

COMPETITIVE MATHS

Formula, Shortcut Tricks & Solved Examples

A simple exam-ready guide for SSC • Banking • Railway • UPSC CSAT • State PSC and other competitive examinations

10 Important Chapters	Formula + Tricks + Solutions
Percentage • Profit & Loss • Average • Ratio & Proportion • Time & Work	Time, Speed & Distance • Simplification • Number System • Interest • Data Interpretation

Designed for quick revision, clear understanding and faster problem solving.

CHAPTER 1: PERCENTAGE

Percentage is one of the most important topics in competitive mathematics. It is used directly or indirectly in profit and loss, interest, data interpretation and many other chapters.

Basic Percentage

FORMULA

$$\text{Percentage} = (\text{Part} \div \text{Total}) \times 100$$

Example: Find 25% of 400.

Step-by-Step Solution:

$$25\% \text{ of } 400 = (25/100) \times 400 = 100.$$

Final Answer: 100

Important Fraction-to-Percentage Conversions

SHORTCUT TRICK

$$1/2 = 50\%; 1/3 = 33.33\%; 1/4 = 25\%; 1/5 = 20\%; 1/8 = 12.5\%; 1/10 = 10\%; 1/20 = 5\%; 1/25 = 4\%.$$

Example: Find 12.5% of 800.

Step-by-Step Solution:

$$12.5\% = 1/8. \text{ Therefore, } 800 \div 8 = 100.$$

Final Answer: 100

Percentage Increase and Decrease

FORMULA

$$\text{Increase\%} = (\text{Increase} \div \text{Original Value}) \times 100$$

$$\text{Decrease\%} = (\text{Decrease} \div \text{Original Value}) \times 100$$

Example: A price increases from ₹200 to ₹250.

Step-by-Step Solution:

$$\text{Increase} = 250 - 200 = 50. \text{ Increase\%} = (50/200) \times 100 = 25\%.$$

Final Answer: 25% increase

Successive Percentage Change

FORMULA

$$\text{Two increases: Net Increase} = a + b + ab/100$$

$$\text{Increase followed by decrease: Net Change} = a - b - ab/100$$

SHORTCUT TRICK

For percentage questions, assume the original value as 100 whenever possible.

Example: A value increases by 10% and then by 20%.

Step-by-Step Solution:

$$\text{Net increase} = 10 + 20 + (10 \times 20)/100 = 32\%.$$

Final Answer: 32% increase

Reverse Percentage Trick

FORMULA

If A is $x\%$ more than B, then B is $[x/(100+x)] \times 100\%$ less than A.

Example: A is 25% more than B. By what percentage is B less than A?

Step-by-Step Solution:

$$(25/125) \times 100 = 20\%.$$

Final Answer: 20% less

CHAPTER 2: PROFIT & LOSS

Profit and Loss questions are based mainly on Cost Price, Selling Price, Marked Price and Discount.

Basic Terms

FORMULA

$$\text{Profit} = \text{SP} - \text{CP}$$

$$\text{Loss} = \text{CP} - \text{SP}$$

$$\text{Profit\%} = (\text{Profit}/\text{CP}) \times 100$$

$$\text{Loss\%} = (\text{Loss}/\text{CP}) \times 100$$

Finding Selling Price

FORMULA

$$\text{SP} = \text{CP} \times (100 + \text{Profit\%})/100$$

$$\text{SP} = \text{CP} \times (100 - \text{Loss\%})/100$$

Example: CP = ₹800 and profit = 15%.

Step-by-Step Solution:

$$\text{SP} = 800 \times 115/100 = ₹920.$$

Final Answer: ₹920

Finding Cost Price

FORMULA

$$\text{CP} = \text{SP} \times 100/(100 + \text{Profit\%})$$

$$\text{CP} = \text{SP} \times 100/(100 - \text{Loss\%})$$

Example: SP = ₹600 and profit = 20%.

Step-by-Step Solution:

$$\text{CP} = 600 \times 100/120 = ₹500.$$

Final Answer: ₹500

Discount

FORMULA

$$\text{Discount} = \text{MP} - \text{SP}$$

$$\text{Discount\%} = (\text{Discount}/\text{MP}) \times 100$$

Example: MP = ₹1,000 and discount = 20%.

Step-by-Step Solution:

$$\text{Discount} = ₹200. \text{ SP} = 1000 - 200 = ₹800.$$

Final Answer: ₹800

Profit After Discount

SHORTCUT TRICK

Assume CP = ₹100 when only percentages are given.

Example: Marked price is 25% above CP and discount is 10%.

Step-by-Step Solution:

Let CP = 100. MP = 125. SP after 10% discount = $125 \times 90/100 = 112.5$. Profit = 12.5.

Final Answer: 12.5% profit

CHAPTER 3: AVERAGE

Average represents equal distribution of the total value among all observations.

