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Number System

This resource provides detailed notes about Number systems with Important points, examples and other things which are helpful for exams as well as contributes to better understanding of the topic.

The Number System is the framework used to represent and calculate quantities. Below are concise, exam-oriented notes starting from the basic building blocks up to Real numbers.

1. Hierarchy of Numbers

Understanding the "family tree" of numbers is the best way to remember them. Each subsequent type includes the previous ones (except for Irrational numbers, which are a separate branch).

- **Natural Numbers ($\mathbb{N}$)** $\subset$ **Whole Numbers ($\mathbb{W}$)** $\subset$ **Integers ($\mathbb{Z}$)** $\subset$ **Rational Numbers ($\mathbb{Q}$)**
- **Real Numbers ($\mathbb{R}$)** = **Rational ($\mathbb{Q}$)** + **Irrational ($\mathbb{P}$)**

2. Basic Types of Numbers

Natural Numbers ($\mathbb{N}$)

These are the basic “counting numbers” used in daily life.

- **Definition:** The set of positive integers starting from 1.
- **Range:** $1, 2, 3, 4, \ldots \infty$
- **Key Exam Point:** The smallest natural number is **1**. There is no largest natural number.

Whole Numbers ($\mathbb{W}$)

These are Natural numbers plus zero.

- **Definition:** The set of natural numbers including **0**.
- **Range:** $0, 1, 2, 3, \ldots \infty$
- **Key Exam Point:** Every Natural number is a Whole number, but **0** is a Whole number that is *not* a Natural number.

Integers ($\mathbb{Z}$)

This set expands to include negative values.

- **Definition:** Whole numbers plus their negative counterparts.
- **Range:** $\cdots - 3, -2, -1, 0, 1, 2, 3 \ldots$
- **Important:** 0 is neither positive nor negative.

3. Rational vs. Irrational Numbers (Crucial for Exams)

This distinction is often the source of most exam questions (MCQs and proofs).

Rational Numbers ($\mathbb{Q}$)

- **Definition:** Any number that can be written in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.
- **Decimal Property:** Their decimal expansion is either **Terminating** (e.g., 0.5) OR **Non-terminating but Repeating** (e.g., $0.333\ldots$).
- **Examples:**
  - $\frac{1}{2}$
  - 5 (can be written as $\frac{5}{1}$)
  - 0 (can be written as $\frac{0}{1}$)
  - -3.5

Irrational Numbers

- **Definition:** Numbers that **cannot** be written as a simple fraction $\frac{p}{q}$.
- **Decimal Property:** Their decimal expansion is **Non-terminating AND Non-repeating**.
- **Examples:**
  - $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$
  - π
  - $0.1010010001\ldots$

Comparison Table: Rational vs. Irrational

Feature	Rational Numbers ($\mathbb{Q}$)	Irrational Numbers
Form	Can be written as $\frac{p}{q}$	Cannot be written as $\frac{p}{q}$
Decimal Type	Terminating or Repeating	Non-terminating and Non-repeating
Examples	2, $\frac{22}{7}$, $0.333\ldots$, $\sqrt{4}$	π, $\sqrt{2}$, $1.414213\ldots$
Perfect Squares	Square roots of perfect squares (e.g., $\sqrt{16} = 4$)	Square roots of non-perfect squares (e.g., $\sqrt{17}$)

4. Real Numbers and Exam Traps

Real Numbers ($\mathbb{R}$)

- **Definition:** The collection of **all** Rational and Irrational numbers together.
- **Visualization:** Every point on the number line represents a unique Real number.

Common Exam Traps and Notes

- **Is Zero Rational?** Yes, because $0 = \frac{0}{1}$.
- **Pi (π) vs. $\frac{22}{7}$**
  - π is **Irrational**.
  - $\frac{22}{7}$ is **Rational**.
  - $\frac{22}{7}$ is just an approximation of π.
- **Prime Roots:** The square root of any prime number ($\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$) is always irrational.
- **All Integers are Rational:** Any integer n can be written as $\frac{n}{1}$.

Divisibility and Divisibility Rules

Definition:
Divisibility means that when you divide one number by another, the result is a whole number with **zero remainder**.

- *Example:* 10 is divisible by 5 because $10 \div 5 = 2$ (remainder 0).
- *Counter Example:* 10 is not divisible by 3 because $10 \div 3 = 3.33\dots$ (remainder 1).

