وزارة التعليم العالي والبحث العلمي

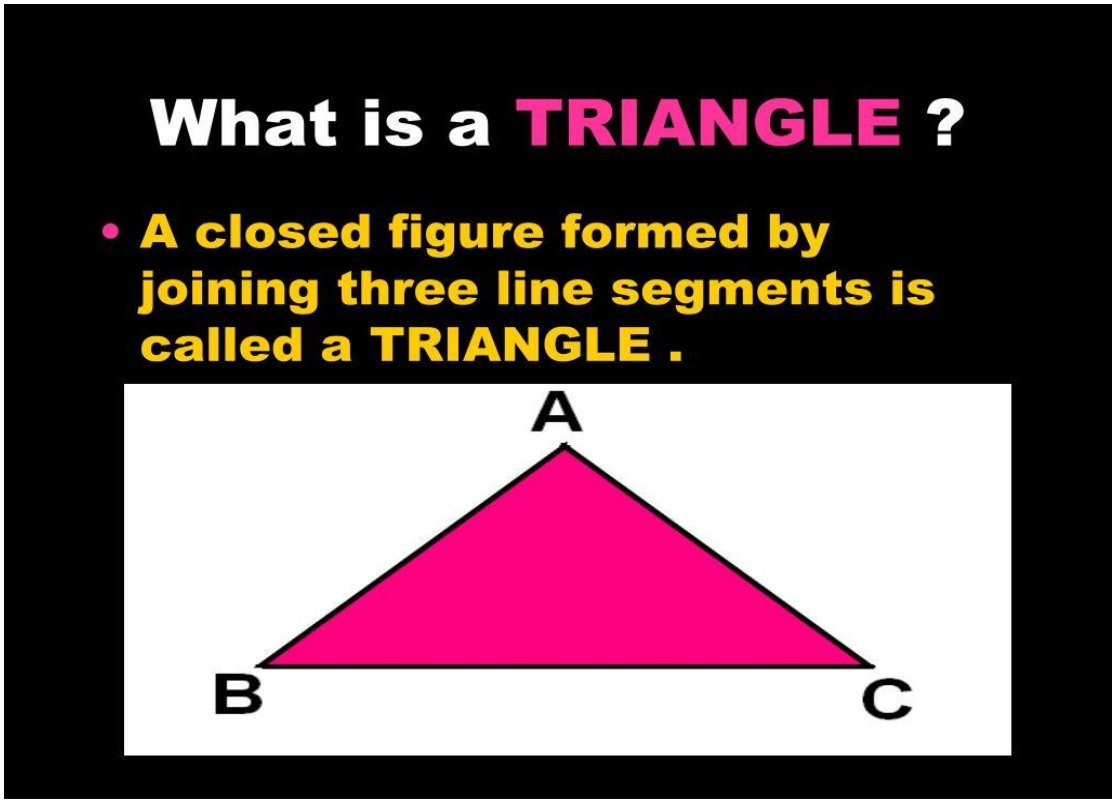
المعهد التقني / السماوة

قسم المساحة

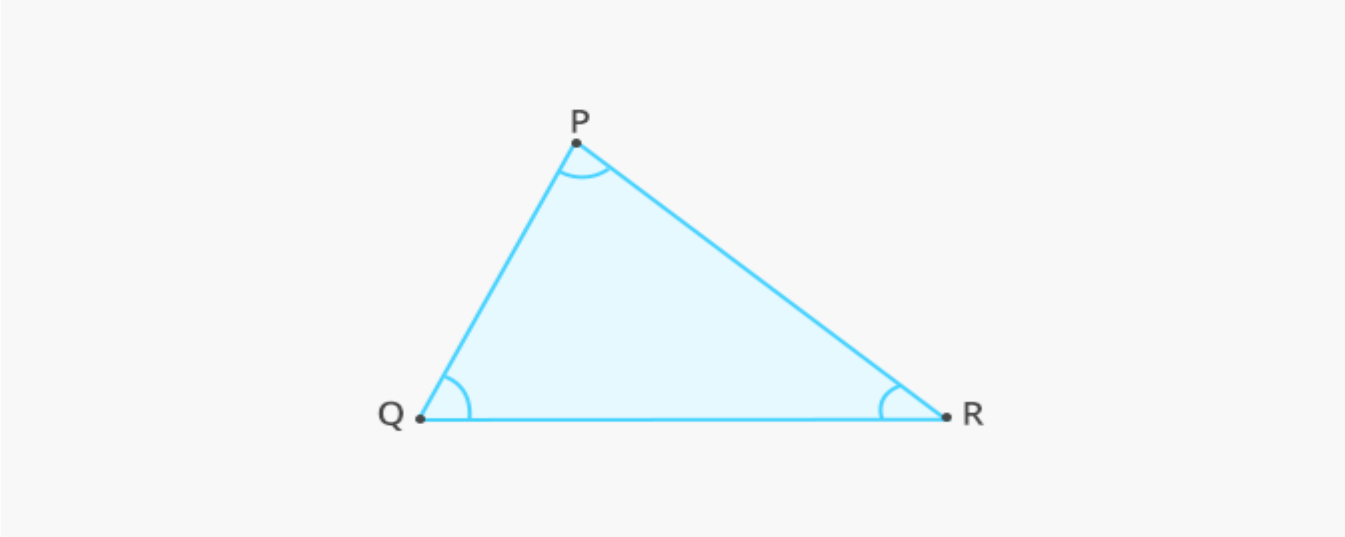
اسم المادة : Mathematics and Spherical Triangles

