

# PRETEXT

## WRITE ONCE, READ ANYWHERE

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# WHAT IS PRETEXT?

- An authoring and publishing system:
  - Extensive support for mathematics (and STEM)
  - Designed to create openly licensed materials
- An abstract specification of a scholarly document
- Implementations of conversions to various formats
- A modern replacement for LaTeX
- A commitment to creating accessible materials
- A community of instructors, authors, and publishers
- Guided by 11 principles, e.g. ...
- Principle #10: PreTeXt recognizes that scholarly documents involve the interaction of authors, publishers, scholars, instructors, students, and readers, with each group having its own needs and goals.

## KEY IDEA: WRITE ONCE

The PreTeXt authoring language captures an author's intent and document structure, AS THE AUTHOR WRITES.

An author concentrates on CONTENT and is not able to influence PRESENTATION.

Principle #1: PreTeXt captures the structure of textbooks and research papers

## PAYOFF: READ ANYWHERE

- PDF: print and electronic versions
- HTML: highly interactive, amazingly accessible
- EPUB/Kindle: an improvement on PDF
- Jupyter notebooks: popular for data science, Python programming
- Runestone: open-source hosting of open textbooks, with LMS, more interactivity
- Braille: embossable and electronic, 100% automated, no transcriber
- Slideshows: you are viewing one now
- Principle #3: PreTeXt documents serve as a single source which can be easily converted to multiple other formats, current and future.

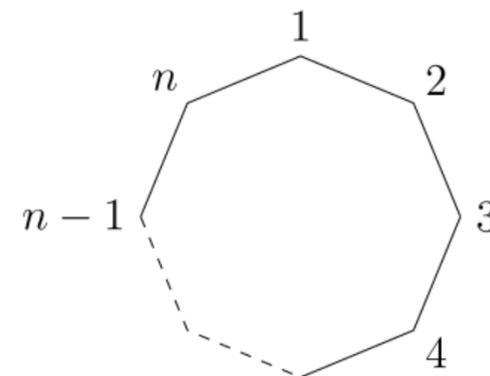
# PDF, FOR PRINT AND SCREEN

- Via LaTeX, two slightly different PDFs are possible.
- Electronic is different than hardcopy print.
  - Active links, colored?
  - Color versus B/W
  - One-sided v. two-sided
  - Page size, margins
- Example: Judson's Abstract Algebra

- A superior offline format
- On desktops or laptops
- Or on tablets or dedicated devices
- Example: Foliate reader on Linux

## 5.2 Dihedral Groups

Another special type of permutation group is the dihedral group. Recall the symmetry group of an equilateral triangle in [Chapter 3](#). Such groups consist of the rigid motions of a regular  $n$ -sided polygon or  $n$ -gon. For  $n = 3, 4, \dots$  we define the  **$n$ th dihedral group** to be the group of rigid motions of a regular  $n$ -gon. We will denote this group by  $D_n$ . We can number the vertices of a regular  $n$ -gon by  $1, 2, \dots, n$  ([Figure 5.2.1](#)). Notice that there are exactly  $n$  choices to replace the first vertex. If we replace the first vertex by  $k$  then the second vertex must be replaced either by vertex  $k + 1$  or by vertex  $k - 1$  hence, there are  $2n$  possible rigid motions of the  $n$ -gon. We summarize these results in the following theorem.



**Figure 5.2.1.** A regular  $n$ -gon

**Theorem 5.2.2.** *The dihedral group,  $D_n$  is a subgroup of  $S_n$  of order  $2n$*

**Theorem 5.2.3.** *The group  $D_n$   $n \geq 3$  consists of all products of the two elements  $r$  and  $s$  satisfying the relations*

$$\begin{aligned} r^n &= 1 \\ s^2 &= 1 \\ srs &= r^{-1}. \end{aligned}$$

**Proof.** The possible motions of a regular  $n$ -gon are either reflections or rotations ([Figure 5.2.4](#)). There are exactly  $n$  possible rotations:

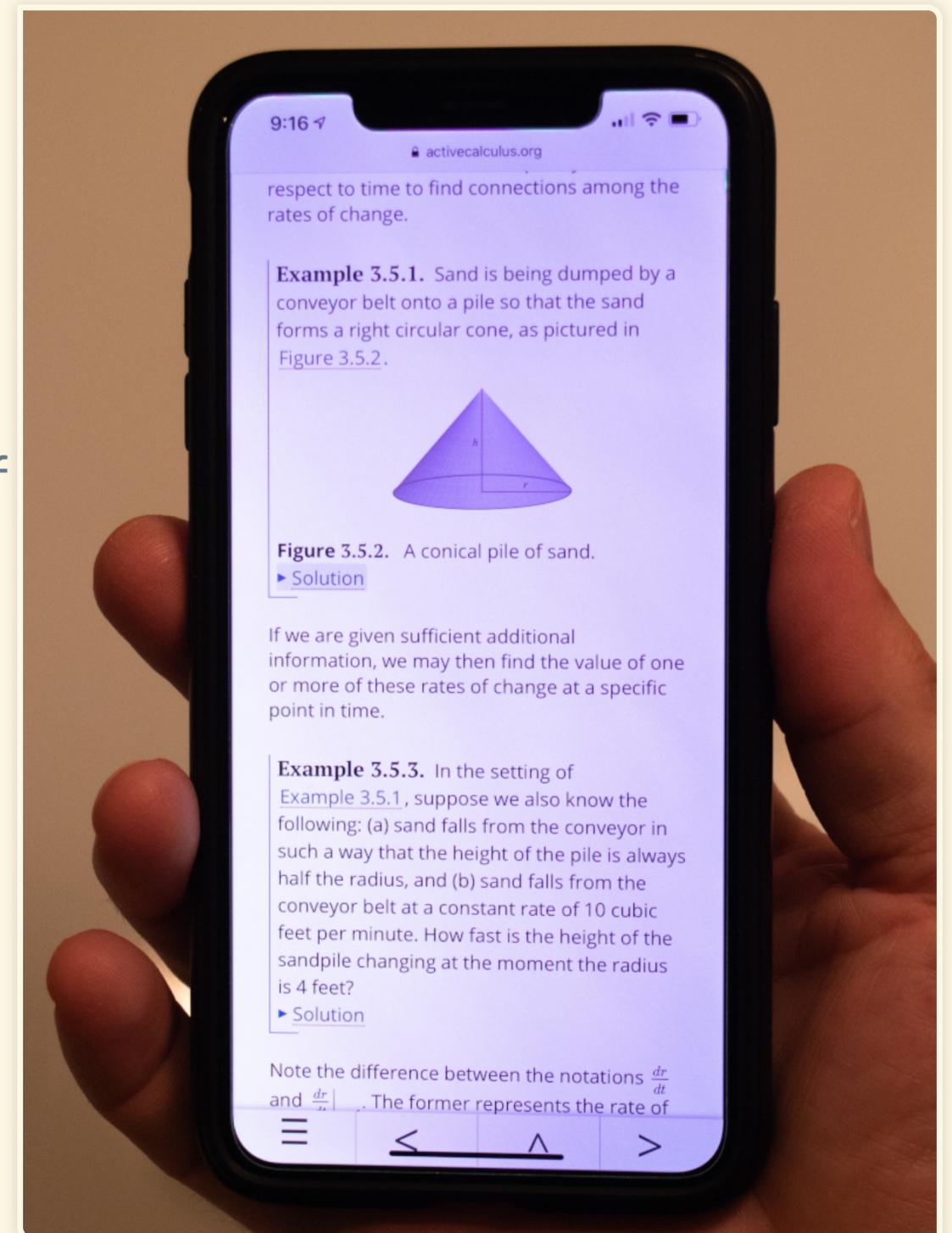
$$\text{id}, \frac{360^\circ}{n}, 2 \cdot \frac{360^\circ}{n}, \dots, (n-1) \cdot \frac{360^\circ}{n}.$$

We will denote the rotation  $360^\circ/n$  by  $r$ . The rotation  $r$  generates all of the other rotations. That is,

$$r^k = k \cdot \frac{360^\circ}{n}.$$

# HTML

- Everybody's favorite
- Takes advantage of HTML, CSS, Javascript
- Works well on small screens
- Accessible: works well with screen readers
- Math is powered by MathJax
- Many interactive features
- Principle #6: PreTeXt makes use of the full capabilities of the Web.



# DEMONSTRATION

Judson's Abstract Algebra: Theory and Applications

# INTERACTIVE ASSESSMENTS

- Author WeBWorK problems within PreTeXt source
- Host PreTeXt book on Runestone, with login and LMS
- More question types coming:
  - short answer, essay
  - multiple choice
  - true/false
  - fill-in
  - etc.
- MyOpenMath: preliminary, PreTeXt “endpoint”
- NUMBAS, STACK?

The screenshot shows a PreTeXt interface with a table of contents on the left and a problem page on the right. The table of contents includes sections for Graphing Lines, Systems of Linear Equations, and Exponents and Polynomials. The problem page features a graph of a line and three questions.

