Additive identity IS ZERO (0). THE SUM OF A NUMBER "A" AND 0 IS "A": $A+0=A$

Additive inverse means the same as "OPPOSITE". THE SUM OF "A" AND ITS OPPOSITE IS 0: $a+(-a)=0$ ← additive inverse

Example 1 ***Add two integers using a number line***

Use the number line to find the sum.

$5+(-7)=-2$

a. $-5+7=$ $+2$ $=(2)$

Remember: To add a positive number, move to the right on a number line. To add a negative number, move to the left.

How do you add a POSITIVE and a NEGATIVE number?

[1] TAKE THE DIFFERENCE OF THE NUMBERS

[2] KEEP THE SIGN OF THE LARGER ABSOLUTE VALUE

b. $-3+(-4)=$ -7

How do you add numbers with the same signs?

[1] ADD THE NUMBERS

[2] KEEP THE SIGN

Your Notes

RULES OF ADDITION

To add two numbers with the *same sign*:

1. Add their ABSOLUTE VALUES
2. The sum has the Same SIGN as the numbers added.

Example: $-5 + (-7) =$ -12

To add two numbers with *different signs*:

1. Subtract the lesser absolute value.
2. The sum has the Same SIGN as the number with the GREATER absolute value.

Example: $-10 + 4 =$ -6

Example 2 ***Add real numbers***

Find the sum.

a. $-2.5 + (-4.2) =$

$=$ Mental STEP

$=$ -6.7

Rule of same signs
Take absolute values.
Add.

b. $10.5 + (-15.0) =$

$=$ MENTAL STEP

$=$ -4.5

Rule of different signs
Take absolute values.
Subtract and take sign from greater absolute value.

Checkpoint **Find the sum.**

1. $-7 + (-3)$	2. $9.6 + (-2.1)$
-10	+7.5

(3) $5+(-9)+(-12)+6$

Tip
- Add −'s
- Then add +'s

$-21+11=$

-10

Your Notes

IN FINAL ANSWERS

Not - → +(-1)
X
NO
NO

PROPERTIES OF ADDITION

Commutative Property The order in which you add two numbers does not change the sum.

$a + b =$ b + a ← NOTICE THE VARIBLES SWITCH. REVERSE THE TERMS. THE RESULTS ARE EQUAL.

Example: $-1 + 3 =$ 3 + (-1)

Associative Property The way you group three numbers in a sum does not change the sum.

$(a + b) + c =$ a + (b + c) ← ASSOCIATE MEANS GROUPING SYMBOLS. NOTICE TERM STAY IN SAME ORDER

Example: $(1 + 2) + 3 =$ 1 + (2 + 3)

Identity Property The sum of a number and 0 is the number.

$a + 0 =$ a ← "ANYTHING PLUS "0" IS ITSELF"

Example: $4 + 0 =$ 4

Inverse Property The sum of a number and its opposite is 0.

$a + (-a) =$ 0 ← ADD OPPOSITES EQUALS ZERO

Example: $-9 +$ 9 $= 0$

* what is the difference between terms and factors?

IMPORTANT DEFINITIONS

** "TERMS" are seperated by +, - SIGNS.

** "FACTORS" are seperated by MULT. SIGNS.

EXAMPLES

3 TERMS:

-2x -5 +10 → 2x, -5, 10

3 FACTORS

-5 x y → -5, x, y

Checkpoint Identify the property being illustrated.

Commutative
Associative
IDENTITY
INVERSE

3. $-5 + 5 = 0$
INVERSE

4. $(-5 + 2) + 3 = -5 + (2 + 3)$
ASSOCIATIVE

5. $x + 5 = 5 + x$
~~COMMUTATIVE~~ COMMUTATIVE

6. $y + 0 = y$
Additive IDENTITY

7. $(5 + 6) + 7 = (6 + 5) + 7$
COMMUTATIVE

2.3 Subtract Real Numbers

Goal • Subtract real numbers.

Your Notes

SUBTRACTION RULE → "ADD THE OPPOSITE"

Words: To subtract b from a, add the OPPOSITE of b to a.

Algebra: $a - b = a + (-b)$

Numbers: $15 - 7 = 15 + (-7)$

THERE IS NO SUCH THING AS SUBTRACTION NOW! We simply add positive and negative #'s.

Example 1 *Subtract real numbers*

Find the difference. ← write as an addition problem

a. $-10 - 4 = -10 + (-4) = -14$

b. $13 - (-11) = 13 + 11 = 24$

Example 2 *Evaluate a variable expression*

Evaluate the expression $a - b + 5.3$ when $a = 6.5$ and $b = -3$.

Solution

$a - (b) + 5.3 = 6.5 - (-3) + 5.3$ **Substitute values.**

$= 6.5 + 3 + 5.3$ **Add the opposite of -3.**

$= 14.8$ **Add.**

ALWAYS use ( )'s when substituting NEGATIVE #'s to make sure you do order of operations correctly.

Checkpoint **Find the difference.**

1. $-4 - 8$

$-4 + (-8) =$

-12

2. $9 - 18$

$9 + (-18) =$

-9

Write as an addition problem → Then evaluate

Checkpoint **Evaluate the expression when $m = 3.2$ and $t = -4$.** Show substitution

3. $m - t + 2 =$

$3.2 - (-4) + 2 =$

$3.2 + 4 + 2 =$

9.2

4. $(m - 3) - t$

$[(3.2) - 3] - (-4)$

$.2 + 4 =$

4.2

Show substitution → write as Add problem → EVALUATE