Operation On Real Numbers

We already learnt that the **collection of rational numbers** and **irrational numbers** together is known as **Real Numbers**. This collection is denoted by **R**.
The sum, difference and the **product of two rational numbers** is always a **rational number.** The quotient of a division of one **rational number** by a **non-zero rational number** is a **rational number. Rational numbers** satisfy the **closure property under addition**, **subtraction**, **multiplication** and **division**.
The sum, difference, multiplication and division of **irrational numbers** are not always **irrational**. **Irrational numbers** do not satisfy the **closure property under addition, subtraction, multiplication and division.**
Real numbers satisfy the **commutative**, **associative** and **distributive laws**. These can be stated as:

- **Commutative Law of Addition:** $a + b = b + a$
- **Commutative Law of Multiplication:** $a \times b = b \times a$
- **Associative Law of Addition:** $a + (b + c) = (a + b) + c$
- **Associative Law of Multiplication:** $a \times (b \times c) = (a \times b) \times c$
- **Distributive Law:** $a \times (b + c) = a \times b + a \times c$ **or** $(a + b) \times c = a \times c + b \times c$

We can represent **real numbers** on the **number line**. The **square root** of any **positive real number** exists and that also can be represented on **number line**

The **sum or difference of a rational number** and **an irrational number** is an irrational number.
The **product or division of a rational number** with an irrational number is an irrational number.
Some of the basic identities involving **square roots** are:

- $\sqrt{ab} = \sqrt{a}\sqrt{b}$
- $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$
- $(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = a - b$
- $(a + \sqrt{b})(a - \sqrt{b}) = a^2 - b$
- $(\sqrt{a} + \sqrt{b})(\sqrt{c} + \sqrt{d}) = \sqrt{ac} + \sqrt{ad} + \sqrt{bc} + \sqrt{bd}$
- $(\sqrt{a} + \sqrt{b})^2 = a + 2\sqrt{ab} + b$

a, b, c and d are positive real numbers.
The **process of converting the denominator** into a **rational number** is called **rationalising** the denominator.