

CAT 2026 · QUANT · NUMBER SYSTEMS

ThinkCAT

Practice Book



CAT Number Systems Formula Sheet

10 topics · 84 formulas · 30 common mistakes · 7 real CAT PYQs one tap away

22

Number Systems questions in CAT 2021-25

7%

of all 330 QA questions

8

in CAT 2025 alone, the most in 5 years

11

were TITA: no negative marks

HOW OFTEN CAT ASKED EACH TOPIC · 2021-25

Tap a topic to open its page

#	Topic	2021	2022	2023	2024	2025	Total	TITA	Page
1	Integer Properties	2	.	1	.	6	9	6	p.11
2	Factors & Multiples	.	.	3	1	2	6	3	p.3
3	Remainders	.	.	.	3	.	3	0	p.5
4	HCF & LCM	.	2	.	.	.	2	2	p.4
5	Divisibility Rules	.	.	1	.	.	1	0	p.2
5	Factorials	.	1	.	.	.	1	0	p.8
-	Unit Digit	.	.	.	.	.	0	0	p.6
-	Last Two/Three Digits	.	.	.	.	.	0	0	p.7
-	Number of Digits	.	.	.	.	.	0	0	p.9
-	Base Systems	.	.	.	.	.	0	0	p.10
All Number Systems		2	3	5	4	8	22	11	

Counts: every official CAT QA question from 2021-2025 (15 slots, 330 questions), tagged to one main topic by ThinkCAT. Deep links open the exact question on thinkcat.in.

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TOPIC 25 · NUMBER SYSTEMS 1 OF 10

OCCASIONAL

Divisibility Rules

1 CAT question from this topic, 2021–25

#5 (tied) of 10 in Number Systems · 0 TITA

0	0	1	0	0
2021	2022	2023	2024	2025

CORE FORMULAS

- 2: last digit even · 4: last two digits · 8: last three digits
- 5: ends in 0 or 5 · 25: ends in 00, 25, 50 or 75 · 125: last three digits
- 3 and 9: the digit sum is divisible by 3 (or 9)
- 11: (sum of odd-place digits) – (sum of even-place digits) is 0 or a multiple of 11
- Composite divisors: split into co-prime parts ($12 = 3 \times 4$, $18 = 2 \times 9$, $24 = 3 \times 8$)
- 7, 11, 13: group digits in threes from the right, alternate + and –; $1001 = 7 \times 11 \times 13$
- k divides a and $b \Rightarrow k$ divides $ma + nb$ for any integers m, n
- The product of n consecutive integers is divisible by $n!$
- $a^n - b^n$ is divisible by $a - b$ (and by $a + b$ if n is even); $a^n + b^n$ by $a + b$ if n is odd

60-SECOND SHORTCUT

The 11 test in 10 seconds

123456789: odd places $9 + 7 + 5 + 3 + 1 = 25$, even places $8 + 6 + 4 + 2 = 20$.
 $25 - 20 = 5$, so it is **not** divisible by 11 and leaves remainder **5**.

DON'T MAKE THESE MISTAKES

- ✗ Divisible by 4 and 6 $\Rightarrow$ divisible by 24
- ✓ 4 and 6 share a 2: **12** passes both and fails 24
- ✗ Digit sum divisible by 3 $\Rightarrow$ divisible by 6
- ✓ 6 also needs an **even** last digit
- ✗ The 11 test uses the plain digit sum
- ✓ Use the **alternating** sum: $121 \rightarrow 1 - 2 + 1 = 0$

SOLVE THE REAL ONES

PYQs and practice on thinkcat.in

CAT 2023 Slot 2

Q2 · Moderate · MCQ

Divisibility set

110+ practice questions

[Practise 110+ Divisibility questions with solutions](#)


