Introduction to Trigonometry

***Trigonometry*** *(from Greek trigonon "triangle" + metron "measure")*

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| triangle | **Trigonometry** ... is all about **triangles.** |

**Right Angled Triangle**

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| A [**right-angled triangle**](http://www.mathsisfun.com/right_angle_triangle.html) (the right angle is shown by the little box in the corner) has names for each side:   * **Adjacent** is adjacent to the angle "θ", * **Opposite** is opposite the angle, and * the longest side is the **Hypotenuse**. | triangle showing Opposite, Adjacent and Hypotenuse |

**Angles**

Angles (such as the angle "***θ***" above) can be in [Degrees](http://www.mathsisfun.com/geometry/degrees.html) or [Radians](http://www.mathsisfun.com/geometry/radians.html). Here are some examples:

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| **Angle** | **Degrees** | **Radians** |
| right angleRight Angle | 90° | π/2 |
| \_\_ Straight Angle | 180° | π |
| right angle Full Rotation | 360° | 2π |

**"Sine, Cosine and Tangent"**

The three most common **functions** in trigonometry are [Sine, Cosine and Tangent](http://www.mathsisfun.com/sine-cosine-tangent.html). You will use them a lot!

They are simply one side of a triangle divided by another.

For any angle "***θ***":

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| Right-Angled Triangle | |  |  | | --- | --- | | Sine Function: | **sin(*θ*) = Opposite / Hypotenuse** | | Cosine Function: | **cos(*θ*) = Adjacent / Hypotenuse** | | Tangent Function: | **tan(*θ*) = Opposite / Adjacent** | |

**Example: What is the sine of 35°?**

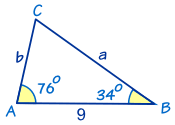
|  |  |
| --- | --- |
| http://www.mathsisfun.com/geometry/images/triangle-28-40-49.gif | Using this triangle (lengths are only to one decimal place):  sin(35°) = Opposite / Hypotenuse = 2.8/4.9 = **0.57...** |

**Sine**, **Cosine** and **Tangent** are often abbreivated to **sin**, **cos** and **tan**.

Solving Triangles

A big part of Trigonometry is [Solving Triangles](http://www.mathsisfun.com/algebra/trig-solving-triangles.html). By "solving" I mean finding missing sides and angles.

### Example: Find the Missing Angle "C"



It's easy to find angle **C** by using [angles of a triangle add to 180°](http://www.mathsisfun.com/proof180deg.html):

So C = 180° - 76° - 34° = **70°**

It is also possible to find missing side lengths and more. The general rule is:

**If you know any 3 of the sides or angles you can find the other 3**  
(except for the three angles case)

Pythagoras Theorem

For the next trigonometric identities we start with [Pythagoras' Theorem](http://www.mathsisfun.com/pythagoras.html):

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| right angled triangle | The Pythagorean Theorem states that, *in a right triangle,* the square of a (**a²**) plus the square of b (**b²**) is equal to the square of c (**c²**):  a2 + b2 = c2 |

Dividing through by *c*2 gives

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a2 | + | b2 | = | c2 |
|  |  |  |
| c2 | c2 | c2 |

This can be simplified to:

(a/c)2 + (b/c)2 = 1

Now, **a/c** is **Opposite / Hypotenuse**, which is **sin(θ)**

And **b/c** is **Adjacent / Hypotenuse**, which is **cos(θ)**

So (a/c)2 + (b/c)2 = 1 can also be written:

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| **sin2 θ + cos2 θ = 1** |

Distance Between 2 Points

Here is how to calculate the distance between two points when you know their coordinates:

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| graph 2 points | Let us call the two points A and B |
|  |  |
| graph 2 points | We can run lines down from A, and along from B, to make a [Right Angled Triangle](http://www.mathsisfun.com/right_angle_triangle.html).  And with a little help from [Pythagoras](http://www.mathsisfun.com/pythagoras.html) we know that:  a2 + b2 = c2 |
|  |  |
| graph 2 points | Now label the [coordinates](http://www.mathsisfun.com/data/cartesian-coordinates.html) of points A and B.  xA means the x-coordinate of point A  yA means the y-coordinate of point A  The horizontal distance "a" is (xA - xB)  The vertical distance "b" is (yA - yB) |

So now we can solve for c (the distance between the points):

|  |  |  |
| --- | --- | --- |
| Start with: |  | c2 = a2 + b2 |
|  |  |  |
| Put in the calculations for a and b: |  | c2 = (xA - xB)2 + (yA - yB)2 |
|  |  |  |
| And the final result: |  | graph 2 points |