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APPSC Group 1 Prelims

English

QUANTITATIVE APTITUDE

PRELIMS VISUAL EDGE



Concepts • Worked examples • Practice



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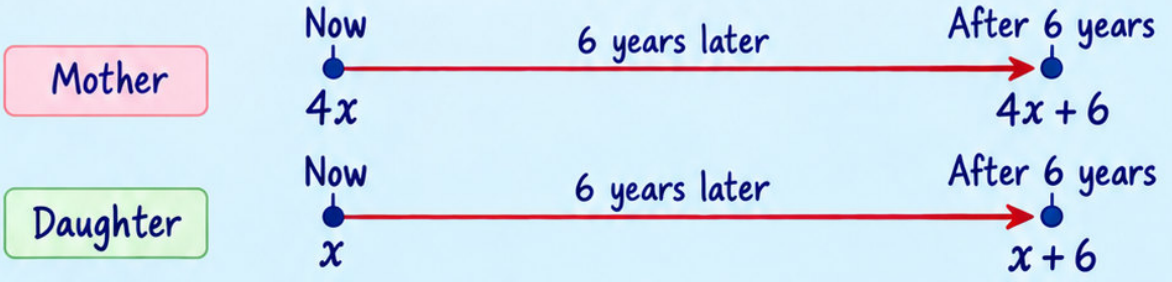
Let present age be x years. After t years it is $x + t$; t years ago it was $x - t$, provided that date falls within the person's lifetime.

Apply the same shift to both people when comparing them at one date.

Equal increments preserve their difference but usually change their ratio.

Use exact elapsed ages unless whole-number reporting is explicitly stated; rounded birthday reports require care.

SAME TIME LINE FOR MOTHER AND DAUGHTER



WORKED EXAMPLE

A mother is four times her daughter's present age. After six years she will be three times her daughter's age. Find both present ages.

1. Let the daughter be x; the mother is $4x$.
2. At the later date, $4x + 6 = 3(x + 6)$.
   $$4x + 6 = 3x + 18$$
   $$x = 12.$$
3. The daughter is 12 years; the mother is $4 \times 12 = 48$ years.
   Six years later their ages are $48 + 6 = 54$ and $12 + 6 = 18$.

Final answer: Daughter: 12 years; mother: 48 years.

COMMON TRAP

Do not advance only one person when translating a future comparison.

QUICK CHECK

What was their age ratio six years ago?

Answer: 7 : 1, since their ages were 42 and 6.

THE NUMBER FAMILY: NESTED SETS

Natural numbers (N):

$N = \{1, 2, 3, \ldots\}$

This unit excludes zero from N.

Whole numbers (W):

$W = \{0, 1, 2, 3, \ldots\}$

Whole numbers add zero.

Integers (Z):

$Z = \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$

Integers include whole numbers and their negatives.

Rational numbers (Q):

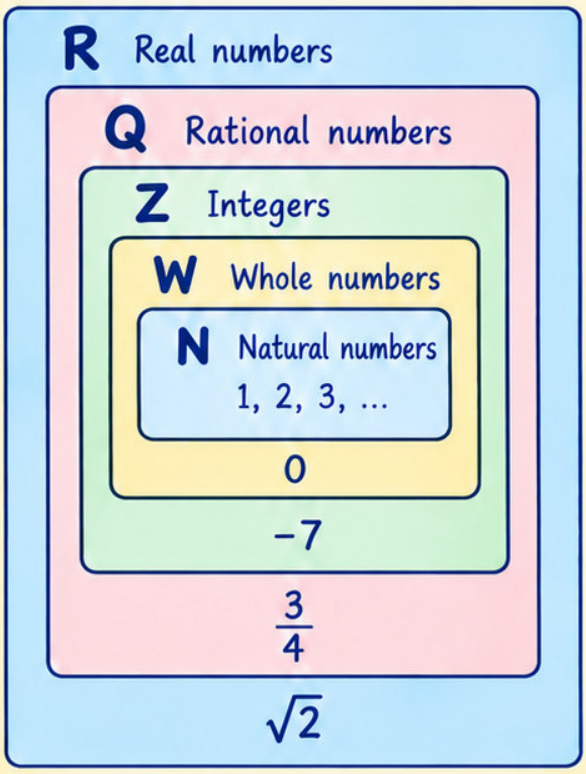
$Q = \left\{ \frac{p}{q} : p \text{ and } q \text{ are integers}, q \neq 0 \right\}$.