TOPIC 26 · NUMBER SYSTEMS 2 OF 10

MOST ASKED

Factors & Multiples

6

CAT questions from this topic, 2021–25

#2 of 10 in Number Systems · 3 TITA



CORE FORMULAS

- $N = p^a q^b r^c \Rightarrow$ number of factors = $(a+1)(b+1)(c+1)$
- Sum of factors = $(1+p+\dots+p^a)(1+q+\dots+q^b)(1+r+\dots+r^c)$
- Product of factors = $N^{f/2}$, where f = number of factors
- Odd factors: ignore the power of 2. Even factors = total - odd
- Perfect square $\Leftrightarrow$ every exponent even $\Leftrightarrow$ an odd number of factors
- Ways to write N as a product of two factors = $f/2$ (round up for a perfect square)
- Exactly 3 factors $\Leftrightarrow N = p^2$. Exactly 4 $\Leftrightarrow N = p^3$ or pq
- Numbers below N that are co-prime to N : $\phi(N) = N(1-1/p)(1-1/q)\dots$
- Factors of a given type: count the allowed exponents. Square factors of $2^4 \cdot 3^3$: $3 \times 2 = 6$

60-SECOND SHORTCUT

Factor count in one line

 $360 = 2^3 \times 3^2 \times 5 \Rightarrow (3+1)(2+1)(1+1)$
 = **24 factors**, of which odd
 (drop the 2s) = $3 \times 2 = 6$.

DON'T MAKE THESE MISTAKES

- ✗ Factors of $2^3 \times 3^2 = 3 \times 2 = 6$
- ✓ Add 1 to each exponent: $4 \times 3 = 12$
- ✗ Exactly 3 factors $\Rightarrow$ any prime
- ✓ Only **squares of primes**: 4, 9, 25, 49
- ✗ Product of the factors of 36 = 36^9
- ✓ 36 has 9 factors: $36^{9/2} = 6^9$

SOLVE THE REAL ONES

Official CAT questions on thinkcat.in

CAT 2023 Slot 3

Q7 · Moderate · TITA

CAT 2023 Slot 1

Q2 · Moderate · MCQ

[Practise 80+ Factors & Factorisation questions](#)


TOPIC 27 · NUMBER SYSTEMS 3 OF 10

OCCASIONAL

HCF & LCM

2 CAT questions from this topic, 2021-25

#4 of 10 in Number Systems · 2 TITA

0	2	0	0	0
2021	2022	2023	2024	2025

CORE FORMULAS

- HCF: lowest power of each common prime. LCM: highest power of every prime
- $\text{HCF} \times \text{LCM} = \text{product of the numbers}$ (two numbers only)
- Fractions in lowest terms: $\text{HCF} = \frac{\text{HCF}(\text{numerators})}{\text{LCM}(\text{denominators})}$; $\text{LCM} = \frac{\text{LCM}(\text{numerators})}{\text{HCF}(\text{denominators})}$
- Same remainder r on dividing by $a, b, c \Rightarrow N = k \cdot \text{LCM}(a, b, c) + r$
- Remainders $a - d, b - d, c - d$ (same shortfall d) $\Rightarrow N = k \cdot \text{LCM} - d$
- Largest number leaving the same remainder with $x, y, z = \text{HCF}(y - x, z - y)$
- HCF h : write the numbers as hx and hy with $\text{HCF}(x, y) = 1$
- Events repeating every a and b minutes coincide every $\text{LCM}(a, b)$ minutes
- $\text{HCF}(a, b) = \text{HCF}(a, b - a)$: subtract to simplify

60-SECOND SHORTCUT

LCM plus remainder

Smallest number leaving remainder 2 when divided by 3, 4 and 5:
 $\text{LCM}(3, 4, 5) + 2 = \mathbf{62}$.

DON'T MAKE THESE MISTAKES

- ✗ $\text{HCF} \times \text{LCM} = \text{product for three numbers}$
- ✓ Holds for **two** numbers only
- ✗ Remainders 1, 2, 3 on dividing by 2, 3, 4: add them
- ✓ Each is divisor - 1: $N = \text{LCM} - 1 = \mathbf{11}$
- ✗ $\text{LCM}(12, 18) = 12 \times 18$
- ✓ Divide by the HCF 6: $\mathbf{36}$

PRACTISE IT NOW

Worked solutions on thinkcat.in

HCF & LCM set

95+ practice questions

Number System PYQs

CAT 2017-25 papers

[Practise 95+ HCF & LCM questions](#)


