LF LearnFrenzy

QUANTITATIVE APTITUDE · FREE STUDY MATERIAL

Simplification

Formulas & Shortcut Tricks

Every important formula, shortcut and exam trick for Simplification in one place – with solved examples, common mistakes and a one-page revision sheet.

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USEFUL FOR

- Bank PO & Clerk (IBPS, SBI, RBI) – "What comes in place of ?"
- SSC CGL / CHSL / MTS
- Railways (RRB NTPC, Group D)
- Campus placements (TCS, Infosys, Wipro, Accenture)
- UPSC CSAT & state PSC exams

Practise **Simplification** free on LearnFrenzy – questions with instant explanations →

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1 Topic introduction

What it is, why it matters and how it is asked

Simplification means reducing a long expression – brackets, “of”, fractions, decimals, powers and percentages – to a single number, in the right order and without slips. It is less about new ideas and more about speed, order and smart shortcuts.

In bank exams it appears as “What will come in place of the question mark (?)”, usually 5 to 10 questions in a row. A student who calculates mentally and checks with digit sums can finish them in a few minutes and buy time for harder sections.

Why it matters in exams

- IBPS, SBI and RBI prelims carry a block of 5–10 simplification questions – the fastest marks in the paper.
- SSC papers test VBODMAS order, identities and x + 1/x results.
- Placement tests reward mental arithmetic: near-base products, squares and percentage shortcuts.

Where it is used

- Every other arithmetic chapter ends in a simplification step.
- Quick estimates of bills, discounts and interest in daily life.
- Checking calculator or spreadsheet results mentally.

Common question patterns

VBODMAS chains
Bars, nested brackets, “of”, ÷ and × in one line.

Missing number (?)
Percentages, fractions, squares and roots on both sides.

Mental products
Numbers near 100 or 1000, ending in 5, × 99, × 11, × 25.

Identities
$(a \pm b)^2$, $a^2 - b^2$, $a^3 \pm b^3$ and $a^3 + b^3 + c^3 - 3abc$.

x ± 1/x
Find $x^2 + 1/x^2$ or $x^3 + 1/x^3$ from $x + 1/x$.

Powers and roots
Fractional and negative exponents, square roots of decimals.

Percent of numbers
x% of y, fraction chains, percentage–fraction swaps.

Operator puzzles
Symbols swapped (+ means ×, …), then BODMAS.

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2 Important formulas

Cards marked MOST USED are the ones to revise first

Order of operations (VBODMAS)

Letter	Stands for	Notes
V	Vinculum (bar)	A bar over terms, like $\overline{7-3}$, is solved first
B	Brackets	( ) first, then { }, then [ ] – innermost outwards
O	Of, orders	"of" (multiply), powers and roots
D, M	Division, multiplication	Same rank – work left to right
A, S	Addition, subtraction	Same rank – work left to right

VBODMAS in action

MOST USED

Bar → ( ) → { } → [ ] → of → ÷ / × (left to right) → + / – (left to right)

Write one step per line; most errors come from doing two levels at once.

EXAMPLE $48 \div 4$ of $3 + [18 - \{6 + (10 - \overline{7-3})\}] = 48 \div 12 + [18 - \{6 + 6\}] = 4 + 6 = \mathbf{10}$.

Division and multiplication: left to right

$a \div b \times c = (a \div b) \times c$, not $a \div (b \times c)$

D before M in the word does not mean division first – they share a rank.

EXAMPLE $72 \div 8 \times 3 = 9 \times 3 = \mathbf{27}$ (not $72 \div 24 = 3$).

Mental multiplication and squares

Square of a number ending in 5

MOST USED

$(10a + 5)^2 = a \times (a + 1)$ followed by 25

Multiply the front part by the next number and write 25 after it.

EXAMPLE 85^2: $8 \times 9 = 72 \rightarrow \mathbf{7{,}225}$.

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Base method (numbers near 100 or 1000)

MOST USED

$$(B + a)(B + b) = B \times (B + a + b) + a \times b \text{ (a, b can be negative)}$$

Add one number to the other's difference from the base, then attach the product of the differences.

B – base (10, 100, 1000 …) **a, b** – differences from the base

EXAMPLE 104 × 97 = 100 × 101 + (4)(−3) = 10,100 − 12 = **10,088**.

× 5, × 25, × 125

$$n \times 5 = n \times 10/2;\ n \times 25 = n \times 100/4;\ n \times 125 = n \times 1000/8$$

Multiply by a power of ten and halve, quarter or eighth – no long multiplication.

