Using log rules to solve equations NAME:

The purpose of this worksheet is to practice using the logarithm rules to algebraically solve equations involving logs. We will also see how the graphical solutions are related. For #1 - 3, steps are given to help you solve them. It is possible to solve the equations other ways but **please try to follow the steps given**. Number 4 shows you how to solve a problem graphically. Numbers 5 and 6 are practice. Solve them any way you please.

1. Solve $3\log_3(x+4) - \log_3 9 = 2$. The steps are outlined below.

a. Figure out what $\log_3 9$ is. Rewrite the equation, substituting that into the left side.

b. Did you get $\log_3 9 = 2$? Add 2 to both sides of your equation and divide by 3 to isolate the log part.

c. Use the equivalence of $y = \log_b x$ and $b^y = x$ to rewrite your equation from above in exponential form. Notice this unburies the *x* from within the log.

d. Solve this equation. (You should have something like $3^{1.33} = x + 4$.) Solve it appropriately.

e. Check your answers in the original equation whenever you solve logarithmic equations. You'll need to use the change of base formula to evaluate the left side of the equation once you substitute your solution.

2. Solve $\log_4(x+10)+\log_4(x+2)=1$. Follow the steps outlined below.

a. Rewrite the equation, using the log rules to rewrite the left side as one log.

b. Use the equivalence of $y=\log_b x$ and $b^y = x$ to rewrite your equation from above in exponential form.

c. Solve this equation. Notice it is a quadratic equation. Multiply the left out and solve by the quadratic formula.

d. Check both answers in the original equation. Again, you'll need the change of base formula to deal with the left side. Remember you rounded your answers so when you plug them in, it's okay to be a little off. Also, remember that you cannot take the log of a negative number. If a solution would cause that, the solution is extraneous and must be crossed out.

3. Solve $\log_4\left(x^2-9\right)-\log_4\left(x+3\right)=3$. The steps are outlined below.
a. Rewrite the equation, using the log rules to rewrite the left side as one log.

b. Notice $\dfrac{x^2-9}{x+3}$ simplifies. Rewrite your equation, simplifying the $\dfrac{x^2-9}{x+3}$.

c. Use the equivalence of $y=\log_b x$ and $b^y=x$ to rewrite your equation from above in exponential form.

d. Solve this equation.

e. Check your answer. Again, the change of base formula will be needed to evaluate the original equation with your solution.

4. Solve $\log_4(x+10)+\log_4(x+2)=1$ graphically. You'll recall when we solved this algebraically we got an extraneous solution which did not work when we checked our answers. This does not happen when you solve graphically, assuming you do not use any of the log rules (except for the change of base formula which is necessary) to rewrite the expressions before you graph. The steps are outlined below.

a. In order to enter the left side into the calculator, the change-of-base formula is needed. Rewrite the left side using the change-of-base formula. Again, do **not** use the log rule you used in number 2 to rewrite the left side. This caused the extraneous solution and we do not want that.

b. Graph the left and right sides of the equation, and see where they intersect. Use the standard window. Find the *x* value where the left and right sides intersect. Copy your graph below and label the solution to the equation.

5. Solve $\log_2(x+4)^2 = 6$. Show your work and check your answers if you do it algebraically. Provide a well labeled graph if you do it graphically. Circle your answers.

(HINT: If you do it graphically, use the change of base formula and graph the left side as $y_1 = \log\left((x+4)^2\right)/\log(2)$. Notice the extra set of parentheses around the $(x+4)^2$. Also, do not use the log rules to rewrite that term as $2\log_2(x+4)$. It will not graph the correct thing.)

6. Solve $2\log_2(x-1)+\log_2 3 = 4$. Show your work and check your answers if you do it algebraically. Provide a well labeled graph if you do it graphically. Circle your answers.

(HINT: If you solve it graphically, do not rewrite $2\log_2(x-1)$ as $\log_2(x-1)^2$. It will not graph the correct thing. You'll want to graph $y_1 = 2\log(x-1)/\log(2)+\log(3)/\log(2)$. This uses the Change-of-base formula.)