Notes Section 5.3 – Exponential Functions and Their Representation

Lesson Objectives

1. The Basics of an Exponential Function
2. Graph an Exponential Function (use calculator!)
3. Evaluating a function using the Natural base, *e*
4. Applications Involving Compound Interest
   a. Regular compounding
   b. Continuous compounding

A. The Basics of an Exponential Function

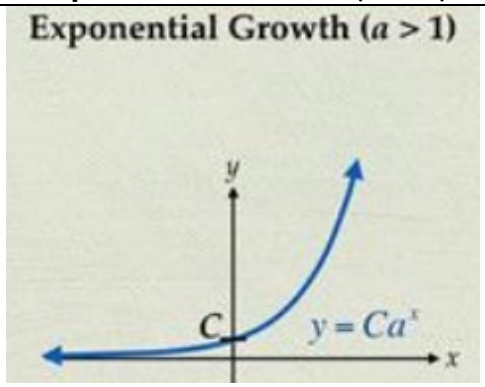
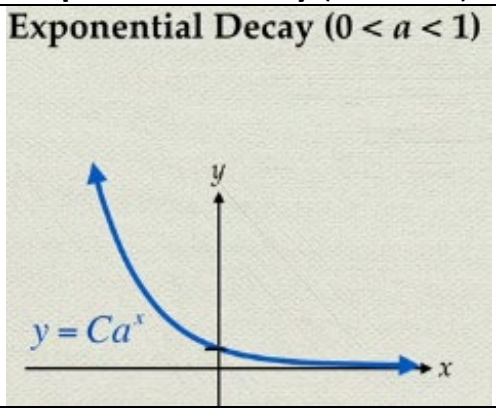
An **exponential function** is of the form: $f(x) =$ _____,

Where *C* is called the _____ ***amount*** (starting amount) and is the *y*-intercept, and

a is called the _____ **factor** (if _____) or the _____ **factor** (if _____)

B. The Graph of an Exponential Function

The graph on an exponential function has two general types, depending on whether it is growth or decay.

Exponential Growth ($a > 1$)	**Exponential Decay** ($0 < a < 1$)
	
_____	_____

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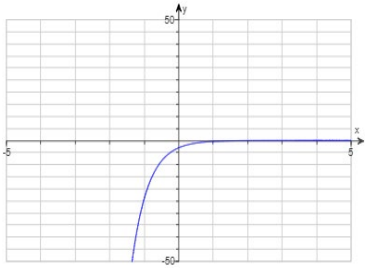
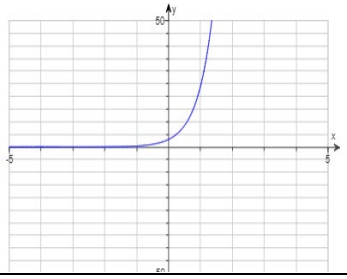
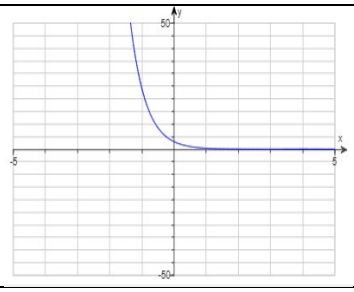
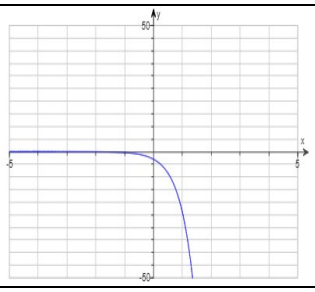
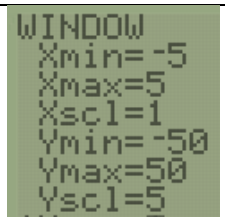
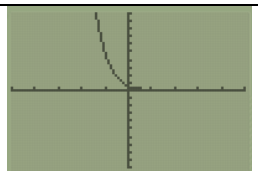
- **EXAMPLE:** Sketch a graph of $y = f(x)$. $f(x) = 3\left(\frac{1}{8}\right)^x$ [5.3.61]

A.	B.	C.	D.
			

$f(x) = 3\left(\frac{1}{8}\right)^x$. The base (1/8) is between 0 and 1, so this is a _____ function (decreasing).

You can easily verify the correct graph using your graphing calculator – PLEASE do this!!

 1. Press **Y=** button and enter your function.	 2. Press **WINDOW** button to adjust graph settings. Then press **GRAPH** button.	 3. This is an exponential decay function. Correct answer is:

C. Evaluating a Function using the Natural base, *e*

The _____ base, ___, is an irrational number (similar to pi, or π).

The value of it is $e \approx 2.718281828\ldots$

To do graphs and/or calculations with the **natural** base ***e***, you can use your calculator.

The button for *e* can be found in two places:

 above the ____ key (used for e^x) or  above the _____ key

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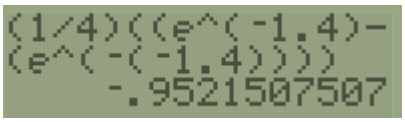
- **EXAMPLE:** Approximate $f(x)$ to four decimal places. [5.3.49]

$f(x) = \frac{1}{4}(e^x - e^{-x})$ $x = -1.4$ Use your _____ for this one!