EXAMPLE 336 × 125 = 336,000/8 = **42,000**.

× 9, × 99, × 999

$$n \times 99 = 100n - n \text{ (and similarly for 9, 999)}$$

Multiply by the next power of ten and subtract the number once.

EXAMPLE 476 × 99 = 47,600 − 476 = **47,124**.

× 11 for a two-digit number

$$ab \times 11 = a \mid (a + b) \mid b \text{ (carry if } a + b \geq 10)$$

Split the digits and put their sum in the middle.

EXAMPLE 76 × 11: 7 | 13 | 6 → carry → **836**.

Squares near 50

$$(50 + a)^2 = (25 + a) \text{ followed by } a^2 \text{ as two digits}$$

Works for 41 to 59; a is negative below 50.

EXAMPLE 47^2: 25 − 3 = 22, $(-3)^2$ = 09 → **2,209**.

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Algebraic identities

Squares

MOST USED

$(a \pm b)^2 = a^2 \pm 2ab + b^2$; $a^2 - b^2 = (a + b)(a - b)$

Difference of squares turns big squares into an easy product.

EXAMPLE $1002^2 - 998^2 = 2000 \times 4 =$ **8,000**.

Sum and difference of squares

$(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$; $(a + b)^2 - (a - b)^2 = 4ab$

Middle terms cancel or double.

EXAMPLE $(0.37)^2 + (0.63)^2 + 2 \times 0.37 \times 0.63 = (0.37 + 0.63)^2 =$ **1**.

Cubes

$(a \pm b)^3 = a^3 \pm b^3 \pm 3ab(a \pm b)$; $a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$

Use $(a + b)^3$ to cube numbers near a round value.

EXAMPLE $103^3 = 1{,}000{,}000 + 27 + 3 \times 100 \times 3 \times 103 =$ **10,92,727**.

Three cubes

MOST USED

$a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$; if $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$

Check whether the three numbers add to zero before cubing anything.

EXAMPLE $15^3 - 8^3 - 7^3$: $15 + (-8) + (-7) = 0 \rightarrow 3 \times 15 \times (-8) \times (-7) =$ **2,520**.

x ± 1/x results

From x + 1/x = k

MOST USED

$x^2 + 1/x^2 = k^2 - 2$; $x^3 + 1/x^3 = k^3 - 3k$; $x^4 + 1/x^4 = (k^2 - 2)^2 - 2$

Square or cube both sides – the cross term is always a constant because $x \times 1/x = 1$.

EXAMPLE $x + 1/x = 4 \rightarrow x^2 + 1/x^2 = 14$ and $x^3 + 1/x^3 = 64 - 12 =$ **52**.

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From x − 1/x = k

$x^2 + 1/x^2 = k^2 + 2$; $x^3 - 1/x^3 = k^3 + 3k$

Signs flip compared with the + case.

EXAMPLE $x - 1/x = 3 \rightarrow x^2 + 1/x^2 = 11$ and $x^3 - 1/x^3 = 27 + 9 =$ **36**.

Special value

$x + 1/x = 2$ means $x = 1$, so $x^n + 1/x^n = 2$ for every n

A favourite trap – no expansion is needed.

EXAMPLE If $x + 1/x = 2$, then $x^{99} + 1/x^{99} =$ **2**.

Powers and roots

Laws of exponents

MOST USED

$a^m \times a^n = a^{m+n}$; $a^m \div a^n = a^{m-n}$; $(a^m)^n = a^{mn}$; $a^0 = 1$; $a^{-n} = 1/a^n$; $a^{m/n} = (\sqrt[n]{a})^m$

Write every base as a power of the same prime, then just work with the powers.

EXAMPLE $8^{2/3} = (\sqrt[3]{8})^2 = 2^2 =$ **4**.

Roots of decimals

$\sqrt{(ab)} = \sqrt{a} \times \sqrt{b}$; $\sqrt{(a/b)} = \sqrt{a} / \sqrt{b}$; an even number of decimal places halves under $\sqrt{}$

Remove the decimal, take the root, then put back half the decimal places.

EXAMPLE $\sqrt{0.0169} = \sqrt{169} / \sqrt{10000} = 13/100 =$ **0.13**.

Percentages and missing numbers

Swap the percentage

MOST USED

x% of y = y% of x

Choose whichever order is easier to compute.

EXAMPLE 18% of 250 = 250% of 18 = 2.5 × 18 = **45**.

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Fraction chains

> **a/b of c/d of N = (a × c × N)/(b × d)**

Cancel across the whole chain before multiplying.