A rational number can be written $\frac{p}{q}$, where p and q are integers and q is not zero.

Real numbers (R):

R contains both rational and irrational numbers.

NESTED SETS DIAGRAM



A NUMBER MAY BELONG TO SEVERAL SETS

A number may belong to more than one set. The smallest applicable set gives its most specific classification.

EXAMPLE: CLASSIFY THE NUMBERS

Number	Reasoning	Smallest set
0	Zero is a whole number but not a natural number under our convention.	Whole (W)
−7	−7 is an integer (negative of a whole number).	Integer (Z)
$\frac{3}{4}$	$\frac{3}{4}$ is a rational number but not an integer.	Rational (Q)
$\sqrt{2}$	$\sqrt{2}$ is irrational, hence a real number.	Irrational real

COMMON TRAP

Negative numbers can be rational.
A minus sign does not imply irrationality.

QUICK CHECK

Is $\frac{12}{3}$ natural or merely rational?

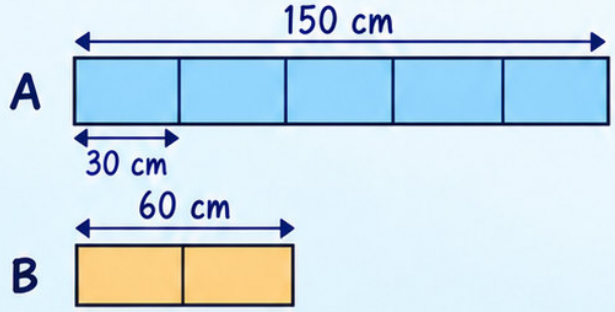
Answer: Natural.

$\frac{12}{3} = 4$, and it also belongs to W, Z, Q and R.

Ratio basics: compare like quantities

- A ratio $a : b$ compares quantities by division: its numerical value is $\frac{a}{b}$ when b is nonzero.
- First express quantities of the same kind in the same unit.
- Multiplying or dividing both terms by the same nonzero factor preserves the ratio; adding the same number generally does not.
- In this unit, sharing and mixture ratios use nonnegative quantities and positive totals.
- For rational terms, clear denominators and cancel the greatest common divisor to obtain simplest integer terms.
- A ratio describes relative size, not the actual amount: 2 : 3 could represent 2 and 3, or 20 and 30.

Same ratio, different totals



Divide both totals by 30 (one cell length).

A: 150 ÷ 30 = 5

B: 60 ÷ 30 = 2

Ratio = 5 : 2

Worked example

Find the simplest ratio of 1.5 metres to 60 centimetres.

1. Convert to the same unit: 1.5 metres = 150 centimetres.
2. The ratio is 150 : 60.
3. Divide both terms by their greatest common divisor, 30.

The ratio is 5 : 2.

Common trap

Comparing 1.5 directly with 60 mixes units and gives the wrong ratio.

Quick check

Simplify $\frac{2}{3} : \frac{5}{6}$.

Multiply both terms by 6.

$\frac{2}{3} \times 6 : \frac{5}{6} \times 6 = 4 : 5$.

Answer: 4 : 5

Arithmetic mean: redistribute the total equally

The arithmetic mean of n observations is their sum divided by n, where n is positive. It is the equal share each observation would have if the total were redistributed without changing that total.

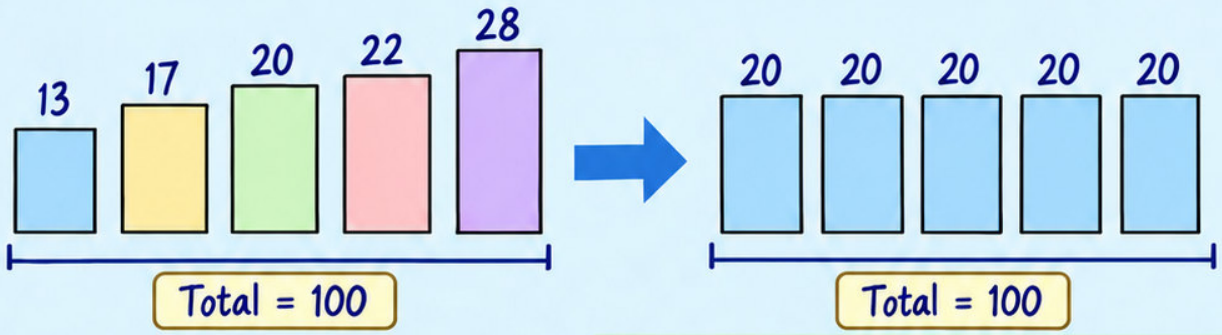
Consequently, total = number of observations × mean.