TOPIC 28 · NUMBER SYSTEMS 4 OF 10

OCCASIONAL

Remainders

3

CAT questions from this topic, 2021–25

#3 of 10 in Number Systems · 0 TITA

0
2021

0
2022

0
2023

3
2024

0
2025

CORE FORMULAS

- Remainders multiply and add:
 $\text{Rem}(a \times b, n) = \text{Rem}(\text{Rem}(a, n) \times \text{Rem}(b, n), n)$
- Negative remainders simplify: $29 \equiv -1 \pmod{30}$, so $29^{100} \equiv 1$
- Fermat: p prime and p does not divide $a \Rightarrow a^{p-1} \equiv 1 \pmod{p}$
- Euler: $\text{HCF}(a, n) = 1 \Rightarrow a^{\phi(n)} \equiv 1 \pmod{n}$
- Wilson: $(p-1)! \equiv -1 \pmod{p}$ for a prime p
- $(x+1)^n \equiv 1 \pmod{x}$; $(x-1)^n \equiv (-1)^n \pmod{x}$
- Powers cycle: find the cycle length and divide the exponent by it
- Chinese remainder: combine answers mod m and mod n when $\text{HCF}(m, n) = 1$
- Remainder on dividing by 10^k = the last k digits

60-SECOND SHORTCUT

Find a power that is 1

 $2^{100} \div 7: 2^3 = 8 \equiv 1$, so $2^{100} = (2^3)^{33} \times 2 \equiv 1 \times 2 = 2$.

DON'T MAKE THESE MISTAKES

- ✗ Fermat works for any divisor
- ✓ The divisor must be **prime** (use Euler otherwise)
- ✗ Remainder -1 on dividing by 7
- ✓ Convert back: remainder **6**
- ✗ $5^{20} \div 3$: 5 leaves 2, so the answer is 2
- ✓ $5 \equiv -1$: $(-1)^{20} = 1$

SOLVE THE REAL ONES

Official CAT questions on thinkcat.in

CAT 2024 Slot 2

Q2 · Easy · MCQ



CAT 2024 Slot 1

Q1 · Easy · MCQ



Practise 45+ Remainder questions with Euler and Fermat



TOPIC 29 · NUMBER SYSTEMS 5 OF 10

NOT ASKED 2021–25

Unit Digit

0

CAT questions from this topic, 2021–25

No standalone unit-digit question in CAT 2021–25. The cycles still drive remainder and last-digit steps.

0	0	0	0	0
2021	2022	2023	2024	2025

CORE FORMULAS

- The unit digit of a product or power depends only on the unit digits
- Cycles of 4: $2 \rightarrow 2, 4, 8, 6$ · $3 \rightarrow 3, 9, 7, 1$ · $7 \rightarrow 7, 9, 3, 1$ · $8 \rightarrow 8, 4, 2, 6$
- Cycles of 2: $4 \rightarrow 4, 6$ (odd, even power) · $9 \rightarrow 9, 1$
- 0, 1, 5 and 6 end in themselves at every power
- Divide the exponent by 4; remainder 0 means take the 4th term of the cycle
- $n!$ ends in 0 for every $n \geq 5$
- Unit digit of a sum: add the unit digits and keep the last digit
- A number ending in 5 times an even number ends in 0

60-SECOND SHORTCUT

Exponent mod 4

7^{2026} : $2026 = 4 \times 506 + 2$, so take the 2nd term of 7, 9, 3, 1. The unit digit is **9**.

DON'T MAKE THESE MISTAKES

- ✗ Exponent remainder 0 $\Rightarrow$ unit digit 1
- ✓ Take the 4th term: 3^8 ends in 1, but **2^8 ends in 6**
- ✗ $1! + 2! + \dots + 100!$ needs all 100 terms
- ✓ From 5! every term ends in 0: $1 + 2 + 6 + 24 \rightarrow 3$
- ✗ 4^n always ends in 4
- ✓ Even powers end in **6**

PRACTISE IT NOW

Worked solutions on thinkcat.in

Remainders set

45+ practice questions

Number System PYQs

CAT 2017–25 papers

Unit digits are remainders mod 10: practise 45+ Remainder questions



TOPIC 30 · NUMBER SYSTEMS 6 OF 10

NOT ASKED 2021-25

Last Two/Three Digits

CAT questions from this topic, 2021-25

0

No CAT 2021-25 question asked for the last two digits outright. The mod-100 tricks still speed up remainder work.