اسم المدرسة : م .م لقاء طارق هادي

Triangles



Properties of a Triangle

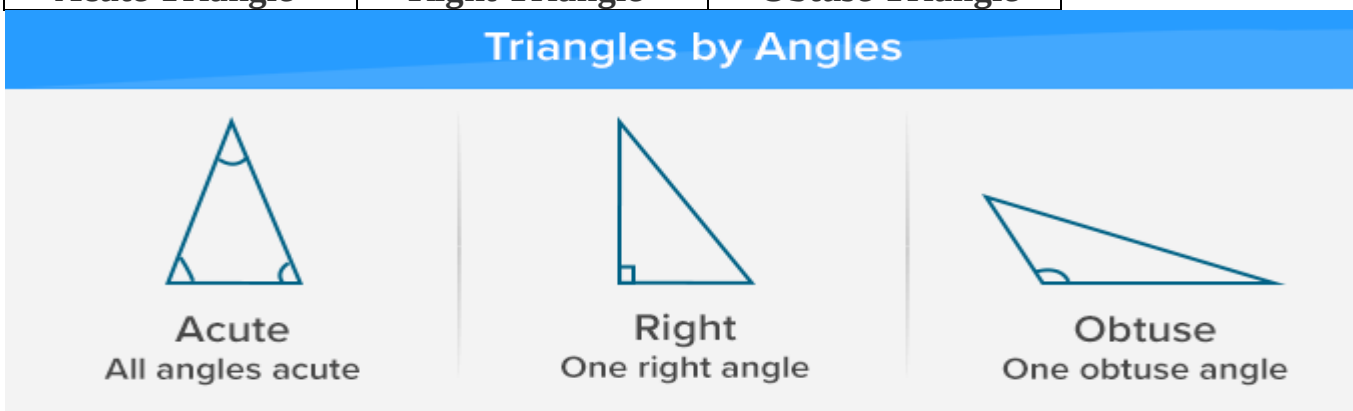


- A triangle has three sides, three vertices, and three angles.
- The sum of the three interior angles of a triangle is always 180°.
- The sum of the length of two sides of a triangle is always greater than the length of the third side.
- A triangle with vertices P, Q, and R is denoted as △PQR.

Different Types of Triangles

To classify triangles according to their angles, we measure each of its interior angles. Triangles can be classified by angles, as:

