CHAPTER – 1

INTEGERS

- Integers are a bigger collection of numbers which is formed by whole numbers and their negatives.
- You have studied in the earlier class, about the representation of integers on the number line and their addition and subtraction.
- We now study the properties satisfied by addition and subtraction.

  (a) Integers are closed for addition and subtraction both. That is, $a + b$ and $a - b$ are again integers, where a and b are any integers.

  (b) Addition is commutative for integers, i.e., $a + b = b + a$ for all integers a and b.

  (c) Addition is associative for integers, i.e., $(a + b) + c = a + (b + c)$ for all integers a, b and c.

  (d) Integer 0 is the identity under addition. That is, $a + 0 = 0 + a = a$ for every integer a.
- We studied, how integers could be multiplied, and found that product of a positive and a negative integer is a negative integer, whereas the product of two negative integers is a positive integer. For example, $-2 \times 7 = -14$ and $-3 \times -8 = 24$.
- Product of even number of negative integers is positive, whereas the product of odd number of negative integers is negative.
- Integers show some properties under multiplication.

  (a) Integers are closed under multiplication. That is, $a \times b$ is an integer for any two integers a and b.

  (b) Multiplication is commutative for integers. That is, $a \times b = b \times a$ for any integers a and b.

  (c) The integer 1 is the identity under multiplication, i.e., $1 \times a = a \times 1 = a$ for any integer a.

  (d) Multiplication is associative for integers, i.e., $(a \times b) \times c = a \times (b \times c)$ for any three integers a, b and c.
- Under addition and multiplication, integers show a property called distributive property. That is, $a \times (b + c) = a \times b + a \times c$ for any three integers a, b and c.
- The properties of commutativity, associativity under addition and multiplication, and the distributive property help us to make our calculations easier.
- We also learnt how to divide integers. We found that,

(a) When a positive integer is divided by a negative integer, the quotient obtained is a negative integer and vice-versa.

(b) Division of a negative integer by another negative integer gives a positive integer as quotient.

- For any integer a, we have

  $(a)\ a \div 0$ *is not defined*

  $(\ )\ \ \div 1 = a$

Chapter – 3

Data Handling

- The collection, recording and presentation of data help us organise our experiences and draw inferences from them.
- Before collecting data we need to know what we would use it for.
- The data that is collected needs to be organised in a proper table, so that it becomes easy to understand and interpret.
- Average is a number that represents or shows the central tendency of a group of observations or data.
- Arithmetic mean is one of the representative values of data. $\text{Mean}=\frac{\text{sum of all observatory}}{\text{Number of observatory}}$
- Mode is another form of central tendency or representative value. The mode of a set of observations is the observation that occurs most often. If each of the value ina data is occurring one time, then all are mode. Sometimes we also say that this data has no mode since none of them is occurring frequently.
- Median is also a form of representative value. It refers to the value which lies in the middle of the data with half of the observations above it and the other half below it. $\text{Median}=\frac{1}{2}\left[\frac{n}{2}\text{th observation + }\left(\frac{n}{2}+1\right)\text{th observation}\right].$
- A bar graph is a representation of numbers using bars of uniform widths. Double bar graphs help to compare two collections of data at a glance.
- Double bar graphs help to compare two collections of data at a glance.
- There are situations in our life, that are certain to happen, some that are impossible and some that may or may not happen. The situation that may or may not happen has a chance of happening.
- **Probability**: A branch of mathematics that is capable of calculating the chance or likelihood of an event taking place (in percentage terms). If you have 10 likelihoods and you want to calculate the probability of 1 event taking place, it is said that its probability is $\frac{}{10}$ or event has a 10% probability of taking place.
- Events that have many possibilities can have probability between 0 and 1.

Chapter-2
Fractions and Decimals

- We have learnt about fractions and decimals along with the operations of addition and subtraction on them, in the earlier class.
- We now study the operations of multiplication and division on fractions as well as on decimals.
- We have learnt how to multiply fractions. Two fractions are multiplied by multiplying their numerators and denominators seprately and writing the product as product of numerators by product of denominators. For example, $\frac{2}{3}\times\frac{5}{7}=\frac{2\times5}{3\times7}=\frac{10}{21}$.
- A fraction acts as an operator 'of'. For example, $\frac{}{2}$ of 2 is $\frac{1}{2}\times\_=$.

