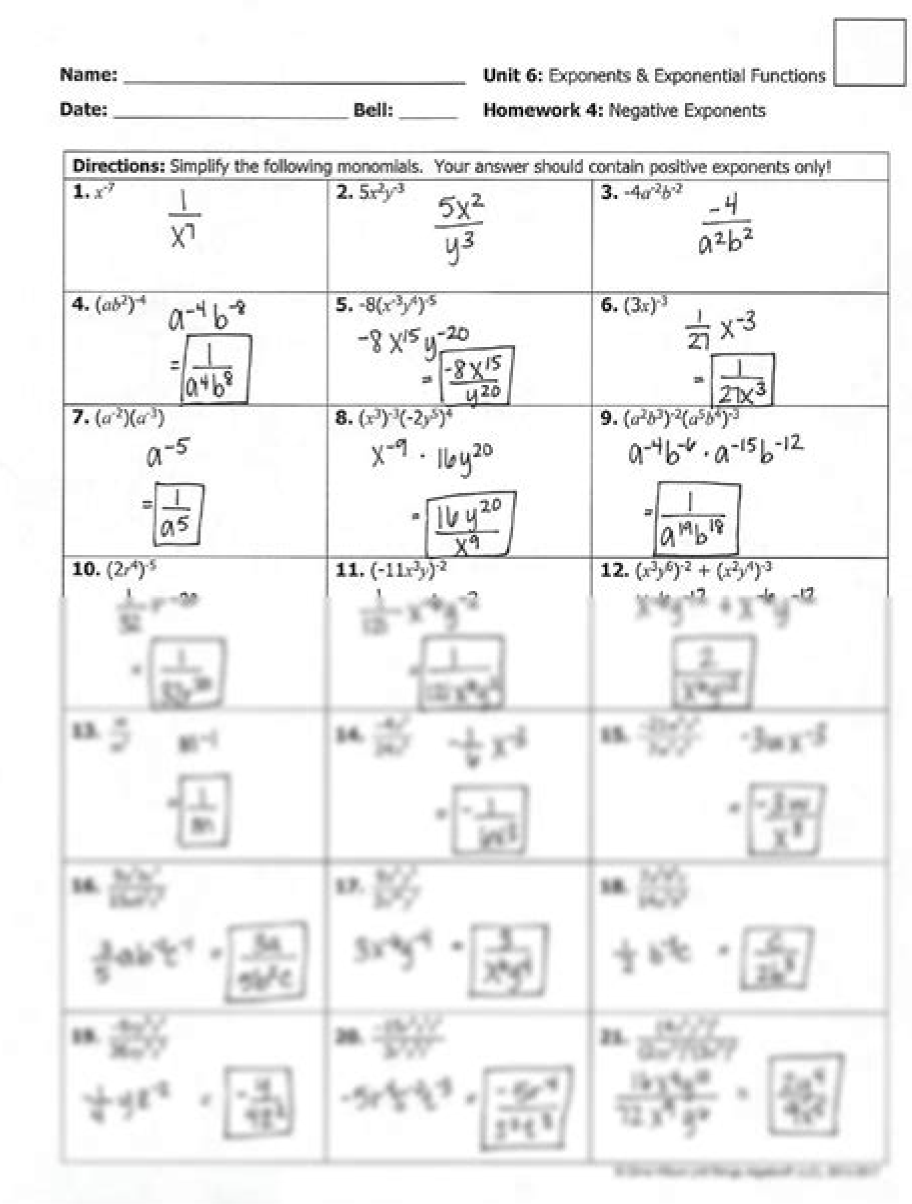
Exponential Functions Answer Key



Name: ______________________ **Unit 6:** Exponents & Exponential Functions

Date: ______________ **Bell:** _____ **Homework 4:** Negative Exponents

Directions: Simplify the following monomials. Your answer should contain positive exponents only!

