# Adding integers

*An elevator three floors below the street goes up seven floors. Where does it stop? How do you add two numbers that pull in opposite directions?*

## WORDS TO KNOW

**Integers:** the whole numbers and their opposites, such as −3, 0 and 5.

**Absolute value:** how far a number is from zero, written $|a|$. So $|-8| = 8$ and $|8| = 8$.

**Sum:** the answer to an addition.

**Opposite:** the number the same distance from zero on the other side. The opposite of 6 is −6.

**Zero pair:** one positive counter (+1) and one negative counter (−1). Together they are worth 0.

## KEY IDEAS

### 1. A sum is a start and a move

To add $a + b$, start at $a$ on the number line and make the move $b$. A positive number moves right. A negative number moves left. Where you land is the sum.

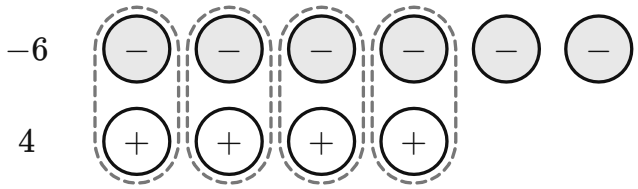
When the move points back toward zero and is longer than the distance to zero, the first steps bring you to zero and the rest carry you past it. Starting at 3 and moving 7 to the left, 3 steps reach 0 and 4 more land on −4.

$$a + 0 = a \qquad a + (-a) = 0$$

A number plus its opposite always lands on 0.

### 2. With counters, zero pairs cancel

Show each number with counters, put the two piles together, and ring the zero pairs. Each zero pair is worth nothing. What is left over is the sum. In the picture, −6 + 4 makes four zero pairs and leaves two negatives, so −6 + 4 = −2.




$$-6 + 4 = -2$$

### 3. Adding without a model

**Same signs:** add the absolute values and keep the shared sign.

**Different signs:** subtract the smaller absolute value from the larger. The sum takes the sign of the number farther from zero.

**Opposites:** the sum is 0, which has no sign.

In a long sum you may change the order and the grouping. Add all the positive numbers, add all the negative numbers, then combine the two totals.


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## WATCH OUT

- **Do not add the sizes when the signs differ.** In $-11 + 3$ the 3 cancels part of the $-11$. The sum is $-8$, not $-14$.
- **Take the sign of the number farther from zero,** not the sign of the first number. In $4 + (-10)$ the $-10$ is farther from zero, so the sum is negative: $-6$.
- **Adding does not always make a number bigger.** Adding a negative number moves left: $8 + (-3) = 5$, which is less than 8.

## WORKED EXAMPLES

**Example 1. Use the number line to find $-4 + 9$.**

1. Start at $-4$. The number 9 is a move of 9 to the right.
2. The first 4 steps bring you to 0. That leaves $9 - 4 = 5$ more steps, which land on 5.

**Answer:** $-4 + 9 = 5$. It is positive because the move right was longer than the distance back to zero.

**Example 2. Find (a) $16 + (-52)$ and (b) $-19 + (-14)$ without a model.**

1. (a) The signs are different, so subtract the absolute values: $52 - 16 = 36$.
2. The number farther from zero is $-52$, so the sum is negative: $16 + (-52) = -36$.
3. (b) Both numbers are negative, so add the absolute values, $19 + 14 = 33$, and keep the negative sign.

**Answer:** (a) $-36$ (b) $-33$. **Check:** on (a), $-36 + 52 = 16$, so 16 and $-52$ do add to $-36$.

**Example 3. Find $-13 + 7 + (-5) + 18 + (-2)$.**

1. Collect the positive numbers: $7 + 18 = 25$.
2. Collect the negative numbers: $-13 + (-5) + (-2) = -20$.
3. Combine the two totals. The signs differ: $25 - 20 = 5$, and 25 is farther from zero.

**Answer:** 5. **Check:** left to right, $-13 + 7 = -6$, then $-6 + (-5) = -11$, then $-11 + 18 = 7$, then $7 + (-2) = 5$.


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