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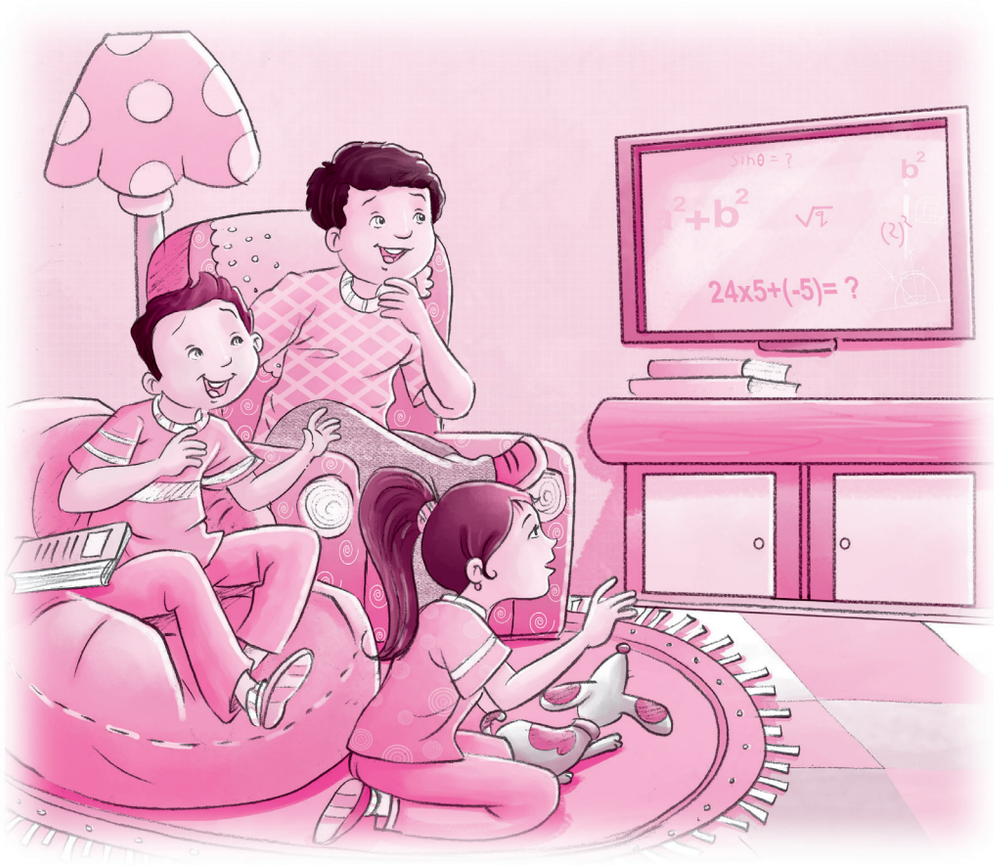

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The Most Popular Series which has been in use for more than 30 years.

PREFACE TO THE REVISED EDITION

The authors wish to express their satisfaction and gratitude for the warm welcome that has been accorded to this series all these years.

1. The text matter and answers have been thoroughly re-checked.
2. The special feature of this edition is the inclusion of ***Multiple Choice Questions, Challengers*** [*High Order Thinking Skills* (**HOTS**)], ***Worksheets*** and ***Chapter Tests.***
3. The authors are grateful to all those teachers and students who have provided valuable feedback for the improvement of the series.

AUTHORS

A NOTE FOR THE TEACHERS

Dear friends,

We feel happy to be able to present for your perusal and consideration the new and thoroughly revised and updated editions of our **Mathematics Today Series for Classes VI, VII and VIII**. No doubt it has been possible as a result of the motivation and feedback received in the form of valuable comments, suggestions and criticism from the learned teachers. We strongly feel that a textbook howsoever good it may be is only a tool to help teachers to teach effectively. It is the teacher and only the teacher who is competent to decide his/her teaching strategies in the classroom and is the best judge of how to use the textbook to meet the special needs of his/her class. It is earnestly hoped that this series will be able to supplement your efforts effectively to create interest of your pupils in the subject and make the study of mathematics interesting and enjoyable and gain mastery over the subject.

Howsoever best one performs or creates there is always scope for improvement. We would be very happy rather grateful to receive your comments, appreciation/criticism and suggestions for further improvement of the books.

With regards

Yours sincerely

AUTHORS

PREFACE

It gives us great satisfaction to be able to bring out this new version of our old Mathematics Today Series for Classes VI to VIII. The old series has been rehashed and redesigned incorporating the current global trends and International practices and the latest philosophy and policy of providing stress free education.

