New Maths Time
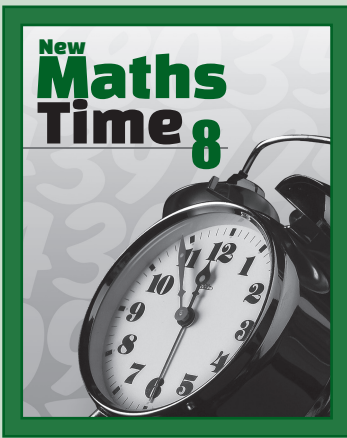
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Orient BlackSwan

NEP Compliant inside

WITH APP

New Maths Time 8

This revised edition of New Maths Time lays strong emphasis on the connect between Maths and its application in real life. It therefore enables students to understand and appreciate the use of Maths in their daily lives.

It is in accordance with:

⊞ the guidelines laid down in the National Curriculum Framework

⊞ tried and tested methodology in the teaching of mathematics

⊞ the needs of the students and teachers

THE PACKAGE

Students' Book

❖ Syllabus compliant
❖ Graded for level
❖ Written simply and with clear diagrams
❖ Provides ample practice for mastery of concepts and skills

Students' App

❖ For more practice and assessment

Teachers' Resource Pack

❖ Lesson Plans
❖ Question Bank with Answers
❖ Worksheets with Answer key
❖ Concept-check Activities
❖ Question papers with Answer key

Smart Book For Teachers

❖ Animations
❖ Videos
❖ Interactive tasks
❖ Games
❖ Presentations
❖ Embedded questions
❖ Worksheets
❖ Question-paper generator

Web Support For Teachers

A portal dedicated to the series with free access for teachers

Learning Outcomes

at the beginning of each chapter define the learning expected from the chapter
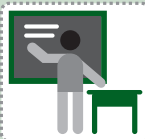
Get Started

Maths In Real Life
introduces topics through real-life examples that students can relate to

New

Check What You Know
are exercises based on what students have already learnt

Concepts Section

Solved Examples
illustrate concepts clearly and lead students from guided to independent learning

Rapid Check
exercises help students evaluate their understanding

In-chapter Exercises
help the teacher assess students

Challenge Yourself
questions help students apply the concepts learnt

New

Skills Section

Multiple Choice Questions
help improve thinking and application skills

Mixed Bag
provides ample practice to master the skills and concepts learnt

Mental Maths
helps develop quick calculation skills

Higher Order Thinking Skills
enhance problem solving and critical thinking

New

Heritage
includes **Vedic maths sections** that teach quick calculation skills and instill a sense of pride in our past

Problem Solving
promotes lateral thinking and sharpens evaluation and analytical skills

Cross-curricular Practice
helps understand the connect between Maths and other subjects

Everyday Maths
helps promote a positive attitude towards maths in students

Activites Section

Maths Lab Activities
help clarify concepts, develop skills and promote application

Group Projects
promote 21st century skills of research, collaboration, communication, creativity and critical thinking

Assessment Section

New

Worksheet
in every chapter aids the reinforcement of concepts

Unit Tests
after every 5 chapters for regular assessment

Two Examination Papers
each covering the portion for a term

Syllabus

Number System (50 hrs)

(i) Rational Numbers   **Chapter 1**
- Properties of rational numbers. (including identities). Using general form of expression to describe properties.
- Consolidation of operations on rational numbers.
- Representation of rational numbers on the number line.
- Between any two rational numbers there lies another rational number. (Making children see that if we take two rational numbers then unlike for whole numbers, in this case you can keep finding more and more numbers that lie between them.)
- Word problem (higher logic, two operations, including ideas like area).

(ii) Powers   **Chapter 2**
- Integers as exponents.
- Laws of exponents with integral powers.

(iii) Squares, Square roots, Cubes, Cube roots   **Chapters 3 and 4**
- Square and square roots.
- Square roots using factor method and division method for numbers containing (a) no more than total 4 digits and (b) no more than 2 decimal places.
- Cubes and cubes roots (only factor method for numbers containing at most 3 digits).
- Estimating square roots and cube roots. Learning the process of moving nearer to the required number.

(iv) Playing with Numbers   **Chapter 5**
- Writing and understanding a 2- and 3-digit number in generalised form ($100a + 10b + c$, where a, b, c can be only digit 0–9) and engaging with various puzzles concerning this. (Like finding the missing numerals represented by alphabets in sums involving any of the four operations.) Children to solve and create problems and puzzles.
- Number puzzles and games.
- Deducing the divisibility test rules of 2, 3, 5, 9, 10 for a two- or three-digit number expressed in the generalised form.

Algebra (20 hrs)

Algebraic Expressions   **Chapters 6, 7 and 8**
- Multiplication and division of algebraic expression (Coefficient should be integers).
- Some common errors (e.g., $2 + x \neq 2x$, $7x + y \neq 7xy$).
- Identities $(a \pm b)^2 = a^2 \pm 2ab + b^2$, $a^2 - b^2 = (a - b)(a + b)$ Factorisation (simple cases only) as examples the following types $a(x + y)$, $(x \pm y)^2$, $a^2 - b^2$, $(x + a).(x + b)$.
- Solving linear equations in one variable in contextual problems involving multiplication and division (word problems) (avoid complex coefficient in the equations).

Ratio and Proportion (25 hrs)   **Chapters 9, 10 and 11**
- Slightly advanced problems involving applications on percentages, profit and loss, overhead expenses, discount, tax.
- Difference between simple and compound interest (compounded yearly up to 3 years or half-yearly up to 3 steps only), Arriving at the formula for compound interest through patterns and using it for simple problems.
- Direct variation – simple and direct word problems.
- Inverse variation – simple and direct word problems.
- Time and work problems – simple and direct word problems.

Geometry (40 hrs)

(i) Understanding Shapes   **Chapter 13**
- Properties of quadrilaterals – sum of angles of a quadrilateral is equal to 360° (By verification).
- Properties of parallelogram (By verification).
- Opposite sides of a parallelogram are equal,
- Opposite angles of a parallelogram are equal,
- Diagonals of a parallelogram bisect each other. [Why (iv), (v) and (vi) follow from (ii)]
- Diagonals of a rectangle are equal and bisect each other.
- Diagonals of a rhombus bisect each other at right angles.
- Diagonals of a square are equal and bisect each other at right angles.

(ii) Representing 3D in 2D   **Chapter 12**
- Identify and Match pictures with objects [more complicated e.g., nested, joint 2D and 3D shapes (not more than 2)].
- Drawing 2D representation of 3D objects (Continued and extended).
- Counting vertices, edges and faces and verifying Euler's relation for 3D figures with flat faces (cubes, cuboids, tetrahedrons, prisms and pyramids).

(iii) Construction   **Chapter 14**
- Construction of quadrilaterals:
  – Given four sides and one diagonal
  – Three sides and two diagonals
  – Three sides and two included angles
  – Two adjacent sides and three angles

Mensuration (15 hrs)   **Chapters 15 and 16**
- Area of a trapezium and a polygon.
- Concept of volume, measurement of volume using a basic unit, volume of a cube, cuboid and cylinder.
- Volume and capacity (measurement of capacity).
- Surface area of a cube, cuboid, cylinder.

Data Handling (15 hrs)   **Chapters 17 and 18**
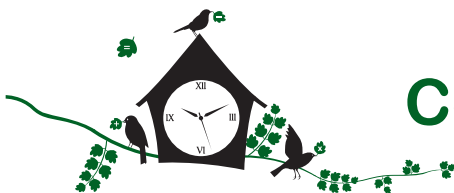- Reading bar graphs, ungrouped data, arranging it into groups, representation of grouped data through bar graphs, constructing and interpreting bar graphs.
- Simple pie charts with reasonable data numbers.
- Consolidating and generalising the notion of chance in events like tossing coins, dice etc. Relating it to chance in life events. Visual representation of frequency outcomes of repeated throws of the same kind of coins or dice. Throwing a large number of identical dice/coins together and aggregating the result of the throws to get large number of individual events. Observing the aggregating numbers over a large number of repeated events. Comparing with the data for a coin. Observing strings of throws, notion of randomness.
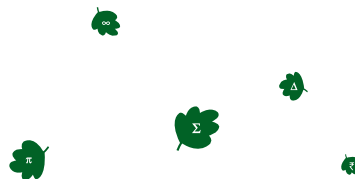
Introduction to Graphs (15 hrs)   **Chapter 19**
Preliminaries
- Axes (same units), Cartesian plane.
- Plotting points for different kind of situations (perimeter vs length for squares, area as a function of side of a square, plotting of multiples of different numbers, simple interest vs number of years etc.)
- Reading off from the graphs.
  – Reading of linear graphs
  – Reading of distance vs time graph

Contents

8 Linear Equations

At the end of the lesson, you will be able to:

- recognise linear equations in one variable and solve linear equations by transposition.
- frame linear equations and solve real-world problems.

Get Started

A. Linear Equations in real life

A taxi charges ₹30 for the first kilometer and ₹15 for every additional kilometer. Write the equation to calculate the taxi fare.

Let the distance travelled be x.
Cost of 1st kilometer = ₹30
Cost per kilometer after that = ₹15
Then fare = ₹ $[30 + 15\,(x - 1)]$

B. Check what you know

(1) Write algebraic expressions for the following statements.
   (i) 5 added to the sum of $5b$ and $3m$.
   (ii) 3 subtracted from the product of −8 and a number q.
   (iii) 2 added to the product of a number p and 43.
   (iv) Twice a number q added to the number a decreased by 6.

Concepts Section

8.1 Linear equations

*An **algebraic expression** is a combination of terms using addition or subtraction.*

$5x + 2$, $\dfrac{y}{2} - 6$ and $x^2 y + y$ are some examples of algebraic expressions.

*The equality of two expressions involving variables is called an **algebraic equation**.*

It contains an equality sign (=) between two expressions.

$3m + 2 = 4$, $2x - 5 = (-2)$ and $\dfrac{y}{2} = 3$ are some examples of algebraic equations in one variable.

> *Equations, in which the highest power of the variable is 1, are called **linear equations** or **simple equations**.*

$x + 5 = 3$, $2y - 3 = 7$ and $\dfrac{2y}{3} = (-2)$ are some examples of linear equations.

The expression on the left side of the equality sign in a linear equation is called the **LHS** and the one on its right is called the **RHS**.

The value of the expression on the LHS of a linear equation and that on its RHS will be equal only for a unique value of the variable in it. For example, $3p = 6$ will be true only for $p = 2$. Therefore, $p = 2$ is called the **solution** or **root** of the equation $3p = 6$.

The process of finding the value of the variable that satisfies a linear equation is called **solving the equation**.

8.2 Solving linear equations

An equation remains unchanged if we:

♣ Add the same number or equal quantities of a variable to both the sides of an equation.

♣ Subtract the same number or equal quantities of a variable from both the sides of an equation.

♣ Multiply and divide both the sides of an equation by the same number or by equal quantities of a variable.