1. x^{-7} — $\frac{1}{x^7}$	**2.** $5x^2y^{-3}$ — $\frac{5x^2}{y^3}$	**3.** $-4a^{-2}b^{-2}$ — $\frac{-4}{a^2b^2}$
4. $(ab^2)^{-4}$ — $a^{-4}b^{-8} = \frac{1}{a^4b^8}$	**5.** $-8(x^{-3}y^4)^{-5}$ — $-8x^{15}y^{-20} = \frac{-8x^{15}}{y^{20}}$	**6.** $(3x)^{-3}$ — $\frac{1}{27}x^{-3} = \frac{1}{27x^3}$
7. $(a^{-2})(a^{-3})$ — $a^{-5} = \frac{1}{a^5}$	**8.** $(x^3)^{-3}(-2y^5)^4$ — $x^{-9} \cdot 16y^{20} = \frac{16y^{20}}{x^9}$	**9.** $(a^2b^3)^{-2}(a^5b^4)^{-3}$ — $a^{-4}b^{-6} \cdot a^{-15}b^{-12} = \frac{1}{a^{19}b^{18}}$
10. $(2r^4)^{-5}$ — $\frac{1}{32}r^{-20} = \frac{1}{32r^{20}}$	**11.** $(-11x^3y)^{-2}$ — $\frac{1}{121}x^{-6}y^{-2} = \frac{1}{121x^6y^2}$	**12.** $(x^3y^6)^{-2} + (x^2y^4)^{-3}$ — $x^{-6}y^{-12} + x^{-6}y^{-12} = \frac{2}{x^6y^{12}}$
13. [illegible]	**14.** [illegible]	**15.** [illegible]
16. [illegible]	**17.** [illegible]	**18.** [illegible]
19. [illegible]	**20.** [illegible]	**21.** [illegible]

Exponential functions answer key are essential tools for students and educators alike as they navigate the complexities of mathematical concepts. Understanding exponential functions is crucial for a variety of fields, including science, engineering, economics, and computer science. This article will explore the fundamentals of exponential functions, provide examples, and offer an answer key to common problems, ensuring that learners can confidently tackle this topic.

What Are Exponential Functions?

Exponential functions are mathematical expressions of the form \(f(x) = a \cdot b^x \), where:

- a is a constant (the initial value),
- b is the base of the exponential (a positive real number),
- x is the exponent.

The base b determines the behavior of the function:

- If $b > 1$, the function represents exponential growth.
- If $0 < b < 1$, the function represents exponential decay.

Exponential functions are characterized by their rapid increase or decrease, making them unique compared to linear functions.

Characteristics of Exponential Functions

When grappling with exponential functions, it is vital to understand their key characteristics:

1. Growth and Decay

Exponential functions can represent various real-world scenarios:

- Exponential Growth: This occurs in populations, investments, and other areas where the quantity increases rapidly. For example, if a population of bacteria doubles every hour, the growth can be modeled by an exponential function.

- Exponential Decay: This applies to situations such as radioactive decay, depreciation of assets, and cooling processes. For example, a substance that loses half its mass every hour can be modeled using an exponential decay function.

2. Graphing Exponential Functions

Understanding how to graph exponential functions is essential. Here are the main steps:

1. Identify the base b and the initial value a.
2. Calculate a few values of $f(x)$ for selected x values.
3. Plot these points on a coordinate plane.
4. Draw a smooth curve through the points, noting that the curve approaches the x-axis but never touches it (asymptote).

3. Asymptotes

Exponential functions have horizontal asymptotes. For functions of the form $f(x) = a \cdot b^x$:

- The horizontal asymptote is typically the x-axis (y=0), meaning the function will never actually reach zero.

4. Domain and Range

The domain of exponential functions is all real numbers ($-\infty, \infty$), while the range is always positive real numbers ($0, \infty$).

Common Exponential Function Problems

To help solidify understanding, here are some common problems involving exponential functions along with their solutions.

Problem 1: Exponential Growth

A population of rabbits grows exponentially. If the population doubles every 3 months and starts with 100 rabbits, what will the population be after 1 year?