The **salient features** of this series are :

1. It follows strictly the new syllabus of the ICSE Council.
2. All the mathematical concepts have been presented in a very simple and lucid form and loading the course content with unnecessary and irrelevant details has been avoided. The approach and orientation is to lay a strong foundation for the students through adequate emphasis on the fundamentals.
3. It aims at complete involvement of the pupils in the learning process. The emphasis throughout the text is on a student-centered performance and the **activity approach** is freely used relating the mathematical concepts to real life situations.
4. Every unit is introduced by a motivating paragraph or story.
5. To facilitate easy and better understanding each unit is divided into a number of subunits with short and separate practice exercises on each subunit.
6. **An attempt has been made to expose the children more fully to the 'Why' of various operations and made abundant use of diagrams, illustrations, cartoons, tables and charts to stimulate the student's interest in the subject and to clarify more difficult concepts.**
7. Colour panels are used throughout as a teaching aid to emphasize important terms and relationships and present useful tips.
8. The problems given in the books avoid tedious calculations and help in strengthening the understanding of basic principles honing the faculties of thinking and reasoning.
9. Each chapter contains a **unit summary of key points** at the end. It reviews the main points covered and helps the students in remembering them.
10. **Mental maths** exercises have been given to help the students acquire speed and sharpen their intellect.
11. A special feature is the inclusion of '**Mixed Review Exercises**' which would keep the students in constant touch with all the topics studied earlier.
12. **Historical Notes, Quizzes, Just For Fun, Puzzles and Enrichment Material** offer further intellectrual challenge to sharp students and help them not only to maintain their interest in the subject and widen their horizon of knowledge but would also be of immense help in preparing for such competitions such as Mathematics Olympiad at various levels.

It is hoped that this series of books will meet more than adequately, the needs of the students they are meant for. Any suggestions for the improvement of the books would be most welcome and gratefully acknowledged.

AUTHORS

SYLLABUS

Teaching Points	Teaching Notes
1. Sets	
Revision of work done in Classes VI and VII	
Idea of a set	Well defined collection of distinct objects.
Notation	Roster method (listing elements) and set builder method.
Finite/ Infinite set	Denoting sets by capital letters and elements by small letters.
Universal set	
Revision of work done in Classes VI and VII	
The empty set	Candidates will be expected to be familiar with the terms and symbols
Equivalent sets	connected with sets, namely,
Equal sets	Sets of numbers : **N, W, I** or **Z, Q** and **R**
Cardinal number of a set	General : $\in, \notin, \xi, \varnothing$ or $\{\}$, $n(A)$.
Subsets	Operational : $A', \cup, \cap$.
Complement of a set	Relation : $=, \neq, \leftrightarrow, \Leftrightarrow, \subset, \supset, \subseteq, \supseteq$.
Union of sets Intersection of sets	
Venn diagrams	Venn diagrams as illustrations to bring out relationship in sets and their use in simple logical problems.
2. Numbers	
Numbers	Natural numbers, whole numbers, integers, rational and irrational numbers, real numbers,
The real Number line	Prime and composite numbers, odd and even numbers. Factors, H.C.F., Multiples, L.C.M.
	Four fundamental operations. Simplification of expressions involving fractions and decimals (Use of principle of BODMAS).
	Symbols : $=, \neq, >, <, \geq, \leq, +, -, \times, \div$, of, brackets.
Directed numbers	Four fundamental operation involving directed numbers.
Ratio, fractions,	Conversion of one to the other.
decimals and percentage	
Squares and Square roots	Square root by factors and division method.
3. Arithmetical Problems	
Simple Interest	Calculation of Interest and Amount only.
Compound Interest by Simple Interest method	Calculation of Interest and Amount only.
Percentage, Profit and Loss	Elementary (Simple and direct question) only.
Time and work	Pupils must be fully conversant with the measures of money length, areas, volume weight and time.
Time and Distance Proportional parts	
4. Algebra	
Fundamental concepts	Pupils will be expected to be familiar with algebraic terms such as term monomial, binomial, trinomial, polynomial degree of a polynomial, coefficient, variable, constant, linear, algebraic fractions.
Fundamental operations	Addition, subtraction and multiplication.
	Division of a polynomial by a monomial or a binomial of first degree.
	Simplification by removal of brackets (Use of principle of BODMAS).
Substitution	Substitution in polynomials (degree 2 or 1) involving at most three unknowns.