♣ In an equation of the form $\dfrac{ax + b}{cx + d} = \dfrac{m}{n}$, cross-multiplication is used to get $n\,(ax + b) = m\,(cx + d)$.

The facts given above help us in solving linear equations.

Instead of performing operations on both the sides, we can move terms from one side to the other.

> *Moving the terms of an equation from one of its sides to the other is called **transposition**.*

When terms are transposed from one side to the other:

(i) Addition and subtraction operations are reversed.

(ii) Multiplication and division operations are reversed.

Operation before transposition	Operation after transposition	Change
Addition	Subtraction	(+) to (−)
Subtraction	Addition	(−) to (+)
Multiplication	Division	(×) to (÷)
Division	Multiplication	(÷) to (×)

To solve a linear equation by transposition, follow the steps given below.

♣ Rearrange the linear equation such that the terms containing variables are on one side and those with numbers are on the other.

♣ Make the coefficient of the variable as 1 to get the value of the variable. This is the required solution of the given equation.

Check the correctness of the solution by substituting it in the given equation.
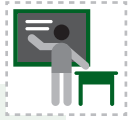
Example 1   Solve: (i) $3a + 8 = 7$ (ii) $\dfrac{2m + 1}{5} = (-3)$ (iii) $\dfrac{2}{3}y - 1 = \dfrac{3}{4}$

(iv) $0.3y + 0.18 = 1.5y - 0.42$ (v) $\dfrac{2p + 1}{3p - 2} = \dfrac{2}{5}$ (vi) $\dfrac{m - 1}{3} + \dfrac{m - 6}{2} = \dfrac{m}{5}$

Solution   (i) $3a + 8 = 7$

♣ 8 is added on the LHS. ∴ transpose it to the RHS with a minus sign.
$3a = 7 - 8 \Rightarrow 3a = (-1)$

♣ 3 is multiplied on the LHS. ∴ transpose it to the RHS as a divisor.

$3a = (-1) \Rightarrow a = \left(\dfrac{-1}{3}\right)$. The solution of the given equation is $\boldsymbol{a = \left(\dfrac{-1}{3}\right)}$.

Check: Substitute $a = \left(\dfrac{-1}{3}\right)$ in the given equation. **LHS** $= 3\left(\dfrac{-1}{3}\right) + 8 = (-1) + 8 = 7 =$ **RHS**.

(ii) $\dfrac{2m + 1}{5} = (-3)$

♣ 5 is the divisor on the LHS. When transposed to the RHS, it becomes a multiplier. $2m + 1 = (-3) \times 5 \Rightarrow 2m + 1 = (-15)$

♣ 1 is added on the LHS. ∴ transpose it to the RHS, with a minus sign.
$2m = (-15) - 1 \Rightarrow 2m = (-16)$

♣ 2 is multiplied on the LHS. ∴ transpose it to the RHS as a divisor.
$\Rightarrow m = (-16) \div 2 \Rightarrow m = (-8)$ The solution of the given equation is m = (−8).

Check: Substitute $m = (-8)$ in the given equation. **LHS** $= \dfrac{2(-8) + 1}{5} = \dfrac{(-15)}{5} = (-3) =$ **RHS**.

(iii) $\dfrac{2}{3}y - 1 = \dfrac{3}{4}$

$\dfrac{2}{3}y = \dfrac{3}{4} + 1$ *(transposing −1 from the LHS to the RHS)*

$\dfrac{2}{3}y = \dfrac{7}{4}$

$y = \dfrac{7}{4} \div \dfrac{2}{3}$ *(transposing $\dfrac{2}{3}$ from the LHS to the RHS)*

$y = \dfrac{7}{4} \times \dfrac{3}{2}$ $\boldsymbol{y = \dfrac{21}{8}}$

Check: Substitute $y = \dfrac{21}{8}$ in the given equation. **LHS** $= \dfrac{2}{3}\left(\dfrac{21}{8}\right) - 1 = \left(\dfrac{7}{4}\right) - 1 = \dfrac{3}{4} =$ **RHS**.

(iv) $0.3y - 1.5y = (-0.42) - 0.18$ *(transposing 0.18 from the LHS and 1.5y from the RHS)*

$-1.2y = (-0.6)$

$y = \left(\dfrac{-0.6}{-1.2}\right)$ *(transposing −1.2 from the LHS to the RHS)*

$\boldsymbol{y = 0.5}$

Check: Substitute $y = 0.5$ in the given equation.
LHS $= 0.3(0.5) + 0.18 = 0.15 + 0.18 = 0.33$; **RHS** $= 1.5(0.5) - 0.42 = 0.75 - 0.42 = 0.33$; ∴ **LHS = RHS**.

(v) $\dfrac{2p+1}{3p-2} = \dfrac{2}{5} \Rightarrow 5(2p+1) = 2(3p-2)$ (*by cross multiplying*)

$10p + 5 = 6p - 4$

$10p - 6p = (-5) - 4$ (*transposing like terms to one side of the equation*)

$4p = (-9) \Rightarrow \boldsymbol{p = \left(\dfrac{-9}{4}\right)}$

Check: Substitute $p = \left(\dfrac{-9}{4}\right)$ in the given equation.

$$\textbf{LHS} = \left(\dfrac{2 \times \dfrac{-9}{4} + 1}{3 \times \dfrac{-9}{4} - 2}\right) = \dfrac{\dfrac{-9}{2} + 1}{\left(\dfrac{-27}{4}\right) - 2} = \dfrac{\left(\dfrac{-7}{2}\right)}{\left(\dfrac{-35}{4}\right)} = \dfrac{-7}{2} \times \dfrac{4}{-35} = \dfrac{2}{5} = \textbf{RHS}$$

(vi) $\dfrac{m-1}{3} + \dfrac{m-6}{2} = \dfrac{m}{5}$

There are two terms on the LHS and variables on both the sides of the equation.

∴ simplify by taking the LCM of all the denominators.

LCM of 3, 2 and 5 is 30. Multiply each term by the LCM, to get:

$$\dfrac{m-1}{3} \times 30 + \dfrac{m-6}{2} \times 30 = \dfrac{m}{5} \times 30$$

$10(m-1) + 15(m-6) = 6m$ (*cancelling common factors*)

$10m - 10 + 15m - 90 = 6m$

$25m - 6m = 100$ (*transposing like terms to one side of the equation*)

$19m = 100$

$$\boldsymbol{m = \dfrac{100}{19}}$$

Check: Substitute $m = \dfrac{100}{19}$ in the given equation.

$$\textbf{LHS} = \dfrac{\dfrac{100}{19} - 1}{3} + \dfrac{\dfrac{100}{19} - 6}{2} = \dfrac{27}{19} - \dfrac{14}{38} = \dfrac{40}{38} = \dfrac{20}{19}; \quad \textbf{RHS} = \dfrac{\dfrac{100}{19}}{5} = \dfrac{100}{95} = \dfrac{20}{19}; \text{ Therefore, } \textbf{LHS = RHS.}$$

Rapid Check I

Solve: (i) $x + 4 = 21$ (ii) $y - 8 = 2$ (iii) $3t = 9$ (iv) $4m = (-12)$

(v) $2m - 3 = 5$ (vi) $2(m+1) = 3(m-1)$ (vii) $3y = \dfrac{1}{3}$ (viii) $2x = 0$

(ix) $0.5y = (-1.25)$ (x) $0.12n + 0.5 = (-0.7)$

Solve the following equations.

(i) $3t - 11 = 7$

(ii) $2y - 5 = (-3)$

(iii) $5m - 3 = 3m + 5$

(iv) $2x - 7 = 3x - 11$

(v) $0.3x - 0.75 = 1.2x - 0.12$

(vi) $0.18(y - 1) = 0.24(2y - 3)$

(vii) $7m - 3(m - 2) = 2(3m - 5)$

(viii) $0.01(t - 0.2) + 0.09t - 0.08 = 0$

(ix) $-2x - (x - 1) + 8 = 0$

(x) $\dfrac{2m - 5}{9} = 3 + 2m$

(xi) $2k - 3(k - 1) + \dfrac{5}{2} = 0$

(xii) $\dfrac{3m}{1 - 2m} + \dfrac{3}{8} = 0$

(xiii) $\dfrac{x - 3}{x - 5} = \dfrac{5}{6}$

(xiv) $\dfrac{2s - 5}{s + 2} = \dfrac{3}{2}$

(xv) $\dfrac{x}{3} - \dfrac{2}{5} = \dfrac{2x}{15} - \dfrac{3}{5}$

(xvi) $\dfrac{x}{2} - \dfrac{x}{3} + \dfrac{x}{4} = \dfrac{5}{12}$

(xvii) $\dfrac{2x - 9}{8} - \dfrac{x - 1}{6} = \left(\dfrac{-x}{12}\right)$

(xviii) $(x + 2)(x + 3) - (x + 2)(x - 3) = 0$

(xix) $(2y + 1)(y - 3) - 3y(y + 2) = y(2 - y) + 10$

(xx) $\dfrac{3}{5}x + \dfrac{2}{3}x - \dfrac{1}{3} = \dfrac{14}{15}x$

(xxi) $\dfrac{2k - 3}{2k + 1} = \dfrac{3k - 5}{3k + 2}$

(xxii) $\dfrac{t + 1}{2} - \dfrac{t - 3}{3} = \dfrac{2t + 5}{6}$

(xxiii) $\dfrac{1}{y - 1} - \dfrac{2}{y + 3} = 0$

(xxiv) $\dfrac{1}{3x - 1} - \dfrac{1}{2x - 3} = 0$

(xxv) $\dfrac{2m - 4}{6} - m = 3\dfrac{1}{3} - \dfrac{m}{12}$

8.3 Applications of linear equations

Many problems in arithmetic, sciences and social sciences can be solved easily using algebra. The unknown quantity in a problem is represented by a variable, say **x** or **y**. Then the condition in the problem is symbolically expressed in the form of an equation using that variable. The solution of the equation gives the value of the unknown quantity.

Let us now consider some examples on application of linear equations.

Solved Examples
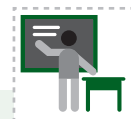
Example 2

The sum of two numbers is 54. If one of them is twice the other, find the numbers.

Solution

Let the smaller number be x.

The larger number = $2 \times$ smaller number = $2x$ (*given that the larger number is 2 times x*)

The sum of two numbers is $x + 2x = 54$ (*given*)

Solve the equation $x + 2x = 54$, to get $3x = 54 \Rightarrow x = 54 \div 3 = 18$

The smaller number is 18 and the larger number is two times 18, which is $2 \times 18 = 36$.

The required numbers are **18** and **36**.

Check: $18 + 36 = 54$

Example 3

When six times a number is reduced by 9, it becomes 45. Find the number.

Solution

Let the required number be x.

Six times the number reduced by 9 becomes 45.   (*given*)

Therefore, $6x - 9 = 45$

$6x = 45 + 9$

$6x = 54$

$x = 54 \div 6 = 9$

Check: $6x - 9 = 6(9) - 9 = 54 - 9 = 45$

The required number is **9**.

