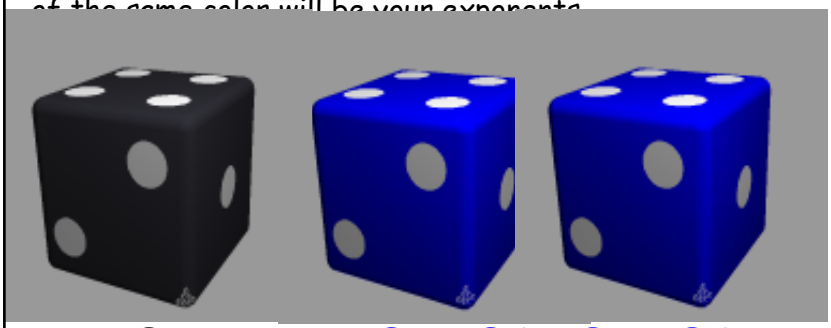
Section 2.4 Exponent Laws I
Product of Powers Investigation

Product of Powers	Repeated Multiplication	Power Form
$10^2 \times 10^3$	(10 x 10) x (10 x 10 x 10)	10^5
$10^3 \times 10^4$	(10 x 10 x 10) x (10 x 10 x 10 x 10)	10^7
$5^4 \times 5^5$	(5 x 5 x 5 x 5) x (5 x 5 x 5 x 5 x 5)	5^9
$2^3 \times 2^1$	(2 x 2 x 2) x (2)	2^4
$3^2 \times 3^5$	(3 x 3) x (3 x 3 x 3 x 3 x 3)	3^7
$4^3 \times 4^2$	(4 x 4 x 4) x (4 x 4)	4^5

Create 5 more examples of your own. Roll 3 dice, the single color will be the base and the other 2 dice of the same color will be your exponents



BASE EXPONENT EXPONENT

$5^4 \times 5^3$

Product of Powers	Repeated Multiplication	Power Form

State a rule for multiplying any two powers with the same base.

Add the exponents

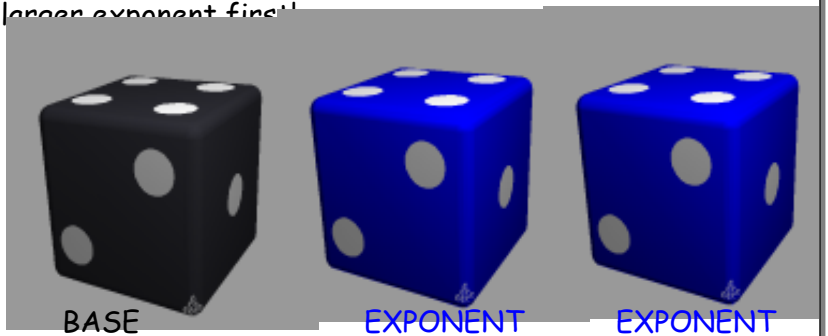
Can you use your rule to multiply $2^3 \times 3^2$? Explain why or why not.

No because they don't have the same base.

Quotients of Powers Investigation

Quotient of Powers	Repeated Multiplication	Power Form
$10^5 \div 10^3$	$\frac{10\times10\times10\times10\times10}{10\times10\times10}$	10^2
$10^8 \div 10^5$	$\frac{10\times10\times10\times10\times10\times10\times10\times10}{10\times10\times10\times10\times10}$	10^3
$5^{10} \div 5^4$	$\frac{5\times5\times5\times5\times5\times5\times5\times5\times5\times5}{5\times5\times5\times5}$	5^6
$9^8 \div 9^3$	$\frac{9\times9\times9\times9\times9\times9\times9\times9}{9\times9\times9}$	9^5
$7^5 \div 7^4$	$\frac{7\times7\times7\times7\times7}{7\times7\times7\times7}$	7^1
$4^7 \div 4^4$	$\frac{4\times4\times4\times4\times4\times4\times4}{4\times4\times4\times4}$	4^3

Create 5 more examples of your own. Roll 3 dice, the single color will be the base and the other 2 dice of the same color will be your exponents. Make sure you put the larger exponent first!



BASE EXPONENT EXPONENT

$2^5 \div 2^4$

Quotient of Powers	Repeated Multiplication	Power Form

State a rule for dividing two powers with the same base.

Subtract the exponents

Can you use your rule to divide $5^2 \div 2^3$? Explain why or why not.

