Section 4.4

TERMINOLOGY 4.4

For each of the following terms, provide 1) a definition in your own words, 2) the formal definition (as provided by your text or instructor), and 3) an example of the term using a drawing or problem. A sample filled-out form is available in the Introduction.

Power Raised to a Power Rule for Exponents

Your definition	
Formal definition	
Example	

Product Raised to a Power Rule for Exponents

Your definition	
Formal definition	
Example	

Quotient Raised to a Power Rule for Exponents

Your definition	
Formal definition	
Example	

Quotient Rule for Exponents

Your definition	
Formal definition	
Example	

Zero Exponent Property

Your definition	
Formal definition	
Example	

READING AND SELF-DISCOVERY QUESTIONS 4.4

1. Describe two ways to simplify the following problem: $\frac{x^5}{x^4}$

   You can subtract the exponent in the denominator from the exponent in the numerator and display that part of the result in the numerator with that exponent for the base. You can subtract the exponent from the numerator from the exponent from the denominator exponent and display that part of the result in the denominator with that exponent for the base.

2. Describe the difference between $x^4 \cdot x^5$ and $(x^4)^5$. State the simplified form of each.

   $x^4 \cdot x^5$ means 4 factors of x times 5 factors of x: $(x \cdot x \cdot x \cdot x)(x \cdot x \cdot x \cdot x \cdot x)$ or x^9.
   $(x^4)^5$ means 5 factors of x^4: $(x^4)(x^4)(x^4)(x^4)(x^4)$ or x^{20}.

CRITICAL THINKING QUESTIONS 4.4

1. Are the Product Rule for Exponents and the Quotient Rule for Exponents related? Explain your answer.

   The Product Rule for Exponents and the Quotient Rule for Exponents are related.

   $a^4 \cdot a^3$ **(a product) can be rewritten as** $\frac{a^4}{a^{-3}}$ **(a quotient), making the relationship very clear. (A quotient can also be rewritten as a product.)**

   The Product Rule says to add the exponents and the Quotient Rule says to subtract the exponents and we know that subtraction is simply the addition of the additive inverse.

2. Why is any non-zero number, when raised to the zero power, equal to 1? (Hint: Try applying the Quotient Rule for Exponents to an expression which consists *only* of the same quantity raised to the same power in both the numerator and denominator.)

   $$1 = \frac{3^4}{3^4} = 3^{4-4} = 3^0$$

   This same demonstration can be made for any non-zero number.

DEMONSTRATE YOUR UNDERSTANDING 4.4

1. Provide the missing exponents for the following equations:

   a) $\left(\frac{x}{5}\right)^{\boxed{3}} = \frac{x^{\boxed{3}}}{125}$

   b) $\left(\frac{3m^2}{7n^{\boxed{4}}}\right)^{\boxed{2}} = \frac{9m^{\boxed{4}}}{49n^8}$

IDENTIFY AND CORRECT THE ERRORS 4.4

In the second column, identify the error(s) you find in each of the following worked solutions. Describe the error made in the second column. Solve the problem correctly in the third column.

Problem	Describe Error	Correct Process
1. Simplify: $\left(\frac{7y}{3y}\right)^2$	**The student has failed to also raise the coefficients in both the numerator and denominator to the power of 2.**	$= \frac{7^{(1)(2)}y^{(1)(2)}}{3^{(1)(2)}y^{(1)(2)}} = \frac{49y^2}{9y^2}$ $= \frac{49}{9y^{2-2}} = \frac{49}{9y^0} = \mathbf{\frac{49}{9}}$
Worked Solution *(What is wrong here?)*		
$= \frac{7^{(1)}y^{(1)(2)}}{3^{(1)}y^{(1)(2)}} = \frac{7y^2}{3y^2}$ $= \frac{7}{3y^{2-2}} = \frac{7}{3y^0} = \mathbf{\frac{7}{3}}$		

Problem	Describe Error	Correct Process
2. Simplify: $\left(\frac{2x^3}{3y}\right)^2$	**The student has incorrectly attributed the power of the variable (*x*) in the numerator to the coefficient as well.**	$=\frac{2^{(1)(2)}x^{(3)(2)}}{3^{(1)(2)}y^{(1)(2)}}$ $=\frac{4x^6}{9y^2}$ $=\mathbf{\frac{4x^6}{9y^2}}$
Worked Solution *(What is wrong here?)*		
$=\frac{2^{(3)(2)}x^{(3)(2)}}{3^{(1)(2)}y^{(1)(2)}}$ $=\frac{8^{(2)}x^6}{9y^2}$ $=\mathbf{\frac{64x^6}{9y^2}}$		