Example 4	Two numbers are in the ratio 2 : 3. If 3 is added to the numbers, the ratio changes to 3 : 4. Find the numbers.
Solution	Let the two numbers be $2x$ and $3x$.

If 3 is added to the numbers, the new numbers are $2x + 3$ and $3x + 3$.

The ratio changes to 3 : 4, therefore $2x + 3 : 3x + 3 :: 3 : 4$

$$\Rightarrow \frac{2x + 3}{3x + 3} = \frac{3}{4} \Rightarrow 4(2x + 3) = 3(3x + 3)$$
$$8x + 12 = 9x + 9$$
$$12 - 9 = 9x - 8x$$
$$3 = x$$

Therefore, $2x = 6$ and $3x = 9$. The numbers are **6** and **9**.

Check: $6 : 9 = 2 : 3$ (*given*) and $6 + 3 : 9 + 3 = 9 : 12 = 3 : 4$

Example 5 At a contributory dinner party, each of the vegetarians paid ₹125 and each of the non-vegetarians paid ₹175. The total collection was ₹6100. If there were 8 more vegetarians than non-vegetarians, find the total number of people who attended the party.

Solution Let the number of vegetarians be v.

Then according to the problem, the number of non-vegetarians = $v - 8$

Amount paid by vegetarians = ₹125 × v or $125v$

Amount paid by non-vegetarians = ₹175 × ($v - 8$) = ₹175 ($v - 8$)

The total amount collected is ₹6100. Therefore, $125v + 175 (v - 8) = 6100$

$$125v + 175v - 1400 = 6100$$
$$300v = 6100 + 1400$$
$$300v = 7500$$
$$v = 7500 \div 300 = 25$$

The number of vegetarians is 25; The number of non-vegetarians is $(25 - 8) = 17$

Therefore, the total number of people who attended the party is $25 + 17 = $ **42**.

Check: ₹$(125 \times 25 + 175 \times 17) = $ ₹$(3125 + 2975) = $ ₹6100

Example 6 The sum of the digits of a 2-digit number is 9. If the number formed by reversing its digits is 27 less than the original number, find the original number.

Solution The sum of the digits of the 2-digit number is 9.

Let the ones digit be x. Then the tens digit is $9 - x$.

Therefore, the original number is $10(9 - x) + x$.

When the digits are reversed, the new number formed = $10x + (9 - x)$

The new number is 27 less than the original number   (*given*)

$$\Rightarrow 10x + (9 - x) = 10(9 - x) + x - 27$$
$$10x + 9 - x = 90 - 10x + x - 27$$
$$9x + 9 = 63 - 9x$$
$$9x + 9x = 63 - 9$$
$$18x = 54$$

Check: $63 - 36 = 27$

$$x = 54 \div 18 = 3$$

Therefore, the ones digit is 3; The tens digit is $9 - 3 = 6$. The original number is **63**.

Example 7

The sum of the ages of Raj and Ben is 37 years. Five years ago, Raj's age was twice that of Ben. Find their present ages.

Solution

Let the present age of Ben be x years.

	Ben's age (in years)	Raj's age (in years)
Present	x	$37 - x$ (*Given sum of ages is 37*)
5 years ago	$x - 5$	$(37 - x) - 5 = 32 - x$

According to the problem, $32 - x = 2(x - 5)$

$$32 - x = 2x - 10$$
$$32 + 10 = 2x + x$$
$$42 = 3x$$
$$x = 42 \div 3 = 14$$

Therefore, Ben's present age is **14 years**; Raj's present age is $(37 - 14) =$ **23 years**

> Check: $(23 - 5) = 18 = 2 \times (14 - 5)$

Example 8

The numerator of a fraction is 5 less than its denominator. If 2 is subtracted from the numerator and 2 is added to the denominator, the fraction becomes $\frac{2}{5}$. Find the original fraction.

Solution

Let the numerator of the fraction be x. Then the denominator is $x + 5$.

According to the problem, new numerator $= x - 2$; New denominator $= x + 5 + 2 = x + 7$

New fraction $= \dfrac{x - 2}{x + 7} = \dfrac{2}{5}$ (*given*)

$\Rightarrow 5(x - 2) = 2(x + 7)$

$$5x - 10 = 2x + 14$$
$$5x - 2x = 10 + 14$$
$$3x = 24 \Rightarrow x = 8$$

Therefore, the original numerator is 8 and the original denominator is $(8 + 5) = 13$

The original fraction is $\dfrac{8}{13}$.

> Check: In $\dfrac{8}{13}$, $8 = 13 - 5$. Also, new fraction $= \dfrac{6}{15} = \dfrac{2}{5}$

Example 9

Ramesh travels from Town A to Town B at an average speed of 45 km/h and returns at an average speed of 55 km/h. If the total journey took 8 hours excluding stops, find the distance between Town A and Town B.

Solution

Let the distance between Town A and Town B be x km.

The average speed of travel for onward journey from Town A to Town B is 45 km/h.

Therefore, time taken for onward journey is $\dfrac{x}{45}$ hours $\left(\because time = \dfrac{distance}{speed} \right)$

The average speed of travel for return journey from Town B to Town A is 55 km/h

Therefore, time taken for return journey is $\dfrac{x}{55}$ hours .

Total time taken = 8 hours (*given*). $\therefore \dfrac{x}{45} + \dfrac{x}{55} = 8$. The LCM of 45 and 55 is 495.

$$\dfrac{x}{45} + \dfrac{x}{55} = 8 \Rightarrow \dfrac{11x + 9x}{495} = 8 \Rightarrow \dfrac{20x}{495} = 8 \quad \Rightarrow \quad 20x = 8 \times 495 \quad x = \dfrac{8 \times 495}{20} = 198$$

Therefore, the distance between Town A and Town B is **198 km**.

Check: Total time = Time for onward journey + Time for return journey $= \left(\dfrac{198}{45} + \dfrac{198}{55} \right)$
$= (4.4 + 3.6) \text{ h} = 8\text{h}$

Rapid Check II

Answer the following questions.

(1) Find two numbers whose sum is 64 and difference is 4.

(2) Tia's age is *d* years while Dia's is (*d* – 6) years. In 10 years, Dia's age will be two-thirds Tia's age. Find Dia's present age.

(3) Five times a number decreased by 6 is 114. Find the number.

(4) The sum of the digits of a 2-digit number less than 20 is 5. Find the number and the number formed by reversing its digits.

(5) Find the number one-third of which is 29.

Exercise 8.2

1 The difference obtained when 8 is subtracted from eight times a number is 27 more than three times the number. Find the number.

2 Divide 125 into two parts such that twice one part is equal to thrice the other part.

3 What number must be subtracted from 35 so that the difference is 6 times the number subtracted?

4 One-third of a number added to four-fifths of itself gives 34. What is the number?

5 Find the 3 consecutive integers whose sum is 495.

6 Find the 3 consecutive odd numbers whose sum is 987.

7 Find the measure of the angles of a triangle which are in the ratio 2 : 3 : 4.

8 The digit in the ones place of a number is twice the digit in its tens place. If 9 is added to the number, the digits of the sum obtained are reverse of those of the number. Find the number.

9 A man leaves half of his property to his wife, one-sixth of his property to each of his two daughters and the remaining ₹45,000 to charity. Find the value of the man's property.

10 The sum of three consecutive multiples of 11 is 1023. Find them.

11 The sum of a number and 6% of itself is 42.4. Find the number.

12 A father is four times as old as his son. In four years time, he will be three times as old as his son. What are their present ages?

13 Mahesh walked from Town A to Town B in 6 hours. On his return journey, he increased his average speed by 1 km/h and covered the distance in 5 hours. Find the distance between the two towns.

14 A certain sum of money is divided among Shreya, Linda and Vipin. Shreya gets one-third of the amount, Linda gets thrice as much as Vipin and Vipin gets ₹1200 less than Shreya. Find the share of each.

15 Vivan is 6 years older than Mira. One half of Vivan's age exceeds one-third of Mira's age by 4 years. Find their ages.

16 Sara had some 2-rupee and 5-rupee coins in her money box. She exchanged them for some 10-rupee coins. If the number of 5-rupee coins is one less than the number of 2-rupee coins, then find the number of 5-rupee coins.

Challenge Yourself

I. A bag of 100 kg of tea made up of leaf and dust tea is bought for ₹17,250. If leaf tea costs ₹210 per kg and dust tea costs ₹85 per kg, find the quantity of leaf and dust tea in the bag.

II. Hari has twice as many blue marbles as green ones. Sharat gives him 60 green marbles and now Hari has the same number of green and blue marbles. Find the number of green and blue marbles he had initially.

Skills Section (applying, analysing and evaluating)

Mental Maths

Answer the following.

1 Which value of x makes $6x - 7 = 9x - 19$ true?

2 Find the number, if the sum obtained on adding 10% of the number to itself is 121.

3 The perimeter of a rectangle is 36 cm. If its length is 4 cm more than its breadth, find the length of the rectangle.

4 Two numbers are in the ratio 2 : 3. If their sum is 55, find the numbers.

5 In a pair of supplementary angles, one angle is three and a half times the other. Find their measures.

Multiple Choice Questions

Choose the correct answer.

1 The value of x which satisfies the equation $\dfrac{x}{3} + 2 = \dfrac{1}{3}$ is: (a) 5   (b) −1   (c) 1   (d) −5

2 The sum of three numbers which are in the ratio 2 : 5 : 7 is 28. The three numbers are:
(a) 4, 10, 14   (b) 10, 4, 14   (c) 2, 5, 7   (d) 6, 15, 21

3 One-fifth of a rational number added to 1 is equal to $\frac{2}{3}$. The original rational number is:

(a) $\frac{7}{3}$ (b) $-\frac{7}{3}$ (c) $-\frac{5}{3}$ (d) $\frac{5}{3}$

4 The sum of the digits of a two-digit number is 7. If 27 is subtracted from it, the digits are reversed in the difference. The product of the digits is:

(a) 10   (b) 9   (c) 11   (d) 8

5 Anu had three times as much money as Neena. When Anu gave ₹30 to Neena, she had only twice as much as Neena. The money both had initially was:

(a) 180, 60   (b) 150, 50   (c) 240, 80   (d) 270, 90

Mixed Bag

1 Solve:

(i) $\frac{3y}{5} = \left(-\frac{3}{7}\right)$

(ii) $\frac{x}{5} - \frac{x}{7} = \frac{1}{35}$

(iii) $2(y-3) + 5y = 4(2y-3) + 8$

(iv) $2 + \frac{x}{3} = 2\frac{1}{3}x - 8$

(v) $\frac{m}{m+16} + 5 = 8$

(vi) $(a-2)^2 - 3a = (a-3)^2$

(vii) $\frac{n}{3} - \frac{3n}{5} + \frac{2n}{15} = \frac{2}{45}$

(viii) $\frac{9y+5}{9y-3} = \left(\frac{-2}{3}\right)$

(ix) $\frac{3-4x}{9} - \frac{3x-2}{3} = 2\frac{1}{9} - \frac{x}{3}$

(x) $\frac{3x-2}{4x-3} = \frac{6x+1}{8x-3}$

(xi) $\frac{x+8}{8} + 2 = \frac{2x-1}{9}$

(xii) $4.75x - 3.75 + 1.25x = 2.25x$

2 The sum of the digits of a 2-digit number is 8. When 18 is added to the number, the digits of the sum obtained are reverse of those of the number. Find the original number.

