

Name \_\_\_\_\_

## Algebra II

### Lesson 8-6

#### Natural Logarithms

In section 8-2 we learned that the number  $e \approx 2.71828$ . We then learned that the inverse of an exponential function is a log function. Well, the inverse of  $e^x$  is the **natural logarithm function**, abbreviated **ln**. Since these are inverses, they “undo” one another. That is  $\ln e^x = x$ .

Just as the previous section, we are able to treat the natural logs as we do the base 10 logs by solving in similar fashion, and our properties hold true for natural logs as well. So to simplify:  $3\ln x + \ln y$  we need to use the power property and the product property we get: \_\_\_\_\_

#### Variable is argument in ln equation:

Also, we can solve  $x$  when it is inside the natural log like we did in 8-5. Here we need to remember that the base of the natural log is  $e$ . We rewrite our natural log into its exponential equivalent and solve for  $x$ .

Solve:  $\ln_e(3x - 9) = 21$

$$e^{21} = 3x - 9$$

$$1318815734 = 3x - 9$$

$$439605247.8 = x$$

1. base **e** to a power is equal to....
2. with a calculator evaluate the *e value*
3. simplify and solve for  $x$   
yes, that is some big number!

#### Variable is exponent in exponential equation

When we have an exponential equation with  $e$  as the base, we can take the natural log of both sides to simplify. When we do this however, realize that the natural log of  $e$  cancels out, leaving just the exponent behind on the ground floor:

Solve:  $e^{\frac{2x}{5}} + 7.2 = 9.1$

$$\ln e^{\frac{2x}{5}} = \ln 1.9$$

$$\frac{2x}{5} = .6419$$

$$2x = 3.2093$$

$$x = 1.6046$$

1. Isolate the variable: Clear extra constants.
2. take the natural log of both sides, understand that the natural log of  $e$  cancels out and leaves the exponent behind
4. Use the calculator to evaluate the **ln** of the constant
3. Now solve for  $x$  algebraically.

Try:

Write as a single log:  $2\ln 8 - 3\ln 4$

Solve using natural logs:  $e^x = 18$

Solve:  $\ln x = -2$

If you invest \$2500 compounded continuously at an interest rate of 5.2% 4 years, how much money will you have at the end of the 4 years?  
Which equation do you need?