This reverse equation is often the quickest way to solve missing-value problems.

The mean need not equal an observed value and need not be an integer even when every observation is an integer.

Use consistent units, count repeated values separately, and round only when requested.

REDISTRIBUTING THE TOTAL EQUALLY



Schematic redistribution; labels give exact values.

WORKED EXAMPLE

Find the mean of 13, 17, 20, 22 and 28.

1. There are five observations.
2. Their sum is $13 + 17 + 20 + 22 + 28 = 100$.
3. Divide the preserved total by the number of observations: $100 \div 5 = 20$.

The arithmetic mean is 20.

COMMON TRAP

Divide by the observation count, not by the number of distinct values.

QUICK CHECK

Five values average 18. Four are 12, 16, 19 and 21. Find the fifth.

22, because the required total is 90 and the four known values sum to 68.

Least number with one common remainder: mind the lower bound

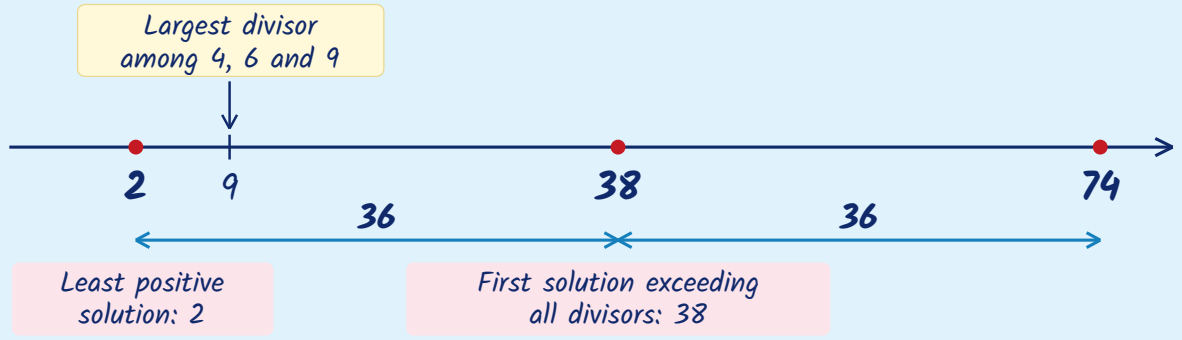
If N leaves valid remainder r with several positive divisors, N − r is a common multiple of them. With L their LCM, N = r + kL.

Require 0 ≤ r < every divisor.

For r > 0, the least positive solution is r itself; all quotients are zero. Then L + r is the least solution exceeding all divisors.

If r = 0, the least positive solution is L; zero qualifies only if nonnegative solutions are allowed.

Solutions are spaced by the LCM



Worked example

Find the least positive number leaving remainder 2 on division by 4, 6 and 9, and the least such number greater than all three divisors.

1. LCM(4, 6, 9) = 36, so solutions are 2 + 36k.
2. The first positive solution is 2.
3. The next is 38, which exceeds 9 and leaves remainder 2 in all three divisions.

Final answer:

Least positive: 2.

Least exceeding all divisors: 38.

Common trap

Do not silently impose a lower bound that the question never states.

Quick check

For common remainder zero, what is the least positive solution?

Answer: 36.

PERCENTAGE: IDENTIFY THE WHOLE BEFORE CALCULATING

Percent means per hundred:

$$p\% = \frac{p}{100}.$$

To find p% of a quantity B, multiply B by $\frac{p}{100}$.

To express a part A as a percentage of a positive whole B, calculate

$$\frac{100A}{B}.$$

The denominator identifies the base, so label it before substituting numbers.

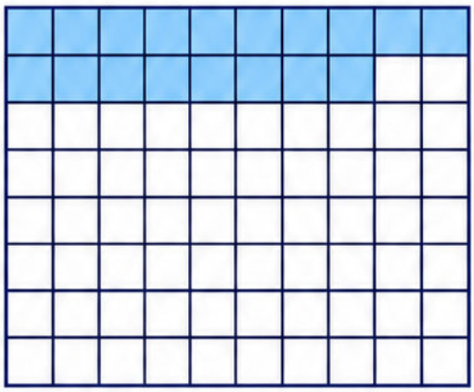
- Percentages can exceed one hundred when the compared amount exceeds the base.
- A percentage by itself does not specify an absolute quantity.
- To convert a decimal into a percentage, multiply its numerical value by one hundred and attach the percent sign; reverse this operation when converting a percentage to a decimal.