3 The tens digit of a number is four times its ones digit. If 27 is subtracted from the number, the digits of the difference obtained are reverse of those of the number. Find the number.

4 A shopkeeper incurs a loss of 10% by selling a toy at ₹459. At what price must he sell it in order to get a profit of 10%?

5 The daily wages of a full-timer and part-timer are ₹160 and ₹120 respectively. If their wages were increased by an equal amount, the full-timer's wage becomes $\frac{6}{5}$ of the part-timer's wage. Find the increase in their wages.

6 The base of a triangle is two-fifths its altitude. If the base is increased by 2 cm and the altitude by 1.5 cm, the area increases by 34 cm². Find the base and altitude of the triangle.

7 The numerator of a rational number is 5 more than its denominator. If 3 is added to the fraction, the new fraction is equivalent to $4\frac{1}{3}$. Find the original fraction.

8 The difference between the squares of two consecutive integers is 47. Find the numbers.

9 The ratio of the ages of two sisters is 3 : 7. In ten years, the ratio of their ages becomes 2 : 3. Find their present ages.

10 The numerator of a fraction is 7 less than the denominator. If one and one-third is added to it, the fraction obtained is $\frac{14}{9}$. Find the original fraction.

III. The length of a rectangle is two and half times its breadth. If the length is decreased by 2 cm and the breadth is increased by 1.5 cm, the area increases by 11 cm². Find the length and breadth of the original rectangle.

IV. In a cinema hall, Category 1 tickets are priced at ₹250 per ticket, Category 2 at ₹200 per ticket and Economy at ₹150 per ticket. The number of Category 2 tickets was fifty more than that of the Category 1 and 100 less than that of the Economy class. If the total amount collected on a particular day was ₹77,500, find the number of tickets sold of each class.

Higher Order Thinking Skills

1 There are a certain number of flowers and a certain number of bees in a garden. If one bee sits on each of the flowers, 8 bees are left without a flower. If two bees sit on a flower, 8 flowers are left out. Find the number of flowers and that of bees.

2 A photograph measures 15 cm × 9 cm. It is to be framed in wood after pasting it on a slightly larger white board. The cost of wooden frame is ₹6 per cm. What would be the width of the border (white space) on all four sides of the photograph, if the cost of the frame is ₹312?

Problem Solving

1 John had a certain number of cupcakes to deliver in 3 different places. At a bakery, he delivered half of the cakes, then at a school canteen, he delivered half of the remaining cupcakes and then delivered half of the remaining cupcakes at a restaurant. If he is left with 80 cakes, how many cakes did he have initially?

2 A vending machine accepts one rupee, two rupee and five rupee coins. If I bought a packet of chips and a bottle of mango juice for ₹25, how many different combinations of coins can I make to pay the amount using at least one coin of each denomination? Find the least and the maximum number of coins that can be used to make the amount.

Activites Section

Maths Lab

Aim: To understand the rules of transposition in solving equations

Method: Take and cut some green, grey and white chart papers into square pieces of size 2 cm × 2 cm.

On a white piece write the = sign.

On another white piece, write × sign on one side and ÷ sign on the other side.

On a third white piece, write (+) sign on one side and (–) sign on the other side.

On green pieces write numbers from 1 to 9. On light green pieces write the variable m (make at least 3 pieces). Use the pieces to represent the equation $2m + 7 = 3$. Then shift the + 7 cards to the RHS. Turn the + card around while doing so. You would get the minus sign.

$$2 \times \boxed{m} + \boxed{7} = \boxed{3} \rightarrow 2 \times \boxed{m} = \boxed{3} - \boxed{7}$$

Now replace the 3 −7 cards with − 4 cards. Shift the 2 and × cards to the RHS.

Turn around the × card while doing so. 2 × becomes ÷ 2 when transposed to the other side.

$$2 \times \boxed{m} = \boxed{-4} \rightarrow \boxed{m} = \boxed{-4} \div \boxed{2}$$

Now replace 4 ÷ 2 cards with 2 card. You get the solution $m = -2$. $\boxed{m} = \boxed{-2}$

Repeat the activity with more equations.

Observation: When terms are transposed, their operation is changed.

Worksheet

A **Choose the correct answer.**

(1) The sum of 3 consecutive multiples of 7 is 273. One of the 3 numbers is:
(a) 77　(b) 98　(c) 105　(d) 112

(2) The value of x for $\dfrac{x}{4} + 5 = \dfrac{2x}{3}$ is:
(a) 12　(b) −12　(c) 3　(d) −3

(3) The value of x for $-8 = 2x + 4$ is:
(a) 6　(b) −4　(c) −6　(d) 12

(4) The sum of 3 numbers in the ratio 1 : 5 : 3 is 45. The numbers are:
(a) 5, 25, 15　(b) 5, 15, 25
(c) 25, 15, 5　(d) 15, 5, 25

(5) A father is eight times as old as his son. In 10 years, he will be three times as old as his son. The age of son is:
(a) 4 yrs　(b) 5 yrs　(c) 3 yrs　(d) 6 yrs

B **Answer the following:**

(6) The sum of 5 consecutive integers is 1000. Find the numbers.

(7) If 5 is subtracted from 3 times a certain number n, the result is 16. Find n.

(8) If two-fifths of a number added to 4 gives 36, find the number.

(9) The angles of a triangle are in the ratio 3 : 5 : 10. Find the measure of each of the angles.

(10) How old is a man whose age fifteen years ago was two-fifths of what it will be in 6 years?

C **Answer the following:**

(11) Solve: $\dfrac{x-1}{3} + \dfrac{2x-3}{5} = \dfrac{3x-1}{3} - \dfrac{2x-5}{15}$

(12) Solve: $2x + 2 + \dfrac{3x-2}{5} - \dfrac{2x-5}{7} = 0$

(13) Find two consecutive numbers such that the difference of their squares is 45.

(14) Find the number which when doubled exceeds its quarter by 14.

(15) In an isosceles triangle, the equal sides exceed twice the unequal side by 2 cm. If the perimeter of the triangle is 34 cm, find the lengths of its sides.

Crack it!

(1) Divide 75 into two parts such that two times one part falls short of 100 by the same amount as 200 falls short of 5 times the other part.

(2) Arnab has ₹180 and Benu has ₹162. If Benu gives a part of her money to Arnab, he will have 4/5th of what Benu has. What amount did Benu give to Arnab?

17 Data and its Representation

At the end of the lesson you will be able to:

- understand data and its types.
- group data and construct frequency distribution table.
- interpret and construct bar graphs, histograms and pie charts.

Get Started

A. Handling data in real life

1 For a class project in **statistics**, I have to find out about the different kinds of snacks liked by the students of our class.

2 The information you are collecting is called '**data**'.

How are you planning to collect **data**?

3 I have made a **questionnaire**. I will **collect** the answers. Then **organize it** and **tabulate** it.

4 Yes! Then you can display it as a **bar graph**.

Interpreting the results is easy then.

You will be able to tell things like which snack is preferred most and which is preferred the least.

Discuss and list the areas where statistics is used in real life.

B. Check what you know

(1) The temperatures for a week in a city in May were 36 °C, 38 °C, 42 °C, 41 °C, 38 °C, 40 °C and 37 °C. What was the average temperature for the week?

(2) The following are the heights of 10 students in a class: 1.35 m, 1.40 m, 1.38 m, 1.32 m, 1.42 m, 1.40 m, 1.38 m, 1.36 m, 1.46 m and 1.44 m. Find the median height.

(3) Find the mean, median and mode for the following test scores of 30 students.
3, 8, 7, 9, 8, 6, 5, 4, 7, 8, 8, 7, 5, 3, 9, 10, 10, 9, 4, 8, 7, 6, 4, 6, 7, 5, 8, 4, 3, 5.

Concepts Section

17.1 What is statistics?

Statistics is a branch of mathematics that deals with the collection, organisation, presentation, analysis and interpretation of data.

Statistics is used in various fields such as natural and social sciences, government activities, business, and so on, which need information in the form of facts and figures. For example, governments use the information about population, collected through census to formulate policies for health and education and plan developmental activities in a state.

Data and its types

Data is a collection of facts in the form of numbers, words, measurements, observations or description of things, for a specific purpose.

Data collected directly from the source is called **primary data**. Data collected from magazines, newspapers, and other reliable sources is called **secondary data**.

The data that is initially collected but not organised is called **raw data**. Raw data can be classified as **qualitative** and **quantitative data**.

Qualitative data is the data that gives descriptive information. Flavours of ice-cream and colours of flowers are some examples of qualitative data.

Quantitative data is the data that is in the form of numbers. The number of cars manufactured, the number of students who passed an examination and the temperature of a place are some examples of quantitative data.

Quantitative data is of two types—**discrete** and **continuous**.

Discrete data is the data which are whole numbers, that is, facts which can be counted.

The number of cars manufactured, the number of ice-cream cones sold and number of runs scored by the players in a match are some examples of discrete data.

Continuous data is the data which cannot be counted, but can be measured.

The heights of students, temperatures and areas are some examples of continuous data.

17.2 Grouping data

We have already learnt to form frequency table for a given set of data using tally marks. When there are a large number of observations in a data, we consolidate the data by dividing it into groups of convenient size and tabulate it using tally marks.

The systematic arrangement of data in a tabular form is called **tabulation**.

The number of times an observation occurs in a data is called **frequency**.

The difference between the highest and the lowest values of a data is the **range**.

The table that lists the observations of a data and records their frequency using tally marks is called the **frequency distribution table**.

The range of values in a data is divided into groups with a fixed number of items. Each such group is called a **class interval**.

In the class interval 0–10, 0 is called the **lower limit** and 10 is called the **upper limit** of the class interval.

The difference between the lower and upper limits of a class interval is called the **class size** or **class width**.

The number of groups and class width are chosen depending on the data and its range. Hence, there are no set rules for choosing the number of groups or their size.

Class intervals are of two types: **overlapping** and **non-overlapping**.

Overlapping intervals

Intervals such as 0–10, 10–20, 20–30 and so on, in which the upper limit of one class is the same as the lower limit of the next class are called *overlapping intervals* or *continuous intervals*. In such intervals, the observations 0 to 9 are included in the interval 0–10, while the observation 10 is included in the interval 10–20 and not in the interval 0–10.

