## Subtracting Integers

The subtraction of integers can be demonstrated in a variety of ways, such as using number lines, manipulatives and a T-chart, calculator or shortcuts.

Parentheses are often used around integers and their positive/negative signs to reduce confusion when trying to perform mathematical operations.

## Subtracting I ntegers Using a Number Line

The process for subtracting integers is a lot like the process for adding them, except the direction is reversed.

Step 1: Draw a number line.
Step 2: Locate the first number on the number line.
Step 3: Move the number of spaces as shown by the second number.

- Move to the left if the second integer is positive.
- Move to the right if the second integer is negative.

The number that you land on after moving the correct number of spaces to the left or right is the answer.

## Examples A) $(+3)-(+5)$

Step 1: Draw a number line using integers.


Step 2: Locate the first number on the number line.


Step 3: From the first number, move five spaces to the left.


## Conclusion:

$(+3)-(+5)=-2$

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B) $(-1)-(+4)$


$$
(-1)-(+4)=-5
$$

Move four places to the left of the first number because the second number is positive.
C) $(-4)-(-6)$


$$
(-4)-(-6)=+2
$$

Move six places to the right of the first number because the second number is negative.
D) $(+5)-(+5)$


$$
(+5)-(+5)=\mathbf{0}
$$

Move five places to the left of the first number because the second number is positive.
E) On Tuesday, the temperature at noon was $+20^{\circ} \mathrm{C}$. The temperature increased by $4^{\circ} \mathrm{C}$ in the next two hours. What was the final temperature at 2:00 p.m.?

Add the temperature and the increase.

$$
\begin{aligned}
& \left(+20^{\circ} \mathrm{C}\right)+\left(+4^{\circ} \mathrm{C}\right)=? \\
& 20^{\circ} \mathrm{C}+4^{\circ} \mathrm{C}=24^{\circ} \mathrm{C}
\end{aligned}
$$



The temperature at 2:00 p.m. was $+24^{\circ} \mathrm{C}$.

You can also use a vertical number line to help you think about subtracting integers.
Think of a hot air balloon floating through the points on a vertical number line.
Positive numbers are like puffs of air to lift the hot air balloon up.
Negative numbers are like sandbags to weigh the hot air balloon down.
To subtract integers, place the first number on the number line. Look at what the second number is (positive $=$ a puff of air; negative $=$ a sandbag). Move along the number line the number of spaces as shown by the second number. Remember that when you're subtracting, you have to remove that number of puffs of air (which will cause the balloon to sink) or sandbags (which will cause the balloon to rise).

## Examples

A) $(-2)-(+4)=$ $\qquad$

Start the balloon here, at the first number.

You land here on (-6).
You land here on (-6).


The operation says to subtract a positive number ( +4 ). This means you remove 4 puffs of air, so the balloon will sink.

Conclusion: $\quad(-2)-(+4)=(-6)$
B) $(+4)-(-2)=$ $\qquad$
What does this mean?
Think about the second number as puffs of air or sandbags. Start with (+4) and SUBTRACT ( -2 ). This means you remove 2 sandbags, which will lighten your hot air balloon and the balloon will rise.

Look on the vertical number line.


Conclusion: $(+4)-(-2)=(+6)$
C) $(+4)-(+3)=$ $\qquad$
Remember, positive numbers are like puffs of air, so you have to subtract or remove 3 puffs of air. This will cause the balloon to sink.


Conclusion: $(+4)-(+3)=(+1)$
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D) $(-4)-(-5)=$ $\qquad$
Remember, negative numbers are like sandbags, so you have to subtract or remove 5 sandbags. This will lighten your hot air balloon and cause it to rise.


Conclusion: $(+4)-(-5)=(+1)$

## Subtracting I ntegers Using Manipulatives and a T-chart

## Examples

A) $(-4)-(-2)$


Step 1: Place objects on the chart to represent the value of the first integer.

Step 2: Remove or subtract the value of the second integer from the chart.


The solution to the problem is the number of objects remaining. The colour of the objects and the sign on the T-chart is the sign used in the solution.

$$
(-4)-(-2)=-2
$$

Proof:

B) $(+4)-(-2)$


Step 1: Place the value of the first integer onto the chart using the correctly coloured objects.

Step 2: Remove or subtract the value of the second integer ( -2 ). To solve the equation, we need to remove 2 negative objects, but there are no negative objects to remove or subtract from the chart.

Two negative objects CAN be brought onto the chart without changing the original question by bringing them in pairs with two positive objects.

Remember: Each pair of objects equals zero, because: $(-1)+(+1)=0$

$$
\square O=0
$$

The solution to the question is the number of objects remaining.

$$
(+4)-(-2)=+6
$$

Proof:

C) $(-3)-(+5)$


Step 1: Add objects to the chart to represent the value of the first integer.

Step 2: We need to remove 5 positive objects. Five positive objects CAN be brought onto the chart without changing the original question by bringing them in pairs, with five negative objects.

Step 3: Remove 5 positive objects.
The solution to the subtraction problem is the number of objects remaining on the chart.

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

Proof:

D) Weather forecasters subtract integers to determine temperature decreases during the day.


