Revised Edition as per New Examination Pattern
CCE (Continuous and Comprehensive Evaluation)

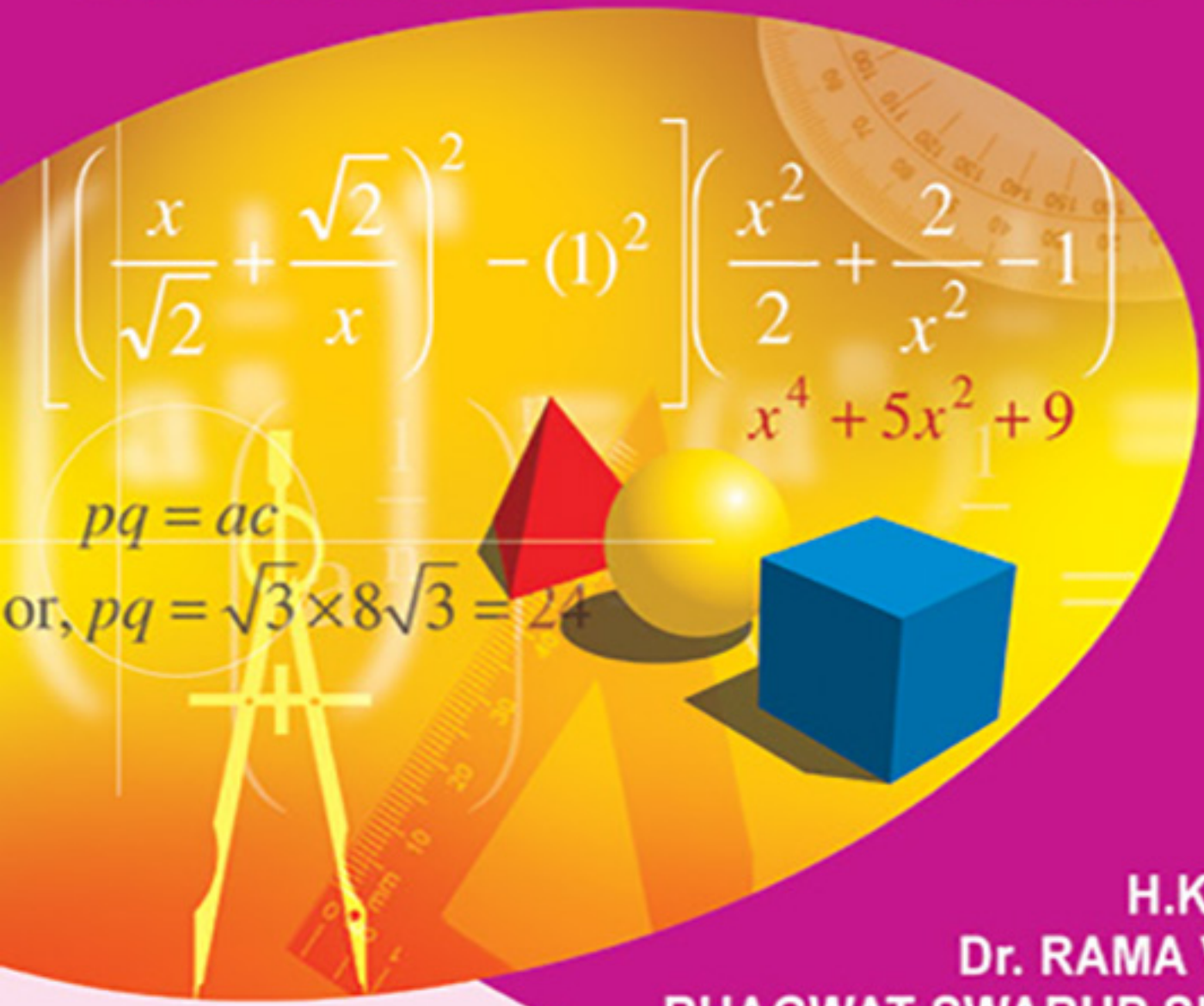
With Latest Pattern of Model Test Papers

