

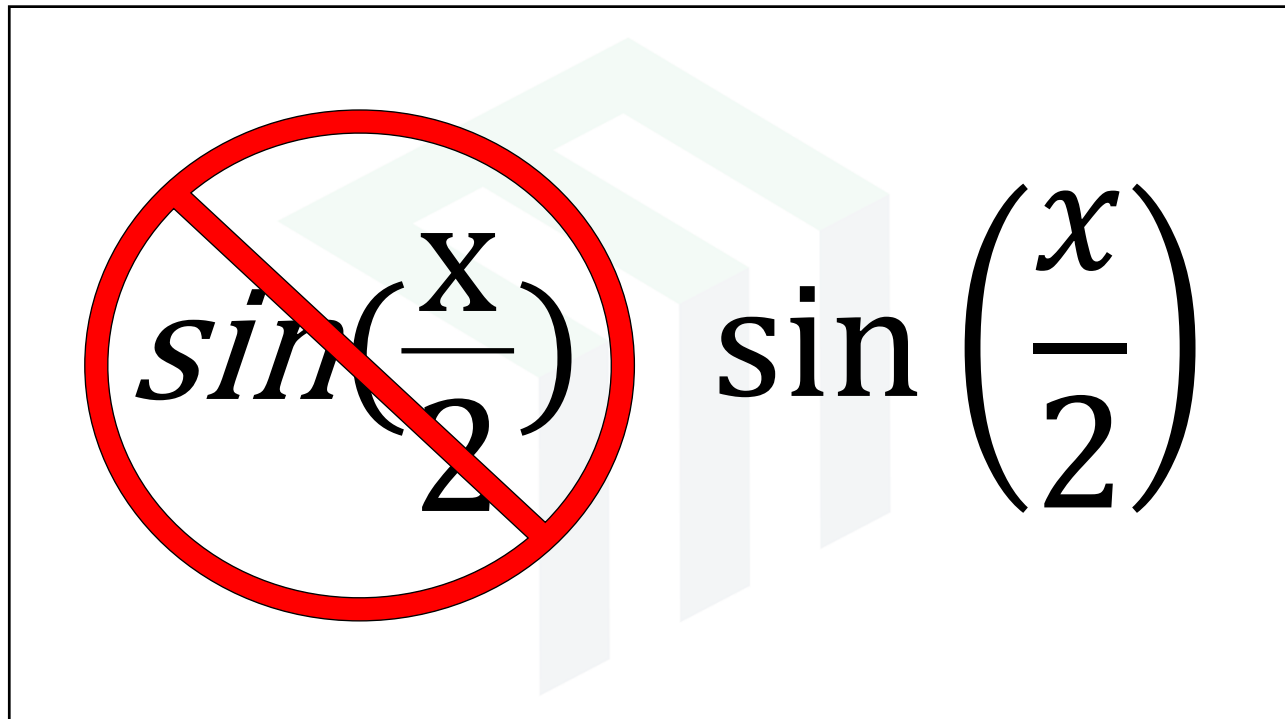


Research Methods in Science in Engineering

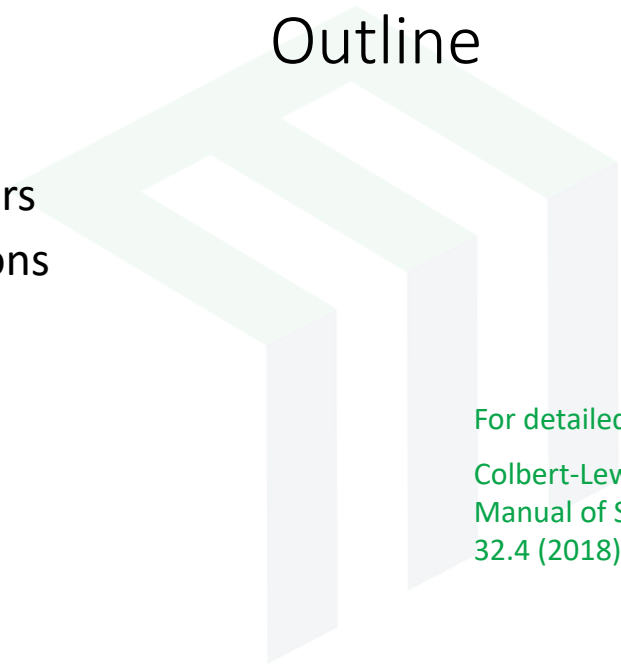
## Formatting of Numbers and Equations

Slide 1

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# Outline

- Numbers
- Equations

For detailed information, see:  
Colbert-Lewis, Danielle. "The Chicago Manual of Style." Reference Reviews 32.4 (2018): 19-20.