2021	2022	2023	2024	2025
0	0	0	0	0

CORE FORMULAS

- 1 Last two digits = remainder mod 100; last three = remainder mod 1000
- 2 Ending in 1: $(...a1)^n$ ends in [last digit of $a \times n$] followed by 1, so 31^7 ends in 11
- 3 Other odd bases: first reach a number ending in 1 ($3^4 = 81$, $7^4 = 2401$, $9^2 = 81$)
- 4 76^n ends in 76; 25^n ends in 25; 5^n ends in 25 for $n \geq 2$
- 5 Powers ($n \geq 2$) of numbers ending in 5 end in 25 or 75
- 6 Even bases: $2^{10} = 1024 \equiv 24$, and 24^n ends in 24 (n odd) or 76 (n even)
- 7 $\phi(100) = 40$: $a^{40} \equiv 1 \pmod{100}$ when $\text{HCF}(a, 10) = 1$
- 8 Last three digits: solve mod 8 and mod 125, then combine

60-SECOND SHORTCUT

Get to ...01 first

7^{100} : $7^4 = 2401$ ends in 01, so $7^{100} = (7^4)^{25}$ ends in **01**.

DON'T MAKE THESE MISTAKES

- ✗ Last two digits of 2^{100} from the unit-digit cycle
- ✓ Use $2^{10} \equiv 24$: $2^{100} \equiv 24^{10}$, ending in **76**
- ✗ 11^5 ends in 55
- ✓ Rule for ...1: $1 \times 5 = 5$, then $1 \rightarrow$ **51**
- ✗ 5^n keeps changing its last two digits
- ✓ **25** for every $n \geq 2$

PRACTISE IT NOW

Worked solutions on thinkcat.in

Remainders set

45+ practice questions

Number System set

400+ practice questions

Practise mod-100 tricks on 45+ Remainder questions



TOPIC 31 · NUMBER SYSTEMS 7 OF 10

OCCASIONAL

Factorials

1 CAT question from this topic, 2021–25

#5 (tied) of 10 in Number Systems · 0 TITA

0	1	0	0	0
2021	2022	2023	2024	2025

CORE FORMULAS

- Power of a prime p in $n!$ = $\lfloor n/p \rfloor + \lfloor n/p^2 \rfloor + \lfloor n/p^3 \rfloor + \dots$
- Trailing zeros of $n!$ = the power of 5 in $n!$
- Composite k : split k into primes; the scarcest prime (per its exponent) sets the power of k
- $n!$ ends in 0 for every $n \geq 5$
- Wilson: $(p - 1)! + 1$ is divisible by any prime p
- $n! + 1$ leaves remainder 1 on division by every number from 2 to n
- $0! = 1 \cdot 5! = 120 \cdot 10! = 36,28,800$
- The product of any k consecutive integers is divisible by $k!$

60-SECOND SHORTCUT

Zeros in 100!

Power of 5 in 100!: $\lfloor 100/5 \rfloor + \lfloor 100/25 \rfloor = 20 + 4 = \mathbf{24}$ trailing zeros.

DON'T MAKE THESE MISTAKES

- $\times$ Zeros in $100! = 100/5 = 20$
- $\checkmark$ Add $\lfloor 100/25 \rfloor$ too: **24**
- $\times$ Power of 18 in $10! = \text{power of } 3 = 4$
- $\checkmark$ $18 = 2 \times 3^2$: $4 \div 2 = \mathbf{2}$
- $\times$ $0! = 0$
- $\checkmark$ **$0! = 1$**

PRACTISE IT NOW

Worked solutions on thinkcat.in

Number System PYQs

CAT 2017–25 papers

Number System set

400+ practice questions

Solve every CAT Number System PYQ, free



TOPIC 32 · NUMBER SYSTEMS 8 OF 10
NOT ASKED 2021-25

Number of Digits

0
CAT questions from this topic, 2021-25

Not asked directly in CAT 2021-25. Powers of 10 still crack the digit-sum questions CAT did ask.