  (a) The product of two proper fractions is less than each of the fractions that are multiplied.

  (b) The product of a proper and an improper fraction is less than the improper fraction and greater than the proper fraction.

  (c) The product of two improper fractions is greater than the two fractions.
- A reciprocal of a fraction is obtained by inverting it upside down. We have seen how to divide two fractions.

  (a) While dividing a whole number by a fraction, we multiply the whole number with the reciprocal of that fraction. For example, $2\div\frac{3}{5}=2\times\frac{5}{3}=10$.

  (b) While dividing a fraction by a whole number we multiply the fraction by the reciprocal of the whole number. For example, $\frac{2}{3}\div7=\frac{2}{3}\times\frac{1}{2}=\frac{2}{21}$.

  (c) While dividing one fraction by another fraction, we multiply the first fraction by the reciprocal of the other. So, $\frac{2}{3}\div\frac{5}{7}=\frac{2}{3}\times\frac{7}{5}=\frac{14}{15}$.
- We also leant how to multiply two decimal numbers. While multiplying two decimal numbers, first multiply them as whole numbers. Count the number of digits to the right of the decimal point in both the decimal numbers. Add the number of digits counted. Put the decimal point in the product by counting the digits from its rightmost place. The count should be the sum obtained earlier. For example, $\times 0.7=0.3$.

Key Notes

- To multiply a decimal number by 10, 100 or 1000, we move the decimal point in the number to the right by as many places as there are zeros over 1. Thus, $\times 10 = 5.3$, $\times 100 = 53$, $\times 1000 = 530$.
- We have seen how to divide decimal numbers.

  (a) To divide a decimal number by a whole number, we first divide them as whole numbers. Then place the decimal point in the quotient as in the decimal number. For example, $\div 4 = 2.1$.

  Note that here we consider only those divisions in which the remainder is zero.

  (b) To divide a decimal number by 10, 100 or 1000, shift the digits in the decimal number to the left by as many places as there are zeros over 1, to get the quotient. So, $\div 10 = 2.3$, $\div 100 = 0.2$, $\div 1000 = 0.0$.

  (c) While dividing two decimal numbers, first shift the decimal point to the right by equal number of places in both, to convert the divisor to a whole number. Then divide. Thus, $\div 0.2 = 24 \div 2 = 12$.

CHAPTER – 4

SIMPLE EQUATIONS

- An equation is a condition on a variable such that two expressions in the variable should have equal value.
- The value of the variable for which the equation is satisfied is called the solution of the equation.
- An equation remains the same if the LHS and the RHS are interchanged.
- In case of the balanced equation, if we

  (i) add the same number to both the sides, or

  (ii) subtract the same number from both the sides, or

  (iii) multiply both sides by the same number, or

  (iv) divide both sides by the same number, the balance remains undisturbed, i.e., the value of the LHS remains equal to the value of the RHS
- The above property gives a systematic method of solving an equation. We carry out a series of identical mathematical operations on the two sides of the equation in such a way that on one of the sides we get just the variable. The last step is the solution of the equation.
- Transposing means moving to the other side. Transposition of a number has the same effect as adding same number to (or subtracting the same number from) both sides of the equation. When you transpose a number from one side of the equation to the other side, you change its sign. For example, transposing +3 from the LHS to the RHS in equation $x + 3 = 8$ gives $x = 8 - 3$ (= 5). We can carry out the transposition of an expression in the same way as the transposition of a number.
- We have learnt how to construct simple algebraic expressions corresponding to practical situations.
- We also learnt how, using the technique of doing the same mathematical operation (for example adding the same number) on both sides, we could build an equation starting from its solution. Further, we also learnt that we could relate a given equation to some appropriate practical situation and build a practical word problem/puzzle from the equation.

Chapter – 5

Lines and Angles

- We recall that

  (i) A line-segment has two end points.

  (ii) A ray has only one end point (its vertex); and

  (iii) A line has no end points on either side.
- An angle is formed when two lines (or rays or line-segments) meet.

