

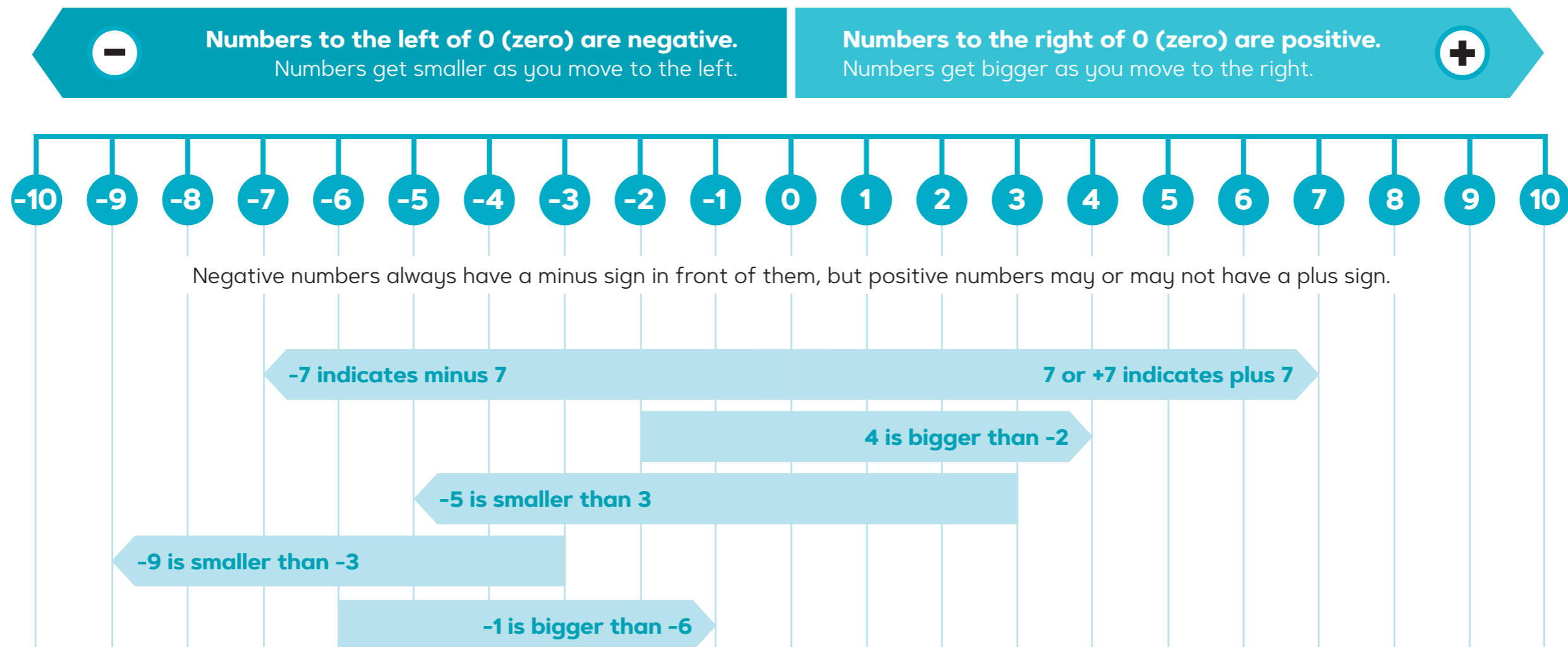
What are negative numbers?

A **negative number** is a number less than zero.
Numbers greater than zero are **positive numbers**.
Zero is neither positive nor negative.

When are negative numbers used?

Temperatures can be measured using negative numbers.
Banks use negative numbers to indicate that accounts are overdrawn.
Depths below sea level can be described using negative numbers.

Negative numbers on the number line



Level 5

Understand and use negative numbers in context.

