

MATIMATICS Grade 8

unit SUMMARY 1

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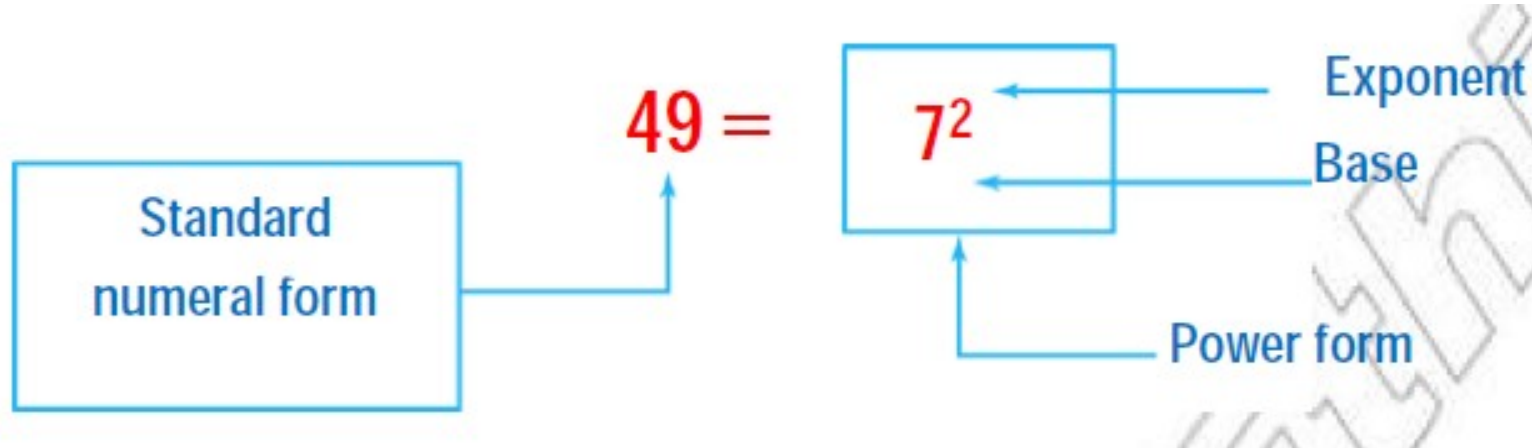
Square, Square Root, Cube and Cube Root (summary)

The Square of a Number

- Addition and subtraction are operations of the first kind while multiplication and division are operation of the second kind. Operations of the third kind are raising to a power and extracting roots.

Square of a Rational Number

- **Definition** : The process of multiplying a rational number by itself is called **squaring** the number.



Perfect square of a Rational No.

Definition : A rational number x is called a perfect square, if and only if $x = n^2$ for some $n \in \mathbb{Q}$.

Note:

- i. The squares of natural numbers are also natural numbers.
- ii. $0 \times 0 = 0$ therefore $0^2 = 0$
- iii. We give No Meaning to the symbol 0^0
- iv. If $a \in \mathbb{Q}$ and $a \neq 0$, then $a^0 = 1$
- v. For any rational number 'a', $a \times a$ is denoted by a^2 and read as “a squared” or “a to the power of 2” or “the square of a”.

Theorem 1.1 Existence theorem

❖ For each rational number x , there is a rational number y ($y \geq 0$) such that $x^2 = y$.

Example

a) $x = 9$, then $y = 9^2 = 9 \times 9 = 81$

b) $x = -17$, then $y = (-17)^2 = -17 \times -17 = 289$

The Square Root of a Rational Number

Definition 1.3: Square roots

❖ For any two rational numbers a and b if $a^2 = b$, then a is called the **square root of b** .

Note:

- i. The notion “**square root**” is the inverse of the notion “**square of a number**”.
- ii. The operation “**extracting square root**” is the inverse of the operation “**squaring**”.
- iii. In extracting square roots of rational numbers, first decompose the number into a product consisting of two equal factors and take one of the equal factors as the square root of the given number.
- iv. The symbol or notation for square root is “ $\sqrt{\quad}$ ” it is called **radical sign**.
- v. For $b \geq 0$, the expression $\sqrt{b}$ is called **radical b** and the number b is called a **radicand**.
- vi. a is the square root of b and written as $a = \sqrt{b}$.

$$\sqrt{b}$$

Square Roots of Perfect Squares

The following properties of squares are important:
for any rational numbers a & b

i. $(a \times b)^2 = a^2 \times b^2$

ii. $\left(\frac{a}{b}\right)^2 = \frac{a^2}{b^2}$, where $b \neq 0$

iii. $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$

iv. $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$, where $b \neq 0$

Example 1

Evaluate the following:

$$\begin{aligned} \text{A, } (0.6)^2 &= \frac{6^2}{10^2} = \frac{36}{100} = 0.36 \\ 0.6 &= \frac{6}{10} \end{aligned}$$