Pairs of Angles	Condition
Two complementary angles	Measures add up to 90°
Two supplementary angles	Measures add up to 180°
Two adjacent angles	Have a common vertex and a common arm but no common interior.
Linear pair	Adjacent and supplementary

- When two lines l and m meet, we say they intersect; the meeting point is called the point of intersection.
- When lines drawn on a sheet of paper do not meet, however far produced, we call them to be *parallel* lines.
- **Point**: A point name a location.
- **Line**: A line is perfectly straight and extends forever in both direction.
- **Line segment**: A line segment is the part of a line between two points.
- **Ray**: A ray is part of a line that starts at one point and extends forever in one direction.
- **Intersecting lines**: Two or more lines that have one and only one point in common. The common point where all the intersecting lines meet is called the point of intersection.
- **Transversal**: A line intersects two or more lines that lie in the same plane in distinct points.
- **Parallel lines**: Two lines on a plane that never meet. They are always the same distance apart.
- **Complementary Angles**: Two angles whose measures add to 90°.
- **Supplementary Angles**: Two angles whose measures add to 180°.
- **Adjacent Angles**: Two angles have a common vertex and a common arm but no common interior points.

- **Linear pairs**: A pair of adjacent angles whose non-common sides are opposite rays.
- **Vertically Opposite Angles**: Two angles formed by two intersecting lines have common arm.
- **Angles made by Transversal**: When two lines are intersecting by a transversal, eight angles are formed.
- **Transversal of Parallel Lines**: If two parallel lines are intersected by a transversal, each pair of:
  - Corresponding angles are congruent.
  - Alternate interior angles are congruent.
  - Alternate exterior angles are congruent.
- If the transversal is perpendicular to the parallel lines, all of the angles formed are congruent to $90°$ angles.

Chapter – 6

The Triangle and its Properties

- **Triangles:** A closed plane figure bounded by three line segments.
- The **six elements** of a triangle are its three angles and the three sides.
- The line segment joining a vertex of a triangle to the mid point of its opposite side is called a **median** of the triangle. A triangle has 3 medians.
- The perpendicular line segment from a vertex of a triangle to its opposite side is called an **altitude** of the triangle. A triangle has 3 altitudes.
- **Type of triangle based on Sides:**
- **Equilateral**: A triangle is said to be **equilateral**, if each one of its sides has the same length. In an equilateral triangle, each angle has measure 60°.
- **Isosceles**: A triangle is said to be **isosceles**, if atleast any two of its sides are of same length. The non-equal side of an isosceles triangle is called its base; the base angles of an isosceles triangle have equal measure.
- **Scalene:** A triangle having all side of different lengths. It has no two angles equal.
- **Property of the lengths of sides of a triangle:** The sum of the lengths of any two sides of a triangle is greater than the length of the third side.
  The difference between the lengths of any two sides is smaller than the length of the third side. This property is useful to know if it is possible to draw a triangle when the lengths of the three sides are known.
- **Types of Triangle based on Angles:**
- **Right Angled Triangle**: A triangle one of whose angles measures $90°$.
- **Obtused Angled Triangle:** A triangle one of whose angles measures more than $90°$.
- **Acute Angled Triangle:** A triangle each of whose angles measures less than $90°$
- In a right angled triangle, the side opposite to the right angle is called the hypotenuse and the other two sides are called its **legs.**
- **Pythagoras property:** In a right-angled triangle, the square on the hypotenuse = the sum of the squares on its legs. If a triangle is not right-angled, this property does not hold good. This property is useful to decide whether a given triangle is right-angled or not.

- An **exterior angle** of a triangle is formed, when a side of a triangle is produced. At each vertex, you have two ways of forming an exterior angle.
  A property of exterior angles: The measure of any exterior angle of a triangle is equal to the sum of the measures of its interior opposite angles.
  The angle sum property of a triangle: The total measure of the three angles of a triangle is 180°.
- **Property of the Lengths of Sides of a Triangle:** The sum of the lengths of any two sides of a triangle is always greater than the length of the third side. The difference of the lengths of any two sides of a triangle is always smaller than the length of the third side.

