

01 Math Review

Engineering Statics, STCS 200

Updated on: August 11, 2025

- ▶ 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.

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

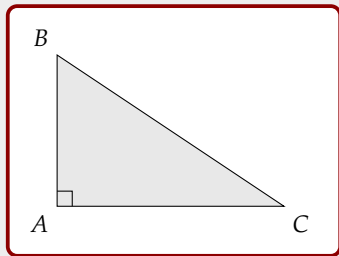
Triangles help avoid issues like this:



Triangles mean we need trigonometry.

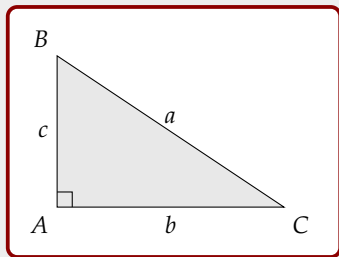
Right Triangle

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



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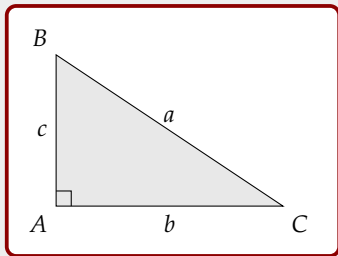
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If we know the lengths of any two sides, we can calculate the length of the third side using the **Pythagorean Theorem**:

Pythagorean Theorem

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

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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.

Non-zero digits

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- ▶ 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.

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 m. This value has 3 significant digits. It is equal to 12300 mm, so in this case the 12300 also has 3 significant digits.
 - ▶ Now consider 12.30 m. This value has 4 significant digits. But it is still equal to 12300 mm, so in this case the 12300 has 4 significant digits.
 - ▶ What if 12300 mm refers to 12.300 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 $1.230 \times (10^3)$.

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- ▶ 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)
- ▶ We cannot expect to get more accuracy in our result at the end of a calculation than from our given input values at the beginning of the calculation so **solutions should be correct to 3 significant digits, not more than the accuracy of the calculation inputs!**
- ▶ 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!**