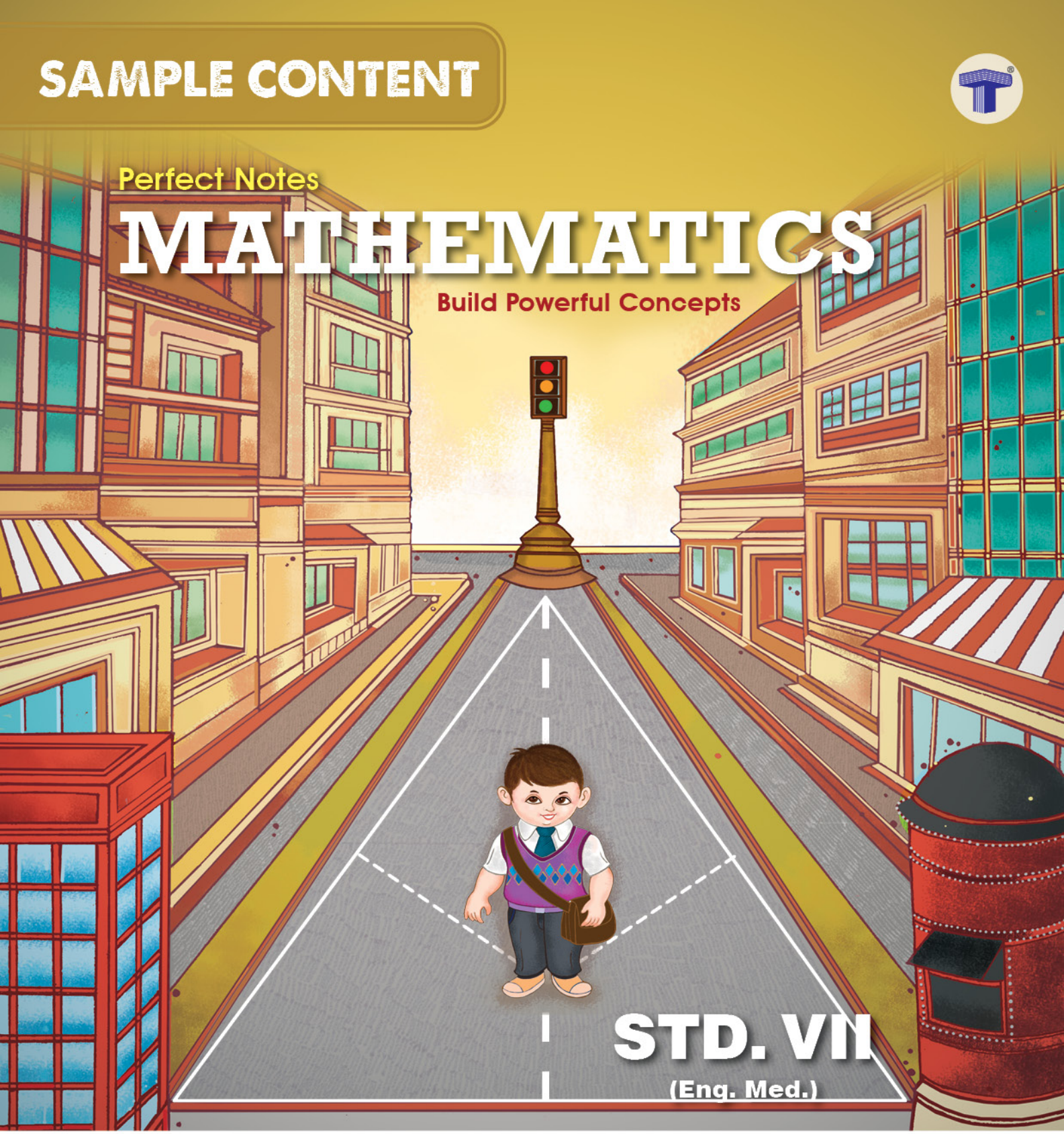
SAMPLE CONTENT

Perfect Notes

MATHEMATICS

Build Powerful Concepts



STD. VII

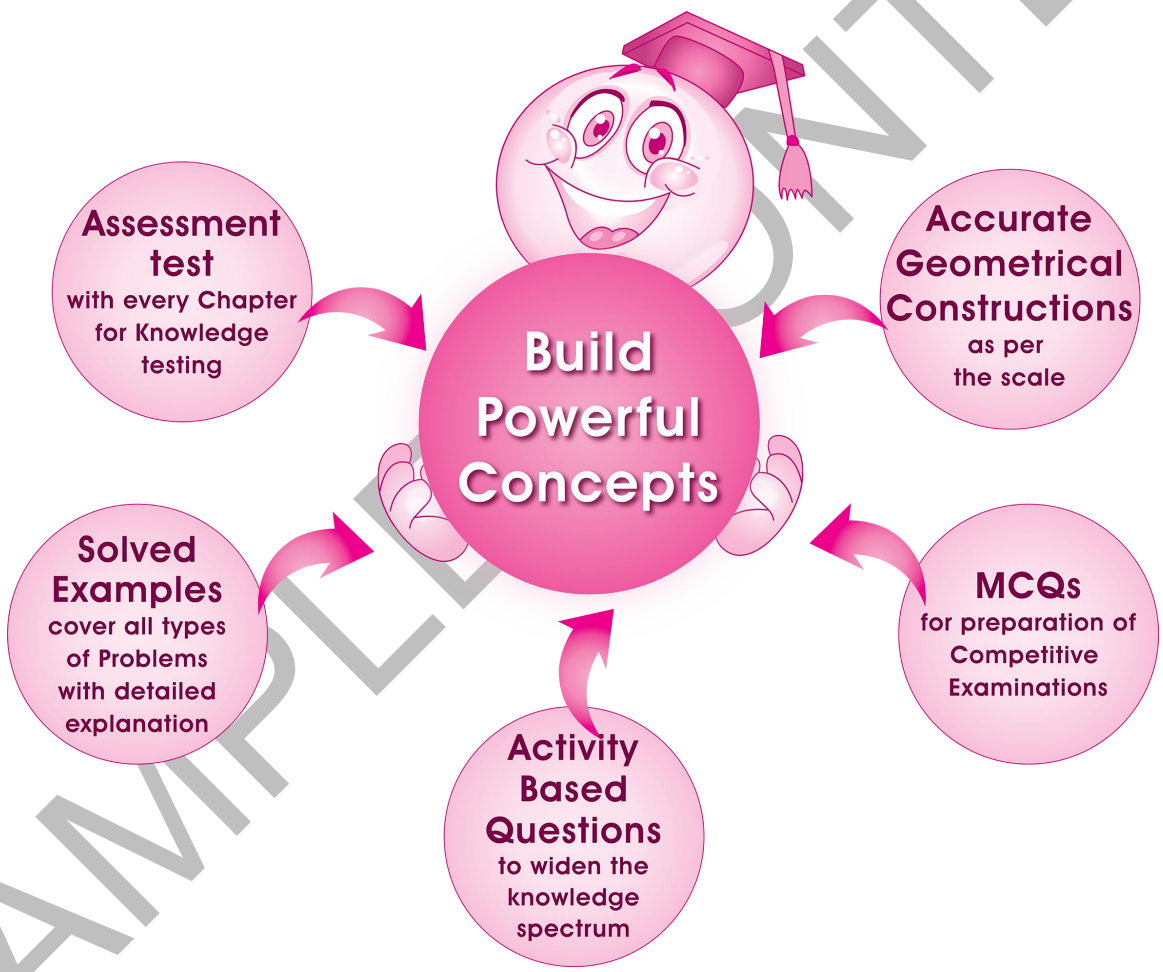
(Eng. Med.)

Target Publications® Pvt. Ltd.

Written as per the latest syllabus prescribed by the Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune.

