

Percentages

Formulas, rules and quick reference - Primary to lower secondary

A practical reference for understanding percentages, converting between forms, finding percentages of quantities, percentage change, and solving everyday problems.

1. Understanding Percentages

Meaning	Percent means 'per hundred'. $x\% = x/100$.
Percentage	A percentage describes a part of a whole using 100 as the base.
100%	100% represents the complete whole.
50%	$50\% = 1/2 = 0.5$.
25%	$25\% = 1/4 = 0.25$.
10%	$10\% = 1/10 = 0.1$.

2. Percentage, Fraction & Decimal

Percent to fraction	$x\% = x/100$, then simplify if required.
Fraction to percent	Fraction $\times 100\% =$ percentage.
Percent to decimal	Divide the percentage by 100.
Decimal to percent	Multiply the decimal by 100.
Fraction to decimal	Divide numerator by denominator.

3. Useful Percentage Benchmarks

1%	$1/100 = 0.01$.
5%	$5/100 = 0.05$.
10%	$10/100 = 0.10$.
20%	$20/100 = 0.20 = 1/5$.
25%	$25/100 = 0.25 = 1/4$.
50%	$50/100 = 0.50 = 1/2$.
75%	$75/100 = 0.75 = 3/4$.

Finding Percentages

Core formulas for percentage calculations

4. Finding a Percentage of a Quantity

Main formula	Percentage of quantity = $\text{percentage}/100 \times \text{quantity}$.
Decimal method	Convert the percentage to a decimal, then multiply by the quantity.
Fraction method	Convert the percentage to a fraction, then multiply by the quantity.
Example structure	25% of 80 = $25/100 \times 80 = 20$.

5. Finding What Percentage One Number Is of Another

Formula	Percentage = $(\text{part}/\text{whole}) \times 100\%$.
Part	The amount being compared is the part.
Whole	The total or reference amount is the whole.
Important	Use the correct whole as the denominator.

6. Finding the Whole

Formula	Whole = $\text{part} \times 100 / \text{percentage}$.
Example structure	If 20% of a number is 14, then whole = $14 \times 100 / 20 = 70$.
Check	Find the stated percentage of the calculated whole.

7. Finding the Percentage

Formula	Percentage = $\text{part} \times 100 / \text{whole}$.
Decimal answer	Part divided by whole gives the decimal form first.
Final step	Multiply by 100 and include the percent sign.

Percentage Increase & Decrease

Changes in prices, quantities and values

8. Percentage Increase

Increase amount	Increase = new value - original value.
Increase percentage	Increase % = (increase/original value) x 100%.
New value	New value = original value x (1 + rate/100).
Multiplier	Increase by r% means multiply by (1 + r/100).

9. Percentage Decrease

Decrease amount	Decrease = original value - new value.
Decrease percentage	Decrease % = (decrease/original value) x 100%.
New value	New value = original value x (1 - rate/100).
Multiplier	Decrease by r% means multiply by (1 - r/100).

10. Finding the Original Value

After increase	Original value = new value / (1 + rate/100).
After decrease	Original value = new value / (1 - rate/100).
Important	Do not simply subtract the percentage from the final value; reverse the multiplier.

11. Repeated Percentage Changes

Successive increases	Apply each increase to the value produced by the previous change.
Successive decreases	Apply each decrease to the value produced by the previous change.
Important	Two percentage changes do not always combine by simple addition or subtraction.

Profit, Loss, Discount & Tax

Real-life percentage applications

12. Profit & Loss

Profit	Profit = selling price - cost price.
Loss	Loss = cost price - selling price.
Profit percentage	Profit % = (profit/cost price) x 100%.
Loss percentage	Loss % = (loss/cost price) x 100%.
Selling price with profit	Selling price = cost price x (1 + profit rate/100).
Selling price with loss	Selling price = cost price x (1 - loss rate/100).

