

MasterLeap Tuition Grade 10 formula sheet

Topics Covered:

- Real Numbers
 - Polynomials
 - Pair of Linear Equations in Two Variables
 - Quadratic Equations
 - Arithmetic Progressions
 - Triangles
 - Coordinate Geometry
 - Introduction to Trigonometry
 - Some Applications of Trigonometry
 - Circles
 - Constructions
 - Areas Related to Circles
 - Surface Areas and Volumes
 - Statistics
 - Probability
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SECTION 1: REAL NUMBERS

Euclid's Division Lemma

- Statement: For positive integers a and b , there exist unique integers q and r such that:
 - $a = bq + r$, where $0 \leq r < b$
- Application: Used in finding HCF through Euclid's division algorithm

Euclid's Division Algorithm (for HCF)

- Step 1: Apply lemma to larger number (c) and smaller number (d): $c = dq + r$
- Step 2: If $r = 0$, d is HCF
- Step 3: If $r \neq 0$, apply lemma to d and r
- Step 4: Continue until remainder = 0; last divisor is HCF

Fundamental Theorem of Arithmetic

- Statement: Every composite number can be expressed as product of primes uniquely (order may vary)
- Example: $90 = 2 \times 3 \times 3 \times 5 = 2 \times 3^2 \times 5$

HCF and LCM Using Prime Factorization

Formula	Example (12 and 18)
HCF = Product of smallest powers of common prime factors	$12=2^2 \times 3, 18=2 \times 3^2 \rightarrow \text{HCF}=2^1 \times 3^1=6$
LCM = Product of greatest powers of all prime factors	$\text{LCM}=2^2 \times 3^2=36$
Relationship	$\text{HCF} \times \text{LCM} = \text{Product of numbers}$ $(6 \times 36 = 12 \times 18 = 216)$

Irrational Numbers

- $\sqrt{2}, \sqrt{3}, \sqrt{5}$ are irrational numbers
- Proof method: Assume rational, derive contradiction

Rational Numbers and Their Decimal Expansions

Type	Property	Example
Terminating Decimal	Denominator of form $2^m 5^n$	$3/8 = 0.375$
Non-terminating Repeating (Recurring)	Denominator has factors other than 2 and 5	$1/3 = 0.333\dots$
<p>Theorem: Rational number p/q in lowest terms has terminating decimal iff $q = 2^m 5^n$</p>		

SECTION 2: POLYNOMIALS

Geometric Meaning of Zeroes

Degree	Graph	Zeroes
Linear	Straight line	1 zero (x-intercept)
Quadratic	Parabola	0, 1, or 2 zeroes
Cubic	Curve	1, 2, or 3 zeroes

Relationship Between Zeroes and Coefficients

Quadratic Polynomial: $ax^2 + bx + c$

- Sum of zeroes ($\alpha + \beta$) = $-b/a$
- Product of zeroes ($\alpha\beta$) = c/a

Cubic Polynomial: $ax^3 + bx^2 + cx + d$

- Sum of zeroes ($\alpha + \beta + \gamma$) = $-b/a$
- Sum of products taken two at a time ($\alpha\beta + \beta\gamma + \gamma\alpha$) = c/a
- Product of zeroes ($\alpha\beta\gamma$) = $-d/a$

Division Algorithm for Polynomials

- Statement: If $p(x)$ and $g(x)$ are polynomials with $g(x) \neq 0$, then there exist polynomials $q(x)$ and $r(x)$ such that:
 - $p(x) = g(x) \times q(x) + r(x)$
 - where degree $r(x) <$ degree $g(x)$

SECTION 3: PAIR OF LINEAR EQUATIONS IN TWO VARIABLES

General Form

- $a_1x + b_1y + c_1 = 0$
- $a_2x + b_2y + c_2 = 0$

Comparison of Ratios and Types of Solutions

Condition	Ratio Comparison	Type of Lines	Number of Solutions
Unique Solution	$a_1/a_2 \neq b_1/b_2$	Intersecting lines	One solution
No Solution	$a_1/a_2 = b_1/b_2$ $\neq c_1/c_2$	Parallel lines	No solution
Infinite Solutions	$a_1/a_2 = b_1/b_2$ $= c_1/c_2$	Coincident lines	Infinite solutions

Algebraic Methods of Solving

Method	Process
Substitution Method	Express one variable in terms of other, substitute in second equation
Elimination Method	Make coefficients of one variable equal, then add/subtract
Cross-Multiplication Method	$\frac{x}{(b_1c_2 - b_2c_1)} = \frac{y}{(c_1a_2 - c_2a_1)} = \frac{1}{(a_1b_2 - a_2b_1)}$

Equations Reducible to Linear Form

- Type: $ax + by = c$, $dx + ey = f$
- Substitution: Let $1/x = u$, $1/y = v$ etc.

