Name: *ANSWER KEY* 12/9/2015

Math 195 Precalculus Quiz 4

Please show all work and **box your final answers**. Calculators are not allowed and cellphones should be put away. Good luck!

1. (8 points) Evaluate the following expressions.
   (a) $\log_9(3)$ $\boxed{1/2}$
   (b) $\log_{10}(0.01)$ $\boxed{-2}$
   (c) $\ln(1)$ $\boxed{0}$
   (d) $\ln(e)$ $\boxed{1}$

2. (8 points) Solve the logarithmic equation for x.

$$\log_{20}(2x-1)+\log_{20}(x+1)=1$$

$\log_{20}\left((2x-1)(x+1)\right) = 1$

$20 = (2x-1)(x+1) = 2x^2 + x - 1$

$0 = 2x^2 + x - 21$

$0 = (2x+7)(x-3)$

$2x+7=0$ $\qquad$ $x-3=0$

$2x=-7$ $\qquad$ $\boxed{x=3}$

$x=-\frac{7}{2}$

↑

NOTE THAT WHEN $x=-\frac{7}{2}$, $2x-1 = 2\left(-\frac{7}{2}\right)-1 = -8$

SO $\log(2x-1)$ IS UNDEFINED WHEN $x=-\frac{7}{2}$

∴ REJECT THIS ANSWER

3. (8 points) Use the laws of logarithms to expand the logarithmic expression.

$$\ln\left(\frac{(xy)^{1/3}}{2(x^2+y^2)}\right)$$

$$= \ln\left((xy)^{1/3}\right) - \ln\left(2(x^2+y^2)\right)$$

$$= \frac{1}{3}\left[\ln(x) + \ln(y)\right] - \left[\ln(2) + \ln(x^2+y^2)\right]$$

$$= \boxed{\frac{1}{3}\ln x + \frac{1}{3}\ln y - \ln(2) - \ln(x^2+y^2)}$$

4. (8 points) A culture starts with 8,600 bacteria. After 1 hour the count is 10,000.

(a) Find a function $P(t)$ that models the number of bacteria after t hours.

$$P(t) = 8600\left(\frac{10000}{8600}\right)^t$$

$$\boxed{P(t) = 8600\left(\frac{50}{43}\right)^t}$$

or $P(t) = 8600\, e^{\ln\left(\frac{50}{40}\right)t}$

(b) After how many hours will the number of bacteria double?

$$P(t) = 8600\left(\frac{50}{43}\right)^t = 2 \cdot 8600 \quad \text{(DOUBLE!)}$$

$$\left(\frac{50}{43}\right)^t = 2$$

$$t\ln\left(\frac{50}{43}\right) = \ln(2)$$

$$\boxed{t = \frac{\ln(2)}{\ln(50) - \ln(43)}}$$

5. (8 points) In the xy-plane below, sketch the graph $y = 1 + \log_2(x + 4)$. Include any horizontal/vertical asymptotes.