Additive Inverses (Opposite):
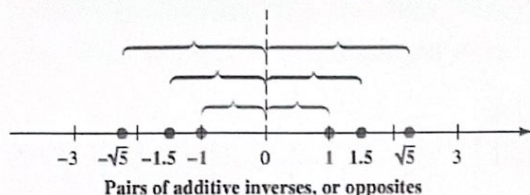
2 & -2 are opposites

2 + -2 = 0

additive inverses

-3   -√5 -1.5 -1   0   1   1.5 √5   3

Pairs of additive inverses, or opposites

FIGURE 11

What is the additive inverse of -9?

↳ 9

What is the additive inverse of 2.4?

↳ -2.4

1.5 Adding and Subtracting Real Numbers

pos: right on #line
neg: ⌄ left

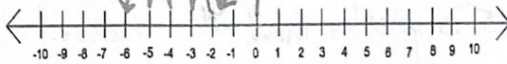**EXAMPLE 1**   Adding Numbers on a Number Line

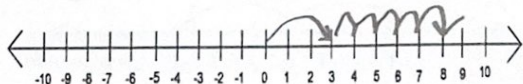Use a number line to find each sum.

(a) $2 + 3$ start   = 5
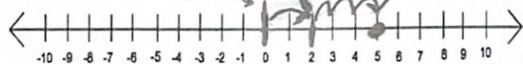
(b) $-2 + (-4) = -6$

c) $3 + 5 = 8$

d) $-1 + (-3) = -4$

Add absolute values

Adding numbers with the same sign

① Find the total amount right, or total amount left.

② If left, use a neg. sign in your final answer

EXAMPLE 2   Adding Two Negative Numbers

Find each sum.

(a) $-2 + (-9)$ Total left: 11
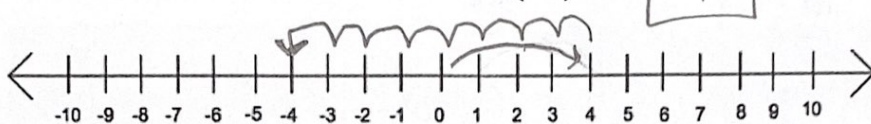
= $\boxed{-11}$

(b) $-8 + (-12)$ Total left: 20

= $\boxed{-20}$

(c) $-15 + (-3)$ Total left: 18

= $\boxed{-18}$

EXAMPLE 3   Adding Numbers with Different Signs   *Pos ₹ Neg*

Use a number line to find the sum $-2 + 5$.
left   right $= \boxed{3}$

Use the number line to find the sum: $4 + (-8)$ $= \boxed{-4}$

Adding numbers with different signs

① Cancel the overlap by <u>subtracting</u> absolute values

② Use the sign of the bigger absolute value in your answer

EXAMPLE 4   Adding Numbers with Different Signs   → *Neg. answer*

Find the sum $-12 + 5$.

$= \boxed{-7}$

$|-12| = 12$
$|5| = 5$ ⟹ $\begin{array}{r} 12 \\ -5 \\ \hline \boxed{7} \end{array}$ ⟹ -12 has bigger distance from zero (absolute value)

EXAMPLE 5   Adding Mentally

Check each answer by adding mentally. If necessary, use a number line.

(a) $7 + (-4)$

$= \boxed{3}$

(b) $-8 + 12$

$= \boxed{4}$

c) $-\frac{1}{2} + \frac{1}{8}$

$-\frac{4}{8} + \frac{1}{8} = \boxed{\frac{-3}{8}}$

d) $-16 + 16$ *(additive inverses)*

$= \boxed{0}$

(opposites)

e) $\frac{3}{4} + -\frac{7}{4} + \frac{5}{4}$

$\frac{-4}{4} + \frac{5}{4} = \boxed{\frac{1}{4}}$

EXAMPLE 6 Using the Definition of Subtraction

Subtraction is the same as "adding the opposite"

(a) $12 - 3$

$= 12 + (-3) = \boxed{9}$

(b) $5 - 7$

$5 + (-7) = \boxed{-2}$

(c) $-6 - 9$

$-6 + (-9) = \boxed{-15}$

(d) $-3 - (-5)$

$-3 + 5$

$= \boxed{2}$

(e) $\dfrac{4}{3} - \left(-\dfrac{1}{2}\right)$

$\dfrac{4}{3} + \dfrac{1}{2} = \dfrac{4 \cdot 2}{3 \cdot 2} + \dfrac{1 \cdot 3}{2 \cdot 3} = \dfrac{8}{6} + \dfrac{3}{6} = \boxed{\dfrac{11}{6}}$

Uses of the Symbol –

We use the symbol – for three purposes:

1. *to represent subtraction,* as in $9 - 5 = 4$;

2. *to represent negative numbers,* such as -10, -2, and -3;

3. *to represent the opposite (or negative) of a number,* as in "the opposite (or negative) of 8 is -8."

