MATHEMATICS · GRADES 10-12

Domains and ranges

Difficulty level: Advanced

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Overview of the concept

This is how you know what values a growth or decay calculation can actually take. A population can never be negative, and a medicine level in the body can never drop below zero, no matter what the formula says. The maths might keep going past those limits, but the real world stops there. Knowing the limits keeps you from reporting an answer that is impossible.

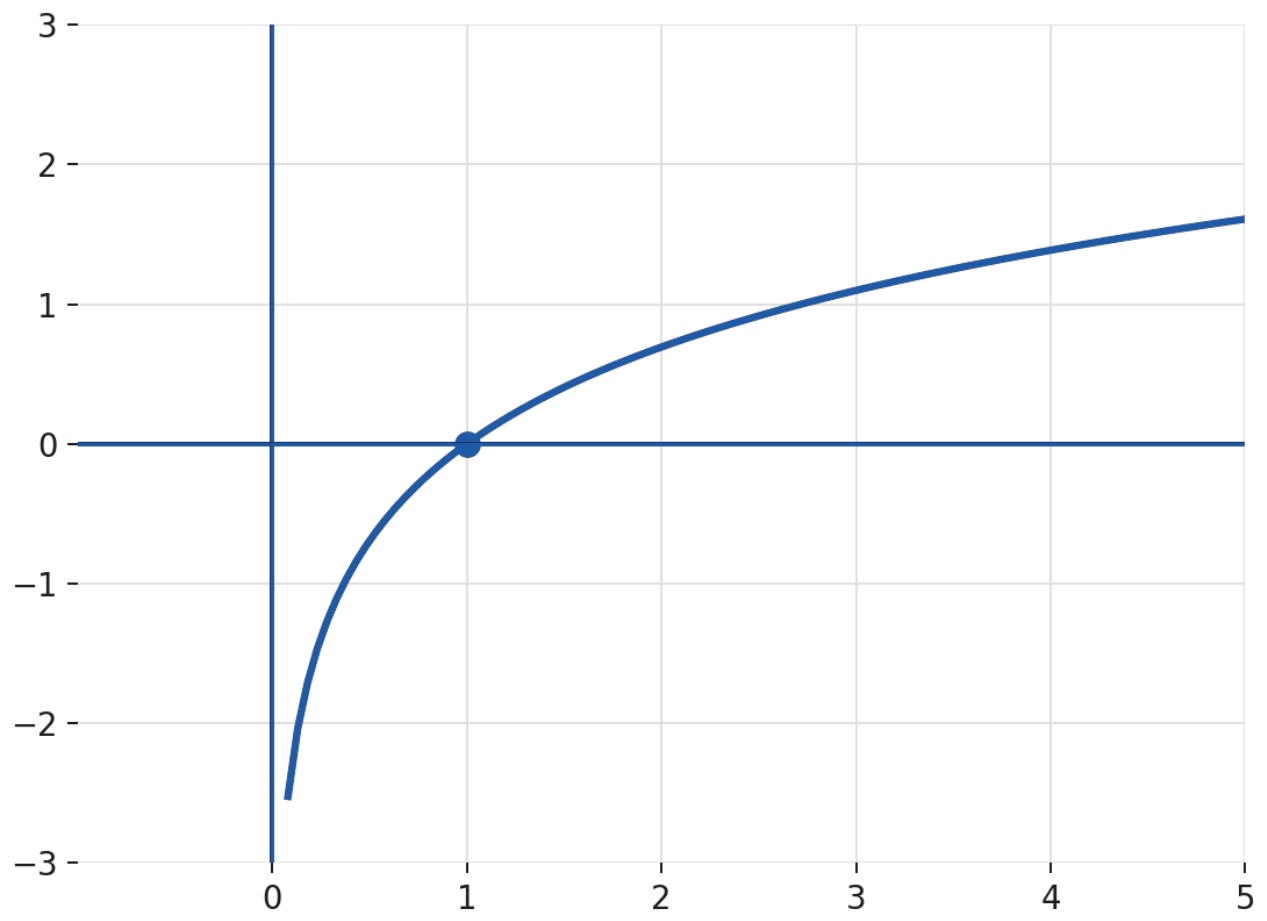


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Worked examples

EXAMPLE 1

Q Find the domain and range of $y = \log_2(x)$



SOLUTION

Domain: a logarithm needs a positive argument, so x must be greater than 0.

