Section Overview

SECTION 4A

Exponents — Lesson 4-1

Why? Exponents are used to write multiplication expressions that have repeated factors.

Simplify $3 \cdot (-10)^3$.

$3 \cdot (-10)^3$

$= 3 \cdot (-10) \cdot (-10) \cdot (-10)$

$= 3 \cdot (-1000)$

$= -3000$

The **base** is 2. Use the base as the factor.

The **exponent** is 4. The exponent indicates how many times to use the base as a factor.

$2^4 = 2 \cdot 2 \cdot 2 \cdot 2 = 16$

2^4 is read "two to the fourth power."

Integer Exponents and Properties of Exponents — Lessons 4-2, 4-3

Why? Properties of exponents allow us to simplify expressions that have exponents.

Properties	Examples
$b^m \cdot b^n = b^{m+n}$	$3^5 \cdot 3^8 = 3^{5+8} = 3^{13}$
$\frac{b^m}{b^n} = b^{m-n}$, if $b \neq 0$	$\frac{6^9}{6^4} = 6^{9-4} = 6^5$
$(b^m)^n = b^{m \cdot n}$	$(9^4)^5 = 9^{4 \cdot 5} = 9^{20}$
$a^0 = 1$, if $a \neq 0$	$100^0 = 1$ or $(-7)^0 = 1$

If the values $m = 2$ and $n = 5$ are used in the property $\frac{b^m}{b^n} = b^{m-n}$, we have $\frac{b^2}{b^5} = b^{2-5} = b^{-3}$. Cases such as this suggest another reason to have a definition for negative exponents.

Negative Exponents

Definition	Examples
$b^{-n} = \frac{1}{b^n}$, if $b \neq 0$.	$3^{-2} = \frac{1}{3^2} = \frac{1}{3 \cdot 3} = \frac{1}{9}$
	$(-2)^{-4} = \frac{1}{(-2)^4} = \frac{1}{(-2) \cdot (-2) \cdot (-2) \cdot (-2)} = \frac{1}{16}$

Multiplying and Dividing Monomials — Lesson 4-4

Why? Applying the properties of exponents to multiplying and dividing monomials makes simplifying expressions much easier.

Action	Rules	Examples
Multiplying Monomials	Multiply the coefficients; add exponents that have the same base.	$(5x^4)(x^2y^3) = (5 \cdot 1)(x^{4+2})(y^3) = 5x^6y^3$ $(-7p^2t^7)(6p^9t^5) = (-7 \cdot 6)(p^{2+9})(t^{7+5}) = -42p^{11}t^{12}$
Dividing Monomials	Divide the coefficients; subtract exponents that have the same base.	$\frac{8r^4s^3}{4r^2s} = \frac{8}{4}(r^{4-2})(s^{3-1}) = 2r^2s^2$ $\frac{3xy^4z}{-12xy^2z^5} = \frac{3}{-12}(x^{1-1})(y^{4-2})(z^{1-5}) = \frac{1}{-4}x^0y^2z^{-4} = -\frac{y^2}{4z^4}$
Raising a Monomial to a Power	Raise each factor to the power; multiply exponents.	$(2cd)^4 = (2^{1 \cdot 4})(c^{1 \cdot 4})(d^{1 \cdot 4}) = 16c^4d^4$ $(-6a^4m^5)^3 = (-6^{1 \cdot 3})(a^{4 \cdot 3})(m^{5 \cdot 3}) = -216a^{12}m^{15}$