AADYAS
JUNIOR COLLEGE
Knowledge, Values and Beyond

Knowledge, Values and Beyond...

MATHS CONCEPTS AND FORMULAE

CBSE X

1. REAL NUMBERS

1. Fundamental Theorem of Arithmetic- Every composite number can be factorized as a product of primes in a unique way, except for the order in which the prime factors occur.
2. A prime number is the one which has exactly two factors namely 1 and itself.
3. A composite number is the one which has at least (minimum of) three factors.
4. Number of primes between 1 and 50 is 15.
5. Prime numbers below 50 are as follows-
   2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, and 47
6. Number of primes between 51 and 100 is 10.
7. Prime numbers between 51 and 100 are as follows-
   53, 59, 61, 67, 71, 73, 79, 83, 89, and 97
8. 2 is the least prime and it is the only even prime.
9. Least composite number is 4.
10. A number that ends in zero has at least one 0 and one 5 in its prime factorization.
11. A number that ends in 5 has at least one 5 and no 2's in its prime factorization.
12. Product of the smallest power of each common prime factor in the numbers gives their HCF.
13. Relatively primes or co-primes are positive integers whose HCF is 1.
14. Product of the greatest power of each prime factor, involved in the numbers gives their LCM.
15. LCM of co-prime numbers is equal to their product.
16. HCF of co-primes is equal to 1.
17. Relation between two numbers, their LCM and their HCF is
    $\text{Product of numbers} = \text{HCF} \times \text{LCM}$.
18. HCF of two numbers is a factor of their LCM.
19. A number of the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$ is called a rational number.

20. A number which is not of the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$ is called an <u>irrational number.</u>

21. Let k be a prime number. If k divides a^2, then <u>k divides a</u> where a is a positive integer.

22. Let k be a prime number then $\sqrt{k}$ is an <u>irrational</u> number.

23. Let a divides b then <u>$b = ac$</u> for some integer c.

24. The sum of a rational and an irrational is <u>irrational.</u>

25. The difference of a rational and an irrational is <u>irrational.</u>

26. The product of a non-zero rational and an irrational is <u>irrational.</u>

27. The quotient of a non-zero rational and an irrational is <u>irrational.</u>

2. POLYNOMIALS

1. <u>0</u> is called the zero polynomial.
2. Degree of a linear polynomial is <u>1.</u>
3. Polynomial whose degree is 2 is called a <u>quadratic polynomial.</u>
4. Standard form of a linear polynomial in one variable x is $ax+b$; $(a \neq 0)$.
5. Standard form of a quadratic polynomial in x is ax^2+bx+c; $(a \neq 0)$.
6. A real number k is said to be a zero of a polynomial $p(x)$, if $p(k)=0$.
7. Zero of a linear polynomial $ax+b$ is equal to $\frac{-b}{a}$.
8. For a linear polynomial $ax+b$, $a \neq 0$, the graph of $y=ax+b$ is a straight line which intersects the x-axis at exactly one point, namely $\left(\frac{-b}{a}, 0\right)$.
9. For any quadratic polynomial ax^2+bx+c, $a \neq 0$, the graph of the corresponding equation $y=ax^2+bx+c$ is of the shape <u>parabola.</u>
10. The zeroes of a polynomial $p(x)$ are exactly <u>abscissas</u> of the points, where the graph of $y=p(x)$ intersects <u>X-axis.</u>
11. A quadratic polynomial can have at most <u>2</u> zeroes.
12. The zeroes of a quadratic polynomial ax^2+bx+c are $\frac{-b-\sqrt{b^2-4ac}}{2a}$ and $\frac{-b+\sqrt{b^2-4ac}}{2a}$.

13. The relation between zeroes and coefficients of the quadratic polynomial

ax^2+bx+c is $\alpha+\beta=\frac{-b}{a}$, or $\alpha\times\beta=\frac{c}{a}$.

14. Linear polynomial whose zero is α is $k(x-\alpha);\ k\neq 0$.

15. Quadratic polynomial whose zeroes are α and β is

$$k\left[x^2-(\alpha+\beta)x+\alpha\beta\right];\ k\neq 0.$$

3. PAIRS OF LINEAR EQUATIONS

1. The standard form of linear equation in two variables x and y is

$ax+by+c=0;\quad a^2+b^2\neq 0.$

2. The standard form of a pair of simultaneous linear equations in two variables

x and y is $a_1x+b_1y+c_1=0,\ a_2x+b_2y+c_2=0;\quad a_1^2+b_1^2\neq 0,\ a_2^2+b_2^2\neq 0.$

3. Geometrically linear equation in two variables is a straight line.

4. Each solution (x, y) of a linear equation in two variables, $ax+by+c=0$, corresponds to a point on the line representing the equation, and vice versa.

5. Given two lines in a plane, what are the three different possibilities?

Intersecting lines, parallel lines, or coincident lines.