 Slide 3

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# Numbers

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## When to Spell Out a Number

**Rule:** Spell out all numbers zero through one hundred and certain round multiples of those numbers.

Thirty-seven people in twelve tribes attended the meeting.

**Alternative Rule:** In STEM writing, it is more common to only spell out single-digit numbers. When a number begins a sentence, it is always spelled out. Measurements or numbers with units are always written as numerals.

Thirty-seven people in 12 tribes attended the meeting.

The pencil was measure to be 5 in.

## Ordinals

**Rule:** Never use superscripts.

Jimmy won ~~X<sup>th</sup>~~ place. → Jimmy won 2<sup>nd</sup> place.

**Rule for Variables:** The variable should be italicized.

The *i*th layer of the device was analyzed to the *n*th degree.

## Scientific Notation

**Rule:** Scientific notation is an equation and should be formatted as a sentence.

$$46,781.11 \text{ m} = 4.678111 \times 10^4 \text{ m}$$

spaces

Not italicized because m is not a variable.

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## Numbers and Units (1 of 2)

**Rule:** Interpret the number and unit as separate words. The number is never spelled out.

A 200-watt bulb was used.

A hyphen was used because the 200 is associated with watt and not bulb.

Sally was 65 in tall.

A space is inserted because 65 and 'in' are separate words.

Units without numbers are always spelled out.

The voltage was measured in millivolts.

Not mV

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## Numbers and Units (2 of 2)

Units that are abbreviated do not include a space between the unit and number.

30%

72°F

6"

## Fractions

**Rule:** Simple fractions are spelled out and hyphenated in noun, adjective, and adverb forms.

He dropped three-fourths of the papers.

The vote requires a three-fourths majority.

The quantity  $\pi$  can be approximated as  $22/7$ .

The pizza was cut into four quarters.

## Repeated Quantities

**Rule:** For expressions including two or more numbers with units, the unit is repeated if close to number and not repeated if the number and unit are separated.

In dry air, I am comfortable in the range 50°F–90°F.

The size of my room is 6" × 10".

The size of my room is 6 × 10 ft.

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## Dashes

### em dash

Used to replace parentheses, colons, and commas. Generally considered informal. Maybe useful to set off information that contains punctuation like commas.

I like three colors: red, green, and blue.

I like three colors (red, green, and blue).

I like three colors—red, green, and blue.

M  
Colors—red

### en dash

The en dash is only used between times, dates, and forms of indexing. It is formal.

I work 7:00am–6:00pm today.

World War II (1939–1945) was...

N  
3–5

### 3-em dash

Used to omit information that cannot be disclosed, such as names in legal documents. They contain six hyphens or an underscore.

The case between ----- and ----- will start tomorrow.

The case between \_\_\_\_ and \_\_\_\_ will start tomorrow.

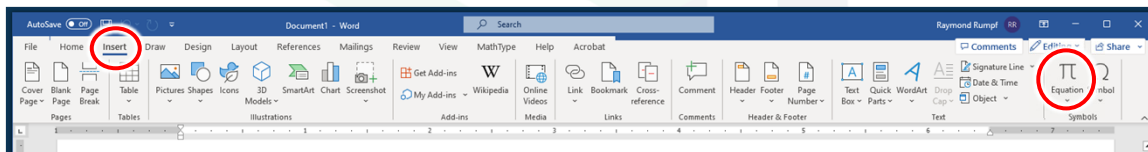
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# Equations

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## Use an Equation Editor

There are no excuses not to use an equation editor. These will automatically format most things correctly.



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## Equations are Parts of Sentences

Equations should read as clearly and grammatically as any other kind of writing.

$x > y$        $x$  is greater than  $y$

$a + b = c$        $a$  plus  $b$  equals  $c$

$a+b=c$        $a$ plusbequalsc

The Pythagorean theorem states that

$$a^2 + b^2 = c^2, \quad \text{Eq. (27)}$$

where  $c$  is the length of the hypotenuse.

Observe the punctuation

## Spaces

Variables and math operations are separate words so they should be separated by spaces.

