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QUANTITATIVE APTITUDE · FREE STUDY MATERIAL

Compound Interest

Formulas & Shortcut Tricks

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

WHAT'S INSIDE

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USEFUL FOR

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

Practise Compound Interest 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

With compound interest, the interest earned each period is added to the principal, and the next period's interest is charged on that larger amount. Interest earns interest, so the money grows faster than under simple interest – the gap widens every year.

The whole chapter rests on $A = P(1 + R/100)^n$. Change the period (half-yearly, quarterly), change the rate each year, compare CI with SI, or run the formula backwards for present value and instalments. Population growth and depreciation use exactly the same formula.

Why it matters in exams

- Bank papers ask 2–3 interest questions, and CI − SI is a favourite in every exam.
- Placement tests use consecutive-year amounts, "n times" growth and instalments.
- Loans, deposits, inflation and population growth all compound.

Where it is used

- Bank deposits, recurring deposits and loans.
- Growth of investments and inflation over years.
- Population, bacteria and depreciation of machines.

Common question patterns

Amount and CI
Yearly, half-yearly or quarterly compounding.

CI – SI
Difference for 2 or 3 years – find P or R.

Consecutive amounts
Amounts after n and n + 1 years – find R and P.

n times
Doubles / triples in t years – how long for 8 or 9 times?

Changing rates
Different rates in different years.

Fractional years
2½ years or 2 years 3 months.

Instalments
Equal annual payments that clear a loan.

Growth and decay
Population, prices, machines; effective rate.

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2 Important formulas

Cards marked MOST USED are the ones to revise first

Amount and interest

Compound amount

MOST USED

$$A = P \times (1 + R/100)^n; \ CI = A - P$$

Each year multiplies the amount by the same factor.

P – principal **R** – rate % per period **n** – number of periods

EXAMPLE ₹10,000 at 10% for 2 years → 10,000 × 1.21 = ₹12,100 → CI = **₹2,100**.

Half-yearly and quarterly compounding

MOST USED

Half-yearly: rate R/2, periods 2n. Quarterly: rate R/4, periods 4n

Divide the yearly rate and multiply the number of periods.

EXAMPLE ₹16,000 at 10% a year, compounded half-yearly for 1 year → $16{,}000 \times 1.05^2$ = **₹17,640**.

Fractional years

$$A = P(1 + R/100)^n \times (1 + f \times R/100) \text{ for } n \text{ years and a fraction } f \text{ of a year}$$

Compound for the whole years, then simple interest for the fraction.

EXAMPLE ₹10,000 at 10% for 2½ years → 12,100 × 1.05 = **₹12,705**.

Different rates in different years

$$A = P \times (1 + R_1/100) \times (1 + R_2/100) \times \ldots$$

Multiply one factor for each year.

EXAMPLE ₹5,000 at 10% then 20% → 5,000 × 1.1 × 1.2 = **₹6,600**.

CI compared with SI

Difference for 2 years

MOST USED

$$CI - SI = P \times (R/100)^2$$

The extra is the interest on the first year's interest.

EXAMPLE ₹12,000 at 5% for 2 years → 12,000 × 0.0025 = **₹30**.

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Difference for 3 years

MOST USED

$$CI - SI = P \times (R/100)^2 \times (3 + R/100)$$

More interest-on-interest piles up in the third year.

EXAMPLE ₹10,000 at 10% for 3 years → 10,000 × 0.01 × 3.1 = **₹310**.

Working backwards

Rate from consecutive amounts

MOST USED

$$R = (A_{n+1}/A_n - 1) \times 100;\ \text{the interest of year } n+1 \text{ is } R\% \text{ of } A_n$$

Each year's amount is the previous one times the same factor.

EXAMPLE ₹13,310 after 3 years, ₹14,641 after 4 years → 14,641/13,310 = 1.1 → **10%**.