Exponents	Positive, integral and zero indices only. Laws of exponents : $x^m.x^n = x^{m+n}; x^m / x^n = x^{m-n}$; $(m > n$ only) $\left(x^m\right)^n = x^{mn}$ and $x^0 = 1$ Proofs of the laws will not be required.
Formulae	Framing of formulae (simple cases). Change of subject of formula.
Products and Expansions	$(x \pm a)(x \pm b)$ $(x \pm a)^2$
Factorisation	Taking common : $ax + bx, a(x + y) \pm b(x + y)$ Grouping and taking common : $ac + bd + ad + bc$ Difference of squares $x^2 - y^2$ Trinomials $ax^2 + bx + c\ (a, b, c \in N)$
Linear equations	Solution of : (i) simple linear equation and problems leading to them. (ii) pairs of simultaneous linear equations in two variables. Simple problems leading to them. Candidates will be expected to find a solution set in a given replacement set for the variable.
Graphs	Graphical representation of a linear equation in two variables. Solution of a pair of simultaneous linear equation in two variables graphically.

5. Mensuration

Area and perimeter of a triangle, rectangle, trapezium and circle	Problems on paths inside or outside a rectangle or a circle may be included.
Volume and surface of cuboids	Pupils should be familiar with the abbreviations; cm, m, km, cm^2, m^2, cm^3, m^3.

6. Geometry

Note : In the Geometry section of the syllabus, pupils will not be expected to prove theorems.

Question should be set to test simple logical deductions, from geometrical properties.

Fundamental concepts	Candidates will be expected to be familiar with line, plane, space, line segments, polygons as a set of points.
Lines	Parallel, intersecting, perpendicular, bisectors of angles, bisectors of line segments.
Angles	Acute, right, obtuse, straight and reflex. Adjacent angles, vertically opposite angles. Complementary and supplementary angles. Alternate, corresponding and interior opposite angles (with reference to parallel lines).
Properties	(a) If two straight lines intersect, the adjacent angles are supplementary and vertically opposite angles are equal. (b) If two angles having a common arm are supplementary the other two arms lie in a straight line. (c) If two parallel lines are cut by a transversal line, (1) the alternate angles are equal, (2) the corresponding angles are equal, (3) the interior opposite angles on the same side of the cutting line are supplementary. (d) The converse of (c).

Polygons Triangles	The angle sum property - interior : (2n – 4)rt. angles, exterior; (4 rt. angles).
Kinds	Scalene, isosceles, equilateral
Properties	(a) Congruency : SAS, ASA, SSS, RHS. (b) The angle sum property. (c) If one side of a triangle is produced, the exterior angle formed is equal to the sum of the interior opposite angles. (d) If two sides of a triangle are equal, the angle opposite to them are equal; and the converse. (e) if two sides of a triangle are unequal, the greater side has the grater angle opposite to it; and the converse. (f) Pythagoras' theorem.
Quadrilaterals,	(a) If a pair of opposite sides of a quadrilateral are equal and parallel, it is a
Parallelogram	parallelogram. (b) The opposite angles of a parallelogram are equal and adjacent angles are supplementary. (c) The diagonals of a parallelogram bisect each other, and each diagonal bisects the parallelogram. (d) Parallelogram on the same base and between the same parallels are equal in area.
Area propositions	(e) The area of a triangle is half that of a parallelogram on the same base and between the same parallels.
Rectangle	(f) The diagonals of a rectangle are equal and bisect each other.
Square	(g) The diagonals of a square bisect each other at right angles and are equal.
Rhombus	(h) The diagonals of a rhombus bisect each other at right angles.
Constructions	Using ruler and compasses **only** :
Angles	An angle equal to a given angle. Bisection of a angle. Construction of angles of 60°, 30°, 90°, 45°.
Lines	Bisector of a line segment. Perpendicular bisector of a line segment. Construction of a perpendicular to a line (i) at a given point in the line and (ii) from an external point.
Triangles	Simple data corresponding to congruency conditions (Question on constructions of triangles given sum/difference of sides/angles **not** to be asked) Opposite angles are supplementary.
Rectangles, Squares and Rhombus	From simple data.
Circle	From simple data. Circumcircle and in circle of a triangle.
1. Arithmetic/Algebra	
Approximation	Significant figures, rounding off to a specified unit (e.g. to the nearest mm, nearest g, nearest paisa, etc.) and decimal places.
Power and roots	Use of tables in computing square, cubes, square roots and cube roots of natural numbers.
(tables and approximation)	Using the division method to find the square roots of a non-perfect square natural number to a specified number of decimal places e.g. find $\sqrt{27}$ correct to 2 decimal places.
H.C.F. and L.C.M.	Using factors only.

