

AA PREP—OPERATIONS WITH EXPONENTS LECTURE

Exponent Rules	
For $a \neq 0, b \neq 0$	
Product Rule	$a^x \times a^y = a^{x+y}$
Quotient Rule	$a^x \div a^y = a^{x-y}$
Power Rule	$(a^x)^y = a^{xy}$
Power of a Product Rule	$(ab)^x = a^x b^x$
Power of a Fraction Rule	$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$
Zero Exponent	$a^0 = 1$
Negative Exponent	$a^{-x} = \frac{1}{a^x}$
Fractional Exponent	$a^{\frac{x}{y}} = \sqrt[y]{a^x}$

EX 1: BASICS

Simplify each expression, assuming that no variable equals zero. Write answers with positive exponents only!

<p>a) $x^4 \cdot x^2 = x^6$ xxxx · xx</p>	<p>b) $(x^4)^2 = x^8$ xxxx · xxxx</p>
<p>c) $\frac{x^5}{x^3} = \frac{x^2}{1} = x^2$ xxxxx / xxx</p>	<p>d) $\frac{x^3}{x^5} = \frac{1}{x^2}$ xxx / xxxxx</p>
<p>e) $\frac{x^{-3}}{x^5} = \frac{1}{x^3 x^5} = \frac{1}{x^8}$</p>	<p>f) $\frac{x^3}{x^{-5}} = \frac{x^3 x^5}{1} = \frac{x^8}{1} = x^8$</p>
<p>g) $12x^0 = 12 \cdot 1 = 12$</p>	<p>h) $(12x)^0 = 1$</p>

EX 2: MORE COMPLICATED

Simplify each expression, assuming that no variable equals zero. Write answers with positive exponents only!

a) $-5x^4y^3 \cdot 2x^6y^{11}$
 $-5 \cdot x^4 \cdot y^3 \cdot 2 \cdot x^6 \cdot y^{11}$
 $-10x^{10}y^{14}$

b) $(-5x^4y^3)^2$
 $25x^8y^6$

c) $(-2x^3y^5)(-8x^0y^1)$
 $-2 \cdot x^3 \cdot y^5 \cdot -8 \cdot y^1$
 $16x^3y^6$

d) $(-3x^4y^5)^2(-2x^5y^7)^3$
 $9x^8y^{10} \cdot -8x^{15}y^{21}$
 $-72x^{23}y^{31}$

e) $\frac{4x^{12}y^{-2}}{20xy^8}$
 $\frac{4x^{12}y^{-2}}{20x^1y^8} = \frac{1x^{11}}{5y^2y^8} = \frac{x^{11}}{5y^{10}}$

f) $\frac{12^{-1}x^{-7}y^1}{6^{-2}x^{-4}y^{-9}}$
 $= \frac{12^1x^7y^9}{36x^4y^{10}} = \frac{12x^7y^9}{36x^4y^{10}} = \frac{3y^{10}}{x^3}$

g) $\left(\frac{15x^2y}{-3x^6y^4}\right)^{-2}$
 $\left(\frac{5x^2x^6y^1y^4}{-1}\right)^{-2} = \left(\frac{5x^8y^5}{-1}\right)^{-2} = \left(\frac{-1}{5x^8y^5}\right)^2 = \frac{1}{25x^{16}y^{10}}$

h) $\left(\frac{2x^{-3}}{5(2x^4)^3}\right)^{-2} \cdot (-2x^{-5}y^{-6})^{-3}$
 $\left(\frac{2x^{-3}}{5 \cdot 8x^{12}}\right)^{-2} \cdot \left(\frac{-2}{x^5y^6}\right)^{-3}$
 $\left(\frac{2x^{-3}}{40x^{12}}\right)^{-2} \cdot \left(\frac{x^5y^6}{-2}\right)^3$
 $\left(\frac{1}{20x^3x^{12}}\right)^{-2} \cdot \left(\frac{x^{15}y^{18}}{-8}\right)$
 $\left(\frac{1}{20x^{15}}\right)^{-2} \cdot \left(\frac{x^{15}y^{18}}{-8}\right)$
 $\left(\frac{20x^{15}}{1}\right)^2 \cdot \left(\frac{x^{15}y^{18}}{-8}\right) = \frac{400x^{45}y^{18}}{-8} = -50x^{45}y^{18}$