Divisibility Tests (1 to 20)

1. Basic Rules (Easy to remember)

Number	Rule	Example
1	All integers are divisible by 1.	5, 100, 987 are all divisible by 1.
2	Last digit is **Even** (0, 2, 4, 6, 8).	**124** (ends in 4), **50** (ends in 0).
3	**Sum of digits** is divisible by 3.	**123** $\rightarrow 1+2+3=6$. 6 is divisible by 3, so 123 is too.
5	Last digit is **0** or 5.	**145** (ends in 5), **290** (ends in 0).
6	Divisible by **both 2 AND 3**.	**24**: Even (divisible by 2) AND $2+4=6$ (divisible by 3).
9	**Sum of digits** is divisible by 9.	**729** $\rightarrow 7+2+9=18$. 18 is divisible by 9.
10	Last digit is **0**.	**540** ends in 0.

2. The "Last Digits" Family (Powers of 2)

Number	Rule	Example
4	**Last 2 digits** are divisible by 4.	**312**: 12 is divisible by 4.
8	**Last 3 digits** are divisible by 8.	**3816**: 816 is divisible by 8 ($816 \div 8 = 102$).
16	**Last 4 digits** are divisible by 16.	**13264**: 3264 is divisible by 16 ($3264 \div 16 = 204$).

3. The "Chunking" Rule (For 7, 11, 13)

A powerful unified method for large numbers.

The Rule:
Form groups of **3 digits** from the right.
Subtract the sum of even-placed groups from the sum of odd-placed groups.
If the result is divisible by **7, 11, or 13**, the whole number is divisible.

For 7:

- *Standard Method:* Double the last digit and subtract from the rest.

- *Example:* **343** → $34 - (3 \times 2) = 28$.
  28 is divisible by 7.

For 11:

- *Standard Method:* Difference between the sum of digits in **odd** and **even** places must be 0 or a multiple of 11.
- *Example:* **1331** → $(1 + 3) - (3 + 1) = 4 - 4 = 0$.

For 13:

- *Standard Method:* Multiply last digit by **4** and add to the rest.
- *Example:* **169** → $16 + (9 \times 4) = 16 + 36 = 52$.
  52 is divisible by 13.

4. Composite Number Rules (Factor Methods)

Number	Components	Rule	Example: 420
12	3 and 4	Divisible by **3** AND **4**.	$4 + 2 + 0 = 6$ (div by 3). Ends in 20 (div by 4). Yes.
14	2 and 7	Divisible by **2** AND **7**.	Even. For 7: $42 - 0 = 42$. Yes.
15	3 and 5	Divisible by **3** AND **5**.	$4 + 2 + 0 = 6$ (div by 3). Ends in 0. Yes.
18	2 and 9	Divisible by **2** AND **9**.	Even. $4 + 2 + 0 = 6$ (not div by 9). **No.**
20	10 and 2	Ends in **0** AND tens digit **even**.	**420** → ends in 0, tens digit 2 is even. Yes.

5. Special Prime Rules (17 and 19)

These use "osculation" techniques like 7 and 13.

osculation is a Vedic-maths method,

Simple idea (for divisibility)

For certain divisors (like 7, 13, 17, 19, etc.), you:

1. Take the **last digit** of the number.
2. Multiply it by a **fixed small number** (called the *osculator*).
3. **Add or subtract** this from the remaining part of the number.
4. Repeat until you get a small number that's easy to check.

If that final small number is divisible by the divisor, the original big number is also divisible.

Example for 19 (osculator = 2, add):

- Check 361:
  Last digit = 1 → $1 \times 2 = 2$
  Remaining = 36 → $36 + 2 = 38$
  38 is divisible by 19 → so 361 is divisible by 19.

17 (Negative Osculator 5)

Multiply last digit by 5 and subtract from the rest.

Example: **289**

1. Last digit: 9 → $9 \times 5 = 45$
2. Subtract: $28 - 45 = -17$
3. 17 is divisible by 17 → ✓

19 (Positive Osculator 2)

Multiply last digit by 2 and add to the rest.

Example: **361**

1. Last digit: 1 → $1 \times 2 = 2$
2. Add: $36 + 2 = 38$
3. 38 is divisible by 19 → ✓ (19×2)

Prime Numbers vs. Composite Numbers

The distinction between Prime and Composite numbers is fundamental to arithmetic. It tells us whether a number is a "basic building block" or "made up of other numbers."

