MasterLeap Tuition Grade 8 formula sheet

Topics Covered:

- Rational Numbers
- Linear Equations in One Variable
- Understanding Quadrilaterals
- Data Handling
- Squares and Square Roots
- Cubes and Cube Roots
- Comparing Quantities
- Algebraic Expressions and Identities
- Mensuration
- Exponents and Powers
- Direct and Inverse Proportions
- Factorization
- Introduction to Graphs

SECTION 1: RATIONAL NUMBERS

Properties of Rational Numbers

Property	Definition	Example

Closure	Sum/difference/product of rational numbers is rational	2/3 + 3/4 = 17/12 (rational)
Commutative	a + b = b + a; a × b = b × a	2/3 + 3/4 = 3/4 + 2/3
Associative	(a + b) + c = a + (b + c); (a × b) × c = a × (b × c)	
Distributive	a × (b + c) = a × b + a × c	
Identity	a + 0 = a; a × 1 = a	0 is additive identity, 1 is multiplicative identity
Inverse	a + (-a) = 0; a × (1/a) = 1	Additive inverse: -a; Multiplicative inverse: 1/a

Representation on Number Line

- Positive rational numbers: To the right of zero
- Negative rational numbers: To the left of zero

Rational Numbers Between Two Numbers

- Method: Find average of two numbers
- Example: Between 1/3 and 1/2 → (1/3 + 1/2)/2 = (5/6)/2 = 5/12

SECTION 2: LINEAR EQUATIONS IN ONE VARIABLE

Standard Form

- ax + b = 0, where a ≠ 0

Solving Linear Equations

Type	Method	Example
Simple	Isolate variable	3x + 5 = 14 → 3x = 9 → x = 3
With variables both sides	Collect variables on one side	5x - 3 = 2x + 9 → 5x - 2x = 9 + 3 → 3x = 12 → x = 4

With brackets	Expand brackets first	$2(x + 3) = 12 \rightarrow 2x + 6 = 12 \rightarrow 2x = 6 \rightarrow x = 3$
With fractions	Multiply by LCM	$(x/2) + (x/3) = 5 \rightarrow$ Multiply by 6: $3x + 2x = 30 \rightarrow 5x = 30 \rightarrow x = 6$

Word Problems

Problem Type	Key Words	Equation Form
Sum of numbers	Sum, total, together	$x + (x + d) = \text{total}$
Consecutive numbers	Consecutive integers	$x, x+1, x+2,...$
Age problems	Years ago, after some years	Present ages, then add/subtract years

Number problems	Digits of a number	Two-digit number = 10x + y

SECTION 3: SQUARES AND SQUARE ROOTS

Square Numbers

Property	Definition	Example
Perfect Square	Number obtained by squaring an integer	1,4,9,16,25,36,49,...
Square of a number	$n^2 = n \times n$	$8^2 = 8 \times 8 = 64$
Square of negative	$(-n)^2 = n^2$	$(-5)^2 = 25$

Properties of Square Numbers

Property	Explanation
Ending digits	Perfect squares end with 0,1,4,5,6,9 (never 2,3,7,8)
Square of even	Square of even number is even
Square of odd	Square of odd number is odd
Square of multiples of 5	Ends with 25
Triangular pattern	Sum of first n odd numbers = n^2

Square Roots

Method	Process

Prime Factorization	Write number as product of primes, pair equal factors, take one from each pair
Long Division Method	Used for large numbers
Estimation	Find between which two perfect squares the number lies

Square Root Rules

Rule	Formula
√(a×b)	√a × √b
√(a/b)	√a ÷ √b
√a ± √b	Cannot combine unless a = b

SECTION 4: CUBES AND CUBE ROOTS

Cube Numbers

Property	Definition	Example
Perfect Cube	Number obtained by cubing an integer	1,8,27,64,125,216,...
Cube of a number	$n^3 = n \times n \times n$	$4^3 = 4 \times 4 \times 4 = 64$
Cube of negative	$(-n)^3 = -n^3$	$(-3)^3 = -27$

Properties of Cube Numbers

Property	Explanation
Ending digits	Cubes end with any digit (0-9)

Cube of even	Cube of even number is even
Cube of odd	Cube of odd number is odd
Sum of first n cubes	$[n(n+1)/2]^2$

Cube Roots

Method	Process
Prime Factorization	Write number as product of primes, group in triplets, take one from each triplet
Estimation	Find between which two perfect cubes the number lies

