

## Section 9.1 Multiplication Properties of Exponents

**1. Property One for Exponents:** If  $r$  and  $s$  are any two whole numbers and  $a$  is an integer, then it is true that:

$$a^r \cdot a^s = a^{r+s}$$

Example 1: Simplify each of the following.

a.  $x^2x^4$

b.  $x^3x^5$

c.  $2x^2 \cdot 3x^4$

**2. Property Two for Exponents:** If  $r$  and  $s$  are any two whole numbers and  $a$  is an integer, then it is true that:

$$(a^r)^s = a^{rs}$$

Example 2: Simplify each of the following.

a.  $(x^3)^4$

b.  $2(x^3)^5$

**3. Property Three for Exponents:** If  $r$  is a whole number and  $a$  and  $b$  are integers, then it is true that:

$$(ab)^r = a^r b^r$$

Example 3: Simplify each of the following.

a.  $(2x)^3$

b.  $(4x^5)^2$

**4. Simplifying Using More Than One Property:** Use the order of operations agreement and the three multiplication properties of exponents to simplify.

Example 4: In each of the following identify the property used in each step.

a.  $(2x^2y^3)(3x^5y^4) = (2 \cdot 3)(x^2x^5)(y^3y^4)$   
 $= 6x^7y^7$

b.  $(3x^3y^2)^4 = 3^4 \cdot (x^3)^4 \cdot (y^2)^4$   
 $= 81x^{12}y^8$

Example 5: Simplify each of the following.

a.  $(4x^3y^5)^2$

b.  $(3x^2y)^2(2x^3y^2)^3$

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Practice Problems. Use the Multiplication Properties of Exponents to simplify each of the following:

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a.  $4x^3 \cdot 5x^5$

b.  $(a^4)^5$

c.  $(5x)^3$

d.  $(2x^3)^2(4x^5)$

e.  $(2xy^2)(5x^3y^4)$

Answers to Practice Problems

a.  $20x^8$ ; b.  $x^{20}$ ; c.  $125x^3$ ; d.  $16x^{11}$ ; e.  $10x^4y^6$

Note: Portions of this document are excerpted from the textbook *Prealgebra*, 7<sup>th</sup> ed. by Charles McKeague