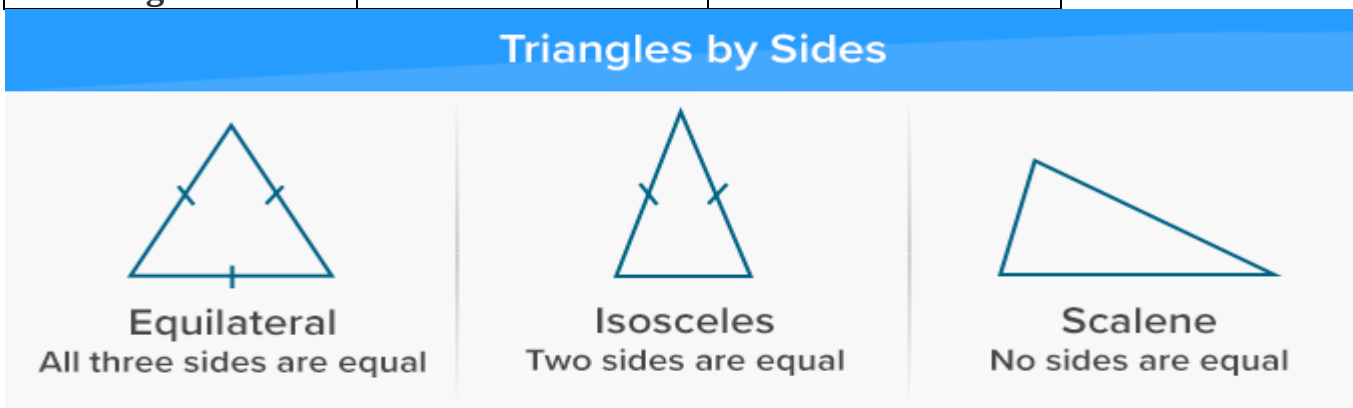
• **Acute Triangle**	• **Right Triangle**	• **Obtuse Triangle**



An acute triangle has all interior angles acute (less than 90°), a right triangle has one right angle (equal to 90°) and an obtuse triangle has one obtuse angle (greater than 90°).

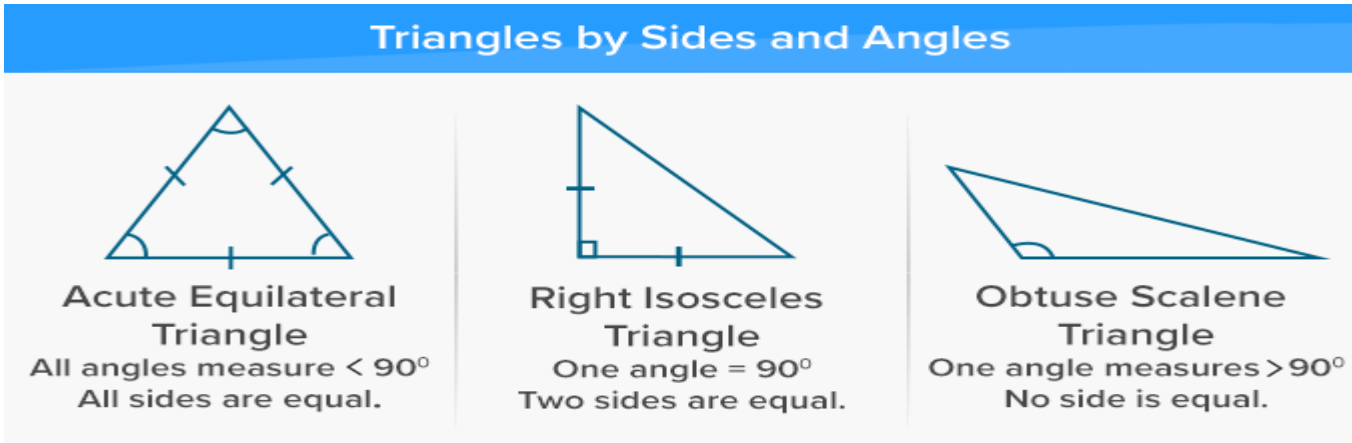
To classify the triangles according to their sides, we measure the length of each of its sides. Triangles can be classified by their sides, as:

