Pakistan School
Kingdom of Bahrain

# Welcome Class 10th (arts)

## Algebraic Formulas and Applications

# Objectives

Students will be able to:

Simplify and rationalize the surds

# 1.3 SURDS AND THEIR APPLICATIONS

## 1.3.1 Surds

**Rational Numbers:**

A number which can be expressed in the form $\left(\frac{p}{q}\right)$, where '$p$' and '$q$' are integers and $q \neq 0$ is called a rational number.

e.g. $\frac{3}{4}, \frac{2}{1}, \frac{8}{7}, \frac{-2}{5}$ are all rational numbers.

**Irrational Numbers:**

A real number which is not a rational number, is called an irrational number. For example:

$\sqrt{2}, \sqrt{3}, \sqrt{5}, \sqrt{7}$ etc. are irrational numbers.

Clearly, an irrational number cannot be expressed in the form $\left(\frac{p}{q}\right)$, where $p$ and $q$ are integers and $q \neq 0$.

## Real Numbers:

The set $\mathbb{R}$ of all real numbers is the union of two disjoint subsets, namely the set $Q$ of all rational numbers and the set $Q'$ of all irrational numbers.

## Surds of Radicals:

A surd is an irrational number that contains a radical signs.

e.g. $\sqrt{2},\ 2\sqrt{3},\ 4+3\sqrt{5},\ 10-4\sqrt{6},\ \frac{\sqrt{2}}{5},\ \frac{9}{\sqrt{7}}$ are all surds.

**Pure Surds:**

A surd which has unity only as rational factor, the other factor being irrational, is called a pure surd.

*Example*: $\sqrt{2}$, $\sqrt{11}$, $\sqrt[4]{3}$, are pure surds.

**Mixed Surds:**

A surd which has rational factor other than unity, the other factor being irrational, is called a mixed surd.

*Example*: $2\sqrt{3}$, $5\sqrt{7}$, are mixed surds.

**1. Remove the radical sign from the denominator:**

**(i)** $\dfrac{1}{\sqrt{5}}$

**Solution:**

$$\frac{1}{\sqrt{5}} = \frac{1}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$$

$$= \frac{\sqrt{5}}{\sqrt{5}\sqrt{5}} = \frac{\sqrt{5}}{\sqrt{5} \times \sqrt{5}}$$

$$= \frac{\sqrt{5}}{\sqrt{5}^2} = \frac{\sqrt{5}}{5}$$

**(ii)** $\dfrac{2}{\sqrt{2}} \cdot \dfrac{7}{\sqrt{3}}$

**Solution:**

$$\frac{2}{\sqrt{2}} \cdot \frac{7}{\sqrt{3}} = \frac{2 \times 7}{\sqrt{2} \times \sqrt{3}}$$

$$= \frac{14}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$$

$$= \frac{14\sqrt{6}}{\sqrt{6}.\sqrt{6}} = \frac{14\sqrt{6}}{\sqrt{6} \times \sqrt{6}}$$

$$= \frac{14\sqrt{6}}{\left(\sqrt{6}\right)^2} = \frac{14\sqrt{6}}{6}$$

$$= \frac{7\sqrt{6}}{3}$$

## 2. Simplify these expressions:

(i) $\sqrt{2}+\sqrt{8}$

**Solution:**

$\sqrt{2}+\sqrt{8}$

$=\sqrt{2}+\sqrt{2\times4}$

$=\sqrt{2}+\sqrt{4}.\sqrt{2}$

$=\sqrt{2}+2\sqrt{2}$

$=\sqrt{2}(1+2)=3\sqrt{2}$

**(ii)** $4\sqrt{50}+\sqrt{200}+\sqrt{50}$

**Solution:**

$$4\sqrt{50}+\sqrt{200}+\sqrt{50}$$

$$=4\sqrt{25\times 2}+\sqrt{100\times 2}+\sqrt{25\times 2}$$

$$=4\sqrt{25}\sqrt{2}+\sqrt{100}.\sqrt{2}+\sqrt{25}.\sqrt{2}$$

$$=4.5\sqrt{2}+10\sqrt{2}+5\sqrt{2}$$

$$=20\sqrt{2}+10\sqrt{2}+5\sqrt{2}$$

$$=\sqrt{2}(20+10+5)$$

$$=35\sqrt{2}$$

**(iv)** $\left(6+\sqrt{2}\right)\left(5-\sqrt{5}\right)$

**Solution:** $\left(6+\sqrt{2}\right)\left(5-\sqrt{5}\right)$

$$=30-6\sqrt{5}+5\sqrt{2}-\sqrt{2}\sqrt{5}$$

$$=30-6\sqrt{5}+5\sqrt{2}-\sqrt{2\times 5}$$

$$=30-6\sqrt{5}+5\sqrt{2}-\sqrt{10}$$

# Activity

Remove the radical sign from denominator

$$\frac{\sqrt{6}}{\sqrt{7}}$$

# Solution

(iii) $\dfrac{\sqrt{6}}{\sqrt{7}}$

**Solution:**

$$\frac{\sqrt{6}}{\sqrt{7}} = \frac{\sqrt{6}}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}}$$

$$= \frac{\sqrt{6} \times \sqrt{7}}{\sqrt{7} \times \sqrt{7}} = \frac{\sqrt{6 \times 7}}{\sqrt{7 \times 7}} = \frac{\sqrt{42}}{\sqrt{7^2}} = \frac{\sqrt{42}}{7}$$

# Homework

Ex 1.3 remaining parts