

Introduction

This lesson covers subtraction of integers. It assumes knowledge of addition of integers.

Standards Assessed

California Content Standards for Algebra I – Grades 8-12

1.0 Students identify and use the arithmetic properties of subsets of integers, rational, irrational, and real numbers, including closure properties for the four basic arithmetic operations where applicable.

Addition Review

Here is a quick summary of the rules for adding rationals.

- If both numbers are positive, then add as usual:

$$4 + 8 = 12$$

- If both numbers are negative, add their absolute values, and make the result negative:

$$-4 + (-8) = -12$$

- If the signs of the numbers differ, then take the difference between their absolute values, and keep the sign of the one with the larger absolute value:

$$4 + (-8) = -4$$

Representing Change with Integers

Positive numbers can be used to represent things such as gain, increase, or height. For example, we might say **+20** represents a bank deposit of \$20, or money received for mowing a neighbor's lawn. On the other hand, negative numbers can be used to represent loss, decrease, or depth. For example, **-10** can represent a withdrawal of \$10 from a bank account, or that the temperature drops 10° overnight. Zero is used to indicate no change.

Practice: Represent the following using integers.

The temperature rose 10° this afternoon. +10

Pedro lost a \$20 bill on the bus. -20

Janet earned \$150 in sales today.

The rock sunk 1,000 meters beneath the sea.

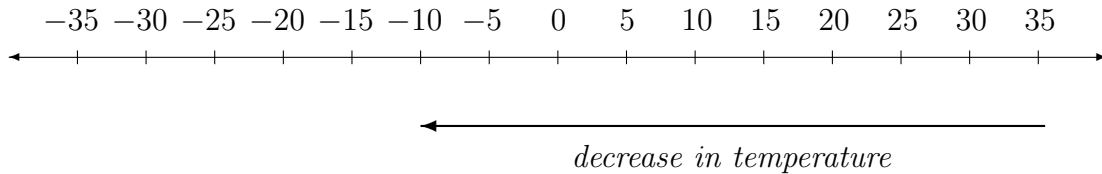
Omar lost 5 pounds.

Janice earned 10 points extra credit on her exam.

An Example

Joanna spent last winter in Wisconsin. One day the temperature dropped from 35°F to -10°F . How much did the temperature drop?

The picture below gives a visual representation of the decrease in temperature. The arrow below the number line represents the temperature decrease, and its length is the actual decrease in temperature.



The length of the arrow is 45, so the temperature dropped 45°F overnight. Said differently, this problem asks us to

find the difference between 35 and -10 .

We find the difference between two numbers by subtracting them. Our problem then says that

$$35 - (-10) = 45.$$

But how?

Subtracting a negative is the same as adding a positive:

$$35 - (-10) = 35 + 10 = 45.$$

One way to understand this is to think of subtracting a negative as subtracting (or removing) a debt. For example, if Lindy owes Richard \$10, her debt is erased if she pays Richard \$10. So whenever we subtract a negative (remove a debt), we are in fact adding a positive (making a payment). And vice-versa, subtracting a positive (losing money) is the same as adding a negative (adding debt). For example,

$$10 - 6 = 10 + (-6) = 4.$$

The general rule is

subtracting a number is the same as adding its opposite.

Using this idea, we can change any subtraction problem into an addition problem. Here are some examples.

$$5 - (-3) = 5 + 3 = 8$$

$$-10 - (-30) = -10 + 30 = 20$$

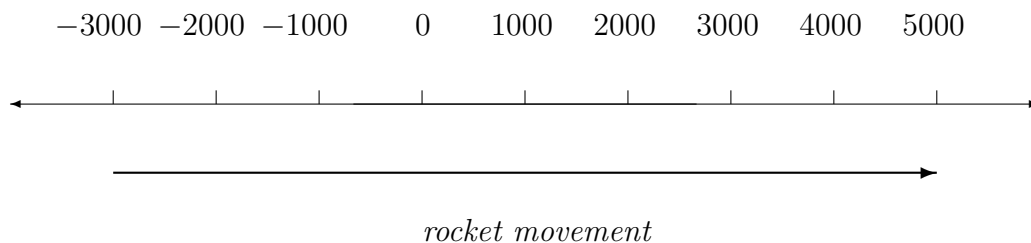
$$23 - 37 = 23 + (-37) = -14$$

$$-11 - 12 = -11 + (-12) = -23$$

Another Example

Experimental Rockets, Inc., fired a rocket from the ocean floor 3000 meters below sea level. The rocket travelled 5000 meters into the air above the ocean before a malfunction caused it to explode. How far did the rocket travel?

On the number line, we can represent 3000 meters below the sea as -3000 , and 5000 meters above sea level as $+5000$.



So our difference is 8000 meters as shown on the line. Instead of using the number line, we could compute the difference directly:

$$5000 - (-3000) = 5000 + 3000 = 8000 \text{ meters.}$$

Exercises

1. The current temperature is 12 degrees below zero. If the temperature drops 15 degrees, what is the resulting temperature?

Answer. Use -12 to represent the temperature. If the temperature drops 15 degrees, then we subtract 15 from the current temperature and get

$$-12 - 15 = -12 + (-15) = -27$$

so the resulting temperature is 27 degrees below zero.

2. The current temperature in Los Angeles is 21°C . The current temperature in Denver, CO is -21°C . What is the difference in temperature between these cities?

3. Nina borrowed \$10 from Claria. Forgetting Nina's debt to her, Claria borrowed \$25 from Nina the next day. Does Nina owe money to Claria, or does Claria owe Nina? How much? Write down the subtraction problem that gives the right answer.

4. After reaching an altitude of 10,000 meters, a rocket fell straight down into the ocean to a depth of 1,500 meters. How far did the rocket travel from its peak height?