7 CHAPTER REVIEW

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- Multi-Language Glossary
- Vocabulary practice

REVIEW KEY VOCABULARY

- order of magnitude
- zero exponent
- negative exponent
- exponential function
- exponential growth
- growth factor, growth rate
- compound interest
- exponential decay
- decay factor, decay rate

VOCABULARY EXERCISES

1. Copy and complete: The function $y = 1200(0.3)^t$ is an exponential _?_ function, and the base 0.3 is called the _?_.

2. **WRITING** *Explain* how you can tell whether a table represents a linear function or an exponential function.

Tell whether the function represents exponential growth or exponential decay. *Explain*.

3. $y = 3(0.85)^x$
4. $y = \frac{1}{2}(1.01)^x$
5. $y = 2(2.1)^x$

REVIEW EXAMPLES AND EXERCISES

Use the review examples and exercises below to check your understanding of the concepts you have learned in each lesson of this chapter.

7.1 Apply Exponent Properties Involving Products

EXAMPLE

Simplify $(3y^3)^4 \cdot y^5$.

$$\begin{aligned}(3y^3)^4 \cdot y^5 &= 3^4 \cdot (y^3)^4 \cdot y^5 && \text{Power of a product property}\\ &= 81 \cdot y^{12} \cdot y^5 && \text{Power of a power property}\\ &= 81y^{17} && \text{Product of powers property}\end{aligned}$$

EXERCISES

EXAMPLES 1, 2, 3, 4, and 5 for Exs. 6–15

Simplify the expression.

6. $4^4 \cdot 4^3$
7. $(-3)^7(-3)$
8. $z^3 \cdot z^5 \cdot z^5$
9. $(y^4)^5$
10. $[(-7)^4]^4$
11. $[(b + 2)^8]^3$
12. $(6^4 \cdot 31)^5$
13. $-(8xy)^2$
14. $(2x^2)^4 \cdot x^5$

15. **EARTH SCIENCE** The order of magnitude of the mass of Earth's atmosphere is 10^{18} kilograms. The order of magnitude of the mass of Earth's oceans is 10^3 times greater. What is the order of magnitude of the mass of Earth's oceans?

7 CHAPTER REVIEW

7.2 Apply Exponent Properties Involving Quotients

EXAMPLE

Simplify $\left(\frac{x^3}{y}\right)^4 \cdot \frac{2}{x^5}$.

$\left(\frac{x^3}{y}\right)^4 \cdot \frac{2}{x^5} = \frac{(x^3)^4}{y^4} \cdot \frac{2}{x^5}$ **Power of a quotient property**

$= \frac{x^{12}}{y^4} \cdot \frac{2}{x^5}$ **Power of a power property**

$= \frac{2x^{12}}{y^4x^5}$ **Multiply fractions.**

$= \frac{2x^7}{y^4}$ **Quotient of powers property**

EXERCISES

EXAMPLES 1, 2, and 3 for Exs. 16–24

Simplify the expression.

16. $\frac{(-3)^7}{(-3)^3}$ **17.** $\frac{5^2 \cdot 5^4}{5^3}$ **18.** $\left(\frac{m}{n}\right)^3$ **19.** $\frac{17^{12}}{17^8}$

20. $\left(-\frac{1}{x}\right)^4$ **21.** $\left(\frac{7x^5}{y^2}\right)^2$ **22.** $\frac{1}{p^2} \cdot p^6$ **23.** $\frac{6}{7r^{10}} \cdot \left(\frac{r^5}{s}\right)^5$

24. PER CAPITA INCOME The order of magnitude of the population of Montana in 2003 was 10^6 people. The order of magnitude of the total personal income (in dollars) for Montana in 2003 was 10^{10}. What was the order of magnitude of the mean personal income in Montana in 2003?

7.3 Define and Use Zero and Negative Exponents

EXAMPLE

Evaluate $(2x^0y^{-5})^3$.

$(2x^0y^{-5})^3 = 2^3 \cdot x^0 \cdot y^{-15}$ **Power of a power property**

$= 8 \cdot 1 \cdot y^{-15}$ **Definition of zero exponent**

$= \frac{8}{y^{15}}$ **Definition of negative exponents**

EXERCISES

EXAMPLES 1, 2, and 4 for Exs. 25–29

Evaluate the expression.

25. 14^0 **26.** 3^{-4} **27.** $\left(\frac{2}{3}\right)^{-3}$ **28.** $7^{-5} \cdot 7^5$

29. UNITS OF MEASURE Use the fact that 1 femtogram $= 10^{-18}$ kilogram and 1 nanogram $= 10^{-12}$ kilogram to complete the following statement: 1 nanogram = __?__ femtogram(s).

CHAPTER REVIEW

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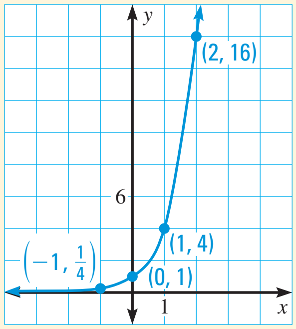
Chapter Review Practice

7.4 Write and Graph Exponential Growth Functions

EXAMPLE

Graph the function $y = 4^x$ and identify its domain and range.



STEP 1 **Make** a table. The domain is all real numbers.

x	−1	0	1	2
y	$\frac{1}{4}$	1	4	16

STEP 2 **Plot** the points.

STEP 3 **Draw** a smooth curve through the points.