WORKED EXAMPLE

A class has 80 students and 18 are absent. What percentage are absent?

1. The part is 18 students; the whole is all 80 students.
2. Absent percentage $= 100 \times \frac{18}{80}$.
3. Simplify $\frac{18}{80} = \frac{9}{40}$, giving 22.5%.

Final answer:
22.5% of the class is absent.



$$\frac{18}{80} \times 100 = 22.5\%.$$

COMMON TRAP

Using the 62 present students as denominator answers a different comparison.

QUICK CHECK

What is 15% of 240?

Answer: 36, from $240 \times \frac{15}{100}$.

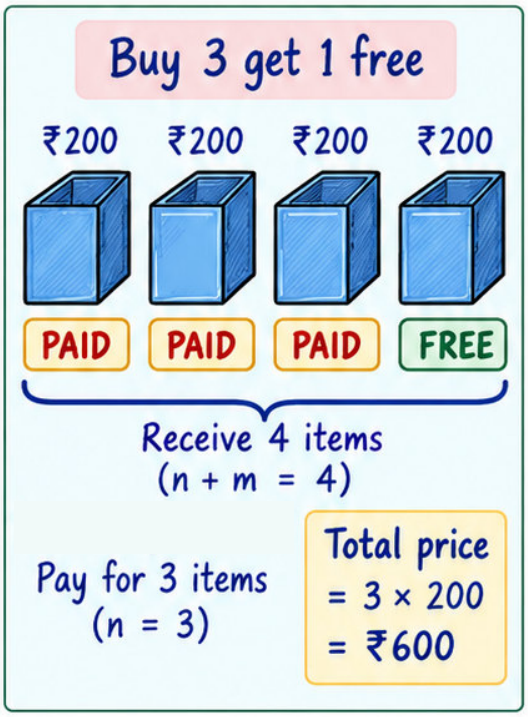
Buy n, get m free: distinguish discount from extra quantity

For identical equally priced articles, a buy n get m free offer provides $n + m$ articles while charging for n.

Relative to normal prices, the effective unit-price factor is $\frac{n}{n+m}$, and discount is $\frac{100m}{n+m}$ percent.

Extra quantity uses paid quantity n as its base, giving $\frac{100m}{n}$: The percentages differ.

Assume equally priced articles and a complete bundle; treat partial bundles or differently priced free items separately.



WORKED EXAMPLE

An item normally costs 200 rupees. Under buy three get one free, find the bundle price, effective unit price and discount percentage.

1. Four items are received while three are paid for: bundle price = 600 rupees.
2. Effective price per item = 600 ÷ 4 = 150 rupees.
3. Compared with normal cost 800, discount = $\frac{200}{800} \times 100 = 25\%$.

Final answer: Bundle 600 rupees; unit price 150 rupees; effective discount 25%.

COMMON TRAP

The extra quantity is $33\frac{1}{3}\%$, but that is **not** the effective price discount.

QUICK CHECK

For buy two get one free, what is the effective discount?

Answer: $33\frac{1}{3}\%$.

APPROACHING OBJECTS CLOSE THE GAP AT A SUMMED RATE

On a straight route, approaching objects close their gap at the sum of positive speeds.

With simultaneous starts D apart, meeting time $= \frac{D}{u + v}$.

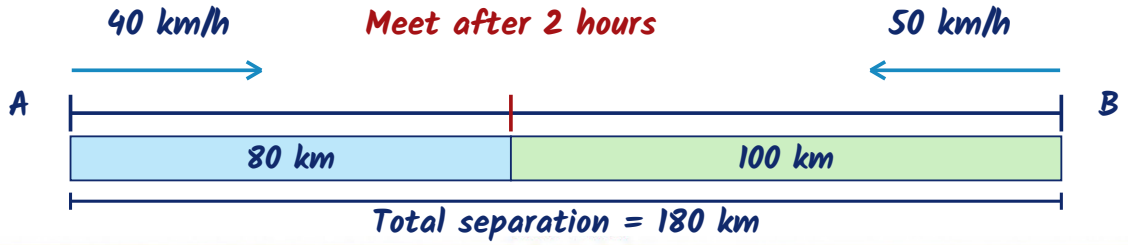
Each distance is its own speed times this common duration; the distances sum to D.

Assume constant speeds and no reversal before meeting.

Objects moving apart also have summed separation rate, but that describes an increasing gap, not a future meeting.