6. Let a man can complete a work in x days. The part of work done by the man in one day is $\frac{1}{x}$, and the part of work done by the man in n days is $n\times\frac{1}{x}$.

7. Let l: $a_1x+b_1y+c_1=0$ and m: $a_2x+b_2y+c_2=0$ be a pair of linear equations having a unique solution. Then

a) Geometrical representation of l and m is intersecting lines.

b) Algebraic condition is $\frac{a_1}{a_2}\neq\frac{b_1}{b_2}$.

c) Lines l and m are consistent.

8. Let l: $a_1x+b_1y+c_1=0$ and m: $a_2x+b_2y+c_2=0$ be a pair of linear equations having no solution. Then

a) Geometrical representation of l and m is parallel lines.

b) Algebraic condition is $\frac{a_1}{a_2}=\frac{b_1}{b_2}\neq\frac{c_1}{c_2}$.

c) Lines l and m are inconsistent.

9. Let $l: a_1x+b_1y+c_1=0$ and $m: a_2x+b_2y+c_2=0$ be a pair of linear equations having infinitely many solutions. Then

a) Geometrical representation of l and m is coincident lines.

b) Algebraic condition is $\frac{a_1}{a_2}=\frac{b_1}{b_2}=\frac{c_1}{c_2}$.

c) Lines l and m are consistent.

d) Lines l and m are also called dependent lines.

10. Expenditure + Savings = Income.

11. Expression for a two-digit number whose one's digit is x and ten's digit is y is $(10y+x)$ and number obtained by reversing the digits is $(10x+y)$.

12. Consider two cars C_1 and C_2 of speeds $x\ km/hr$ and $y\ km/hr$ respectively where $x>y$. Then

a) Relative speed if C_1, C_2 are moving in same direction is $(x-y)km/hr$.

b) Relative speed if C_1, C_2 are moving in opposite direction is $(x+y)km/hr$.

13. Relation between Speed, Distance and Time is $\text{Distance} = \text{Speed}\times\text{Time}$.

14. Let there be x rows of persons in a room and number of persons per row is y. Then the total number of persons in the room is equal to $x\times y$ (No. of rows $\times$ No. of columns).

15. The sum of a pair of opposite angles in a cyclic quadrilateral is 180°.

16. Let speed of boat in still water is $x\ km/hr$ and that of stream is $y\ km/hr$.

Then a) Speed upstream is $(x-y)km/hr$.

b) Speed downstream is $(x+y)km/hr$.

4. QUADRATIC EQUATIONS

1. Standard form of a quadratic equation in one variable x is $ax^2+bx+c=0;\ a\neq 0$.

2. A quadratic equation in one variable x has utmost (a maximum of) two roots.

3. Two consecutive integers can be of the form $x,\ x+1$.

4. Two consecutive odd positive integers can be of the form $x,\ x+2$.

5. Two consecutive even positive integers can be of the form $x,\ x+2$.

6. Two consecutive multiples of positive integer k can be of the form $x,\ x+k$.

7. Let a tap can completely fill a water tank in x hours. The fraction of tank that can be filled in one hour is $\frac{1}{x}$ and the fraction of tank that can be filled in n hours is $n\times\frac{1}{x}$.

8. The zeroes of the quadratic polynomial ax^2+bx+c and the roots of the quadratic equation $ax^2+bx+c=0$ are <u>one and the same.</u>

9. A number and its reciprocal can be of the form $x,\ \frac{1}{x}$.

10. The roots of a quadratic equation $ax^2+bx+c=0$ are $\frac{-b-\sqrt{b^2-4ac}}{2a}$ and $\frac{-b+\sqrt{b^2-4ac}}{2a}$.

    These roots in combination as $\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ are known as <u>Quadratic Formula.</u>

11. The discriminant of a quadratic equation $ax^2+bx+c=0$ is b^2-4ac.

12. Consider a quadratic equation $ax^2+bx+c=0$.

    a) Its roots are not real if $b^2-4ac<0$.

    b) Its roots are real and equal if $b^2-4ac=0$.

    c) Its roots are real and unequal if $b^2-4ac>0$.

13. The product of a number and its reciprocal is equal to <u>1.</u>

14. The polynomial corresponding to a quadratic equation $ax^2+bx+c=0$ is a perfect square if $b^2-4ac=0$.

15. Total number of articles $\times$ Cost per article $=$ Total cost of articles

16. Angle subtended by a diameter of a circle on any of its semicircular arcs is equal to <u>90° (right angle).</u>

<u>5. ARITHMETIC PROGRESSIONS</u>

1. A sequence in which except the first term every other term is obtained by adding a fixed number to the preceding term is called <u>Arithmetic Progression.</u>

2. Standard form of an AP is

   $a,\ a+d,\ a+2d,\ \ldots\ldots\ldots\ldots,\ a+(n-2)d,\ a+(n-1)d.$

3. A finite AP is the one which has fixed (or finite) number of terms.

4. An infinite AP is the one which has infinitely many number of terms.

5. The formula to find common difference of an AP is $d=a_{n+1}-a_n;\ n\geq 1$.

6. The n^{th} term (or last term) of an AP is $a_n(\text{or } l)=a+(n-1)d$.

7. Let d be the common difference of certain AP. The common difference of new AP obtained by reversing the order of terms is equal to –d.

