Practice	Rules and Examples
Ex 1: $7a + -8a$ Ex 2: $9x + 2x - 5x^2 + x^2$ Ex 3: $3x + 4y + 2 - 7 - 3x^2 + 9y$	Combining Like Terms: When adding monomials that have the same base and same exponent, add the coefficients $m \cdot x + n \cdot x = (m+n) \cdot x$ $6x + 2x = (6+2)x = 8x$
Ex 1: $x^3 \cdot x^8$ Ex 2: $2^4 \cdot 2^2$ Ex 2: $(2x^2y)(-3x^3y^4)$	Product Rule: When multiplying monomials that have the same base, add the exponents. $x^m \cdot x^n = x^{m+n}$ $x^6 \cdot x^2 = x^{6+2} = x^8$
Ex 1: $\frac{3^5}{3^3}$ Ex 2: $\frac{x^2y^5}{xy^3}$ Ex 3: $\frac{36m^3n^5}{-9mn^4}$	Quotient Rule: When dividing monomials that have the same base, subtract the exponents. $\frac{x^m}{x^n} = x^{m-n}$ $\frac{x^6}{x^2} = x^{6-2} = x^4$
Ex 1: $(x^3)^2$ Ex 2: $(3^5)^4$ Ex 3: $(z^5)^8$	Power Rule: When raising monomials to powers, write the base and multiply the exponents. $(x^m)^n = x^{m \cdot n}$ $(x^6)^2 = x^{6 \cdot 2} = x^{12}$
Ex 1: $(2a)^5$ Ex 2: $(6x^3)^2$ Ex 3: $(2x^3yz^2)^3$	Power of a Product Rule: When raising monomials to powers, write the base and multiply the exponents. $(xy)^m = x^m \cdot y^n$ $(2x^2y^3)^4 = 2^{1 \cdot 4} x^{2 \cdot 4} y^{3 \cdot 4} = 16x^8y^{12}$
Ex 1: $\left(\frac{x^2}{y}\right)^4$ Ex 2: $\left(\frac{2x}{3y^2}\right)^3$	Power of a Quotient Rule: When raising monomials to powers, write the base and multiply the exponents. $\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$ $\left(\frac{3m^2n^7}{m}\right)^5 = (3^{1(5)} m^{2(5)-1(5)} n^{7(5)}) = 3^5 m^{10-5} n^{35} = 243m^5n^{35}$
Ex 1: 4^{-2} Ex 2: $-4x^5y^{-2}$ Ex 3: $\frac{a^{-2}b^3}{c^{-4}d^{-1}}$ Ex 4: $\left(\frac{x^2}{y}\right)^{-3}$	Negative Exponents: If a factor in the numerator or denominator is moved across the fraction bar, the sign of the exponent is changed. $x^{-m} = \frac{1}{x^m}$ $\frac{1}{x^{-m}} = x^m$ $\left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$ $x^{-3} = \frac{1}{x^3}$ CAUTION: $-x \neq \frac{1}{x}$ For example: $-3 \neq \frac{1}{3}$
Ex 1: 7^0 Ex 2: $(5x^4\,y^0\,z^3\,z^{-3})^2$	Zero Exponent: If a factor is raised to the power of 0, the result is 1 $x^0 = 1$ $(3x^3y^2)^0 = 1$

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Exponent Rules

Combining Like Terms:

$$m \cdot x + n \cdot x = (m+n) \cdot x$$

Product Rule:

$$x^m \cdot x^n = x^{m+n}$$

Quotient Rule:

$$\frac{x^m}{x^n} = x^{m-n}$$

Power Rule:

$$(x^m)^n = x^{m \cdot n}$$

Power of a Product Rule:

$$(x^m)^n = x^{m \cdot n}$$

Power of a Product Rule:

$$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$$

Negative Exponents:

$$x^{-m} = \frac{1}{x^m} \qquad \frac{1}{x^{-m}} = x^m \qquad \left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$$

CAUTION: $-x \neq \frac{1}{x}$ For example: $-3 \neq \frac{1}{3}$

Zero Exponent: $x^0 = 1$

Name:_____

Role Play

Group Roles Practice

Exponent Laws Assignment

Task Reader: We are now working on number ___

We need to write each expression as a single power and then evaluate _____

Questioner: What operation symbols do we see?

What exponent laws do we see at play?

What is the rule that applies to that law?

What do we do with the exponents?

Are there any other variables that need to be simplified/combined using exponent laws?

Do we have any coefficients that need to be simplified and evaluated?

Solution Confirmer: Did we simplify the entire expression?