Inequations	Simplification of algebraic fractions (cancelling the H.C.F. / in Nr. and Dr.) Addition and subtraction of simple algebraic fraction by finding the L.C.M. of the denominators.
Quadratic equations	Solution of quadratic equations in one variable, using factors only. *Problems leading to quadratic equation excluded.*
2. Mensuration	
Area and perimeter of a trapezium	Use of the formula for area; direct problems only.
3. Geometry	
Circles	Terms : radius, diameter, circumference, chords, arcs, semicircle, major arc, minor arc, sectors, segments, central angle, tangents, $\angle$ in a semicircle = 90°.
Symmetry, Reflection, Rotation	Figures having symmetry, line symmetry, rotation through 90°.
4. Statistics	Tabulation of raw-data. Frequency tally. Frequency distribution and column graphs based on frequency distribution and not frequency density. Introduction to grouped data - tabulating data and finding mean. Introducing median and mode, revising earlier concepts.

CONTENTS

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1

UNIT I : SET THEORY

Sets

Introduction

You have already studied '**sets**' in classes VI and VII. All the topics in '**Set Theory**' mentioned in the syllabus were covered in these classes. Here we shall review and strengthen these concepts further. We shall also take up the properties of operations on sets in detail.

What is a Set ?

A set is a well defined collection of objects

By '*well defined*' we mean that it must be possible to tell beyond doubt whether or not a given object belongs to the collection under consideration.

For example :

1. If we consider the group of months whose names begin with **M**, then you know that March is included in this group, but June is not. This collection of months is well defined and so is a set.

   The following are also well defined collections and so are examples of sets:
2. The set of numbers 1, 3, 5, 7 and 9.
3. The set of pupils in your class.

The following **do not describe a well defined collection and so are not sets.**

1. **The vegetables which taste good to all.**

   As tastes differ from person to person, different persons will include different vegetables in this collection.
2. **All good movies**

   You may like a particular movie but your friend may not.

   Sets are usually denoted by the capital letters A, B, C, ... etc.

Sets of Numbers

You are familiar with the sets of natural numbers, whole numbers, integers, rational numbers. About the sets of irrational numbers and real numbers you will learn in the next chapters. We have

$\boldsymbol{N}$ = set of natural numbers, *i.e.*, $\boldsymbol{N} = \{1, 2, 3, ...\}$

$\boldsymbol{W}$ = set of whole numbers, *i.e.*, $\boldsymbol{W} = \{0, 1, 2, 3, ...\}$

$\boldsymbol{Z}$ = set of integers, *i.e.*, $\boldsymbol{Z} = \{ ..., -3, -2, -1, 0, 1, 2, 3, ...\}$

$\boldsymbol{Q}$ = set of rational numbers

$\boldsymbol{R}$ = set of real numbers.

Members of a Set and Symbol '$\in$' for 'belongs to'

The objects that belong to a set are called members or **elements** of the set. Elements of a set are usually denoted by small letters a, b, c, ...

For example :

1. $7 \in$ the set of odd numbers.
2. $8 \notin$ the set of odd numbers.
3. $-20 \notin$ the set of whole numbers.

4. $\frac{1}{3} \notin$ the set of integers.
5. $-\frac{1}{3} \in$ the set of rational numbers.
6. $a \in \{a, b, c\}, b \in \{a, b, c\}, c \in \{a, b, c\}, d \notin \{a, b, c\}$.
7. $1 \notin \{0, 2, 4, 6, 8\}$
8. $9 \in$ set of square numbers.
9. $4 \notin$ set of multiples of 3.

How to Describe a Set ?

There are two ways to name a set:

(*i*) The Roster method.

In this method, the elements of the set are listed within braces.

For example : $A = \{1, 2, 3, 4, 5\}$ or $A = \{5, 3, 1, 2, 4\}$

The order in which elements are listed is unimportant. If P is the set of counting numbers less than 100, you may list the members as $P = \{1, 2, 3, 4, ..., 99\}$. The three dots after 4 means that the numbers after 4 continue in the same manner until 99 is reached.