1. Prime Numbers ($\mathbb{P}$)

Definition: A natural number greater than 1 that has **exactly two** factors: 1 and itself.

- It cannot be divided by any other number completely.
- *Analogy:* Think of prime numbers as "atoms" in math—they cannot be broken down any further.

Examples:

- **2**: The smallest prime number (factors: 1, 2).
- **13**: (factors: 1, 13).

- **29**: (factors: 1, 29).

Key Properties:

- **The Number 1:** 1 is **NOT** a prime number because it has only *one* factor (1 itself). It breaks the "exactly two factors" rule.
- **Even Primes: 2** is the **only** even prime number. All other prime numbers are odd.
- **Smallest Odd Prime:** 3.
- **Co-Primes:** Any two prime numbers are always co-prime to each other (their Highest Common Factor is 1).

2. Composite Numbers

Definition: A natural number greater than 1 that has **more than two** factors.

- These numbers can be "built" by multiplying smaller numbers together.

Examples:

- **4**: Factors are 1, 2, 4 (3 factors).
- **6**: Factors are 1, 2, 3, 6 (4 factors).
- **15**: Factors are 1, 3, 5, 15.

Key Exam Properties:

- **Smallest Composite Number: 4**.
- **Smallest Odd Composite Number: 9**.
- **Fundamental Theorem of Arithmetic:**
  Every composite number can be written as a unique product of prime numbers.
  Example:
  $12 = 2 \times 2 \times 3$

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3. Comparison Table (Summary)

Feature	Prime Number	Composite Number
Factors	Exactly 2 (1 and itself)	More than 2
Smallest Number	2	4
Examples	2, 3, 5, 7, 11, 13	4, 6, 8, 9, 10, 12
Parity	All are odd (except 2)	Can be even or odd
Status of 1	1 is NEITHER prime NOR composite.	

4. How to Check if a Number is Prime (Step-by-Step)

For a large number N, follow these steps instead of checking every number:

1. Find the approximate square root of N ($\sqrt{N}$).
2. List all prime numbers smaller than $\sqrt{N}$.
3. Check divisibility **only** with these primes.
4. If none divide N, then N is Prime.

Example: Is 103 Prime?

1. $\sqrt{103} \approx 10.1$ (since $10^2 = 100$).
2. Primes less than 10: **2, 3, 5, 7**.
3. Test divisibility:
   - **2?** No (odd number).
   - **3?** No ($1 + 0 + 3 = 4$, not divisible by 3).
   - **5?** No (doesn't end in 0 or 5).
   - **7?** No ($103 \div 7 = 14$ rem 5).
4. Final verdict: **103 is Prime**.

Prime Factorization

Definition:
Prime Factorization is the process of breaking down a composite number into a product of its **prime factors**.

- Think of it as finding the "DNA" of a number.
- The result is unique for every number (except for the order of factors).

Prime Factors:
The factors of a number that are also prime numbers.

- *Example for 12:* The factors are 1, 2, 3, 4, 6, 12. The **Prime Factors** are just **2** and **3**.

Methods to Find Prime Factorization

There are two standard methods used in exams.

1. Division Method (Ladder Method)

Best for large numbers and written exams.

- **Steps:**

1. Divide the number by the smallest prime number (2, 3, 5...) that divides it completely.
2. Take the quotient and divide it again by the smallest possible prime.
3. Repeat until the quotient becomes **1**.
4. Multiply all the divisors to get the prime factorization.

- **Example: Factorize 72**
  - $72 \div 2 = 36$
  - $36 \div 2 = 18$
  - $18 \div 2 = 9$
  - $9 \div 3 = 3$
  - $3 \div 3 = 1$
  - **Result:**
    $72 = 2 \times 2 \times 2 \times 3 \times 3 = 2^3 \times 3^2$

2. Factor Tree Method

Best for visual learners and smaller numbers.

- **Steps:**
  1. Write the number at the top.
  2. Split it into any two factors (branches).
  3. If a factor is composite, split it further.
  4. Circle the prime numbers — stop when all ends are prime.
- **Example: Factorize 48**
  - **48** splits into **8** × **6**
    - **8** → **4** × **2** (Circle 2)
      - **4** → **2** × **2** (Circle both)
    - **6** → **2** × **3** (Circle both)
  - **Result:**
    $48 = 2 \times 2 \times 2 \times 2 \times 3 = 2^4 \times 3$

Important Exam Notes

- **Exponents:** Always write the final answer using powers if a factor repeats.
  Correct: $2^3 \times 5^2$
  Less standard: $2 \times 2 \times 2 \times 5 \times 5$

- **Order Doesn't Matter:**
  $2 \times 3 \times 5$ is the same as $5 \times 2 \times 3$.