Chapter – 7

Congruence of Triangles

- **Congruence**: The relation of two objects being congruent is called congruence. Congruent objects are exact copies of one another.
- **Congruence of Plane Figures**: The method of superposition examines the congruence of plane figures. Two planes figures say F_1 and F_2 are said to be congruent, if the tracecopy of F_1 fits exactly on that of F_2.
- **Congruence of Line Segments**: Two line segments, say $\overline{AB}$ and $\overline{CD}$, are congruent, if they have equal lengths. We write this as $\overline{AB} = \overline{CD}$. However, it is common to write it as $\overline{AB} = \overline{CD}$.
- **Congruence of Angles**: Two angles, say $\angle ABC$ and $\angle PQR$, are congruent, if their measures are equal. We write this as $\angle ABC \cong \angle PQR$ or as $\angle ABC = m\angle PQ$ or simply as $\angle ABC =$ $\angle PQR$.
- **Congruence of Triangles**: Two triangles are congruent if they are copies of each other and when superposed, they cover each other exactly.
- Congruent objects are exact copies of one another.
- The method of superposition examines the congruence of plane figures.
- Two plane figures, say, F_1 *and* F_1 are congruent if the trace-copy of F_1 fits exactly on that of F_2 We write this as F1 ≅ F2
- Two line segments, say, $\overline{AB}$ *and* $\overline{CD}$, are congruent if they have equal lengths. We write this as $\overline{AB} \cong \overline{CD}$. However, it is common to write it as $\overline{AB} = \overline{CD}$.
- Two angles, say, ∠ABC and ∠PQR, are congruent if their measures are equal. We write this as ∠ABC ≅ ∠PQR or as m∠ABC = m∠PQR. However, in practice, it is common to write it as ∠ABC ∠PQR.
- **SSS Congruence of two triangles:** Under a given correspondence, two triangles are congruent if the three sides of the one are equal to the three corresponding sides of the other.
- **SAS Congruence of two triangles:** Under a given correspondence, two triangles are congruent if two sides and the angle included between them in one of the triangles are equal to the corresponding sides and the angle included between them of the other triangle.

- **ASA Congruence of two triangles:** Under a given correspondence, two triangles are congruent if two angles and the side included between them in one of the triangles are equal to the corresponding angles and the side included between them of the other triangle.
- **RHS Congruence of two right-angled triangles:** Under a given correspondence, two right-angled triangles are congruent if the hypotenuse and a leg of one of the triangles are equal to the hypotenuse and the corresponding leg of the other triangle.
- **There is no such thing as AAA Congruence of two triangles:** Two triangles with equal corresponding angles need not be congruent. In such a correspondence, one of them can be an enlarged copy of the other. (They would be congruent only if they are exact copies of one another).

Chapter – 8

Comparing Quantities

- **Comparing Quantities:** We are often required to compare two quantities, in our daily life. They may be heights, weights, salaries, marks etc. To compare two quantities, their units must be the same.
- We are often required to compare two quantities in our daily life. They may be heights, weights, salaries, marks etc.
- While comparing heights of two persons with heights150 cm and 75 cm, we write it as the ratio 150 : 75 or 2 : 1.
- **Ratio**: A ratio compares two quantities using a particular operation.
- **Percentage**: Percentage are numerators of fractions with denominator 100. Percent is represent by the symbol % and means hundredth too.
- Two ratios can be compared by converting them to like fractions. If the two fractions are equal, we say the two given ratios are equivalent.
- If two ratios are equivalent then the four quantities are said to be in proportion. For example, the ratios 8 : 2 and 16 : 4 are equivalent therefore 8, 2, 16 and 4 are in proportion.
- A way of comparing quantities is percentage. Percentages are numerators of fractions with denominator 100. Per cent means per hundred. For example 82% marks means 82 marks out of hundred.
- Fractions can be converted to percentages and vice-versa. For example, $\frac{1}{4}=\frac{1}{4}\times$
  whereas, $75\%=\frac{75}{100}=\frac{3}{4}$
- Decimals too can be converted to percentages and vice-versa. For example, $=0.25\times100\%=25$
- Percentages are widely used in our daily life,
  (a) We have learnt to find exact number when a certain per cent of the total quantity is given.
  (b) When parts of a quantity are given to us as ratios, we have seen how to convert them to percentages.
  (c) The increase or decrease in a certain quantity can also be expressed as percentage.
  (d) The profit or loss incurred in a certain transaction can be expressed in terms of percentages.
  (e) While computing interest on an amount borrowed, the rate of interest is given in terms of per cents. For example, ` 800 borrowed for 3 years at 12% per annum.
- **Simple Interest:** Principal means the borrowed money.
- The extra money paid by borrower for using borrowed money for given time is called interest (I).
- The period for which the money is borrowed is called 'Time Period' (T).
- Rate of interest is generally given in percent per year.
- Interest (I): $\frac{\times R\times T}{100}$
- Total money paid by the borrower to the lender is called the amount.