WORKED EXAMPLE

Two travellers start simultaneously towards each other from towns 180 kilometres apart, at 40 and 50 kilometres per hour. Find their meeting time and distances.



① Closing speed $= 40 + 50$
$= 90$ km/h.

② Meeting time $= 180 \div 90$
$= 2$ hours.

③ They cover $40 \times 2 = 80$ km and $50 \times 2 = 100$ km.

Final answer: They meet after two hours, eighty kilometres from the slower traveller's start.

COMMON TRAP

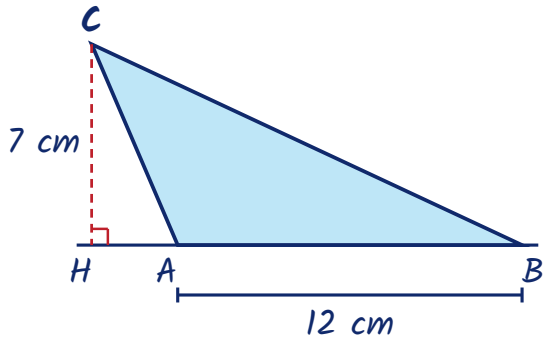
Adding speeds requires directions that close the gap, not merely two moving objects.

QUICK CHECK

If the separation were 270 kilometres at the same speeds, when would they meet?

Answer: After three hours.

TRIANGLE AREA NEEDS A PERPENDICULAR HEIGHT



$$\text{Triangle area} = \frac{\text{base} \times \text{perpendicular height}}{2}$$

Height is the shortest distance from the opposite vertex to the line containing the chosen base; it may fall outside an obtuse triangle.

A sloping side is not automatically a height.

Perimeter adds all three sides.

Positive side lengths form a nondegenerate triangle only when each is smaller than the other two combined.

Area uses square units and perimeter linear units.

Base and height alone do not generally determine perimeter.

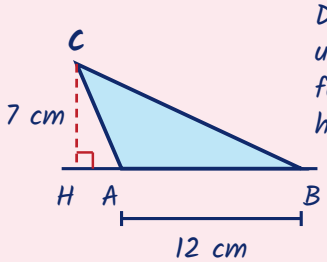
WORKED EXAMPLE

A triangle has base twelve centimetres and perpendicular height seven centimetres. Find its area.

1. Choose the given base and its matching perpendicular height.
   Base = 12 cm
   Height = 7 cm
2. The corresponding parallelogram has area $12 \times 7 = 84$ square centimetres.
3. The triangle occupies half that area:
   $\frac{84}{2} = 42$.

Final answer: The area is 42 square centimetres.

COMMON TRAP



Do not substitute an unlabelled sloping edge for the perpendicular height.

QUICK CHECK

A triangle has area 24 square centimetres and base eight centimetres. Find its height.

Answer: Six centimetres, because $\frac{8 \times 6}{2} = 24$.

A sphere's surface and volume use different powers of radius

A sphere of radius $r > 0$ has surface area $4\pi r^2$ and volume $\frac{4\pi r^3}{3}$.

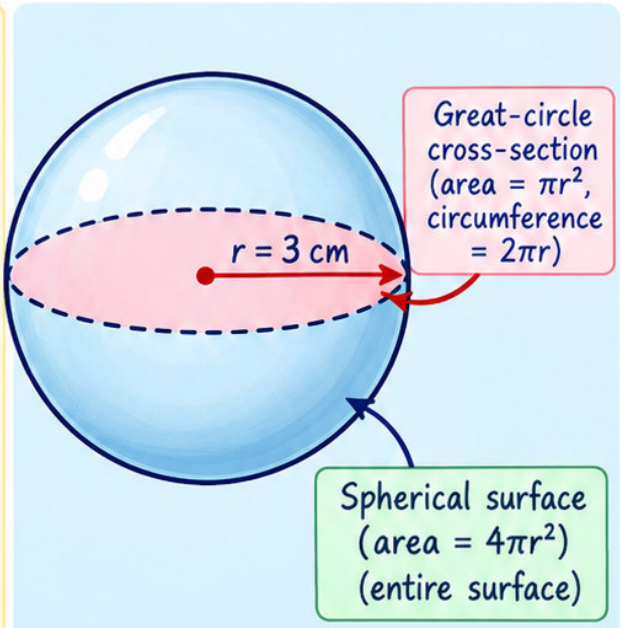
It has no flat base, so its curved surface is its entire surface.

