

Math113 College Algebra  
**Third Midterm Exam**  
Colorado Mesa University 2024 Spring

NAME: \_\_\_\_\_

1. How do you write this expression with only a single  $x$  and no parenthesis?

$$\frac{35x^2}{\sqrt{49x^3}}x^5$$

2. This expression can be written as a single logarithm  $\log_3$  ("stuff"). What must the "stuff" be?

$$-2\log_3(3x) + \frac{1}{3}\log_3(y^{12})$$

3. Demonstrate how to find the value(s) of  $x$  that satisfy this equation.

$$\log_4\left(\frac{x+3}{2}\right) = 4$$

4. Suppose the size of colony of ants triples every year. You count the ants today, and find that there are 12345 ants. If you come back in eighteen months, how many ants should you expect to find?

5. Write down how you would explain to an adult how we can tell the number  $\log_2(125)$  is about equal to 7 without referring to a calculator. You may want to make some drawings or write out some manual computations to accompany your explanation.

6. Suppose you open a Citi Accelerated Savings Account<sup>1</sup> offered by Citigroup. This account guarantees an annual interest rate of 4.35% APR, compounded monthly.

(a) If your account balance is between \$0 and \$29,999.99, Citi may charge you a monthly service fee of \$4.50. What is the minimum account balance you'd need to maintain to ensure the monthly interest on the balance covers that fee?

(b) If you were to deposit \$30,000 into your account (avoiding the service fee) and make no further deposits, how long before the balance of your account would double?

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<sup>1</sup>[citi.com/banking/current-interest-rates/savings-accounts](https://www.citi.com/banking/current-interest-rates/savings-accounts)

$$S = P \left(1 + \frac{r}{n}\right)^{nt}$$

$$S = Pe^{rt}$$

$$S = P \left( \frac{\left(1 + \frac{r}{n}\right)^{nt} - 1}{\frac{r}{n}} \right)$$

$$S = P \left( \frac{1 - \left(1 + \frac{r}{n}\right)^{-nt}}{\frac{r}{n}} \right)$$

- (c) Reading the fine print, you see that you can also avoid the monthly service fee by having regular monthly contributions of at least \$250 deposited directly into your account. You open the account with an initial balance of \$0 and set up an automatic direct deposit through your job so that \$250 from each of your monthly paychecks is deposited into this account.

If you make no deposits/withdrawals to or from the account besides the regular deposits from your paycheck, *exactly* how long will it be until the balance of the account is over \$25,000?

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$$S = P \left( \frac{\left( 1 + \frac{r}{n} \right)^{nt} - 1}{\frac{r}{n}} \right)$$

$$S = P \left( \frac{1 - \left( 1 + \frac{r}{n} \right)^{-nt}}{\frac{r}{n}} \right)$$

7. Here is select historical data on the population of Slovenia according to the The World Bank.

Years since 1960	0	10	20	30	40	50	60
Population (Millions)	1.58	1.72	1.90	2.00	1.99	2.05	2.10

Perform regression to find a *logistic function*  $N(t)$  that models the population of Slovenia  $t$  years since 1960. (If you don't have the means to do this, see the exam proctor.)

(a) Using this model, demonstrate *algebraically* how to calculate the year during which the population of Slovenia is projected to hit 2,110,000.

(b) According to this model, what was Slovenia's population in 1992?

(c) According to this model, what is the upper-limit (carrying capacity) of Slovenia's population?

\* (OPTIONAL) The prompts on this exam were designed to elicit evidence of your understanding of the mathematics we've discussed in this course. But perhaps you've learned things that weren't prompted for. Perhaps you've gained some mathematical understanding that you haven't had an opportunity yet to exhibit on this exam. Now is your opportunity. On this page, demonstrate anything you've learned in this class that you haven't already gotten a chance to present on this exam.

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