0	0	0	0	0
2021	2022	2023	2024	2025

CORE FORMULAS

- 1 Digits in $N = \lfloor \log_{10} N \rfloor + 1$
- 2 $\log_{10} 2 \approx 0.301$, $\log_{10} 3 \approx 0.477$, $\log_{10} 7 \approx 0.845$
- 3 $2^{10} = 1024 \approx 10^3$, so 2^n has about $0.301n + 1$ digits
- 4 Pair every 2 with a 5 to make powers of 10 before counting
- 5 k -digit numbers run from 10^{k-1} to $10^k - 1$: there are $9 \times 10^{k-1}$ of them
- 6 Digits needed to write 1 to 999: $9 + 180 + 2,700 = 2,889$
- 7 The digit sum of $a \times 10^k$ equals the digit sum of a

60-SECOND SHORTCUT
Count with logs

2^{100} : $100 \times 0.30103 = 30.103$, so 2^{100} has $\lfloor 30.103 \rfloor + 1 = \mathbf{31 \text{ digits}}$.

DON'T MAKE THESE MISTAKES

- ✗ Digits = $\log_{10} N$
- ✓ Floor it, then add 1: 1,000 has **4** digits
- ✗ $5^{20} \times 2^{25}$ has 45 digits
- ✓ It is 32×10^{20} : **22 digits**
- ✗ Page numbers 1 to 100 use 300 digits
- ✓ $9 + 180 + 3 = \mathbf{192}$

PRACTISE IT NOW

Worked solutions on thinkcat.in

Number System set

400+ practice questions

Number System PYQs

CAT 2017-25 papers

Practise 400+ Number System questions



TOPIC 33 · NUMBER SYSTEMS 9 OF 10

NOT ASKED 2021-25

Base Systems

0

CAT questions from this topic, 2021-25

No base-system question in CAT 2021-25. It takes an hour to learn, so keep it for the last week.

0	0	0	0	0
2021	2022	2023	2024	2025

CORE FORMULAS

- $(d_k \dots d_1 d_0)$ in base $b = d_k b^k + \dots + d_1 b + d_0$, and every digit is below b
- Decimal to base b : divide by b repeatedly and read the remainders bottom-up
- Binary $\leftrightarrow$ octal: groups of 3 bits; binary $\leftrightarrow$ hexadecimal: groups of 4 bits
- The largest k -digit number in base b is $b^k - 1$
- In base b : divisible by $b - 1 \Leftrightarrow$ the digit sum is divisible by $b - 1$
- In base b : divisible by $b + 1 \Leftrightarrow$ the alternating digit sum is divisible by $b + 1$
- Digits of N in base $b = \lfloor \log N \div \log b \rfloor + 1$
- Trailing zeros of N in base $b =$ the highest power of b that divides N

60-SECOND SHORTCUT

Repeated division

45 in base 3: $45 = 1 \cdot 27 + 2 \cdot 9 + 0 \cdot 3 + 0 \Rightarrow 1200_3$. Check: $27 + 18 = 45$.

DON'T MAKE THESE MISTAKES

- ✗ 8 is a valid octal digit
- ✓ Octal uses **0 to 7** only
- ✗ Read the remainders top-down
- ✓ Read them **bottom-up**: $6 = 110_2$, not 011
- ✗ 10_2 means ten
- ✓ $10_2 = 2$

PRACTISE IT NOW

Worked solutions on thinkcat.in

Number System set

400+ practice questions

Number System PYQs

CAT 2017-25 papers

Base questions sit inside the 400+ Number System set



TOPIC 34 · NUMBER SYSTEMS 10 OF 10

MOST ASKED

Integer Properties

9

CAT questions from this topic, 2021–25

#1 of 10 in Number Systems · 6 TITA



CORE FORMULAS

- 1 Odd $\pm$ odd = even; even $\times$ anything = even; odd $\times$ odd = odd
- 2 Squares end in 0, 1, 4, 5, 6 or 9 and leave remainder 0 or 1 on division by 3 or 4
- 3 Digit problems: write abc as $100a + 10b + c$ ($a \geq 1$, each digit 0–9)
- 4 Reversals: $ab - ba = 9(a - b)$; $abc - cba = 99(a - c)$
- 5 $xy = N$ in positive integers: one ordered solution per factor of N
- 6 $x_1 + \dots + x_k = n$: $C(n + k - 1, k - 1)$ solutions in whole numbers, $C(n - 1, k - 1)$ in positive integers
- 7 Every prime above 3 is of the form $6k \pm 1$
- 8 Palindromes: 90 three-digit (aba), 900 five-digit (abcba)
- 9 $(x + a)(y + b) = N \Rightarrow$ read the solutions off the factor pairs of N

60-SECOND SHORTCUT

Clues become equations

A 3-digit number grows by 297 when reversed: $99(c - a) = 297 \Rightarrow c - a = 3$, so $a = 1$ to 6 and b is free: **$6 \times 10 = 60$** numbers.

