

Algebra 2 with Support
Logarithmic Functions REVIEW: Solving Logarithmic Equations
Spring 2016

Name _____ Date: _____ Class: _____

Multiple Choice. Choose the best answer.

- B 1. What is the first step in solving the following logarithmic equation? $\log_3(x - 5) = \log_3(2x)$
- A. Log both sides B. Equate the Log arguments C. Rewrite in Exponential Form

- B 2. Rewrite $3^{-2} = \frac{1}{9}$ in logarithmic form.
- A. $\log_3 -2 = \frac{1}{9}$ B. $\log_3 \frac{1}{9} = -2$ C. $\log_{-2} \frac{1}{9} = 3$ D. $\log_{-2} 3 = \frac{1}{9}$

- C 3. What is the first step in solving the following logarithmic equation? $\log_5(x + 3) = 3$
- A. Log both sides B. Equate the Log arguments C. Rewrite in Exponential Form

- D 4. What is the base for \ln ?
- A. 0 B. 10 C. 1 D. e

- B 5. What is the base for \log when no base is given?
- A. 0 B. 10 C. 1 D. e

- B 6. Rewrite the logarithm $\log_3 \frac{1}{27} = -3$ in exponential form.
- A. $\log_{-3} 3 = \frac{1}{27}$ B. $3^{-3} = \frac{1}{27}$ C. $\frac{1}{27}^{-3} = 3$ D. $-3^3 = \frac{1}{27}$

- C 7. Which of the following expanded logs is **WRONG**?
- A. $\log_2(5x) = \log_2 5 + \log_2 x$ B. $\log_3 \frac{x}{5} = \log_3 x - \log_3 5$
C. $\log_2 x^7 = x \log_2 7$ D. $\log_2 x^7 = 7 \log_2 x$

- C 8. Rewrite in exponential form: $\log 100 = 2$
- A. $100 = 2^{\log}$ B. $10 = 100^2$ C. $10^2 = 100$ D. $100^2 = 1,000$

Solve for x . Simplify completely or round to two decimals. **CIRCLE YOUR ANSWER.**

$\log(3n + 9) = \log(4n + 5)$ $3n + 9 = 4n + 5$ $9 = n + 5$ <div style="border: 1px solid black; border-radius: 50%; padding: 5px; display: inline-block;"> $n = 4$ </div>	$\log(2x - 3) = \log(4x + 5)$ $2x - 3 = 4x + 5$ $-3 = 2x + 5$ $-8 = 2x$ <div style="border: 1px solid black; border-radius: 50%; padding: 5px; display: inline-block;"> $x = -4$ </div> <p style="text-align: right;">ARUMENT becomes $\log(-11) = \log(-11)$ this is extraneous NO SOLUTION</p>
$\log(3n + 4) = 2$ $10^2 = 3n + 4$ $100 = 3n + 4$ $96 = 3n$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $n = 32$ </div>	$\log_3(2x - 3) = 3$ $3^3 = 2x - 3$ $27 = 2x - 3$ $30 = 2x$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $x = 15$ </div>
$\log(x) + \log(9) = \log(54)$ $\log 9x = \log 54$ $9x = 54$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $x = 6$ </div>	$\log(x - 1) - \log(2) = \log(42)$ $\log \frac{x-1}{2} = \log 42$ $\frac{x-1}{2} = 42$ $x-1 = 84$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $x = 85$ </div>
$\log_2(x + 3) = 5$ $2^5 = x + 3$ $32 = x + 3$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $x = 29$ </div>	$\log(x + 2) + \log(4) = 2$ $\log_{10} 4(x + 2) = 2$ $100 = 4x + 8$ $92 = 4x$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $x = 23$ </div>

Solve for x . Simplify completely or round to three decimals. **CIRCLE YOUR ANSWER.**

$$\log(2x + 3) = \log(x - 4)$$

$$2x + 3 = x - 4$$

$$x + 3 = -4$$

$$x = -7$$

NO SOLUTION

$$\ln(-5x+2) = \ln(3x+2)$$

$$-5x + 2 = 3x + 2$$

$$2 = 8x + 2$$

$$0 = 8x$$

$x = 0$

$$\log_2(x - 3) = 3$$

$$2^3 = x - 3$$

$$8 = x - 3$$

$x = 11$

$$\ln(2x - 3) = 4$$

$$e^4 = 2x - 3$$

$$54.598.. = 2x - 3$$

$$57.598.. = 2x$$

$x \approx 28.799$

$$\log(6x + 1) = 3$$

$$10^3 = 6x + 1$$

$$1000 = 6x + 1$$

$$999 = 6x$$

$x = 166.5$

$$\log(2x + 1) - \log(2x) = \log(5)$$

$$\log \frac{2x + 1}{2x} = \log 5$$

$$\frac{2x + 1}{2x} = \frac{5}{1}$$

$$2x + 1 = 10x \quad \left| \begin{array}{l} 1 = 8x \\ x = \frac{1}{8} \end{array} \right.$$

