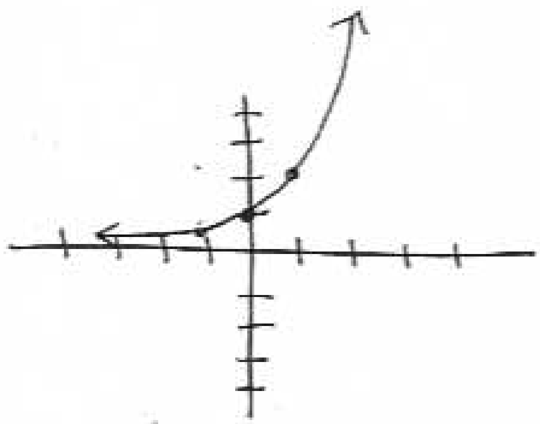
Graphing Exponential Functions

The equation $\boxed{f(x) = b^x \quad b>0,\ b\neq 1}$ defines an exponential function for each different constant b. b is called the base. The independent variable x may assume any real value.

Example 1

$f(x) = 2^x$

x	y
-1	$2^{-1} = \frac{1}{2}$
0	$2^0 = 1$
1	$2^1 = 2$



HA: $y=0$

start : $(0,1)$
shift : $(0,0)$

$(0,1)$

consider $\boxed{f(x) = b^{x-h} + k}$ $\boxed{\text{HA}}$: $y=k$

(h,k) acts in a similar manner to parabolas
(h,k) represents shifts in the starting point

h = horizontal shift
k = vertical shift

"start points" $(0,1)$ $\overset{(+b)}{b>0}$ $b^{x-h}+k$
$(0,-1)$ $-b$ $-b^{x-h}+k$

note: b itself is always positive by definition
The negative sign represents a reflection.

Example 2

$$f(x) = -3^{x+1} - 4$$

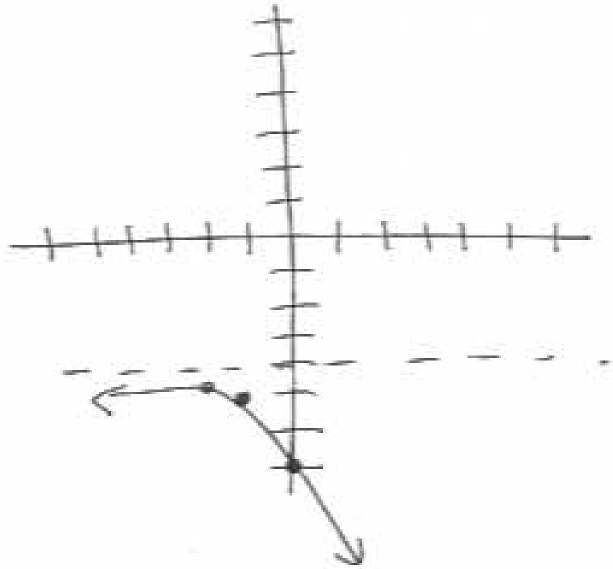
$(h, k) = (-1, -4)$

start $= (0, -1)$
shift $= (-1, -4)$

$(-1, -5)$

HA: $y = -4$

x	y
-2	$-3^{-2+1} - 4 = -4\frac{1}{3}$
-1	5
0	$-3^{0+1} - 4 = -7$



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

Range: $(-\infty, -4)$

Example 3

$$f(x) = e^{x} + 2$$

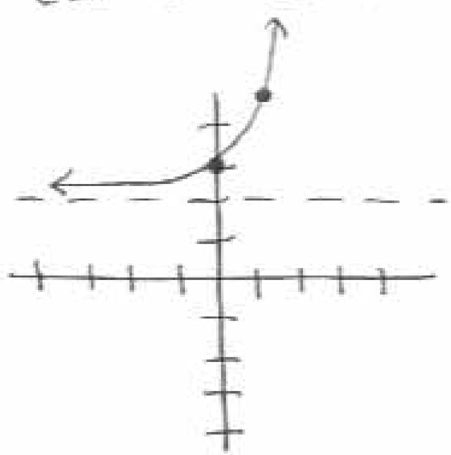
Recall $e \cong 2.71\ldots$ (It is a constant like π)

$(h, k) = (0, 2)$

Start $= (0, 1)$
shift $= (0, 2)$

$(0, 3)$

HA: $y = 2$



x	y
-1	$e^{-1} + 2$
0	3
1	$e^{1} + 2 \cong 4.71$

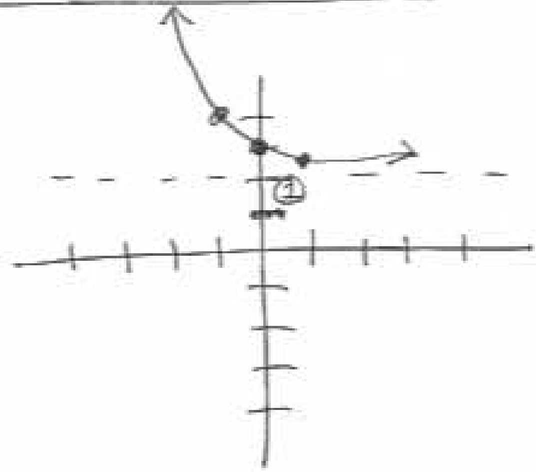
Domain: $(-\infty, \infty)$

Range: $(2, \infty)$

Example 4 $\quad f(x) = 2^{-x} + 1$

(h, k)
Shift $= (0, 1)$

start $= (0, 1)$
$+$ shift $\quad (0, 1)$
$\quad (0, 2)$



x	y
-1	$2^{1}+1 = 3$
0	2
1	$2^{-1}+1 = 1\frac{1}{2}$

HA: $y = 1$

Domain: $(-\infty, \infty)$
Range: $(1, \infty)$

Formulas to Know

Compound Interest

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

A = accumulated amount
P = principal
r = annual rate
n = number of times compounded per year
t = number of years

Continuous Compound Interest

$$A = Pe^{rt}$$

P = principal
A = accumulated amount
r = annual rate
t = number of years compounded

* r must be expressed as a decimal