On Wednesday, the temperature was $-2^{\circ} \mathrm{C}$ at 6:00 a.m. By 10:00 a.m., the temperature increased $4^{\circ} \mathrm{C}$. By 1:00 p.m., the temperature dropped $1^{\circ} \mathrm{C}$. What was the final temperature at 1:00 p.m.?

$$
\left(-2^{\circ} \mathrm{C}\right)+\left(+4^{\circ} \mathrm{C}\right)-\left(+1^{\circ} \mathrm{C}\right)=?
$$

Use manipulatives.


The temperature at 1:00 p.m. was $+1^{\circ} \mathrm{C}$.

## Subtracting Integers Using a Calculator

Calculators can be used to subtract integers if the calculator
 has an integer button. On many models, the integer button looks like this:


Depending on the model of calculator, subtraction of integers using a calculator can be accomplished using one of two methods.

## Calculator Method \#1

## Example

1. Enter the value of the first integer, followed by the $++/-$ key only if the integer is
negative.

2. Press the $-\quad$ key.
3. Enter the value of the second integer, followed by the $+/-\quad$ key only if the integer is negative.

4. Press the $=$ key to display the answer.

$$
(-12)-(-26)=+14
$$

## Calculator Method \#2

## Example

E.g., (-10) - (+14)

1. If the first integer is negative, press the $++/-$ key on the calculator, then enter the value of the first integer.

2. Press the $-\quad$ key.
3. If the second integer is negative, press the $++/-$ key, then enter the value of the second integer. In this example, the second integer is positive so the $+/-$ key is not pushed.

4. Press the $\quad=\quad$ key to display the answer.


$$
(-10)-(+14)=-24
$$

## Example

Check out these examples of subtracting integers using a calculator.
A) $(+16)-(-4)$


$$
(+16)-(-4)=+20
$$

B) On Monday, the temperature increased from $+4^{\circ} \mathrm{C}$ to $+19^{\circ} \mathrm{C}$. By how many degrees did the temperature change during the day?

Subtract the lower temperature from the higher temperature.

$$
19^{\circ} \mathrm{C}-4^{\circ} \mathrm{C}=15^{\circ} \mathrm{C}
$$

Use a calculator.


The change in temperature was $+15^{\circ} \mathrm{C}$.

## Subtracting I ntegers Using Shortcuts

Subtraction of integers can be thought of as "adding the opposite." That is, changing the subtraction question into an addition question.


- The subtraction sign (-) is changed to an addition sign (+) between the two integers.
$(+5)+(-2)$
- The sign of the second integer is also changed to its opposite sign. In the example, the opposite of -2 is +2 .

$$
(+5)+(+2)
$$

Apply the rules for adding integers.

Proof: $\quad(+5)-(-2)=+7$


Proof: $\quad(+5)+(+2)=+7$



Weather forecasters or meteorologists must be able to add and subtract integers to compare temperatures from one region to another and determine temperature increases or decreases during the day.

Meteorologists create number sentences or mathematical questions and then solve these questions to determine temperature changes or differences.

## Example

At 6:00 a.m., the temperature was $-18^{\circ} \mathrm{C}$. Within the next hour, the temperature dropped another $5^{\circ} \mathrm{C}$. It then rose by $3^{\circ} \mathrm{C}$, only to drop again $6^{\circ} \mathrm{C}$. What was the final temperature?
$\left(-18^{\circ} \mathrm{C}\right)+\left(-5^{\circ} \mathrm{C}\right)+\left(+3^{\circ} \mathrm{C}\right)+\left(-6^{\circ} \mathrm{C}\right)$. The final temperature is $-26^{\circ} \mathrm{C}$.
What is the difference between the initial and final temperatures?
$\left(-18^{\circ} \mathrm{C}\right)-\left(-26^{\circ} \mathrm{C}\right)=+8^{\circ} \mathrm{C}$


## Practice: Subtracting Integers

1. Answer the following by changing the subtraction equation into an addition equation. The first two have been done for you.
a) $(+2)-(-7)$
$=(+2)+(+7)$

$$
=+9
$$

b) $(-2)-(+6)$
$=(-2)+(-6)$

$$
=-8
$$

c) $(+7)-(+4)$

$$
=
$$ $=(+7)+(-\quad)$

d) $(-8)-(-4)$ $=(-8)+(\quad)$ $=$
e) $(-2)-(-5)$
$=$
$=$
f) $(+5)-(-7)$
=
$=$
2. Write each problem as a mathematical sentence or question using integers. Then choose a calculation method, such as a number line, manipulatives or a calculator, to find the solution to each problem.
a) The temperature increases from $-15^{\circ} \mathrm{C}$ to $+2^{\circ} \mathrm{C}$ during the day. What is the difference between these two temperatures?
b) The temperature drops from $-13^{\circ} \mathrm{C}$ to $-24^{\circ} \mathrm{C}$. What is the difference between these two temperatures?
c) A climber starts at an elevation of -180 m and climbs to an elevation of 240 m . How high did this person climb in total?
d) The temperature of a cup of hot chocolate is $50^{\circ} \mathrm{C}$. A frozen treat has a temperature of $-10^{\circ} \mathrm{C}$. What is the temperature difference between these two items?