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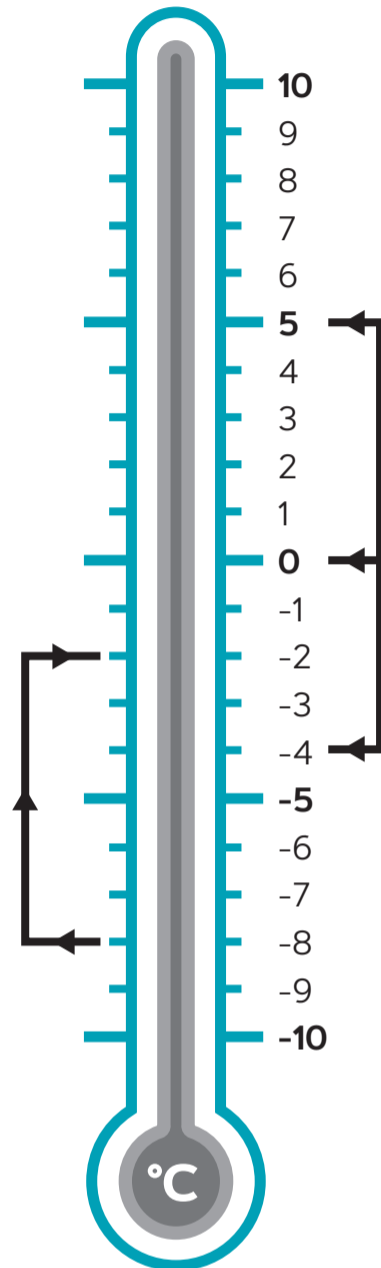
Temperatures can be measured using negative numbers. Banks use negative numbers to indicate that accounts are overdrawn. Depths below sea level can be described using negative numbers.

Negative numbers in temperature

The temperature in Moscow is -8°C at 7.00 am and increases by 6°C during the morning.

What is the new temperature?

1. Find -8 on the number line.
2. Move 6 steps upwards.
3. Record the new temperature, which is -2°C .



The average January temperature in Dublin is 5°C . In Oslo the average January temperature is -4°C .

What is the difference in average temperature between the two cities?

1. Find 5 and -4 on the number line.
2. Count the steps from 5 to 0 and then from 0 to -4 and add them together: $5 + 4 = 9$ steps.
3. Record the total, 9°C . This is the difference in temperature.

Negative numbers in the context of sea level

Sea level is the base level for measuring heights on land or depths under the sea:

- The base (sea) level is zero.
- Heights above sea level are positive numbers.
- Depths below sea level are negative numbers.

Example

Mount Everest is the tallest peak on Earth at a height of 8848 m above sea level.

The Mariana Trench is the lowest point on the surface of Earth at 10 994 m below sea level.

What is the difference in height between them?

Mount Everest: $+8848$ m

Mariana Trench: $-10\,994$ m

The difference in height is $8848 + 10\,994 = 19\,842$ m

This is almost 20 km.

Negative numbers in bank balances

Hannah has £35 in her bank account. She spends £60 on a new pair of jeans.

What is the balance in her bank account?

Hannah has spent £25 ($\pounds 60 - \pounds 35$) more than she actually has in her account, so she owes the bank £25

Her balance is now $-\pounds 25$

The next day Hannah puts £100 into her bank account.

What is her balance now?

Hannah owed the bank £25, so she now has £75 in her account ($\pounds 100 - 25$).

Her balance is now £75

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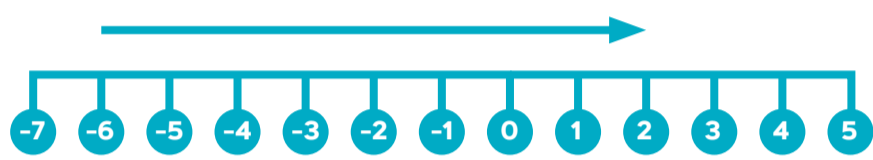
Adding with negative numbers can be done using a **number line** or by **calculation**.