8. The formula to find the k^{th} term from the end of an AP which contains n terms is $l-(k-1)d$.

9. Three terms of an AP can be $(a-d),\ a,\ (a+d)$.

10. Four terms of an AP can be $(a-3d),\ (a-d),\ (a+d),\ (a+3d)$.

11. Five terms of an AP can be $(a-2d),\ (a-d),\ a,\ (a+d),\ (a+2d)$.

12. The formula to find the first n terms of an AP is $S_n=\frac{n}{2}\times(a+l)$ or

$S_n=\frac{n}{2}\times(a+a_n)$ or $S_n=\frac{n}{2}\times[2a+(n-1)d]$.

13. Let S_n be the sum to n terms of an AP. Then $a_n=$ S_n-S_{n-1}.

14. The sum of first n natural numbers is equal to $n\times\frac{(n+1)}{2}$.

15. The sum of first n odd natural numbers is equal to n^2.

16. The sum of first n even natural numbers is equal to n^2+n.

17. The formula to find the circumference of a semi-circle is (πr) for open semi-circle and $(\pi r+2r)$ for closed semi-circle.

18. If a, b, c are in AP, then $b=\frac{a+c}{2}$ and b is called the arithmetic mean (AM) of a and c.

19. Consider an AP having m terms followed by n terms.
    a) The total number of terms in the AP is $(m+n)$ terms.
    b) The sum of last n terms of the AP is equal to $S_{m+n}-S_m$.

6. TRIANGLES

1. Two plane figures having the same shape are called Similar figures.

2. Two congruent figures have same shape and same size.

3. Two polygons (including triangles) of the same number of sides are similar, if their corresponding angles are equal and their corresponding sides are in the proportion and the converse is also true.
4. The ratio of any two corresponding sides in two equi-angular triangles is always the same.
5. Basic Proportionality Theorem- A line is drawn parallel to one side of a triangle, divides the other two sides in the same ratio.
6. Converse of Basic Proportionality Theorem- If a line divides any two sides of a triangle in the same ratio, then the line is parallel to the third side.
7. Converse of Mid-point Theorem- A line drawn through the mid-point of one side of a triangle parallel to another side bisects the third side.
8. Mid-point Theorem- The line-segment joining the mid-points of any two sides of a triangle is parallel to and half the length of the third side.
9. AAA Similarity Criterion- If in two triangles, corresponding angles are equal, then the two triangles are similar.
10. AA Similarity Criterion- If two angles of one triangle are respectively equal to two angles of another triangle, then the two triangles are similar.
11. SSS Similarity Criterion- If in two triangles, sides of one triangle are proportional to the sides of the other triangle, then the two triangles are similar.
12. The inclination of sun-rays at different points in a place at an instant of time is same.
13. SAS Similarity Criterion- If one angle of a triangle is equal to one angle of the other triangle and the sides including these angles are in proportion, then the two triangles are similar.
14. All the congruent figures are similar but the converse is not necessarily true.

7. COORDINATE GEOMETRY

1. The distance of a point from the y-axis is called its abscissa or first coordinate.
2. The distance of a point from the x-axis is called its ordinate or second coordinate.
3. The formula to find the distance between two points (x_1, y_1) and (x_2, y_2) is $\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}$ or $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$.

4. The formula to find the distance between origin and a point (x_1, y_1) is $\sqrt{x_1^2+y_1^2}$.

5. A quadrilateral in which both the pairs of opposite sides are equal is a parallelogram.

6. A quadrilateral in which both the pairs of opposite sides are equal and diagonals are equal is a rectangle.

7. A quadrilateral in which all sides are equal is a rhombus.

8. A quadrilateral in which all sides are equal and diagonals are equal is a square.

9. A triangle in which two sides are equal is an isosceles triangle.

10. A triangle in which two sides are equal and square of largest side is equal to the sum of squares of other two sides then the triangle is termed as right-isosceles triangle.

11. A triangle in which no two sides are equal is a scalene triangle.

12. A triangle in which all the sides are equal is an equilateral triangle.

13. A point on x - axis is of the form $(a, 0)$.

14. A point on y - axis is of the form $(0, b)$.

15. The condition for three points A, B and C to be collinear is either $AB+BC=AC$, or $BC+AC=AB$, or $AC+AB=BC$.

16. The centroid of a triangle whose vertices are (x_1, y_1), (x_2, y_2) and (x_3, y_3) is $\left(\frac{x_1+x_2+x_3}{3}. \frac{y_1+y_2+y_3}{3}\right)$.

