

# Angles

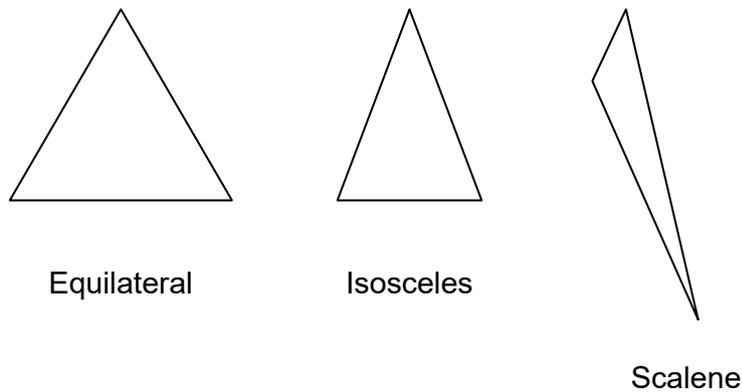
An angle is a measure of the amount of turn. At GCSE, we measure angles in degrees. The symbol for degrees is  $^{\circ}$ .

We can split the size of angle into minutes ( $'$ ) and seconds ( $''$ ). There are  $60'$  in  $1^{\circ}$  and there are  $60''$  in  $1'$ . Consequently, there are  $3600''$  in  $1^{\circ}$ .

## Angles in triangles

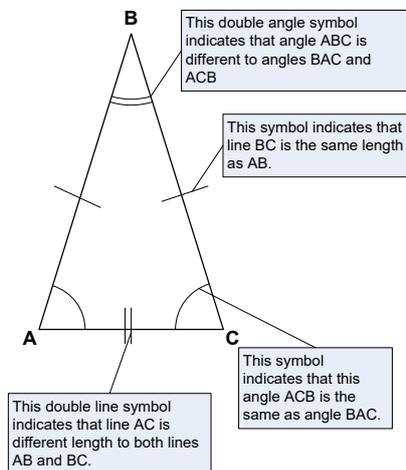
If you add all the internal angles of a triangle together, they total  $180^{\circ}$ .

There are three types of triangle, examples of which are pictured below.

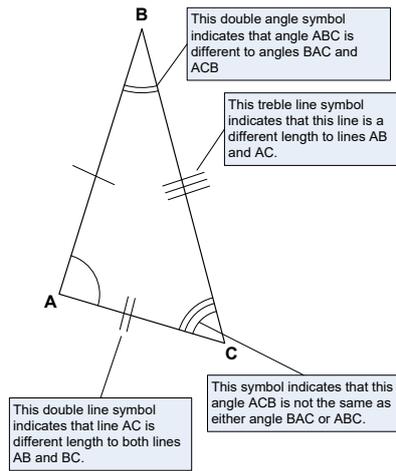


An equilateral triangle has all sides and angles the same. All the angles are  $60^{\circ}$ .

An isosceles triangle has two sides and two angles the same. The other side and angle is different.

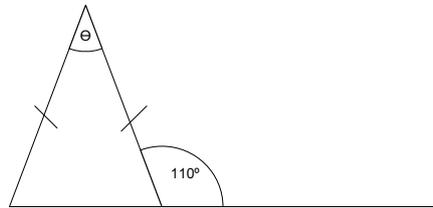


A scalene triangle has three sides which are all of different lengths and three angles that are all different.

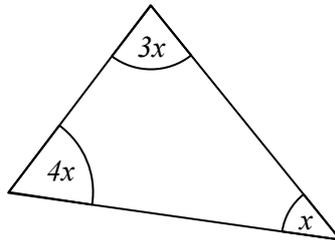


Angles in a triangle total  $180^\circ$ . This is one of the questions that you might be asked about a lot on exam papers.

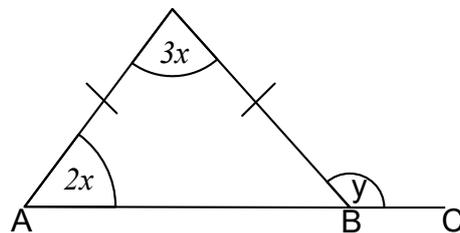
1. Calculate the size of angle  $\theta$



2. What is the value of  $x$ ?



3. ABC is a straight line. Calculate the angle  $y$ .

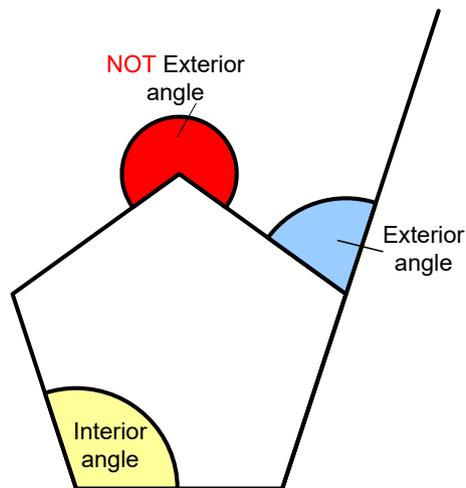


# Interior and Exterior angles

A polygon is a many sided shape. Interior angles are angles on the inside of the shape. Exterior angles are angles on the outside of the shape. You will need to be able to work out both of these for any regular polygon.

A regular polygon is a shape whose sides are all the same length and whose angles are all the same.

Below is a pentagon. The Interior and Exterior angles are shown as is a common mistake for what an exterior angle might be: it isn't.



## Size of the Exterior angles

When added together, the sum of the exterior angles totals  $360^\circ$ .

So in a regular polygon,

$$\theta = \frac{360}{n} \text{ where } \begin{cases} \theta \text{ is the size of one exterior angle} \\ n \text{ is the number of sides} \end{cases}$$

So the exterior angle on the above pentagon:

$$\begin{aligned} \theta &= \frac{360}{n} \\ &= \frac{360}{5} \\ &= 72^\circ \end{aligned}$$

## Size of the Interior angles

When added together, the sum of the interior angles =  $180(n-2)$  where  $n$  is the number of sides.

What is the sum of the angles in an icosagon?

An icosagon is a twenty-sided shape so:

$$\begin{aligned}\theta_{Total} &= 180(n - 2) \\ &= 180(20 - 2) \\ &= 180(18) \\ &= 3240^\circ\end{aligned}$$

So, as there are 20 sides, there are 20 angles so the size of a single interior angle of a regular icosagon is

$$\begin{aligned}\theta_{single\ angle} &= \frac{3240}{20} \\ &= 162^\circ\end{aligned}$$

The size of an external angle is

$$\begin{aligned}\theta_{external} &= \frac{360}{n} \\ &= \frac{360}{20} \\ &= 18^\circ\end{aligned}$$

### Interior Angles and Exterior Angles

If angle  $a$  is the interior angle of a polygon and angle  $b$  is the exterior angle of a polygon,  $a+b = 180^\circ$ .

#### Problems:

1. What is the interior angle of a nonagon?
2. What is the interior angle of a hexagon?
3. What is the exterior angle of a nonagon?
4. What is the exterior angle of a hexagon?
  
5. Shape X is a regular polygon. The size of an interior angle is 11 times the size of an exterior angle. How many sides does polygon X have?
6. Shape Y is a regular polygon. The size of the interior angle is 8 times the size of the exterior angle. How many sides does polygon Y have?
7. The ratio of interior angle to exterior angle of a regular polygon is 14:1. What type of polygon is the shape?
8. The ratio of exterior angle to interior angle of a regular polygon is 1:7. What type of polygon is the shape?