The class size of the interval 0–10 is: **(upper limit–lower limit) = 10–0 = 10**

Non-overlapping intervals

Intervals such as 0–9, 10–19, 20–29 and so on, in which the upper limit of one class is not the same as the lower limit of the next class are called *non-overlapping intervals*. In these types of intervals, the observations 0 to 9 are included in the interval 0–9, while the observations from 10 to 19 are included in the interval 10–19.

The class size of the interval 0–9 is: **(upper limit – lower limit) + 1 = (9–0) + 1 = 10**

Solved Examples

Example 1	The following data represents the marks obtained by 50 students. 38, 42, 45, 42, 48, 34, 23, 26, 28, 41, 30, 17, 15, 21, 25, 37, 38, 46, 45, 42,12, 15, 21, 20, 30, 31, 43, 34, 33, 35, 24, 25, 28, 23, 39, 38, 26, 21, 37, 39, 45, 47, 35, 23, 27, 19, 42, 40, 49, 50. Construct a continuous frequency distribution table.
Solution	The lowest value in the data is 12 and the highest value is 50. Divide the range into 5 continuous class intervals of width 10 marks each, as 10–20, 20–30, 30–40, 40–50 and 50–60.

Class interval	Tally marks	Frequency
10–20	⅟⅟⅟⅟	5
20–30	⅟⅟⅟⅟ ⅟⅟⅟⅟ ⅟⅟⅟⅟	15
30–40	⅟⅟⅟⅟ ⅟⅟⅟⅟ ⅟⅟⅟⅟	15
40–50	⅟⅟⅟⅟ ⅟⅟⅟⅟ IIII	14
50–60	I	1
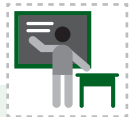
17.3 Bar graphs

A *bar graph* is a graphical representation of data using horizontal or vertical bars of equal width. The length or the height of each bar is proportional to the value of the item it represents. The gap between any two bars should be the same throughout the graph. The *x*- and the *y*-axes are labelled to mark the data represented by them. The scale of the graph and the legend are mentioned clearly. Finally, the bar graph is given a suitable title.

Example 2 Construct a bar graph for the following data of the sales of television sets in a week at a retail shop.

Size (in inches)	14	20	24	32	40	52
Number of TV sets	12	18	16	40	20	14

Solution

(i) Draw the x- and y-axes and mark their point of intersection as the origin O.

(ii) Take the size of the television on the x-axis and the corresponding number of television sets sold on the y-axis.

(iii) Since the range of values is from 12 to 40, take the scale, 1 division = 2 TVs on the y-axis and any suitable width (say 2 divisions) for the bars on the x-axis.

(iv) Draw the bars with heights corresponding to the number of TVs sold as shown in the figure.

(v) Give the title: Sale of television sets in a retail shop.

Sale of television sets in a retail shop

Scale on the y-axis
1 division = 2 TVs
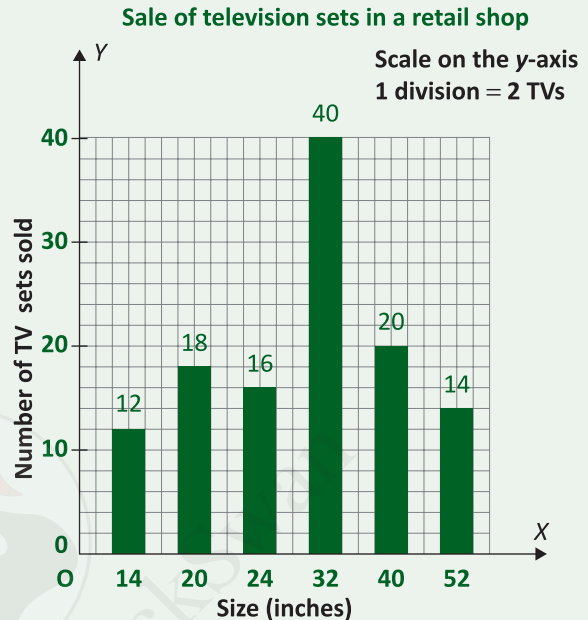
Double bar graph

A *double bar graph* is drawn to compare two quantities having the same units using a single graph. Two bars corresponding to the two data are drawn side by side so that the data is compared at a glance. For example, a double bar graph can be drawn representing day and night temperatures on the same graph, but not of temperature and humidity as they are not measured in the same units. Procedure for drawing a double bar graph is the same as that of a bar graph.

Example 3 The following table gives the averages of maximum (day) and minimum (night) temperatures at a place for four months. Represent the given information using a double bar graph.

Months	January	February	March	April
Max. temp (°C)	28	32	34	36
Min. temp (°C)	24	26	28	30

Solution   (i) Draw the *x*- and *y*-axes and mark their point of intersection as the origin O.

(ii) Take the names of months on the *x*-axis and the corresponding average temperatures (in °C) on the *y*-axis.

(iii) Since the range of values is from 24 to 36, take the scale, 1 division = 2 °C on the *y*-axis and any suitable width (such as 2 divisions) for the bars on the *x*-axis.

(iv) Draw the bars with heights corresponding to the maximum and minimum temperatures for the four months as shown in the figure and shade or colour them differently.

Average maximum and minimum temperatures (in °C) of a place

Scale on the *y*-axis
1 division = 2 °C

Min. temp.

Max. temp.

(v) Give the title: Average maximum and minimum temperatures (in °C) of a place.
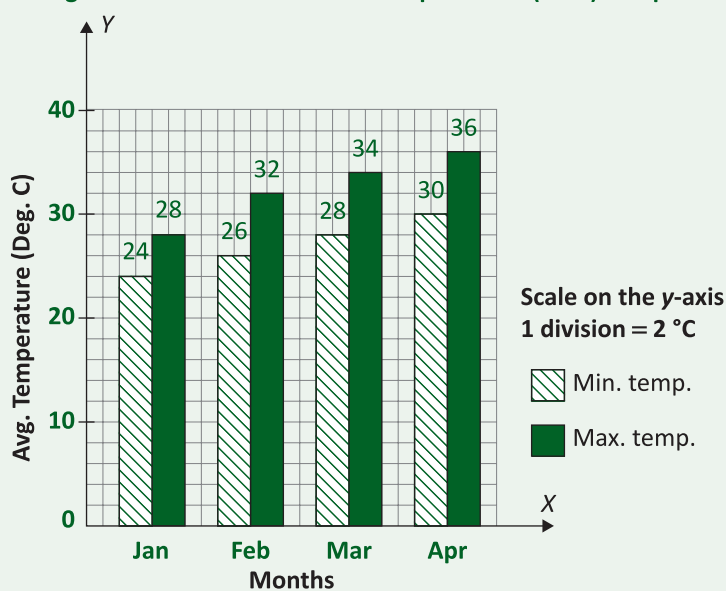
17.4 Histogram

A *histogram* is a graphical representation of grouped data using rectangular bars of different heights placed adjacent to one another. The bases of the rectangles represent the class intervals and the heights represent the frequencies. There is no gap between the bars in a histogram.

Let us draw a histogram for the data in the following table.

Class interval	20–25	25–30	30–35	35–40	40–45
Frequency	1	12	11	9	7

(i) On a graph paper, draw the *x*- and *y*-axes and mark their point of intersection as the origin O.

(ii) Take the weights along the *x*-axis and frequency along the *y*-axis.

(iii) Choose a suitable scale for both the axes. For *x*-axis, choose 1 cm = 1 kg and for *y*-axis, 1 cm = 1 student.

(iv) Write the class intervals on the *x*-axis and number of students on the *y*-axis.

(v) Draw the bars with heights equal to the number of students corresponding to the weights as shown in the figure.

(vi) Give the title: Weights of 40 students of a class.

Weights of 40 students of a class

Scale
x-axis 1 cm = 1 kg
y-axis 1 cm = 1 student
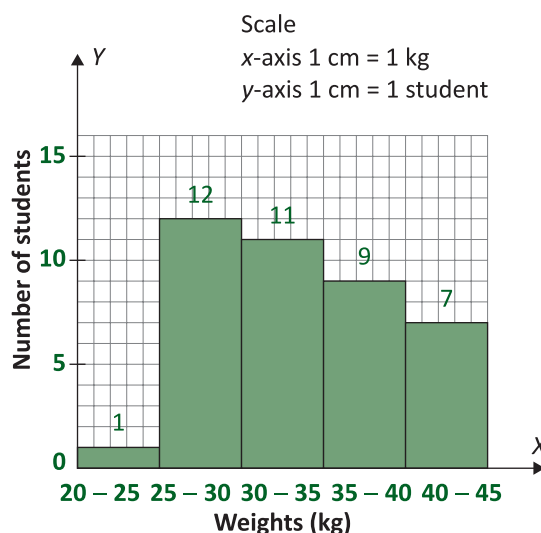
Fig. 17.1

Rapid Check I

Answer the following questions.

(1) Give an example each of discrete data and continuous data.

(2) In the following table, find: (i) the class width of the intervals (ii) the total number of observations

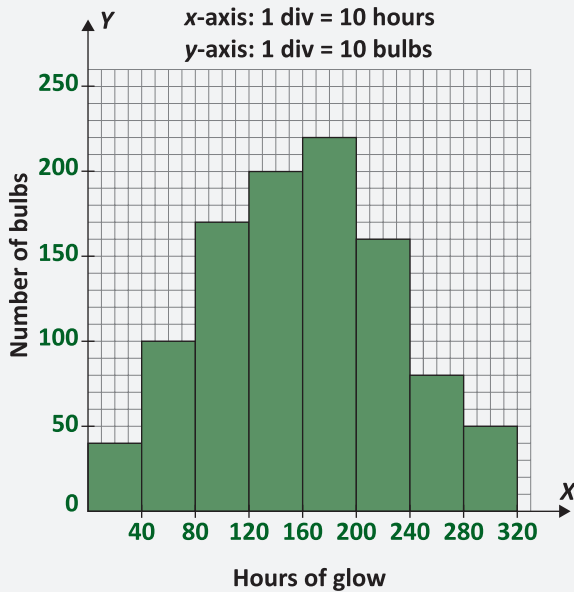| Class interval	0–10	10–20	20–30	30–40	40–50	50–60	60–70
Frequency	2	4	8	8	7	5	4

(3) The first two class intervals of grouped data are given below. Write the next three successive class intervals.

