

### How "Fast" is the Speed of Light?

Light travels at a constant, finite speed.

A traveler moving at the speed of light would reach Earth 7.8 times in one second!

In scientific notation all numbers are written as  $a \times 10^b$  where the exponent  $a$  is an integer. The exponent  $b$  is chosen such that  $1 \leq |a| < 10$ .

$a \in \mathbb{R}$   
 $b \in \mathbb{Z}$   
 $1 \leq |a| < 10$   
less than ten

Ex 1: What is the speed of light in scientific notation?

$$300,000,000 \text{ m/s} = 3 \times 10^8 \text{ m/s}$$

Ex 2: Write 0.000000345 in scientific notation.

$$3.45 \times 10^{-7} \rightarrow \text{neg. exponents means division}$$

Ex 3: Write -0.000006789 in scientific notation.

$$-6.789 \times 10^{-6} \quad |-6.789| = 6.789 \checkmark$$

Ex 4: Write 1/10 in scientific or exponential notation.

$$\frac{1}{10} = 10^{-1} = 1 \times 10^{-1}$$

$\rightarrow$  exp. notation       $\rightarrow$  S.N.

Ex 5: How many micrograms are in one gram?

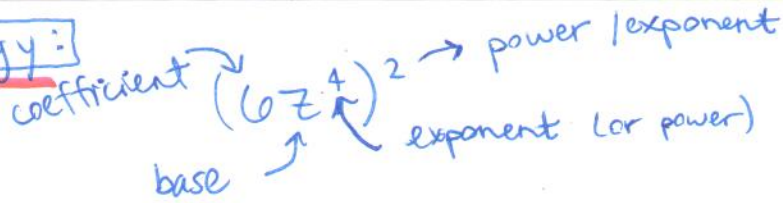
$$1,000,000 \mu\text{g} = 10^6 \mu\text{g} = 1 \text{ g}$$

Ex 6: List the prefixes from Mega- to Milli-

For instance, Micro =  $10^{-6}$

- Mega =  $10^6$
- Kilo =  $10^3$
- Hecto =  $10^2$
- Deca =  $10^1$
- \*base - m, L, g =  $10^0 = 1$
- deci =  $10^{-1}$
- centi =  $10^{-2} = \frac{1}{100} = \frac{1}{10^2}$
- milli =  $10^{-3}$

Terminology:



**Simplifying Expressions**

Defn: Expression-- numbers, variables, and operators (+, -, x,  $\div$ )  
grouped together to show value

Simplify the following expressions. Write answers with positive exponents only.

- \*Rule: When multiplying exponents whose bases are the same, add the exponents.
- \*Rule: When dividing exponents, subtract the exponents.

The result goes in the numerator!

Use Ex to motivate rule  $\rightarrow$

Ex 1:  $\frac{5x^5}{3x^3} = \frac{5 \cancel{x \cancel{x} \cancel{x}}}{3 \cancel{x} \cancel{x}} = \frac{5x^2}{3}$

coefficient  $\rightarrow$  5  $\rightarrow$  exponent  $\rightarrow$  4  $\rightarrow$  base  $\rightarrow$  z

\*Rule: Any # or variable raised to the zero power = 1



Ex 2:  $(-46x^2y^3z)^0 = 1$

Ex 3:  $-(-46x^2y^3z)^0 = -1$  \* Do not keep negative exponents!



Ex 4:  $\frac{15a^5b^2c^4}{25a^3b^3c^4} = \frac{3a^{5-3}b^{2-3}c^{4-4}}{5} = \frac{3a^2b^{-1}c^0}{5} = \frac{3a^2}{5b}$

\*Rule: When raising exponents to the n<sup>th</sup> power, multiply the exponent by n

Note—Coefficients inside parenthesis are raised to the exponent too!

Ex 5:  $(\frac{15m^3n^{-2}p^{-1}}{25m^{-2}n^{-4}})^{-3} = \text{Step 1 } (\frac{3m^{3-2}n^{-2-4}p^{-1}}{5})^{-3} = (\frac{3m^1n^{-6}p^{-1}}{5})^{-3}$

Sidenote:

1. can simplify inside first
2. Flip fraction to change -3 to 3 (ie. ~~reciprocal~~)
3. Raise each term to  $\wedge 3$ .

Step 2 =  $(\frac{3^1p^1}{5^1m^1n^6})^3$

Step 3 =  $(\frac{125p^3}{27m^15n^6})$

With a partner, simplify the following expressions. Write your answer with positive exponents only!

1.  $\frac{3x^3}{7x}$   $\frac{3}{7}x^2$

2.  $12y^2y^3$   $12y^5$

3.  $\frac{4(x-2)}{4}$   $x-2$

4.  $\frac{3yz^2}{4az}$   $\frac{3yz}{4a}$

5.  $\frac{m^{-2}}{m^3}$   $\frac{1}{m^5}$

6.  $\frac{\beta^2\alpha^2}{\alpha^2\beta^2}$   $1$

7.  $2^3$   $8$

8.  $a^0b$   $b$

9.  $(\frac{3}{x})^{-2}$   $(\frac{x}{3})^2 = \frac{x^2}{9}$

10.  ~~$\frac{(3^{-1}a^4b^{-3})^{-2}}{(6a^2b^{-1}c^{-2})^2} = \frac{1}{(3^{-1}a^4b^{-3})^2(6a^2b^{-1}c^{-2})^2}$~~   
 ~~$= \frac{1}{(3^{-2}a^8b^{-6})(36a^4b^{-2}c^{-4})} = \frac{9b^8c^4}{36a^{12}}$~~   
 $= \frac{b^8c^4}{4a^{12}}$