"n times" growth

MOST USED

$$\text{If P becomes x times in t years, it becomes } x^k \text{ times in } k \times t \text{ years}$$

Powers multiply the factor, so time adds.

EXAMPLE Doubles in 5 years → 8 = 2^3 times in **15 years**.

Present value

$$P = A/(1 + R/100)^n$$

How much must be invested today to have A after n years.

EXAMPLE To have ₹14,641 after 4 years at 10% → invest 14,641 ÷ 1.4641 = **₹10,000**.

Equal annual instalments

MOST USED

$$\text{Loan } P = x/(1 + r) + x/(1 + r)^2 + \ldots\ (r = R/100)$$

The loan equals the present value of all the instalments.

EXAMPLE ₹10,500 at 10% repaid in 2 equal yearly instalments → x(1/1.1 + 1/1.21) = 10,500 → x = **₹6,050**.

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Effective rate and growth

Effective annual rate

Compounded k times a year at R% → effective rate = $[(1 + R/100k)^k - 1] \times 100$

More frequent compounding gives a little more than R%.

EXAMPLE 10% compounded half-yearly → $1.05^2 - 1$ = **10.25%**.

Population and depreciation

Growth: $P(1 + R/100)^n$; decay: $P(1 - R/100)^n$

The same formula with a minus sign for decline.

EXAMPLE A machine worth ₹50,000 loses 20% a year → after 2 years 50,000 × 0.64 = **₹32,000**.

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3 Shortcut tricks & smart techniques

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

Effective percentages for 2 and 3 years

MOST USED

USE WHEN Any yearly CI question at a common rate.

Rate	2 years	3 years
5%	10.25%	15.7625%
10%	21%	33.1%
15%	32.25%	52.0875%
20%	44%	72.8%

EXAMPLE ₹6,000 at 20% for 3 years → CI = 72.8% of 6,000 = **₹4,368**.

Fraction-rate ratio

MOST USED

USE WHEN The rate is a simple fraction (10% = 1/10, 12.5% = 1/8, 20% = 1/5).

1. Rate 1/k → P : A = k^n : $(k + 1)^n$.
2. Use the ratio to find P or A without decimals.

EXAMPLE 12.5% for 2 years → P : A = 64 : 81; if P = ₹6,400, A = **₹8,100**.

CI – SI in one step

USE WHEN The difference between CI and SI is given or asked.

1. 2 years: $P(R/100)^2$.
2. 3 years: $P(R/100)^2(3 + R/100)$.

EXAMPLE Difference ₹48 for 2 years at 4% → P = 48 ÷ 0.0016 = **₹30,000**.

Year-by-year interest

USE WHEN Interest for a particular year (e.g. the 3rd year) is asked.

1. Interest in year k = R% of the amount at the end of year k – 1.
2. Successive yearly interests are in the ratio 1 : (1 + r) : $(1 + r)^2$ …

EXAMPLE ₹10,000 at 10% → year 1: 1,000, year 2: 1,100, year 3: **₹1,210**.

Doubling rule of 72

USE WHEN Estimating how long money takes to double.

1. Doubling time ≈ 72 ÷ R years.
2. Use only to check options – exact questions need the formula.

EXAMPLE At 8% a year money doubles in about 72 ÷ 8 = **9 years**.

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4 Solved examples

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

1 YEARLY CI

Find the compound interest on ₹8,000 at 15% per annum for 2 years.

STEP BY STEP

1. $A = 8{,}000 \times 1.15^2 = 8{,}000 \times 1.3225 = 10{,}580$.
2. $CI = 10{,}580 - 8{,}000 = 2{,}580$.

SHORTCUT

2 years at 15% = 32.25% of 8,000 = 2,580.

Why it works: Two years of 15% compounding add 15 + 15 + 2.25 per cent.

Answer: ₹2,580

2 HALF-YEARLY

Find the compound interest on ₹20,000 for 1½ years at 8% per annum compounded half-yearly.