EXAMPLE 3/4 of 2/5 of 1,200 = 3 × 2 × 1,200/20 = **360**.

Missing number (?)

MOST USED

> **Simplify the known side completely, then undo the operations around ? in reverse order**

Treat ? as an unknown x and balance the equation.

EXAMPLE 45% of 640 + ? = 24^2 − 120 → 288 + ? = 456 → ? = **168**.

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3 Shortcut tricks & smart techniques

Each trick says when to use it – that matters as much as the trick

Digit-sum check for "?" questions

MOST USED

USE WHEN The options are far apart in digit sum – common in bank papers.

1. Reduce every number to its digit sum (keep adding digits until one digit is left).
2. Do the same operations on the digit sums.
3. Pick the option whose digit sum matches.

EXAMPLE 347 × 26 + 1,128: digit sums 5 × 8 = 40 → 4, plus 3 → 7. The answer 10,150 has digit sum 7 ✓

Unit-digit elimination

USE WHEN Products or sums with options that end in different digits.

1. Find only the last digit of the result.
2. Strike out options that end differently.

EXAMPLE 4,872 × 13 must end in 2 × 3 = **6** – only one option survives.

Base method near 1000

MOST USED

USE WHEN Both numbers are just below or above 1000.

1. Find each number's difference from 1000.
2. Cross-add: one number plus the other's difference.
3. Attach the product of differences as three digits.

EXAMPLE 996 × 993: 996 – 7 = 989, (–4)(–7) = 028 → **9,89,028**.

Break and rebuild (distributive law)

USE WHEN One factor is close to a round number.

1. Write it as round number ± small number.
2. Multiply both parts and add or subtract.

EXAMPLE 35 × 48 = 35 × 50 – 35 × 2 = 1,750 – 70 = **1,680**.

Pull out the common factor

USE WHEN Two products share a number.

1. Spot the repeated factor.
2. Add or subtract the other factors first – often they make a round number.

EXAMPLE 47 × 83 + 47 × 17 = 47 × (83 + 17) = 47 × 100 = **4,700**.

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Percentages as fractions

USE WHEN Percentages like 12.5%, 37.5%, 16.67%, 62.5%.

1. Replace the percentage by its fraction (12.5% = 1/8, 37.5% = 3/8, 16.67% = 1/6, 62.5% = 5/8).
2. Divide first, then multiply.

EXAMPLE 37.5% of 640 = 3/8 × 640 = **240**.

Three-cubes identity in disguise

MOST USED

USE WHEN A long expression contains $a^3 + b^3 + c^3 - 3abc$ divided by $a^2 + b^2 + c^2 - ab - bc - ca$.

1. Name the three numbers a, b, c.
2. The whole fraction equals a + b + c.

EXAMPLE For a = 5.3, b = 2.4, c = 1.3 the fraction equals 5.3 + 2.4 + 1.3 = **9**.

Operator puzzles

USE WHEN "If + means ×, − means ÷ …, find the value."

1. Rewrite the whole expression with the real symbols first.
2. Only then apply BODMAS.

EXAMPLE + → ×, − → ÷, × → −, ÷ → +: 18 + 4 − 8 × 3 ÷ 2 becomes 18 × 4 ÷ 8 − 3 + 2 = 9 − 3 + 2 = **8**.

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4 Solved examples

The full method on the left, the exam shortcut on the right

1 VBODMAS

Simplify $7 + [42 \div \{20 - (5 \times 3 - \overline{9 - 7})\}]$.

STEP BY STEP

1. Bar first: $\overline{9 - 7} = 2$.
2. Small bracket: $5 \times 3 - 2 = 13$.
3. Curly bracket: $20 - 13 = 7$.
4. Square bracket: $42 \div 7 = 6$.
5. Finally $7 + 6 = 13$.

SHORTCUT

Work strictly inside-out: 2 → 13 → 7 → 6 → 13.

Why it works: The bar groups 9 – 7 even though it sits inside a subtraction.

Answer: 13

2 MISSING NUMBER

35% of 840 + 7/8 of 576 = ? + 289.

STEP BY STEP

1. 35% of 840 = 0.35 × 840 = 294.
2. 7/8 of 576 = 7 × 72 = 504.
3. Left side = 798.
4. ? = 798 – 289 = 509.

SHORTCUT

35% of 840 = 840 × 7/20 = 294 (swap to fractions); 576 ÷ 8 = 72 → 504.

Why it works: Fractions like 7/20 and 7/8 divide exactly, so no decimals are needed.

Answer: 509

3 SQUARES

$?^2 + 17^2 = 1{,}189$.

