MATHEMATICS · GRADES 10-12

Graphing exponential functions

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you picture growth that speeds up, like a savings account compounding or a virus spreading, so you can see how fast it takes off. A table of numbers hides how quickly exponential growth climbs, but a graph shows the slow start and the sudden steep climb in one picture. That is how you see why compound interest is so powerful over decades, why an outbreak can look small one week and huge the next, and why a small leak can become a flood if it keeps doubling.



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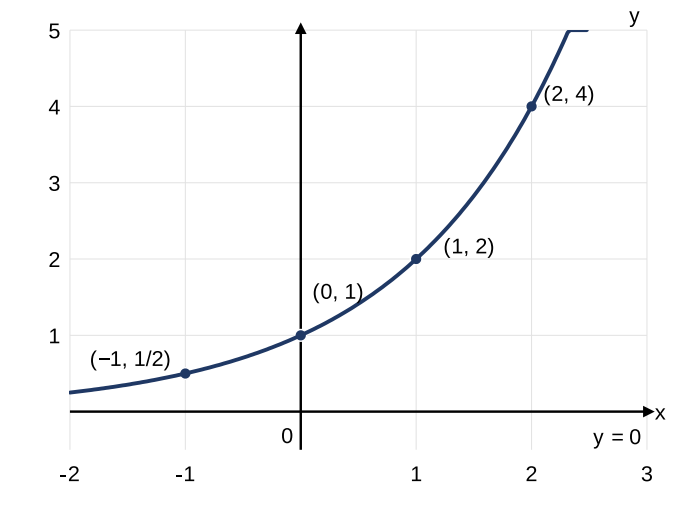
Worked examples

EXAMPLE 1

Q Graph $y = 2^x$



SOLUTION

Find points: (0, 1), (1, 2), (2, 4), (-1, $\frac{1}{2}$)

Note the horizontal asymptote: as x gets very negative, y gets close to 0, so y = 0

Plot the points and draw a smooth curve that rises to the right and approaches y = 0 on the left.

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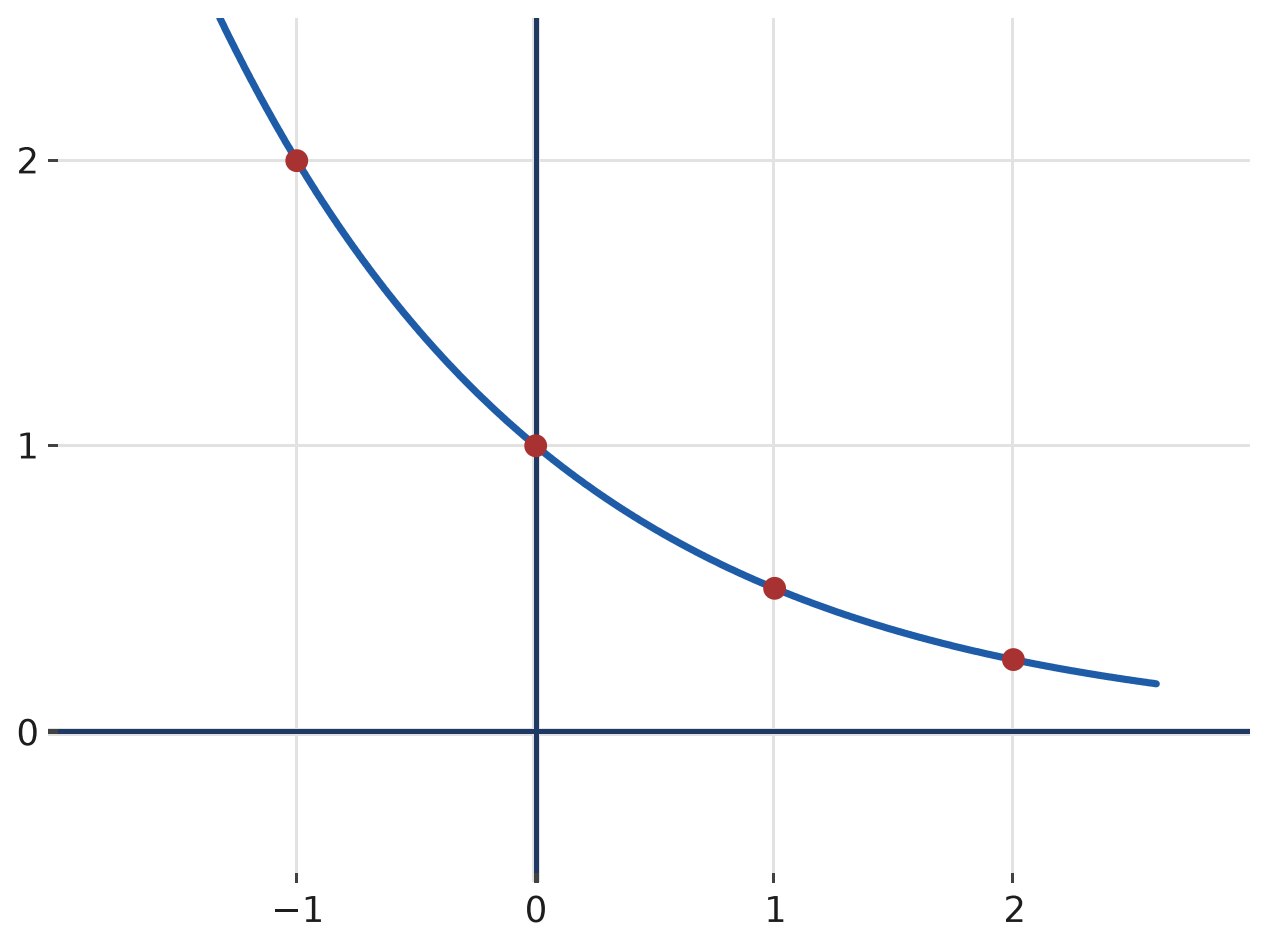
EXAMPLE 2