(i) 30–50, 50–70   (ii) 12–18, 18–24

(4) In a set of data, the lowest and the highest values are 15 and 66 respectively. Construct overlapping class intervals with the following class widths.   (i) 10   (ii) 8
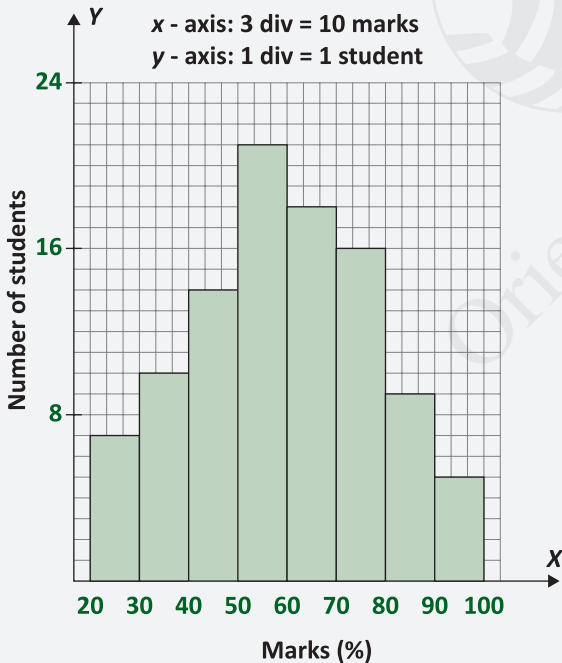

Exercise 17.1

1 Prepare a frequency distribution table for the given data that represents the occurrence of numbers 1 to 6 when a dice was thrown 50 times.
4, 5, 6, 3, 4, 5, 2, 1, 2, 3, 1, 2, 3, 6, 5, 6, 5, 5, 4, 4, 3, 3, 2, 3, 4, 5, 2, 4, 1, 3, 5, 3, 5, 2, 1, 3, 4, 5, 2, 3, 1, 2, 1, 2, 3, 1, 4, 5, 6, 3

2 The following data gives the ages (in years) of female workers in a factory.
21, 18, 19, 22, 34, 36, 43, 42, 53, 56, 23, 24, 25, 19, 18, 20, 21, 21, 22, 23, 26, 28, 32, 31, 34, 32, 42, 40, 41, 43, 45, 42, 50, 52, 53, 50, 48, 48, 36, 35, 23, 25, 43, 38, 36, 37, 28, 19, 20, 19
Form a frequency distribution table with class width 5.

3 The following data shows the prices of mobile phones sold by a mobile shop.
₹5200, ₹6700, ₹2800, ₹3200, ₹9800, ₹14,000, ₹8900, ₹9500, ₹12,000, ₹13,600, ₹7800, ₹6900, ₹5600, ₹4500, ₹4200, ₹5400, ₹8600, ₹12,500, ₹14,800, ₹3200, ₹2500, ₹4300, ₹7000, ₹14,800, ₹4300, ₹5000, ₹2900, ₹3900, ₹16,900, ₹17,500, ₹5800, ₹3800, ₹2700, ₹4800, ₹9000, ₹11,000, ₹12000, ₹3000, ₹8000, ₹6000
Prepare a frequency distribution table with overlapping class intervals.

4 The marks of 50 students are as follows.
48, 50, 38, 28, 19, 20, 37, 42, 49, 50, 50, 39, 29, 19, 20, 22, 23, 28, 32, 34, 45, 45, 32, 30, 28, 30, 31, 41, 21, 38, 37, 45, 46, 43, 39, 32, 33, 34, 33, 23, 23, 24, 28, 42, 34, 35, 36, 43, 42, 41

(i) Prepare a frequency distribution table.

(ii) Represent the information in the form of a histogram.

5 1000 bulbs were tested for the number of hours they will glow and the results are represented in the following histogram. Study the histogram and answer the given questions.

(i) What is the size of the class interval?

(ii) Find the range of hours in which maximum number of bulbs glow.

(iii) A bulb is considered defective if it glows for less than 40 hours. Find the number of defective bulbs.

(iv) How many bulbs glow between 80 and 120 hours?

(v) How many bulbs glow for more than 200 hours?

The number of hours 1000 bulbs glow

x-axis: 1 div = 10 hours
y-axis: 1 div = 10 bulbs

Hours of glow

Study the histogram and answer the following questions.

(i) What is the class size?
(ii) How many students wrote the examination?
(iii) What percentage of students scored marks above 80%?
(iv) If 40 marks is the minimum for passing, how many students failed the examination?

7 The following histogram represents the salary of 42 employees in a small firm.

Salary of employees in a small firm

y-axis: 1 div = 1 person
x-axis: 1 div = ₹ 5000

Salary (in '000 rupees)

6 The following histogram represents the marks obtained by a set of students in an examination.

Marks obtained by a set of students in an examination

x - axis: 3 div = 10 marks
y - axis: 1 div = 1 student

Marks (%)
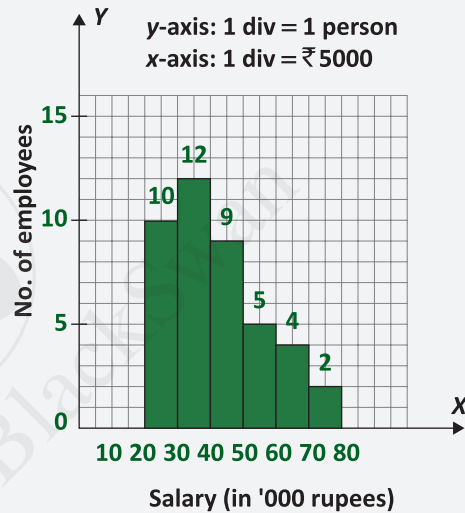
Study the histogram and answer the questions that follow.

(i) Find the number of employees in the firm who earn ₹20,000 to ₹40,000.
(ii) Find the number of employees who earn greater than or equal to ₹50,000.
(iii) Find the number of employees who earn less than ₹50,000.
(iv) Find the percentage of employees (correct to one decimal place) who earn more than ₹50,000.

8 Construct a histogram for the following distribution.

Class interval	0–10	10–20	20–30	30–40	40–50	50–60
Frequency	4	7	9	12	8	3

9 Construct a histogram for the information given in the following table.

Height (in cm)	166–169	169–172	172–175	175–178	178–181
Number of players	2	5	8	6	4

10 In a shoe shop the following sizes of shoes are sold in a day. Draw a histogram to represent the data.

Size of shoes	0–3	3–6	6–9	9–12	12–15
Number of shoes	15	25	40	15	5

17.5 Pie chart

A **pie chart** or **pie diagram** is a diagrammatic representation of information in a circle which is divided into sectors proportionate to the size of information they represent. It is visually appealing and easy to interpret and is also called a **circle graph**.

Popularity of sports

■ Football
□ Basktball

Fig. 17.2a

The whole circle represents the full range of data. The circle is divided into many sectors, each representing one part of the data. The area of the sector is proportional to the part of the information that it represents. This type of graph is widely used in business, media and advertisements.

Subject preferred by students

■ PT
◨ Arts
▦ English
◼ Maths
□ Science

Fig. 17.2b

For example, the pie chart in Fig 17.2a represents the favourite sports of a group of students. The chart is divided into two halves with different filling patterns. From the chart, we infer that 50% of the students like football and 50% like basketball.
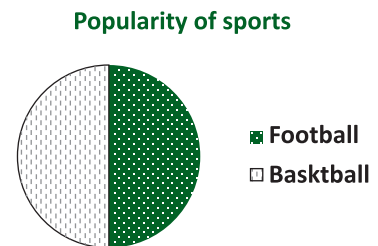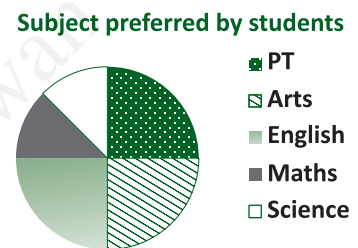
The pie chart in Fig. 17.2b represents the favourite subjects of a group of students. The chart is divided into five parts patterned differently. The legend shows the subjects represented by each filling pattern. We can see that PT, Arts and English are liked by equal number of students. Maths and Science are liked by equal number of students. Suppose that there were 40 students in a class.

From the chart, we infer that $\frac{1}{4}$ of the 40 students like PT. Therefore, the number of students who like PT is: $\frac{1}{4} \times 40 = 10$. We can infer and calculate that 10 students like Arts and 10 students like English. Of the remaining $\frac{1}{4}$, equal number of students like Science and Maths.

Therefore, the number of students who like Science and Maths is 5 each.

Figure 17.3 shows the pie chart representing the annual sales figures of a company. The whole circle represents the total sales in the year and each sector represents a part of the sale, the sales in a quarter (quarter means a 3-month period). From the graph, we can see that the sales were maximum in the 1st quarter and minimum in the 4th quarter.
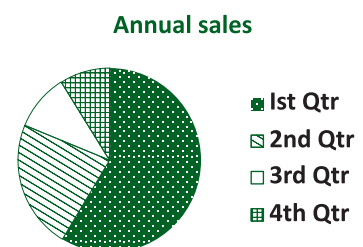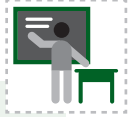
Annual sales

■ Ist Qtr
◨ 2nd Qtr
□ 3rd Qtr
▦ 4th Qtr

Fig. 17.3

Let us understand the construction and interpretation of a pie chart through the given examples.

Example 4 The sale percentages of books in a day at a bookshop in the city are:
Poetry: 20%; Technology: 30%; Travel: 10 %; Fiction: 25 % and Sports: 15 %.
Draw a pie chart to represent the data.

Solution

As the data is expressed in percentage, the whole circle represents their sum, 100%. The pie chart to represent the given data will be drawn by dividing the circle into 5 sectors representing the 5 items of information.

The angle at the centre of the circle is 360°, which represents the complete data.

(1) To divide the circle into sectors, calculate the central angles corresponding to each item of the data.

♣ Angle representing Poetry = 20% of 360° = 72°
♣ Angle representing Technology = 30% of 360° = 108°
♣ Angle representing Travel = 10% of 360° = 36°
♣ Angle representing Fiction = 25% of 360° = 90°
♣ Angle representing Sports = 15% of 360° = 54°

Note: 72° + 108° + 36° + 90° + 54° = 360°
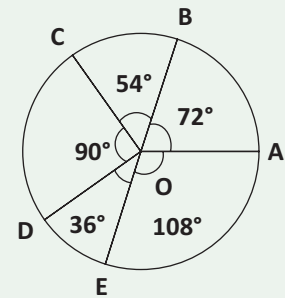
(2) Draw a circle with centre O and any convenient radius.

From the centre, draw the radius OA.

(3) Using a protractor, draw ∠AOB = 72°,
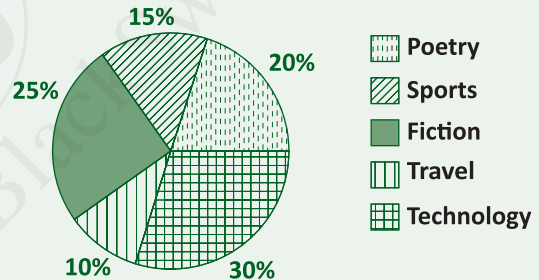∠BOC = 54°, ∠COD = 90°,
∠DOE = 36° and ∠EOA = 108°.

(4) On the diagram mark the percentages and the names of the items.

(5) Colour or fill the sectors differently. The completed pie chart is as shown in Fig. 17.6.

Sales of books

Poetry
Sports
Fiction
Travel
Technology

Example 5 The given pie chart represents the percentage sales of smartphones of four different brands at a mobile shop in a week. Find:
  (i) the most popular brand
  (ii) the least popular brand
  (iii) the total number of phones sold if 180 phones of Brand D were sold
  (iv) the number of phones of each brand (other than Brand D) that were sold.

