Algebra 2 Name:
Log Word problems Date:

Logarithmic Word Problems

Complete the following questions on **separate paper.** You may approximate answers using a calculator.

1. The Richter scale is used for measuring the magnitude of an earthquake. The Richter magnitude is given by $R = 0.67\log(0.37E) + 1.46$ where E is the energy (in kilowatt-hours) released by the earthquake.

a. An earthquake releases 15,500,000,000 kilowatt-hours of energy. What is the earthquake's magnitude?

b. How many kilowatt-hours of energy would an earthquake have to release in order to be a 8.5 on the Richter scale.

2. The wind speed *s* (in miles per hour) near the center of a tornado is related to the distance *d* (in miles) the tornado travels by the equation $s = 93\log d + 65$.

a. On March 18, 1925, a tornado whose wind speed was about 280 miles per hour struck the Midwest. How far did the tornado travel?

3. Jonas purchased a new car for $15,000. Each year the value of the car depreciates by 30% of its value the previous year. In how many years will the car be worth $500?

4. Brad created a chart that shows the population of a town will increase to 96,627 people from a current population of 11,211 people. The rate of increase is an annual increase of 4.18%. Brad forgot to include the number of years this increase will take. How many years was it? (Solve algebraically.)

5. Jack planted a mysterious bean just outside his kitchen window. It immediately sprouted 2.56 cm above the ground. Jack kept a careful log of the plant's growth. He measured the height of the plant each day at 8am and recorded these data.

Day	0	1	2	3	4
Height (cm)	2.56	6.4	16	40	100

a. Define variables and write an exponential equation for this pattern. If the pattern were to continue, what would be the heights on the fifth day

b. Jack's younger brother measured the plant at 8pm on the evening of the third day and found it to be about 63.25 cm tall. Show how to find this value mathematically.

c. Find the height of the sprout at 12noon on the sixth day.

d. Find the time at which the sprout has doubled in height.

e. Find the day and time when the plant reaches a height of 1 km.

6. Cristo looks at an old radio dial and notices that the numbers are not evenly spaced. He hypothesizes that there is an exponential relationship involved. He tunes the radio to 88.7FM. After 6 "clicks" of the tuning knob, he is listening to 92.9FM.

a. Write an exponential model to represent the situation. Let *x* represent the number of "clicks" past 88.7FM and let *y* represent the station number.

b. Use the equation you have found to determine how many "clicks" Cristo should turn to get from 88.7FM to 106.3FM.

7. Newton's Law of Cooling describes the way the temperature of objects adjusts to the ambient temperature over time. This relationship is an exponential function. Let $H(t) = 93(0.91)^t + 68$ describe the temperature of a beverage (in degrees F) *t* minutes after a Dunkin' Donuts employee hands it to you.

a. Is the beverage hot coffee or iced coffee? How can you tell by looking at the equation?

b. What is the asymptote of the graph of $H(t)$ and what does it mean in the context of this problem?

c. Sketch a rough graph of $H(t)$. Only do the portion of the function where $t \geq 0$, since the negative values of *t* don't make sense in the context of the problem.

d. Calculate the coordinates of the y-intercept of $H(t)$. What do they mean in the context of the problem?

e. What is the range of $H(t)$? (remember, only where $t \geq 0$). What meaning does it have in the context of the problem?

f. What is the value of $H(10)$ and what meaning does it have in context?

g. Exactly when does the temperature hit 90°? Solve with logs.

g. Exactly when does the temperature hit 75°? Solve with logs.

Answer Key

1. a. 8 **b**. 8.69×10^{10} kilowatt-hours

2. **a.** 205 miles

3. 9.53 years

4. 52.6 years

5. a. t = # of days h = height of plant $h(t) = 2.56(2.5)^t$ **b.** h(3.5)

c. 728.12 cm **d.** 2:09am **e.** Day 9 8:02 am

6. a. $y = 88.7(1.0077)^x$ **b.** 23.6 "clicks"

7. $y = (1.26)^x$