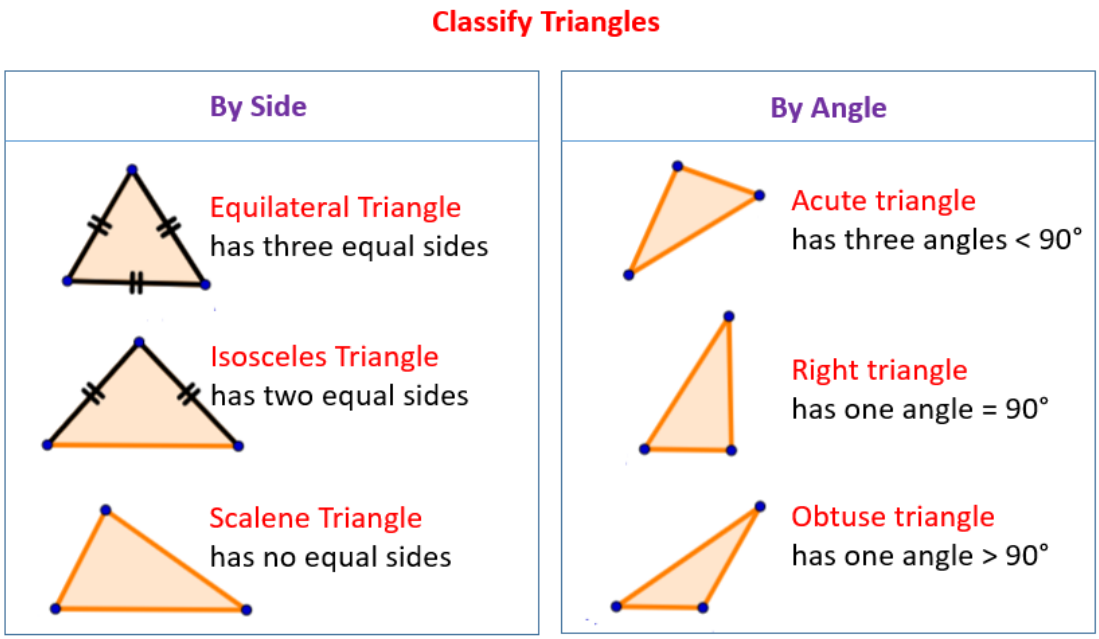
• **Equilateral Triangle**	• **Isosceles Triangle**	• **Scalene Triangle**



To classify triangles according to both angles and sides, we measure the interior angles and length of the sides of the triangle. Few examples of triangles classified on the basis of both angles and sides are:

• **Acute Equilateral Triangle**	• **Right Isosceles Triangle**	• **Obtuse Scalene Triangle**





Definition

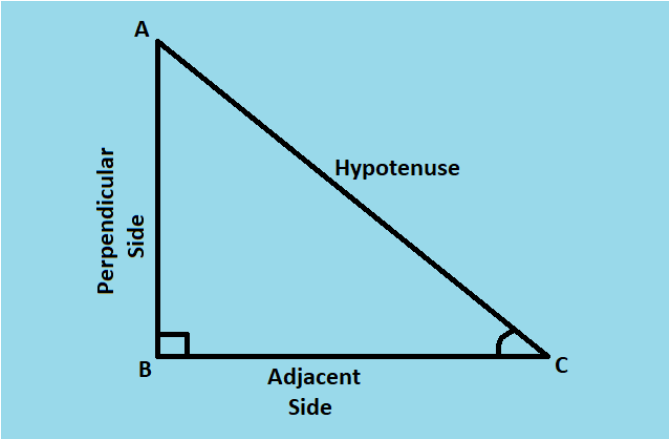
Trigonometric Ratios are defined as the values of all the trigonometric functions based on the value of the ratio of sides in a right-angled triangle. **The ratios of sides of a right-angled triangle with respect to any of its acute angles are known as the trigonometric ratios of that particular angle**.

The three sides of the right triangle are:

- Hypotenuse (the longest side)
- Perpendicular (opposite side to the angle)
- Base (Adjacent side to the angle)

How to Find Trigonometric Ratios?

Consider a right-angled triangle, right-angled at B.



With respect to ∠C, the ratios of trigonometry are given as:

- **sine:** Sine of an angle is defined as the ratio of the side opposite(perpendicular side) to that angle to the hypotenuse.
- **cosine:** Cosine of an angle is defined as the ratio of the side adjacent to that angle to the hypotenuse.
- **tangent:** Tangent of an angle is defined as the ratio of the side opposite to that angle to the side adjacent to that angle.
- **cosecant:** Cosecant is a multiplicative inverse of sine.
- **secant:** Secant is a multiplicative inverse of cosine.
- **cotangent:** Cotangent is the multiplicative inverse of the tangent.

