MATHEMATICS · GRADES 10-12

# Inverse functions

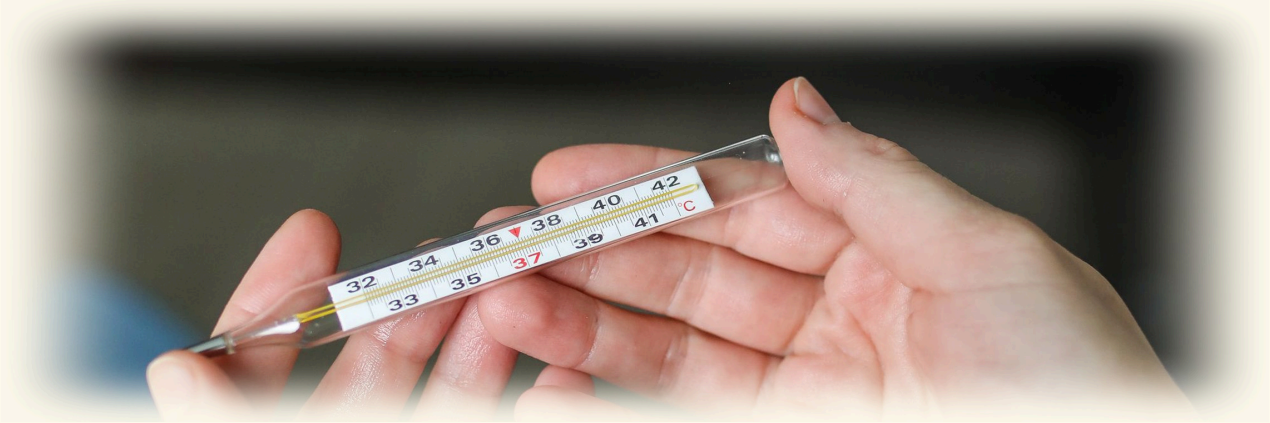
### Difficulty level: Advanced

### Mathematics: Grades 10-12

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## *Overview of the concept*

This is how you work backwards from a result to the input that made it, like turning a temperature in Fahrenheit back into Celsius. An inverse function undoes what the original function did, so you can start from the answer and find the question. You use it to convert temperatures, to work out what price before tax led to the price you paid, or to find the original measurement behind a converted one.




## *Rule*

**To find an inverse function, swap x and y, then solve for y.**

Replace f(x) with y, swap the two letters, and rearrange until y is alone. The result undoes the original function.

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## Worked examples

**EXAMPLE 1**

### Q Find the inverse of $f(x) = 2x + 3$

**SOLUTION**

Replace f(x) with y: $y = 2x + 3$

Swap x and y: $x = 2y + 3$

$x - 3 = 2y$

$y = \frac{(x - 3)}{2}$, so f inverse $(x) = \frac{(x - 3)}{2}$

**EXAMPLE 2**

### Q Find the inverse of $f(x) = x^3 + 1$

**SOLUTION**

Replace f(x) with y: $y = x^3 + 1$

Swap x and y: $x = y^3 + 1$

$x - 1 = y^3$

$y = (x - 1)\frac{1}{3}$, so f inverse $(x) = (x - 1)\frac{1}{3}$

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## Practice questions

**1** A machine adds 5 to any number it is given. What function undoes it?

- **A** f inverse (x) = x + 5
- **B** f inverse (x) = x - 5
- **C** f inverse (x) = 5 - x
- **D** f inverse (x) = $\frac{x}{5}$

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**2** Find the inverse of $f(x) = 3x$.

- **A** f inverse (x) = $\frac{x}{3}$
- **B** f inverse (x) = 3x
- **C** f inverse (x) = x - 3
- **D** f inverse (x) = $\frac{3}{x}$

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**3** Find the inverse of $f(x) = x - 7$.

- **A** f inverse (x) = x - 7
- **B** f inverse (x) = 7 - x
- **C** f inverse (x) = x + 7
- **D** f inverse (x) = $\frac{x}{7}$

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**4** Find the inverse of $f(x) = 2x - 4$.

- **A** f inverse (x) = $\frac{(x - 4)}{2}$
- **B** f inverse (x) = 2x + 4
- **C** f inverse (x) = $\frac{x}{2} - 4$
- **D** f inverse (x) = $\frac{(x + 4)}{2}$

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**5** **Find the inverse of $f(x) = x^3 + 1$.**

A f inverse (x) = $\sqrt[3]{(x+1)}$

B f inverse (x) = $\sqrt[3]{(x-1)}$

C f inverse (x) = $(x - 1)^3$

D f inverse (x) = $\sqrt[3]{x} + 1$

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**6** **What is f inverse (9) if $f(x) = x^3 + 1$?**

A 2

B 3

C 8

D 10

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**7** The inverse of a function is f inverse $(x) = \sqrt[3]{(x-5)}$. What is the original function?

- **A** $x^3 + 5$
- **B** $x^3 - 5$
- **C** $(x + 5)^3$
- **D** $(x - 5)^3$

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**8** Find the inverse of $f(x) = \frac{x}{2} + 3$.

- **A** f inverse $(x) = 2(x - 3)$
- **B** f inverse $(x) = \frac{x - 3}{2}$
- **C** f inverse $(x) = 2x + 3$
- **D** f inverse $(x) = \frac{x}{2} - 3$

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**9** **Find the inverse of $f(x) = -x + 4$.**

A f inverse (x) = 4 - x

B f inverse (x) = x - 4

C f inverse (x) = x + 4

D f inverse (x) = -x - 4

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**10** **Find the inverse of $f(x) = 2x^3 + 1$.**

A f inverse (x) = $\sqrt[3]{((x+1)/2)}$

B f inverse (x) = $\sqrt[3]{((x-1)/2)}$

C f inverse (x) = $\sqrt[3]{(x-1)}/2$

D f inverse (x) = $\sqrt[3]{(x-1)} + 2$

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## ANSWER KEY

**1.** f inverse (x) = x - 5

**2.** f inverse (x) = $\frac{x}{3}$

**3.** f inverse (x) = x + 7

**4.** f inverse (x) = $\frac{(x + 4)}{2}$

**5.** f inverse (x) = $\sqrt[3]{(x-1)}$

**6.** 2

**7.** $x^3 + 5$

**8.** f inverse (x) = 2(x - 3)

**9.** f inverse (x) = 4 - x

**10.** f inverse (x) = $\sqrt[3]{((x-1)/2)}$

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