Cube Root Rules

Rule	Formula
$\sqrt[3]{(a \times b)}$	$\sqrt[3]{a} \times \sqrt[3]{b}$
$\sqrt[3]{(a/b)}$	$\sqrt[3]{a} \div \sqrt[3]{b}$

SECTION 5: COMPARING QUANTITIES

Ratio and Proportion

Concept	Formula	Example
Ratio	a : b = a/b	4 : 5 = 4/5
Proportion	a/b = c/d	2/3 = 4/6

Percentage

Application	Formula	Example
Percentage of a number	(p% of x) = (p × x)/100	20% of 80 = 16
Percentage increase	New = Original × (1 + r/100)	80 increased by 15% = 92
Percentage decrease	New = Original × (1 - r/100)	80 decreased by 15% = 68
Successive percentage	a% + b% + (ab/100)%	10% increase then 20% increase = 32% total

Profit and Loss

Formula	Expression
Profit %	(Profit/CP) × 100

Loss %	(Loss/CP) × 100
SP when profit % given	CP × (100 + Profit%)/100
SP when loss % given	CP × (100 - Loss%)/100
CP when profit % given	(SP × 100)/(100 + Profit%)
CP when loss % given	(SP × 100)/(100 - Loss%)

Discount and Tax

Formula	Expression
Discount	MP - SP
Discount %	(Discount/MP) × 100

SP after discount	MP × (100 - Discount%)/100
Sales Tax/VAT	Tax = (Price × Tax Rate)/100
Bill Amount	Price + Tax

Compound Interest

Formula	Expression	Variables
Amount	$A = P(1 + R/100)^n$	P = Principal, R = Rate, n = Time (years)
Compound Interest	CI = A - P	
Half-yearly	$A = P(1 + R/200)^{2n}$	
Quarterly	$A = P(1 + R/400)^{4n}$	

SECTION 6: ALGEBRAIC EXPRESSIONS AND IDENTITIES

Basic Operations

Operation	Rule	Example
Addition	Add like terms	$(3x^2 + 2x) + (5x^2 - 3x) = 8x^2 - x$
Subtraction	Subtract like terms	$(7x^2 - 3x) - (2x^2 + x) = 5x^2 - 4x$
Multiplication	Multiply each term	$2x(3x + 4) = 6x^2 + 8x$
Multiplication (binomials)	FOIL method	$(x+2)(x+3) = x^2 + 5x + 6$

Standard Identities

Identity	Formula
Identity I	$(a + b)^2 = a^2 + 2ab + b^2$
Identity II	$(a - b)^2 = a^2 - 2ab + b^2$
Identity III	$(a + b)(a - b) = a^2 - b^2$
Identity IV	$(x + a)(x + b) = x^2 + (a + b)x + ab$

Applications of Identities

Type	Method
Finding squares	Use $(a \pm b)^2 = a^2 \pm 2ab + b^2$
Finding products	Use $(a+b)(a-b) = a^2 - b^2$

Simplifying expressions	Apply appropriate identity
Evaluating numerical values	Break numbers into convenient form

SECTION 7: FACTORIZATION

Methods of Factorization

Method	Process	Example
Common Factors	Find common factor in all terms	$6x^2 + 9x = 3x(2x + 3)$
Regrouping	Group terms with common factors	$ax + ay + bx + by = a(x+y) + b(x+y) = (x+y)(a+b)$
Using Identities	Apply algebraic identities	$x^2 - 9 = (x+3)(x-3)$

Splitting Middle Term	For quadratic $ax^2 + bx + c$	$x^2 + 5x + 6 = x^2 + 2x + 3x + 6 = x(x+2) + 3(x+2) = (x+2)(x+3)$

Factorization of Quadratics

Form	Method
$x^2 + bx + c$	Find p,q such that $p+q = b$ and $pq = c \rightarrow (x+p)(x+q)$
$ax^2 + bx + c$	Multiply a and c, find factors that sum to b, split middle term

SECTION 8: UNDERSTANDING QUADRILATERALS

Types of Quadrilaterals

Quadrilateral	Properties

Parallelogram	Opposite sides parallel and equal, opposite angles equal, diagonals bisect each other
Rectangle	Parallelogram with all angles 90°, diagonals equal
Rhombus	Parallelogram with all sides equal, diagonals perpendicular bisectors
Square	Rectangle with all sides equal, diagonals equal and perpendicular
Trapezium	One pair of opposite sides parallel
Kite	Two pairs of adjacent sides equal, diagonals perpendicular

