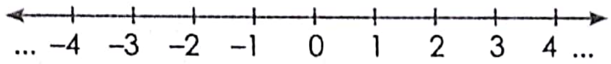
1 Integers

Key Concepts

1. Integers are a combined set of negative numbers and whole numbers. i.e.,

$$\{-3, -2, -1, 0, 1, 2, 3 \dots\}$$

2. There is no greatest or smallest integer.
3. On a number line, integer on the right of zero is greater than that on the left.



Example: $-4 < -3 < -2 < -1 < 0 < 1 < 2 < 3 < 4$

4. 0 is neither positive nor negative integer.
5. Integers are closed under addition and subtraction.
6. Addition is commutative for integers. For any two integers a and b; $a + b = b + a$
7. Addition is associative for integers. For any three integers a, b and c; $(a + b) + c = a + (b + c)$
8. 0 is the additive identity for integers.
9. The operation of subtraction is closed under the closure property. If a and b are integers, then $a - b$ is also an integer.
10. Integers are closed under multiplication, i.e., product of two integers is also an integer.
11. Multiplication is commutative for integers. For any two integers a and b; $(a \times b) = (b \times a)$
12. Multiplication is associative for integers. For any three integers a, b and c,

$$a \times (b \times c) = (a \times b) \times c,\ (b + c) \times a = (b \times a) + (c \times a)$$

13. Distributive property of multiplication of integers over addition and subtraction. For any three integers a, b and c, $a \times (b + c) = (a \times b) + (a \times c)$ and $a \times (b - c) = (a \times b) - (a \times c)$
14. If a is any integer, then $a \times 1 = 1 \times a = a$. 1 is the multiplicative identity for integers.
15. When a positive integer is divided by a negative integer, the quotient is negative and vice-versa. Also, division of a negative integer by a negative integer gives a positive quotient (Division by 0 is not possible).
16. The product of two integers with unlike signs is always negative. i.e., $-a \times b = -ab$
17. The product of two integers with like signs is always positive. i.e., $a \times b = ab$ or $-a \times -b = ab$
18. The product of an integer and 0 is always 0. For any integer a, $a \times 0 = 0$; $0 \times a = 0$. The property is known as zero factor property.
19. For any integer a, $a \div 0$ is not defined and $a \div 1 = a$.

2 Fractions and Decimals

Key Concepts

1. A fraction represents a part of a whole or a collection.
2. A fraction whose numerator is less than its denominator is called a proper fraction.

   For example, $\frac{3}{10}, \frac{5}{8}, \frac{3}{25}$ are proper fractions.
3. A fraction whose numerator is more than or equal to its denominator is called an Improper fraction.

   For example, $\frac{11}{9}, \frac{8}{8}, \frac{13}{2}$ are improper fractions.
4. A combination of whole number and a proper fraction is called a mixed fraction.

   For example, $3\frac{1}{7}, 7\frac{8}{2}, 9\frac{5}{17}$ are mixed fractions.
5. To multiply two (or more) fractions, multiply the numerators together for the numerator of the product, and multiply the denominators together for the denominator of the product.

   For example, $\frac{13}{9} \times \frac{7}{10} = \frac{13 \times 7}{9 \times 10} = \frac{91}{90}$
6. Two fractions are said to be reciprocal of each other, if their product is 1.
7. Like fractions are the fractions having same denominators but different numerators.

   For example, $\frac{7}{9}, \frac{15}{9}, \frac{32}{9}$ are like fractions.
8. Unlike fractions are the fractions having different denominators.

   For example, $\frac{5}{11}, \frac{1}{9}, \frac{7}{14}$ are unlike fractions.
9. For adding or subtracting unlike fractions, change them into like fractions and then add or subtract.
10. To find the reciprocal of a fraction, simply interchange the numerator and the denominator.
11. Reciprocal of zero does not exist because division by zero is not defined.
12. To divide a fraction by another fraction, multiply the first fraction by the reciprocal of the second fraction (divisor) and then simplify the product to the lowest terms.
13. To multiply two or more decimals, multiply the numbers as they were whole numbers ignoring the decimal points. Then, count the number of decimal places in each of the factors and use their sum to determine where the decimal point is placed in the product. Locate the decimal point in the product by counting from right the numbers of decimal places obtained. Insert zeroes to the left of the product, if necessary, to have enough digits for decimal places.
14. To multiply a decimal number by 10, 100, 1000, we move the decimal point to the right by as many places as there are zeroes after 1.
15. To divide a decimal by 10, 100 or 1000, the quotient is obtained by moving the decimal point in the dividend to the left by as many places as there are zeroes after 1.