S. Chand's

Mathematics

For Class IX

TERM - II



H.K. DASS
Dr. RAMA VERMA
BHAGWAT SWARUP SHARMA

S. CHAND

This book has been written according to the NCERT syllabus prescribed by the Central Board of Secondary Education (CBSE) for Class–IX and also according to the new examination pattern CCE (Continuous and Comprehensive Evaluation)

S. Chand's

MATHEMATICS

FOR CLASS – IX

TERM – II

Including Formative and Summative Assessments

With latest pattern of Model Test Papers

H. K. DASS
M.Sc., Diploma in Specialist Studies (Maths)
University of Hull, England

Dr. RAMA VERMA
M.Sc. (Gold Medallist), Ph.D.
Associate Professor, Mata Sundri College
Delhi University

BHAGWAT SWARUP SHARMA
M.Sc., M.Ed. (PGT Maths)
Delhi Public School, Faridabad
Haryana

S. CHAND
School

S. CHAND SCHOOL BOOKS
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7361, Ram Nagar, Qutab Road, New Delhi-110055
Phone: 23672080-81-82, 9899107446, 9911310888; Fax: 91-11-23677446
www.schandpublishing.com; e-mail : helpdesk@schandpublishing.com

Branches :

Ahmedabad	:	Ph: 27541965, 27542369, ahmedabad@schandgroup.com
Bengaluru	:	Ph: 22268048, 22354008, bangalore@schandgroup.com
Bhopal	:	Ph: 4274723, 4209587, bhopal@schandgroup.com
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Chennai	:	Ph. 28410027, 28410058, chennai@schandgroup.com
Coimbatore	:	Ph: 2323620, 4217136, coimbatore@schandgroup.com (Marketing Office)
Cuttack	:	Ph: 2332580; 2332581, cuttack@schandgroup.com
Dehradun	:	Ph: 2711101, 2710861, dehradun@schandgroup.com
Guwahati	:	Ph: 2738811, 2735640, guwahati@schandgroup.com
Haldwani	:	Mob. 09452294584 (Marketing Office)
Hyderabad	:	Ph: 27550194, 27550195, hyderabad@schandgroup.com
Jaipur	:	Ph: 2219175, 2219176, jaipur@schandgroup.com
Jalandhar	:	Ph: 2401630, 5000630, jalandhar@schandgroup.com
Kochi	:	Ph: 2378740, 2378207-08, cochin@schandgroup.com
Kolkata	:	Ph: 22367459, 22373914, kolkata@schandgroup.com
Lucknow	:	Ph: 4076971, 4026791, 4065646, 4027188, lucknow@schandgroup.com
Mumbai	:	Ph: 22690881, 22610885, mumbai@schandgroup.com
Nagpur	:	Ph: 2720523, 2777666, nagpur@schandgroup.com
Patna	:	Ph: 2300489, 2302100, patna@schandgroup.com
Pune	:	Ph: 64017298, pune@schandgroup.com
Raipur	:	Ph: 2443142, Mb. : 09981200834, raipur@schandgroup.com (Marketing Office)
Ranchi	:	Ph: 2361178, Mob. 09430246440, ranchi@schandgroup.com
Siliguri	:	Ph: 2520750, siliguri@schandgroup.com (Marketing Office)
Visakhapatnam	:	Ph: 2782609 (M) 09440100555, visakhapatnam@schandgroup.com (Marketing Office)

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Preface to the Revised Edition

It gives us immense pleasure in presenting the revised edition of **S. Chand's Mathematics for Class – IX (Term–II)** as per the latest CCE (continuous and comprehensive evaluation) pattern and guidelines issued by CBSE by circular no. 39/20-09-2009 for term–I and term–II separately.

A team of dedicated, sincere and hard-working authors have put their sincere efforts in revising this textbook and we hope that this revised edition will be widely accepted by students.

The fundamental theory of each chapter is given in the beginning of each chapter for the ready reference of the students. The classification and order of the chapters in the book is made very systematically and in proper sequence so that students can learn and understand the continuity of topics and subject matter properly.

We are confident that the book in its present form will be complete in itself and prove to be a boon to the students for their preparation as per the new pattern of CCE.