No because the bases are NOT the same

Summary Notes

Exponent Law for a Product of Powers

$a^m \times a^n = a^{m+n}$ where $a \neq 0$ and m and n are whole numbers

To multiply powers with the same base, (excluding a base of zero), keep the base and add the exponents.

1: Write as a single power, then evaluate.

A) $4^3 \times 4^4$

$= 4^{3+4} = 4^7 = (4)(4)(4)(4)(4)(4)(4) = 16384$

B) $7^5 \times 7^{-5}$

$= 7^{5+-5} = 7^0 = 1$

C) $(-3)^2 \times (-3)^4$

$= (-3)^{2+4} = (-3)^6 = (-3)(-3)(-3)(-3)(-3)(-3) = 729$

2: Write as a single power.

A) $9^5 \times 9 = 9^{5+1} = 9^6$

B) $8^{-11} \times 8^{13} = 8^{-11+13} = 8^2$

C) $3.8^4 \times 3.8^2 = 3.8^{4+2} = 3.8^6$

D) $\left(\frac{1}{4}\right)^{12} \times \left(\frac{1}{4}\right)^{8} = \left(\frac{1}{4}\right)^{12+8} = \left(\frac{1}{4}\right)^{20}$

E) $5^2 \times 5 \times 5^3 = 5^{2+1+3} = 5^6$

Exponent Law for a Quotient of Powers

$a^m \div a^n = a^{m-n}$ where $a \neq 0$, m and n are whole numbers and $m \geq n$

To divide powers with the same base, (excluding a base of zero), keep the base and subtract the exponents.

3: Write as a single power, then evaluate.

A) $2^5 \div 2^2 = 2^{5-2} = 2^3 = (2)(2)(2) = 8$

B) $\frac{(-6)^8}{(-6)^6} = (-6)^{8-6} = (-6)^2 = (-6)(-6) = 36$

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

4: Write as a single power.

A) $12^6 \div 12 = 12^{6-1} = 12^5$

B) $(1.4)^6 \div (1.4)^2 = (1.4)^{6-2} = (1.4)^4$

C) $\frac{5^7}{5^3} = 5^{7-3} = 5^2$

D) $\frac{8^3}{8^{-2}} = 8^{3-(-2)} = 8^{3+2} = 8^5$

Note: "Evaluate" means to find the answer in "standard form"

Example: Evaluate $4^3 = 4 \times 4 \times 4 = 64$

Evaluate $2^3 \times 2^2$
$= 2^{3+2}$
$= 2^5$
$= (2)(2)(2)(2)(2)$
$= 32$

"Express as a single power" means leave your answer in "exponent form"

$$\frac{5^8}{5^2} = 5^{8-2} = 5^6$$

Express as a single power

A) $5^2 \times 5^4 \times 5$
$= 5^{2+4+1}$
$= 5^7$

B) $6^6 \times 6^{-2}$
$= 6^{6+(-2)}$
$= 6^4$

C) $(-6)^7 \div (-6)^6$
$= (-6)^{7-6}$
$= (-6)^1$

D) $10^8 \div 10^2$
$= 10^{8-2}$
$= 10^6$

Often you will have problems where you will have to apply more than one exponent law!

E) $8^{12} \div 8^7 \times 8^2$
$= 8^{12 - 7} \times 8^2$
$= 8^5 \times 8^2$
$= 8^7$

F) $\frac{2^3 \times 2^5}{2^2} = \frac{2^{3+5}}{2^2} = \frac{2^8}{2^2} = 2^{8-2} = 2^6$

G) $\frac{(-4)^{10}}{(-4)^3 \times (-4)^3} = \frac{(-4)^{10}}{(-4)^{3+3}} = \frac{(-4)^{10}}{(-4)^6} = (-4)^{10-6} = (-4)^4$

H) $6^2 + 6^3 \times 6^2$
$= 6^2 + 6^{3+2}$
$= 6^2 + 6^5$ (since there is not an adding law we cannot write this expression as a single power - you could however, evaluate if you were asked to)

I) $(-10)^4[(-10)^6 \div (-10)^4] - 10^7$
$=(-10)^4[(-10)^{6-4}] - 10^7$
$= (-10)^4[(-10)^2] - 10^7$
$= (-10)^{4+2} - 10^7$
$= (-10)^6 - 10^7$

Complete
Pages 76 - 78
#'s 4, 5, 6, 8, 10, 15