Exponential Patterns

Key idea

An exponential pattern **multiplies** by the same factor each step — a constant ratio.

Rule: $y = a \cdot b^x$.

Growth or decay

$b > 1$ gives **growth**.

$0 < b < 1$ gives **decay**.

Example

$4,\ 12,\ 36,\ 108, \ldots$ multiplies by 3 each time.

Starting value 4, so $y = 4 \cdot 3^x$.

Common mistake

A constant *difference* means **linear**, not exponential.

Only a constant *ratio* is exponential.

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Exponential Graphs

Key idea

In $y = a \cdot b^x + c$, the $+c$ slides the graph so the horizontal asymptote is $y = c$.

The graph gets close to $y = c$ but never reaches it.

Growth example

$y = 2^x + 3$: shifted up 3.

y-intercept $= 4$, asymptote $y = 3$.

Decay example

$y = 6\left(\frac{1}{2}\right)^x + 1$: halves each step.

y-intercept $= 7$, asymptote $y = 1$.

Common mistake

The shift c changes the asymptote; the stretch a does **not**.

Keep those two effects separate when sketching.

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