

**Instructions:** This quiz is closed book, closed note, and an individual effort. Electronic devices other than approved calculators are not allowed on your person (e.g., no cell phones or calculators with CAS). Answer each question. **Show all work to receive full credit.** Unless the question specifies, you may provide either an exact answer or round to two decimal places. If you get stuck, please attempt to explain what you want to do. This may give more partial credit.

1. (3 points)

- (a) Expand the following expression as much as possible (this includes any rules with powers of natural logarithms).

$$\ln\left(\frac{8x^4}{5}\right)$$

- (b) Solve the following equation for  $t$ .

$$e^{3t} = 5e^{2t}$$

- (c) Write the following expression with only one logarithm (This includes any rules with powers of natural logarithms).

$$(3 \ln(3) + 2 \ln(x)) - (4 \ln(5) + \ln(1))$$

2. (4 points) A population is currently 200 and is growing at 5% per year.

- (a) Write a formula for the population,  $P$ , as a function of time,  $t$  in years.

- (b) If instead the population began at 2,000 and was decaying at a rate of 10% per year, write a formula for the population as a function of time.

3. (4 points) A small stone is thrown into still water and create a circular wave. The radius  $r$  of the water wave increases at the rate of 2 cm per second.

(a) Find an expression for the radius,  $r$ , in terms of time,  $t$ , (in seconds) after the stone was thrown.

(b) If  $A$  is the area of the water wave in terms of  $r$  (reminder: area of a circle is  $A = \pi r^2$ ), write a function for the area of the water wave in terms of time,  $t$ .

(c) Determine if the function found above is a power function. If so, what is the constant of proportionality and is the area proportional to time squared or inversely proportional to time squared?

4. (4 points) Draw the graph of the function  $f(x) = x^2$ .

(a) Draw the graph of the function  $f(x) = (x + 2)^2$  on the same plane as  $f(x) = x^2$  (label each function).

(b) On the same graph, draw the function  $f(x) = -2(x + 2)^2$  (label the function).