UNIQUE FEATURES OF THE BOOK

The book is divided into three parts :

Part – I : Summative Assessment

- In each chapter, detailed theory, examples and exercises are given.
- For quick revision, a revision exercise is given at the end of each chapter.
- To check the performance, chapter tests are given.
- To summarize the concepts, facts are given in the form of chapter's flashback after revision exercise of each chapter.

Part – II : Formative Assessment

This part is divided into two sections :

Section – A : Worksheets for formative assessment:

- True and false
- Fill in the blanks
- MCQs with more than one correct option

Section – B : Activities for lab manual

Part – III

10 Model test papers based on the latest pattern of CBSE examination w.e.f. 2014.

We are thankful to the management and the editorial team of S. Chand & Company Pvt. Ltd., New Delhi for help and support in publication of this book.

We are also thankful to Shri Kapil Bandhu, Govt. Co-ed. Senior Secondary School, Narela, Dr. Arvind Kumar, Mr. Naseer John, Shri Vishwasanathi School, Shri Manish Sharma (PGT Maths) of Delhi Public School, Panipat (Refinery) for giving feedback to improve the textbook.

We also convey our sincere thanks to our family members for their kind co-operation and valuable support during the time of writing this textbook.

Last but not least, our valuable thanks to Ms. Parul Bhardwaj, Principal, KCM Public School and Shri Anil Bhardwaj, M.D., KCM Public School for their great motivational and moral support all the time.

Although every effort has been made to keep this book error-free, still some printing errors might be crept in. If you bring to our notice any mistakes, errors or discrepancies, we would be extremely thankful to you. You may send your valuable suggestions, feedback or queries through email at: hk_dass@yahoo.com, bs_sharma30@rediffmail.com and msanyal@schandgroup.com.

Authors

SYLLABUS

(TERM–II)
(OCTOBER TO MARCH)

There will be two **Formative Tests** and a **Summative Test**. The weightages and time schedule will be as under:

Type of test	Weightage	Time Schedule
Formative 3	10 %	October – November
Formative 4	10 %	January – February
Summative – II	90 Marks (30% weightage)	March
Total	**50 %**	

General Instructions :

- As per CCE guidelines, the syllabus of Mathematics for Class-IX has been divided termwise.
- The units specified for each term shall be assessed through both formative and summative assessments.
- In each term, there will be two formative assessments, each carrying 10% weightage.
- The summative assessment in term I will carry 30% weightage and the summative assessment in the term II will carry 30% weightage.
- Listed laboratory activities and projects will necessary be assessed through formative assessments.

Course Structure Class–IX

	Second Term	Marks : 90
	UNITS	**MARKS**
II.	Algebra	16
III.	Geometry	38
V.	Mensuration	18
VI.	Statistics and Probability	18
	Total	**90**

UNIT II : ALGEBRA

1. LINEAR EQUATIONS IN TWO VARIABLES (14) Periods

Recall of linear equations in one variable. Introduction to the equation in two variables. Prove that a linear equation in two variables has infinitely many solutions and justify their being written as ordered pairs of real numbers, plotting them and showing that they seem to lie on a line. Examples, problems from real life, including problems on Ratio and Proportion and with algebraic and graphical solutions being done simultaneously.

UNIT III : GEOMETRY

2. QUADRILATERALS (10) Periods

(*i*) (Prove) The diagonal divides a parallelogram into two congruent triangles.
(*ii*) (Motivate) In a parallelogram opposite sides are equal and conversely.
(*iii*) (Motivate) In a parallelogram opposite angles are equal, and conversely.
(*iv*) (Motivate) A quadrilateral is a parallelogram if a pair of its opposite sides is parallel and equal.
(*v*) (Motivate) In a parallelogram, the diagonals bisect each other and conversely.

(*vi*) (Motivate) In a triangle, the line segment joining the mid points of any two sides is parallel to the third side and (motivate) its converse.

3. AREA OF PARALLELOGRAMS AND TRIANGLES (4) Periods

Review concept of area, recall area of a rectangle.

(*i*) (Prove) Parallelograms on the same base and between the same parallel lines have the same area.

