01 Math Review

Engineering Statics, STCS 200

Updated on: August 11, 2025

Statics and Math

- Statics is all math! All but the most trivial statics problems require algebra and/or trigonometry and/or geometry to solve.
- The good news is that the math is not very difficult. You won't need anything more advanced than high-school math.
- We will do a quick review here that should cover all the math you'll need for STCS 200.

Trigonometry

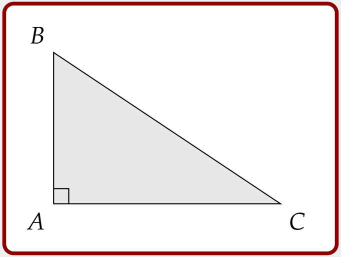
Triangles are a strong, stable shape and often used in engineering.

Triangles help avoid issues like this:

Triangles mean we need trigonometry.

Right Triangle

A **right triangle** is a triangle having one 90° angle.



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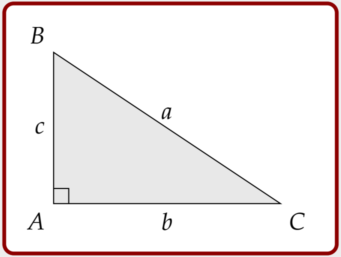

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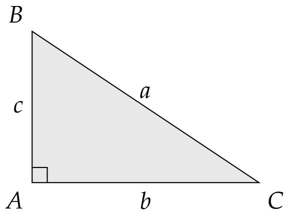

Label the three sides a, b and c. The side a, opposite the right angle, is called the **hypotenuse**.

If we know the lengths of any two sides, we can calculate the length of the third side using the **Pythagorean Theorem**:

Pythagorean Theorem

$$a^2 = b^2 + c^2$$

Right Triangle Exercises

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- Significant digits are a measure of the **accuracy** of a number.

  It is **extremely important** to recognize that we can get no more accuracy out of a calculation than we put in. If the inputs to a problem have three significant digits, we cannot expect any higher accuracy than three significant digits in our result — even if the calculator does give ten digits.

Significant Digits

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Non-zero digits **are** significant:

- 1234 has 4 significant digits.
- 12.34 has 4 significant digits.

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Zeros between non-zero digits are significant

- 12034 has 5 significant digits.
- 12.0034 has 6 significant digits.

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Leading zeros are **not** significant

- 0.1234 has 4 significant digits.
- 0.0001234 has 4 significant digits.

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Trailing zeros (after a decimal point) **are** significant

- 1234.0 has 5 significant digits.
- 1.23400 has 6 significant digits.

Trailing zeros (on whole numbers, i.e. integers) are more **complicated**

- 12300 can have 3, 4 or 5 significant digits!
  - Consider $12.3\,\mathrm{m}$. This value has 3 significant digits. It is equal to $12300\,\mathrm{mm}$, so in this case the 12300 also has 3 significant digits.
  - Now consider $12.30\,\mathrm{m}$. This value has 4 significant digits. But it is still equal to $12300\,\mathrm{mm}$, so in this case the 12300 has 4 significant digits.
  - What if $12300\,\mathrm{mm}$ refers to $12.300\,\mathrm{m}$? Then it has 5 significant digits.
- Usually, the trailing zeros are placeholders for the magnitude of a value and we don't need to worry unduly.
- If we want to emphasize that 12300 has 4 significant digits, we can write $1.230 \times \left(10^3\right)$.

Calculations for Exercises

- In practice, it is often difficult to measure objects more accurately than to three significant digits so **input values for exercises are generally given to 3 significant digits**. (Or sometimes 4 significant digits when the leading significant digit is a 1)

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- Intermediate calculations will accumulate rounding errors quickly if we use only three significant digits and these can affect the final result. **For intermediate calculations, use 5 or more significant digits.**

  (When I write solutions down, I use 5 significant digits for intermediate calculations. You may use more if it is more convenient for you, e.g., if you are storing intermediate results in your calculator.)

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  - 2.3456 becomes 2.35 because the first non-significant digit (the 5 in this case) is ≥ 5 and so the 4 rounds up.
  - 2.3446 becomes 2.34 because the first non-significant digit (the 4 in this case) is < 5 and the last significant digit, 4, remains unchanged.
- When the first discarded digit is a 5 (or higher), round up the digit before the 5 (or higher)
- There are various rules (such as the odd-even rule) which take a more complicated approach to rounding 5 but, for our purposes, **5 rounds up**!

Right Triangle Exercises