Q Graph $y = \left(\frac{1}{2}\right)^x$



SOLUTION

Find points: (0, 1), (1, $\frac{1}{2}$), (2, $\frac{1}{4}$), (-1, 2)

Note the horizontal asymptote: y = 0

Plot the points and draw a smooth curve that falls to the right and rises to the left.

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Practice questions

1 Graph $y = 4^x$.

A Points $(0, 1)$, $(1, 4)$, $(2, 16)$, $(-1, \frac{1}{4})$; horizontal asymptote $y = 0$; smooth curve rising to the right

B Points $(0, 1)$, $(1, \frac{1}{4})$, $(2, \frac{1}{16})$, $(-1, 4)$; horizontal asymptote $y = 0$; smooth curve falling to the right

C Points $(0, 1)$, $(1, 4)$, $(2, 16)$, $(-1, \frac{1}{4})$; horizontal asymptote $y = 1$; smooth curve rising to the right

D Points $(0, 0)$, $(1, 4)$, $(2, 16)$, $(-1, \frac{1}{4})$; horizontal asymptote $y = 0$; smooth curve rising to the right

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2 Graph $y = (\frac{1}{5})^x$.

A Points $(0, 1)$, $(1, \frac{1}{5})$, $(2, \frac{1}{25})$, $(-1, 5)$; horizontal asymptote $y = 0$; smooth curve falling to the right

B Points $(0, 1)$, $(1, 5)$, $(2, 25)$, $(-1, \frac{1}{5})$; horizontal asymptote $y = 0$; smooth curve rising to the right

C Points $(0, 1)$, $(1, \frac{1}{5})$, $(2, \frac{1}{25})$, $(-1, 5)$; horizontal asymptote $y = 1$; smooth curve falling to the right

D Points $(0, 0)$, $(1, \frac{1}{5})$, $(2, \frac{1}{25})$, $(-1, 5)$; horizontal asymptote $y = 0$; smooth curve falling to the right

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3 Which point lies on the graph of $y = 3^x$?

- **A** (1, 3)
- **B** (2, 6)
- **C** (-1, -3)
- **D** (0, 0)

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4 For $y = (\frac{1}{3})^x$, find y when $x = -2$.

- **A** 9
- **B** $\frac{1}{9}$
- **C** $-\frac{1}{9}$
- **D** 3

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5 For $y = 2^x$, find y when $x = 3$

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6 For $y = 2^x$, state the horizontal asymptote.

A. $y = 1$

B. $y = -1$

C. $y = 0$

D. $y = 2$

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7 For $y = 2^x$, find the y-intercept.

- **A** (0, 1)
- **B** (1, 0)
- **C** (0, 0)
- **D** (1, 1)

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8 What is the domain of $y = 5^x$?

- **A** All real numbers
- **B** $x > 0$
- **C** $y > 0$
- **D** $x \geq 0$

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9 What is the range of $y = (\frac{1}{4})^x$?

- **A** $y > 0$
- **B** $y < 0$
- **C** $y \geq 0$
- **D** All real numbers

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10 For $y = 5^x$, find x when $y = 25$.

- **A** 2
- **B** 5
- **C** 25
- **D** 0

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ANSWER KEY

1. Points $(0, 1)$, $(1, 4)$, $(2, 16)$, $(-1, \frac{1}{4})$; horizontal asymptote $y = 0$; smooth curve rising to the right

2. Points $(0, 1)$, $(1, \frac{1}{5})$, $(2, \frac{1}{25})$, $(-1, 5)$; horizontal asymptote $y = 0$; smooth curve falling to the right

3. $(1, 3)$

4. 9

5. 8

6. $y = 0$

7. $(0, 1)$

8. All real numbers

9. $y > 0$

10. 2

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