Math113 College Algebra

Third Midterm Exam

Colorado Mesa University 2024 Fall

NAME: _____

1. This expression can be written as the logarithm of a single whole number. I.e. this expression is equal to $\ln(n)$ for some whole number n. What must n be?

   $$\frac{1}{2}\ln(49) + 3\ln(2)$$

2. How can you equivalently write this expression using only a single x with a positive exponent?

   $$\frac{\sqrt{x^7}}{x^2}$$

3. Suppose the size of a population of camels, growing continuously, triples every year. You count the camels today and find that there are 27 camels. If you come back in thirty months, how many camels should you expect to find?

4. Recall that the formula for the future value S of P dollars invested at an interest rate r compounded continually for t years is $S = Pe^{rt}$. Solve this formula for r.

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

$$\log_2\left(\frac{x-8}{3}\right) = 4$$

6. Here is historical data on the population of North Macedonia according to the The World Bank[1].

Years since 1960	10	20	30	40	50	60
Population (Millions)	1.66	1.91	2.04	2.03	2.06	2.07

(a) Perform regression to find a function N that you think accurately models this population of North Macedonia t years since 1960, and write down it's formula $N(t)$. What type of function did you choose, and why do you think it will provide an accurate model?

(b) Explain what your model predicts will happen to North Macedonia's population in the long term.

(c) Demonstrate how to *algebraically* calculate the year during which your model indicates North Macedonia's population officially crossed the two million person threshold.

[1] data.worldbank.org/indicator/SP.POP.TOTL?locations=MK

7. Suppose you open an Impact Money Market Account[2] offered by National Cooperative Bank (NCB). This account guarantees an annual interest rate of 2.5% APR, compounded *daily*.

   (a) What is the annual percent yield (APY) on this account? I.e. by what percent does your balance increase after a single year? Round the APY to the nearest thousandth of a percent.

   (b) If you were to deposit $7,000 into your account today and make no further deposits, how long before the balance of your account would double?

[2] ncb.coop/personal-banking/checking-accounts

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

(c) Suppose it's been years since you've you opened the account with NCB. You suddenly lose your job, and will need to live off the money you've amassed in this account until you find a new one. Your current account balance is \$47,850.61, and between all your monthly expenses — food, rent, gas, health insurance, etc — you plan on withdrawing about \$1260 per month (exactly \$42 per day) to live on. Demonstrate how you can calculate *exactly* how long you have to find a new job before you run out of money. Be sure to specify the units on your answer.

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