STD. VII

Mathematics



Printed at: **Quarterfold Printabilities,** Navi Mumbai

Balbharati Registration No.: 2018MH0022 **TEID: 13795** P.O. No. 201723

PREFACE

Mathematics: Std. VII has been prepared as per the new 'Continuous Comprehensive Evaluation' (CCE) system which is more child-centric and focuses on active learning and making the process of education more enjoyable and interesting.
Preparing this Mathematics book was a rollercoaster ride. We had a plethora of ideas, suggestions and decisions to ponder over. However our basic premise was to keep this book in line with the new, improved syllabus and provide students with an absolutely fresh material.

To begin with, let us look at this book as a **'powerful concept building tool'**. We want this book to act as a facilitator for students to deeply understand mathematical concepts presented in the class VII book by the Maharashtra State Education Board. The understanding of these concepts would eventually help students, link textual problems with their daily life and comprehend its application for future use.

Every chapter covers a multitude of solved examples related to the topic. These examples are textual as well external practice problems, so as to reinforce the topic's understanding within the reader.

The part of **Formative Assessment** covers Activity Based Questions from the text book. We've partially solved these questions and added additional ones for practice sake.

Every chapter ends with an **Assessment Test.** This test stands as a testimony to the fact that the child has understood the chapter thoroughly. The **Multiple Choice Questions** included in this test facilitate students to prepare for competitive examinations.

All the diagrams are neat and have proper labelling. The book has a unique feature that all the constructions are as per the scale.

With absolute trust in our work, we hope, our holistic efforts towards making this book are paid off if students understand mathematics conceptually rather than just focusing on the problem solving part. This text would definitely act as a reference point for the same.

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.
Please write to us on : mail@targetpublications.org

A book affects eternity; one can never tell where its influence stops.

Best of luck to all the aspirants!

From,
Publisher

Edition: Second

Contents

6. Indices

Summative Assessment

Let's Study

Base and Index

1. If any number 'a' is multiplied m times, then the multiplication (a × a × a × a …. m times) can be written as a^m, where a is the base and m is the index.

2. a^m is read as 'a raised to the power m' or 'the m^{th} power of a'.

Examples:

i. $3^5 = 3 \times 3 \times 3 \times 3 \times 3 = 243$

ii. $\left(\frac{-3}{2}\right)^4 = \left(\frac{-3}{2}\right) \times \left(\frac{-3}{2}\right) \times \left(\frac{-3}{2}\right) \times \left(\frac{-3}{2}\right) = \frac{81}{16}$

3. The first power of any number is the number itself.

Examples: i. $5^1 = 5$ ii. $(-7)^1 = -7$

Note: *If the power or index of a number is 1, the convention is not to write it.*

Let's Practise : Practice Set 26

1. Complete the table below:

Sr. No.	Indices (Numbers in index form)	Base	Index	Multiplication form	Value
i.	3^4	3	4	$3 \times 3 \times 3 \times 3$	81
ii.	16^3				
iii.		(–8)	2		
iv.				$\frac{3}{7} \times \frac{3}{7} \times \frac{3}{7} \times \frac{3}{7}$	$\frac{81}{2401}$
v.	$(-13)^4$				

Solution:

Sr. No.	Indices (Numbers in index form)	Base	Index	Multiplication form	Value
i.	3^4	3	4	$3 \times 3 \times 3 \times 3$	81
ii.	16^3	**16**	**3**	**16 × 16 × 16**	**4096**
iii.	$\mathbf{(-8)^2}$	(–8)	2	**(–8) × (–8)**	**64**
iv.	$\left(\frac{3}{7}\right)^4$	$\frac{3}{7}$	**4**	$\frac{3}{7} \times \frac{3}{7} \times \frac{3}{7} \times \frac{3}{7}$	$\frac{81}{2401}$
v.	$(-13)^4$	**(–13)**	**4**	**(–13) × (–13) × (–13) × (–13)**	**28561**

2. Find the value of.

i. 2^{10} ii. 5^3 iii. $(-7)^4$ iv. $(-6)^3$

v. 9^3 vi. 8^1 vii. $\left(\frac{4}{5}\right)^3$ viii. $\left(-\frac{1}{2}\right)^4$