Chapter – 9

Rational Numbers

- **Rational Number**: A number that can be expressed in the form $\frac{}{q}$, where p and q are integers and q ≠ 0, is called a rational number. The numbers $\frac{-}{7}, \frac{}{8}$, etc. are rational numbers.
- All integers and fractions are rational numbers.
- If the numerator and denominator of a rational number are multiplied or divided by a non-zero integer, we get a rational number which is said to be equivalent to the given rational number. For example $\frac{-3}{7}=\frac{-3\times 2}{7\times 2}=\frac{-6}{14}$. so we say $\frac{-}{14}$ is the quivalent form of $\frac{-}{7}$. Also note that $\frac{-6}{14}=\frac{-6\div 2}{14\div 2}=\frac{-3}{7}$
- Rational numbers are classified as Positive and Negative rational numbers. When the numerator and denominator, both, are positive integers, it is a positive rational number. When either the numerator or the denominator is a negative integer, it is a negative rational number. For example, $\frac{}{8}$ is a positive rational number whereas $\frac{-}{9}$ is a negative rational number.
- The number 0 is neither a positive nor a negative rational number.
- A rational number is said to be in the standard form if its denominator is a positive integer and the numerator and denominator have no common factor other than 1. The numbers $\frac{-}{3}, \frac{}{7}$ etc. are in standard form.
- There are unlimited number of rational numbers between two rational numbers.
- Two rational numbers with the same denominator can be added by adding their numerators, keeping the denominator same. Two rational numbers with different denominators are added by first taking the LCM of the two denominators and then converting both the rational numbers to their equivalent forms having the LCM as the denominator. For example, $\frac{-2}{3}+\frac{3}{8}=\frac{-16}{24}+\frac{9}{24}=\frac{-16+9}{24}=\frac{-7}{24}$. Here, LCM of 3 and 8 is 24.

- While subtracting two rational numbers, we add the additive inverse of the rational number to be subtracted to the other rational number. Thus, $\frac{7}{8}-\frac{2}{3}=\frac{7}{8}+$ additive inverse of $\frac{2}{3}=\frac{7}{8}+\frac{-}{3}=\frac{+\ -}{24}=\frac{}{24}$
- To multiply two rational numbers, we multiply their numerators and denominators separately, and write the product as $\frac{}{product\ of\ denominators}$
- To divide one rational number by the other non-zero rational number, we multiply the rational number by the reciprocal of the other. Thus, $\frac{-7}{2}\div\frac{4}{3}=\frac{-7}{2}\times(\text{reciprocal of }\frac{4}{3})$

  $=\frac{-7}{2}\times\frac{3}{4}=\frac{-}{8}$

Chapter –10

Practical Geometry

In this Chapter, we looked into the methods of some ruler and compasses constructions.

- Given a line l and a point not on it, we used the idea of 'equal alternate angles' in a transversal diagram to draw a line parallel to l.
  We could also have used the idea of 'equal corresponding angles' to do the construction.
- **Construction of Parallel Lines**: Draw a line segment *l* and mark a point A not lying on it.
- Take any point B on *l* and join B to A.
- With B as centre and convenient radius, draw an arc cutting *l* at C and AB and D.
- Now with A as centre and the same radius as in above step draw an arc EF cutting AB at G.
- Place the metal point of the compasses at C and adjust the opening so that the pencil point is at D.
- With the same opening as in above step and with G as centre draw another arc cutting the arc EF and H.
- Now join AH and draw a line m.
- We studied the method of drawing a triangle, using indirectly the concept of congruence of triangles.
  The following cases were discussed:
  (i) SSS: Given the three side lengths of a triangle.
  (ii) SAS: Given the lengths of any two sides and the measure of the angle between these sides.
  (iii) ASA: Given the measures of two angles and the length of side included between them.
  (iv) RHS: Given the length of hypotenuse of a right-angled triangle and the length of one of its legs.

