Algebra RH

Essential Question: How can we represent exponential relationships symbolically?

Do Now: Read the scenario below and answer the questions that follow.

When a piece of paper is folded in half, the total thickness doubles. Suppose an unfolded piece of paper is 0.1 millimeter thick. The equation $t(n) = 0.1(2)^n$ represents the total thickness, $t(n)$, as a function of the number of folds, n.

a) The function $\boxed{t(n) = 0.1(2)^n}$ is an explicit rule created from $t(n) = ab^n$. In the explicit rule, what is the value of a? What does this number represent in the context of the problem?

to find any term

$a = 0.1$ An unfolded paper is 0.1 mm thick.

b) What is the value of **b**? What does this number represent in the context of the problem?

$b = 2$ The thickness of the paper is doubling each time. (with each fold)

c) Using the function, determine the thickness of the paper after 5 folds.

$t(5) = 0.1(2)^5$ $n = 5$

$= 3.2$ After 5 folds, the thickness of the paper is 3.2 mm

How do we write a function rule to represent an exponential relationship?

1. Identify the values of a and **b** in $\boxed{f(x) = ab^x}$.
   - **a** represents the initial value (0, a)
   - **b** represents the common ratio
2. Write the function by substituting the values of **a** and **b** into $f(x) = ab^x$.

1. The height $h(n)$ of a dropped ball is an exponential function of the number of bounces n. The ball was dropped from an initial height of 40 inches. On its first bounce, it reached a height of 30 inches and on its second bounce, it reached a height of 22.5 inches. Write an exponential function in the form of $\boxed{h(n) = ab^n}$ that represents this scenario.

n (# of bounces)	h(n) (height (inches))
0	40
1	30
2	22.5

$a = 40$

$b = 0.75$

$\frac{22.5}{30} = 0.75$

$\frac{30}{40} = 0.75$

$h(n) = 40(0.75)^n$

geometric sequence

$h(n) = 30(0.75)^{n-1}$

2. A pharmaceutical company is testing a new antibiotic. The number of bacteria present in a sample 1 hour after application of the antibiotic is 50,000. After another hour, the number of bacteria present in the sample is 25,000. The number of bacteria remaining, ***r*(*n*)**, is an exponential function of the number of hours, ***n***, since the antibiotic was applied.

a) Complete the table below that describes the relationship.

Number of Hours ***n***	0 Initial Amount	1	2	3	4
Amount of Bacteria ***r*(*n*)**	100 000	50,000	25,000	12,500	6,250

$\times 2$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

b) Write an exponential function to represent the above scenario.

$a = 100\,000 \rightarrow r(n) = 100\,000\,(0.5)^n$

$b = 1/2$ or $r(n) = 50{,}000\,(0.5)^{n-1}$

c) Using your function, determine the amount of bacteria that will remain in the sample after the 7th hour.

$\uparrow n = 7$

$r(7) = 100\,000\,(0.5)^7$ (hundredth)

$= 781.25$

781.25 bacteria remains

3. Suppose you invest some money in an interest bearing account. After the first month, the balance, including interest, is \$10,500. Following the second month, the balance is \$11,025. Following the 3rd month, the balance is \$11,576.25. Write an exponential function in $\boxed{f(x) = ab^x}$ form to represent the balance in the account after **x** months. Use the table below to help you.

Months **x**	0	1	2	3
Balance in Account f(x)	10 000	10 500	11 025	11576.25

$\rightarrow f(x) = 10000\,(1.05)^x$

TAKE AWAY

In order to represent an exponential relationship as a function in the form of **f(x) = ab^x**, identify a, initial value (y-intercept), and **b**, common ratio.