11.  $(-3x^{-1}y^2)^2$   
 $9x^{-2}y^4 = \frac{9y^4}{x^2}$

12.  $\frac{3x^{-2}y}{xy}$   $\frac{3y}{x^3y} = \frac{3}{x^3}$

13.  $\frac{-6}{x^{-2}}$   $-6x^2$

14.  $(-5x^{-2}y)(-2x^{-3}y^2)$   
 $10x^{-5}y^3 = \frac{10y^3}{x^5}$

15.  ~~$(-3x^{-1}y^2)^2$~~   
 $-(-4y^4)^2 = -16y^8$

# Simplifying Expressions and Polynomials ~~Unit 1~~ Unit 2

- Defn:
- Expression - #'s and vars. grouped together to show value
  - Polynomial - sums of expressions
  - Like terms - terms w/ same variable ~~attached~~ to w/ same exponent attached to that variable.
- poly = many  
nomial = name/term  
mono- = one term  
bi- = two terms  
tri = 3 terms

## I. ~~Combining like terms~~ Adding Poly's.

Ex: a, b, c, e, h, i

## II. Multiplying Poly's

Ex: f, j, k, l.  
j vs j<sup>2</sup>

## III. Dividing Poly's

$$\textcircled{1} \frac{6x-18}{6x-36} = \frac{3(x-5)}{6(x-6)} = \frac{1(2x-5)}{2(x-6)}$$

$$\textcircled{2} \frac{6x-17}{6x-36}$$

$$\textcircled{3} \frac{(2x-5)}{(x-6)} \cdot \frac{(x-6)}{(12x+5)} = \frac{2x-5}{12x+5}$$

# Unit 20: Simplifying Expressions & Polynomials

- Defn:
- Expression - #'s and vars. grouped together to show value
  - Polynomial - sums of expressions
  - Like Terms - terms with the same exponent & variable

I: Combining Like Terms  
 \* When adding/subtracting, can only combine like terms

a)  $x + x + y = 2x + y$

b)  $x^3 + x^3 + x = 2x^3 + x$   
 (Annotations: 'exponent' points to the 3 in  $x^3$ ; 'base' points to the  $x$  in  $x$ )

c)  $y^7 - y^2 = y^7 - y^2$   
 (Annotations: 'coefficient' points to the 1 in  $y^7$ ; 'base' points to the  $y$  in  $y^7$ )

d)  $x^2 + 5x^2 = 6x^2$

e)  $9z^8 - 12z^3 + 4y - z^3 - 7y = 9z^8 - 13z^3 - 3y$

f)  $7 + 5(3c - 1)$   
 $= 7 + 15c - 5$  → Distributive Prop  
 $= 2 + 15c$  or  $15c + 2$

g)  $\frac{3(2x-5)}{6(x-6)} = \frac{6x-15}{6x-36} = \frac{2x-5}{2x-12}$  OR  $\frac{3(2x-5)}{2(6(x-6))}$

## II. Adding Polynomials

h)  $(5x^2 - 2x + 3) + (-4x^2 + 5x - 6) = x^2 + 3x - 3$

i)  $(5x^2 - 2x + 3) - (-4x^2 + 5x - 6) = 9x^2 - 7x + 9$

- poly = many
- Monomial = one term
- Bi = 2 terms
- Tri = 3 terms
- nomial = name/term

$= \frac{2x-5}{2x-12}$

### III Multiplying Polynomials

j)  $(2y+7)(5y-3)$   
 (Binomial)(Binomial)

FOIL (Distr. Prop)

$= 10y^2 + 29y - 21$

jII)  $2y+7 \cdot 5y-3$   
 $= 2y + 35y - 21$   
 $= 37y - 21$

k)  $(x+1)(x-1)$

$= x^2 + x - x - 1 = x^2 - 1$

→ Difference of Two Squares

$(x+1)(x-1) = x^2 - 1$  — UG

l)  $(x-3)(x^2 - 2x + 7)$

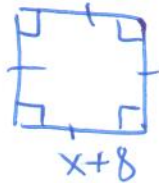
- Distr Prop

$= x^3 - 5x^2 + 13x - 21$

#### Writing & Simplifying Poly. Activity

# 2:  $3(x-7) = (3x-21) + 30 = \frac{3x+9}{3} = x+3 - x = 3$

# 5:

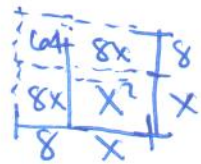


$A = l \cdot w$

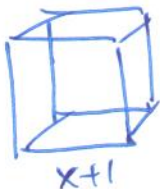
$A = (x+8)(x+8)$

$= x^2 + 8x + 8x + 64$

$= x^2 + 16x + 64$



# 3:



$V = l \cdot w \cdot h$

$V = (x+1)(x+1)(x+1)$

$= (x+1)(x^2 + 2x + 1)$

$= x^3 + 3x^2 + 3x + 1$

$= x^2 + 8x + 8x + 64$

$= x^2 + 16x + 64$