REVIEW: Zero and Negative Exponents

Name _____

Key Concept and Vocabulary

Zero Exponents

Any nonzero number to the zero power is equal to 1. Zero to the zero power, 0^0, is undefined.

Numbers: $6^0 = 1$

Algebra: $a^0 = 1$, where $a \neq 0$

Negative Exponents

For any integer n and any number a not equal to 0, a^{-n} is equal to 1 divided by a^n.

Numbers: $4^{-2} = \frac{1}{4^2}$

Algebra: $a^{-n} = \frac{1}{a^n}$, where $a \neq 0$

Skill Examples

1. $5^{-3} = \frac{1}{5^3} = \frac{1}{125}$
2. $3^{-6} \cdot 3^6 = 3^{-6+6} = 3^0 = 1$
3. $\frac{4^2}{4^5} = 4^{2-5} = 4^{-3} = \frac{1}{4^3} = \frac{1}{64}$
4. $\frac{7b^{-4}}{b^3} = 7b^{-4-3} = 7b^{-7} = \frac{7}{b^7}$

Application Example

5. A faucet leaks water at a rate of 5^{-4} liter per second. How many liters of water leak from the faucet in 1 hour?

   There are 3600 seconds in 1 hour. Multiply the time by the rate.

$$3600 \times 5^{-4} = 3600 \cdot \frac{1}{5^4}$$
$$= 3600 \cdot \frac{1}{625}$$
$$= 5\frac{19}{25} = 5.76$$

∴ So, 5.76 liters of water leak from the faucet in 1 hour.

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Evaluate the expression.

6. $4^{-4} =$ _____ $\frac{1}{256}$
7. $8^{-2} =$ _____ $\frac{1}{64}$
8. $(-5)^{-6} =$ _____ $\frac{1}{15{,}625}$
9. $9^{-4} \cdot 9^4 =$ _____ 1
10. $\frac{2^3}{2^8} =$ _____ $\frac{1}{32}$
11. $\frac{5^3}{5^5} =$ _____ $\frac{1}{25}$
12. $\frac{(-4)^4}{(-4)^6} =$ _____ $\frac{1}{16}$
13. $\frac{1}{3^{-3}} \cdot \frac{1}{3^7} =$ _____ $\frac{1}{81}$
14. $\frac{4^5 \cdot 4^{-2}}{4^4} =$ _____ $\frac{1}{4}$

Simplify. Write the expression using only positive exponents.

15. $\frac{3x^4}{x^9} =$ _____ $\frac{3}{x^5}$
16. $\frac{a^{-5}}{14a^8} =$ _____ $\frac{1}{14a^{13}}$
17. $\frac{3w^{-4}}{w^{-2}} =$ _____ $\frac{3}{w^2}$

METRIC UNITS **In Exercises 18–21, use the table.**

18. How many millimeters are in a centimeter? _____ 10
19. How many decimeters are in a micrometer? _____ $\frac{1}{10^5}$
20. How many nanometers are in a centimeter? _____ 10^7
21. How many micrometers are in a millimeter? _____ 10^3

Unit of Length	Length
decimeter	10^{-1} m
centimeter	10^{-2} m
millimeter	10^{-3} m
micrometer	10^{-6} m
nanometer	10^{-9} m