17. Let point B lies on line-segment AC and between A and C, then B divides AC into two sections AB and BC.

18. Section formula is given by the expression $\left(\frac{m_1 x_2+m_2 x_1}{m_1+m_2}. \frac{m_1 y_2+m_2 y_1}{m_1+m_2}\right)$.

19. Mid-point formula is given by the expression $\left(\frac{x_1+x_2}{2}. \frac{y_1+y_2}{2}\right)$.

20. The formula to find area of a rhombus is $\frac{1}{2}\times(\text{product of diagonals})$.

21. The formula to find the area of a square using its diagonal is $\frac{1}{2}\times(\text{square of a diagonal})$.

22. Center of a circle is the <u>mid-point</u> of its diameter.

23. A quadrilateral in which diagonals bisect each other is a <u>parallelogram.</u>

24. The formula to find area of a trapezium is $\frac{1}{2} \times \text{altitude} \times (\text{sum of parallel sides})$.

25. The formula to find area of a parallelogram is $\text{base} \times \text{altitude}$.

26. A median of a triangle divides it into two triangles of equal <u>area.</u>

27. The point of concurrence of medians of a triangle is called <u>centroid.</u>

28. The points of trisection of a line-segment divide it in the ratio 1 : 2 and 2 : 1.

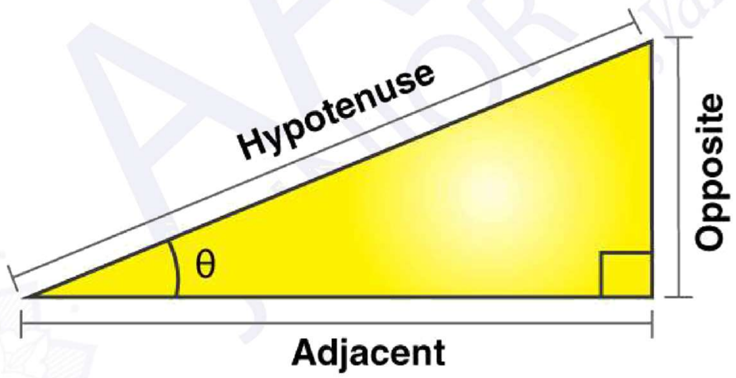
8. INTRODUCTION TO TRIGONOMETRY

1. Define the six Trigonometric Ratios with respect to acute angle θ of a right-triangle.

$$\sin\theta = \frac{\text{side opposite to } \theta}{\text{hypotenuse}} \qquad \operatorname{cosec}\theta = \frac{\text{hypotenuse}}{\text{side opposite to } \theta}$$

$$\cos\theta = \frac{\text{side adjacent to } \theta}{\text{hypotenuse}} \qquad \sec\theta = \frac{\text{hypotenuse}}{\text{side adjacent to } \theta}$$

$$\tan\theta = \frac{\text{side opposite to } \theta}{\text{side adjacent to } \theta} \qquad \cot\theta = \frac{\text{side adjacent to } \theta}{\text{side opposite to } \theta}$$



2. Write the reciprocal relations of trigonometric ratios.

a) $\sin\theta \times \operatorname{cosec}\theta = 1, \quad \sin\theta = \frac{1}{\operatorname{cosec}\theta}, \quad \operatorname{cosec}\theta = \frac{1}{\sin\theta}$

b) $\cos\theta \times \sec\theta = 1, \quad \cos\theta = \frac{1}{\sec\theta}, \quad \sec\theta = \frac{1}{\cos\theta}$

c) $\tan\theta \times \cot\theta = 1, \quad \tan\theta = \frac{1}{\cot\theta}, \quad \cot\theta = \frac{1}{\tan\theta}$

3. Write the quotient relations of trigonometric ratios.

$$\frac{\sin\theta}{\cos\theta} = \tan\theta, \quad \frac{\cos\theta}{\sin\theta} = \cot\theta, \quad \frac{\sec\theta}{\operatorname{cosec}\theta} = \tan\theta, \quad \frac{\operatorname{cosec}\theta}{\sec\theta} = \cot\theta$$

4. Write all the possible versions of trigonometric Identities.

a) $\sin^2\theta+\cos^2\theta=1$

$\Rightarrow \quad \sin^2\theta=1-\cos^2\theta \quad \Rightarrow \quad \sin^2\theta=(1-\cos\theta)(1+\cos\theta)$