(*ii*) (Motivate) Triangles on the same base and between the same parallel lines are equal in area and its converse.

4. CIRCLES (15) Periods

Through examples, arrive at definitions of a circle related concepts, radius, circumference, diameter, chord, arc, subtended angle.

(*i*) (Prove) Equal chords of a circle subtend equal angles at the centre and (motivate) its converse.

(*ii*) (Motivate) The perpendicular from the centre of a circle to a chord bisects the chord and conversely, the line drawn through the centre of a circle to bisect a chord is perpendicular to the chord.

(*iii*) (Motivate) There is one and only one circle passing through three given non-collinear points.

(*iv*) (Motivate) Equal chords of a circle (or of congruent circles) are equidistant from the centres) and conversely.

(*v*) (Prove) The angle subtended by an arc at the centre is double the angle subtended by it at any point on the remaining part of the circle.

(*vi*) (Motivate) Angles in the same segment of a circle are equal.

(*vii*) (Motivate) If a line segment joining two points subtends equal angle at two other points lying on the same side of the line containing the segment, the four points lie on a circle.

(*viii*) (Motivate) The sum of the either pair of the opposite angles of a cyclic quadrilateral is 180° and its converse.

5. CONSTRUCTIONS (10) Periods

(*i*) Construction of bisectors of line segments & angles, 60°, 90°, 45° angles, *etc.* equilateral triangles.

(*ii*) Construction of a triangle given its base, sum/difference of the other two sides and one base angle.

(*iii*) Construction of a triangle of given perimeter and base angles.

UNIT V : MENSURATION

6. SURFACE AREAS & VOLUMES (12) Periods

Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/cones

UNIT VI : STATISTICS & PROBABILITY

7. STATISTICS (13) Periods

Introduction of Statistics : Collection of data, presentation of data—tabular form, ungrouped/grouped, bar graphs, histograms (with varying base lengths), frequency polygons, qualitative analysis of data to choose the correct form of presentation for the collected data. Mean, Median, Mode of ungrouped data.

8. PROBABILITY (12) Periods

History, repeated experiments and observed frequency approach to probability. Focus is on empirical probability. (A large amount of time to be devoted to group and to individual activities to motivate the concept, the experiments to be drawn from real-life situations and from examples used in the chapter on statistics).

QUESTIONS PAPER DESIGNS 2014–15 CLASS–IX							
MATHEMATICS			**Time–3 Hours**				**Marks–90**
S. No.	Typology of Questions	Very Short Answer (VSA) (1 Mark)	Short Answer – I (VSA) (2 Marks)	Short Answer – II (VSA) (3 Marks)	Long Answer (LA) (4 Marks)	Total Marks	% Weightage
1	**Remembering – (Knowledge based** Simple recall questions, to know specific facts, terms, concepts, principles, or theories; Identify, define, or recite, information)	1	2	2	3	23	26%
2	**Understanding – (Comprehension -** to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase, or interpret information)	1	1	1	2	14	16%
3	**Application** (Use abstract information in concrete situation, to apply knowledge to new situations; Use given content to interpret a situation, provide an example, or solve a problem)	1	2	3	2	22	24%
4	**High Order Thinking Skills (Analysis & Synthesis -** Classify, compare, contrast, or differentiate between different pieces of information; Organize and / or integrate unique pieces of information from a variety of sources)	1	1	4	1	19	21%
5	**Creating, Evaluation and Multi-Disciplinary -** (Generating new ideas, product or ways of viewing things Appraise, judge, and / or justify the value or worth of a decision or outcome, or to predict outcomes based on values)				3*	12	13%
	TOTAL	**4 × 1 = 4**	**6 × 2 = 12**	**10 × 3 = 30**	**11 × 4 = 44**	**90**	**100%**

Note : The question paper will include a section on Open Text based assessment (questions of 7 marks each from the syllabus-a total of 14 marks). The case studies will be supplied to students in advance. These case studies are designed to test the analytical and higher order thinking skills of students.

* One of the LSA (4 marks) will to assess the values in herent in the texts.