Let N be the set of counting numbers. You can list N this way

$$N = \{1, 2, 3, 4, ...\}$$

Here the three dots mean that the numbers continue in the same manner without end.

Let B be the set of letters in the word 'floor'. You can list B this way.

$$B = \{f, l, o, r\}$$

Note Repetition is not done while listing the elements.

(*ii*) The Rule (or property) method or the Set-builder form.

The rule method denotes the set by using words, formulas, or properties.

Thus, set A, P and N described above by roster method can be denoted by rule method as under :

A = The set of natural numbers less than 6.

N = The set of natural numbers.

P = The set of natural numbers less than 100.

More concisely, when the members of a set S possess a property P and x is any element of S, then we write the set S as

$$S = \{x \mid x \text{ has a property } P\} \text{ or } S = \{x : x \text{ has a property } P\}$$

and read it as, S is the set of elements x, such that x has the property P. The vertical line or the colon means ***'such that'.***

This is called the **set builder form**.

For example :

(*i*) Let A be the set of colleges affiliated to Delhi University.

Then, $A = \{x \mid x \text{ is a college affiliated to Delhi University}\}$.

(*ii*) Let E be the set of even whole numbers less than twenty.

Then, $E = \{n : n \text{ is an even whole number less than } 20\}$

or $E = \{x \mid x = 2n, n \in W \text{ and } n < 10\}$.

(*iii*) Let P be the set of reciprocals of natural numbers. Then $P = \left\{x : x = \frac{1}{n}, n \in N\right\}$.

Ex. 1. Write the following sets in roster form :

(*a*) $A = \{x \mid x = 7n, n \in Z \text{ and } -3 \le n < 3\}$ **(*b*)** $B = \{x : x \in W, 5x - 7 < 19\}$

(*c*) $C = \left\{x : x = \frac{p}{p+3}, p \in N \text{ and } p < 7\right\}$

Sol. (*a*) Given $n \in Z$ and $-3 \le n < 3$, *i.e.*, n can take up values $-3, -2, -1, 0, 1, 2$
(Note that n being less than 3, it does not take up the value 3).
Also, $x = 7n$, putting $x = -3, -2, -1, 0, 1, 2$, we obtain $x = -21, -14, -7, 0, 7, 14$.
Hence, the given set can be written in the roster form as $A = \{-21, -14, -7, 0, 7, 14\}$.

(*b*) Given $5x - 7 < 19, x \in W$ or $5x < 19 + 7, x \in W$ or $5x < 26, x \in W$ or $x < \frac{26}{5}, x \in W$

The whole numbers less than $\frac{26}{5}$ are 0, 1, 2, 3, 4, 5

$\therefore \quad B = \{0, 1, 2, 3, 4, 5\}$.

(*c*) Given $p \in N$ and $p < 7$ so p will take up the values 1, 2, ..., 6.

So $x = \frac{1}{1+3}, \frac{2}{2+3}, \frac{3}{3+3}, \frac{4}{4+3}, \frac{5}{5+3}, \frac{6}{6+3} = \frac{1}{4}, \frac{2}{5}, \frac{3}{6}, \frac{4}{7}, \frac{5}{8}, \frac{6}{9}$ or $\frac{1}{4}, \frac{2}{5}, \frac{1}{2}, \frac{4}{7}, \frac{5}{8}, \frac{2}{3}$

Hence, $C = \left\{\frac{1}{4}, \frac{2}{5}, \frac{1}{2}, \frac{4}{7}, \frac{5}{8}, \frac{2}{3}\right\}$.

Ex. 2. Write the following sets in set builder form:

(*a*) $F = \left\{\frac{5}{12}, \frac{6}{13}, \frac{7}{14}, \frac{8}{15}, \frac{9}{16}, \frac{10}{17}\right\}$ **(*b*)** $G = \{0, 1, 16, 81, 256, 625\}$

Sol. (*a*) Do you observe that in the given set, the denominator of each fraction is 7 more than the numerator ?
$\therefore$ In the set builder form

$$F = \left\{x : x = \frac{n}{n+7}, n \in N \text{ and } 5 \le n \le 10\right\}.$$

(*b*) Do you observe that elements of the given set are the fourth powers of the first five whole numbers?
$\therefore$ In the set builder form

$$G = \{x \mid x = n^4, n \in W \text{ and } n \le 5\}.$$

EXERCISE 1 (A)

1. Which of the following collections are sets?

(*a*) Planets of our solar system. (*b*) Interesting books in the library.
(*c*) Colours of rainbow. (*d*) Beautiful girl students of your school.
(*e*) Top five wicket takers in Test Cricket. (*f*) Smart and handsome boys of your class.
(*g*) Presidents of India. (*h*) Good football players.