DON'T MAKE THESE MISTAKES

- ✗ 1 is a prime
- ✓ Primes start at 2; **2 is the only even prime**
- ✗ Positive solutions of $x + y + z = 10$: $C(12, 2)$
- ✓ That counts zeros too. Positive: $C(9, 2) = \mathbf{36}$
- ✗ Ends in 1, 3, 7 or 9 $\Rightarrow$ prime
- ✓ **$91 = 7 \times 13$**

SOLVE THE REAL ONES

Official CAT questions on thinkcat.in

CAT 2025 Slot 2

Q9 · Moderate · TITA

CAT 2025 Slot 1

Q4 · Moderate · TITA

[Practise 60+ Integral Solutions questions](#)


SCREENSHOT THIS PAGE

12× = asked 12 times in CAT 2021-25

The Number Systems Formula Wall

25 Divisibility Rules

1×

p.2

- 4: last 2 digits · 8: last 3 digits
- 3, 9: digit sum · 11: alternating sum
- 7, 11, 13: alternating sum of 3-digit groups
- $a^n - b^n$ is divisible by $a - b$

30 Last Two/Three Digits

0×

p.7

- $(...a1)^n$ ends in $[a \cdot n]1$
- $76^n \rightarrow 76 \cdot 25^n \rightarrow 25 \cdot 5^n \rightarrow 25$
- $2^{10} \equiv 24$; 24^n : odd 24, even 76
- $\phi(100) = 40$

26 Factors & Multiples

6×

p.3

- $p^a q^b$ has $(a + 1)(b + 1)$ factors
- Product of factors = $N^{f/2}$
- Odd factors: drop the 2s
- Exactly 3 factors $\Leftrightarrow p^2$

31 Factorials

1×

p.8

- Power of p in $n! = \sum [n/p^k]$
- Trailing zeros = power of 5
- Composite k : scarcest prime decides
- Wilson: $(p - 1)! \equiv -1 \pmod{p}$

27 HCF & LCM

2×

p.4

- $HCF \times LCM = a \times b$
- Same remainder r : $k \cdot LCM + r$
- Same shortfall d : $k \cdot LCM - d$
- Same remainder with x, y, z : HCF of the differences

32 Number of Digits

0×

p.9

- Digits = $\lfloor \log_{10} N \rfloor + 1$
- $\log 2 \approx 0.301$, $\log 3 \approx 0.477$
- Pair 2s with 5s first
- 1 to 999 uses 2,889 digits

28 Remainders

3×

p.5

- Fermat: $a^{p-1} \equiv 1 \pmod{p}$
- Euler: $a^{\phi(n)} \equiv 1 \pmod{n}$
- Wilson: $(p - 1)! \equiv -1 \pmod{p}$
- $(x + 1)^n \equiv 1 \pmod{x}$

33 Base Systems

0×

p.10

- Value = $\sum \text{digit} \times b^k$; digits $< b$
- To base b : divide, read remainders upward
- Binary $\rightarrow$ octal: 3 bits; hex: 4 bits
- $b - 1$ test: digit sum

29 Unit Digit

0×

p.6

- 2: 2 4 8 6 · 3: 3 9 7 1
- 7: 7 9 3 1 · 8: 8 4 2 6
- 4: 4 6 · 9: 9 1 · 0, 1, 5, 6 fixed
- Exponent remainder 0 $\rightarrow$ 4th term

34 Integer Properties

9×

p.11

- $abc - cba = 99(a - c)$
- Squares leave 0 or 1 mod 3 and mod 4
- Whole-number solutions:
 $C(n + k - 1, k - 1)$
- Primes above 3 are $6k \pm 1$

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Free CAT mock ↗

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