STEP 4 **Identify** the range. As you can see from the graph, the range is all positive real numbers.

EXAMPLES 2 and 3
for Exs. 30–34

EXERCISES

Graph the function and identify its domain and range.

30. $y = 6^x$
31. $y = (1.1)^x$
32. $y = (3.5)^x$
33. $y = \left(\frac{5}{2}\right)^x$

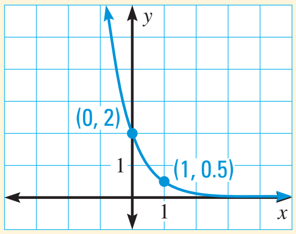
34. Graph the function $y = -5 \cdot 2^x$. Compare the graph with the graph of $y = 2^x$.

7 CHAPTER REVIEW

7.5 Write and Graph Exponential Decay Functions

EXAMPLE 1

Tell whether the graph represents *exponential growth* or *exponential decay*. Then write a rule for the function.



The graph represents exponential decay ($y = ab^x$ where $0 < b < 1$). The y-intercept is 2, so $a = 2$. Find the value of b by using the point (1, 0.5) and $a = 2$.

$y = ab^x$ **Write function.**

$0.5 = 2 \cdot b^1$ **Substitute.**

$0.25 = b$ **Solve for *b*.**

A function rule is $y = 2(0.25)^x$.

EXAMPLE 2

CAR VALUE A family purchases a car for \$11,000. The car depreciates (loses value) at a rate of about 16% annually. Write a function that models the value of the car over time. Find the approximate value of the car in 4 years.

Let V represent the value (in dollars) of the car, and let t represent the time (in years since the car was purchased). The initial value is 11,000, and the decay rate is 0.16.

$V = a(1 - r)^t$ **Write exponential decay model.**

$= 11{,}000(1 - 0.16)^t$ **Substitute 11,000 for *a* and 0.16 for *r*.**

$= 11{,}000(0.84)^t$ **Simplify.**

To find the approximate value of the car in 4 years, substitute 4 for t.

$V = 11{,}000(0.84)^t = 11{,}000(0.84)^4 \approx \$5477$

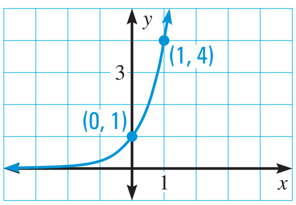
The approximate value of the car in 4 years is \$5477.

EXERCISES

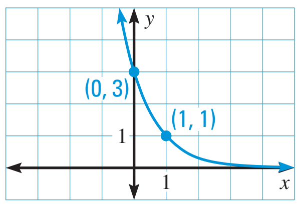
EXAMPLES 4 and 5 for Exs. 35–37

Tell whether the graph represents *exponential growth* or *exponential decay*. Then write a rule for the function.

35.



36.



37. CAR VALUE The value of a car is \$13,000. The car depreciates (loses value) at a rate of about 15% annually. Write an exponential decay model for the value of the car. Find the approximate value of the car in 4 years.

7 CHAPTER TEST

Simplify the expression. Write your answer using exponents.

1. $(62 \cdot 17)^4$ **2.** $(-3)(-3)^6$ **3.** $\frac{8^4 \cdot 8^5}{8^3}$ **4.** $(8^4)^3$

5. $\frac{2^{15}}{2^8}$ **6.** $5^3 \cdot 5^0 \cdot 5^5$ **7.** $[(-4)^3]^2$ **8.** $\frac{(-5)^{10}}{(-5)^3}$

Simplify the expression.

9. $t^2 \cdot t^6$ **10.** $\left(\frac{s}{t}\right)^6$ **11.** $\frac{1}{9^{-2}}$ **12.** $-(6p)^2$

13. $(5xy)^2$ **14.** $\frac{1}{z^7} \cdot z^9$ **15.** $(x^5)^3$ **16.** $\left(-\frac{4}{c}\right)^2$

Simplify the expression. Write your answer using only positive exponents.

17. $\left(\frac{a^{-3}}{3b}\right)^4$ **18.** $\frac{3}{4d} \cdot \frac{(2d)^4}{c^3}$ **19.** $y^0 \cdot (8x^6y^{-3})^{-2}$ **20.** $(5r^5)^3 \cdot r^{-2}$

21. Graph the function $y = 4^x$. Identify its domain and range.

22. Graph the function $y = \frac{1}{2} \cdot 4^x$. Compare the graph with the graph of $y = 4^x$.

23. ANIMATION About 10^7 bytes of data make up a single frame of an animated film. There are about 10^3 frames in 1 minute of a film. About how many bytes of data are there in 1 hour of an animated film?

24. SALARY A recent college graduate accepts a job at a law firm. The job has a salary of \$32,000 per year. The law firm guarantees an annual pay increase of 3% of the employee's salary.

a. Write a function that models the employee's salary over time. Assume that the employee receives only the guaranteed pay increase.

b. Use the function to find the employee's salary after 5 years.

25. SCIENCE At sea level, Earth's atmosphere exerts a pressure of 1 atmosphere. Atmospheric pressure P (in atmospheres) decreases with altitude and can be modeled by $P = (0.99987)^a$ where a is the altitude (in meters).

a. Identify the initial amount, decay factor, and decay rate.

b. Use a graphing calculator to graph the function.

c. Estimate the altitude at which the atmospheric pressure is about half of what it is at sea level.