Self-Check for Tutorial 21
Logarithms

Note: Use the logarithm rules in the video tutorial to solve these problems. There are other rules for working with logarithms. After working through the problems in this Self-Check, consult a text book for additional rules or properties for working with both common and natural logarithms.

1. The population of a certain bacteria doubles every 10 minutes. How long will it take a population of 200 to reach 1,638,000? Use the formula $F = B \cdot (2)^{T}$ where *F* is the final count, *B* is the beginning count, and T is the number of times the bacteria must double.

2. $A = P(e)^{rt}$ is the formula for continuous compounding interest. *A* is the final amount, *P* is the initial amount, *r* is the interest rate as a decimal and *t* is the time in years. If $500 is put in the bank at a rate of 5% and the money is compounded continuously, how long will the money need to be in the bank to grow to $2000?

3. Solve $5^{x+3} = 7^{3x-5}$ for *x*.

Answers to Self-Check for Tutorial 21
Logarithms

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1. The population of a certain bacteria doubles every 10 minutes. How long will it take a population of 200 to reach 1,638,000? Use the formula $F = B \cdot (2)^T$ where F is the final count, B is the beginning count, and T is the number of times the bacteria must double.

$1{,}638{,}000 = 200 \cdot (2)^T$

$8192 = 2^T$

$\log_2(8192) = \log_2(2^T)$

$\log_2(8192) = T\log_2(2)$

$\log_2(8192) = T$

Note: By definition $\log_2(2)=1$

Apply change-of-base rule

$\frac{\log_{10}(8192)}{\log_{10}(2)} = T$

$13 = T$

If $T = 13$, the bacteria will double in 13 ten-minute periods or 2 hours and 10 minutes.

2. $A = P(e)^{rt}$ is the formula for continuous compounding interest. *A* is the final amount, *P* is the initial amount, *r* is the interest rate as a decimal and *t* is the time in years. If $500 is put in the bank at a rate of 5% and the money is compounded continuously, how long will the money need to be in the bank to grow to $2000?

$2000 = 500(e)^{.05t}$ solve for t

$\frac{2000}{500} = e^{.05t}$

$4 = e^{.05t}$

$\ln(4) = \ln(e)^{.05t}$

$\ln(4) = .05t$

$\frac{\ln(4)}{.05} = t$

$27.72588722 = t$

Therefore, $500 will become $2000 in approximately 27.73 years with continuous compounding.

Answers to Self-Check for Tutorial 21
Logarithms

3. Solve $5^{x+3} = 7^{3x-5}$ for x.

$$\log(5^{x+3}) = \log(7^{3x-5})$$
$$(x + 3)\cdot \log(5) = (3x - 5)\cdot\log(7)$$
$$x \log(5) + 3 \log(5) = 3x \log(7) - 5\log(7)$$
$$x \log(5) - 3x \log(7) = -3 \log(5) - 5\log(7)$$
$$x (\log(5) - 3 \log(7)) = -3 \log(5) - 5\log(7)$$
$$x = \frac{-3 \log(5) - 5\log(7)}{(\log(5) - 3 \log(7))}$$

$x = 3.442965302$