Math113 College Algebra
Third Midterm Exam
Colorado Mesa University Fall 2023

NAME: _____

1. How do you write $x^{-2}\left(x^3\right)^5$ with only a single x and no parenthesis?

2. What is the value of $\log_{10}\left(10x^2\right)$ if we know that $\log_{10}(x) = 42$?

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

   $\log_3(x-9) = 7$

4. Here is data from a 2003 study[1] on the mean concentration of paracetamol (i.e. Tylenol®) in the blood plasma of twelve healthy patients after being administered a 1000mg does in tablet form.

Time after administration (minutes)	15	30	60	80	100	120
Concentration (g/ml)	18.46	15.77	11.61	10.79	9.80	8.54

(a) Do you think an exponential, logarithmic, or logistic model would fit the data best, and why?

(b) Based on your choice in the previous part, perform regression to find a function f that models the paracetamol concentration x minutes after administration. Write a formula for your model below with parameters rounded to three decimal places.

(c) What does your model predict the paracetamol concentration to be after three hours?

(d) What is the *exact* time after which your model predicts the paracetamol concentration will be under 7g/ml?

[1] Sevilla-Tirado FJ, González-Vallejo EB, Leary AC, Breedt HJ, Hyde VJ, Fernández-Hernando N. *Bioavailability of two new formulations of paracetamol, compared with three marketed formulations, in healthy volunteers.* Methods Find Exp Clin Pharmacol. 2003 Sep;25(7):531-5. doi: 10.1358/mf.2003.25.7.778092. PMID: 14571283.

5. Coloramo Credit Union offers *Certificates of Deposit* (CDs) to its members[2]. A CD offers a higher interest rate than a typical savings account, in exchange for agreeing that you won't withdraw your funds for a certain fixed amount of time.

   (a) Coloramo offers a five-year CD with a 2.722% interest rate compounded monthly. If you invest $2,718 into this CD, how much will your CD be worth after those five years?

   (b) You wish that your money grew faster than this, so you begin shopping around for accounts with better annual interest rates. What interest rate should you be looking for if you want your $2,718 to appreciate to $3,600 over the next five years?

$$S = P\left(1 + \frac{r}{n}\right)^{nt} \qquad S = Pe^{rt} \qquad S = P\left(\frac{\left(1 + \frac{r}{12}\right)^{12t} - 1}{\frac{r}{12}}\right) \qquad S = P\left(\frac{1 - \left(1 + \frac{r}{12}\right)^{-12t}}{\frac{r}{12}}\right)$$

6. After Bartholomew slipped and fell in a Baskin-Robbins, breaking both his clavicles, he sued for injury damages and won. The court awarded him $1.2 million that Baskin-Robbins agreed to pay either as one large lump sum, OR as a *structured settlement* funded though an annuity that would pay out over the next forty years. The annuity would earn 4% annual interest.

(a) If he accepts the annuity-funded structured settlement, how much money will Bartholomew receive per month?

(b) How much *less* money total will Bartholomew receive if he accepts the award as a lump sum now instead of as an annuity-funded structured settlement?

$$S = P\left(1 + \frac{r}{n}\right)^{nt} \qquad S = Pe^{rt} \qquad S = P\left(\frac{\left(1 + \frac{r}{12}\right)^{12t} - 1}{\frac{r}{12}}\right) \qquad S = P\left(\frac{1 - \left(1 + \frac{r}{12}\right)^{-12t}}{\frac{r}{12}}\right)$$

(c) Bartholomew decides that the monthly payments he'd receive from the annuity payouts is not enough—he wants \$12,000 per month! Bartholomew decides to try to renegotiate the forty-year term of the structured settlement for a shorter term so his monthly payments will be higher. What term length, in years, should he ask for?

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* (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, write about anything you've learned in this class that you haven't already gotten a chance to demonstrate on this exam.