Solution:

i. $2^{10} = 2\times2\times2\times2\times2\times2\times2\times2\times2\times2$ **$= 1024$**	ii. $5^3 = 5\times5\times5$ **$= 125$**
iii. $(-7)^4 = (-7)\times(-7)\times(-7)\times(-7)$ **$= 2401$**	iv. $(-6)^3 = (-6)\times(-6)\times(-6)$ **$= -216$**
v. $9^3 = 9\times9\times9$ **$= 729$**	vi. $8^1 =$ **8**
vii. $\left(\frac{4}{5}\right)^3 = \frac{4}{5}\times\frac{4}{5}\times\frac{4}{5} =$ **$\frac{64}{125}$**	viii. $\left(-\frac{1}{2}\right)^4 = \left(-\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)\times\left(-\frac{1}{2}\right) =$ **$\frac{1}{16}$**

Let's Study

Square and Cube

1. Square: The second power of any number is the square of that number.

Example: $5^2 = 5\times5 = 25$

5^2 is read as '5 raised to 2', or '5 squared' or 'the square of 5'.

2. Cube: The third power of any number is the cube of that number.

Example: $4^3 = 4\times4\times4 = 64$

4^3 is read as '4 raised to 3', or '4 cubed' or 'the cube of 4'.

Multiplication of Indices with the Same Base

If a is a rational number and m and n are positive integers, then $a^m \times a^n = a^{m+n}$

Examples:

i. $3^2\times3^5 = 3\times3\times3\times3\times3\times3\times3 = 3^7$ ii. $\left(\frac{-3}{4}\right)^3\times\left(\frac{-3}{4}\right)^2 = \left(\frac{-3}{4}\right)^{3+2} = \left(\frac{\mathbf{-3}}{\mathbf{4}}\right)^{\mathbf{5}}$

$\therefore\ 3^2\times3^5 = 3^{2+5} = \mathbf{3^7}$

Let's Practise : Practice Set 27

1. Simplify:

i. $7^4\times7^2$ ii. $(-11)^5\times(-11)^2$ iii. $\left(\frac{6}{7}\right)^3\times\left(\frac{6}{7}\right)^5$ iv. $\left(-\frac{3}{2}\right)^5\times\left(-\frac{3}{2}\right)^3$

v. $a^{16}\times a^7$ vi. $\left(\frac{P}{5}\right)^3\times\left(\frac{P}{5}\right)^7$

Solution:

i. $7^4\times7^2 = 7^{4+2} = \mathbf{7^6}$

ii. $(-11)^5\times(-11)^2 = (-11)^{5+2} = \mathbf{(-11)^7}$

iii. $\left(\frac{6}{7}\right)^3\times\left(\frac{6}{7}\right)^5 = \left(\frac{6}{7}\right)^{3+5} = \left(\frac{\mathbf{6}}{\mathbf{7}}\right)^{\mathbf{8}}$

iv. $\left(-\frac{3}{2}\right)^5\times\left(-\frac{3}{2}\right)^3 = \left(-\frac{3}{2}\right)^{5+3} = \left(-\frac{\mathbf{3}}{\mathbf{2}}\right)^{\mathbf{8}}$

v. $a^{16}\times a^7 = a^{16+7} = \mathbf{a^{23}}$

vi. $\left(\frac{P}{5}\right)^3\times\left(\frac{P}{5}\right)^7 = \left(\frac{P}{5}\right)^{3+7} = \left(\frac{\mathbf{P}}{\mathbf{5}}\right)^{\mathbf{10}}$

Let's Study

Division of Indices with the Same Base

1. If a is a non-zero rational number and m and n are positive integers and m > n, then

$$\frac{a^m}{a^n} = a^{m-n}$$

Example:

i. $\frac{7^5}{7^3} = \frac{7\times7\times7\times7\times7}{7\times7\times7}$

$\therefore \frac{7^5}{7^3} = 7^{5-3} = \mathbf{7^2}$

2. The meaning of a^0

If $a \neq 0$, then $\frac{a^m}{a^m} = 1$

Also, $\frac{a^m}{a^m} = a^{m-m} = a^0$

$\therefore$ $\mathbf{a^0 = 1}$

Examples:

i. $2^0 = \mathbf{1}$

ii. $100^0 = \mathbf{1}$

3. The meaning of a^{-m}

$a^{-m} = a^{-m} \times 1$

$= a^{-m} \times \left(\frac{a^m}{a^m}\right) \ldots \left[\frac{a^m}{a^m}=1\right]$