- **Uses:**
  Prime factorization is the fastest way to find **LCM** and **HCF (GCD)** of numbers.

Practice Examples

Number	Calculation	Prime Factorization
30	$30 \div 2 = 15 \rightarrow 15 \div 3 = 5 \rightarrow 5 \div 5 = 1$	$2 \times 3 \times 5$
36	$36 \div 2 = 18 \rightarrow 18 \div 2 = 9 \rightarrow 9 \div 3 = 3 \ldots$	$2^2 \times 3^2$
100	$100 \div 2 = 50 \rightarrow 50 \div 2 = 25 \rightarrow 25 \div 5 = 5 \ldots$	$2^2 \times 5^2$

Co-prime Numbers (or Relatively Prime Numbers)

1. Definition

Co-prime numbers are a set of two numbers that have **only one common factor**, which is **1**.

- This means their Highest Common Factor (HCF) or Greatest Common Divisor (GCD) is exactly **1**.
- **Important:** The numbers themselves **do not** have to be prime. They just need to be "prime to each other".

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2. How to Check if Numbers are Co-prime?

To check if A and B are co-prime, find the factors of both. If the only number appearing in both lists is **1**, they are co-prime.

Example 1: 8 and 15 (Classic exam example)

- Factors of **8**: **1**, 2, 4, 8
- Factors of **15**: **1**, 3, 5, 15
- **Common Factor**: Only **1**
- **Result:** 8 and 15 are **Co-prime** (even though both are composite numbers).

Example 2: 12 and 18

- Factors of **12**: **1**, **2**, **3**, 4, 6, 12
- Factors of **18**: **1**, **2**, **3**, 6, 9, 18
- **Common Factors**: 1, 2, 3, 6
- **Result:** NOT Co-prime (they share more than just 1).

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3. Key Exam Properties and Tricks

These appear frequently in MCQs and True/False questions.

1. **Consecutive Numbers:** Any two consecutive integers are **always** co-prime. *Examples:* (5, 6), (24, 25), (99, 100)
2. **Two Prime Numbers:** Any two prime numbers are **always** co-prime. *Examples:* (3, 5), (11, 13), (17, 23)
3. **Prime and Composite:** A prime number and a composite number *can* be co-prime if the composite number is **not** a multiple of the prime.
   Examples: (7, 16) → co-prime
   (7, 21) → not co-prime
4. **One is Universal:** The number **1** is co-prime to every other number. *Examples:* (1, 100), (1, 5)

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4. Summary Table

Pair	Co-prime?	Reason
(4, 9)	**Yes**	Factors {1,2,4} and {1,3,9}; only common factor is 1.
(6, 8)	**No**	Both are even (share factor 2).
(17, 18)	**Yes**	Consecutive numbers.
(1, 1000)	**Yes**	1 is co-prime to all numbers.
(13, 39)	**No**	$39 = 13 \times 3$ → common factor 13.

Here are detailed notes on LCM and HCF, structured for easy understanding and exam preparation.

1. Concept Definition

HCF (Highest Common Factor)

- **Also known as:** GCD (Greatest Common Divisor) or GCM (Greatest Common Measure).
- **Definition:** The largest number that divides two or more numbers **exactly** (without remainder).
- **Key Concept:** It is a **factor**, so the answer will always be **equal to or smaller** than the smallest number in the set.
  Analogy: The biggest measuring cup that can measure out both quantities exactly.

LCM (Least Common Multiple)

- **Definition:** The smallest number that is a **multiple** of two or more numbers.
- **Key Concept:** It is a **multiple**, so the answer will always be **equal to or larger** than the largest number in the set.
  Analogy: The first time two events happening at different intervals occur together (bells ringing, lights blinking, etc.)

