SURDS

The number whose exact roots cannot be found are called surds. On the others hand, A number which cannot be simplified to remove a square root or cube root etc. is surds. For example,
$\sqrt{2}$ (square root of 2) cannot be simplified, so it is a surd.
$\sqrt{4}$ (square root of 4) can be simplified to 2, so it is a surd.
The surds are the types of irrational number which are under the radical sign like $\sqrt{3}$, $\sqrt{7}$, $\sqrt{17}$ etc. The sign ($\sqrt{\ }$) is radical sign.

Order of surds

WHAT IS A SURD

Let a be a rational number and n be a positive integer such that $a^{\frac{1}{n}} = \sqrt[n]{a}$ is irrational..Then $\sqrt[n]{a}$ is called a surd of order n.

Order of Surds
Consulting the following examples

$\sqrt{2}$ is a surd of order 2.
$\sqrt[3]{7}$ is a surd of order 3.
$\sqrt[4]{13}$ is a surd of order 4.

Pure and Mixed Surds
A surd in which the whole of the rational number is under the radical sign and makes the radicand is called pure surd. For example, each of the surds √7, √10, √x, etc. are pure suds. Similarly, In other words, if some part of the quantity under the radical sign is taken out of it, then it makes the mixed surd. For example, each of the surds 2√7, 3√6, a√b, 2√x, etc are mixed surds.

Simple and Compound Surds
A surd having a single term only is called simple surds. For example, each of the surds √2, 7√3, $\sqrt[3]{7}$, $\sqrt[4]{6}$ etc. are simple surds. Similarly, the algebraic sum of two or more simple surds or the algebraic sum of a rational number and simple surds is called a compound surds. For example, each of the surds (√5 + √7), (√5 - √7), (5√8 - 3√8) etc are compound surds.

Binomial and Trinomial Surds
A algebriac sum of two surds or a sum of two unlike terms are called binomial surds. ($\sqrt{7} + \sqrt{10}$), ($\sqrt{11} - \sqrt{7}$) etc are the examples of binomial surds. The algebraic sum of three surds and a rational quantity or the sum of three unlike terms are called trinomial surds. $\sqrt{5} + \sqrt{7} + \sqrt{13}$ is the example of trinomial surds.

Like and Unlike Surds
The surd having the same radicand same order or that have different multiples of the same surd is called like surds. √5, 7√5, 10√5, etc. are the examples of like surds. Similarly, the surd which does not have the same radicand and same order is unlike surds.√2, 9√3, 8√5, etc are the examples of unlike surds.

Conjugate Surds
Conjugate surds are the binomial surds which differ only in sign connecting their terms. Two surds of a form (-2√5 + √3) and (-2√5 - √3) are conjugate to each other. The sum or difference of two conjugate surds is a rational number (2 + √3) + (2 - √3) = 4 is a rational number.

Addition and Subtraction of Surds

As we know that only the like terms can be added and subtracted. Therefore, the like surds can be added or subtracted. Unlike terms neither be added nor be subtracted, For examples
2√3 + 5√3 = 7√3
7√2 - 2√2 = 5√2

Multiplication and Division of Surds

Multiplication or division of surds can be done when the surds are of the same order. While multiplying surds are multiplied with surds and rational number with the rational number.For examples,
$\sqrt{5} \times \sqrt{5} = 5$
$\sqrt{55} \div \sqrt{5} = \sqrt{11}$

Transformation of surds from one order to another

A surd of any order may be transformtion into a surd of differents order. The process is as follow:
Transform $\sqrt[3]{2}$ to a surd of order 12.
Step I : Change $\sqrt[3]{2}$ to $2^{\frac{1}{3}}$
Step II : Multiply denominator and numerator of $\frac{1}{3}$ by 4 to make denominators 12 and obtain $2^{\frac{4}{12}}$
Step III : Change $2^{\frac{4}{12}}$ to $\sqrt[12]{2^4}$ or $\sqrt[12]{16}$ Hence, $\sqrt[3]{2} = \sqrt[12]{16}$

Rationalization of Surds

$$\frac{3}{5\sqrt{7}} = \frac{3 \times \sqrt{7}}{5\sqrt{7} \times \sqrt{7}} = \frac{3\sqrt{7}}{5 \times 7} = \frac{3\sqrt{7}}{35}$$

Rationalization of Surds
The process of reducing the given surds to a rational form after multiplying it by a suitable surd is known as the rationalization of surds.