$$\log(x - 2) + \log(4) = \log(x - 4)$$

extraneous \rightarrow $\log\left(\frac{4}{3} - \frac{4}{3}\right) \rightarrow \log\left(-\frac{2}{3}\right)$

$$\log 4(x - 2) = \log(x - 4)$$

$$4(x - 2) = (x - 4)$$

$$4x - 8 = x - 4$$

$$3x - 8 = -4$$

$$3x = 4$$

$x = \frac{4}{3}$ NO SOLUTION

$$\log(x + 1) + \log(4) = 2$$

$$\log_4(x + 1) = 2$$

$$10^2 = 4x + 4$$

$$100 = 4x + 4$$

$x = 24$

$$2\log x + 3\log x = \log 8 + \log 4 + 2\log 9 + \log 3$$

$$\log x^2 \cdot x^3 = \log(8 \cdot 4 \cdot 9^2 \cdot 3)$$

$$\log x^5 = \log 7776$$

$$x^5 = 7776$$

$$x = (7776)^{1/5}$$
$$x = 6$$

$$\log_{1.75} 2x = 3.4 \quad \text{BOB}$$

$$1.75^{3.4} = 2x$$

$$6.703... = 2x$$

$$x \approx 3.352$$

$$\ln 4x - \ln(2x-3) = \ln 5 - \ln 7$$

$$\ln \frac{4x}{2x-3} = \ln \frac{5}{7}$$

$$\frac{4x}{2x-3} = \frac{5}{7}$$

$$(4x)(7) = 5(2x-3)$$

$$28x = 10x - 15$$

$$18x = -15$$

$$x = \frac{-15}{18} = -\frac{5}{6}$$

NO SOLUTION

$$\log_3 \left(\frac{5x}{7} \right) = 4$$

$$3^4 = \frac{5x}{7}$$

$$81 = \frac{5x}{7}$$

$$567 = 5x$$

$$x = 113.4$$

Expand the following logarithmic expressions. Simplify completely. CIRCLE YOUR ANSWER.

$\log(5x)$ $\log 5 + \log x$	$\log_2\left(\frac{5}{x^2}\right)^3$ $3\log_2 5 - 3\log_2 x^2$ $3\log_2 5 - \frac{3}{2}\log_2 x$
$\log_8(7^3\sqrt{x})$ $\log_8 7 + \frac{1}{3}\log_8 x$	$\log\sqrt{xyz}$ $\frac{1}{2}\log x + \frac{1}{2}\log y + \frac{1}{2}\log z$
$\log\left(\frac{x^5y}{z}\right)$ $5\log x + \log y - \log z$	$\log\left(\frac{a\sqrt{b}}{c^3}\right)$ $\log a + \frac{1}{2}\log b - 3\log c$

Condense the following logarithmic expressions. Simplify completely. CIRCLE YOUR ANSWER.

$\log(2) - \log(4)$ $\log \frac{2}{4} \rightarrow \log \frac{1}{2}$	$2\log(3) + \log(5)$ $\log 3^2 \cdot 5$ $\log 45$
$\log_4(z) - \log_4(w)$ $\log_4 \frac{z}{w}$	$\frac{1}{2}\ln(x) + 5\ln(y)$ $\ln\sqrt{x} \cdot y^5$
$\log(h) + 4\log(y) - \frac{1}{2}\log(b)$ $\log \frac{h \cdot y^4}{\sqrt{b}}$	$3\log_2 a - 3\log_2 r + 3\log_2 t$ $\log_2 \frac{a^3 \cdot t^3}{r^3}$

Assignment

Date _____ Period _____

Solve each equation. Round your answers to the nearest ten-thousandth.

