LESSON MAKER PRO

Base Rate Detectives

Read exponential bases, rates, and change patterns.

HIGH SCHOOL · HSF-IF.C.8b

CCSS.Math.Content.HSF-IF.C.8b "Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$..."

NAME _____ DATE _____

PRACTICE: READ THE BASE

In $y = a(b^x)$, the base b is the multiplier for each 1-unit increase in x. For a positive decimal rate r, $b = 1 + r$ means 100r% growth. For $0 < r < 1$, $b = 1 - r$ means 100r% decay. Use exponent properties to rewrite expressions so the exponent is just x.

WORKED EXAMPLE

Interpret $y = (1.04)^{(3t)}$. Rewrite it in the form $y = b^t$, then state the percent rate of change and whether it is growth or decay.

1. Use $a^{(kt)} = (a^k)^t$: $y = ((1.04)^3)^t$.
2. $(1.04)^3 = 1.124864$, so $y = (1.124864)^t$.
3. $1.124864 = 1 + 0.124864$, so the rate is a 12.4864% increase.

Answer: $y = (1.124864)^t$; 12.4864% growth.

PRACTICE 6 problems

1 For $y = (1.07)^x$, state the percent rate of change and classify the function as growth or decay.

ANSWER _____

2 For $y = (0.96)^x$, state the percent rate of change and classify the function as growth or decay.

ANSWER _____

3 Rewrite $y = (1.2)^{(2x)}$ in the form $y = b^x$. Then state the percent rate of change and classification.

ANSWER _____

4 Rewrite $y = (0.9)^{(2x)}$ in the form $y = b^x$. Then state the percent rate of change and classification.

ANSWER _____

5 Rewrite $y = (1.44)^{(x/2)}$ in the form $y = b^x$. Then state the percent rate of change and classification.

ANSWER _____

6 For $y = 5(0.75)^x$, state the percent rate of change and classify the function as growth or decay.

ANSWER _____

APPLY IT Show your work

1 An esports club models its fundraiser balance with $B = 200(1.1)^w$, where w is the number of weeks. What is the starting balance? What is the weekly percent rate of change and classification? Find the balance after 2 weeks.

WORK SPACE

ANSWER _____

2 The resale value of a used game console is modeled by $V = 640(0.875)^m$, where m is the number of months. What is the starting value? What is the monthly percent rate of change and classification? Find the value after 2 months.

WORK SPACE

ANSWER _____

CHALLENGE One step up

A student says $A = 300(1.21)^{(x/2)}$ and $B = 300(1.1)^x$ have different growth rates because they look different. Are the models equivalent? Explain using exponent properties, then state the percent growth rate.

WORK SPACE AND ANSWER

Base Rate Detectives

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	For $y = (1.07)^x$, state the percent rate of change and classify the function as growth or decay.	**7% growth.**
2	For $y = (0.96)^x$, state the percent rate of change and classify the function as growth or decay.	**4% decay.**
3	Rewrite $y = (1.2)^{(2x)}$ in the form $y = b^x$. Then state the percent rate of change and classification.	**$y = (1.44)^x$; 44% growth.**
4	Rewrite $y = (0.9)^{(2x)}$ in the form $y = b^x$. Then state the percent rate of change and classification.	**$y = (0.81)^x$; 19% decay.**
5	Rewrite $y = (1.44)^{(x/2)}$ in the form $y = b^x$. Then state the percent rate of change and classification.	**$y = (1.2)^x$; 20% growth.**
6	For $y = 5(0.75)^x$, state the percent rate of change and classify the function as growth or decay.	**25% decay.**

PART 2 · APPLY IT

1. **Starting balance: $200. Rate: 10% growth per week. After 2 weeks: $242.** The coefficient 200 is the starting balance. Since 1.1 = 1 + 0.1, multiply 200 by 1.1 twice: $200(1.1)^2 = 242$.
2. **Starting value: $640. Rate: 12.5% decay per month. After 2 months: $490.** The coefficient 640 is the starting value. Since 0.875 = 1 - 0.125, the value decays 12.5% each month, and $640(0.875)^2 = 490$.

CHALLENGE

Yes. Since $1.21 = (1.1)^2$, $A = 300(((1.1)^2)^{(x/2)}) = 300(1.1)^x$, which is B. Both models show 10% growth per x-unit.

Accept equivalent rewritten forms, such as 1.44^x for $(1.2)^{(2x)}$, and equivalent percent statements, such as a decrease of 19%. For the challenge, students should show that the exponent operations produce a base of 1.1.