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2. Comparison Table

Feature	HCF (Highest Common Factor)	LCM (Least Common Multiple)
What is it?	Largest divisor common to all numbers	Smallest number divisible by all numbers
Result Size	Small ($\leq$ smallest number)	Large ($\geq$ largest number)
Prime Factors Rule	Product of **lowest** powers of common primes	Product of **highest** powers of all primes
Real-world Keyword	"Maximum," "Largest," "Divide," "Cut"	"Minimum," "Smallest," "Together," "Simultaneous"
Example (4, 6)	**2** (Common factors: 1, **2**)	**12** (Smallest common multiple)

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3. Methods to Calculate (With Examples)

Method A: Prime Factorization (Best for Exams)

Steps:

1. Find prime factors of all numbers.
2. **HCF** = product of common primes with **lowest powers**.
3. **LCM** = product of all primes with **highest powers**.

Example: Find HCF and LCM of 12 and 18.

- $12 = 2^2 \times 3^1$
- $18 = 2^1 \times 3^2$

HCF:
Lowest powers: 2^1 and 3^1
Result:
$\text{HCF} = 2 \times 3 = \mathbf{6}$

LCM:
Highest powers: 2^2 and 3^2
$\text{LCM} = 4 \times 9 = \mathbf{36}$

Method B: Division Method (Euclid's Algorithm – Best for Large Numbers)

HCF Steps:

1. Divide the larger number by the smaller one.
2. Replace the larger number with the smaller and the smaller with the remainder.
3. Repeat until remainder = 0.
4. The last non-zero remainder is the HCF.

Example: HCF of 24 and 36

1. $36 \div 24 \rightarrow$ remainder = 12
2. $24 \div 12 \rightarrow$ remainder = 0
3. Last divisor = **12**
   HCF = 12

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4. Golden Formula (Huge Exam Trick)

For any two numbers A and B:

$$A \times B = \text{HCF}(A, B) \times \text{LCM}(A, B)$$

Important: Works **only for 2 numbers**, not for 3 or more.

Example:

HCF of two numbers = 5
Product of numbers = 150
Find LCM.

$150 = 5 \times \text{LCM}$
$\text{LCM} = \frac{150}{5} = 30$

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5. Tips, Tricks & Word Problem Keywords

1. Co-prime Shortcut

If numbers are co-prime:

- **HCF = 1**
- **LCM = product of numbers**
  Example: $8 \times 9 = 72$

2. Multiples Trick

If one number is a multiple of the other (like 5 and 20):

- **HCF = smaller number**
- **LCM = larger number**

3. Word Problem Clues

Use **LCM** when the question uses words like:

- "When will they meet again?"
- "Repeat together"
- "Smallest number divisible by…"

Use **HCF** when the question has:

- "Maximum possible groups"
- "Largest size"
- "Cut into equal parts"

The Master Trick: "The Difference Method"

Instead of dividing or factorizing, you simply use **subtraction**.

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1. HCF of 2 Numbers

Trick Rule

The HCF of two numbers is always equal to their **Difference** or a **factor of that Difference**.

Steps:

1. Subtract the smaller number from the larger one.
2. Check if the **Difference divides both** original numbers.
   - If **YES** → That difference is the HCF.
   - If **NO** → Find the **factors** of the difference.
     The **largest factor** that divides both numbers is the HCF.

Example A (Direct Difference): HCF of 12 and 18

1. Difference: $18 - 12 = 6$
2. Check 6:
   - $12 \div 6 = 2$ → Yes
   - $18 \div 6 = 3$ → Yes
3. **HCF = 6**

Example B (Factor of Difference): HCF of 48 and 60

1. Difference: $60 - 48 = 12$
2. Check 12:
   - $48 \div 12 = 4$ → Yes
   - $60 \div 12 = 5$ → Yes
3. **HCF = 12**

Example C (Harder): HCF of 26 and 34

1. Difference: $34 - 26 = 8$
2. Check 8 → Does NOT divide 26
3. Factors of 8: **8, 4, 2, 1**
   - Try 4 → No
   - Try 2 →
     - $26 \div 2$ → Yes
     - $34 \div 2$ → Yes
4. **HCF = 2**

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2. HCF of 3 Numbers (or More)

Trick Rule

Find the **smallest difference** between any two numbers in the set.
The HCF will be either **that difference** or a **factor** of it.

Steps:

1. Pick the pair of numbers that are **closest** to each other.
2. Find their **difference**.
3. Check if this difference divides **all** numbers.
   - If **YES** → That is the HCF.

- If **NO** → Test the **factors** of the difference (largest to smallest).