When adding a positive number to a negative number:

- Ignore the signs and subtract the smaller number from the bigger number
- Look back at what sign the bigger number had
- Include this sign in the answer

Example: Work out $-6 + 8$

Using a number line



Find -6 on the number line.
Move 8 steps in the positive direction (to the right).
The answer is 2 (or +2)

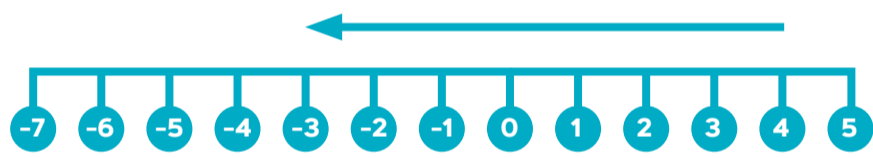
OR

By calculation

This can be rewritten as $+8 - 6$
 $+8 - 6 = 8 - 6$
 $8 - 6 = 2$
8 originally had a positive sign
The answer is 2

Example: Work out $4 - 7$

Using a number line



Find 4 on the number line.
Move 7 steps in the negative direction (to the left).
The answer is -3

OR

By calculation

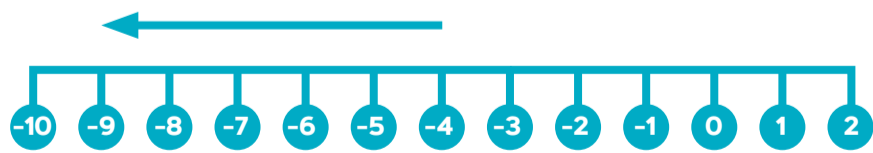
This can be rewritten as $-7 + 4$
Ignore the signs and subtract 4 from 7
 $7 - 4 = 3$
7 originally had a negative sign
The answer is -3

When adding a negative number to a negative number:

- Ignore the signs and add the numbers together
- Include a negative sign in the answer

Example: Work out $-4 + -5$

Using a number line



Find -4 on the number line.
Move 5 steps in the negative direction (to the left).
The answer is -9

OR

By calculation

Ignore the signs and add 4 and 5
 $4 + 5 = 9$
Include a negative sign in the answer
The answer is -9

Level 5

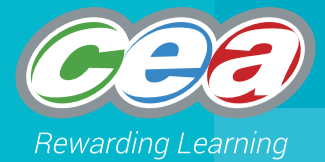
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Adding and subtracting with negative numbers

Calculations involving negative numbers can have two signs side by side.

If the signs are the same, replace with a **+** sign.

Add 5 to 3

$$\begin{aligned} 3 + (+5) &= 3 + +5 \\ &= 3 + 5 = \mathbf{8} \end{aligned}$$

Subtract -5 from 3

$$\begin{aligned} 3 - (-5) &= 3 - -5 \\ &= 3 + 5 = \mathbf{8} \end{aligned}$$

If the signs are different, replace with a **-** sign.

Add -5 to 3

$$\begin{aligned} 3 + (-5) &= 3 + -5 \\ &= 3 - 5 = \mathbf{-2} \end{aligned}$$

Subtract +5 from 3

$$\begin{aligned} 3 - (+5) &= 3 - +5 \\ &= 3 - 5 = \mathbf{-2} \end{aligned}$$

Rules for adding and subtracting with negative numbers

When there are two signs side by side you should use these rules.

$$+ \text{ and } + = +$$

$$+ \text{ and } - = -$$

$$- \text{ and } + = -$$

$$- \text{ and } - = +$$

The rules can be applied to more complex calculations.

$$7 + (-1) - (-4) = 7 + -1 - -4 = 7 - 1 + 4 = 6 + 4 = \mathbf{10}$$

$$-8 + (-4) - (-3) + (-2) - 7 = -8 + -4 - -3 + -2 - 7 = -8 - 4 + 3 - 2 - 7 = -21 + 3 = \mathbf{-18}$$