**4 Graphing Lines**

- Cartesian Coordinates
- Graphing Equations
- Exploring Two-Variable Data and Rate of Change
- Slope
- Slope-Intercept Form
- Point-Slope Form**
- Standard Form
- Horizontal, Vertical, Parallel, and Perpendicular Lines
- Summary of Graphing Lines
- Linear Inequalities in Two Variables
- Graphing Lines Chapter Review

**5 Systems of Linear Equations**

- Solving Systems of Linear Equations by Graphing
- Substitution
- Elimination
- Systems of Linear Equations Chapter Review

**6 Exponents and Polynomials**

- Exponent Rules
- Scientific Notation
- Adding and Subtracting Polynomials
- Multiplying Polynomials

Authored in PreTeXt  
POWERED BY MathJax

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**Remark 4.6.4 Alternative Point-Slope Form.** It is also common to define point-slope form as

$$y - y_0 = m(x - x_0) \quad (4.6.2)$$

by subtracting  $y_0$  from each side. Some exercises may appear using this form.

**Checkpoint 4.6.5.**

Consider the line in this graph:

a. Identify a point visible on this line that has integer coordinates.

b. What is the slope of the line?

c. Use point-slope form to write an equation for this line, making use of a point with integer coordinates.

**Solution:**

# BRAILLE

Principle #11: PreTeXt recognizes the inherent value in producing material that is accessible to everyone.

- MathJax's Speech Rule Engine makes Nemeth braille
- `liblouis` makes braille for literary text
- `liblouis` formats an embossed page
- One-line (electronic) display is also possible
- PreTeXt makes the integration possible
- Speech Rule Engine makes 2D math using layout
- Working on tactile graphics for diagrams with labels
- This talk could be converted to braille!





# JUPYTER NOTEBOOKS

- Computational notebook format
- Popular in data science community
- We support a Sage kernel
- Conversion could use some attention

# ACCESSIBILITY

- HTML output follows standards, screen readers work exceedingly well
- Extra devices, like “Skip to Main Content” link
- Author support: “description” element for images
- Math support: from Speech Rule Engine within MathJax
- Braille, using Nemeth braille and 2D layouts

# MISCELLANEOUS

- WeBWorK, natively
- Super-simple YouTube, Vimeo, MP4 embeddings
- Desmos, Geogebra, various Javascript libraries
- Automatic index, back-of-the-book solutions
- Solutions Manual conversion (PDF only)
- Literate Programming support, code generation
- International use: 14 contributed localizations
- Code on GitHub: 39 contributors, 167 forks

# UNDERGRADUATE MATHEMATICS CURRICULUM

All PreTeXt textbooks. Lower-division first.

- ORCCA: Open Resources for Community College Algebra (Jordan)
- Modeling, Functions, and Graphs: Algebra for College Students (Yoshiwara/Yoshiwara)
- Advanced High School Statistics (Diez/Çetinkaya-Rundel/Dorazio/Barr)
- Active Calculus (Boelkins, GVSU)
- APEX Calculus (through multivariate) (Hartman)
- Calculus (4 volumes) (Feldman/Rechnitzer/Yeager)
- A First Course in Linear Algebra (Beezer)
- Understanding Linear Algebra (Austin, GVSU)
- Discover Linear Algebra: A First Course in Linear Algebra (Sylvestre)

The PreTeXt Catalog: [pretextbook.org/catalog.html](http://pretextbook.org/catalog.html)

# UNDERGRADUATE MATHEMATICS CURRICULUM

All PreTeXt textbooks. Now upper-division.

- The Ordinary Differential Equations Project (Judson)
- Notes on Diffy Qs: Differential Equations for Engineers (Lebl)
- Applied Discrete Structures (Levasseur)
- Discrete Mathematics: an Open Introduction (Levin)
- Applied Combinatorics (Keller/Trotter)
- Combinatorics Through Guided Discovery (Bogart)
- Introduction to Game Theory: a Discovery Approach (Nordstrom)
- Geometry with an Introduction to Cosmic Topology (Hitchman)
- Number Theory: In Context and Interactive (Crisman)
- How We Got From There To Here: A Story of Real Analysis (Rogers/Bowman)
- Abstract Algebra: Theory and Applications (Judson)

The PreTeXt Catalog: [pretextbook.org/catalog.html](http://pretextbook.org/catalog.html)

# CONCLUSION

Principle #8: PreTeXt is free: the software is available at no cost, with an open license. The use of PreTeXt does not impose any constraints on documents prepared with the system.

## Links

- [pretextbook.org](http://pretextbook.org)
- [buzzard.ups.edu/talks.html](http://buzzard.ups.edu/talks.html)
- Twitter: [#PreTeXtGang](https://twitter.com/PreTeXtGang)

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