$= \frac{a^{-m+m}}{a^m} = \frac{a^0}{a^m}$

$\therefore$ $\mathbf{a^{-m} = \frac{1}{a^m}}$ ...$[a^0 = 1]$

Examples:

i. $3^{-2} = \mathbf{\frac{1}{3^2}}$

ii. $\left(\frac{6}{5}\right)^{-4} = \frac{1}{\left(\frac{6}{5}\right)^4} = \left(\frac{5}{6}\right)^4$

Remember This

1. $a^{-m} \times a^m = a^{-m+m} = a^0 = 1$
   Hence, a^{-m} is the multiplicative inverse of a^m.
2. If $a \neq 0$, $b \neq 0$ and m is a positive integer, then $\left(\frac{a}{b}\right)^{-m} = \left(\frac{b}{a}\right)^m$

Even and Odd Powers of –1

1. If m is an even number, then $(-1)^m = 1$.
2. If m is an odd number, then $(-1)^m = -1$.

Let's Practise : Practise Set 28

1. Simplify:

i. $a^6 \div a^4$ ii. $m^5 \div m^8$ iii. $p^3 \div p^{13}$ iv. $x^{10} \div x^{10}$

Solution:

i. $a^6 \div a^4 = a^{6-4} = \mathbf{a^2}$

ii. $m^5 \div m^8 = m^{5-8} = \mathbf{m^{-3}}$

iii. $p^3 \div p^{13} = p^{3-13} = \mathbf{p^{-10}}$

iv. $x^{10} \div x^{10} = x^{10-10} = x^0 = \mathbf{1}$

2. Find the value of:

i. $(-7)^{12} \div (-7)^{12}$ ii. $7^5 \div 7^3$ iii. $\left(\frac{4}{5}\right)^3 \div \left(\frac{4}{5}\right)^2$ iv. $4^7 \div 4^5$

Solution:

i. $(-7)^{12} \div (-7)^{12} = (-7)^{12-12} = (-7)^0 = \mathbf{1}$

ii. $7^5 \div 7^3 = 7^{5-3} = 7^2 = \mathbf{49}$

iii. $\left(\frac{4}{5}\right)^3 \div \left(\frac{4}{5}\right)^2 = \left(\frac{4}{5}\right)^{3-2} = \mathbf{\frac{4}{5}}$

iv. $4^7 \div 4^5 = 4^{7-5} = 4^2 = \mathbf{16}$

Let's Study

The Index of the Product or Quotient of Two Numbers

If a and b are non-zero rational numbers and m is an integer, then

i. $(a \times b)^m = a^m \times b^m$ ii. $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

Examples:

i. $(3 \times 5)^4 = (3 \times 5) \times (3 \times 5) \times (3 \times 5) \times (3 \times 5)$
$= 3 \times 3 \times 3 \times 3 \times 5 \times 5 \times 5 \times 5$
$= 3^4 \times 5^4$
$\therefore$ $(3 \times 5)^4 = 3^4 \times 5^4$

ii. $\left(\frac{2}{3}\right)^3 = \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} = \frac{2 \times 2 \times 2}{3 \times 3 \times 3} = \frac{2^3}{3^3}$
$\therefore$ $\left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3}$

Power of a Number in Index Form

If a is a non-zero rational number and m and n are integers, then $(a^m)^n = a^{m \times n} = a^{mn}$.