Chapter –11

Perimeter and Area

- **Perimeter** is the distance around a closed figure whereas area is the part of plane occupied by the closed figure.
- **Area** is the measure of the part of plane or region enclosed by it.
- We have learnt how to find perimeter and area of a square and rectangle in the earlier class. They are:

  (a) Perimeter of a square = 4 × side

  (b) Perimeter of a rectangle = 2 × (length + breadth)

  (c) Area of a square = side × side

  (d) Area of a rectangle = length × breadth
- Area of a parallelogram = base × height
- Area of a triangle = $\frac{}{2}$ (area of the parallelogram generated from it) = $\frac{1}{2} \times base \times height$
- Area of equilateral triangle = $\frac{\sqrt{3}}{4} \times (side)^2$
- The distance around a circular region is known as its circumference.
- The ratio of circumference and diameter of a circle is a constant is denoted by π (pi).
- Circumference of a circle = πd, where d is the diameter of a circle and $\pi = \frac{\pi}{7}$ *or 3.14* (approximately).
- Area of a circle = πr^2, where r is the radius of the circle.
- Based on the conversion of units for lengths, studied earlier, the units of areas can also be converted: $1\ cm^2 = 100\ mm^2$

  $1\ m^2 = 10000\ cm^2$,

  $1\ hectare = 10000\ m^2$

Chapter –12

Algebraic Expressions

- **Algebraic expressions** are formed from **variables** and **constants**. We use the operations of **addition, subtraction, multiplication** and **division** on the variables and constants to form expressions. For example, the expression $4xy + 7$ is formed from the variables x and y and constants 4 and 7. The constant 4 and the variables x and y are multiplied to give the product $4xy$ and the constant 7 is added to this product to give the expression.
- **Variable:** Symbols which are used to represent or replace numbers. They are denoted as x, y, z, a, b, c…… and can take different numerical values. We generally use small letters to represent variables.
- **Constant:** A symbol having a fixed numerical value. Example: 2, -10, etc.
- Expressions are made up of **terms**. Terms are **added** to make an expression. For example, the addition of the terms $4xy$ and 7 gives the expression $4xy + 7$.
- A term is a **product of factors**. The term $4xy$ in the expression $4xy + 7$ is a product of factors x, y and 4. Factors containing variables are said to be **algebraic factors**.
- The **coefficient** is the numerical factor in the term. Sometimes anyone factor in a term is called the coefficient of the remaining part of the term.
- Any expression with one or more terms is called a **polynomial**.
- Specifically a one term expression is called a **monomial**.
- A two-term expression is called a **binomial.**
- A three-term expression is called a **trinomial**.
- Terms which have the same algebraic factors are **like**terms. Terms which have different algebraic factors are **unlike** terms. Thus, terms $4xy$ and $– 3xy$ are like terms; but terms $4xy$ and $– 3x$ are not like terms.
- The **sum** (or **difference**) **of two like terms** is a **like** term with coefficient equal to the **sum** (or **difference**) **of the coefficients** of the two like terms. Thus, $8xy – 3xy = (8 – 3)xy$, i.e., $5xy$.
- When we **add** two algebraic expressions, the like terms are added as given above; the **unlike** terms are **left as they are.** Thus, the sum of $4x^2 + 5x$ and $2x + 3$ is $4x^2 + 7x + 3$; the like terms $5x$ and $2x$ add to $7x$; the unlike terms x^2 and 3 are left as they are.
- In situations such as solving an equation and using a formula, we have to **find the value of an expression**. The value of the expression depends on the value of the variable from which the expression is formed. Thus, the value of $7x – 3$ for $x = 5$ is 32, since $7(5) – 3 = 35 – 3 = 32$.
- **Rules and formulas** in mathematics are **written** in a concise and general form using algebraic expressions: Thus, the area of rectangle = lb, where l is the length and b is the breadth of the rectangle.
- The general (n_{th}) term of a number pattern (or a sequence) is an expression in n.
- Thus, the n_{th} term of the number pattern 11, 21, 31, 41, . . . is $(10n + 1)$.