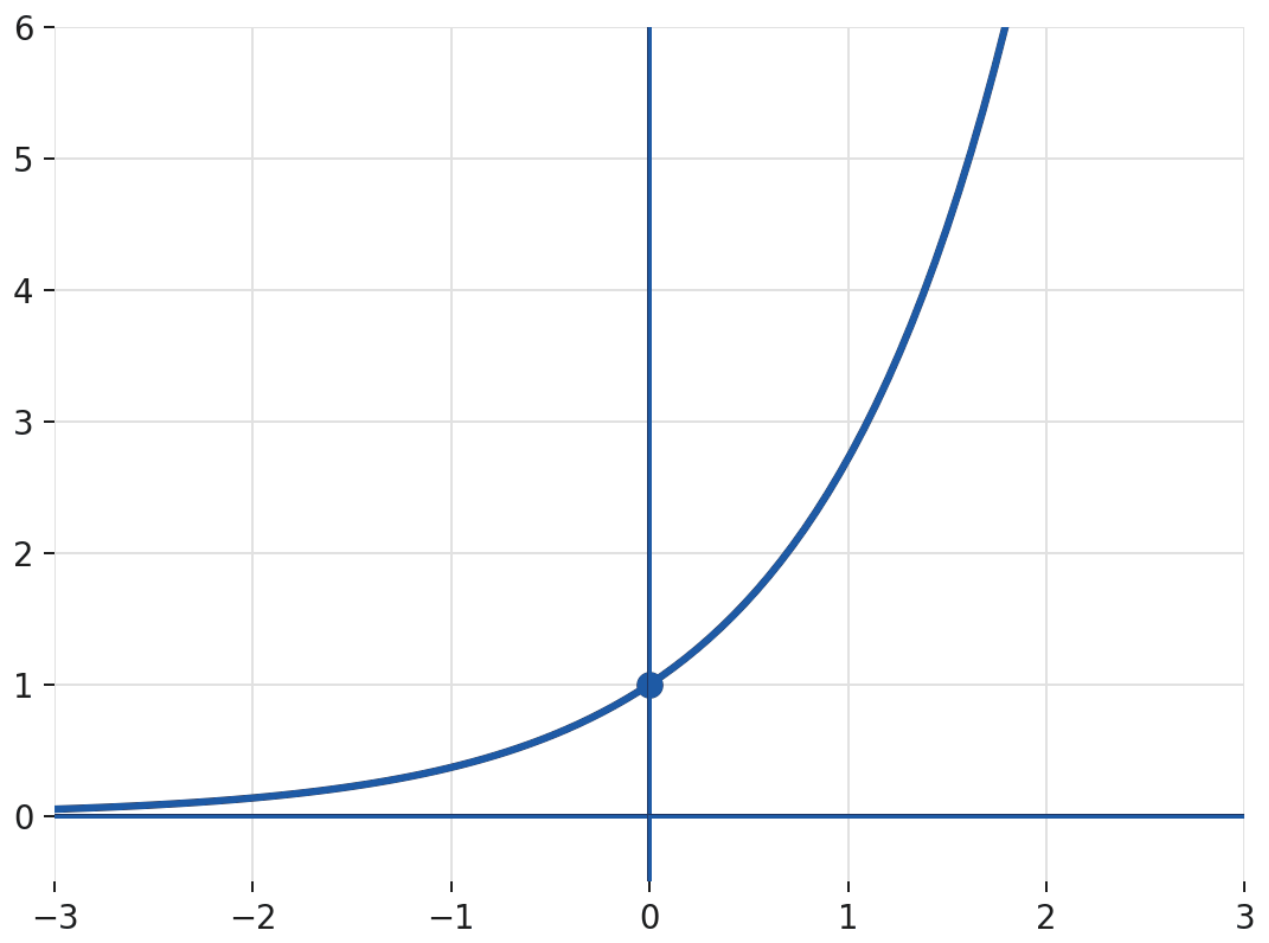
Range: a logarithm can give any real number as its output.

