Name _____ Date _____ Period____

5.7 Exponential base e and Natural Logs Notes

Warm up $\log_{10} x$ $\log x$ common Log	Solve $4^{x+2} = 45$ $\log 4^{x+2} = \log 45$ $(x+2)\log 4 = \log 45$ $x + 2 = \frac{\log 45}{\log 4}$ $x = \frac{\log 45}{\log 4} - 2$ ≈ 0.746 Rewrite the Log equation into an exponential equation. $\log x = 7$ $10^7 = x$
Irrational number e 2.7118281...	The number e is used in many real-world applications, such as economics, statistics, and science that involve exponential growth and decay.
Example of exponential model	Newton's Law of Cooling $T(t) = T_s + (T_0 - T_s)e^{-kt}$ t = time taken for the cooling $T(t)$ = the temperature of the given object at time t T_s = the surrounding temperature T_0 = the initial temperature of the object k = decay constant
Log of base e Natural Log	$e^p = n$ Rewritten into log form $\log_e n = p$ $\log_e n = p$ Is written as $\ln(n) = p$

Directions. Rewrite each exponential into log form and each log into exponential form.

1. $e^x = 24$

$\log_e 24 = x$

$\ln 24 = x$

2. $e^{x+5} = 72$

$\ln 72 = x+5$

3. $\ln x = 58$

$e^{58} = x$

4. $\ln(x-9) = 32$

$e^{32} = x-9$

Directions: Solve the following equations. See notes 5.5 + 5.6

5. $2\ln k = \ln(2k+15)$

$\ln k^2 = \ln(2k+15)$

$k^2 = 2k+15$

$k^2 - 2k - 15 = 0$

$(k-5)(k+3) = 0$

$k = 5, -3$

$k = 5$

Check $k = -3$ extraneous

6. $\ln 72 - \ln 4 = \ln 6 + \ln(a-2)$

$\ln\left(\frac{72}{4}\right) = \ln[6(a-2)]$

$\ln(18) = \ln(6a-12)$

$18 = 6a - 12$

$30 = 6a$

$a = 5$

Check ✓

7. $\ln x - \ln 9 = 7$

$\ln\left(\frac{x}{9}\right) = 7$

$e^7 = \frac{x}{9}$

$x = 9 \cdot e^7$

$x \approx 9869.698$

8. $\ln 8x = 2$

$e^2 = 8x$

$x = \frac{e^2}{8}$

$x \approx 0.924$

9. $2e^{c-9} + 3 = 87$

$2e^{c-9} = 84$

$e^{c-9} = 42$

Take ln of both sides

$\ln e^{c-9} = \ln 42$

$\log_e e^{c-9} =$

$c - 9 = \ln 42$

$c = \ln 42 + 9$

$c \approx 12.738$

$\log_3 3^2$ simplifies to 2

10. $e^{x+3} - 6 = 24$

$e^{x+3} = 30$

$\ln e^{x+3} = \ln 30$

$x + 3 = \ln 30$

$x = \ln 30 - 3$

$x \approx 0.401$