NA01 — Number System & Simplification

🔢 Numerical Ability – NA01 AFCAT Level ☆ Low Priority

📌 **AFCAT Focus:** NA01 tests **number types** (prime, composite, HCF, LCM), **BODMAS simplification**, and **recurring decimals.** AFCAT questions are direct — typically 1–2 per paper. Master HCF×LCM = Product, and the BODMAS order. Average students can score full marks here with formula memorisation alone.

1. Types of Numbers

FIG 1.1 — NUMBER SYSTEM AT A GLANCE

📐 **RATIONAL NUMBERS** (can write as p/q)

Natural: 1, 2, 3, 4... (no zero)

Whole: 0, 1, 2, 3... (includes zero)

Integers: ...-2, -1, 0, 1, 2... (no fractions)

Terminating decimals: 0.5, 1.25, 0.75

Recurring decimals: $0.333\overline{3}$, $0.\overline{142857}$

⚡ Natural ⊂ Whole ⊂ Integer ⊂ Rational

🔢 **IRRATIONAL NUMBERS** (cannot write as p/q)

Non-terminating, non-recurring decimals

Examples: √2, √3, π, e

√(perfect square) = **Rational** — e.g. √4=2 ✓

√(non-perfect square) = **Irrational** — e.g. √2 ✗

Rational + Irrational = **Irrational**

π = 3.14159... √2 = 1.41421... e = 2.71828...

Topic A — Number Types — Complete Reference

Direct AFCAT Facts

Natural — Counting numbers: **1, 2, 3, 4, 5...** Does NOT include 0. Also called positive integers.

Whole — Natural numbers + zero: **0, 1, 2, 3, 4...** Whole numbers include 0; natural numbers do not.

Integer — All whole numbers + negative numbers: **..., −3, −2, −1, 0, 1, 2, 3...** No fractions or decimals.

Rational — Any number expressible as **p/q where q ≠ 0**. Includes integers, fractions, terminating & recurring decimals. E.g. 3/4, −2, 0.5, $0.3\overline{3}$

Irrational — Cannot be written as p/q. Non-terminating, non-recurring decimals. E.g. **√2, √3, π, e.** √(perfect square) is rational.

Prime — Exactly 2 factors: 1 and itself. Smallest prime = **2** (only even prime). Primes up to 50: 2,3,5,7,11,13,17,19,23,29,31,37,41,43,47. Note: **1 is NOT prime.**

Composite — More than 2 factors. Smallest composite = **4**. All even numbers > 2 are composite. 1 is neither prime nor composite.

Co-prime — Two numbers with **HCF = 1**. Need not be prime individually. E.g. (8, 9), (14, 15), (4, 9). Any two consecutive integers are always co-prime.

Twin Prime — Prime pairs differing by **2**. E.g. (3,5), (5,7), (11,13), (17,19), (29,31), (41,43). The pair (2,3) is NOT twin prime (differ by 1).

Even / Odd — Even: divisible by 2 — (0, 2, 4, 6...). Odd: not divisible by 2 — (1, 3, 5...). Key: Odd + Odd = Even. Even × Odd = Even. Odd × Odd = Odd. Zero is even.

Topic B — Place Value vs Face Value

AFCAT Direct

Face Value — The **digit itself**, regardless of its position. Face value of 7 in 3,7,452 = **7**. Face value never changes with position.

Place Value — The value of a digit based on its **position** in the number. In 3,7,452 — place value of 7 = 7 × 1,000 = **7,000**.

Example — Number: **85,634**

8 → place value = 80,000, face value = 8

5 → place value = 5,000, face value = 5

6 → place value = 600, face value = 6

3 → place value = 30, face value = 3

4 → place value = 4, face value = 4

Key: Place value = Face value × Position value (ones=1, tens=10, hundreds=100...)

AFCAT Trap

Q: "What is the difference between place value and face value of 6 in 46,821?"

Place value of 6 = 6,000. Face value = 6. Difference = 6,000 − 6 = **5,994.**

HCF & LCM

2. HCF & LCM

FIG 2.1 — HCF VS LCM: KEY DIFFERENCES

HCF — Highest Common Factor	LCM — Lowest Common Multiple
Also called GCD or GCF	Smallest number divisible by both
Take LOWEST powers of common primes	**Take HIGHEST powers** of all primes
HCF(12,18): $12=2^2\times3$, $18=2\times3^2$ → HCF = 2×3 = **6**	LCM(12,18): $12=2^2\times3$, $18=2\times3^2$ → LCM = $2^2\times3^2$ = **36**
Divides both numbers exactly	Is a multiple of both numbers
HCF ≤ smaller of the two numbers	LCM ≥ larger of the two numbers

⭐ KEY FORMULA: HCF × LCM = A × B | Always verify with this!

