2.2 Exponent Laws

Math 9 2.2 **Exponent Laws** Name: _____

Complete each table.

	Expanded Form	Single Power
$3^2 \times 3^4$	$(3 \times 3) \times (3 \times 3 \times 3 \times 3)$	3^6
$4^3 \times 4$	$(4 \times 4 \times 4) \times 4$	4^4
$6^4 \times 6$	$(6 \times 6 \times 6 \times 6) \times 6$	6^5
$2^3 \times 2 \times 2^2$	$(2 \times 2 \times 2) \times 2 \times (2 \times 2)$	2^6
$k^3 \times k^5$	$(k \cdot k \cdot k) \cdot (k \cdot k \cdot k \cdot k \cdot k)$	k^8

	Expanded Form	Single Power
$5^5 \div 5^3$	$\frac{5 \times 5 \times 5 \times 5 \times 5}{5 \times 5 \times 5}$	5^2
$7^4 \div 7$	$\frac{7 \times 7 \times 7 \times 7}{7}$	7^3
$10^4 \div 10^3$	$\frac{10 \times 10 \times 10 \times 10}{10 \times 10 \times 10}$	10^1
$2^5 \div 2^2$	$\frac{2 \times 2 \times 2 \times 2 \times 2}{2 \times 2}$	2^3
$p^6 \div p^2$	$\frac{p \cdot p \cdot p \cdot p \cdot p \cdot p}{p \cdot p}$	p^4

Do you notice any patterns?

Product Rule: When multiplying powers with the same base, add the exponents.

$$(a^m)(a^n) = a^{m+n}$$

Quotient Rule: When dividing powers with the same base, subtract the exponents.

$$a^m \div a^n = a^{m-n}$$

Practise: Write each product or quotient as a single power. Then evaluate.

a) $3^2 \times 3^3 = 3^5 = 243$

b) $5^2 \times 5 \times 5^2 = 5^5 = 3125$

c) $(-2)^4 \times (-2)^3 = (-2)^7 = -128$

d) $\left(\frac{1}{2}\right)^3 \times \left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)^5 = \frac{1^5}{2^5} = \frac{1}{32}$

e) $(-3)^4 \times (-3)^2 = (-3)^6 = 729$

f) $(-8)^7 \div (-8)^5 = (-8)^2 = 64$

g) $4^7 \div 4 \div 4^3 = 4^3 = 64$

h) $\left(\frac{2}{3}\right)^5 \div \left(\frac{2}{3}\right)^2 = \left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3} = \frac{8}{27}$

i) $\frac{\left(\frac{3}{4}\right)^3 \times \left(\frac{3}{4}\right)^2}{\left(\frac{3}{4}\right)^5} = \frac{\left(\frac{3}{4}\right)^5}{\left(\frac{3}{4}\right)^5} = \left(\frac{3}{4}\right)^0 = 1$

Complete the table.

	Expanded Form	Single Power
$(2^2)^3$	$(2^2) \times (2^2) \times (2^2)$ $= (2 \times 2) \times (2 \times 2) \times (2 \times 2)$	2^6
$(5^4)^2$	$(5^4) \times (5^4)$ $= (5 \times 5 \times 5 \times 5) \times (5 \times 5 \times 5 \times 5)$	5^8
$(10^3)^4$	$(10^3) \times (10^3) \times (10^3) \times (10^3)$ $= (10 \cdot 10 \cdot 10) \cdot (10 \cdot 10 \cdot 10) \cdot (10 \cdot 10 \cdot 10) \cdot (10 \cdot 10 \cdot 10)$	10^{12}

Do you notice a pattern?

Power of a Power Rule:
A power of a power can be written as a single power by multiplying the exponents.

$$(a^m)^n = a^{mn}$$

Practise: Write each as a single power, then evaluate.

a) $(3^2)^4 = 3^8 = 6561$ b) $[(-2)^3]^4 = (-2)^{12} = 4096$ c) $\left[\left(\frac{2}{3}\right)^2\right]^2 = \left(\frac{2}{3}\right)^4 = \frac{16}{81}$

Simplify each algebraic expression by applying the exponent laws.

a) $y^3 \times y^5 = y^8$ b) $p^7 \div p^3 = p^4$ c) $a^2b^3 \times a^6b^4 = a^8b^7$

What is the value of 2^0? Let's work backwards to figure this out.

2^3	$2 \times 2 \times 2 = 8$ ÷2
2^2	$2 \times 2 = 4$ ÷2
2^1	2 ÷2
2^0	1

When the exponent of a power is 0, the value of the power is 1 (if the base is not 0).

$3^0 = 1$ $(-5)^0 = 1$ $(4371 \div 65)^0 = 1$

$-(-1)^0 = -1$ $-7^0 = -1$ $(32x)^0 = 1$

$-(-1)^0 =$ -1 $-7^0 =$ -1 $(32x)^0 =$ 1