Smartphone sales
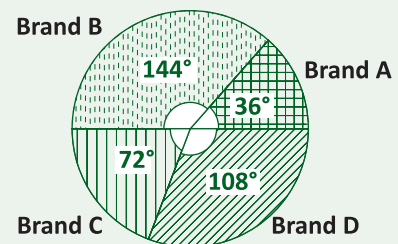
Solution

From the pie chart, we infer that:

  (i) The most popular brand is Brand B.

  (ii) The least popular brand is Brand A.

(iii) The angle of the sector representing Brand D is 108°. It is given that 180 phones of Brand D were sold.

If 108° represents 180 phones, the number of phones the whole circle (360°) will represent is:

$$\frac{180}{108°} \times 360° = 600$$

The total number of phones sold is **600**.

(iv) The number of phones of each brand (other than Brand D) sold:

Brand A = $\frac{36°}{360°} \times 600 = $ **60**; Brand B = $\frac{144°}{360°} \times 600 = $ **240**;

Brand C = $\frac{72°}{360°} \times 600 = $ **120**

The number of phones of each brand (other than Brand D) that were sold is:
Brand A: **60**; Brand B: **240** and Brand C: **120.**

Rapid Check II

The following table gives the career choice of a group of class 12 students.

Career choice	Medicine	Engineering	Commerce	Sciences	Humanities
Number of students	10	40	50	20	30

(i) Calculate the percentage of students who chose sciences and humanities respectively.
(ii) If a pie chart is drawn, calculate the angle of the sector represented by commerce.

Exercise 17.2

1 The following pie chart represents the number of trees in an agricultural farm. Study the pie chart and answer the following questions.

Trees in a farm

Neem 6, Mango 22, Guava 18, 15, 7, 4 Jackfruit, Tamarind, Lemon
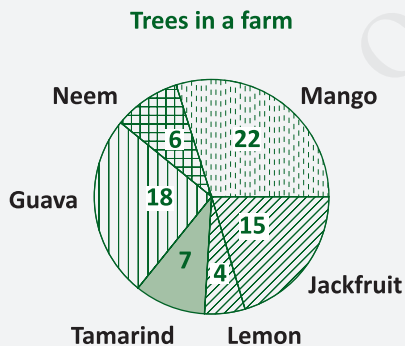
(i) What is the total number of trees in the farm?
(ii) What percentage of the trees are guava trees?
(iii) Calculate the angle of the sector represented by the lemon trees.

2 The following table represents the number of tickets in five halls at a multiplex theatre.

Hall	A	B	C	D	E
Tickets sold	450	150	300	250	350

Represent the information on a pie chart and answer the following questions.

(i) Find the total number of tickets sold for a show if all the tickets are booked.
(ii) If the cost of a ticket is ₹120 in the Halls B, C and D and ₹150 in the Halls A and E, find the total amount earned for a show if all the tickets are booked.
(iii) Calculate the angle of the sector represented by the tickets available in Hall C.
(iv) If only 60% of the tickets are sold for a show in each hall, calculate the total

number of tickets sold for a show in Halls A and E.

3 The given pie chart represents the valid votes obtained by four candidates for the post of president of a club in a city. Study the pie chart and answer the following questions if the total number of valid votes polled is 960.
   (i) Who has won the election? How many votes did the winning candidate obtain?
   (ii) By how many votes did the winning candidate defeat the nearest contestant?

(iii) Which candidate got the least number of votes? How many votes were polled for the candidate?

Votes polled

Q (3)
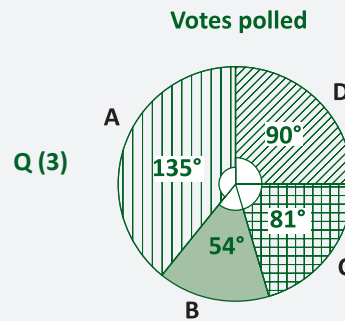
4 The number of plants sold in a week in a nursery is as follows. Represent the information on a pie chart.

Plants	Rose	Jasmine	Hibiscus	Sunflower	Marigold
Number of plants	80	50	60	20	30

5 150 people had registered with a travel agency for a tour. The following table shows the languages spoken in the group. Represent the information in the form of a pie chart.

Languages	Tamil	Hindi	Marathi	Telugu	Gujarati	Malayalam
Number of people	10	60	20	15	30	15

6 The following table shows the count of a few mammals in a sanctuary. Represent the information on a pie chart.

Mammals	Elephant	Bear	Giraffe	Cheetah	Tiger
Number	70	90	20	15	30

Skills Section (applying, analysing and evaluating)

Mental Maths

Answer the following.

1 The pie chart represents the sales of cars at a retail showroom in a year. Study the pie chart and answer the given questions without actually calculating.
   (i) Did any one quarter account for 50% of the annual sales?
   (ii) Which quarter accounted for a little more than a quarter of annual sales?
   (iii) Which quarter accounted for 20% of the annual sales?

Cars sold
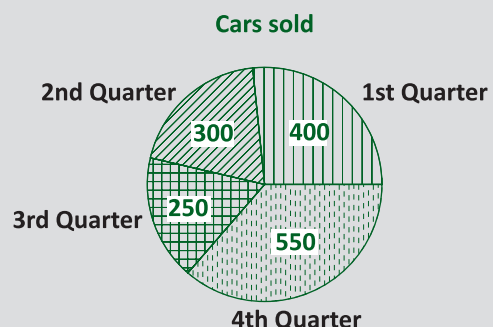
2 The bar graph represents information about the number of students admitted to various courses in a college. Study the graph and answer the given questions.

(i) How many students were admitted to course in physics?

(ii) How many students were admitted to course in visual communications?

(iii) How many more students were admitted in commerce as compared to corporate studies?

Number of students admitted to various courses

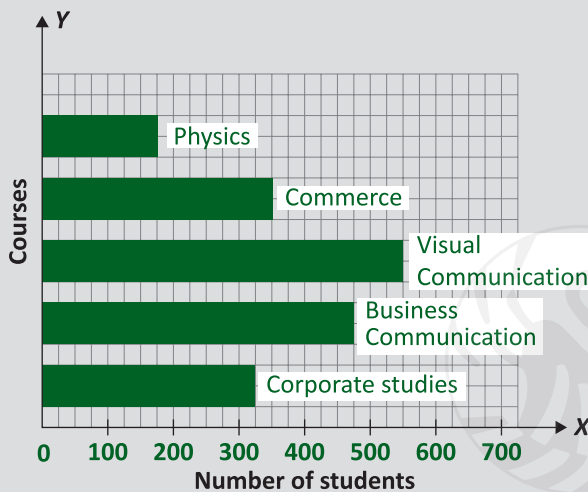**3** The histogram represents the weights (in kg) of people who have enrolled for a fitness programme. Study the histogram and answer the given questions.

(i) What is the class size?

(ii) How many people weigh greater than or equal to 70 kg?

(iii) How many people weigh more than 50 kg but less than 90 kg?

Weights of people enrolled for a fitness programme
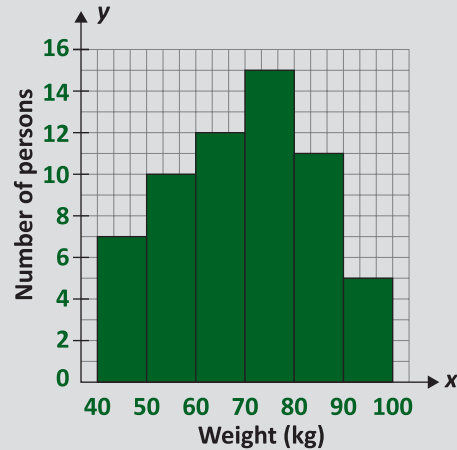
4 Study the following double bar graph and answer the questions that follow.

(i) What does the graph represent?

(ii) Which village has the maximum literacy rates for both males and females and what are the literacy rates?

(iii) In which village are the literacy rates of males and females equal?

Literacy rates
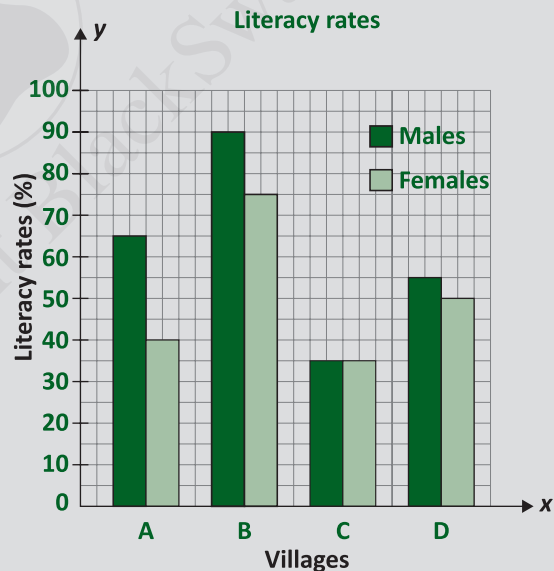
Multiple Choice Questions

Choose the correct answer.

1 The data that can only be measured and not counted is:

(a) continuous data   (b) discrete data   (c) qualitative data   (d) secondary data

2 The graph that is drawn to compare two quantities having the same units is:

(a) double bar graph   (b) bar graph   (c) histogram   (d) pie chart

234

3 The difference between the lower and upper limits of a class interval is called:
   (a) class interval   (b) range   (c) frequency   (d) class width

4 A retail shopkeeper sold shirts of the following sizes (in cm) in a week. 44, 42, 36, 38, 28, 22, 24, 26, 40, 42, 39, 38, 46, 44, 34, 36, 36, 38, 40, 40, 42, 46, 18, 20, 18, 22, 20, 32, 32, 30
   The range is:
   (a) 22   (b) 32   (c) 28   (d) 26

Mixed Bag

1 The marks of 50 students are given below.
35, 45, 67, 83, 90, 98, 78, 68, 87, 96, 98, 64, 62, 43, 40, 35, 36, 29, 38, 42, 56, 57, 53, 67, 75, 72, 79, 80, 86, 78, 75, 74, 65, 67, 64, 58, 67, 56, 55, 89, 38, 25, 58, 96, 99, 46, 49, 78, 77, 66
Construct a frequency distribution table for the given data.

2 The maximum temperatures (in °C) recorded on 30 consecutive days in a city are given below.
32, 37, 38, 36, 28, 29, 28, 28, 30, 36, 39, 40, 40, 41, 42, 41, 40, 39, 38, 38, 32, 32, 33, 34, 31, 30, 29, 28, 27, 28
Construct a frequency distribution table taking a suitable class interval.

3 A teashop owner earns ₹7500, ₹4800, ₹5100, ₹4900, ₹4200, ₹6000 and ₹7200 from Sunday to Saturday in that order. Construct a bar graph for the amounts earned in a week.