Basic Average

FORMULA

Average = Sum of Observations $\div$ Number of Observations

Sum = Average $\times$ Number

Example: Find the average of 10, 20, 30, 40 and 50.

Step-by-Step Solution:

Sum = 150. Number = 5. Average = $150/5 = 30$.

Final Answer: 30

New Average

FORMULA

New Average = New Total $\div$ New Number

Example: Average of 5 students is 40. A student scoring 60 joins.

Step-by-Step Solution:

Old total = $5 \times 40 = 200$. New total = 260. New average = $260/6 = 43.33$.

Final Answer: 43.33

Replacement Trick

FORMULA

Change in Average = (New Value – Old Value) $\div$ Number of Items

Example: Average of 10 numbers is 25. 20 is replaced by 40.

Step-by-Step Solution:

Change = 20. Change in average = $20/10 = 2$. New average = 27.

Final Answer: 27

CHAPTER 4: RATIO & PROPORTION

Ratio compares quantities. Proportion shows equality between two ratios.

Basic Ratio

FORMULA

$$a:b = a/b$$

Example: 20 boys and 30 girls.

Step-by-Step Solution:

$$20:30 = 2:3.$$

Final Answer: 2:3

Dividing a Quantity in a Ratio

SHORTCUT TRICK

Add the ratio parts first.

Example: Divide ₹800 in the ratio 3:5.

Step-by-Step Solution:

Total parts = 8. One part = $800/8 = 100$. Shares = 300 and 500.

Final Answer: ₹300 and ₹500

Proportion

FORMULA

If $a:b = c:d$, then $ad = bc$.

Example: $3:5 = x:20$.

Step-by-Step Solution:

$$3 \times 20 = 5x. \quad 60 = 5x. \quad x = 12.$$

Final Answer: 12

Direct and Inverse Proportion

FORMULA

Direct: both quantities change in the same direction.

Inverse: one increases while the other decreases.

For inverse proportion: $\text{Workers} \times \text{Days} = \text{Constant}$.

CHAPTER 5: TIME & WORK

Time and Work problems are based on efficiency and the amount of work completed per unit of time.

One-Day Work

FORMULA

If A completes work in x days, A's one-day work = $1/x$.

Example: A completes a work in 10 days.

Step-by-Step Solution:

A's one-day work = $1/10$.

Together Work

FORMULA

Combined Work = $1/x + 1/y$

Example: A takes 10 days and B takes 15 days.

Step-by-Step Solution:

$1/10 + 1/15 = 3/30 + 2/30 = 5/30 = 1/6$.

Final Answer: 6 days

LCM Efficiency Method

SHORTCUT TRICK

Take LCM of the individual times as total work. Efficiency = Total Work $\div$ Days.

Example: A takes 12 days and B takes 18 days.

Step-by-Step Solution:

LCM = 36. A efficiency = 3 units/day. B efficiency = 2 units/day. Together = 5 units/day. Time = $36/5 = 7.2$ days.

Final Answer: 7.2 days

Work and Wages

FORMULA

Wages are proportional to Efficiency $\times$ Time.

Example: A works 5 days and B works 10 days with equal efficiency.

Step-by-Step Solution:

Wage ratio = $5:10 = 1:2$.

Final Answer: 1:2

CHAPTER 6: TIME, SPEED & DISTANCE

These questions are based on the relationship between distance, speed and time.

Basic Formula

FORMULA

Distance = Speed $\times$ Time

Speed = Distance $\div$ Time

Time = Distance $\div$ Speed

Unit Conversion

FORMULA

1 m/s = $18/5$ km/h

1 km/h = $5/18$ m/s

Example: Convert 72 km/h into m/s.

Step-by-Step Solution:

$72 \times 5/18 = 20$ m/s.

Final Answer: 20 m/s

Average Speed for Equal Distances

FORMULA

Average Speed = $2xy/(x+y)$

Example: A person travels at 40 km/h and returns at 60 km/h.

Step-by-Step Solution:

Average speed = $(2 \times 40 \times 60)/(40+60) = 48$ km/h.

Final Answer: 48 km/h

Relative Speed

FORMULA

Same direction: Difference of speeds.

Opposite directions: Sum of speeds.

Train Problems

FORMULA

Train crossing a pole: Time = Train Length $\div$ Speed

Train crossing a platform: Time = (Train Length + Platform Length) $\div$ Speed

CHAPTER 7: SIMPLIFICATION

Simplification questions test arithmetic speed and the correct order of operations.

BODMAS Rule

FORMULA

B = Brackets
O = Orders/Of
D = Division
M = Multiplication
A = Addition
S = Subtraction

Example: $20 + 10 \times 2$

Step-by-Step Solution:

First multiplication: $10 \times 2 = 20$. Then $20 + 20 = 40$.