4 Simple Equations

Key Concepts

1. An equation is a statement that expresses equality between two algebraic expressions.
2. A number or a combination of numbers connected by symbols of operations is called an algebraic expression.
3. The value of the variable in an equation which satisfies the equation is called a solution to the equation.
4. Subtracting the same number from both sides of an equation yields an equivalent equation.
5. Adding the same number to both sides of an equation, yields an equivalent equation.
6. Multiplying both sides of an equation by the same non-zero number, yields an equivalent equation.
7. Dividing both sides of an equation, by the same non-zero number, yields an equivalent equation.
8. Transposing a term means changing its sign and taking it to the other side of the equation.
9. To solve a word problem:
   - Read the problem carefully, and identify what is to be found (the unknown). Choose a variable to represent the numerical value of the unknown quantity.
   - Write down mathematical expressions for other unknown quantities using the assigned variable. If possible, draw figures or diagrams.
   - Translate the problem into an equation.
   - Solve the equation and give the answer in terms of the unknown quantity.

5 Lines and Angles

Key Concepts

1. Two angles are called complementary, if their sum is 90°. If two angles are complementary then each angle is called complement of the other.

2. Two angles are supplementary, if their sum is 180°. If two angles are supplementary then each angle is called the supplement of the other.

3. Two angles are said to be equal, if they have the same measure.

4. Two angles are adjacent, if they have the same vertex, have a common arm and non-common arms are on opposite sides of the common arm.

5. A linear pair is a pair of adjacent angles whose non-common sides are opposite rays.

6. Angles in a linear pair are supplementary.

7. Two angles formed by intersecting lines are called vertically opposite angles, if they are opposite to each other (not adjacent).

8. Vertically opposite angles have equal measures.

9. A transversal is a line that intersects two or more lines at distinct points.

10. If two lines are parallel, then angles in each pair of corresponding angles are equal.

11. If two lines are parallel, then angles in each pair of alternate interior angles are equal.

12. If two lines are parallel, then angles in each pair of interior angles on the same side of the transversal are supplementary.

13. Two lines are intersected by a transversal. The lines will be parallel if

    (i) angles in each pair of corresponding angles are equal.

    (ii) angles in each pair of alternate interior angles are equal.

    (iii) angles in each pair of interior angles on the same side of the transversal are supplementary.

6 The Triangle and Its Properties

Key Concepts

1. A closed figure obtained by joining three non-collinear points in a plane (in pairs), is a triangle.
2. A triangle has three vertices, three sides and three angles.
3. A median of a triangle is a line segment joining a vertex of the triangle to the mid-point of the side opposite the vertex.
4. An altitude of a triangle is a perpendicular line segment from a vertex of the triangle to its opposite side.
5. There are three vertices of a triangle, therefore a triangle has three medians and three altitudes.
6. The sum of the measures of the interior angles of a triangle is 180°.
7. The measure of an exterior angle of a triangle is equal to the sum of the measures of its two interior opposite angles.
8. Angles opposite to the equal sides of a triangle are equal.
9. The sum of the lengths of any two sides of a triangle is greater than the length of the third side.
10. In a right triangle, the sum of the squares of the two sides of the triangle is equal to the square of the hypotenuse (Pythagoras Property).
11. If the sum of the squares of two sides of a triangle equals the square of the third side, then the triangle will be a right triangle. The angle opposite the longest side will be a right angle.
12. If the triangle is not right-angled, pythagoras property does not hold good.
Pythagoras property is useful to decide whether the given triangle is a right-angled triangle or not.

7 Congruence of Triangles

Key Concepts

1. Objects/figures which have the same shape and size are called congruent objects/figures.
2. Two plane figures, say A_1 and A_2 are congruent, if the trace copy of A_1 fits exactly on that of A_2, i.e., $A_1 \cong A_2$
3. Two line segments are congruent, if they have the same length and vice-versa.
4. Two angles are congruent, if they have the same measure and vice-versa.
5. Two squares are congruent, if they have the sides of the same length.
6. Two rectangles are congruent, if they have the same length and same breadth.
7. Two circles are congruent, if they have the same radius.
8. Two triangles are congruent, if there is a correspondence between the vertices of the two triangles so that their corresponding parts are congruent (equal).
9. Two triangles are congruent, if the three sides of one triangle are respectively equal to the three corresponding sides of the other triangle.
10. Two triangles are congruent, if two sides and the included angle of one triangle are respectively equal to two sides and the included angle of the other triangle.
11. Two triangles are congruent, if two angles and the included side of one triangle are respectively equal to the corresponding two angles and the included side of another triangle.
12. Two right-angled triangles are congruent, if the hypotenuse and one side of one right triangle are respectively equal to the corresponding hypotenuse and one side of the other right triangle.