STEP BY STEP

1. Rate per half-year = 4%; periods = 3.
2. $A = 20{,}000 \times 1.04^3 = 22{,}497.28$.
3. $CI = 2{,}497.28$.

SHORTCUT

$1.04^3 = 1.124864 \rightarrow 12.4864\%$ of 20,000.

Why it works: Half-yearly compounding halves the rate and doubles the periods.

Answer: ₹2,497.28

3 CI − SI (2 YEARS)

The difference between CI and SI on a sum for 2 years at 4% per annum is ₹48. Find the sum.

STEP BY STEP

1. $CI - SI = P(4/100)^2 = 0.0016P = 48$.
2. $P = 30{,}000$.

SHORTCUT

$48 \div 0.0016 = 30{,}000$.

Why it works: For 2 years the difference is just the interest on the first year's interest.

Answer: ₹30,000

4 CI − SI (3 YEARS)

The difference between CI and SI for 3 years at 10% per annum is ₹93. Find the sum.

STEP BY STEP

1. $CI - SI = P \times 0.01 \times 3.1 = 0.031P$.
2. $P = 93 \div 0.031 = 3{,}000$.

SHORTCUT

$P(R/100)^2(3 + R/100) = 93 \rightarrow P = 3{,}000$.

Why it works: The 3-year formula adds the extra interest-on-interest of the third year.

Answer: ₹3,000

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5 CONSECUTIVE AMOUNTS

A sum amounts to ₹17,640 in 2 years and to ₹18,522 in 3 years at compound interest. Find the principal.

STEP BY STEP

1. Rate = 18,522/17,640 − 1 = 0.05 → 5%.
2. P = 17,640 ÷ 1.05^2 = 16,000.

SHORTCUT

Interest in year 3 = 882 = 5% of 17,640 → divide 17,640 by 1.1025.

Why it works: Consecutive amounts differ by one year's factor.

Answer: ₹16,000

6 N TIMES

A sum triples in 4 years at compound interest. In how many years will it become 9 times?

STEP BY STEP

1. $(1 + r)^4 = 3$.
2. $9 = 3^2 \rightarrow (1 + r)^8 = 9$.
3. Time = 8 years.

SHORTCUT

x^2 times → 2 × 4 = 8 years.

Why it works: Squaring the growth factor doubles the time.

Answer: 8 years

7 CHANGING RATES

Find the amount on ₹25,000 for 2 years if the rate is 4% in the first year and 5% in the second, compounded yearly.

STEP BY STEP

1. After year 1: 25,000 × 1.04 = 26,000.
2. After year 2: 26,000 × 1.05 = 27,300.

SHORTCUT

25,000 × 1.04 × 1.05 = 27,300.

Why it works: Each year's rate applies to the amount at the start of that year.

Answer: ₹27,300

8 INSTALMENTS

A loan of ₹10,500 at 10% compound interest is repaid in two equal annual instalments. Find each instalment.

STEP BY STEP

1. 10,500 = x/1.1 + x/1.21.
2. 10,500 = x(1.1 + 1)/1.21 = 2.1x/1.21.
3. x = 10,500 × 1.21 ÷ 2.1 = 6,050.

SHORTCUT

Present values add up to the loan.

Why it works: Each instalment repays the loan's value discounted back to today.

Answer: ₹6,050

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9 POPULATION

A town's population of 1,50,000 rises by 4% in one year and falls by 5% the next. What is it after 2 years?

STEP BY STEP

1. After year 1: 1,50,000 × 1.04 = 1,56,000.
2. After year 2: 1,56,000 × 0.95 = 1,48,200.

SHORTCUT

1,50,000 × 1.04 × 0.95 = 1,48,200.

Why it works: A fall is a factor less than 1 in the same chain.

Answer: 1,48,200

10 FRACTIONAL TIME

Find the amount on ₹12,000 at 10% per annum compounded yearly for 2 years and 3 months.