The new expression as a single power and evaluated is _____

Do we see this answer as an option on the board?

Does everyone have this written down?

Teacher Liason: Our group is having trouble with number ___. We discussed it and think ___, but could you explain ____?

Hi Mrs. Theo, we are currently working on number _____, we are doing fine/need help.

Group Member Grade

on a scale of 1 - 10 how well did your partner perform their role?

what could they do to improve in their group role for next time?

Member Name:

Rating:

Needs to improve on:

Member Name:

Rating:

Needs to improve on:

Member Name:

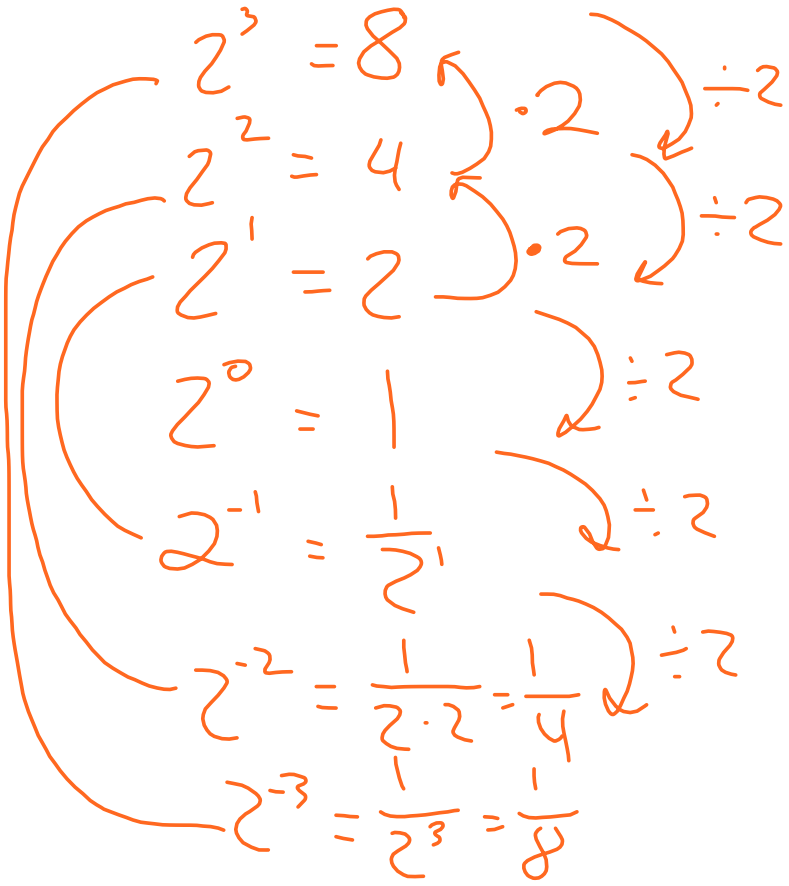
Rating:

Needs to improve on:

Member Name:

Rating:

Needs to improve on:


$2^3 = 8$
$2^2 = 4$
$2^1 = 2$
$2^0 = 1$
$2^{-1} = \frac{1}{2^1}$
$2^{-2} = \frac{1}{2 \cdot 2} = \frac{1}{4}$
$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$
·2
·2
÷2
÷2
÷2
÷2
÷2

You bored? Ok, Board Work time!

19) $\dfrac{(x^{-3})^4 x^4}{2x^{-3}}$

$\dfrac{1 \cdot x^{-12} \cdot x^4}{2 \cdot x^{-3}}$

$\dfrac{1}{2} \cdot x^{-12+4+3}$

$\dfrac{1}{2} \cdot x^{-5}$

$\dfrac{1}{2x^5}$

20) $\dfrac{(2x^3z^2)^3}{x^3y^4z^2 \cdot x^{-4}z^3}$

$\dfrac{2^3 x^9 z^6}{x^{-1} y^4 z^5}$

$8 x^{9-(-1)} y^{0-4} z^{6-5}$

$\dfrac{8x^{10}z}{y^4}$

21) $\dfrac{(2pm^{-1}q^0)^{-4} \cdot 2m^{-1}p^3}{2pq^2}$

22) $\dfrac{(2hj^2k^{-2} \cdot h^4 j^{-1}k^4)^0}{2h^{-3}j^{-4}k^{-2}}$

Exponent Rules Review **Name**_____ **Per**_____

Multiplication

Part 1: Simplify each expression.