Examples:

i. $(4^3)^4 = 4^3 \times 4^3 \times 4^3 \times 4^3$
$= 4^{3+3+3+3}$
$= 4^{12}$
$\therefore$ $(4^3)^4 = 4^{3 \times 4}$
$= 4^{12}$

ii. $(3^{-2})^{-4} = \frac{1}{\left(3^{-2}\right)^4}$
$= \frac{1}{3^{-2} \times 3^{-2} \times 3^{-2} \times 3^{-2}} = \frac{1}{3^{-8}} = 3^8$
$\therefore$ $(3^{-2})^{-4} = 3^{-2 \times -4} = 3^8$

Remember This

1. Laws of Indices:

If a and b are a non-zero numbers and m and n are integers, then

i. $a^m \times a^n = a^{m+n}$ ii. $a^m \div a^n = a^{m-n}$ iii. $a^1 = a$

iv. $a^0 = 1$ v. $a^{-m} = \frac{1}{a^m}$ vi. $(ab)^m = a^m \times b^m$

vii. $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$ viii. $(a^m)^n = a^{mn}$ ix. $\left(\frac{a}{b}\right)^{-m} = \left(\frac{b}{a}\right)^m$

Let's Practise : Practice Set 29

1. Simplify:

i. $\left[\left(\frac{15}{12}\right)^3\right]^4$ ii. $(3^4)^{-2}$ iii. $\left[\left(\frac{1}{7}\right)^{-3}\right]^4$ iv. $\left[\left(\frac{2}{5}\right)^{-2}\right]^{-3}$ v. $(6^5)^4$

vi. $\left[\left(\frac{6}{7}\right)^5\right]^2$ vii. $\left[\left(\frac{2}{3}\right)^{-4}\right]^5$ viii. $\left[\left(\frac{5}{8}\right)^3\right]^{-2}$ ix. $\left[\left(\frac{3}{4}\right)^6\right]^1$ x. $\left[\left(\frac{2}{5}\right)^{-3}\right]^2$

Solution:

i. $\left[\left(\frac{15}{12}\right)^3\right]^4 = \left(\frac{15}{12}\right)^{3 \times 4} = \left(\frac{\mathbf{15}}{\mathbf{12}}\right)^{\mathbf{12}}$

ii. $(3^4)^{-2} = 3^{4 \times (-2)} = \mathbf{3^{-8}}$

iii. $\left[\left(\frac{1}{7}\right)^{-3}\right]^4 = \left(\frac{1}{7}\right)^{(-3) \times 4} = \left(\frac{\mathbf{1}}{\mathbf{7}}\right)^{\mathbf{-12}}$

iv. $\left[\left(\frac{2}{5}\right)^{-2}\right]^{-3} = \left(\frac{2}{5}\right)^{(-2) \times (-3)} = \left(\frac{\mathbf{2}}{\mathbf{5}}\right)^{\mathbf{6}}$

v. $(6^5)^4 = 6^{5\times4} = \mathbf{6^{20}}$

vi. $\left[\left(\frac{6}{7}\right)^5\right]^2 = \left(\frac{6}{7}\right)^{5\times2} = \left(\frac{\mathbf{6}}{\mathbf{7}}\right)^{\mathbf{10}}$

vii. $\left[\left(\frac{2}{3}\right)^{-4}\right]^5 = \left(\frac{2}{3}\right)^{(-4)\times5} = \left(\frac{\mathbf{2}}{\mathbf{3}}\right)^{\mathbf{-20}}$

viii. $\left[\left(\frac{5}{8}\right)^3\right]^{-2} = \left(\frac{5}{8}\right)^{3\times(-2)} = \left(\frac{\mathbf{5}}{\mathbf{8}}\right)^{\mathbf{-6}}$

ix. $\left[\left(\frac{3}{4}\right)^6\right]^1 = \left(\frac{3}{4}\right)^{6\times1} = \left(\frac{\mathbf{3}}{\mathbf{4}}\right)^{\mathbf{6}}$

x. $\left[\left(\frac{2}{5}\right)^{-3}\right]^2 = \left(\frac{2}{5}\right)^{(-3)\times2} = \left(\frac{\mathbf{2}}{\mathbf{5}}\right)^{\mathbf{-6}}$

2. Write the following numbers using positive indices:

i. $\left(\frac{2}{7}\right)^{-2}$ ii. $\left(\frac{11}{3}\right)^{-5}$ iii. $\left(\frac{1}{6}\right)^{-3}$ iv. $(y)^{-4}$

Ans: i. $\left(\frac{7}{2}\right)^{2}$ ii. $\left(\frac{3}{11}\right)^{5}$ iii. 6^3 iv. $\frac{1}{y^4}$

Something more

When writing a very large or a very small number, it is expressed as the product of a decimal fraction with a one-digit integer and the power of 10. This is known as the standard form of a number.