CONTENTS

TERM – II (OCTOBER – MARCH)

PART – I : SUMMATIVE ASSESSMENT

PART – II : FORMATIVE ASSESSMENT

PART – III

TERM – I (APRIL – SEPTEMBER)

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- Polynomials
- Co-ordinate Geometry
- Introduction to Euclid's Geometry
- Lines and Angles
- Triangles
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Part – I

Summative Assessment

- Linear Equations in Two Variables
- Quadrilaterals
- Area of Parallelograms and Triangles
- Circles
- Constructions
- Surface Areas & Volumes
- Statistics
- Probability

My work has always tried to unite the true with the beautiful and when I have to choose one or the other, I usually choose the beautiful.

– *Hermann Weyl*

1

CHAPTER

Unit – II Algebra

Linear Equations in Two Variables

TOPICS

1. Introduction
2. Linear equations
3. Solutions of linear equations
4. Graphs of a linear equation in two variables
5. Equations of lines parallel to x-axis and y-axis.

INTRODUCTION

We have learned about constants, variables, powers and algebraic expressions.

We have also learned about linear algebraic expressions and their terms. Now we will understand the concept of equating the linear algebraic expression to some constant value to convert into linear equations.

CONCEPT – 1

(*a*) Equation

An equation is a statement of equality of two algebraic expressions involving one or more unknown quantities, called the variables.

(*b*) Equation in one variable

The equations involving only one variable are called equations in one variable. For example

(*i*) $2x+5=0$ (*ii*) $3y+2=\frac{y}{2}$ (*iii*) $t^2+t-2=0$ (*iv*) $x^2+x-6=0$

(*v*) $y^3-8=0$ (*vi*) $3t-6=0$

(*c*) Linear equation

An equation involving only one linear polynomial is called a linear equation.

For example (*i*) $4x-20=8\frac{1}{2}$ (*Power of x is* 1)

(*ii*) $\frac{3}{2}y+7=\frac{y}{2}$ (*Power of y is* 1)

(*iii*) $\sqrt{2}t+6\sqrt{2}=3\sqrt{2}$ (*Power of t is* 1)

The following equations are not linear

(*i*) $x^2+x-2=0$ (*ii*) $x^3+x^2+x+2=0$ (*iii*) $x+\frac{1}{x}-2=0$ (*iv*) $y^2+\frac{1}{y^2}=4$

Here the power of x (or y) in the above equations is more than one, that is why these equations are not linear.

EXAMPLE 1. ***Which of the following equations are linear equations.***

(*i*) $3x+5=\frac{3}{2}$ (*ii*) $x+\frac{1}{x}=2$ (*iii*) $x^3+x-1=0$

(*iv*) $101x+2000=99x+1000$ (*v*) $x(x-1)=2$

SOLUTION. (*i*) $3x+5=\frac{3}{2}$

This equation involves the variable x, only in first degree. So it is a linear equation.

(*ii*) $x+\frac{1}{x}=2 \Rightarrow x^2+1=2x$

This equation involves the variable x in second degree. So it is not a linear equation.

(*iii*) This equation involves the variable x in third degree. So it is not a linear equation.

(*iv*) This equation involves the variable x only in first degree. So it is a linear equation.

(*v*) This equation involves the variable x in second degree. So it is not a linear equation.

(*d*) Solution of a linear equation

The value of the variable (unknown) which when substituted for the variable makes both sides of the given equation equal. This value of the variable is called the solution of the equation. It is also known as the *root* of the equation.

For example, $x = 3$ is the solution of the equation $3x + 11 = 20$.

Because L.H.S.= $3 \times 3 + 11 = 9 + 11 = 20$ = R.H.S.

(*e*) Properties of an equation

1. We can add same number (or quantity) to both sides of an equation. For example, $2x - 10 = 0$
   $\Rightarrow 2x - 10 + 10 = 10$ (Adding 10 on both sides).
2. We can subtract same number (or quantity) from both sides of an equation. For example,
   $3x+5=0 \Rightarrow 3x+5-5=-5$ (subtracting 5 from both sides).
3. We can multiply both sides of an equation by the same number (non-zero). For example,
   $\frac{x}{2}=5 \Rightarrow 2\left(\frac{x}{2}\right)=2\times 5$ (Multiplying by 2 on both sides) $\Rightarrow x = 10$
4. We can divide both sides of an equation by the same number (non-zero). For example,
   $7x+20=62 \Rightarrow \frac{1}{7}(7x)+\frac{20}{7}=\frac{62}{7}$ (Dividing both sides by 7).
   By these operations, the equation remains unchanged.

