LF LearnFrenzy

QUANTITATIVE APTITUDE · FREE STUDY MATERIAL

Percentage

Formulas & Shortcut Tricks

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

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USEFUL FOR

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

Practise **Percentage** 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

Per cent means “out of 100”. A percentage is simply a fraction with denominator 100, so 35% = 35/100 = 0.35. It lets us compare quantities of different sizes on one common scale – a mark of 42 out of 60 and 56 out of 80 are both exactly 70%.

Percentage is the language of change: price rises, population growth, depreciation, election results, exam cut-offs and salary hikes. Profit and loss, simple and compound interest, and data interpretation are all built on it, which is why it is the most reused chapter in arithmetic.

Why it matters in exams

- Every SSC, bank and railway paper asks 2–4 direct percentage questions and many more inside data interpretation.
- Placement tests use successive change, “more than / less than” traps and price–consumption problems.
- Fast fraction–percentage conversion saves time in nearly every other arithmetic chapter.

Where it is used

- Price rises, discounts, taxes and salary increments.
- Population growth, inflation and depreciation of machines and vehicles.
- Marks, cut-offs, vote shares and survey results.

Common question patterns

More / less than
If A is 25% more than B, by what % is B less than A?

Successive change
Two or three increases and decreases one after another.

Price and consumption
Price rises – how much should consumption fall?

Growth and decay
Population after n years; value of a machine after depreciation.

Elections
Turnout, invalid votes and the winning margin.

Exams
Pass marks and maximum marks from two candidates’ scores.

Income and savings
Income and expenditure both change – effect on savings.

Area and mixtures
Change in area or volume; concentration after mixing.

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2 Important formulas

Cards marked MOST USED are the ones to revise first

The basics

Percentage of a number and as a percentage

MOST USED

> x% of N = x × N/100; A as a percentage of B = (A/B) × 100

"Of" means multiply; "what percent" means divide and multiply by 100.

EXAMPLE 42 out of 60 as a percentage = 42/60 × 100 = **70%**.

Percentage change

MOST USED

> % change = (new − original)/original × 100

Always divide by the original (old) value, never by the new one.

EXAMPLE Price rises from ₹80 to ₹92 → (12/80) × 100 = **15%** increase.

Increase or decrease by r%

> New value = original × (1 + r/100) or × (1 − r/100)

Turn every percentage change into a multiplying factor.

EXAMPLE ₹2,400 increased by 15% = 2,400 × 1.15 = **₹2,760**.

Original value from the new value

> Original = new value ÷ (1 ± r/100)

Divide by the factor – do not subtract r% of the new value.

EXAMPLE After an 18% rise the price is ₹590 → original = 590 ÷ 1.18 = **₹500**.

Comparisons

"More than" and "less than"

MOST USED

> If A is r% more than B, B is [r/(100 + r)] × 100 % less than A; if A is r% less than B, B is [r/(100 − r)] × 100 % more than A

The base changes, so the two percentages are never equal.

EXAMPLE A is 25% more than B → B is 25/125 × 100 = **20%** less than A.

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Percentage points versus per cent

> **Change in percentage points = new % − old %; per cent change = (that difference / old %) × 100**

A rate moving from 8% to 10% rises by 2 points, which is a 25% increase.

EXAMPLE 8% → 10%: 2 points, and 2/8 × 100 = **25%** increase.

Successive and combined change

Two successive changes

MOST USED

> **Net % change = a + b + ab/100 (use negative values for decreases)**

The extra ab/100 is the change on the change.

EXAMPLE +20% then −10% → 20 − 10 − 200/100 = **+8%**.

Equal rise and fall

> **+r% followed by −r% (either order) → net loss of $r^2/100$ %**

A rise and an equal fall never cancel – you always end below the start.

EXAMPLE +15% then −15% → loss of 225/100 = **2.25%**.

Price, consumption and expenditure

MOST USED

> **Expenditure = price × consumption. To keep expenditure fixed when price rises r%, cut consumption by [r/(100 + r)] × 100 %**

If price falls r%, consumption can rise by [r/(100 − r)] × 100 %.

EXAMPLE Price +25% → cut consumption by 25/125 × 100 = **20%**.

Area and volume changes

> **Length +a%, breadth +b% → area changes by a + b + ab/100 %. Side +r% → area $(2r + r^2/100)$ %, volume $(1 + r/100)^3 - 1$**

Area is a product of two lengths, so use the successive-change rule.

