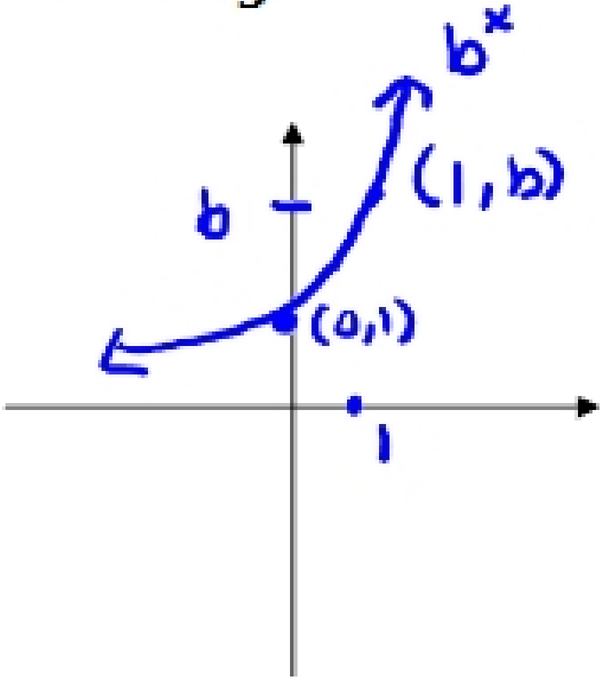
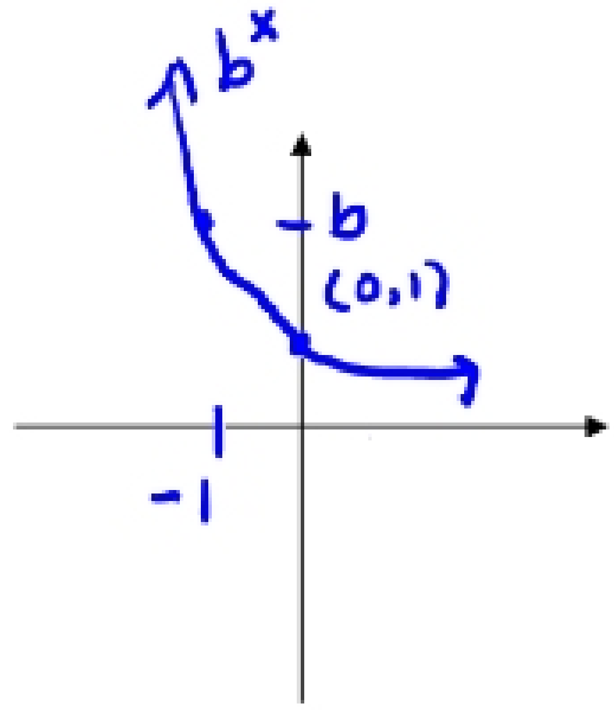
**For any exponential function $f(x) = b^x$ the graph looks like one of the following.**