STEP BY STEP

1. 2 whole years: 12,000 × 1.21 = 14,520.
2. 3 months = 1/4 year at simple interest: 14,520 × 1.025 = 14,883.

SHORTCUT

12,000 × 1.21 × (1 + 10/400) = 14,883.

Why it works: The part year is not compounded – it earns simple interest on the amount so far.

Answer: ₹14,883

11 EFFECTIVE RATE

What is the effective annual rate of 8% per annum compounded quarterly (to two decimal places)?

STEP BY STEP

1. Quarterly rate = 2%; 4 periods.
2. $1.02^4 = 1.08243216$.
3. Effective rate ≈ 8.24%.

SHORTCUT

$(1 + 0.08/4)^4 - 1 = 8.243\ldots\%$.

Why it works: Interest added every quarter earns interest in the remaining quarters.

Answer: 8.24%

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5 Important exam tips

Patterns, traps and habits that save marks

Frequently asked question patterns

- CI for 2–3 years compounded yearly, half-yearly or quarterly.
- CI − SI for 2 and 3 years – find P or R.
- Amounts in consecutive years – find R and P.
- “n times” growth.
- Different rates in different years; fractional years.
- Equal annual instalments and present value.
- Population growth, depreciation and effective rates.

Common mistakes to avoid

- Forgetting to halve the rate and double the periods for half-yearly compounding.
- Compounding the fractional part of a year.
- Using the 2-year CI − SI formula for 3 years.
- Giving the amount when the question asks for the interest.
- Treating “becomes 9 times” as 9 × t years instead of 2t when it triples in t.
- Adding rates for different years instead of multiplying factors.

Points to remember

- $A = P(1 + R/100)^n$.
- $CI - SI = P(R/100)^2$ for 2 years; × (3 + R/100) for 3 years.
- Consecutive amounts: ratio = 1 + R/100.
- x times in t years → x^k times in kt years.
- 10% for 2 years = 21%; for 3 years = 33.1%.

Speed and accuracy

- Learn the effective-percentage table for 5%, 10%, 15% and 20%.
- Use fraction ratios (1000 : 1331 for 10%, 64 : 81 for 12.5%).
- Work year by year when rates change.
- Estimate with the rule of 72 to eliminate options.

Preparation strategy

- Master yearly compounding and CI − SI before instalments.
- Practise on LearnFrenzy in order: Easy → Medium → Hard → Exam Pattern Mix → Data Sufficiency.
- Aim for 45 seconds per CI question.
- Keep an error log of compounding-period slips.
- 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

Amount	$P(1 + R/100)^n$	CI	$A - P$
Half-yearly	$R/2, 2n$	Quarterly	$R/4, 4n$
Fraction f of a year	$\times (1 + fR/100)$	Changing rates	$P \times \Pi(1 + R_i/100)$
CI − SI (2 years)	$P(R/100)^2$	CI − SI (3 years)	$P(R/100)^2(3 + R/100)$
Consecutive amounts	$R = (A_{n+1}/A_n - 1) \times 100$	n times	x^k in kt years
Present value	$A/(1 + R/100)^n$	Instalments	$P = \Sigma\, x/(1 + r)^k$
Effective rate	$(1 + R/100k)^k - 1$	Depreciation	$P(1 - R/100)^n$

Shortcut tricks

- 10%: 21% (2 y), 33.1% (3 y).
- 20%: 44% (2 y), 72.8% (3 y).
- 1/k rate → $k^n : (k + 1)^n$.
- Year-k interest = R% of A_{k-1}.
- Fraction of a year = SI.
- Rule of 72 to estimate.

Must-know numbers

Powers of 1.1	$1.1^2 = 1.21 \cdot 1.1^3 = 1.331 \cdot 1.1^4 = 1.4641$
Powers of 1.05	$1.05^2 = 1.1025 \cdot 1.05^3 = 1.157625$
Powers of 1.2	$1.2^2 = 1.44 \cdot 1.2^3 = 1.728$

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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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