

**Sample Exam 3**  
**Math 19, Spring 2013**

**Asymptotes:** If any horizontal or vertical asymptotes appear in your answers, please label them with (for example)  $x = 5$  and  $y = -7$  instead of just 5 and  $-7$ .

1. (12 points) Simplify as much as possible. Show all your work, and give your final answers as exact values and not decimal approximations.

(a)  $7^{\log_7(33)}$

(b)  $\log_5 25^{13}$

(c)  $\log_2 \left( \frac{1}{8} \right)$

2. (12 points) Solve the equation  $37(1 - e^{-5x}) = 31$  for  $x$ . Show all your work, and put your final answer in **exact form**, not a decimal approximation.

3. (10 points) Graph the function  $y = f(x) = 3 + 2(5^x)$ . Clearly indicate all intercepts and asymptotes on your graph, and state the domain and range of  $f(x)$ .

4. (10 points) Suppose  $t$  is a number such that the terminal point  $P(x, y)$  determined by  $t$  is  $\left( -\frac{5}{13}, \frac{12}{13} \right)$ . Sketch  $P(x, y)$  on the unit circle, and find the values of the six trig functions of  $t$ . Show all your work.

5. (10 points) Suppose  $t$  is a number such that the terminal point determined by  $t$  is in Quadrant III and  $\sin t = -\frac{1}{7}$ . Find the values of  $\cos t$  and  $\tan t$ , and briefly **JUSTIFY** any sign choices you make, possibly by drawing a picture.

6. (12 points) There has been a sudden outbreak of zombies in Daly City. Dr. Amy and Dr. Gina determine that the number of zombies in Daly City  $t$  days after the outbreak begins is modelled by

$$n(t) = n_0 e^{rt},$$

where  $n_0$  and  $r$  are constants.

(a) Drs. Amy and Gina also determine that when the outbreak started, there were 10,200 zombies in Daly City, and now,  $t = 12$  days later, there are 18,500 zombies. Solve for the constant  $r$ , and give your answer to at least 6 decimal places.

(b) The human population of Daly City is 102,000. Assuming that the human population of Daly City stays constant, how many days after the outbreak will there be more zombies than humans in Daly City? Write your final answer in the form of a complete sentence, using the correct units, and rounding off numerical answers to one decimal place.

7. (10 points) Expand the expression  $\log \left( \frac{(x-3)(x^2+4)^5}{\sqrt{(x-7)^3(x^2+1)}} \right)$  completely. Show all your work.

8. (10 points) Consider the function  $y = 4 \sin(13x)$ .

- (a) Find the amplitude and the period of this function. Make sure that your answers are boxed or otherwise clearly indicated.
- (b) Sketch the graph of this function below, drawing at least one complete period. Make sure that the coordinates of every peak, valley, or midpoint of your graph are clearly labelled.

9. (14 points) Let  $R(x) = \frac{7(x+5)(x-6)}{(x+4)(x-10)} = \frac{7x^2 - \dots}{x^2 - \dots}$ . When indicated, make sure you put your answer in the appropriate box. Show all your work.

- (a) Find the  $x$ -intercept(s) of  $R(x)$  and the  $y$ -intercept of  $R(x)$ .
- (b) Find all vertical and horizontal asymptotes of  $R(x)$ .
- (c) Sketch the graph of  $R(x)$ . Make sure that all of the above information is clearly visible in your graph. (It is more important that the key features are visible than for your graph to be drawn to scale.)