9 Rational Numbers

Key Concepts

1. A rational number is a number that can be expressed in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$.
2. Every integer is a rational number.
3. The number 0 is neither a positive nor a negative rational number.
4. A rational number equivalent to a rational number $\frac{a}{b}$ can be obtained by multiplying/dividing its numerator and denominator by the same non-zero integer.
5. A rational number $\frac{a}{b}$ is said to be in standard form, if b is positive and the integers a and b have no common factor other than 1.
6. A rational number can be reduced to its standard form by dividing its numerator and denominator by their HCF keeping negative sign (if any) only in the numerator.
7. A negative rational number is to the left of 0 whereas a positive rational number is to the right of 0 on a number line.
8. A negative rational number is always less than a positive rational number.
9. 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 their denominators and then converting the given rational numbers to their equivalent forms having the LCM as the denominator.
10. For any rational 'a', there is another rational number '–a' such that $a + (-a) = 0$ and $(-a) + a = 0$. '–a' is called the additive inverse of a and vice-versa.
11. If $\frac{p}{q}$ and $\frac{r}{s}$ are any two rational numbers, then $\frac{p}{q} \times \frac{r}{s} = \frac{p \times r}{q \times s}$, $q \neq 0, s \neq 0$
12. The reciprocal of a positive rational number is always a positive rational number and reciprocal of a negative rational number is always a negative rational number.
13. The reciprocal of a (non-zero) rational number is also called its multiplicative inverse.
14. The reciprocal of a non-zero rational number $\frac{p}{q}$ is $\frac{q}{p}$.
15. The reciprocal of rational number zero (0) does not exist.
16. For the two rational numbers $\frac{p}{q}$ and $\frac{r}{s}$; $\frac{p}{q} \div \frac{r}{s} = \frac{p}{q} \times \frac{s}{r} = \frac{p \times s}{q \times r}$, $q \neq 0, s \neq 0, r \neq 0$

14 Symmetry

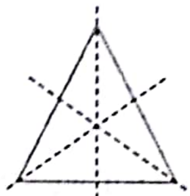
Key Concepts

1. If we fold a picture (or figure) in two halves such that the two halves match each other exactly, then the picture (or figure) is said to have a line symmetry.

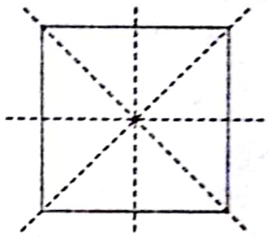
2. The line from where we folded the picture is called the line of symmetry or axis of symmetry of the picture.

3. Each regular polygon has as many lines of symmetry as its sides.

4. An equilateral triangle has three lines of symmetry.


Equilateral triangle

5. A square has four lines of symmetry.


Square

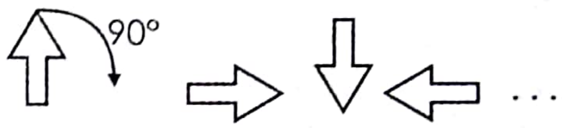
6. A regular pentagon has five lines of symmetry.

7. A regular hexagon has six lines of symmetry.

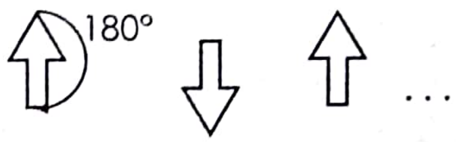
8. Rotation turns an object about a fixed point called the centre of rotation.

9. The angle by which the object rotates is called the angle of rotation.

10. A quarter turn means a rotation of 90°.



11. A half turn means a rotation of 180°.



12. A full turn means a rotation of 360°.

13. If, after a rotation, an object looks exactly the same (i.e., coincides with its original position), we say that it has a rotational symmetry. In a complete turn of 360°, the number of times an object looks exactly the same is called the order of rotational symmetry.