Chapter –13

Exponents and Powers

- **Exponents:** Exponents are used to express large numbers in shorter form to make them easy to read, understand, compare and operate upon.
- **Expressing Large Numbers in the Standard Form:** Any number can be expressed as a decimal number between 1.0 and 10.0 (including 1.0) multiplied by a power of 10. Such form of a number is called its standard form or scientific motion.
- Very large numbers are difficult to read, understand, compare and operate upon. To make all these easier, we use exponents, converting many of the large numbers in a shorter form.
- The following are exponential forms of some numbers?

  $10,000 = 10^4 (\textit{read as } 10 \textit{ raised to } 4)$

  $=$,.

  $128 = 2^7$

  Here, 10, 3 and 2 are the bases, whereas 4, 5 and 7 are their respective exponents. We also say, 10,000 is the 4th power of 10, 243 is the 5th power of 3, etc.
- Numbers in exponential form obey certain laws, which are: For any non-zero integers a and b and whole numbers m and n,

  $(a)\ a^m \times a^n = a^{m+n}$

  $(b)\ a^m \div a^n = a^{m-n},\ m > n$

  $(c)\ (a^m)^n = a^{mn}$

  $(d)\ a^m \times b^m = (ab)^m$

  $(e)\ a^m \div b^n = \left(\frac{}{b}\right)^m$

  (f) $^0 = 1$

  (g) (–1) even number = 1 (–1) odd number = – 1

Chapter –14
Symmetry

- A figure has line symmetry, if there is a line about which the figure may be folded so that the two parts of the figure will coincide.
- Regular polygons have equal sides and equal angles. They have multiple (i.e., more than one) lines of symmetry.
- Each regular polygon has as many lines of symmetry as it has sides.

Regular Polygon	Regular hexagon	Regular pentagon	Square	Equilateral triangle
Number of lines of symmetry	6	5	4	3

- Mirror reflection leads to symmetry, under which the left-right orientation have to be taken care of.
- Rotation turns an object about a fixed point. This fixed point is the centre of rotation. The angle by which the object rotates is the angle of rotation.
- A half-turn means rotation by 180^0 ; a quarter-turn means rotation by 90^0. Rotation may be clockwise or anticlockwise.
- If, after a rotation, an object looks exactly the same, we say that it has a rotational symmetry.
- In a complete turn (of 360^0), the number of times an object looks exactly the same is called the order of rotational symmetry. The order of symmetry of a square, for example, is 4 while, for an equilateral triangle, it is 3.
- Some shapes have only one line of symmetry, like the letter E; some have only rotational symmetry, like the letter S; and some have both symmetries like the letter H. The study of symmetry is important because of its frequent use in day-to-day life and more because of the beautiful designs it can provide us.

Chapter –15

Visualising Solid Shapes

- The circle, the square, the rectangle, the quadrilateral and the triangle are examples of **plane figures;** the cube, the cuboid, the sphere, the cylinder, the cone and the pyramid are examples of **solid shapes.**
- Plane figures are of **two-dimensions (2-D)** and the solid shapes are of three-dimensions (**3-D).**
- The corners of a solid shape are called its vertices; the line segments of its skeleton are its **edges;** and its flat surfaces are its **faces.**
- A net is a skeleton-outline of a solid that can be folded to make it. The same solid can have several types of nets.
- Solid shapes can be drawn on a flat surface (like paper) realistically. We call this **2-D representation of a 3-D solid.**
- Two types of sketches of a solid are possible:

  (a) An **oblique** sketch does not have proportional lengths. Still it conveys all important aspects of the appearance of the solid.

  (b) An **isometric sketch** is drawn on an isometric dot paper, a sample of which is given at the end of this book. In an isometric sketch of the solid the measurements kept proportional.
- **Visualising solid** shapes is a very useful skill. You should be able to see 'hidden' parts of the solid shape.
- Different sections of a solid can be viewed in many ways:

  (a) One way is to view by cutting or slicing the shape, which would result in the cross-section of the solid.

  (b) Another way is by observing a 2-D shadow of a 3-D shape.

  (c) A third way is to look at the shape from different angles; the front-view, the **side-view** and the top view can provide a lot of information about the shape observed.