Name: Key Date: ______________ Class Period: ________

Algebra 2 **6.3: Logarithms (Day 2 Worksheet)**

*Note the "**NC**" and "**C**" indications. When using a calculator, round final answers to three decimals.*

1. Evaluate each logarithm. ***NC***

a. $\log 1{,}000$

Think: $10^{?} = 1{,}000$

$\boxed{3}$

b. $\log_3 27$

Think: $3^{?} = 27$

$\boxed{3}$

c. $\log_2 \left(\frac{1}{32}\right)$

Think: $2^{?} = \frac{1}{32}$

$\boxed{-5}$

d. $\log_{16} 4$

Think: $16^{?} = 4$

$\boxed{\frac{1}{2}}$

2. Solve each equation for x by rewriting in logarithmic form. Show all work. ***C***

a. $4^x = 99$

$\log_4 99 = x$

$\boxed{x \approx 3.315}$

b. $6^x = 42$

$\log_6 42 = x$

$\boxed{x \approx 2.086}$

c. $2^x = 1.5$

$\log_2 1.5 = x$

$\boxed{x \approx 0.585}$

d. $15 - 2^x = 10$

$2^x = 5$

$\log_2 5 = x$

$\boxed{x \approx 2.322}$

e. $4^{x-5} = 17$

$\log_4 17 = x - 5$

$x = 5 + \log_4 17$

$\boxed{x \approx 7.044}$

f. $4 - 8^x = 1$

$8^x = 3$

$\log_8 3 = x$

$\boxed{x \approx 0.528}$

3. Solve each equation for x by rewriting in logarithmic form. Show all work. ***NC***

a. $9^{x-5} = 81$

$\log_9 81 = x - 5$

$x - 5 = 2$

$\boxed{x = 7}$

b. $2^{6x-9} = \frac{1}{64}$

$\log_2 \frac{1}{64} = 6x - 9$

$-6 = 6x - 9$

$6x = 3$

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

c. $2^{3+x} - \frac{1}{4} = 0$

$2^{3+x} = \frac{1}{4}$

$\log_2 \frac{1}{4} = 3 + x$

$-2 = 3 + x$

$\boxed{x = -5}$

4. Solve each equation for x by rewriting in exponential form. Show all work. ***NC***

a. $\log_x 16 = 2$

$x^2 = 16$

$x = \sqrt{16}$

$\boxed{x = 4}$ (base is positive)

b. $\log_{32} x = \frac{3}{5}$

$32^{3/5} = x$

$\left(\sqrt[5]{32}\right)^3 = x$

$2^3 = x$

$\boxed{x = 8}$

c. $\log_1 6 = x$

$1^x = 6$

Not possible!

$\boxed{\text{No solution}}$

d. $6 = 2\log_3(10x-3)$

$\frac{6}{2} = \frac{2\log_3(10x-3)}{2}$

$\log_3(10x-3) = 3$

$3^3 = 10x-3$

$10x-3 = 27$

$10x = 30$

$\boxed{x=3}$

e. $-4\log_2\left(\frac{1}{5x+4}\right)-5=19$

$-4\log_2\left(\frac{1}{5x+4}\right)=24$

$\log_2\left(\frac{1}{5x+4}\right)=-6$

$2^{-6}=\frac{1}{5x+4}$

$5x+4=64$

$\boxed{x=12}$

f. $\log_x 3 = 0$

$x^0 = 3$

Not possible!

$\boxed{\text{No Solution}}$

5. The Richter magnitude of an earthquake is $R = 0.67\log(0.37E)+1.46$, where E is the energy (in kilowatt-hours) released by the earthquake. ***C***

a. What is the magnitude of an earthquake that releases 11,800,000,000 kilowatt-hours of energy? Round to the nearest tenth.

$R = 0.67\log(0.37\cdot 11{,}800{,}000{,}000)+1.46$

$\boxed{\therefore R \approx 7.9}$

b. How many kilowatt-hours of energy would an earthquake have to release in order to be an 8.2 on the Richter scale? Round to the nearest whole number.

$8.2 = 0.67\cdot\log(0.37E)+1.46$

$6.74 = 0.67\cdot\log(0.37E)$

$\log(0.37E) = \frac{6.74}{0.67}$

$10^{\left(\frac{6.74}{0.67}\right)} = 0.37E$

$E = \frac{10^{\left(\frac{6.74}{0.67}\right)}}{0.37}$

$\boxed{E \approx 31{,}009{,}857{,}353 \text{ kWh}}$

c. If walls may start to crack at a magnitude of 4 or higher, what is the least number of kilowatt-hours an earthquake would have to release to start cracks in walls? Round to the nearest whole number.

$4 = 0.67\log(0.37E)+1.46$

$\log(0.37E) = \frac{2.54}{0.67}$

$E = \frac{10^{\left(\frac{2.54}{0.67}\right)}}{0.37}$

$\boxed{\therefore E \approx 16{,}705 \text{ kWh}}$

6. The function $c(t) = 108(2.71828)^{-0.08t}+75$ calculates the temperature (in °F) of a cup of coffee that was handed out a drive-thru window t minutes ago.

a. What was the coffee's temperature the instant it was handed out the window?

$C(0) = 108(2.71828)^0+75$

$\boxed{\therefore \text{The initial temp. was } 183°\text{F.}}$

b. After how many minutes is the coffee in the cup 98° F? Round to the nearest whole minute.

$98 = 108(2.71828)^{-0.08t}+75$

$2.71828^{-0.08t} = \frac{23}{108}$

$\log_{2.71828}\left(\frac{23}{108}\right) = -0.08t$

$t = \frac{\log_{2.71828}\left(\frac{23}{108}\right)}{-0.08}$

$\boxed{\therefore t \approx 19 \text{ minutes}}$