Key

## Lesson #2 Exponential Functions

An exponential function $f$ with base b is defined by:

$f(x) = b^x$ $\quad b \neq 0$ $\quad b > 0$ $\quad b \neq 1$

$0 < b < 1$ decay

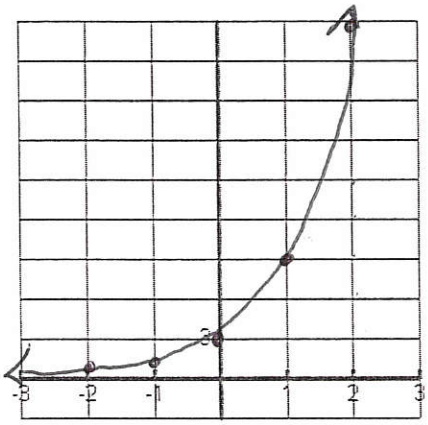
$b > 1$ growth

where $b > 0$ and $b \neq 1$ and x is ANY real number

Sketch the graph on the grid provided and label the points for every integer shown on the x-axis.

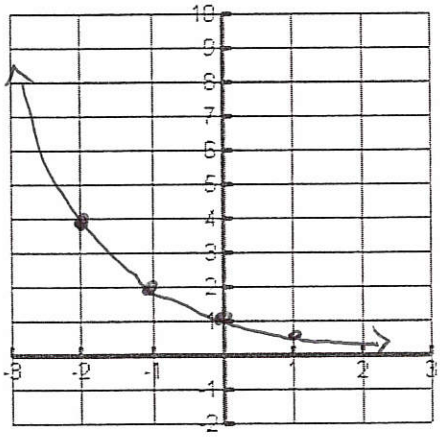
a) $f(x) = 3^x$

| x | y |
|---|---|
| -2 | 1/9 |
| -1 | 1/3 |
| 0 | 1 |
| 1 | 3 |
| 2 | 9 |



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

| x | y |
|---|---|
| -2 | 4 |
| -1 | 2 |
| 0 | 1 |
| 1 | 1/2 |



What is the domain for each function above? $(-\infty, \infty)$

What is the range of each function above? $(0, \infty)$

What is the y-intercept for each of the functions above? $(0, 1)$ Why?

$\#^0 = 1$

Are there any horizontal asymptotes for these functions? yes $y = 0$

Why can't b = 0 or be negative? $0^{\text{power}} = 0$ $\quad (\text{pos}\#)^{\text{power}} = \text{pos.}$

For $f(x) = b^x$, the graph is increasing from left to right.

For $f(x) = b^{-x} = \left(\frac{1}{b}\right)^x$, the graph is decreasing from left to right.

Do exponential functions have inverses? yes Are they one-to-one? "U"

Exponential Functions Transformations

The graphs of exponential functions can be translated vertically or horizontally, reflected, stretched, or shrunk.

Recall what you learned last unit when applying the transformations: $f(x) = a(base)^{bx \pm c} \pm d$

**Ex:** Describe each of the transformations from the parent function $f(x) = 3^x$

a) $g(x) = 3^{(x+1)}$ left 1

b) $h(x) = 3^x - 2$ Down 2

c) $k(x) = -3^x$ reflected over x axis

d) $j(x) = 3^{-x}$ = reflected over y axis

e) $m(x) = 2 \cdot 3^x$ new y intercept at (0, 2)
y values stretched b.a.f.o 2.

Exponential Functions using the Calculator $y = a\,b^x$

1) Let y represent the mass (in grams) of radioactive strontium, whose half-life is about 29 years. The quantity of strontium present after $x$ years is given by the following function: $y = 10\left(\frac{1}{2}\right)^{\frac{x}{29}}$

a) What is the initial mass (when x = 0) 10

b) How much of the initial mass is present after 80 years? $y = 10\left(\frac{1}{2}\right)^{\frac{80}{29}} =$

c) How many years will it take for 8.5 grams to be present?
6.8 yrs. $8.5 = 10\left(\frac{1}{2}\right)^{x/29}$

d) How many years will it take for 0.65 grams to be present?

$.65 = 10\left(\frac{1}{2}\right)^{x/29}$

$y_1 = .65$

$y_2 = 10\left(\frac{1}{2}\right)^{x/29}$

calc intersect.

~~3.95~~ 114.36 years

let $y_1 = 8.5$

let $y_2 = 10\left(\frac{1}{2}\right)^x$

calc intersect.