4 In 5 one-day matches, the runs scored by Arjun were 43, 88, 20, 1 and 78. In the same matches the runs scored by Arnab were 56, 58, 49, 52 and 50. Construct a double bar graph to represent the information. Which batsman's performance was more consistent?

5 In a month, 8 Labradors, 12 pugs, 6 German shepherds, 15 Pomeranians and 4 spaniels are sold in a pet shop. Represent the information by means of a pie chart.

6 On a particular day, 600 cars, 252 vans, 120 buses, 348 trucks and 120 three-wheelers crossed a toll gate on a highway from 8 a.m. to 6 p.m. Represent the information on a pie chart.

7 A retail shopkeeper sold shirts of the following sizes (in cm) in a week.
44, 42, 36, 38, 28, 22, 24, 26, 40, 42, 39, 38, 46, 44, 34, 36, 36, 38, 40, 40, 42, 46, 18, 20, 18, 22, 20, 32, 32, 30, 32, 30, 28, 26, 24, 26, 24, 22, 20, 20, 38, 38, 40, 42, 40, 42, 40, 38, 36, 36, 28, 26, 26, 22, 24, 24, 36, 38, 40, 38. Construct a frequency distribution table and represent the information by means of a histogram.

8 The percentage of marks obtained by 72 students of Class 8 in mathematics are given below.

Marks (%)	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100
No. of students	1	3	2	12	10	8	14	12	6	4

Represent the data by means of a histogram.

9 Construct a histogram for the following data.

Yield per acre (in tonnes)	0–2	2–4	4–6	6–8	8–10
Number of groundnut fields	4	12	18	10	6

10 Prepare a pie chart for the market share of five brands of consumer goods given below.

Brand	A	B	C	D	E
Market share (%)	10	20	30	25	15

11 The given pie chart represents the production of various crops (in million tonnes) for the year 2012–2013 of a certain state. Read the chart and answer the questions that follow.

(i) What is the total production of crops?
(ii) What are the respective central angles of the sectors represented by pulses and millets?
(iii) What is the ratio of the angles of the sectors represented by rice and groundnut?
(iv) What is the ratio of the production of rice to the production of pulses?

Production of crops 2013 – 14 (in million tonnes)

Rice 45
Pulses 24
Millets 9
Maize 6
Groundnut 36

Higher Order Thinking Skills

1 The GDP (in trillions of dollars) of the largest six economies of the world is given in the following table. Represent the information using a bar diagram. Choose the scale on y-axis as 1 cm = 2000 trillion dollars.

Countries	USA	China	India	Japan	Germany	Russia
GDP (in trillions of dollars)	15,940	12,610	4761	4704	3250	2486

2 The birth rate per 1000 people for 30 countries is given below (*all values are rounded to the nearest ones*): 39, 22, 15, 12, 8, 20, 24, 17, 10, 10, 23, 8, 12, 38, 17, 12, 15, 13, 13, 26, 10, 31, 42, 31, 23, 18, 20, 17, 24, 17. Represent the data in a histogram. If the world average is 18.9 births per 1000, find the number of countries whose birth rate is greater than the world average.

3 The percentage of marks of 130 students who appeared for a competitive test is given below. Represent the data by means of a histogram. Use your graph to find out the percentage of students who have qualified for the interview, if the cut off marks is 50%.

Percentage of marks	20–30	30–40	40–50	50–60	60–70	70–80
Number of students	12	32	28	18	20	10

Cross-curricular Practice

Maths in Commerce

The double bar chart shows import and export of a country between 2010 and 2015 in hundred crores of its currency. Study the graph and answer the questions given below.

(a) In which year was the import the maximum and by how much was it greater than that of the previous year?

(b) In which year was the export the minimum and by how much was it lower than the maximum export figure?

(c) In which years were the exports lower than the imports and by how much in all?

(d) Over the years which has been more—amount earned by exports or amount spent on imports?

Import and export of a country

Everyday Maths

Deforestation is the permanent destruction of native forests. It is a worldwide occurrence that has resulted in the disappearance of about 80 % of the Earth's tropical forests. Deforestation happens when trees are cut down for firewood, to grow crops, to use wood to build houses and furniture, to make roads and so on. The fatal floods and landslides in Uttarakhand in 2013 that resulted in countless deaths are the result of soil erosion due to deforestation.

The destruction of forests affects many animals and plant too!

Discuss in class the steps you can take against deforestation. Remember, every step you take counts.

Activites Section

Maths Lab

Collect data on the average rainfall received in the years in 2013, 2014 and 2015 in the state you live. Make a double bar graph to compare in which year rainfall was maximum and also the months in which rainfall was the maximum.

Heritage

Kaziranga National Park in Assam is spread over 858 sq. km It is located in the floodplains on both sides of the Brahmaputra. It has patches of mixed deciduous forests interspersed with vast stretches of savannah grasslands and wetlands.

It is home to over 180 species of mammals, including rare and endangered species like the great Indian one-horned rhinoceros, the royal Bengal tiger, the golden langur and hoolock gibbon, and a spectacular range of bird population.

In 1985, Kaziranga was declared a World Heritage Site by UNESCO for its unique natural environment.

A Choose the correct answer.

(1) In a class of 30 students, if 6 students take French, the central angle of the sector representing students who have taken French is:
(a) 70°   (b) 72°   (c) 20°   (d) 144°

(2) A Class 8 student sleeps for 8 h, is in school for 7 h, plays for 2 h, does home work for 1.5 h and does other activities in the remaining time of the day. The central angle of the sector that represents the time spent at school is:
(a) 105°   (b) 115°   (c) 125°   (d) 70°

(3) If the central angle of a sector representing the expenditure on food in a household is 144°, the percent of the total salary spent on food is:
(a) 30%   (b) 25%   (c) 60%   (d) 40%

(4) If 45% of students of a school speak Marathi, the central angle representing students who speak Marathi is:
(a) 162°   (b) 144°   (c) 152°   (d) 150°

B Answer the following:

(5) The weights of 50 students are given in the following table.

Weights (kg)	30–34	34–38	38–42	42–46	46–50
Number of students	6	8	16	14	6

Show the information in the form of a histogram.

(6) A pie chart represents the percentage of votes polled for four candidates A, B, C and D in a municipal election. The angle of the sector representing votes for candidate B is 120°.
(i) What fraction of the pie chart is represented by the sector representing votes for candidate B?
(ii) What is the total votes polled, if the number of votes polled for candidate B is 8000?
(iii) How many votes were polled for candidate C if he secured 20% of the votes?

(7) The given histogram shows the heights of applicants who have been selected for the physical tests for the post of a policeman. Study the table and answer the questions that follow.
(i) What is the class size?
(ii) How many candidates attended the physical test?
(iii) Find the number of candidates whose heights are between 180 cm and 195 cm.

Q (7)

Heights of applicants
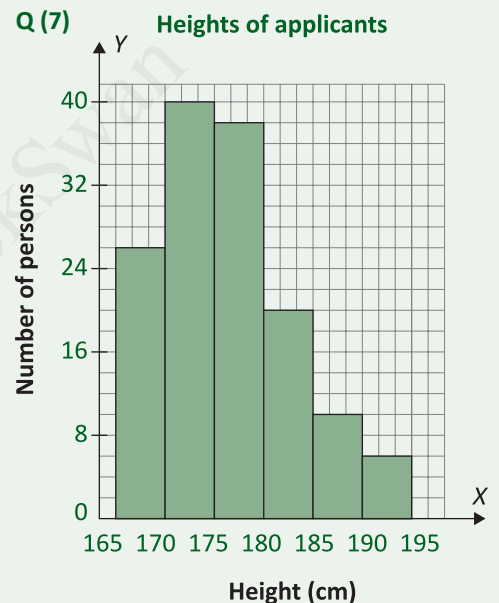
(8) The following table gives the monthly budget of a family of 4. The expenses are expressed as a fraction of the income earned per month. Represent the data by means of a pie diagram.

Particulars	Food	Clothes	Education	Rent	Transport	Miscellaneous
Fractional part	$\frac{1}{3}$	$\frac{1}{24}$	$\frac{1}{24}$	$\frac{1}{4}$	$\frac{1}{12}$	$\frac{1}{4}$

(9) The following table shows the literate female population of 200 villages in a state. Represent the information as a histogram.

Female literacy (%)	0–20	20–40	40–60	60–80	80–100
Number of villages	25	35	70	50	20

New Maths Time

Class 8

Orient BlackSwan

The National Education Policy (NEP) 2020 emphasises certain crucial parameters based on content and pedagogy. The New Maths Time series provides a rich range of exercises and activities for each of the parameters. Here is a quick reference guide to some of the examples in this book.

The New Maths Time series is mapped perfectly to the National Education Policy 2020.

21st Century Skills
A broad set of skills, knowledge, work habits and character traits that are important for success in the 21st century

The NEP parameters	Features	Page nos.
The 4Cs		
Critical Thinking	Higher Order Thinking Skills	24
Critical Thinking	Higher Order Thinking Skills	111
Critical Thinking	Challenge Yourself	53
Critical Thinking	Problem Solving	90
Collaboration	Group Projects	247
Social and Emotional Learning	Everyday Maths	24

Integrated Approach
An approach to teaching and learning that works by connecting knowledge and skills across the curriculum, by bringing real life examples to the classroom

The NEP parameters	Features	Page nos.
Subject Integration	Cross-curricular Practice (Biology)	37
	Cross-curricular Practice (Physics)	64
	Cross-curricular Practice (Science)	127
	Cross-curricular Practice (Biology)	143
	Cross-curricular Practice (Architecture)	206
Art Integration	Cross-curricular Practice	264
Health and Wellness	Cross-curricular Practice	24
Life Skills	Group Projects	38
	Everyday Maths	144
	Get Started: Handling data in real life	223

Sustainable Development Goals

A framework of 17 global goals designed to be a blueprint to achieve a better and more sustainable future for all

The NEP parameters	Features	Page nos.
Sustainable Development Goals	Everyday Maths	237
	Heritage	237

The NEP parameters	Features	Page nos.
Know more about India	Heritage: Vedic Mathematics	54
	Heritage: Vedic Mathematics	64
	Heritage	127

India Knowledge

A strong focus on ancient knowledge from India, traditional values, modern developments and future aspirations

Digital Integration

The use of digital tools to enhance and support the teaching–learning process

ICT/Digital resources

Orient BlackSwan Smart App - Interactive Tasks for Practice and Revision and Games

Teachers' Smart Book   - Teachers Resources, Animations, Question Paper Generator, Games, Interactive Tasks, Presentations, Videos, Worksheets, Embedded Questions

Teacher Empowerment

Teachers' Resource Pack - Lesson Plans, Worksheet with Answer Keys, Question Bank with Answers, Question Papers with Answer Key

Teachers' Portal   - Teachers Resources, Animations, Question Paper Generator, Games, Interactive Tasks, Presentations, Videos, Worksheets, Embedded Questions , Lesson Plan for Online Teaching

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