🔧 HCF Applications

- **Largest tile/piece:** Find HCF of dimensions (e.g., largest square tile for a 12×18 room = HCF(12,18) = 6 m)
- **Largest number that divides:** HCF of the numbers

🔧 LCM Applications

- **Events repeating together:** LCM of their periods (e.g., bells ringing every 4 and 6 min: LCM = 12 min)
- **Smallest number divisible by both:** LCM of the numbers

- **Distribute into equal groups:** HCF gives max group size
- If HCF of a, b = H, then a = Hx, b = Hy where HCF(x,y) = 1

- **Least time/distance:** Real-life scheduling problems
- LCM of co-prime numbers = their product

✎ Worked Example — HCF Real-Life: Largest Tile Size

A room is 12 m × 8 m. Find the largest square tile that can cover the floor exactly (no cutting).

The tile side must divide both 12 and 8 exactly.

HCF(12, 8): $12 = 2^2 \times 3$, $8 = 2^3$

HCF = 2^2 = **4 m**

Number of tiles = (12 × 8) / (4 × 4) = 96/16 = **6 tiles**

✓ Largest tile side = 4 m | Tiles needed = 6

✎ Worked Example — LCM: Bells Tolling Together

Three bells toll at intervals of 9, 12 and 15 minutes. If they toll together at 8:00 AM, when will they next toll together?

Step 1: Find LCM(9, 12, 15)

$9 = 3^2$ $12 = 2^2 \times 3$ $15 = 3 \times 5$

LCM = $2^2 \times 3^2 \times 5 = 4 \times 9 \times 5$ = **180 minutes = 3 hours**

Step 2: 8:00 AM + 3 hours = **11:00 AM**

✓ Answer: 11:00 AM

SIMPLIFICATION & BODMAS

3. Simplification & BODMAS

FIG 3.1 — BODMAS ORDER OF OPERATIONS

B	O	D	M	A	S
Brackets	Orders	Division	Multiply	Addition	Subtract
( ) [ ] { }	Powers, Roots	÷	×	+	−
① First	② Second	③ Equal	③ Equal	④ Equal	④ Equal

D & M are EQUAL priority — go left to right
e.g. 8 ÷ 2 × 4 = 4 × 4 = **16** (not 1)

A & S are EQUAL priority — go left to right
e.g. 10 − 3 + 2 = 7 + 2 = **9** (not 5)

💡 **BODMAS Key Rule:** D and M have equal priority — go **left to right**. Same for A and S. Brackets order: **( ) first, then [ ], then { }**. Never skip a step in AFCAT MCQs — always work innermost brackets outward.

✎ Worked Example — BODMAS

Simplify: $18 \div 3 \times \{5 + [4 - (2 + 1)]\} - 2^2$

Step 1 (Inner bracket): (2+1) = 3
Step 2 [Square bracket]: [4−3] = 1
Step 3 {Curly bracket}: {5+1} = 6
Step 4 (Orders): $2^2 = 4$
Step 5 (D&M left to right): 18÷3 = 6, then 6×6 = 36
Step 6 (A&S): 36 − 4 = **32**

✓ Answer: 32

DECIMAL FRACTIONS & RECURRING DECIMALS

4. Decimal Fractions & Recurring Decimals

Type	Definition	Example	Fraction Form
Terminating Decimal	Ends after finite digits	0.75, 1.25, 0.5	3/4, 5/4, 1/2

Type	Definition	Example	Fraction Form
Pure Recurring	All digits after decimal repeat	$0.3\overline{3} = 0.\underline{3}$	Numerator = repeating block; Denominator = 9s equal to block length e.g. $0.\underline{3} = 3/9 = 1/3$
Mixed Recurring	Some digits fixed, rest repeat	$0.16\overline{6} = 0.1\underline{6}$	(Number − Non-repeating) ÷ (9s for repeat, 0s for non-repeat) e.g. $0.1\underline{6} = (16-1)/90 = 15/90 = 1/6$

Recurring Decimal Formula:

Pure recurring: $0.\underline{ab} = ab / 99$ $0.\underline{abc} = abc / 999$

Mixed recurring: $0.x\underline{y} = (xy - x) / 90$ $0.x\underline{yz} = (xyz - xy) / 900$

APPROXIMATION & ROUNDING

5. Approximation & Rounding Off

🔢 Rounding Rules

- **Rounding to nearest 10:** Look at units digit. If ≥ 5 → round up; if < 5 → round down.
  E.g. 47 → 50 | 43 → 40
- **Rounding to nearest 100:** Look at tens digit. If ≥ 5 → round up.
  E.g. 867 → 900 | 832 → 800
- **Rounding to decimal places:** Look at the next digit after required place.
  E.g. 3.456 to 2 d.p. → 3.46 | 3.453 to 2 d.p. → 3.45
- **Significant figures:** Count from first non-zero digit.