SECTION 4: QUADRATIC EQUATIONS

Standard Form

- $ax^2 + bx + c = 0$, where $a \neq 0$

Solution Methods

Method	Process	Example
Factorization	Split middle term, factorize, set each factor = 0	$x^2 + 5x + 6 = 0 \rightarrow$ $(x+2)(x+3)=0 \rightarrow x = -2,$ -3
Completing Square	Make perfect square, take square root	$x^2 + 6x + 5 = 0 \rightarrow$ $(x+3)^2 = 4 \rightarrow x+3 = \pm 2$ $\rightarrow x = -1, -5$
Quadratic Formula	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	

Nature of Roots (Discriminant)

- $D = b^2 - 4ac$

Discriminant	Nature of Roots
$D > 0$	Two distinct real roots

$$D = 0$$

Two equal real roots (one root)

$$D < 0$$

No real roots (complex roots)

Relationship Between Roots and Coefficients

- For equation $ax^2 + bx + c = 0$ with roots α and β :
 - Sum of roots $(\alpha + \beta) = -b/a$
 - Product of roots $(\alpha\beta) = c/a$

Formation of Quadratic Equation

- If α and β are roots, equation is: $x^2 - (\alpha + \beta)x + \alpha\beta = 0$
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SECTION 5: ARITHMETIC PROGRESSIONS

Definition

- Sequence in which each term differs from previous term by constant (common difference)
- Example: 2, 5, 8, 11, ... (common difference = 3)

General Term (nth Term)

- $a_n = a + (n - 1)d$
 - a = first term
 - d = common difference

- n = term number

Sum of First n Terms

Formula	Expression
S_n	$n/2 [2a + (n - 1)d]$
S_n	$n/2 (a + l)$ where l = last term

Properties of AP

Property	Statement
If terms added/subtracted by constant	Result is also an AP
If terms multiplied/divided by constant	Result is also an AP

Three terms in AP

Can be taken as $a-d, a, a+d$

Four terms in AP

Can be taken as $a-3d, a-d, a+d, a+3d$

Finding Number of Terms

- From last term: $n = [(l - a)/d] + 1$
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SECTION 6: TRIANGLES

Similarity of Triangles

Criterion

Condition

AAA (or AA)

Corresponding angles equal

SSS

Corresponding sides in same ratio

SAS

Two sides proportional and included angle equal

Basic Proportionality Theorem (Thales Theorem)

- Statement: If line drawn parallel to one side of triangle intersects other two sides, then it divides those sides in same ratio
- Converse: If line divides two sides in same ratio, then it is parallel to third side

Criteria for Similarity

Criterion	Condition
AAA Similarity	All corresponding angles equal
SSS Similarity	All corresponding sides in same ratio
SAS Similarity	Two sides proportional and included angle equal

Areas of Similar Triangles

- Ratio of areas of two similar triangles = (Ratio of corresponding sides)²

Pythagoras Theorem

- In right triangle: (Hypotenuse)² = (Base)² + (Height)²
 - Converse: If $a^2 + b^2 = c^2$, then triangle is right-angled
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SECTION 7: COORDINATE GEOMETRY

Distance Formula

- Distance between $P(x_1, y_1)$ and $Q(x_2, y_2)$:
 - $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Section Formula

Type	Formula
Internal Division (m:n)	$[(mx_2 + nx_1)/(m+n), (my_2 + ny_1)/(m+n)]$
External Division (m:n)	$[(mx_2 - nx_1)/(m-n), (my_2 - ny_1)/(m-n)]$

Midpoint Formula

- Midpoint = $[(x_1 + x_2)/2, (y_1 + y_2)/2]$

Area of Triangle

- Area = $\frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$
- Collinearity: Points are collinear if area = 0

Area of Quadrilateral

- Area = Area of two triangles formed by diagonal

Centroid of Triangle

- Centroid = $[(x_1 + x_2 + x_3)/3, (y_1 + y_2 + y_3)/3]$
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SECTION 8: INTRODUCTION TO TRIGONOMETRY

Trigonometric Ratios

Ratio	Formula
$\sin \theta$	Opposite/Hypotenuse
$\cos \theta$	Adjacent/Hypotenuse
$\tan \theta$	Opposite/Adjacent
$\operatorname{cosec} \theta$	$1/\sin \theta$
$\sec \theta$	$1/\cos \theta$

cot θ

$1/\tan \theta$

Values at Standard Angles

Angle	0°	30°	45°	60°	90°
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sin	0	$1/2$	$1/\sqrt{2}$	$\sqrt{3}/2$	1
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cos	1	$\sqrt{3}/2$	$1/\sqrt{2}$	$1/2$	0
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tan	0	$1/\sqrt{3}$	1	$\sqrt{3}$	∞
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cosec	∞	2	$\sqrt{2}$	$2/\sqrt{3}$	1
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sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞
cot	∞	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

Trigonometric Identities

Identity	Formula
I	$\sin^2 \theta + \cos^2 \theta = 1$
II	$\sec^2 \theta - \tan^2 \theta = 1$
III	$\operatorname{cosec}^2 \theta - \cot^2 \theta = 1$

Complementary Angles

Relation	Formula
$\sin(90^\circ - \theta)$	$\cos \theta$
$\cos(90^\circ - \theta)$	$\sin \theta$
$\tan(90^\circ - \theta)$	$\cot \theta$
$\cot(90^\circ - \theta)$	$\tan \theta$
$\sec(90^\circ - \theta)$	$\operatorname{cosec} \theta$
$\operatorname{cosec}(90^\circ - \theta)$	$\sec \theta$