Examples:

i. The distance between Earth and Sun (approximately) is 1,49,00,00,00,000 metres.
1,49,00,00,00,000 m = 149×10^9 m
= 1.49×10^{11} m (Standard Form)

ii. The atomic diameter of Nitrogen (approximately) is 0.000000000184 m = 1.84×10^{-10} m.

Try This:

1. Try to write the following numbers in the standard form. (Textbook pg. no. 48)

i. The diameter of Sun is 1400000000 m. ii. The velocity of light is 300000000 m/sec.

Ans: i. 1400000000 m = **1.4×10^9 m** ii. 300000000 m/s = **3.0×10^8 m/sec.**

2. The box alongside shows the number called Googol. Try to write it as a power of 10. (Textbook pg. no. 48)

Ans: 1×10^{100}

Googol

10000000000000000000000000
00000000000000000000000000
00000000000000000000000000
00000000000000000000000000

Let's Study

Square Root of a Number

1. 25 is the square of 5, then it means that 5 is a square root of 25.
Symbolically, it is written as $\sqrt{25} = 5$.
2. We know, $3 \times 3 = 9$ and $(-3) \times (-3) = 9$
$\therefore$ $\sqrt{9} = 3$ and $\sqrt{9} = -3$.

Remember This

If x is a positive number, it has two square roots. The positive square root is shown as $\sqrt{x}$ and the negative one is shown as $-\sqrt{x}$.

Finding Square Root by the Factors Method

Example: Find the square root of 400.

Step 1 : Factorize 400 into its primes.
$400 = 2 \times 2 \times 2 \times 2 \times 5 \times 5$

Step 2 : Make pairs of equal factors from the prime factors obtained.
$400 = \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{5 \times 5}$

Step 3 : Take one factor from each pair and multiply to get the square root.
$\therefore \quad \sqrt{400} = 2 \times 2 \times 5$
$\therefore \quad \sqrt{400} = \mathbf{20}$

2	400
2	200
2	100
2	50
5	25
5	5
	1

Something more

Square root by Division Method:

Example: Find the square root of 156.25.

Step 1 : Write the number in division symbol. Starting from the right (units) end of the number, mark off pairs of digits by drawing a line above each pair.

Step 2 : Consider the first pair (or single digit) from the left. The closest perfect square smaller than (or equal to) 1 is 1. Hence, write 1 in the quotient and to the left of the division symbol.

Step 3 : Subtract 1 from 1. The remainder is 0. To the left, add the number which was written in quotient.
So, 1 + 1 = 2

Step 4 : Bring the next pair (56) down.

Step 5 : Select a number such that if we write that number to right of 2 and then multiply the number formed by the number written to the right of 2, we get a number smaller than 56.
Now 21 × 1 = 21, 22 × 2 = 44, 23 × 3 = 69
Since 44 < 56, and 69 > 56, write 2 in quotient and 44 below 56. Subtract the two numbers. Also write 2 in the left column and add 2 to the number formed.
So, 22 + 2 =24

Step 6 : Bring the next pair (25) down.
Now, 244 × 4 = 976, 245 × 5 = 1225
So, write 5 in the quotient, and 1225 below 1225.
Subtract the two numbers.
Also in the right column, 245 + 5 = 250
Stop the division when you get 0 as remainder.
$\therefore \quad \sqrt{156.25} = \mathbf{12.5}$

	12.5
1	$\overline{1}\overline{56}.\overline{25}$
+ 1	− 1
22	056
+ 2	− 44
245	1225
+ 5	− 1225
250	0

Let's Practise : Practice Set 30

1. Find the square root:
i. 625 ii. 1225 iii. 289 iv. 4096
v. 1089

***Solution*:**

i.