$$\begin{aligned} \text{B, } \sqrt{\frac{64}{9}} &= \frac{\sqrt{64}}{\sqrt{9}} = \frac{\sqrt{8 \times 8}}{\sqrt{3 \times 3}} = \frac{8}{3} \\ \sqrt{\frac{25}{4}} &= \frac{\sqrt{25}}{\sqrt{4}} = \frac{\sqrt{5 \times 5}}{\sqrt{2 \times 2}} = \frac{5}{2} \end{aligned}$$

$$\text{C, } 8 \times 5 = 8(5) = 8(4 + 1) = 8(4) + 8(1) = 4 \times 5 = 20$$

Example 2

If $\sqrt{10.5625} = 3.25$, then the exact value of $\sqrt{1056.25}$ is: _____

Solution

$$\begin{aligned}\sqrt{1056.25} &= \sqrt{10.5625 \times 100} \\ &= \sqrt{10.5625} \times \sqrt{100} \\ &= \sqrt{1056.25} \times \sqrt{10 \times 10} \\ &= 3.25 \times 10 \\ &= 32.5\end{aligned}$$

Example 3

Simplify the expression

$$\frac{\sqrt{12x^3}}{\sqrt{3x}} \quad (\text{where } x \neq 0).$$

Solution

$$\begin{aligned}\frac{\sqrt{12X^3}}{\sqrt{3X}} &= \sqrt{\frac{12X^3}{3X}} = \sqrt{4X^2} \\ &= \sqrt{4} \times \sqrt{X^2} \\ &= 2X\end{aligned}$$

Cubes and Cube Roots

Definition : A cube number is the result of multiplying a rational number by itself, then multiplying by the number again.

➤ If the number to be cubed is 'a', then the product $a \times a \times a$ read as '**a**' **cubed**.

Theorem 1.2 Existence theorem

For each rational number x , there is a rational number y such that $Y = X^3$.

Cube Root of a Number

Definition: The cube root of a given number is one of the three identical factors whose product is the

given number. **Note:** i) $4^3 = 64$, 64 is the cube of 4 and 4 is the cube root of 64
i.e. $\sqrt[3]{64} = 4$.

ii) $\sqrt{\quad}$ is a radical sign.

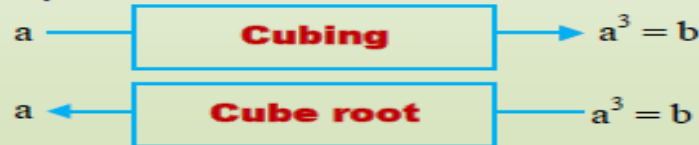
Or symbolically: $\sqrt[n]{x}$

Index $\downarrow$

$\leftarrow$ Radicand

$\uparrow$ Radical sign

iii) The relation of cubing and extracting cube root can be expressed as follows:



iv) a is the cube root of b and written as $a = \sqrt[3]{b}$.

Cube Roots of Perfect Cubes

Definition : A rational number x is called a perfect cube if and only if $x = n^3$ for some $n \in \mathbb{Q}$.

The following properties of squares are important:
for any rational numbers a & b

- i. $(a \times b)^3 = a^3 \times b^3$
- ii. $\left(\frac{a}{b}\right)^3 = \frac{a^3}{b^3}$, where $b \neq 0$
- iii. $\sqrt[3]{a \times b} = \sqrt[3]{a} \times \sqrt[3]{b}$
- iv. $\sqrt[3]{\frac{a}{b}} = \frac{\sqrt[3]{a}}{\sqrt[3]{b}}$, where $b \neq 0$

Example 1

Evaluate the following :

A, $5^3 = 5 \times 5 \times 5 = 125$

$$\left(\frac{4}{10}\right)^3 = \frac{4^3}{10^3} = \frac{4 \times 4 \times 4}{10 \times 10 \times 10} = \frac{64}{1000} = 0.064$$

B, $(0.4)^3 =$

$$\frac{\sqrt[3]{32}}{\sqrt[3]{-4}} = \sqrt[3]{\frac{32}{-4}} = \sqrt[3]{-8} = \sqrt[3]{-2 \times -2 \times -2} = -2$$

C, $\quad =$

Example 2

The simplified form of the expression $\sqrt[3]{2x^2} \cdot x \sqrt[3]{4x}$ is: _____

Solution

$$\begin{aligned}\sqrt[3]{2X^2} \times \sqrt[3]{4X} &= \sqrt[3]{2X^2(4X)} \\ &= \sqrt[3]{8X^3} \\ &= \sqrt[3]{8} \times \sqrt[3]{X^3} \\ &= 2X\end{aligned}$$

*Thank
you*

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Exercise

1. If the volume of a cube is 343 cubic cm, what is the length of a side of the cube?
2. The simplified form of the expression $2\sqrt{18} - 4\sqrt{72} + 4\sqrt{50}$
3. If $\sqrt[3]{x} = 7$ and $\sqrt{y} = 3$ then the value of $\frac{\sqrt[3]{27x}}{\sqrt{49y}}$ is
4. Find the value of y, if $\sqrt[3]{y+3} = 2$
5. If $x=2.1$ then what is the value of X^2 ?