1) $\log_5 x - \log_5 6 = 2$

$\log_5 \frac{x}{6} = 2$

$5^2 = \frac{x}{6}$

$25 = \frac{x}{6}$

$150 = x$

2) $\log_5 7 + \log_5 x = \log_5 45$

$\log_5 7x = \log_5 45$

$7x = 45$

$x = \frac{45}{7} \approx 6.429$

3) $\log_9 x - \log_9 2 = \log_9 72$

$\log_9 \frac{x}{2} = \log_9 72$

$\frac{x}{2} = \frac{72}{1}$

$x = 144$

4) $\log_4 3x - \log_4 9 = 1$

$\log_4 \frac{3x}{9} = 1$

$\frac{4^1}{1} = \frac{3x}{9}$

$36 = 3x$
 $x = 12$

5) $\log_2 5 + \log_2 (x-8) = 5$

$\log_2 5(x-8) = 5$

$2^5 = 5(x-8)$

$32 = 5x - 40$

$72 = 5x$

$x = \frac{72}{5} = 14.4$

6) $\log_2 (x-6) + \log_2 9 = 3$

$\log_2 9(x-6) = 3$

$2^3 = 9(x-6)$

$8 = 9x - 54$

$62 = 9x$

$x = \frac{62}{9} \approx 6.889$

7) $\log_3 2x - \log_3 6 = 1$

$\log_3 \frac{2x}{6} = 1$

$\frac{3}{1} = \frac{2x}{6}$

$18 = 2x$

$x = 9$

Solve each equation.

8) $\log_8 10 - \log_8 (x-1) = 1$

$\log_8 \frac{10}{x-1} = 1$

$\frac{8}{1} = \frac{10}{x-1}$

$8(x-1) = 10$

$8x - 8 = 10$

$8x = 18$

$x = \frac{18}{8} = 9/4$

9) $\log_3 2 - \log_3 (x-2) = \log_3 14$

$\log_3 \frac{2}{x-2} = \log_3 14$

$\frac{2}{x-2} = \frac{14}{1}$

$\rightarrow 30 = 14x$

$2 = 14x - 28$

$x = \frac{30}{14}$

$= \frac{15}{7}$

10) $\log_8 4x^2 + \log_8 4 = 2$

$\log_8 4x^2 \cdot 4 = 2$

$\log_8 16x^2 = 2$

$8^2 = 16x^2$

$4 = x^2$

$64 = 16x^2$

$x = 2, -2$

11) $\log_8 4x + \log_8 9 = \log_8 14$

$\log_8 4x \cdot 9 = \log_8 14$

$\log 36x = \log 14$

$36x = 14$

$x = \frac{14}{36} = \frac{7}{18}$

$= \frac{7}{18}$

SCRAMBLED ANSWERS #1-11

144

6.889

12

144

6.889

9

14.4

150

2.22

9

12

$$12) -4 + \log_9 10x = 0$$

$$\log_9 10x = 4$$

$$9^4 = 10x$$

$$6561 = 10x$$

$$\cancel{6561} = 10x$$

$$14) -7 \log_6 (n+6) = 0$$

$$\log_6 (n+6) = 0$$

$$6^0 = n+6$$

$$1 = n+6$$

$$n = -5$$

$$16) -8 \log_{11} (x+1) = -24$$

$$\log_{11} (x+1) = 3$$

$$11^3 = (x+1)$$

$$1331 = x+1$$

$$x = 1330$$

$$18) \log 10 = \log (x+1)$$

$$10 = x+1$$

$$9 = x$$

$$20) \log (-p+2) = \log -3p$$

$$-p+2 = -3p$$

$$2 = -2p$$

$$p = -1$$

$$22) 6 \log_6 (x+8) = 18$$

$$\log_6 (x+8) = 3$$

$$6^3 = x+8$$

$$\cancel{216} = x+8$$

$$x = 208$$

$$13) -\log_7 4n = 1$$

$$\log_7 4n = -1$$

$$7^{-1} = 4n$$

$$\frac{1}{7} = 4n \rightarrow n = \frac{1}{28}$$

$$15) -5 + \log_6 (p+8) = -1$$

$$\log_6 (p+8) = 4$$

$$6^4 = p+8$$

$$1296 = p+8 \rightarrow 1288 = p$$

$$17) \log (5-3v) = \log 2v$$

$$5-3v = 2v$$

$$5 = 5v$$

$$v = 1$$

$$19) \log (-2b+6) = \log b$$

$$-2b+6 = b$$

$$6 = 3b$$

$$b = 2$$

$$21) -3 \log (x+2) = 3$$

$$\log (x+2) = -1$$

$$10^{-1} = x+2$$

$$\frac{1}{10} = x+2$$

$$23) \log 4m+7 = 10$$

$$x = -19$$

$$\text{or } x = \frac{-19}{10}$$

$$\log 4m = 3$$

$$10^3 = 4m$$

$$\cancel{1000} = 4m$$

$$m = 250$$

SCRABLED ANSWERS # 12-23

~~208~~

1330

~~○~~

~~○~~

~~6561~~

~~1288~~

~~2~~

~~○~~

~~19~~

~~28~~

~~250~~

~~○~~

Solve for x.