$\Rightarrow \quad \cos^2\theta=1-\sin^2\theta \quad \Rightarrow \quad \cos^2\theta=(1-\sin\theta)(1+\sin\theta)$

b) $1+\tan^2\theta=\sec^2\theta$

$\Rightarrow \quad \sec^2\theta-\tan^2\theta=1 \quad \Rightarrow \quad (\sec\theta-\tan\theta)(\sec\theta+\tan\theta)=1$

$\Rightarrow \quad \sec\theta-\tan\theta=\dfrac{1}{\sec\theta+\tan\theta} \quad \Rightarrow \quad \sec\theta+\tan\theta=\dfrac{1}{\sec\theta-\tan\theta}$

$\Rightarrow \quad \tan^2\theta=\sec^2\theta-1 \quad \Rightarrow \quad \tan^2\theta=(\sec\theta-1)(\sec\theta+1)$

c) $1+\cot^2\theta=\text{cosec}^2\theta$

$\Rightarrow \quad \text{cosec}^2\theta-\cot^2\theta=1 \quad \Rightarrow \quad (\text{cosec}\,\theta-\cot\theta)(\text{cosec}\,\theta+\cot\theta)=1$

$\Rightarrow \quad \text{cosec}\,\theta-\cot\theta=\dfrac{1}{\text{cosec}\,\theta+\cot\theta}$

$\Rightarrow \quad \text{cosec}\,\theta+\cot\theta=\dfrac{1}{\text{cosec}\,\theta-\cot\theta}$

$\Rightarrow \quad \cot^2\theta=\text{cosec}^2\theta-1 \quad \Rightarrow \quad \cot^2\theta=(\text{cosec}\,\theta-1)(\text{cosec}\,\theta+1)$

5. Write the trigonometric ratios of complementary angles.

$\sin\theta=\cos(90°-\theta) \qquad \cos\theta=\sin(90°-\theta)$

$\tan\theta=\cot(90°-\theta) \qquad \cot\theta=\tan(90°-\theta)$

$\text{cosec}\,\theta=\sec(90°-\theta) \qquad \sec\theta=\text{cosec}(90°-\theta)$

6. List out the trigonometric ratios of standard angles.

Angle / T-ratio	0°	30°	45°	60°	90°
Sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
Cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
Tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined
Cosec	Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
Sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not defined
Cot	Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

7. Two angles are said to be complementary if their sum is <u>90°.</u>

8. In a right-triangle, the two acute angles are complementary.

9. Let θ be an acute angle. Then

   a) As θ increases from $0°$ to $90°$, $\sin\theta$ increases from 0 to 1.

   b) As θ increases from $0°$ to $90°$, $\cos\theta$ decreases from 1 to 0.

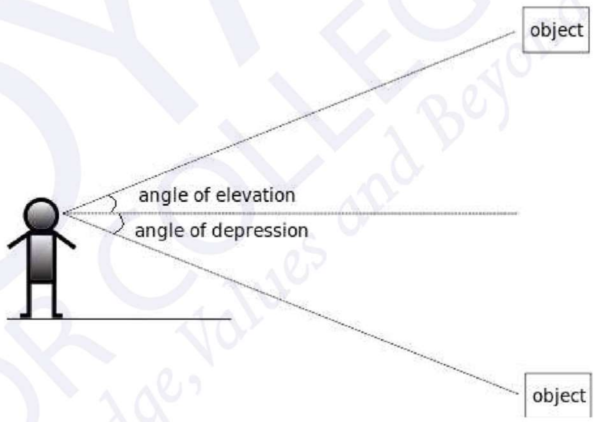
   c) As θ increases from $0°$ to $90°$, $\tan\theta$ increases from 0 to ∞.

10. The value of $\sin A$ or $\cos A$ never exceeds 1, whereas the value of $\sec A$ or $\operatorname{cosec} A$ is always more than or equal to 1.

9. APPLICTONS OF TRIGONOMETRY

1. The height or length of an object or the distance between two distant objects can be determined with the help of Trigonometry.

2. The line of sight is the line drawn from the eye of an observer to the point in the object viewed by the observer.



3. The angle of elevation of an object, is the angle formed by the line of sight with the horizontal through point of observation when it is above the eye level. (See the figure)

4. The angle of depression of an object, is the angle formed by the line of sight with the horizontal through point of observation when it is below the eye level.

10. STATISTICS

1. The different measures of central tendency of a numerical data are Mean, Median, and Mode.

2. Class-mark of a class is the arithmetic mean of lower and upper limits and is denoted by x_i.

3. Class-size or Class-length is the difference between two successive upper limits or two successive lower limits of a distribution.

