# Graphing Exponential Functions

Exponential functions have the variable in the exponents. They have an initial value, and a base with an exponent.

$y = a \cdot b^x$ $\qquad$ $y = a(1 \pm r)^t$

Ex. $y = \frac{1}{3}(1.2)^x$

↳ b-value indicates growth.
↳ growth factor is $1.2 - 1 = .2$
↳ 20% growth rate
↳ initial value: $a = \frac{1}{3}$ → y-int: $(0, \frac{1}{3})$

Ex. $y = 4(.85)^x$

↳ b-value indicates decay
↳ decay factor is $1 - .85 = .15$
↳ 15% decay rate
↳ initial value: $a = 4$ → y-int: $(0, 4)$

## G R A P H I N G

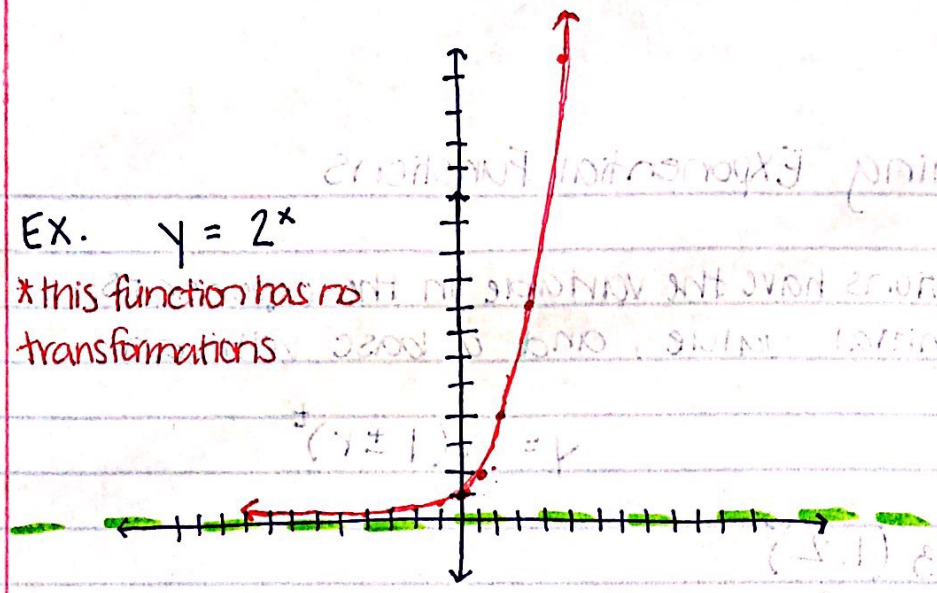
Ex. $y = 2^x$

base: 2 (growth)
initial value: 1 → y-int: (0, 1)

* If a function is shifted L or R, you will see a # added or subtracted in the exponent. $y = 2^{x+2}$ (left 2) $y = 2^{x-5}$ (right 5)
* If a function is shifted up or down, you will see a # added or subtracted to the entire function. $y = 2^x + 1$ (up 1) $y = 2^x - 3$ (down 3)
* If a function is reflected, you will see a negative multiplied to the front. $y = -(2)^x$

Ex. $y = 3(4)^{x+3} - 7$

left 3, down 7 from the original graph of $y = 3(4)^x$.



EX. $y = 2^x$

*this function has no transformations

| X | Y |
|---|---|
| -4 | .0625 |
| -3 | .125 |
| -2 | .25 |
| -1 | .5 |
| 0 | 1 |
| 1 | 2 |
| 2 | 4 |
| 3 | 8 |
| 4 | 16 |

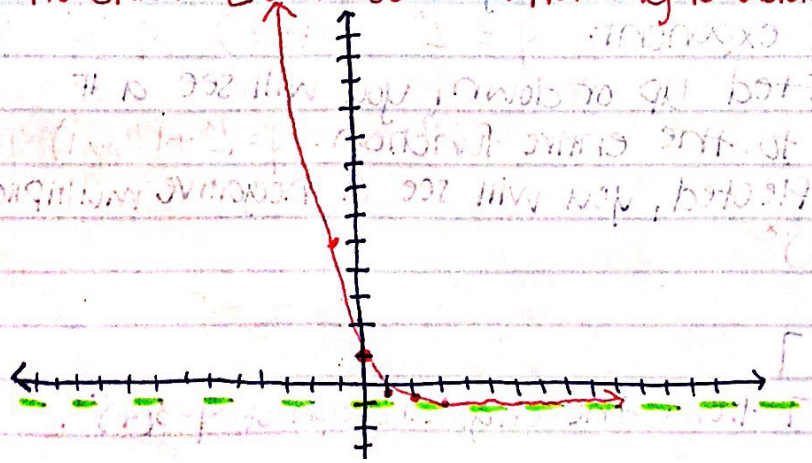
Asymptote: a line that the function gets really, really close to, but never touches.

**This function has an asymptote of y=0 (horizontal)**

* By looking at the eqn, we know the asymptote is y=0 because there is NO # added or subtracted to the entire function.

EX. $y = 2\left(\frac{1}{3}\right)^x - 1$

→ decay function because b=1/3
→ shifts down 1
→ asymptote is at y=-1 (since the graph shifted down 1
→ a=2 so the y-int is (0,2) but minus 1 bc of the shift → (0,1)
→ no shift L or R because nothing is added or subtracted to the exponent



| X | Y |
|---|---|
| -4 | 161 |
| -3 | 53 |
| -2 | 17 |
| -1 | 5 |
| 0 | 1 |
| 1 | .3333 |
| 2 | -.7778 |
| 3 | -.9259 |

Example:
$y = \frac{1}{2}(3)^{x-2} + 5$
What is the real y-int?
R 2, ↑ 5
(0, 1/2)
+2 +5
Real y-int: (2, 5½)