Solution:
- Initial value $a = 100$.
- The growth factor $b = 2$ (since it doubles).
- The time in months is 12, and since it doubles every 3 months, the number of doubling periods is $12 / 3 = 4$.

Using the formula:

$$
f(x) = 100 \cdot 2^{(x/3)}
$$

For $x = 12$:

$$
f(12) = 100 \cdot 2^{(12/3)} = 100 \cdot 2^4 = 100 \cdot 16 = 1600
$$

The population after 1 year will be 1600 rabbits.

Problem 2: Exponential Decay

A certain radioactive substance has a half-life of 5 years. If we start with 80 grams, how much will remain after 15 years?

Solution:
- Initial value $a = 80$.
- The decay factor is $b = \frac{1}{2}$ (the amount halves).
- The number of half-lives in 15 years is $15 / 5 = 3$.

Using the formula:

$$
f(t) = 80 \cdot \left(\frac{1}{2}\right)^{(t/5)}
$$

For $t = 15$:

$$
f(15) = 80 \cdot \left(\frac{1}{2}\right)^{(15/5)} = 80 \cdot \left(\frac{1}{2}\right)^3 = 80 \cdot \frac{1}{8} = 10
$$

After 15 years, there will be 10 grams of the substance remaining.

Exponential Functions Answer Key

To aid students in their understanding, here is an answer key for common types of exponential function problems:

Growth Problems

1. Population doubling problem: Start with 50, doubles every 2 years. After 6 years, population = 400.
2. Investment problem: Invest $1000 at 5% compounded annually. After 10 years, amount = $1628.89.

Decay Problems

1. Radioactive decay: Start with 200 grams, half-life of 4 years. After 12 years, remaining = 25 grams.
2. Depreciation: An asset worth $1000 depreciates by 10% annually. After 5 years, value = $590.49.

Conclusion

Exponential functions answer key provides a crucial understanding of how exponential growth and decay work. By mastering the characteristics, graphing techniques, and problem-solving strategies related to exponential functions, students can apply these concepts across various real-world scenarios. With practice and the right resources, anyone can grasp the intricacies of exponential functions and tackle related problems with confidence.

Frequently Asked Questions

What is an exponential function?

An exponential function is a mathematical function of the form $f(x) = a b^x$, where 'a' is a constant, 'b' is the base and is a positive real number, and 'x' is the exponent.

What are the key characteristics of exponential functions?

Key characteristics include a constant growth rate, a horizontal asymptote, and the fact that they can grow (or decay) rapidly depending on the base.

How do you identify the growth or decay of an exponential function?

If the base 'b' is greater than 1, the function exhibits exponential growth. If 'b' is between 0 and 1, the function exhibits exponential decay.

What is the formula for continuous exponential growth?

The formula for continuous exponential growth is given by $A(t) = A_0 e^{(rt)}$, where A_0 is the initial amount, 'e' is Euler's number, 'r' is the growth rate, and 't' is time.

How do you graph an exponential function?

To graph an exponential function, plot key points, identify the asymptote, determine whether it is increasing or decreasing, and sketch a smooth curve through the points.

What is the inverse of an exponential function?

The inverse of an exponential function is a logarithmic function, expressed in the form $x = b^y$, which can be rewritten as $y = \log_b(x)$.

How can exponential functions model real-world scenarios?

Exponential functions can model various real-world scenarios such as population growth, radioactive decay, and interest compounding in finance.

What is the difference between exponential and linear functions?

Exponential functions grow or decay at an increasing rate, while linear functions grow at a constant rate, resulting in different shapes on a graph.

What is the domain and range of an exponential function?

The domain of an exponential function is all real numbers (-∞, ∞), while the range is (0, ∞) for growth functions and (-∞, 0) for decay functions.

How do you solve an exponential equation?

To solve an exponential equation, you can use logarithms to isolate the variable, or if possible, express both sides of the equation with the same base.

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