1. $\log_5 x = \frac{3}{2} \log_5 9 + \log_5 2$

$\log_5 x = \log_5 9^{\frac{3}{2}} \cdot 2$

$\log_5 x = \log_5 54$

$x = 54$

2. $\log(4x^2) = \log(11x-6)$

$4x^2 = 11x - 6$

$4x^2 - 11x + 6 = 0$

$(x-2)(4x-3) = 0$
 $x = 2 \quad x = \frac{3}{4}$

3. $\log(3x+5) - \log(x-5) = \log 8$

$\log \frac{3x+5}{x-5} = \log 8$

$\frac{3x+5}{x-5} = \frac{8}{1}$

$3x+5 = 8x-40$
 $45 = 5x \quad | \quad x = 9$

4. $\log_7 x + \log_7(2x+3) = \log_7 2$

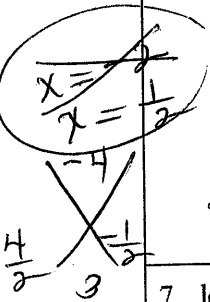
$\log_7 x(2x+3) = \log_7 2$

$x(2x+3) = 2$

$2x^2 + 3x = 2$

$2x^2 + 3x - 2 = 0$

$(x+2)(2x-1) = 0$



5. $2 \log_2 x = 6$

$\log_2 x = 3$

$2^3 = x$

$x = 8$

6. $\log_2 x^5 = 20$

$2^{20} = x^5$

$1048576 = x^5$

$x = 16$

7. $\log_4(x^2-17) = 3$

$4^3 = x^2 - 17$

$64 = x^2 - 17$

$x^2 = 81$

$x = 9, x = -9$

8. $\log(x^2-1) - \log 12 = 1$

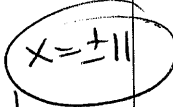
$\log \frac{x^2-1}{12} = 1$

$10 = x^2 - 1$

$12 = x^2 - 1$

$120 = x^2 - 1$

$x^2 = 121$



9. $\log 8 + 3 \log x = 3$

$\log 8 + \log x^3 = 3$

$\log 8x^3 = 3$

$10^3 = 8x^3$

$1000 = 8x^3$

$125 = x^3$

$x = 5$

Answers: 1. 54

2. $\frac{3}{4}, 2$

3. 9

4. $\frac{1}{2}$

5. 8

6. 16

7. ± 9

8. ± 11

9. 5

Solve the following logarithmic equations using the appropriate method. Round to three decimal places where necessary. Show all steps. Check for extraneous solutions.

11. $\log(x+4) = \log(4x-11)$

$$x+4 = 4x-11$$

$$4 = 3x-11$$

$$15 = 3x$$

$$x = 5$$

12. $\log_5(6x-1) = 3$

$$5^3 = 6x-1$$

$$125 = 6x-1$$

$$126 = 6x$$

$$x = 21$$

13. $\ln 8x = -3$

$$e^{-3} = 8x$$

$$\frac{0.049..}{8} = x$$

$$x \approx .006$$

14. $3\log 14x - 5 = -1$

$$3\log 14x = 4$$

$$\log 14x = \frac{4}{3}$$

$$10^{\frac{4}{3}} = 14x$$

$$21.54.. = 14x$$

$$x \approx 1.539$$

15. $\log_4(x+2)(x-4) = 2$

F.O.I.L.

$$4^2 = (x+2)(x-4)$$

$$16 = x^2 - 4x + 2x - 8$$

$$0 = x^2 - 2x - 24$$

NOW
BIG
X

$$x = 6, x = -4$$

$$(x-6)(x+4) = 0$$

16. $\log_{1.38} x = 6$

$$1.38^6 = x$$

$$x \approx 6.907$$

17. $\log_2(x-9) = 0$

$$2^0 = x-9$$

$$1 = x-9$$

$$10 = x$$

18. $\log \frac{x}{4} = 2$

$$10^2 = \frac{x}{4}$$

$$x = 400$$

$$100 = \frac{x}{4}$$