

Name: _____

PID: _____

NOTE: You must show the steps necessary to arrive at your answer unless otherwise noted. Use your judgment, if you can't do the entire problem in your head, then you probably should write down at least some intermediate steps.

This assignment has 11 pages. There are 56 total points.

Problem 1 (2 points). You may use a calculator, but you must show your work.

- (a) The crow population at UCSD was 3000 at the beginning of 2019 and grows at an annual rate of 9% per year. Write down a formula which outputs the total crow population at UCSD t years after 2019.
- (b) The UCSD student body has a population of 35,000 people. Assuming that student enrollment stays the same every year, how long do we have until the crows outnumber the students? (That is, what is the first year that the crow population will exceed 35,000?) [*calculator allowed*]

Problem 2 (4 points). Make a general sketch of the following functions on the **same** coordinate grid. Do not use a calculator, and do not plot specific points other than the y-intercept (simply make sure that the y-intercept and general shape are correct).

- $a(x) = 2(1.2)^x$
- $b(x) = 2(1.0)^x$
- $c(x) = 2(0.8)^x$
- $d(x) = 2(0.2)^x$

Problem 3 (2 points). Simplify the expression $\frac{x^{r+d}}{x^d} \cdot y^r$ as much as possible.

Problem 5 (6 points). Let $s(u) = 3(2)^u$. Write down a formula for the following functions in the form $a \cdot b^u$ (i.e. the exponent is only “u”).

(a) $s(u)$ shifted right by 3 units.

(b) $s(u)$ horizontally stretched (expanded) by a factor of two.

(c) Sketch $s(u)$ and the functions from part (a) and (b) on the same coordinate grid.

Problem 6 (4 points). What is the long run behavior of:

(a) $h(a) = 12(0.3)^a$?

(b) $c(t) = -0.5 \cdot (0.8)^t$?

Problem 7 (4 points). Solve each equation for the variable without using a calculator. Recall that e is Euler's Number.

(a) $\log_3(y) = 2$

(b) $\log_{10}(2a) = 3$

(c) $\ln(x) = 3$

(d) $\log_{16}(x) = \frac{-1}{2}$

Problem 8 (5 points). Simplify the following expressions:

$$\frac{2^{3a}}{8^b}$$

$$y^{2\log_y(4)}$$

$$\log_2(2^{10a})$$

$$\log_{10}(1000)$$

$$\log_y(-y)$$

Problem 9 (2 points). Suppose $0 < a < b$. Is $\ln(a)$ less than, greater than, or equal to $\ln(b)$, or is it impossible to tell? Why?

Problem 10 (1 point). Does the function $g(y) = \ln(y)$ have a horizontal intercept (i.e. a zero)? If so where is it? Write your answer as a coordinate pair.

Problem 11 (2 points). Solve the equation $\log_3(x) + \log_3(6x) - \log_3(3x) = 2$ for x by using properties of logarithms to simplify the expression.

Problem 12 (2 points). Solve the equation $\ln(\sqrt{\frac{x^3}{8}}) = 3$ by first simplifying the expression using properties of logarithms. Your answer should have an e in it (do not write as a decimal).

Problem 13 (2 points). Let c be some number between 2 and 5. You do not know what the exact value is, but you will use it in this problem. Roughly sketch $f(x) = \log_{10}(x-3)$ and $g(x) = c \cdot \log_{10}(x-3)$ on the same coordinate plane. Label asymptotes and horizontal intercepts, but do not plot any other points.

Problem 14 (8 points).

(a) What is the domain of $f(y) = \log_{10}(y)$?

(b) What is the range of $f(y) = \log_{10}(y)$?

(c) Let x be some number greater than 1. What is the domain of $k(a) = \log_x(a+10)$?

(d) What is the range of $a(s) = 2(5.2)^s + 2$?

Problem 15 (4 points).

(a) Let b be some positive number bigger than 1. Is $f(y) = \log_b(\frac{1}{y})$ increasing, decreasing, or partially increasing and partially decreasing? You may want to simplify using properties of logarithms.

(b) What is the domain of $f(y)$?

(c) What is the range of $f(y)$?

[OPTIONAL]

Survey Questions.

1. Do you find the lectures to go:

too fast **too slow** **roughly the right speed**

2. What is one course topic that you feel most confident in? What is one you feel least sure about?