A bank statement shows the following credits and debits:

-£9.45, +£26.13, +£18.70, -£30.38

If the bank balance was £50 to begin with, what is the total balance now?

$$\begin{aligned} £50 + -£9.45 + +£26.13 + +£18.70 + -£30.38 &= \\ 50 - 9.45 + 26.13 + 18.7 - 30.38 &= 55 \end{aligned}$$

The total bank balance is **£55**

The temperatures recorded at midnight for six consecutive nights were as follows:

-3°C, -2°C, 5°C, 4°C, -2°C and 1°C

What was the mean temperature?

$$\begin{aligned} (-3) + (-2) + 5 + 4 + (-2) + 1 &= \\ -3 - 2 + 5 + 4 - 2 + 1 &= 3 \end{aligned}$$

$$\text{Mean} = 3 \div 6 = 0.5$$

The mean temperature was **0.5°C**

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Multiplying and dividing with negative numbers

Calculations involving negative numbers can have two signs side by side.

When **multiplying** two numbers with **same** signs, the result must be **positive**.

Multiply 7 by 10

$$\begin{aligned} +7 \times +10 &= ++70 \\ &= +70 \text{ or } 70 \end{aligned}$$

Multiply -9 by -5

$$\begin{aligned} -9 \times -5 &= --45 \\ &= +45 \text{ or } 45 \end{aligned}$$

When **multiplying** two numbers with **different** signs, the result must be **negative**.

Multiply 4 × -3

$$\begin{aligned} +4 \times -3 &= +-12 \\ &= -12 \end{aligned}$$

Multiply -7 × 8

$$\begin{aligned} -7 \times +8 &= -+56 \\ &= -56 \end{aligned}$$

You should use these rules when multiplying with negative numbers.

$$+ \text{ multiplied by } + = +$$

$$+ \text{ multiplied by } - = -$$

$$- \text{ multiplied by } + = -$$

$$- \text{ multiplied by } - = +$$

When **dividing** two numbers with **same** signs, the result must be **positive**.

Divide 21 by 7

$$\begin{aligned} +21 \div +7 &= ++3 \\ &= +3 \text{ or } 3 \end{aligned}$$

Divide -16 by -2

$$\begin{aligned} -16 \div -2 &= --8 \\ &= +8 \text{ or } 8 \end{aligned}$$

When **dividing** two numbers with **different** signs, the result must be **negative**.

Divide -24 by 3

$$\begin{aligned} -24 \div +3 &= +-8 \\ &= -8 \end{aligned}$$

Divide 35 by -5

$$\begin{aligned} +35 \div -5 &= + -7 \\ &= -7 \end{aligned}$$

You should use these rules when dividing with negative numbers.

$$+ \text{ divided by } + = +$$

$$+ \text{ divided by } - = -$$

$$- \text{ divided by } + = -$$

$$- \text{ divided by } - = +$$

More complex calculations with negative numbers

Calculate

$$\begin{aligned} -2 \times 3 + 4 \\ &= (-2 \times 3) + 4 \\ &= -6 + 4 \\ &= -2 \end{aligned}$$

Calculate

$$\begin{aligned} -3 \times -3 + 6 \times -5 \\ &= (-3 \times -3) + (6 \times -5) \\ &= +9 + -30 \\ &= -21 \end{aligned}$$

Calculate

$$\begin{aligned} (2 - 10) \div (-4 \times 2) \\ &= (-8) \div (-8) \\ &= -8 \div -8 \\ &= 1 \end{aligned}$$

Calculate

$$\begin{aligned} (6 - 15) \times (4 + -2) \\ &= (-9) \times (2) \\ &= -9 \times 2 \\ &= -18 \end{aligned}$$

Order of operation rules must be applied (BIDMAS)

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