**$b > 1$**




**$0 < b < 1$**

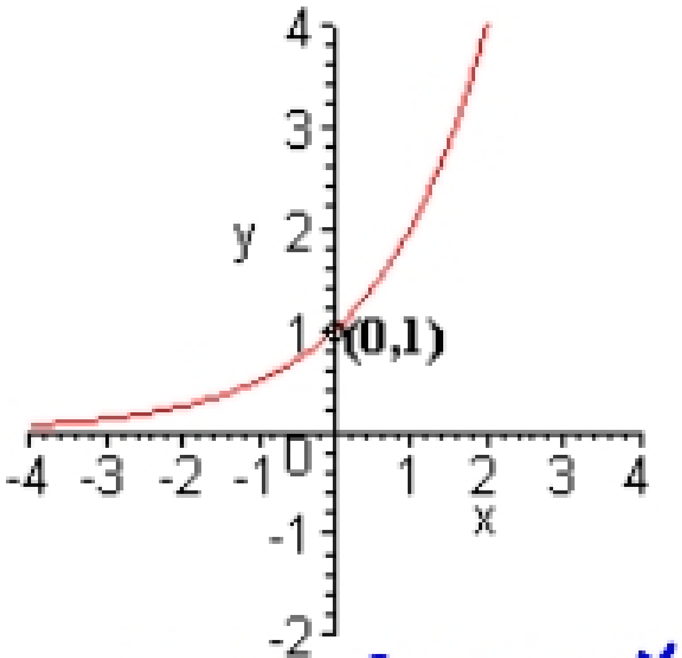
$f(x) = \frac{1}{2}^x$

$f(-1) = (1/2)^{-1} = 2$

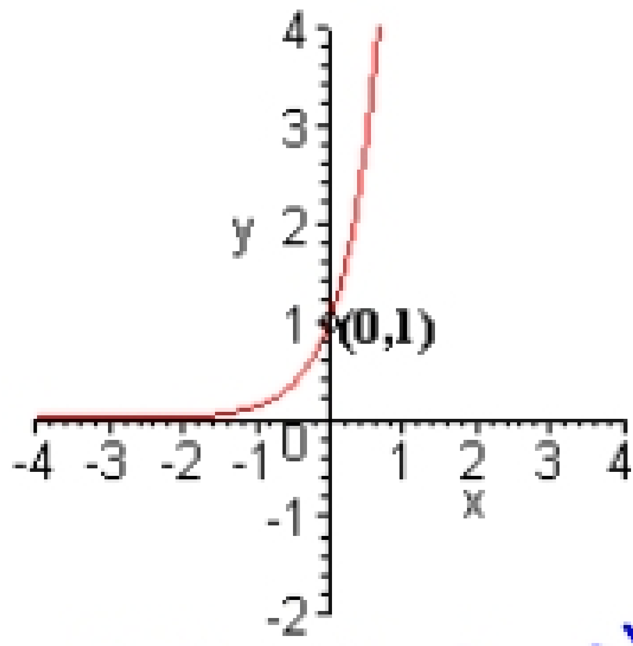
**<u>Notice</u>: for $f(x) = b^x$**

- **Domain is** $(-\infty, \infty)$.
- **Range is** $(0, \infty)$.
- **Horizontal asymptote is** $y = 0$.
- **Always passes through the points** $(0,1)$ $(1,b)$.

• **For $b > 1$, a larger b results in a steeper graph**

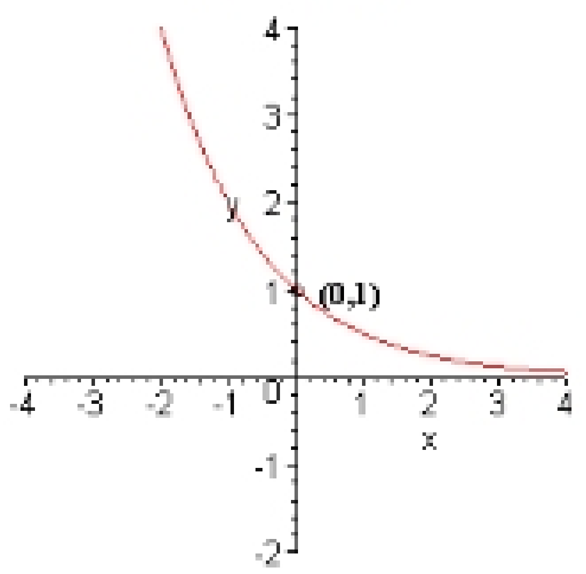


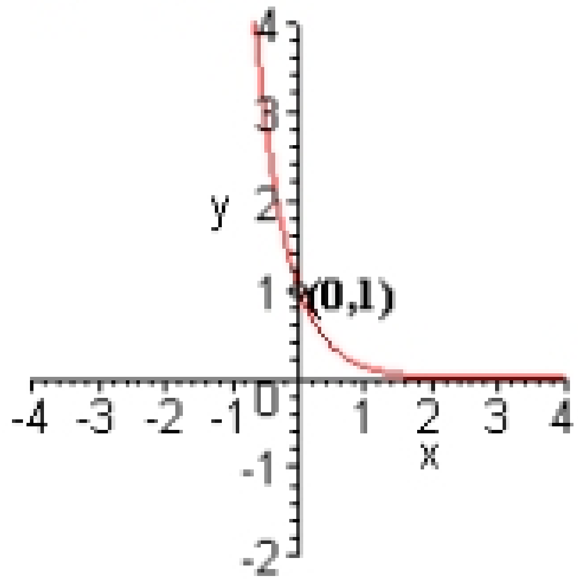

**b=2** $f(x) = 2^x$




**b=8** $f(x) = 8^x$

- For $0 < b < 1$, a smaller b results in a steeper graph.