EXAMPLE Side of a square +10% → area + (20 + 1) = **21%**.

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Growth and depreciation

Population growth

MOST USED

$P_n = P \times (1 + r/100)^n$; n years ago: $P \div (1 + r/100)^n$

Each year's growth is on the new, larger population.

P – present value **r** – rate per year **n** – number of years

EXAMPLE 50,000 growing 10% a year → after 2 years 50,000 × 1.21 = **60,500**.

Depreciation

Value after n years = $V \times (1 - r/100)^n$

Machines, cars and phones lose a percentage of their current value each year.

EXAMPLE ₹80,000 at 15% a year → after 2 years 80,000 × 0.7225 = **₹57,800**.

Different rates each year

Multiply the factors: $P \times (1 + r_1/100) \times (1 + r_2/100) \times \ldots$

Order does not matter when you multiply.

EXAMPLE 20,000 with +5%, then +10% → 20,000 × 1.05 × 1.10 = **23,100**.

Elections, exams and savings

Elections

MOST USED

Valid votes = votes polled – invalid votes; winning margin = (winner % – loser %) of valid votes

Percentages of candidates are usually of valid votes, not of all voters.

EXAMPLE 10,000 polled, 5% invalid, winner 55% of valid → margin 10% × 9,500 = **950**.

Pass marks from two candidates

MOST USED

Maximum marks = $(a + b)/(y - x) \times 100$

One scores x% and fails by a marks; another scores y% and passes by b marks.

EXAMPLE 30% fails by 15, 40% passes by 25 → maximum = 40/10 × 100 = **400** (pass mark 135).

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Income, expenditure and savings

> **Savings = income − expenditure; work out the new savings with each changed amount**

Assume the income is 100 to keep the numbers easy.

EXAMPLE Income ₹40,000, spends 75%; income +20%, spending +10% → savings 10,000 → 15,000 = **+50%**.

Mixtures and concentration

> **Concentration % = (amount of the part / total) × 100; the part that is not added stays the same**

Adding water changes the total, not the amount of acid.

EXAMPLE 40 L with 20% acid + 10 L water → 8 L acid in 50 L = **16%**.

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3 Shortcut tricks & smart techniques

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

Percentage ↔ fraction table

MOST USED

USE WHEN Every calculation with awkward percentages such as 12.5%, 16.67% or 37.5%.

Percentage	Fraction	Percentage	Fraction
50%	1/2	12.5%	1/8
33.33%	1/3	11.11%	1/9
25%	1/4	9.09%	1/11
20%	1/5	8.33%	1/12
16.67%	1/6	37.5%	3/8
14.28%	1/7	62.5%	5/8

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

Multiplying-factor chain

MOST USED

USE WHEN Two or more changes one after another.

1. Write each change as a factor: +20% → 1.20, –15% → 0.85.
2. Multiply all the factors with the starting value.

EXAMPLE ₹2,500 → +20% → –15% = 2,500 × 1.2 × 0.85 = **₹2,550**.

Take the base as 100

USE WHEN No actual values are given – only percentages.

1. Start with 100 for price and 100 for consumption.
2. Apply the changes and compare with 100 × 100.

EXAMPLE Price +30%, consumption –20% → 130 × 80 = 10,400 vs 10,000 → **+4%** expenditure.

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Ready pairs: more ↔ less

MOST USED

USE WHEN "More than / less than" and price–consumption questions.

A is more than B by	B is less than A by
20%	16.67% (1/6)
25%	20% (1/5)
33.33%	25% (1/4)
50%	33.33% (1/3)
100%	50% (1/2)

EXAMPLE Price up 50% → consumption must fall by **33.33%** to keep spending the same.

Percentage of a percentage, and the swap

USE WHEN Chains like "20% of 30% of 500", or an awkward x% of y.

1. Multiply the percentages as fractions.
2. x% of y = y% of x – pick the easier order.

EXAMPLE 36% of 25 = 25% of 36 = **9**.

Reverse percentage in one step

USE WHEN The value after a change is given and the original is asked.

1. Divide by the factor, e.g. 1.18 for +18% or 0.88 for –12%.
2. Check by applying the change again.

EXAMPLE After a 12% fall a phone costs ₹15,840 → original = 15,840 ÷ 0.88 = **₹18,000**.

Measurement error in area

USE WHEN A side is measured wrongly and the error in the area is asked.

1. An error of e% in a side gives $(2e + e^2/100)$% in a square's area.

EXAMPLE Side measured 5% too long → area error 10 + 0.25 = **10.25%**.