So the domain is x greater than 0 and the range is all real numbers.

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EXAMPLE 2

Q Find the domain and range of $y = 2^x$



SOLUTION

Domain: any real number can be an exponent, so the domain is all real numbers.

Range: a positive base to any power is always positive, so y must be greater than 0.

So the domain is all real numbers and the range is y greater than 0.

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Practice questions

1 Find the domain and range of $y = \log_2(x - 3)$.

- **A** Domain x greater than 0, range all real numbers
- **B** Domain x greater than 3, range y greater than 0
- **C** Domain x greater than 3, range all real numbers
- **D** Domain all real numbers, range y greater than 0

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2 **Find the domain and range of $y = 2^x + 1$.**

- **A** Domain all real numbers, range y greater than 0
- **B** Domain all real numbers, range y greater than 1
- **C** Domain x greater than 0, range y greater than 1
- **D** Domain all real numbers, range y greater than 2

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3 **Find the domain and range of $y = \log_{10}(x - 1)$.**

- **A** Domain x greater than 0, range all real numbers
- **B** Domain x greater than 1, range y greater than 0
- **C** Domain x greater than 1, range all real numbers
- **D** Domain x greater than -1, range all real numbers

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4 **Find the domain and range of $y = 3^x$.**

- **A** Domain all real numbers, range y greater than 0
- **B** Domain x greater than 0, range all real numbers
- **C** Domain all real numbers, range all real numbers
- **D** Domain x greater than 0, range y greater than 0

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Find the domain and range of $y = \ln(x + 2)$.

A. Domain x greater than 2, range all real numbers

B. Domain x greater than -2, range all real numbers

C. Domain x greater than 0, range all real numbers

D. Domain x greater than -2, range y greater than 0

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6 **Find the domain and range of $y = (\frac{1}{2})^x$.**

A Domain x greater than 0, range y greater than 0

B Domain all real numbers, range y less than 0

C Domain all real numbers, range y greater than 0

D Domain all real numbers, range all real numbers

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7 **Find the domain and range of $y = \log_3(x + 5)$.**

A. Domain x greater than -5, range all real numbers

B. Domain x greater than 5, range all real numbers

C. Domain x greater than 0, range all real numbers

D. Domain x greater than -5, range y greater than 0

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8 **Find the domain and range of $y = -2^x$.**

A Domain all real numbers, range y greater than 0

B Domain all real numbers, range y less than 0

C Domain x greater than 0, range y less than 0

D Domain all real numbers, range all real numbers

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Find the domain and range of $y = \log(x)$.

A. Domain x greater than 0, range y greater than 0

B. Domain x greater than 1, range all real numbers

C. Domain x greater than 0, range all real numbers

D. Domain all real numbers, range y greater than 0

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10 **Find the domain and range of $y = \log_2(-x)$.**

A Domain x greater than 0, range all real numbers

B Domain x less than 0, range all real numbers

C Domain x less than 0, range y greater than 0

D Domain all real numbers, range y greater than 0

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ANSWER KEY

1. Domain x greater than 3, range all real numbers
2. Domain all real numbers, range y greater than 1
3. Domain x greater than 1, range all real numbers
4. Domain all real numbers, range y greater than 0
5. Domain x greater than -2, range all real numbers
6. Domain all real numbers, range y greater than 0
7. Domain x greater than -5, range all real numbers
8. Domain all real numbers, range y less than 0
9. Domain x greater than 0, range all real numbers
10. Domain x less than 0, range all real numbers

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