13. Discount

Discount amount	Discount = marked price - selling price.
Discount percentage	Discount % = (discount/marked price) x 100%.
Sale price	Sale price = marked price x (1 - discount rate/100).
Discounted amount	Discount = marked price x discount rate/100.

14. Tax / GST

Tax amount	Tax = price before tax x tax rate/100.
Price including tax	Final price = price before tax x (1 + tax rate/100).
Price before tax	Price before tax = final price / (1 + tax rate/100).
Reminder	Use the tax rate given in the question; rates vary by country and product.

Percentage Change in Everyday Life

Applications in data, shopping, finance and measurement

15. Comparing Two Values

Difference	Difference = larger value - smaller value.
Percentage difference	For two values when no original/reference is specified, percentage difference = absolute difference / average of the two values x 100%.
Average	Average of two values = (value 1 + value 2)/2.

16. Population & Data

Percentage of a group	Percentage = subgroup/total group x 100%.
Percentage change	Change % = change/original value x 100%.
Pie-chart connection	A full circle represents 100%; sector angle = percentage x 360 degrees / 100.

17. Simple Interest

Simple interest	SI = principal x rate x time / 100.
Amount	Amount = principal + simple interest.
Rate	Rate is normally expressed as a percentage per year unless the question states otherwise.
Time	Use the time unit required by the stated rate.

18. Everyday Examples

Shopping	Discounts, sale prices, taxes and price changes.
Sports	Win percentages, success rates and performance data.
School	Test scores, attendance and class data.
Travel	Budget changes, exchange-rate percentages and comparisons.
Health & fitness	Data and progress can be expressed as percentages when appropriate.

Reverse Percentages & Multi-Step Problems

Useful strategies for more challenging questions

19. Reverse Percentage Problems

After discount	Original price = sale price / $(1 - \text{discount rate}/100)$.
After tax	Price before tax = final price / $(1 + \text{tax rate}/100)$.
After increase	Original value = final value / $(1 + \text{increase rate}/100)$.
After decrease	Original value = final value / $(1 - \text{decrease rate}/100)$.

20. Multi-Step Percentage Problems

Step 1	Identify the original value and the percentage being applied.
Step 2	Calculate the first change.
Step 3	Use the new value as the starting value for the next change when appropriate.
Step 4	Check whether each percentage is based on the original or the new value.

21. Percentage Points vs Percentage Change

Percentage points	The difference between two percentages, such as 40% to 50% = 10 percentage points.
Percentage change	The change relative to the original percentage: $10/40 \times 100\% = 25\%$.
Important	Do not confuse percentage points with percentage change.

22. Estimation & Reasonableness

Estimate first	Use friendly numbers to predict the approximate answer.
Check direction	An increase should make the value larger; a decrease should make it smaller.
Check size	A small percentage change should normally produce a relatively small change.
Check units	Keep money, quantities and other units consistent.

Quick Reference & Common Mistakes

Fast reminders for teaching, revision and self-checking

23. Essential Formula Box

Percentage of quantity	Percentage/100 x quantity.
What percentage?	Part/whole x 100%.
Percentage change	Change/original x 100%.
Profit %	Profit/cost price x 100%.
Loss %	Loss/cost price x 100%.
Discount %	Discount/marked price x 100%.

24. Common Mistakes to Watch

Wrong base	Percentage increase, decrease, profit and loss are normally based on the original or stated reference value.
Missing percent sign	A percentage and a decimal are different forms; convert carefully.
Reverse percentage	To find an original value, divide by the percentage multiplier.
Successive changes	Do not automatically add two percentage changes.
Percentage points	Do not confuse percentage points with percentage change.

25. Calculation Checks

Estimate	Round first and predict a sensible answer.
Reverse the operation	Use the reverse formula to check the result.
Compare	Check whether the result is larger or smaller in the expected direction.
Reasonableness	Ask whether the size of the percentage change makes sense.

Maths Connects Us All

Percentages give us a common way to compare quantities, changes and data across shopping, business, sport, education and everyday life.