🔢 Approximation in AFCAT

- **Approximate first, eliminate options:** If 497 × 203 ≈ 500 × 200 = 1,00,000 → exact answer near 1,00,000
- **Square roots (approximate):** √50 ≈ 7.07 | √200 ≈ 14.14 | √10 ≈ 3.16
- **When to round up:** When purchasing material (always buy more, not less)
- **When to round down:** When distributing items evenly (floor the value)

0.00427 to 2 sig. fig. = 0.0043

- AFCAT uses approximation to test whether students can estimate quickly without a calculator

✎ Worked Example — Approximation

Approximate: 4,998 × 52 ÷ 25.03 (choose nearest from: 9,990 / 10,400 / 10,000 / 9,600)

Round each value: 4,998 ≈ 5,000 | 52 ≈ 50 | 25.03 ≈ 25

5,000 × 50 ÷ 25 = 2,50,000 ÷ 25 = **10,000**

✓ Answer ≈ 10,000

📐 Formula Sheet — NA01

HCF & LCM

HCF × LCM = A × B

HCF: take **lowest** powers of common primes

LCM: take **highest** powers of all primes

Co-prime: HCF = 1; LCM = A×B

Number Types

Smallest prime: **2** (only even prime)

1 is **neither prime nor composite**

Twin primes: differ by **2**

Co-prime: HCF = **1**

BODMAS Order

Brackets → **O**rders → **D**iv → **M**ul → **A**dd → **S**ub

D & M: left to right equally

A & S: left to right equally

Bracket order: ( ) → [ ] → { }

Recurring Decimals

$0.\underline{a} = a/9$

$0.\underline{ab} = ab/99$

$0.\underline{ab} = (ab-a)/90$

$0.\underline{abc} = (abc-ab)/900$

Divisibility Rules

By 2: last digit even

By 3: sum of digits ÷ 3

Squares & Cubes (Quick)

$\sqrt{2} = 1.414$ $\sqrt{3} = 1.732$ $\sqrt{5} = 2.236$

$1^3=1$, $2^3=8$, $3^3=27$, $4^3=64$, $5^3=125$

By 4: last 2 digits ÷ 4

By 9: sum of digits ÷ 9

By 11: (sum odd−sum even) ÷ 11

$6^3=216$, $7^3=343$, $8^3=512$, $9^3=729$, $10^3=1000$

$\sqrt[3]{512}=8$, $\sqrt[3]{729}=9$, $\sqrt[3]{1000}=10$

📝 Topic-Wise PYQs — NA01

Q1. The HCF of 36 and 84 is: AFCAT PYQ

(a) 6 (b) 12 (c) 18 (d) 24

✓ Answer: (b) 12

$36 = 2^2\times3^2$ | $84 = 2^2\times3\times7$. HCF = $2^2\times3 = 12$. (Take lowest powers of common primes.)

Q2. LCM of 12, 18 and 24 is: AFCAT PYQ

(a) 36 (b) 48 (c) 72 (d) 144

✓ Answer: (c) 72

$12=2^2\times3$ | $18=2\times3^2$ | $24=2^3\times3$. LCM = $2^3\times3^2 = 8\times9 = 72$.

Q3. Simplify: 5 + 3 × 4 − 12 ÷ 3 AFCAT PYQ

(a) 13 (b) 9 (c) 17 (d) 28

✓ Answer: (a) 13

BODMAS: 12÷3 = 4; 3×4 = 12; then 5 + 12 − 4 = **13**. Common mistake: doing 5+3 first.

Q4. $0.\underline{36}$ as a fraction is: Tricky

(a) 36/99 (b) 4/11 (c) 9/25 (d) 36/100

✓ Answer: (b) 4/11

Pure recurring $0.\underline{36}$ = 36/99 = 4/11. (Two repeating digits → denominator = 99.)

Q5. Which of the following is NOT a prime number? AFCAT PYQ

(a) 89 (b) 97 (c) 91 (d) 83

✓ Answer: (c) 91

91 = 7 × 13. Not prime. 83, 89, 97 are all prime. Quick check: try dividing by primes up to √91 ≈ 9.5, so check 2,3,5,7 only.

Q6. If HCF of two numbers is 8 and their LCM is 96, and one number is 32, the other is: AFCAT PYQ

(a) 16 (b) 24 (c) 48 (d) 64

✓ Answer: (b) 24

HCF×LCM = A×B → 8×96 = 32×B → B = 768/32 = **24**.

🧠 Quick Memory Chart — NA01

🔢 Number Types

- Smallest prime: **2**
- Only even prime: **2**
- 1 = **neither prime/composite**
- Twin primes: **differ by 2**
- Co-prime: **HCF = 1**
- 0 is **even, whole, not natural**

🔢 HCF & LCM

- HCF: **lowest powers** (common)
- LCM: **highest powers** (all)
- **HCF × LCM = A × B**
- Co-prime: LCM = **A×B**
- HCF always **divides** LCM
- LCM ≥ HCF always

🔢 BODMAS

- B → O → D → M → A → S
- D & M: **left to right**
- A & S: **left to right**
- Bracket: **( ) [ ] { }**
- Square root: **Order (O)**
- Always innermost first