

Student Workbook

Graphs of Exponential Functions

Learning Target: I can graph exponential functions and their transformations, and write an equation from graph features.

Vocabulary

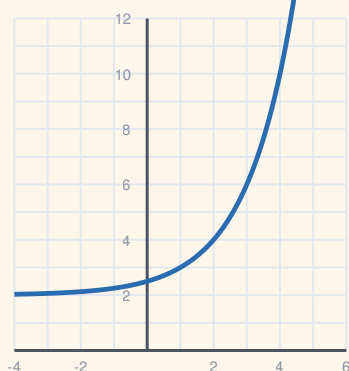
Term	Meaning
Parent Function	$f(x) = b^n$, passing through (0,1) with horizontal asymptote $y=0$.
Horizontal Asymptote	A horizontal line the graph approaches but never touches or crosses.

Key Concept: The Parent Function & Its Asymptote

$g(x) = a \cdot b^{(n-h)} + k$ The horizontal asymptote shifts to $y = k$. Domain is always all real numbers; range depends on k and whether a is positive or negative.

EXAMPLE 1

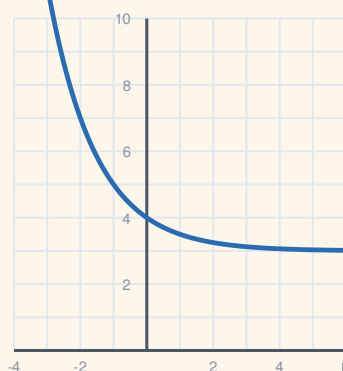
$$g(x) = 2^{(n-1)} + 2 \text{ (parent: } 2^n\text{)}$$



Shift right 1, up 2. Asymptote: $y=2$.

EXAMPLE 2

$$g(x) = \left(\frac{1}{2}\right)^n + 3 \text{ (parent: } \left(\frac{1}{2}\right)^n\text{, a decay curve)}$$



Shift up 3. Asymptote: $y=3$.

COMMON MISTAKE

The horizontal asymptote is $y = k$, NOT $y = 0$! Students often forget that vertical shifts move the asymptote along with the graph.

Key Concept: Writing the Equation from a Graph

EXAMPLE 3

A graph has asymptote $y = -2$, and passes through $(0,1)$ and $(1,4)$. Find the equation $g(x) = ab^n - 2$.

At $x=0$: $1 = a - 2 \rightarrow a = \underline{\hspace{2cm}}$

At $x=1$: $4 = \underline{\hspace{2cm}} b - 2 \rightarrow b = \underline{\hspace{2cm}}$

Equation: $g(x) = \underline{\hspace{2cm}}$

Guided Practice — Part A: Asymptote, Domain, Range

A1 $f(x) = 3^n$

A2 $f(x) = 2^{(n+1)} - 5$

Guided Practice — Part B: Describe the Transformations

B1 $g(x) = 5^{(n-2)} + 3$ (parent: 5^n)

B2 $g(x) = -2(3)^n + 1$ (parent: 3^n)

Guided Practice — Part C: Graph the Transformation

C1 $g(x) = 2^{(n-1)} + 2$

C2 $g(x) = (\frac{1}{2})^n + 3$

Guided Practice — Part D: Write the Equation from a Graph

D1 Asymptote $y=5$, passes through $(0,7)$ and $(1,9)$.

D2 Asymptote $y=0$, passes through $(0,4)$ and $(2,36)$.

BEFORE YOU MOVE ON

Check with a partner: does your asymptote value match the vertical shift (k), not just default to $y=0$?