STEP BY STEP

1. $17^2 = 289$.
2. $?^2 = 1{,}189 - 289 = 900$.
3. ? = 30.

SHORTCUT

A square ending in 00 → its root ends in 0 → 30.

Why it works: Knowing squares to 30 turns this into one subtraction.

Answer: 30

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4 BASE METHOD

Find 108 × 112 mentally.

STEP BY STEP

1. Write 108 = 100 + 8 and 112 = 100 + 12.
2. (100 + 8)(100 + 12) = 10,000 + 100 × 20 + 96.
3. = 12,096.

SHORTCUT

108 + 12 = 120 → 120 | 96 → 12,096.

Why it works: The base method is just the expansion (B + a)(B + b) = B(B + a + b) + ab.

Answer: 12,096

5 IDENTITIES

Simplify $(6.25)^2 - 2 \times 6.25 \times 3.25 + (3.25)^2$.

STEP BY STEP

1. The shape is $a^2 - 2ab + b^2$ with a = 6.25, b = 3.25.
2. It equals $(a - b)^2$.
3. $(6.25 - 3.25)^2 = 3^2 = 9$.

SHORTCUT

Spot $(a - b)^2 \rightarrow 3^2 = 9$.

Why it works: Recognising the identity avoids squaring two decimals.

Answer: 9

6 THREE CUBES

Find the value of $11^3 - 7^3 - 4^3$.

STEP BY STEP

1. Direct: 1,331 − 343 − 64 = 924.

SHORTCUT

11 + (−7) + (−4) = 0, so the sum of cubes = 3 × 11 × (−7) × (−4) = 924.

Why it works: When a + b + c = 0, $a^3 + b^3 + c^3 = 3abc$ – no cubing at all.

Answer: 924

7 X + 1/X

If $x + 1/x = 5$, find $x^4 + 1/x^4$.

STEP BY STEP

1. Square: $x^2 + 2 + 1/x^2 = 25 \rightarrow x^2 + 1/x^2 = 23$.
2. Square again: $x^4 + 2 + 1/x^4 = 529$.
3. $x^4 + 1/x^4 = 527$.

SHORTCUT

$k^2 - 2 = 23$, then $23^2 - 2 = 527$.

Why it works: Each squaring adds the constant 2 from x × 1/x = 1, which must be removed.

Answer: 527

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8 POWERS

Simplify $(243)^{0.8} \times (32)^{-0.6}$.

STEP BY STEP

1. $243 = 3^5$, so $243^{0.8} = 3^4 = 81$.
2. $32 = 2^5$, so $32^{-0.6} = 2^{-3} = 1/8$.
3. $81 \times 1/8 = 81/8 = 10.125$.

SHORTCUT

Power of $5 \times 0.8 = 4$ and $5 \times (-0.6) = -3 \rightarrow 3^4 / 2^3$.

Why it works: Writing bases as powers turns decimals in the exponent into whole numbers.

Answer: 81/8 = 10.125

9 DIFFERENCE OF SQUARES

Find $75.5^2 - 24.5^2$.

STEP BY STEP

1. $a^2 - b^2 = (a + b)(a - b)$.
2. $(75.5 + 24.5)(75.5 - 24.5) = 100 \times 51$.
3. = 5,100.

SHORTCUT

Sum 100, difference 51 → 5,100.

Why it works: Numbers chosen to add to a round value are a signal for this identity.

Answer: 5,100

10 OPERATOR PUZZLE

If × means +, + means ÷, − means × and ÷ means −, find 16 + 4 − 3 × 9 ÷ 5.

STEP BY STEP

1. Rewrite: $16 \div 4 \times 3 + 9 - 5$.
2. $16 \div 4 = 4$, then $\times 3 = 12$.
3. $12 + 9 - 5 = 16$.

SHORTCUT

Translate symbols in one pass, then VBODMAS.

Why it works: Applying BODMAS before translating gives a different, wrong order.

Answer: 16

11 MIXED

$\sqrt{?} \times 14 + 18\%$ of $450 = 333$.

STEP BY STEP

1. 18% of 450 = 81.
2. $\sqrt{?} \times 14 = 333 - 81 = 252$.
3. $\sqrt{?} = 18$, so ? = 324.

SHORTCUT

450% of 18 = 81 (swap); $252 \div 14 = 18 \rightarrow 18^2 = 324$.

Why it works: Undo the operations around ? in reverse order: subtract, divide, then square.

