Warm Up

Solve for x:

let $2^x = \text{☺}$

$$32(2^{2x}) - 12(2^x) + 1 = 0$$

$$32(\text{☺})^2 - 12(\text{☺}) + 1 = 0$$

$-8 \times -4 = 32$

$-8 + -4 = -12$

$$32(\text{☺})^2 - 8\text{☺} - 4\text{☺} + 1 = 0$$

$$-8\text{☺}(-4\text{☺}+1) \quad 1(-4\text{☺}+1) = 0$$

$$(-8\text{☺}+1)(-4\text{☺}+1) = 0$$

$-8\text{☺} = -1$	$-4\text{☺} = -1$
$\text{☺} = 1/8$	$\text{☺} = 1/4$
$2^x = 1/8$	$2^x = 1/4$
$= 1/2^3$	$2^x = 1/2^2$
$2^x = 2^{-3}$	$2^x = 2^{-2}$
$x = -3$	$x = -2$

Transformations of the Exponential Function

$y = a(b)^x$

intial value

base

check with...

Properties:

If $b > 1$, then the graph will be Growth

If $0 < b < 1$, then the graph will be Decay

y - intercept: happens when , so... $\boxed{y\text{-int} = a}$

Transformations of the Exponential Function

$$y = a(b)^x + d$$

intial value

base

vertical translation

check with...

Properties:

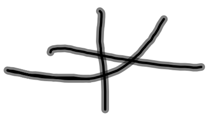
If $b > 1$, then the graph will be .

If $0 < b < 1$, then the graph will be .

y - intercept: happens when , so... $\boxed{y\text{-int} = a + d}$

> **Horizontal Asymptote -** a horizontal line that a graph approaches but never intersects.

Equation of Horizontal Asymptote will be... $\boxed{y = d}$



Domain - describes all possible x-values
Range - describes all possible y-values

Thus, for exponential functions... Domain: $\{x \in R\}$

Range: $\{y > d\}$

Horizontal Asymptote

Exercise: Complete the following table...

Equation	Growth/Decay	y-intercept	Eq'n for Horizontal Asymptote
$y = 3(5)^x - 4$	G	-1	$y = -4$
$y = 4\left(\frac{2}{5}\right)^x + 1$	D	5	$y = 1$
$y = (2^x) - 2$	G	-1	$y = -2$
$y = \frac{3}{4}\left(\frac{1}{2}\right)^x$	D	$\frac{3}{4}$	$y = 0$
$y = 5(3)^x$	G	5	$y = 0$

$(4)^x$

Determine a function that would represent each table of values

x	0	1	2	3	4	5
y	1	4	16	64	256	1024

$y = 4^x$

$2(3)^x$

x	0	1	2	3	4	5
y	2	6	18	54	162	486

$y = 2(3)^x$

x	0	1	2	3	4
y	.75	.375	.1875	.09375	.04688

$y=3/4(1/2)^x$

$.75(0.5)^x$

Examine the following sets of data and determine a function that would represent each set of data:

• Verify your solutions on a TI-83 calculator

x	0	1	2	3	4
y	2	2.4	2.88	3.456	4.1472

$y = 2(1.2)^x$

Notice that the scale is no longer established using increments of 1...

• How does this change the development of the representative function?

x	0	2	4	6	8
y	1	3	9	27	81

$(3)^{\frac{x}{2}}$

x	0	$\frac{1}{2}$	1	$\frac{3}{2}$	2
y	5	10	20	40	80

$x \cdot \frac{2}{1}$ $\quad 5(2)^{\frac{x}{\frac{1}{2}}} = 5(2)^{2x}$

Applications of the Exponential Function

$$y = a(b)^{\frac{x}{c}}$$

Increment (x scale)

Initial Amount (y-intercept)

Base

Properties:

If $b > 1$, then the graph will be .

If $0 < b < 1$, then the graph will be .

y - intercept: happens when , so...

Domain - describes all possible x-values
Range - describes all possible y-values

Thus, for exponential functions... Domain: $\{x \in R\}$

Range: $\{y > d\}$

Example

x	0	2	4	6
y	3	12	48	192

Write the equation of the exponential function

$3(4)^{\frac{x}{2}}$

Now you try!

Fit an exponential equation to the following data:

x	0	3	6	9
y	5	10	20	40

$5(2)^{x/3}$

x	0	2	4	6
y	2	0.4	0.08	0.016

$2(1/5)^{x/2}$

x	0	0.75	1.5	2.25
y	4	8	16	32

$$y = 4(2)^{\frac{x}{3/4}} = 4(2)^{4x/3}$$

$$\frac{x}{3/4} = x \cdot \frac{4}{3} = 4/3\,x$$

Homework...

~~p. 123 #54~~ p.136 ~~#40~~ #30

3.5 Solving Exponential Equations 10–12

p. 129 #9 - 12

p. 140 #43 (without technology)
#44
#46

Solutions

p. 123 #54. a) grasshopper will NEVER reach the fence.
b) horizontal asymptote

p. 129 9. b. This graph has a horizontal asymptote at y = 0.
c. The y intercept is at (0 , 2).
e. The graph is a decay curve, since 0 < b < 1.

10.

Question	Function	y-intercept	Growth or decay	Reason
a	$y = 4(3.2)^x$	(0, 4)	growth	b = 3.2 > 1
b	$y = 2.1(0.8)^x$	(0, 2.1)	decay	b = 0.8 < 1
c	$y = 0.3(1.1)^x$	(0, 0.3)	growth	b = 1.1 > 1
d	$y = 0.7(0.85)^x$	(0, 0.7)	decay	b = 0.85 < 1

11. All three functions have a = 1, since they all cross the y axis at y = 1. The function f has a b that is greater than 0 but less than 1, since it is a decay curve. The functions g and h both have a b that is greater than 1, since they are both growth curves. The b in the equation for g will be greater than the b in the equation for h, since the curve for the function g rises at a faster rate than the curve for the function h.

12. a. f has a = 1, g has a = 2 and h has a = 3. We can see this by looking at the y intercepts of each of the graphs. For all three graphs, the ratio of successive y terms is 1.5, so the b for all three is equal to 1.5
b. The equations would be $f(x) = 1.5^x$, $g(x) = 2(1.5)^x$ and $h(x) = 3(1.5)^x$.

p. 140 #43. b)

Equation	Eq'n for Horizontal Asymptote
$y = 2^x$	$Y = 0$
$y = 2^x - 1$	$Y = -1$
$y = 2^x + 3$	$Y = 3$

#44. a) ii b) iv c) v d) vi e) i f) iii

#46.

Equation	Growth/Decay	*y*-intercept	Eq'n for Horizontal Asymptote
$y = 2^x - 3$	Growth	(0, -2)	$Y = -3$
$y = 2(3)^x + 1$	Growth	(0, 3)	$Y = 1$
$y = 20(0.8)^x - 2.4$	Decay	(0, 17.6)	$Y = -2.4$
$y = 1.7(1.25)^x$	Growth	(0, 1.7)	$Y = 0$