Lesson 7-2 and 7-3 Scientific Notation & Multiplying Powers with the Same Base

A number is expressed in scientific notation when it is written as a product of a factor and a power of 10.

The factor must be great than or equal to 1 and less than 10.

In symbols: $a \times 10^n, where\ 1 \leq a < 10$ and n is an integer.

Scientific Notation to Standard Form

A. 7.48×10^{-3} = 0.00748 (negative exponent, move decimal to the left.)
3 places to the left.

B. 2.19×10^{5} = 219,000 (positive exponent, move decimal to the right.)
5 places to the right.

C. 3.16×10^{-2} = 0.0316

D. 7.61×10^{3} = 7,610

Standard to Scientific Notation

Number of places the decimal was moved.

E. 0.000000672 = $6.72 * 10^{-7}$ (zero's in front, negative exponent)
Must have one non-zero digit in front of the decimal

F. 3,022,000,000,000 = $3.022 * 10^{12}$ (zero's in back, positive exponent)

G. 458,000,000 = $4.58 * 10^{8}$

H. 0.0000452 = $4.52 * 10^{-5}$

Practice: Try to do these on your own.

Express each number in standard form:

1. 3.65×10^{5}
2. 7.02×10^{-4}
3. 8.003×10^{8}
4. 7.451×10^{6}
5. 5.91×10^{0}
6. 7.99×10^{-1}

Express each number in scientific notation

7. 0.00000000012
8. 50,000,000,000
9. 590,000,000
10. 0.03621
11. 0.0042×10^{-3}
12. 433×10^{4}

Product of Powers

To multiply two powers that have the same base, add the exponents.

$m^2 \cdot m^3 = m^{2+3} = m^5$

PROOF $(m \cdot m)(m \cdot m \cdot m) = m^5$

Power of a Power

To raise a power to a power, multiply the exponents

$(m^2)^3 = m^{2 \cdot 3} = m^6$

PROOF $m^2 \cdot m^2 \cdot m^2 = (m \cdot m)(m \cdot m)(m \cdot m) = m^6$

Power of a Product

To find the powers of a product, find the power of each factor and multiply.

I. $(r^4)(-12r^7) = -12 \cdot r^4 r^7$

$= -12r^{11}$

J. $(6cd^5)(5c^5d^2) = (6 \cdot 5)(c \cdot c^5)(d^5 d^2)$

$= 30c^6d^7$

K. $((2^3)^3)^2 = (8^3)^2$

$= (512)^2$

$= 262,144$

$=$ OR

$= 2^{3 \cdot 3 \cdot 2} = 2^{18} = 262,144$

L. $(4ab^2c^3)^2 = 4^2 \cdot a^2 \cdot (b^2)^2 (c^3)^2$

$= 16a^2b^4c^6$

$=$ _____

Square every term, then multiply.

Simplifying Monomial Expressions

To simplify an expression involving monomials, write an equivalent expression in which:

- Each factor appears exactly once
- There are no powers of powers, and
- All fractions are in simplest form.
- All exponents are positive!

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M. Simplify $[(\frac{1}{2}g^3h^4)]^2(2gh^5)^4 = \frac{(\frac{1}{2})^2(g^3)^2(h^4)^2(2)^4(g^4)(h^5)^4}{}$

raise every factor to the appropriate power $= \frac{(\frac{1}{4}g^6h^8)(16g^4h^{20})}{}$

$= \frac{(\frac{1}{4}\cdot 16)(g^6g^4)(h^8h^{20})}{} = \frac{4g^{10}h^{28}}{}$

Group like terms — Multiply constants / Add exponents

Practice: Do these on your own.

Determine whether each expression is a monomial.

1. $5 - 7d$
2. $\frac{4a}{3b}$
3. n

Simplify

7. $x(x^4)(x^6)$
8. $(4a^4b)(9a^2b^3)$
9. $[(4^2)^2]^3$

10. $(3y^5z)^2$
11. $(-4mn^2)(12m^2n)$
12. $(-2v^3w^4)^3(-3vw^3)^2$

Multiplication and Division with Scientific Notation

I. $(7 \times 10^{-6})(4.3 \times 10^{12}) = \underline{(7 \cdot 4.3)} \cdot \underline{(10^{-6} \cdot 10^{12})}$ Group powers of 10 together

$= \underline{30.1 \cdot 10^6}$

$= \underline{(3.01 * 10^1) \cdot 10^6}$ Rewrite 30.1 in scientific notation

$= 3.01 * 10^7$ Add exponents for the "like" bases (10).

J. $\frac{6.4 \times 10^4}{1.6 \times 10^7} = \left(\frac{6.4}{1.6}\right) * (10^4 \cdot 10^{-7}) = 4 * 10^{-3}$