4. Class-Mark is used in finding Mean of a grouped data.

5. Cumulative Frequency is used to find Median of a grouped data.

6. Frequency of a class is the number of observations falling in that class.

7. Less than Cumulative frequency of a class is the sum of frequencies from the beginning till that class.

8. Greater than Cumulative frequency of a class is the sum of frequencies from the end till that class.

9. Formula to find the Mean (or Average) of a raw data is $\bar{x}=\frac{\Sigma x_i}{n}$.

10. Formula to find the Mean of a grouped data using Direct Method is $\bar{x}=\frac{\Sigma f_i x_i}{\Sigma f_i}$.

11. Formula to find the Mean of a grouped data using Assumed Mean Method is $\bar{x}=A+\frac{\Sigma f_i d_i}{\Sigma f_i}$.

12. Formula to find the Mean of a grouped data using Step-Deviation Method is $\bar{x}=A+\frac{(\Sigma f_i u_i)h}{\Sigma f_i}$.

13. Mode of a data is the most frequent (most repeated)observation.

14. Formula to find the Mode of a grouped data is $Z=l+\frac{(f_1-f_0)h}{2f_1-f_0-f_2}$.

15. Modal class of a frequency distribution is the class which has the highest frequency.

16. To find median of raw data, we write observations in ascending (or descending) order.

17. The Median of a raw data when the number of terms is

a) odd is $\left(\frac{n+1}{2}\right)^{th}$ term and b) even is $\frac{1}{2}\left[\left(\frac{n}{2}\right)^{th}\text{ term } + \left(\frac{n}{2}+1\right)^{th}\text{ term}\right]$

18. The formula to find the Median of a grouped data is $M=l+\frac{\left(\frac{n}{2}-cf\right)}{f}\times h$.

19. We decide the median class using $\frac{n}{2}$ value and LCF.

20. The empirical relationship among the measures of central tendency is given by $\text{Mode}=3\,\text{Median}-2\,\text{Mean}$ or $\text{Mean}-\text{Mode}=3(\text{Mean}-\text{Median})$.

11. CIRCLES

1. A circle is a set of points equidistant from a fixed point in a plane. The fixed point is called centre and fixed distance is called radius.
2. Area of a ΔABC using Heron's Formula is $A=\sqrt{s(s-a)(s-b)(s-c)}$

   where $s=\frac{1}{2}\times(a+b+c)$.
3. A straight line which intersects a circle in two distinct points is called a secant and the straight line which touches (or intersects) the circle in exactly one point is called a tangent.
4. A rope around the pulley on both sides can be considered as a tangent.
5. How many tangents are possible to a circle in the following situations.

   a) At a point on the circle — Ans- 1

   b) From any point on the circle — Ans- infinitely many

   c) From a point exterior to the circle — Ans- 2

   d) From a point interior to the circle — Ans- zero
6. The point common to tangent and circle is called point of contact.
7. There cannot be more than two tangents parallel to a given secant.
8. Every chord is a secant but the converse may not be true.
9. The tangent at any point of a circle is perpendicular to the radius through the point of contact.
10. The line containing the radius through the point of contact is also called the normal to the circle at the point.
11. How many tangents can a circle have? Ans- infinitely many
12. The length of the segment of the tangent from the external point and the point of contact with the circle is called the length of the tangent.
13. The lengths of tangents drawn from an external point to a circle are equal.
14. Tangents drawn from an external point to a circle subtends equal angles at the centre.
15. Line joining the external point, from where tangents are drawn to a circle and the centre of the circle, bisects the angle between tangents.
16. In two concentric circles, the chord of the larger circle, which touches the smaller circle, is tangent at the point of contact.

17. The tangents drawn at the ends of a diameter of a circle are ___________

18. The perpendicular at the point of contact to the tangent to a circle passes through the centre of the circle.

19. The length of a tangent from a point, at a distance $d\ units$ from the centre of the circle of radius $r\ units$ is $\sqrt{d^2-r^2}$.

20. The parallelogram circumscribing a circle is a rectangle.

21. Opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

12. PROBABILITY

1. An unbiased coin can only land in one of two possible ways— either head up or tail up (we dismiss possibility of its landing on its edge).

2. The outcomes of a coin or a die are equally likely.

3. The possible outcomes of a coin are head, tail.

4. The possible outcomes of a die are 1, 2, 3, 4, 5, 6.

5. The experimental or empirical probability $P(E)$ of an event E is defined as $P(E)=\frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$.

6. The theoretical or classical probability $P(E)$ of an event E is defined as $P(E)=\frac{\text{Number of outcomes favourable to the event}}{\text{Number of all possible outcomes}}$.

7. Number of days in a year is 365 and that of a leap-year is 366.

8. An event having only one outcome is called an elementary event. Sum of probabilities of all the elementary events of an experiment is 1.

9. The event $\overline{E}$, representing 'not E', is called the complement of the event E.

10. The relation between probability an event E and the probability of its complement $\overline{E}$ is $P(E)+P(\overline{E})=1$.

11. The probability of an event which is impossible to occur is 0.
Such an event is called an impossible event.

12. The probability of an event which is sure (or certain) to occur is 1.
Such an event is called a sure event or a certain event.