1.) $2^3 \cdot 2^4$ 2.) $8^1 \cdot 8^3$ 3.) $t^4 \cdot t^4$ 4.) $x^5 \cdot x^9$

5.) $3^4 \cdot x^3 \cdot x^5$ A.) $(0.5^3)(0.5^2)$ B.) $(\frac{1}{2})(\frac{1}{2})^3$

Part 2: Find the product of the expressions.

6.) $(6x^2)(4x^2)$ 7.) $(3x^3y^2)(-6y^5)$ 8.) $(5p^3)(-m^8p^2)$

9.) $(10g^3h^8v^6)(11gh^8)$ 10.) $(4f^9h^3)(-5f^6)(-3h^2)$

11.) $(-2^2x^3y^4)((-3)^2x^4y^4)$ 12.) *Challenge: $(3x^ay^bz^c)(-y^fz^g)$

$-1 \cdot 2^2 \cdot (-3)^2 x^3 \cdot x^4 y^4 \cdot y^4$

$-1 \cdot 4 \cdot 9 \; x^{3+4} \; y^{4+4}$

$-36 x^7 y^8$

Power to a Power

Part 1: Find the product. Expand if it helps you.

13.) $(p^2)^5$ 14.) $(x^m)^2$

15.) $(2x)^2$ 16.) $(10^2)^3$

17.) $(2^3x)^2$ 18.) $2(3a^2)^3$

$2 \cdot 3^{1 \cdot 3} \cdot a^{2 \cdot 3}$ 54 a^6

$2 \cdot 27 \cdot a^6$

19.) $(-3^2x^6)^5$ 20.) $(7j^2)^3$

21.) $\left(\frac{8x^2}{2x^2}\right)^2$ 22.) $\left(\frac{3x}{2y^2}\right)^5$

Division

Part 1: Simplify to find the quotients.

23.) $\frac{a^8}{a^3}$

24.) $\frac{7^{11}}{7^8}$

25.) $\frac{7 \cdot b^5}{b^4}$

26.) $\frac{x^{10}}{x^4}$

27.) $\frac{12 \cdot g^8 \cdot h^4}{g^3 \cdot h^5}$

$12 \cdot g^{8-3} h^{4-5}$

$12 g^5 h^{-1}$

$\frac{12 g^5}{h^1}$

28.) $\frac{4 \cdot p^{11}}{8 \cdot p^6}$

$\frac{4}{8} p^{11-6}$

29.) $\frac{c^9}{6c^4}$

30.) $\frac{2 \cdot x^3 y^8}{4 \cdot y^2}$

31.) $\frac{3x^{14} y^{11}}{18x^2}$

Negative and Zero Exponents

Rewrite **without negative exponents** and simplify.

32.) $6 \cdot c^3 \cdot d^{-2}$

33.) $6x^4 x^{-10}$

34.) $(2^0 \cdot x^{-3})^4$

36.) $\frac{a^{12} b^{-3}}{a^5 b^5}$

37.) $\left(\frac{5x^{13} y^5 z^2}{3 \cdot 5^2}\right)^0$

38.) $(g^3 \cdot g^{-2})^4$

39.) $\left(\frac{4c^{-5}}{8d^0}\right)^3$

40.) $\left(\frac{x^{-8}}{y^{11}}\right)^{-2}$

41.) $\frac{(2x^3) \cdot (x^4)^2}{8x^{11}}$

$\frac{2}{8} \cdot x^{3+4 \cdot 2-11}$

$\frac{1}{4} x^0 \rightarrow \frac{1}{4} \cdot 1$

$\boxed{\frac{1}{4}}$

Look and Find the Answers! If you can't find it, you made a mistake!

4096	t^8	128	0.03125	$81x^8$	x^{14}	$\frac{1}{16}$

$-5m^8p^5$	$-3x^9y^{b+f}z^{c+g}$	$60f^{15}h^5$	$-18x^3y^7$	
$24x^4$	$-36x^7y^8$	$110g^4h^{16}v^6$		

p^{10}	$\frac{243x^{10}}{32y^{10}}$	$4x^2$	$1,000,000$	$64x^2$	$54a^6$
16	$-59049x^{30}$	$343j^6$	x^{2m}		

x^6	$\frac{p^5}{2}$	$\frac{12g^5}{h}$	$\frac{x^{12}y^{11}}{6}$	343	a^5	$\frac{x^3y^6}{2}$	$\frac{c^5}{6}$	$7b$

$\frac{a^7}{b^8}$	$\frac{6c^3}{d^2}$	$\frac{1}{8c^{15}}$	$x^{16}y^{22}$	$\frac{6x^4}{x^{10}}$	$\frac{1}{x^{12}}$	1	g^4	$\frac{1}{4}$