SECTION 9: APPLICATIONS OF TRIGONOMETRY

Line of Sight and Angles

Term	Definition
Line of Sight	Line from eye to object
Angle of Elevation	Angle above horizontal when looking up
Angle of Depression	Angle below horizontal when looking down

Height and Distance Formulas

Situation	Formula
Height of object	$h = d \times \tan \theta$ (where d = distance, θ = angle)
Distance to object	$d = h / \tan \theta$
When two angles given	Use tan ratios and solve equations

SECTION 10: CIRCLES

Tangent Properties

Property	Statement
Tangent at any point	Perpendicular to radius through point of contact
Tangents from external point	Equal in length
Angle between tangent and chord	Equal to angle in alternate segment

Number of Tangents from a Point

Point Location	Number of Tangents
Inside circle	0

On circle	1
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Outside circle	2
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Length of Tangent

- From external point P to circle with center O, radius r, distance OP = d:
 - Length of tangent = $\sqrt{d^2 - r^2}$
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SECTION 11: AREAS RELATED TO CIRCLES

Circle Formulas

Measurement	Formula
Circumference	$2\pi r$
Area	πr^2

Sector of Circle

Measurement	Formula	Variables
Area of sector	$(\theta/360) \times \pi r^2$	θ = angle of sector (degrees)
Length of arc	$(\theta/360) \times 2\pi r$	
Perimeter of sector	$2r + \text{arc length}$	

Segment of Circle

Measurement	Formula
Area of segment	Area of sector - Area of triangle
Area of minor segment	$(\theta/360)\pi r^2 - \frac{1}{2}r^2 \sin \theta$
Area of major segment	$\pi r^2 - \text{Area of minor segment}$

Area of Combinations of Plane Figures

- Area enclosed = Sum of areas of individual figures
 - Area of shaded region = Area of larger figure - Area of smaller figure(s)
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SECTION 12: SURFACE AREAS AND VOLUMES

Combination of Solids

Solid	Surface Area	Volume
Cuboid	$2(lb + bh + hl)$	$l \times b \times h$
Cube	$6a^2$	a^3
Cylinder	$2\pi r(h + r)$	$\pi r^2 h$
Cone	$\pi r(l + r)$	$\frac{1}{3}\pi r^2 h$
Sphere	$4\pi r^2$	$\frac{4}{3}\pi r^3$

Hemisphere

$$3\pi r^2 \text{ (total)}$$

$$\frac{2}{3}\pi r^3$$

Conversion of Solids

- When one solid melted and recast into another:
 - Volume remains constant
 - New shape volume = Original volume

Frustum of Cone

Measurement	Formula
Slant height (l)	$l = \sqrt{h^2 + (R - r)^2}$
Curved Surface Area	$\pi l(R + r)$
Total Surface Area	$\pi l(R + r) + \pi R^2 + \pi r^2$
Volume	$\frac{1}{3}\pi h(R^2 + Rr + r^2)$

SECTION 13: STATISTICS

Mean for Grouped Data

Method	Formula
Direct Method	$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$
Assumed Mean Method	$\bar{x} = a + \left(\frac{\sum f_i d_i}{\sum f_i} \right)$ where $d_i = x_i - a$
Step Deviation Method	$\bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$ where $u_i = (x_i - a)/h$

Mode for Grouped Data

- $\text{Mode} = l + \left[\frac{(f_1 - f_0)}{(2f_1 - f_0 - f_2)} \right] \times h$
 - l = lower limit of modal class
 - f_1 = frequency of modal class
 - f_0 = frequency of class before modal class
 - f_2 = frequency of class after modal class
 - h = class size

Median for Grouped Data

- $\text{Median} = l + \left[\frac{(n/2 - cf)}{f} \right] \times h$
 - l = lower limit of median class

- n = total frequency
- cf = cumulative frequency of class before median class
- f = frequency of median class
- h = class size

Ogive (Cumulative Frequency Curve)

- Less than ogive: Plot upper limits vs. cumulative frequency
- More than ogive: Plot lower limits vs. cumulative frequency
- Median from ogive: x-coordinate of intersection point

Empirical Relationship

- $3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$
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SECTION 14: PROBABILITY

Basic Probability Formula

- $P(E) = \text{Number of favorable outcomes} / \text{Total number of outcomes}$

Complementary Events

- $P(\text{not } E) = 1 - P(E)$
- $P(E) + P(\text{not } E) = 1$

Types of Events

Event Type	Definition
Impossible Event	$P(E) = 0$
Sure/Certain Event	$P(E) = 1$
Elementary Event	Single outcome of experiment
Compound Event	Combination of elementary events

Probability Range

- $0 \leq P(E) \leq 1$

Important Results

Situation	Formula
Probability of getting head/tail in coin	$1/2$

Probability of getting specific
number on die

1/6

Probability of drawing specific card

1/52

For mutually exclusive events

$P(A \text{ or } B) = P(A) + P(B)$

For non-mutually exclusive events

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