(*f*) Solving of an equation

The method of finding the roots of an equation is known as solving the equation.

(*g*) Transposition

Any term of the equation may be taken to R.H.S. from L.H.S. or L.H.S from R.H.S of the equality by changing its sign (from + ve to – ve and from – ve to + ve). This process is called transposition, for example

1. $6x = 24 - 2x$
   $6x + 2x = 24$ (*– 2x from R.H.S. becomes + 2x to L.H.S. by changing its sign*).
2. $3x - 12 = 9$
   $3x = 9 + 12$ (*– 12 from L.H.S. becomes + 12 to R.H.S. by changing its sign*).

(*h*) Solution by transposition

Step I. Transpose the term involving the variable (unknown) from R.H.S. to the L.H.S., and those terms which do not involve variable from L.H.S. to R.H.S. While transposing, the sign of the term is to be changed.

Step II. Simplify the two sides to obtain the equation in the form $ax = b$.

Step III. Divide both sides of the equation by the coefficient of x.

The following examples will make the method more clear.

(*i*) Linear equations in two variables

An equation of the form $ax+by+c=0$ where a, b, c are real numbers and $a \neq 0$, $b \neq 0$, is called a linear equation in two variables (unknown), x and y are called variables. For example

(*i*) $3x + 4y + 5 = 0$, (*ii*) $-x + y = -1$, (*iii*) $\frac{x}{2}+\frac{y}{3}=\frac{1}{6}$, (*iv*) $\sqrt{2}x+\sqrt{3}y=\sqrt{5}$

The following equations are not linear in two variables.

(*i*) $\frac{1}{x}+\frac{1}{y}=6$, (*ii*) $\sqrt{x}+\sqrt{y}=4$, (*iii*) $y = x^2+4$

Because (*i*) on simplification it becomes $x + y = 6xy$, xy is of degree 2, (*ii*) on squaring it becomes $x+y+2\sqrt{xy}=16$ and if you again remove the radical sign it will not be of degree 1, (*iii*) It is the equation of degree 2.

(*j*) Solution of linear equations in two variables

The pair of values of x and y which satisfies the given equation is called a solution of the equation.

We know that every linear equation in one variable has a unique solution. But we cannot say about the solution of linear equation involving two variables. In this equation there are two variables. A solution contains one value for x and anothere value for y which satisfy the given equation.

For example; $3x + 4y = 24$, Here $x = 4$, $y = 3$ is a solution because when we substitute $x = 4$ and $y = 3$ in the equation. Then, we get $3x + 4y = 3 \times 4 + 4 \times 3 = 12 + 12 = 24$. This solution is written as an ordered pair (4, 3), first writting the value of x and then the value of y.

But (2, 3) is not a solution of the above equation because on putting $x = 2$ and $y = 3$, we get

$3x + 4y = 3 \times 2 + 4 \times 3 = 6 + 12 = 18$, which is not 24. But (0, 6) is also a solution for the given equation. So, in this way we have seen two solutions. In this way we get many – many solutions. Substitute any value of x say $x = 5$, in $3x + 4y = 24$ we get $3(5) + 4(y) = 24$ which is a linear equation in one variable. On solving we get $y=\frac{9}{4}$. So, $\left(5, \frac{9}{4}\right)$ is another solution of $3x + 4y = 24$. Therefore, there is no end of different solutions of a linear equation in two variables.

