

Name: ANSWERS

Instructions: No calculators! Answer all problems in the space provided! Do your rough work on scrap paper.

1. (a) For  $f(x) = \frac{1}{x+2}$ , find and simplify a formula for the average rate of change between  $x = a$  and  $x = b$ .

$$f_{avg} = \frac{-1}{(a+2)(b+2)}$$

- (b) Find the average rate of change on the interval  $[1,3]$ .  $f_{avg} = -\frac{1}{15}$

2. Simplify the expressions:

(a)  $\ln\left(\frac{xe^{5x}}{\sqrt{x+1}}\right) = \ln x + 5x - \frac{1}{2}\ln(x+1)$  (b)  $e^{2\ln 4x} = (4x)^2$  OR  $16x^2$

(c)  $\ln x - \ln \sqrt{x} + 2 \ln 3x = \ln(9x^{5/2})$  (combine)

3. The growth of a bacteria population is modeled by  $P(t) = 35e^{0.05t}$ , where  $P(t)$  is the size of the population at time  $t$  (in hours). When will the population reach a size of 45 bacteria? You may leave decimals, "e"s and "ln"s in your answer.

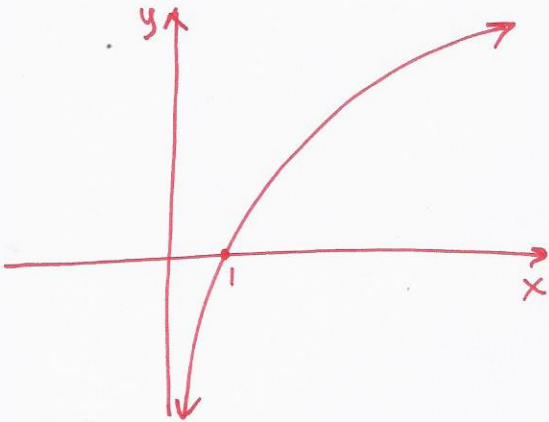
After  $\frac{\ln(9/7)}{0.05}$  hours, we will have 45 bacteria.

4. Solve the following equations:

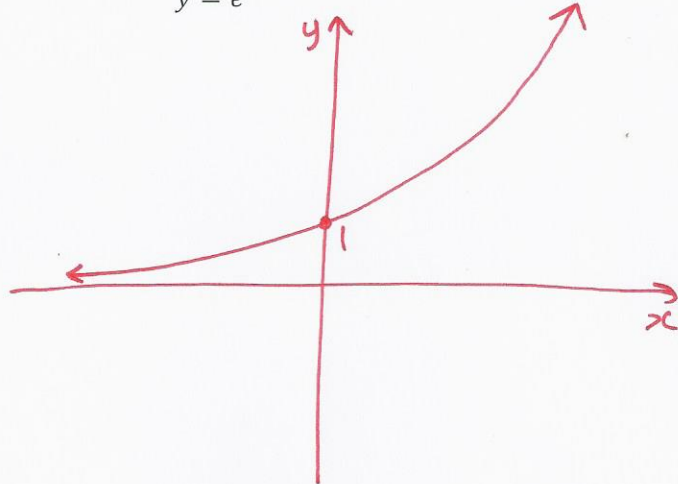
(a)  $2e^{3x-1} = 5 \Rightarrow x = \frac{\ln(\frac{5}{2})+1}{3}$  (b)  $\ln \sqrt{x+1} = 3 \Rightarrow x = e^6 - 1$

5. Graph the following:

$y = \ln x$



$y = e^x$



Bonus:

1. Compute the following limits:

(a)  $\lim_{h \rightarrow 0} \frac{\frac{1}{(x+h)^2} - \frac{1}{x^2}}{h} = -\frac{2}{x^3}$

(b)  $\lim_{x \rightarrow 9} \frac{3x-27}{|x-9|} = \text{DNE}$

(c)  $\lim_{t \rightarrow \infty} \frac{(2t^2+1)^2}{(t+1)^2(t^2+t)} = 4$

(b)  $\lim_{x \rightarrow -\infty} \frac{4x^2+9x^3}{5-3x^3} = -3$

2. Let  $f(x) = 2x^2 + 1$ , compute  $\lim_{h \rightarrow 0} \frac{f(2+h)-f(2)}{h} = 8$