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4 Solved examples

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

1 MORE / LESS THAN

Meena's salary is 25% more than Kavita's. By what percentage is Kavita's salary less than Meena's?

STEP BY STEP	SHORTCUT
1. Let Kavita = 100; then Meena = 125. 2. Difference = 25 on Meena's 125. 3. Less by 25/125 × 100 = 20%.	r/(100 + r) × 100 = 25/125 × 100 = 20%.

Why it works: The comparison is now made on Meena's larger salary, so the percentage is smaller.

Answer: 20%

2 PRICE AND CONSUMPTION

The price of sugar rises by 20%. By what percentage must a family reduce its consumption to keep its expenditure the same?

STEP BY STEP	SHORTCUT
1. Old: price 100, consumption 100 → spending 10,000. 2. New price 120 → consumption = 10,000 ÷ 120 = 83.33. 3. Reduction = 16.67%.	20/120 × 100 = 16 2/3%.

Why it works: Spending is price × consumption, so consumption must fall in the ratio 100 : 120.

Answer: 16 2/3%

3 SUCCESSIVE CHANGE

A price is raised by 25% and the new price is then reduced by 20%. What is the net change?

STEP BY STEP	SHORTCUT
1. Start at 100 → after +25%: 125. 2. After −20% of 125: 125 − 25 = 100. 3. Net change = 0%.	25 − 20 + (25)(−20)/100 = 25 − 20 − 5 = 0.

Why it works: 1.25 × 0.80 = 1 exactly – the two changes are reciprocal.

Answer: No change (0%)

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4 POPULATION

A town has 1,25,000 people and grows by 4% every year. What will its population be after 2 years?

STEP BY STEP

1. After 1 year: 1,25,000 × 1.04 = 1,30,000.
2. After 2 years: 1,30,000 × 1.04 = 1,35,200.

SHORTCUT

1,25,000 × 1.0816 = 1,35,200.

Why it works: The second year's 4% is on 1,30,000, not on the original figure.

Answer: 1,35,200

5 DEPRECIATION

A machine loses 10% of its value every year. Two years after purchase it is worth ₹64,800. What was its purchase price?

STEP BY STEP

1. Value now = cost × 0.9 × 0.9 = cost × 0.81.
2. Cost = 64,800 ÷ 0.81 = 80,000.

SHORTCUT

Divide by the factor: 64,800 ÷ 0.81 = ₹80,000.

Why it works: Going backwards in time means dividing by the yearly factor.

Answer: ₹80,000

6 ELECTION

In an election between two candidates, 20% of the voters did not vote and 500 votes were invalid. The winner got 60% of the valid votes and won by 1,800 votes. How many voters were on the list?

STEP BY STEP

1. Margin = (60 − 40)% of valid votes = 1,800 → valid = 9,000.
2. Votes polled = 9,000 + 500 = 9,500.
3. Polled = 80% of voters → voters = 9,500 ÷ 0.8 = 11,875.

SHORTCUT

1,800 ÷ 0.2 = 9,000 valid; (9,000 + 500) ÷ 0.8 = 11,875.

Why it works: Work outwards: margin → valid → polled → total voters.

Answer: 11,875

7 EXAM

A student who scores 35% fails by 24 marks; another who scores 42% passes by 32 marks. What are the maximum marks?

STEP BY STEP

1. Let maximum marks be M: pass mark = 0.35M + 24 = 0.42M − 32.
2. 0.07M = 56 → M = 800.
3. Pass mark = 280 + 24 = 304.

SHORTCUT

(24 + 32) ÷ (42 − 35) × 100 = 56/7 × 100 = 800.

Why it works: The 7% gap between the two scores equals the 56-mark gap between them.

Answer: 800

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8 SAVINGS

Rohit saves 20% of his income. His income rises by 15% and his expenditure by 10%. By what percentage do his savings increase?

STEP BY STEP

1. Income 100 → spending 80, savings 20.
2. New income 115, new spending 88 → savings 27.
3. Increase = 7/20 × 100 = 35%.

SHORTCUT

Base 100: savings move from 20 to 115 − 88 = 27 → +35%.

Why it works: Savings are a small part of income, so their percentage change is magnified.

Answer: 35%

9 AREA

The length of a rectangle is increased by 20% and its breadth decreased by 10%. What is the percentage change in its area?