A linear equation in two variables has infinitely many solutions

SOLVED EXAMPLES

EXAMPLE 1. ***Find different solutions of the equation $x + 2y = 10$.***

SOLUTION. We have,

	$x + 2y = 10$	$\Rightarrow$	$y=\frac{10-x}{2}$	solutions
When	$x = 2$	$\Rightarrow$	$y=\frac{10-2}{2}=4$,	$x = 2, y = 4$
When	$x = 4$	$\Rightarrow$	$y=\frac{10-4}{2}=3$	$x = 4, y = 3$
When	$x = 6$	$\Rightarrow$	$y=\frac{10-6}{2}=2$	$x = 6, y = 2$
When	$x = 8$	$\Rightarrow$	$y=\frac{10-8}{2}=1$	$x = 8, y = 1$
When	$x = 10$	$\Rightarrow$	$y=\frac{10-10}{2}=0$	$x = 10, y = 0$
.....		.....		.....

It clearly shows that there is an unlimited of pairs of x and y which will satisfy the equation.

(2, 4), (4, 3), (6, 2), (8, 1), (10, 0).....

are called the solutions of the equation $x + 2y = 10$.

A linear equation in two variables has an infinite number of solutions. **Ans.**

EXAMPLE 2. ***The cost of a notebook is twice the cost of a pen. Write a linear equation in two variables to represent this statement.*** **[NCERT Textbook]**

SOLUTION. Let the cost of a notebook be ₹ x and that of a pen be ₹ y.

Since the cost of a notebook is twice the cost of a pen, so the required linear equation in two variables to represent the above statement is given by $\boldsymbol{x = 2y}$. **Ans.**

EXERCISE 1.1

1. Which of the following statement is true, and why $4x + 3y = 15$ has :
   (*i*) Unique solution (*ii*) Only two solutions
   (*iii*) No solutions (*iv*) Infinitely many solutions
2. Write down five solutions of each of the following equations :
   (*i*) $x + y = 0$ (*ii*) $x + 4y = 0$ (*iii*) $x + 2y = 6$
   (*iv*) $10x + 11y = 21$ (*v*) $13x - 12y = 25$
3. Choose the correct solutions of the equation $x - y = 12$:
   (*i*) (4, 3) (*ii*) (0, – 12)
   (*iii*) (12, 0) (*iv*) (12, 12)
   (*v*) $\left(\sqrt{24}, -\sqrt{12}\right)$
4. Find the value of a from the equation $3x + 4y = a$:
   If its one solution is $x = 2$, $y = 1$.

ANSWERS

1. (*iv*); It has infinitely many solutions, because putting different values of x we get different values of y.
2. (*i*) : (1, – 1), (– 2, 2), (0, 0), $\left(-\frac{1}{2}, \frac{1}{2}\right)$, $(\pi, -\pi)$

   (*ii*) : (0, 0), (4, – 1), (8, – 2), $\left(3, -\frac{3}{4}\right)$, $\left(\sqrt{5}, -\frac{\sqrt{5}}{4}\right)$

   (*iii*) : (2, 2), (0, 3), (6, 0), (– 2, 4), $\left(1, \frac{5}{2}\right)$

   (*iv*) : (1, 1), $\left(0, \frac{21}{11}\right)$, $\left(\frac{21}{10}, 0\right)$, $\left(-\frac{1}{10}, 2\right)$, $\left(a, \frac{21-10a}{11}\right)$

   (*v*) : (1, – 1), $\left(0, -\frac{25}{12}\right)$, $\left(\frac{25}{13}, 0\right)$, $\left(2, \frac{1}{12}\right)$, $\left(\frac{25+12k}{13}, k\right)$
3. (*ii*), (*iii*)
4. $a = 10$

CONCEPT – 2

Graph of a linear equation in two variables

We have solved linear equations in two variables algebrically. Now, we wish to represent a linear equation in two variables geometrically in the co-ordinate plane.

Let us consider the linear equation $x + 2y = 10$ again. In the previous example we got the following solutions of the equation $x + 2y = 10$.

x	2	4	6	8	10
$y = \frac{10-x}{2}$	4	3	2	1	0
Points	C	D	E	F	G

Let us plot these points (2, 4), (4, 3), (6, 2), (8, 1), (10, 0) etc on a graph paper, we find that these points lie on a straight line AB.

This is the reason why a first degree equation in two variables is called a linear equation.

Note: We have to choose the value of x in such a way that y must be an integer.

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