Final Answer: 40

Fast Multiplication Tricks

SHORTCUT TRICK

$\times 5 = \times 10 \div 2$
 $\times 25 = \times 100 \div 4$
 $\times 125 = \times 1000 \div 8$
 $\times 99 = \times (100 - 1)$
 $\times 101 = \times (100 + 1)$

Example: 48×99

Step-by-Step Solution:

$48 \times (100 - 1) = 4800 - 48 = 4752$.

Final Answer: 4752

CHAPTER 8: NUMBER SYSTEM

Number System includes types of numbers, factors, multiples, divisibility, HCF, LCM and remainders.

Types of Numbers

FORMULA

Natural: 1,2,3,...

Whole: 0,1,2,3,...

Integers: ..., -2, -1, 0, 1, 2, ...

Prime: Exactly two factors.

Composite: More than two factors.

Divisibility Rules

SHORTCUT TRICK

2: Last digit even.

3: Sum of digits divisible by 3.

5: Last digit 0 or 5.

9: Sum of digits divisible by 9.

11: Difference between alternate digit sums is 0 or a multiple of 11.

Example: Is 123 divisible by 3?

Step-by-Step Solution:

$1+2+3 = 6$. Since 6 is divisible by 3, 123 is divisible by 3.

Final Answer: Yes

HCF and LCM

FORMULA

For two numbers: $\text{HCF} \times \text{LCM} = \text{Product of the two numbers}$.

Example: HCF of 12 and 18 is 6; LCM is 36.

Step-by-Step Solution:

$6 \times 36 = 216$ and $12 \times 18 = 216$.

Final Answer: Rule verified

CHAPTER 9: SIMPLE & COMPOUND INTEREST

Interest questions are common in Banking, SSC and other competitive examinations.

Simple Interest

FORMULA

$$SI = (P \times R \times T)/100$$

$$\text{Amount} = \text{Principal} + SI$$

Example: $P = ₹5,000$, $R = 10\%$, $T = 2$ years.

Step-by-Step Solution:

$$SI = (5000 \times 10 \times 2)/100 = ₹1,000. \text{ Amount} = ₹6,000.$$

Final Answer: SI = ₹1,000; Amount = ₹6,000

Compound Interest

FORMULA

$$\text{Amount} = P(1 + R/100)^T$$

$$CI = \text{Amount} - \text{Principal}$$

Two-Year Shortcut

FORMULA

$$\text{For 2 years: } CI - SI = P \times (R/100)^2$$

Example: $P = ₹10,000$ and $R = 10\%$.

Step-by-Step Solution:

$$\text{Difference} = 10000 \times (10/100)^2 = ₹100.$$

Final Answer: ₹100

CHAPTER 10: DATA INTERPRETATION

Data Interpretation requires careful reading of tables, graphs and charts followed by fast calculation.

Percentage in DI

FORMULA

$$\text{Percentage} = (\text{Part} \div \text{Total}) \times 100$$

Ratio in DI

FORMULA

Ratio = A:B. Always simplify the ratio by dividing by the common factor.

Example: A = 40 and B = 60.

Step-by-Step Solution:

$$40:60 = 2:3.$$

Final Answer: 2:3

Average in DI

FORMULA

$$\text{Average} = \text{Total} \div \text{Number of Values}$$

Percentage Change

FORMULA

$$\text{Percentage Change} = [(\text{New} - \text{Old}) \div \text{Old}] \times 100$$

Pie Chart

FORMULA

$$\text{Value} = (\text{Angle} \div 360) \times \text{Total}$$

Example: Total students = 720 and sector angle = 90°.

Step-by-Step Solution:

$$\text{Value} = (90/360) \times 720 = 180.$$

Final Answer: 180 students

DI Solving Strategy

SHORTCUT TRICK

1. Read the question first.
2. Identify only the required data.
3. Estimate when possible.
4. Eliminate impossible options.
5. Perform exact calculation only when necessary.

MASTER QUICK REVISION SHEET

Topic	Must-Remember Formula / Trick
Percentage	Percentage = $\text{Part/Total} \times 100$; $25\% = 1/4$; $12.5\% = 1/8$
Profit & Loss	Profit% and Loss% are calculated on CP; Discount% is calculated on MP
Average	Total = Average $\times$ Number
Ratio	Divide total according to the sum of ratio parts
Time & Work	More efficiency means less time; use LCM method
Speed	Distance = Speed $\times$ Time; equal-distance average speed = $2xy/(x+y)$
Simplification	Follow BODMAS
Number System	HCF $\times$ LCM = Product of two numbers
Interest	SI = $\text{PRT}/100$; for 2 years, $\text{CI} - \text{SI} = \text{P}(\text{R}/100)^2$
DI	Read the question first and calculate only the required data

Practice regularly. First understand the formula, then learn the shortcut, and finally solve questions under time pressure.