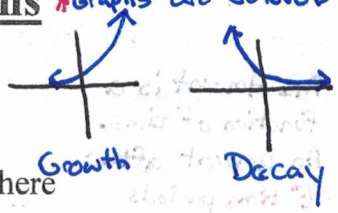
5.4 – Exponential Models and Equations

Graphs are CURVED Lines!



Exploring Exponential Models – Basic Exponential Functions

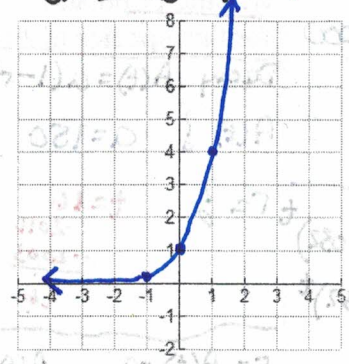
– **exponential function** → a function in the form $y = a(b)^x$ where b is the base and the exponent is ALWAYS a variable.

- If the base is a value where $b > 1$ then the exponential function represents a Growth!
- If the base is a value where $0 < b < 1$ (Decimal or Fraction) then the exponential function represents a Decay
- The y-intercept of an exponential function is represented by the point $(0, a)$

Example 1: Graph the following functions. Identify if it's a growth or decay. *NOT A STRAIGHT LINE*

a.) $y = 4^x$ → Circle one: (growth) decay

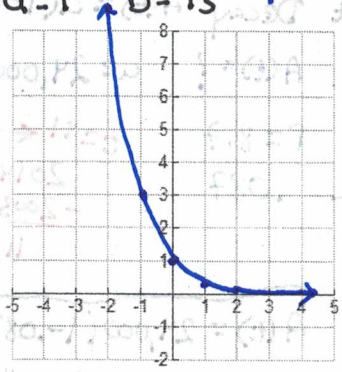
$y = ab^x$ $a = 1$ $b = 4$ y-int: $(0,1)$ $(0,a)$



x	y
-1	1/4
0	1
1	4
2	16
3	64

b.) $y = \left(\frac{1}{3}\right)^x$ → Circle one: growth (decay)

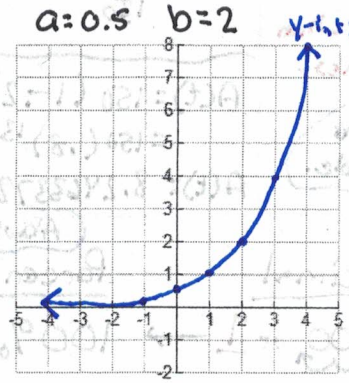
$y = ab^x$ $a = 1$ $b = 1/3$ y-int: $(0,1)$



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

c.) $y = 0.5(2)^x$ → Circle one: (growth) decay

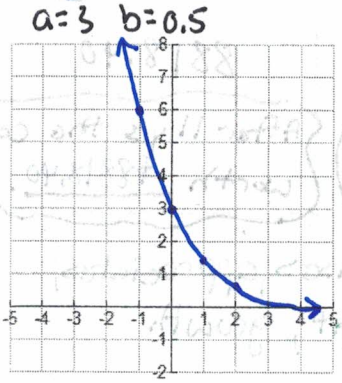
$y = a \cdot b$ $a = 0.5$ $b = 2$ y-int: $(0, 0.5)$



x	y
-1	1/4
0	0.5
1	1
2	2
3	4
4	8

d.) $y = 3(0.5)^x$ → Circle one: growth (decay)

$y = a \cdot b$ $a = 3$ $b = 0.5$



x	y
-2	12
-1	6
0	3
1	1.5
2	3/4

Exploring Exponential Models – Exponential Growth and Decay

You can model exponential growth or decay with the function below:

The Amount is a function of time. An amount after "t" time periods

$$A(t) = a(1 \pm r)^t$$

+r; growth rate
-r; decay rate
} Usually a %; need to change to a decimal.

t is time

Initial Amount (Starting Amount)

* If you are missing "r"

$$r = \frac{A(t) - a}{a}$$

Note – The rate (r) is usually given as a percent. You must change the rate to a decimal when using the formula.

Example 2: Use the exponential growth/decay formula to answer each question.

a.) Suppose your parents invest $1,200 in a savings account with 6% annual interest rate when you were born. How much will be in the account after 18 years?

$A(t) = a(1+r)^t$

$A(t) = ?$ $a = 1{,}200$

$r = 6\% \rightarrow .06$ $t = 18$

$A(t) = 1200(1+.06)^{18}$

$A(t) = 1200(1.06)^{18}$

$y = a \cdot b^x$

$A(t) = 3425.206983$

3425.21

After 18 yrs you will have $3425.21.

b.) You bought a car in 2003 for $24,000. The car's value depreciates by 8.7% each year. How much will your car be worth in 2014?

Decay $A(t) = a(1-r)^t$

$A(t) = ?$ $a = 24{,}000$

$r = 8.7$ $.087$

$t = 11$ ← 2014 − 2003 = 11

$A(t) = 24{,}000(1-.087)^{11}$

$A(t) = 24{,}000(.913)^{11}$

$A(t) = 8818.400004$

8818.40

After 11 yrs the car is worth $8818.40.

c.) A population of 125,000 grows at 3.2% per year. How many years will it take for the population to double in size?

Growth $A(t) = a(1+r)^t$

$A(t) = 250{,}000$ $a = 125{,}000$

$r = 3.2\%$ $.032$ $t = ?$

$250{,}000 = 125{,}000(1+.032)^t$

$250{,}000 = 125{,}000(1.032)^t$

$y = a \cdot b^x$

Put the right side of the function into Y=. Use the TABLE to find when the population doubles.

In about 23 yrs the population will double.

d.) In 2003, the world population of the Iberian lynx was 150. In 2004, the population decreased to 120. If this trend continues, what will the population be for this species in 2016?

Decay $A(t) = a(1-r)^t$

$A(t) = ?$ $a = 150$

$r = ?$ $t = 13$ ← 2016 − 2003 = 13

$r = \frac{A(t) - a}{a}$ $A(t) = 120$ $a = 150$

$r = \frac{120 - 150}{150} = -.2$

$A(t) = 150(1-.2)^{13}$

$= 150(.8)^{13}$

$A(t) = 8.246337208$

About 8 lynx.

+r : grows, increases, appreciates, savings account, growth

−r : decay, decreases, depreciates, decomposes.

Percent	Decimal	Percent
100% →	1.00 or 1 →	100%
75% →	.75 →	75%
2% →	.02 →	2%
1.75% →	.0175 →	1.75%
.85% →	.0085 →	.85%

DO NOT FORGET % sign