5	625
5	125
5	25
5	5
	1

$\therefore \quad 625 = \underline{5 \times 5} \times \underline{5 \times 5}$
$\therefore \quad \sqrt{625} = 5 \times 5 = \mathbf{25}$

ii.

5	1225
5	245
7	49
7	7
	1

$\therefore \quad 1225 = \underline{5 \times 5} \times \underline{7 \times 7}$
$\therefore \quad \sqrt{1225} = 5 \times 7 = \mathbf{35}$

iii.

17	289
17	17
	1

$\therefore \quad 289 = \underline{17 \times 17}$
$\therefore \quad \sqrt{289} = \mathbf{17}$

iv.

2	4096
2	2048
2	1024
2	512
2	256
2	128
2	64
2	32
2	16
2	8
2	4
2	2
	1

$\therefore \quad 4096 = \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{2 \times 2}$

$\therefore \quad \sqrt{4096} = 2 \times 2 \times 2 \times 2 \times 2 \times 2$

$= \mathbf{64}$

v.

3	1089
3	363
11	121
11	11
	1

$\therefore \quad 1089 = \underline{3 \times 3} \times \underline{11 \times 11}$

$\therefore \quad \sqrt{1089} = 3 \times 11$

$= \mathbf{33}$

Formative Assessment

Activity

1. The radius of the earth is approximately 6400 km. Convert the radius into metre and centimeter and express it in standard form.

***Solution*:** Radius of earth $= 6400 \text{ km} = 6400 \times 1000 \text{ m} = 6400000$

$= \mathbf{6.4 \times 10^6 \text{ m}}$

Radius of earth $= 6.4 \times 10^6 \text{ m} = 6.4 \times 10^6 \times 100 \text{ cm}$

$= \mathbf{6.4 \times 10^8 \text{ cm}}$

2. Make a list of different objects from your surroundings which are perfect examples of square numbers.

Ans: Chess board, Rubik's cube, snakes and ladders board, Su-do-ku puzzle etc.

Assignment Test

1. Choose the correct option for each of the following question:

i. 'm raised to the power a' can be symbolically written as_____ .

(A) a^m (B) a^{-m}

(C) m^a (D) m^{-a}

ii. The first power of 10 is _____ .

(A) 1 (B) 10

(C) 100 (D) 1000

iii. The value of 6^3 is _____ .

(A) 36 (B) 216

(C) 27 (D) 729

iv. Which of the following option is wrong?

(A) $(-1)^6 = 1$ (B) $(-1)^9 = -1$

(C) $(-1)^8 = -1$ (D) $(-1)^{11} = -1$

2. Simplify the following:

i. $9^5 \times 9^8$ ii. $\left(\frac{-8}{7}\right)^6 \div \left(\frac{-8}{7}\right)^2$ iii. $\left(\frac{x}{2}\right)^7 \times \left(\frac{x}{2}\right)^3$ iv. $8^{15} \div 8^{15}$

v. $\left[\left(\frac{6}{8}\right)^5\right]^3$ vi. $\left[\left(\frac{-8}{5}\right)^3\right]^{-2}$ vii. $\left(\frac{1}{8}\right)^6 \times \left(\frac{1}{8}\right)^2$ viii. $\left(\frac{1}{8}\right)^6 \div \left(\frac{1}{8}\right)^2$

3. Find the square root of each of the following numbers:

i. 576 ii. 2025

Answers:

1. i. (C) ii. (B) iii. (B) iv. (C)

2. i. 9^{13} ii. $\left(\frac{-8}{7}\right)^4$ iii. $\left(\frac{x}{2}\right)^{10}$ iv. 1

v. $\left(\frac{6}{8}\right)^{15}$ vi. $\left(\frac{-8}{5}\right)^{-6}$ vii. $\left(\frac{1}{8}\right)^8$ viii. $\left(\frac{1}{8}\right)^4$

3. i. 24 ii. 45

Std. VII

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