Example 1: HCF of 30, 42, 135

1. Closest pair → 30 and 42
2. Difference: $42 - 30 = 12$
3. Check 12 → Does NOT divide 30
4. Factors of 12: **12, 6, 4, 3, 2, 1**
   - Try 6 →
     - $30 \div 6$ → Yes
     - $42 \div 6$ → Yes
     - $135 \div 6$ → No
   - Try 4 → No (135 is odd)
   - Try 3 →
     - $30 \div 3$ → Yes
     - $42 \div 3$ → Yes
     - $135 \div 3$ → Yes ($1 + 3 + 5 = 9$ → divisible by 3)
5. **HCF = 3**

Example 2: HCF of 36, 48, 72

1. Closest difference:
   - $48 - 36 = 12$
   - $72 - 48 = 24$ → Smallest difference = **12**
2. Check 12:
   - $36 \div 12$ → Yes
   - $48 \div 12$ → Yes
   - $72 \div 12$ → Yes
3. **HCF = 12**

Summary of Trick

1. **Calculate the Difference** (smallest gap between any two numbers).
2. **Test the Difference** (does it divide all numbers?).
3. **If NO**, test its **factors**, starting from the **largest**.

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6. Practice Question

Q: Three bells ring at intervals of 12, 15, and 20 minutes. If they rang together at 9:00 AM, when will they ring together again?

Solution:

Step 1: Use LCM (because it's a repeat cycle).
Prime factorize:

- $12 = 2^2 \times 3$
- $15 = 3 \times 5$
- $20 = 2^2 \times 5$

Step 2: Take highest powers:
$\text{LCM} = 2^2 \times 3^1 \times 5^1 = 4 \times 3 \times 5 = 60$

They ring together every **60 minutes**.

Final Answer:
$9:00\ \text{AM} + 1\ \text{hour} = \mathbf{10:00\ AM}$

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1. Multiplication of Two-Digit Numbers

Let's multiply **23 by 14**.

Method 1: Traditional Method (Standard School Method)

1. **Multiply by the Ones Digit:**
   Multiply the top number (23) by the ones digit of the bottom number (4).
   - $23 \times 4 = 92$
2. **Multiply by the Tens Digit:**
   Multiply 23 by the tens digit (1). Place a zero as placeholder.
   - $23 \times 10 = 230$
3. **Add the Results:**
   - $92 + 230 = 322$

Visual Layout:

```
23
x 14
----
92   ⟵ (23 × 4)
x 230   ⟵ (23 × 1) with a 0 placeholder
---
322
```

Method 2: Vedic Maths Trick (Vertical & Crosswise)

Let the numbers be $AB \times CD$ (i.e., 23×14).

1. **Step 1: Vertical (Right)**
   - Multiply rightmost digits: $3 \times 4 = 12$
   - Write **2**, carry **1**
2. **Step 2: Crosswise**
   - Inner + outer: $(2 \times 4) + (3 \times 1) = 8 + 3 = 11$
   - Add carry: $11 + 1 = 12$
   - Write **2**, carry **1**
3. **Step 3: Vertical (Left)**
   - Multiply leftmost digits: $2 \times 1 = 2$
   - Add carry: $2 + 1 = 3$

Final Answer: $\boxed{322}$

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2. Multiplication of Three-Digit Numbers

Let's multiply **123 by 456**.

Method 1: Traditional Method

1. **Ones place:**
   $123 \times 6 = 738$
2. **Tens place:**
   $123 \times 50 = 6150$
3. **Hundreds place:**
   $123 \times 400 = 49200$
4. **Add all results:**

```
738
6150
+49200
------
56088
```

Method 2: Vedic Maths Trick (Vertical & Crosswise)

Let the numbers be $ABC \times DEF$ (i.e., 123×456).

- **Step 1 (Right):**
  $3 \times 6 = 18 \rightarrow$ write **8**, carry **1**
- **Step 2 (Crosswise – Right 2):**
  $(2 \times 6) + (3 \times 5) + 1 = 12 + 15 + 1 = 28$
  Write **8**, carry **2**
- **Step 3 (Crosswise – All 3):**
  $(1 \times 6) + (3 \times 4) + (2 \times 5) + 2 = 6 + 12 + 10 + 2 = 30$
  Write **0**, carry **3**
- **Step 4 (Crosswise – Left 2):**
  $(1 \times 5) + (2 \times 4) + 3 = 5 + 8 + 3 = 16$
  Write **6**, carry **1**
- **Step 5 (Left):**
  $1 \times 4 + 1 = 4 + 1 = 5$
  Write **5**

Final Answer: 56088