Answer: 324

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5 Important exam tips

Patterns, traps and habits that save marks

Frequently asked question patterns

- Bank "?" questions mixing percentages, fractions, squares and roots.
- VBODMAS chains with a bar and nested brackets.
- Identities with decimal values: $(a \pm b)^2$, $a^2 - b^2$, three cubes.
- $x + 1/x$ and $x - 1/x$ results up to the fourth power.
- Fractional and negative exponents with bases 2, 3 and 5.
- Mental products near 100 or 1000 and squares ending in 5.
- Operator and symbol-substitution puzzles.

Common mistakes to avoid

- Doing ÷ and × in the wrong order – they go left to right.
- Ignoring the bar (vinculum) or treating "of" like ordinary ×.
- Forgetting the −2 or +2 in $x^2 + 1/x^2$.
- Writing the base-method product with the wrong number of digits (two digits for base 100, three for 1000).
- Applying BODMAS before translating swapped operators.
- Taking the square root of a decimal with an odd number of decimal places without adjusting.
- Rounding in the middle of an exact question.

Points to remember

- x% of y = y% of x.
- If $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$.
- $x + 1/x = 2$ means $x = 1$.
- $a^0 = 1$ for any non-zero a.
- Squares end only in 0, 1, 4, 5, 6 or 9.

Speed and accuracy

- Learn squares to 50, cubes to 20 and the percentage–fraction table.
- Check answers with digit sums and unit digits before marking.
- Look for an identity whenever squares or cubes of decimals appear.
- Use the base method for any product near 100 or 1000.

Preparation strategy

- Do the simplification block first in bank prelims – it sets your pace.
- Practise on LearnFrenzy in order: Easy → Medium → Hard → Exam Pattern Mix → Data Sufficiency.
- Target 20–30 seconds per "?" question; skip anything that needs long division.
- Keep an error log of order-of-operation slips; they repeat until noticed.
- Read the Quick Revision Sheet (next page) the night before the exam.

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6 Quick revision sheet

Everything on one page for the night before the exam

Formulas

Order	**V · B · O · D/M · A/S**	÷ and ×	**left to right**
$(10a + 5)^2$	**a(a + 1) | 25**	(B + a)(B + b)	**B(B + a + b) + ab**
n × 99	**100n − n**	ab × 11	**a | a + b | b**
$(50 + a)^2$	**$(25 + a) \mid a^2$**	$a^2 - b^2$	**(a + b)(a − b)**
$(a + b)^3$	**$a^3 + b^3 + 3ab(a + b)$**	a + b + c = 0	**$a^3 + b^3 + c^3 = 3abc$**
$x + 1/x = k$	**$x^2 + 1/x^2 = k^2 - 2$**	$x + 1/x = k$	**$x^3 + 1/x^3 = k^3 - 3k$**
$x - 1/x = k$	**$x^2 + 1/x^2 = k^2 + 2$**	$x - 1/x = k$	**$x^3 - 1/x^3 = k^3 + 3k$**
$a^{m/n}$	**$(\sqrt[n]{a})^m$**	x% of y	**y% of x**

Shortcut tricks

- Digit sum checks any “?” answer.
- Unit digit kills wrong options.
- Near a base → base method.
- Round number ± small → split.
- 12.5% = 1/8, 37.5% = 3/8.
- Translate operators, then BODMAS.

Must-know numbers

Squares 31–40	961 · 1024 · 1089 · 1156 · 1225 · 1296 · 1369 · 1444 · 1521 · 1600
Squares 41–50	1681 · 1764 · 1849 · 1936 · 2025 · 2116 · 2209 · 2304 · 2401 · 2500
Cubes 16–20	4096 · 4913 · 5832 · 6859 · 8000
% ↔ fraction	12.5% = 1/8 · 16.67% = 1/6 · 37.5% = 3/8 · 62.5% = 5/8 · 83.33% = 5/6 · 87.5% = 7/8
Powers	2^{10} = 1024 · 3^5 = 243 · 3^6 = 729 · 5^4 = 625 · 7^3 = 343

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7 A message from LearnFrenzy

For everyone preparing for placements, competitive and government exams

Keep going – you are closer than you think

Success in examinations is not just about how many hours you study. It is about how effectively you understand concepts, practise questions, and improve yourself every day.

Every formula you learn, every problem you solve, and every mistake you correct brings you one step closer to your goal.

Whether you are preparing for campus placements, competitive examinations, or government jobs, remember that consistency, confidence, and smart preparation make a real difference.

Don't just memorize formulas. Understand the concepts, practise smart techniques, and develop the confidence to solve problems independently.

Your hard work today can create the opportunities you dream of tomorrow.

— Team LearnFrenzy

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