$b=\frac{1}{2}$ $f(x)=\frac{1}{2}^x$

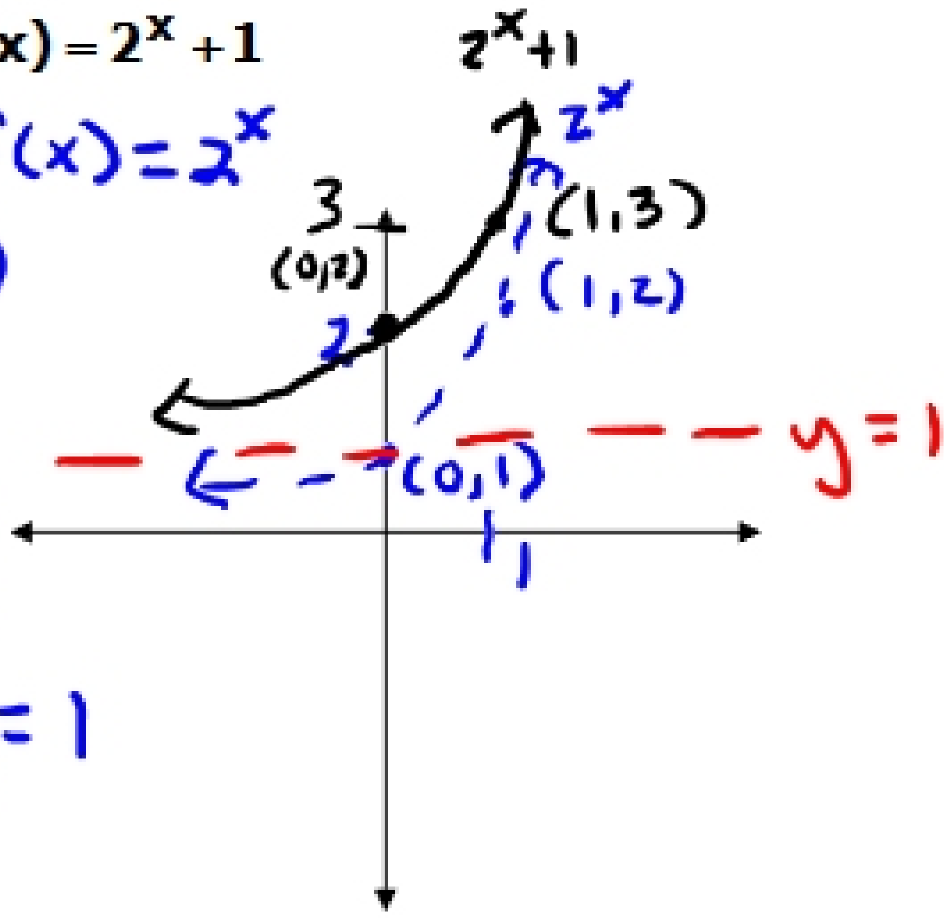
$b=\frac{1}{8}$ $f(x)=\frac{1}{8}^x$

**Example 1:**

Sketch the graph of $f(x)=2^x+1$

Basic graph: $f(x)=2^x$

Domain: $(-\infty,\infty)$




$(0,1) \to$ up 1 $\to (0,2)$

$(1,2) \to$ up 1 $\to (1,3)$

HA: $y=0$ up 1 $\to y=1$

Range: $(1,\infty)$

y int: $x=0$ $y=2^0+1$

$y=1+1=2$ $(0,2)$

**Example 2:**

Sketch the graph of $f(x) = -2^x$

Basic graph: $f(x) = 2^x$

Domain: $(-\infty, \infty)$

$(0,1) \rightarrow$ x-axis reflection $\rightarrow (0,-1)$

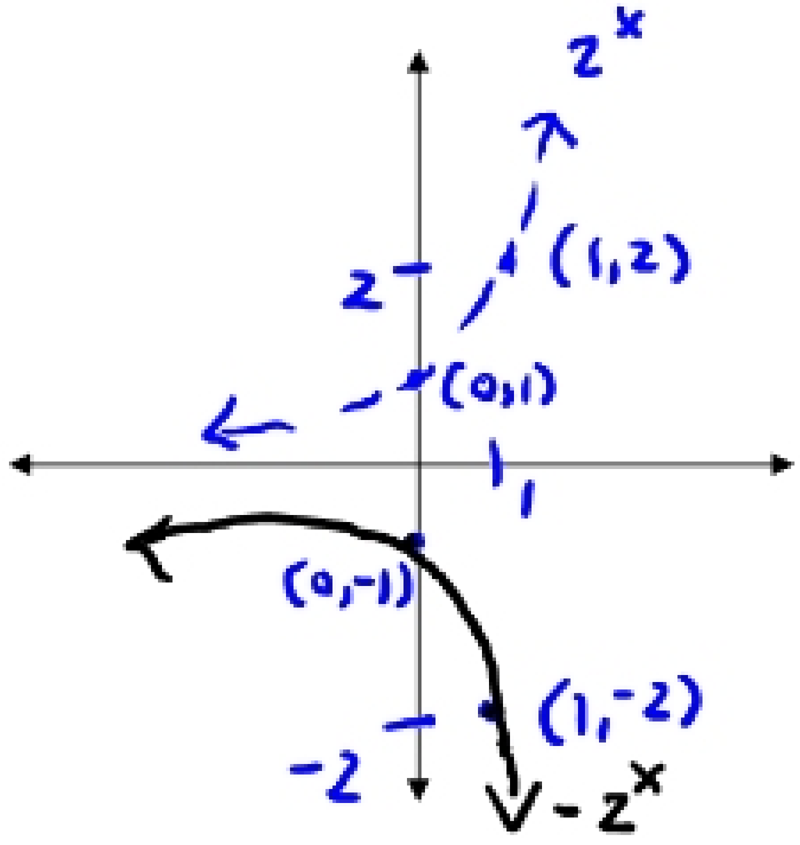
$(1,2) \rightarrow$ x-axis reflection $\rightarrow (1,-2)$

HA: $y=0 \rightarrow y=0$

yint: $x=0$

$y = -2^0 = -1$

$(0,-1)$




**Example 3:**

Sketch the graph of $f(x) = 4^{x-1}$

Basic graph: $f(x) = 4^x$

Domain: $(-\infty, \infty)$

$(0,1) \rightarrow$ right 1 $\rightarrow (1,1)$

$(1,4) \rightarrow$ right 1 $\rightarrow (2,4)$

HA: $y=0 \rightarrow y=0$

Range: $(0, \infty)$

yint: $y = 4^{0-1} = 4^{-1} = 1/4$

$(0, 1/4)$