13. The range of probability of an event E is $0 \le P(E) \le 1$.
14. The sum of probabilities of complementary events is 1.
15. The sum of probabilities of mutually exclusive events is 1.
16. The probability of an event is more than or equal to 0 and less than or equal to 1.
17. The set of all possible outcomes of an experiment is called sample space.
18. Sample space when a coin is tossed twice is $\{(H,H),(H,T),(T,H),(T,T)\}$.
19. Sample space when a coin is tossed thrice is

$$\{(H,H,H),(H,H,T),(H,T,H),(T,H,H),$$
$$(T,T,T),(T,T,H),(T,H,T),(H,T,T)\}$$

20. Sample space when a die is thrown twice is

$$\{(1,1),(1,2),(1,3),(1,4),(1,5),(1,6),$$
$$(2,1),(2,2),(2,3),\ \ldots\ldots\ldots\ldots,(6,5),(6,6)\}$$

21. The number of 1 digit positive integers is nine and the numbers are 1, 2, 3, 4, 5, 6, 7, 8, 9.
22. The number of 2 digit positive integers is ninety and the numbers are 10, 11, 12, ..., 98, 99.
23. The number of 3 digit positive integers is 900 and the numbers are 100, 101, 102, ..., 998, 999.
24. The number of odd positive integers up to 100 is 50.
25. The number of even positive integers up to 100 is 50.
26. The positive integers other than 1 and primes are called Composite numbers.
27. Number of cards in a pack of cards is 52.
28. Number of colors in a pack of cards is two and the colors are red and black.
29. Number of cards of color red is 26 and that of color black is 26.
30. Number of sets in a pack of cards is four and sets are Diamonds, Hearts, Spades, and Clubs.
31. The sets of cards which are red in color are Diamonds and Hearts.
32. The sets of cards which are black in color are Spades and Clubs.
33. Number of cards in one set is 13.
34. The number of number-cards in a set is nine and the numbers are 2, 3, 4, 5, 6, 7, 8, 9, 10.

35. The number of face-cards in a set is three and the face cards are King, Queen, and Jack.

36. The number of ace-cards in a pack of cards is four.

37. The number of number-cards in a pack of cards is 36.

38. The number of face-cards in a pack of cards is 12.

13. AREAS RELATED TO CIRCLES

1. With respect to a Circle

   a) Area, $A = \pi r^2$ b) Circumference, $C = 2\pi r$

   c) Diameter, $d = 2r$

2. With respect to a Ring or Annulus

   a) Width, $w = R - r$

   b) Area, $A = \pi R^2 - \pi r^2 = \pi(R^2 - r^2) = \pi(R-r)(R+r) = \pi w(R+r)$

3. With respect to a Minor Sector

   a) Area, $A = \dfrac{\theta}{360°} \times \pi r^2$ b) Arc length, $(l) = \dfrac{\theta}{360°} \times 2\pi r$

   c) Perimeter, $P = l + 2r$

4. With respect to a Major Sector

   a) Area, $A = \dfrac{360° - \theta}{360°} \times \pi r^2$ b) Arc length, $(L) = \dfrac{360° - \theta}{360°} \times 2\pi r$

   c) Perimeter, $P = L + 2r$

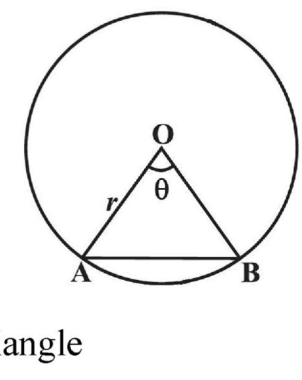
5. With respect to a closed Semi-Circle

   a) Area, $A = \dfrac{1}{2} \times \pi r^2$ b) Perimeter, $P = \pi r + 2r$

6. With respect to a closed Quadrant of a Circle

   a) Area, $A = \dfrac{1}{4} \times \pi r^2$ b) Perimeter, $P = \dfrac{1}{2} \times \pi r + 2r$

7. With respect to Segments of a Circle (See the Figure)



   a) Area of $\Delta AOB = \dfrac{1}{2} \times r^2 \sin\theta$ or $r^2 \sin\dfrac{\theta}{2} \cos\dfrac{\theta}{2}$

   b) Area of minor segment =

   Area of minor sector $-$ Area of triangle

   c) Area of major segment $=$ Area of major sector $+$ Area of triangle

8. The formula to find the area of a sector when its arc-length (l) and radius (r) is given by $\frac{1}{2} \times l r$.

9. A car or a truck wiper sweeps through the area which is of the form of sector of a circle.

10. A minute-hand of a clock sweeps through the area which is of the form of sector of a circle.

11. Minor segment is the region of a circle bounded by a chord and minor-arc.

12. Major segment is the region of a circle bounded by a chord and major-arc.

13. Minor sector is the region of a circle bounded by a minor-arc and radii.

14. Major sector is the region of a circle bounded by a major-arc and radii.

15. The distance covered by a wheel of a motor-vehicle or a cart, when number of turns made by the wheel is n and its radius is r is $d = n \times 2\pi r$.