$-|-2|$

↑

The opp. of $|-2|$

EXAMPLE 7 Adding and Subtracting with Grouping Symbols

Perform each indicated operation.

a) $-6 - [2 - (8 + 3)]$

P
E
MD
AS

neg. subtr. $-6 - [2 - 11]$

$= -6 - [-9]$

$= -6 + 9 = \boxed{3}$

b) $|4 - 7| + 2|6 - 3|$

P
E
MD
AS

$|-3| + 2 \cdot |3|$

$3 + 2 \cdot 3$

$3 + 6 = \boxed{9}$

You try!

e) $8 - [(-3 + 7) - (3 - 9)]$

$8 - [4 - (-6)]$

$8 - [4 + 6]$

$8 - 10 = \boxed{-2}$

f) $3|6 - 9| - |4 - 12|$

$3 \cdot |-3| - |-8|$

$3 \cdot 3 - 8$

$9 - 8 = \boxed{1}$

Word or Phrase	Example	Numerical Expression and Simplification
Sum of	The *sum of* −3 and 4	−3 + 4, or 1
Added to	5 *added to* −8	−8 + 5, or −3
More than	12 *more than* −5	−5 + 12, or 7
Increased by	−6 *increased by* 13	−6 + 13, or 7
Plus	3 *plus* 14	3 + 14, or 17

Add (handwritten)

Word, Phrase, or Sentence	Example	Numerical Expression and Simplification
Difference between	The *difference between* −3 and −8	−3 − (−8) simplifies to −3 + 8, or 5
Subtracted from*	12 *subtracted from* 18	18 − 12, or 6
From…, subtract….	*From* 12, *subtract* 8.	12 − 8 simplifies to 12 + (−8), or 4
Less	6 *less* 5	6 − 5, or 1
Less than*	6 *less than* 5	5 − 6 simplifies to 5 + (−6), or −1
Decreased by	9 *decreased by* −4	9 − (−4) simplifies to 9 + 4, or 13
Minus	8 *minus* 5	8 − 5, or 3

Subtract (handwritten)

EXAMPLE 8 Translating Words and Phrases (Addition)

Write a numerical expression for each phrase, and simplify the expression.

a) The sum of -8 and 4 and 6

add!
$$-8 + 4 + 6$$
$$-4 + 6 = \boxed{2}$$

b) 3 more than -5, increased by 12

add 3 onto -5   add!
$$3 + {}^-5, + 12$$
$$-2 + 12 = \boxed{10}$$

Write a numerical expression and then simplify.

c) The difference between 5 and -8, decreased by 4   subtract

subtract in order
$$5 - (-8) - 4$$
$$5 + 8 - 4$$
$$13 - 4 = \boxed{9}$$

d) 7 less than -2

take 7 away from
$$-2 - 7$$
$$-2 + {}^-7$$
$$\boxed{-9}$$

EXAMPLE 10 Solving a Problem Involving Subtraction

The record-high temperature in the United States is 134°F, recorded at Death Valley, California, in 1913. The record low is −80°F at Prospect Creek, Alaska, in 1971. See FIGURE 16. What is the difference between these highest and lowest temperatures? (*Source: National Climatic Data Center.*)

⤷ subtract

$$134 - (-80)$$
$$134 + 80 \quad = \boxed{214°}$$

134°

134°
+ 80°
‾‾‾‾‾
214°
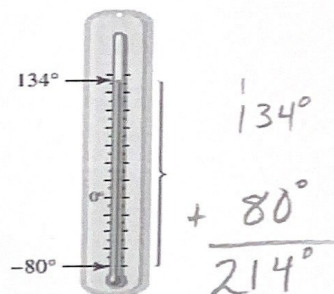
10b) Find the difference between a gain of 226 yards on the football field by the Chesterfield Bears and a loss of 7 yards by the New London Wildcats.   226

loss
−7

$$226 - (-7)$$
$$= 226 + 7 = 233 \text{ yards}$$