Angle Sum Property

- Sum of interior angles of any quadrilateral = 360°

Diagonals Properties

Shape	Diagonal Property
Parallelogram	Diagonals bisect each other
Rectangle	Diagonals are equal and bisect each other
Rhombus	Diagonals are perpendicular bisectors
Square	Diagonals are equal, perpendicular bisectors
Kite	Diagonals are perpendicular, one diagonal bisects the other

SECTION 9: MENSURATION

Area Formulas

Shape	Formula	Variables
Trapezium	$\frac{1}{2} \times (a + b) \times h$	a,b = parallel sides, h = height
Rhombus	$\frac{1}{2} \times d_1 \times d_2$	d_1,d_2 = diagonals
Quadrilateral (general)	$\frac{1}{2} \times d \times (h_1 + h_2)$	d = diagonal, h_1,h_2 = heights from vertices
Polygon (regular)	½ × Perimeter × Apothem	

Volume and Surface Area

Shape	Volume	Lateral Surface Area	Total Surface Area
Cube	a^3	$4a^2$	$6a^2$

Cuboid	$l \times b \times h$	$2h(l + b)$	$2(lb + bh + hl)$
Cylinder	$\pi r^2 h$	$2\pi rh$	$2\pi r(h + r)$
Cone	$\frac{1}{3}\pi r^2 h$	πrl	$\pi r(l + r)$
Sphere	$\frac{4}{3}\pi r^3$	$4\pi r^2$	$4\pi r^2$
Hemisphere	$\frac{2}{3}\pi r^3$	$2\pi r^2$	$3\pi r^2$

Important Conversions

Unit	Conversion
$1\ m^3$	1000 liters
$1\ cm^3$	1 mL

1 m^2	10,000 cm^2

SECTION 10: EXPONENTS AND POWERS

Laws of Exponents (Negative and Zero)

Law	Formula	Example
Zero Exponent	$a^0 = 1$ $(a \neq 0)$	$5^0 = 1$
Negative Exponent	$a^{-n} = 1/a^n$	$2^{-3} = 1/8$
Product	$a^m \times a^n = a^{m+n}$	$2^3 \times 2^4 = 2^7$
Quotient	$a^m \div a^n = a^{m-n}$	$2^5 \div 2^3 = 2^2$
Power of Power	$(a^m)^n = a^{mn}$	$(2^3)^2 = 2^6$

Power of Product	$(ab)^m = a^m b^m$	$(2\times3)^2 = 2^2 \times 3^2$
Power of Quotient	$(a/b)^m = a^m/b^m$	$(2/3)^3 = 8/27$

Standard Form (Scientific Notation)

- Writing in standard form: Number between 1 and 10 × power of 10
- Example: 5,670,000 = 5.67×10^6
- Example: 0.000045 = 4.5×10^{-5}

SECTION 11: DIRECT AND INVERSE PROPORTIONS

Direct Proportion

Property	Formula	Example
Definition	As x increases, y increases in same ratio	More items → More cost
Equation	$y = kx$ or $x_1/y_1 = x_2/y_2$	

Graph	Straight line through origin

Inverse Proportion

Property	Formula	Example
Definition	As x increases, y decreases	More workers → Less time
Equation	$xy = k$ or $x_1y_1 = x_2y_2$	
Graph	Hyperbola	

Identifying Proportion

Situation	Type	Check
Speed and time (fixed distance)	Inverse	Product constant

Number of items and cost	Direct	Ratio constant
Workers and days (fixed work)	Inverse	Product constant
Distance and time (fixed speed)	Direct	Ratio constant

SECTION 12: INTRODUCTION TO GRAPHS

Cartesian Plane

Component	Description
x-axis	Horizontal line
y-axis	Vertical line
Origin	Point where axes intersect (0,0)

Coordinates	(x,y) where x = distance from y-axis, y = distance from x-axis
Quadrants	I (+,+), II (-,+), III (-,-), IV (+,-)

Types of Graphs

Graph Type	Use	Example
Line Graph	Show trends over time	Temperature over days
Linear Graph	Direct proportion relationship	Distance-time graph
Bar Graph	Compare categories	Marks in different subjects
Pie Chart	Show parts of a whole	Expenditure distribution

Reading Graphs

- Coordinates: Always (x,y) → x first, then y

- Scale: Uniform intervals on axes
- Title: Tells what graph represents
- Labels: Indicate what axes represent