$a + b = c$        $a$  plus  $b$  equals  $c$

$a+b=c$        $a$ plusbequalsc

Exceptions: superscripts, subscripts, parentheses, brackets, etc.

$$2(x + y) = z^2$$

$$[A]^T$$



## Use of *Italics*

**Fonts** – Fonts intended for math are typically designed so italic letters do not overlap each other. Times Roman font is most common. MS Word uses Cambria Math.

**Variables** – Only variables should be italicized in equations. This is done to differentiate variables from ordinary letters. All variables are italicized except when they are multiple letters or upper-case Greek letters. Functions are not italicized.

$$\text{FOV} = \frac{\Lambda}{\lambda} \sin(\theta + \pi)$$

## Use of *Italics*: Examples

$$\text{cos } x$$

$$\text{cos } x$$

$$\text{cos}(x)$$

$$\text{cos } x$$

$$K = \frac{2\pi}{\Lambda}$$

$$K = \frac{2\pi}{\Lambda}$$

$$C = BW \log(1 + \text{SNR})$$

$$C = BW \log(1 + \text{SNR})$$

$$P_{\text{avg}} = \frac{A^2}{2}$$

$$P_{\text{avg}} = \frac{A^2}{2}$$

## Do NOT Type ()'s, []'s, or {}'s

Always use an equation editor and insert the ()'s, []'s, or {}'s properly so that they are sized and spaced correctly around the variables.

Typed

$$\cos(x)$$

$$\cos\left(\frac{\theta}{2}\right)$$

Inserted via Equation Editor

$$\cos(x)$$

$$\cos\left(\frac{\theta}{2}\right)$$

vs

## Use the Correct Math Symbols

$$ab$$

Ordinary multiplication

$$a \cdot b$$

Ordinary multiplication

$$\vec{a} \cdot \vec{b}$$

Vector dot product

$$\vec{a} \times \vec{b}$$

Vector cross product

$$a * b$$

Convolution

Aside: Different parts of the world have different conventions. The above is popular in the USA. Regardless of the convention, learn the rules and follow them to avoid any confusion interpreting the equations.

## Wrap-Around Equations

Sometimes equations are so long that they cannot fit on a single line and must wrap around to a second line.

If the runover line begins with an operation sign, the operation sign should be lined up with the first character to the right of the relation sign on the previous line.

$$\frac{\pi}{4} = \frac{1}{2} - \frac{1}{3 \cdot 2^3} + \frac{1}{5 \cdot 2^5} - \frac{1}{7 \cdot 2^7} + \frac{1}{9 \cdot 2^9} - \frac{1}{11 \cdot 2^{11}} + \dots$$

$$+ \frac{1}{3} - \frac{1}{3 \cdot 3^3} + \frac{1}{5 \cdot 3^5} - \frac{1}{7 \cdot 3^7} + \frac{1}{9 \cdot 3^9} - \dots$$

$$+ \frac{1}{4} - \frac{1}{3 \cdot 4^3} + \frac{1}{5 \cdot 4^5} - \frac{1}{7 \cdot 4^7} + \frac{1}{9 \cdot 4^9} - \dots$$

aligned

Three dots to continue the series.

Observe the period at the end.

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## In-Line Equations

Incidental equations that are not critical or too large should be put inline with the text.

Under the condition

$$a > b,$$

Eq. (1)

the value of  $c$  can be approximated as

$$c \approx \frac{a}{2} + b$$

Eq. (2)

Under the condition  $a > b$ , the value of  $c$  can be approximated as

$$c \approx \frac{a}{2} + b$$

Eq. (1)

The condition  $a > b$  is too incidental to warrant having its own separate equation.

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## Horizontal Vs. Vertical Fractions (1 of 2)

Fractions for inline equations must always be horizontal.

The magnitude of the grating vector  $\vec{k}$  conveys period  $\Lambda$  according to  $|\vec{k}| = 2\pi/\Lambda$ . More words more words more words more words more words more words more words more words.

The magnitude of the grating vector  $\vec{k}$  conveys period  $\Lambda$  according to  $|\vec{k}| = \frac{2\pi}{\Lambda}$ . More words more words more words more words more words more words more words more words.

} Vertical fractions introduce awkward white space.

## Horizontal Vs. Vertical Fractions (2 of 2)

Fractions in superscripts or subscripts must always be horizontal.

~~$x^{\frac{a}{b}}$~~

$x^{a/b}$