STEP BY STEP

1. Area = l × b → new area = 1.2l × 0.9b = 1.08lb.
2. Change = +8%.

SHORTCUT

20 − 10 − 200/100 = +8%.

Why it works: Area is a product, so the successive-change formula applies.

Answer: +8%

10 MIXTURE

60 litres of milk contain 15% water. How much pure milk must be added to bring the water down to 10%?

STEP BY STEP

1. Water = 15% of 60 = 9 L (it does not change).
2. 9 L must be 10% of the new total → total = 90 L.
3. Milk to add = 90 − 60 = 30 L.

SHORTCUT

Water fixed at 9 L = 10% → total 90 L → add 30 L.

Why it works: Only milk is added, so the amount of water stays 9 L.

Answer: 30 litres

11 PERCENTAGE POINTS

A bank cuts its interest rate from 12% to 9%. By what percentage has the rate been reduced?

STEP BY STEP

1. Fall = 12 − 9 = 3 percentage points.
2. As a percentage of the old rate: 3/12 × 100 = 25%.

SHORTCUT

3 points on a base of 12 → 25%.

Why it works: Percentage points measure the gap; per cent measures the gap relative to the old rate.

Answer: 25%

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5 Important exam tips

Patterns, traps and habits that save marks

Frequently asked question patterns

- “A is r% more than B – by what % is B less than A?”
- Two or three successive increases and decreases.
- Price rises and the cut in consumption needed.
- Population growth and depreciation over 2–3 years.
- Elections with non-voters and invalid votes.
- Maximum and pass marks from two students’ scores.
- Income, expenditure and savings chains; area and mixture changes.

Common mistakes to avoid

- Dividing by the new value instead of the original in % change.
- Assuming +r% and –r% cancel – they leave a loss of $r^2/100$ %.
- Taking “25% more” and “25% less” as opposite comparisons of the same size.
- Confusing percentage points with per cent.
- Finding the original by subtracting r% of the new value instead of dividing by the factor.
- Taking candidates’ shares out of all voters when they are of valid votes.
- Adding successive percentages directly (20% + 10% ≠ 30%).

Points to remember

- Factor for +r% is (1 + r/100); for –r% it is (1 – r/100).
- Net of +a% and +b% = a + b + ab/100.
- r% more ↔ r/(100 + r) × 100 % less.
- x% of y = y% of x.
- $1.1^2 = 1.21$, $1.2^2 = 1.44$, $0.9^2 = 0.81$, $1.05^2 = 1.1025$.

Speed and accuracy

- Learn the percentage–fraction table by heart.
- Take 100 as the base when no values are given.
- Use multiplying factors for every chain of changes.
- Check options quickly by applying the change to the answer.

Preparation strategy

- Master the factor method first – most other formulas follow from it.
- Practise on LearnFrenzy in order: Easy → Medium → Hard → Exam Pattern Mix → Data Sufficiency.
- Aim for 30–45 seconds per percentage question.
- Keep an error log of base mistakes (old vs new value).
- 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

x% of N	**xN/100**	A as % of B	**A/B × 100**
% change	**change/original × 100**	+r% factor	**1 + r/100**
Original	**new ÷ factor**	r% more → less	**r/(100 + r) × 100**
r% less → more	**r/(100 − r) × 100**	Successive a, b	**a + b + ab/100**
+r then −r	**$-r^2/100$ %**	Keep spending	**cut r/(100 + r) × 100**
Square side +r%	**area $2r + r^2/100$**	Population	**$P(1 + r/100)^n$**
Depreciation	**$V(1 - r/100)^n$**	Maximum marks	**(a + b)/(y − x) × 100**
Margin	**(w% − l%) of valid**	x% of y	**y% of x**

Shortcut tricks

- Base 100 when no values given.
- Chain factors: 1.2 × 0.85 …
- 12.5% = 1/8, 37.5% = 3/8.
- 25% more ↔ 20% less.
- Original = new ÷ factor.
- Points ≠ per cent.

Must-know numbers

Fractions	1/2 50% · 1/3 33.33% · 1/4 25% · 1/6 16.67% · 1/7 14.28% · 1/8 12.5% · 1/9 11.11% · 1/11 9.09% · 1/12 8.33%
Eighths	3/8 37.5% · 5/8 62.5% · 7/8 87.5%
Factors²	$1.05^2 = 1.1025$ · $1.1^2 = 1.21$ · $1.2^2 = 1.44$ · $0.9^2 = 0.81$ · $0.8^2 = 0.64$

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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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