16. The distance covered by a bucket used to draw water from a well is $d = n \times 2\pi r$, where n is the number of turns made by the pulley whose radius is r.

17. Formula to find the area of a regular-hexagon is $A = 6 \times \frac{\sqrt{3}a^2}{4}$.

18. Approximate value of π is 3.14 or $\frac{22}{7}$.

19. Approximate value of $\sqrt{3}$ is 1.73

14. SURFACE AREAS AND VOLUMES

1. $1\,m = 100\,cm$ and $1\,cm = \frac{1}{100}\,m$.

2. $1\,are = 100\,m^2$.

3. $1\,hectare = 100\,are = 10{,}000\,m^2$.

4. Formula to find volume of water transferred by a pipe or canal in a certain time when speed of water flow and cross-section of pipe of canal is given by

$V =$ Area of cross-section of pipe or canal $\times$ Speed of water flow $\times$ Time.

5. Formula to find volume of water transferred by a pipe or canal in a certain time when volume of water flow is unit time is given by

$V =$ Volume of water flow per unit time $\times$ Time.

6. In case of problems related to melting and recasting volume remains constant.

7. Ignoring the volume of cement mixture, the number of bricks used to construct a wall can be found using the formula $\frac{\text{Volume of wall}}{\text{Volume of one brick}}$.

8. $1\,m^3 = 1000\,l$ and $1\,l = 1000\,cm^3$.

9. The sharpened edge of a pencil is of the form of a cone.

10. Currency coin is of the form of a cylinder.

11. An oil funnel is the combination of a frustum and a cylinder.

12. Metallic wire is of the form of a cylinder.

13. With respect to a Triangle of sides *a, b* and c

a) Area, $A = \sqrt{s(s-a)(s-b)(s-c)}$

b) Perimeter, $P = a+b+c(=2s)$

14. Area of a triangle when one of its side and corresponding altitude is given is $A=\frac{1}{2}\times bh$.

15. With respect to a Rectangle

a) Area, $A = l\times b$

b) Perimeter, $P = 2\times(l+b)$

c) Diagonal, $d = \sqrt{l^2+b^2}$

16. With respect to a Square

a) Area, $A = a^2$

b) Perimeter, $P = 4\times a$

c) Diagonal, $d = \sqrt{2}\times a$

17. With respect to a Cuboid

a) Diagonal, $d = \sqrt{l^2+b^2+h^2}$

b) Sum of lengths of edges = $4\times(l+b+h)$

c) $LSA = 2h\times(l+b)$

d) $TSA = 2\times(lb+bh+hl)$

e) Volume, $V = l\times b\times h$

18. The longest length of a cuboid or a cube is its diagonal.

19. <u>With respect to a Cube</u>

a) Diagonal, $d = \sqrt{3} \times a$

b) Sum of lengths of edges = $12 \times a$

c) $LSA = 4 \times a^2$

d) $TSA = 6 \times a^2$

e) Volume, $V = a^3$

20. In a right-circular cylinder or a right-circular one, the axial line (the line passing through the centre of base) is <u>perpendicular</u> to the base.

21. <u>With respect to a Right-Circular Cylinder</u>

a) $CSA = 2\pi r h$

b) $TSA = 2\pi r \times (h + r)$

c) Volume, $V = \pi r^2 h$

22. <u>With respect to a Right-Circular Cone</u>

a) Area of base = πr^2

b) $CSA = \pi r l$

c) Slant height, $l = \sqrt{h^2 + r^2}$

d) $TSA = \pi r \times (l + r)$

e) Volume, $V = \frac{1}{3} \times \pi r^2 h$

23. If a cylinder and a cone are of equal radii and equal heights, then the ratio of their capacities in the given order is <u>3 : 1.</u>

24. <u>With respect to a Sphere</u>

a) Height, $h = 2r$

b) Width, $w = 2r$

c) $CSA / TSA / SA = 4 \times \pi r^2$

d) Volume, $V = \frac{4}{3} \times \pi r^3$

25. <u>With respect to a Hemi-Sphere</u>

a) Area of base = πr^2

b) Height, $h = r$

c) Width, $w = 2r$

d) $CSA = 2 \times \pi r^2$

e) $TSA = 3 \times \pi r^2$

f) Volume, $V = \frac{2}{3} \times \pi r^3$

26. If a road-roller of radius r, makes n turns, then the area covered by the roller is given by the expression $n \times$ CSA of roller $(= n \times 2\pi r h)$.

27. Volume of a submerged object is equal to the volume of <u>water displaced</u> by the object.

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