2. Re-write the following statements, using set notation :

(*a*) 3 is an element of set of natural numbers. (*b*) -5 is not an element of the set of natural numbers.

3. Let A = {Prime numbers ≤ 19}.
Insert the appropriate symbol '∈' or '∉' in blank spaces :

(*a*) 4 ... A (*b*) 7 ... A (*c*) 9 ... A (*d*) 13 ... A (*e*) $\sqrt{3}$ ... A (*f*) 1 ... A.

4. Answer true or false :

(*a*) $0 \in W$ (*b*) $0 \in N$ (*c*) $12 \in$ set of factors of 24. (*d*) If V = set of vowels, then $k \in V$.

5. Specify each of the following sets in the roster form :

(*a*) The set of prime numbers less than 10. (*b*) The set of letters in the word '*SATELLITE*'.
(*c*) The set of natural numbers less than 0.

6. Specify each of the following sets by stating a rule :

(*a*) {15, 16, 17, 18, ...} (*b*) {5, 10, 15, ...} (*c*) {0, 2, 4, 6, ...} (*d*) {–5, –3, –1, –2, –4}

7. Specify each of the following sets in the set builder form :

(*a*) A = {4, 8, 12, 16, 20, 24, ...} (*b*) B = {4, 9, 16, 25, 36, 49, ...} (*c*) C = {..., –4, –3, –2, –1, 0}

(*d*) $D = \left\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \cdots\right\}$ (*e*) ϕ

8. Write the following sets in roster form

(*a*) $\{x \mid x \in N, x < 6\}$ (*b*) {d | d is a digit in the number 5354725} (*c*) $\{y \mid y = 3x - 1, x \in N\}$

(*d*) $\{x \mid x = n^2, n \in N, 4 \le n \le 10\}$ (*e*) $\left\{x \mid x = \frac{p+1}{2p+3}, p \in W \text{ and } p \le 6\right\}$

TYPES OF SETS

Finite and Infinite Sets

If the members of a set can be counted with the counting coming to an end, the set is a **finite set,** *e.g.*, A = {1, 3, 5, 7} is a finite set. *If the process of counting the members of a set cannot come to an end,* the set is said to be an **infinite set**. The set of natural numbers is an infinite set.

For example :

The following are finite sets :

(*i*) The set of oceans.
(*ii*) The set of human beings living on earth.
(*iii*) $\{x : x = 3n + 1, n \in Z, -2 \le n < 2\}$.

The following are infinite sets:

(*i*) Set of rational numbers between 0 and 1.
(*ii*) Set of all points on a line segment.
(*iii*) $\{x : x \in Z, x < 0\}$.

Singleton Set

A set containing only one element is called a singleton set.

For example : {7} is a singleton set, containing only one element, namely, 7.

The Empty Set

A set that has no members is called the empty set or the null set. It is denoted by the symbol { } or ϕ.

There is only one empty set and it is called **'the empty set'**. There is nothing like **'an empty set'** or **'empty sets.'**

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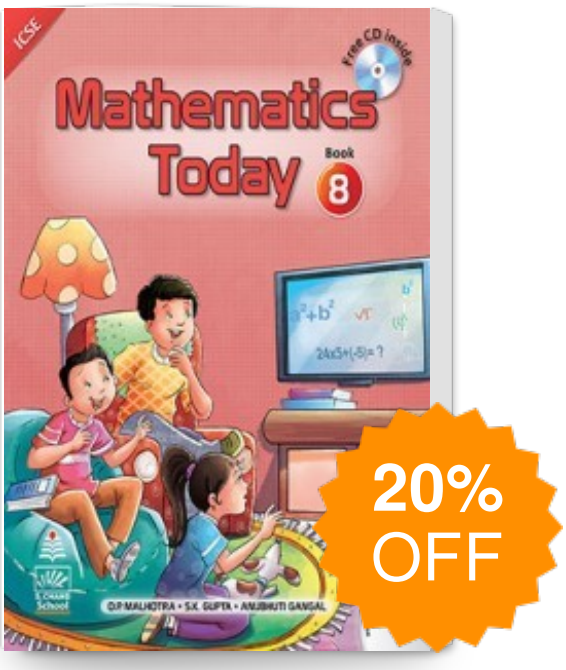

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