The above ratios are abbreviated as sin, cos, tan, cosec, sec and tan respectively in the order they are described. So, for Δ *ABC*, the ratios are defined as:

sin C = (Side opposite to ∠C)/(Hypotenuse) = AB/AC

cos C = (Side adjacent to ∠C)/(Hypotenuse) = BC/AC

tan C = (Side opposite to ∠C)/(Side adjacent to ∠C) = AB/BC

cosec C= 1/sin ,C = (Hypotenuse)/ (Side Opposite to ∠C) = AC/AB

sec C = 1/cos, C = (Hypotenuse)/ (Side adjacent to ∠C) = AC/BC

cot C = 1/tan ,C = (Side adjacent to ∠C)/(Side opposite to ∠C)= BC/AB

Trigonometric Ratios Table

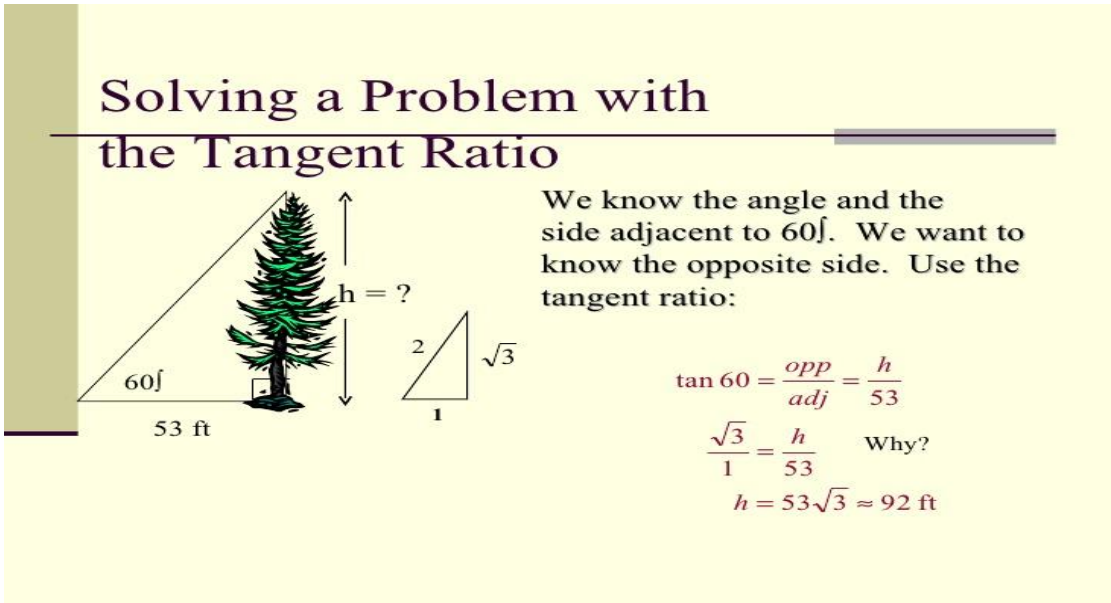
The trigonometric ratios for some specific angles such as 0 °, 30 °, 45 °, 60 ° and 90° are given below, which are commonly used in mathematical calculations.

commonly used in mathematical calculations.

Angle	**0°**	**30°**	**45°**	**60°**	**90°**
Sin C	0	1/2	1/√2	√3/2	1
Cos C	1	√3/2	1/√2	1/2	0
Tan C	0	1/√3	1	√3	∞
Cot C	∞	√3	1	1/√3	0
Sec C	1	2/√3	√2	2	∞
Cosec C	∞	2	√2	2/√3	1

From this table, we can find the value for the trigonometric ratios for these angles. Examples are:

- Sin 30° = ½
- Cos 90° = 0
- Tan 45° = 1



The solution to a right – angled triangle:

(The Pythagorean Theorem)

Pythagoras' theorem uses trigonometry to discover the longest side (hypotenuse) of a right triangle (right angled triangle in British English). It states that for a right triangle:

The square on the hypotenuse equals the sum of the squares on the other two sides.
If the sides of a triangle are a, b and c and c is the hypotenuse, Pythagoras' Theorem states that:

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

$$c = \sqrt{(a^2 + b^2)}$$

The hypotenuse is the longest side of a right triangle, and is located opposite the right angle.

So, if you know the lengths of two sides, all you have to do is square the two lengths, add the result, then take the square root of the sum to get the length of the hypotenuse.

Example : The sides of a triangle are 3 and 4 units long. What is the length of the hypotenuse?

Solution:

Call the sides a, b, and c. Side c is the hypotenuse.

$a = 3$
$b = 4$

c = **Unknown**
So, according to the Pythagorean theorem:

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

So, $c^2 = 3^2 + 4^2 = 9 + 16 = 25$

$$c = \sqrt{25}$$

$$c = 5$$