A great-circle cross-section has area πr^2 and circumference $2\pi r$; neither is the sphere's surface area.

Diameter equals $2r$ and must be halved before substitution.

Surface area has square units, volume cubic units.

Keep π symbolic for exact answers and check powers carefully: doubling radius quadruples surface area but multiplies volume by eight.



WORKED EXAMPLE

Find the surface area and volume of a sphere with radius three centimetres.

Radius $r = 3$ cm
Diameter $= 2r = 6$ cm

1. **Surface area:** $4\pi \times 3^2 = 36\pi$ square centimetres.
2. **Volume:** $\frac{4\pi \times 3^3}{3} = 36\pi$ cubic centimetres.
3. Their numerical coefficients match here, but their dimensions and units differ.

Final answer: Surface area is 36π square centimetres; volume is 36π cubic centimetres.

Common trap

Using πr^2 gives a great-circle disk area, not the entire sphere's surface.

Quick check

What is the volume of a sphere with twice this radius?

Answer: 288π cubic centimetres, eight times the original volume.

A simple quadrilateral has four angles totalling 360 degrees

A simple quadrilateral has four sides and noncrossing boundary edges. Its interior-angle sum is 360 degrees, whether convex or concave; a concave quadrilateral has one reflex interior angle.

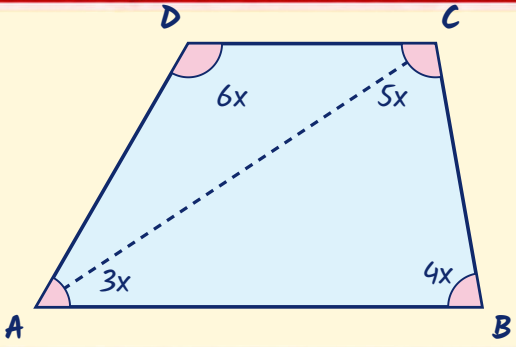
A diagonal divides a convex quadrilateral into two triangles, explaining the sum.

Do not apply ordinary interior-angle labels unchanged to a self-crossing bow-tie figure.

For an algebraic problem, add all four interior angles, solve, and check the proposed convex or concave classification.

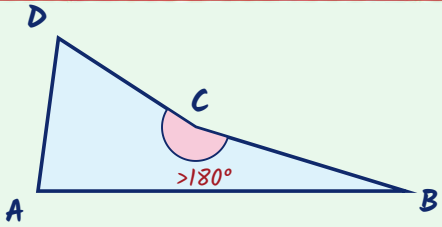
Four equal angles must each be ninety degrees, but do not by themselves require equal side lengths.

Convex quadrilateral with a diagonal



Diagonal AC divides the quadrilateral into two triangles.

Concave quadrilateral (one reflex angle)



WORKED EXAMPLE

A convex quadrilateral has interior angles 3x, 4x, 5x and 6x degrees. Find all four angles.

1. The angle sum is 360: $3x + 4x + 5x + 6x = 360$.
2. Thus $18x = 360$ and $x = 20$.
3. The angles are 60°, 80°, 100° and 120°, all below 180°.

Final answer:

The angles are 60°, 80°, 100° and 120°.

COMMON TRAP

Using a triangle's 180-degree sum omits one triangle's contribution.

QUICK CHECK

Three quadrilateral angles are 95°, 85° and 110°. Find the fourth.

Answer: 70°.

Read table headings before choosing a denominator

- A table's row labels, column labels and units define each number. Read them before calculating.
- A category percentage uses that category's total, while an overall percentage uses the combined population.
- Row totals and column totals should reconcile when they describe the same complete set.
- Do not add a subtotal again after its components have already been counted.
- Here every entry is an exact employee count, departments do not overlap, and the two displayed categories exhaust each department.

Number of employees

Department	Men	Women	Total
A	24	16	40
B	18	22	40
C	28	12	40
Total	70	50	120

Example

What percentage of all employees are women, and what percentage within department B are women?

Solution

1. Women total $16 + 22 + 12 = 50$; all employees total 120.
2. Overall women's percentage
$$= \frac{50}{120} \times 100 = 41\frac{2}{3}\%.$$
3. Department B has 40 employees, so its women's percentage is
$$= \frac{22}{40} \times 100 = 55\%.$$

Final answer

Overall: $41\frac{2}{3}\%$ | Within B: 55%

Common trap

The same numerator can produce different percentages when the population base changes.

Quick check

What fraction of all employees belong to department A?

One third, since 40 of 120 employees are in A.

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