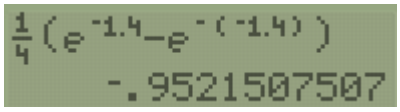
There are 2 ways to do this:

_____ (w/parentheses) or the "_____" method

Direct substitution: $f(-1.4) = \left(\frac{1}{4}\right)\left(\left(e^{(-1.4)}\right) - \left(e^{-(-1.4)}\right)\right)$

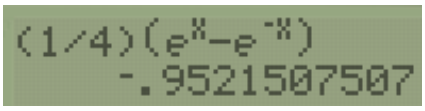


or



rounds to _____

"**Go to the STO→**" method (plug in – 1.4 for x in calculator)



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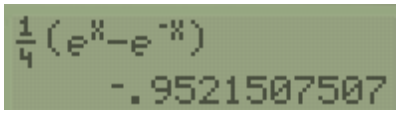


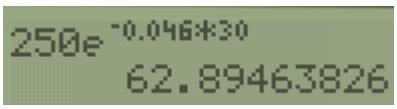
same answer

- **EXAMPLE:** A sample of 250 grams of a radioactive substance decays according to the function $A(t) = 250e^{-0.046t}$, where t is the time in years. How much of the substance will be left in the sample after 30 years? Round your answer to the nearest whole gram. [*Lial 10.6-30]

  Define your variables.
  $A(t)$: **amount of substance** and t: **time in years**

  To find out how much substance is left after 30 years ($t = 30$), calculate ***A*(30)**, which simply means plug in $t = 30$ into the given function formula $A(t) = 250e^{-0.046t}$ (Use calculator).

  Direct Substitution:



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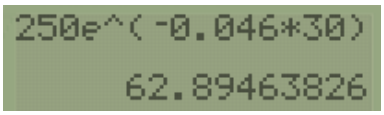
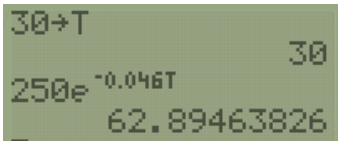


  "**Go to the STO→**"



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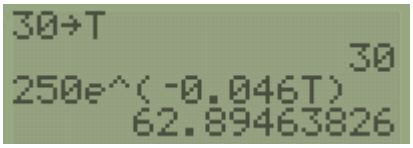

  Answer: after 30 years, the amount of substance is approximately **63** grams.

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D. Applications Involving Compound Interest

1. Regular Compoundings Formula:

Where: ***A*** is the _____ value, or final value (**amount**)

P is the _____ (initial amount, starting amount, deposit, etc.)

r is the interest _____, converted from percent to _____ (just divide by 100)

n is the number of interest-_____ per year:

***n* = 1**	***n* = 2**	***n* = 4**	***n* = 12**	***n* = 365**
_____ or _____	_____	_____	_____	_____

t is the _____ in years

- **EXAMPLE:** Use the compound interest formula to determine the final value of the given amount. $1,000 at 15% compounded semiannually for 8 years [5.3-21]

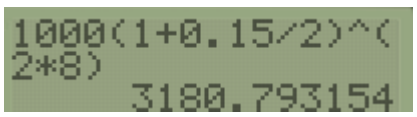
__= 1000 _____ _____ ___ = 8

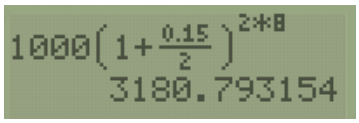
$1000 Principal rate is 15% semiannually 8 years

Using the Compound Interest formula: $A = P\left(1 + \frac{r}{n}\right)^{nt}$

Substitute your given information: $A = \_\_\_\_\_\left(1 + \frac{\_\_\_\_}{\_\_}\right)^{\_\_\_\_}$

Use your calculator to compute the final amount:





Because it's money, it rounds to ___ decimal places: **$_____** **Answer**

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2. Continuous Compounding Formula: _____

Where: ***A*** is the future value, or final value (_____)

P is the **principal** (_____ amount, starting amount, deposit, etc.)

r is the _____ **rate**, converted from percent to decimal (just divide by 100)

t is the time in _____

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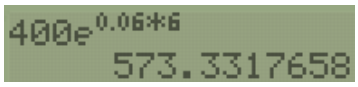
- **EXAMPLE:** Use the compound interest formula to determine the final value of the given amount. $400 at 6% compounded continuously for 6 years [5.3.103]

___ = 400 __= 0.06 _____ compounding ___= 6

Using the Continuous Compound Interest formula: $A = P e^{r t}$

Substitute your given information: $A =$ _____

Use your calculator to compute the final amount:



Because it's _____, it rounds to 2 decimal places: **$_____ Answer**

Sources Used:

1. MyLab Math for *Algebra for College Students*, 8th Edition, Lial, Pearson Education Inc.
2. MyLab Math for *College Algebra with Modeling and Visualization*, 6th Edition, Rockswold, Pearson Education Inc.
3. Wabbitemu calculator emulator version 1.9.5.21 by Revolution Software, BootFree ©2006-2014 Ben Moody, Rom8x ©2005-2014 Andree Chea. Website https://archive.codeplex.com/?p=wabbit