Class 9 Maths Chapter 11: The World of Algorithms - Notes, Important Questions and MCQs (2026-27)

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These Class 9 Maths Chapter 11 notes (Part II, Chapter 11) cover “The World of Algorithms” from the new NCERT textbook Ganita Manjari (Part II, 2026-27): what an algorithm is, digit-by-digit addition, algorithms for the greatest common divisor (GCD), data structures like lists, analysing efficiency, Euclid’s subtraction algorithm and Āryabhaṭa’s division algorithm – with traced examples, tables, Q&A, 10 MCQs and a free PDF.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

Table of Contents

- Chapter Overview
- Important Topics and Concepts
- Traced Examples
- Comparing GCD Algorithms
- Important Terms and Formulas
- Short Answer Questions
- Long Answer Questions
- MCQs with Answers
- Quick Revision Points
- Chapter Summary
- Exam Tips and PYQ Pattern
- Frequently Asked Questions
- Conclusion

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Chapter Overview

An algorithm is a systematic, step-by-step procedure to solve a problem. Everyday school methods – adding numbers column by column, long division – are algorithms. Algorithms use basic steps we know how to do, may repeat steps and may include conditions (“do this only if…”).

A good algorithm must be correct and efficient. The chapter compares several ways of finding the GCD of two numbers – from listing all divisors to Euclid’s subtraction method and Āryabhaṭa’s faster division-by-remainder method – and shows how to count the steps each one takes.

Important Topics and Concepts

What is an Algorithm?

- A finite, ordered list of clear steps that solves a problem for any valid input.
- Basic steps: operations we already know (add, compare, divide).
- Repetition: “for each j from 1 to n, check …”.
- Conditions: “add j to the list only if j divides n”.
- We must justify that the algorithm is correct and analyse how many steps it takes.

Adding Numbers Digit by Digit

- Write numbers in columns by place value.
- Add the units digits; write the units digit of the sum and carry the tens.
- Repeat for each place moving left.
- Works for any number of digits – a classic algorithm based on the Indian place-value system.

GCD by Listing Divisors

- Step 1: list all divisors of a by checking every j from 1 to a.
- Step 2: list all divisors of b similarly.
- Step 3: find common divisors and choose the greatest.
- Improvement: check divisors of both numbers together, only up to the smaller number, and use lists (data structures) to store intermediate results.
- This method is slow for large numbers – the number of steps grows with the size of the numbers.

Euclid’s Subtraction Algorithm

- Key fact: gcd(a, b) = gcd(a – b, b) when a > b.
- Repeatedly subtract the smaller number from the larger until both are equal; that number is the GCD.
- Recorded by Euclid in his book Elements.
- Example: gcd(48, 18) → (30, 18) → (12, 18) → (12, 6) → (6, 6) → 6.

Āryabhaṭa’s Division Algorithm

- Repeated subtraction of b from a leaves the remainder of a ÷ b – so replace subtraction with division.
- gcd(a, b) = gcd(b, r), where r is the remainder when a is divided by b.
- Stop when the remainder is 0; the last non-zero divisor is the GCD.
- Described in Āryabhaṭa’s Āryabhaṭīya (499 CE) using place-value long division.
- Much faster: the number of steps depends on the number of digits, not the size of the numbers.

Traced Examples

Step-by-step.

- Euclid’s subtraction for gcd(35, 15): (35,15) → (20,15) → (5,15) → (5,10) → (5,5) → GCD 5.
- Division method for gcd(252, 105): 252 = 2×105 + 42; 105 = 2×42 + 21; 42 = 2×21 + 0 → GCD 21.

- Division method for gcd(1071, 462): 1071 = 2×462 + 147; 462 = 3×147 + 21; 147 = 7×21 + 0 → GCD 21.
- Listing method for gcd(12, 18): divisors of 12 {1,2,3,4,6,12}, of 18 {1,2,3,6,9,18}; common max = 6.
- Steps comparison for gcd(99, 2): subtraction needs about 49 subtractions; division needs 2 steps (99 = 49×2 + 1; 2 = 2×1 + 0).

Comparing GCD Algorithms

Method	Idea	Speed
Listing divisors	Check every number up to a and b	Slow for large numbers
Improved listing	Check together up to smaller number	Faster, still slow
Euclid's subtraction	gcd(a, b) = gcd(a – b, b)	Can be slow if numbers differ a lot
Āryabhaṭa's division	gcd(a, b) = gcd(b, a mod b)	Very fast – grows with number of digits

Important Terms and Formulas

Term	Meaning
Algorithm	Systematic step-by-step procedure
Input	Data given to an algorithm
Output	Result produced
Loop / repetition	Repeating a step several times
Condition	Step done only if a test is true
Data structure	Way of storing data, e.g. a list
GCD	Greatest common divisor of two numbers
Euclid's rule	gcd(a, b) = gcd(a – b, b)
Division rule	gcd(a, b) = gcd(b, r)
Efficiency	How many steps an algorithm needs

Short Answer Questions

Q1. What is an algorithm?

A systematic step-by-step procedure to solve a problem.

Q2. Name three features of algorithms.

Basic steps, repetition and conditional steps.

Q3. Why is digit-by-digit addition an algorithm?

It follows fixed steps (add column, carry) that work for any numbers.

Q4. State the key idea of Euclid's algorithm.

gcd(a, b) = gcd(a – b, b) for a > b.

Q5. How does Āryabhaṭa's method improve Euclid's?

Q6. Find gcd(84, 36) by division.

84 = 2×36 + 12; 36 = 3×12 + 0 → 12.

Q7. Why must we justify an algorithm?

To ensure it always gives the correct answer.

Q8. What does analysing an algorithm mean?

Counting how many steps it takes as the input grows.

Long Answer Questions

Q1. Find gcd(391, 323) using the division algorithm and explain each step.

391 = 1×323 + 68.

323 = 4×68 + 51.

68 = 1×51 + 17.

51 = 3×17 + 0.

Last non-zero remainder 17 is the GCD.

Q2. Why does Euclid’s subtraction algorithm work?

Any common divisor d of a and b divides a – b.

Any common divisor of a – b and b also divides a = (a – b) + b.

So the pairs (a, b) and (a – b, b) have the same common divisors.

Hence gcd(a, b) = gcd(a – b, b).

Numbers keep decreasing, so the process ends with equal numbers – the GCD.

Q3. Compare the efficiency of the listing method and Āryabhaṭa’s method.

Listing checks every number up to a and b – steps grow with the numbers themselves.

For numbers near 1,000,000 this means about a million checks.

Division method reduces numbers quickly via remainders.

Its steps grow roughly with the number of digits.

So the division method is far more efficient.

MCQs with Answers

1. An algorithm is(a) a guess (b) a step-by-step procedure (c) a graph (d) a formula onlyAnswer: (b) a step-by-step procedure

2. gcd(48, 18) is(a) 3 (b) 6 (c) 9 (d) 12Answer: (b) 6

3. Euclid’s algorithm is based on(a) gcd(a,b) = gcd(a+b,b) (b) gcd(a,b) = gcd(a–b,b) (c) gcd(a,b) = ab (d) lcmAnswer: (b) gcd(a,b) = gcd(a–b,b)

4. Āryabhaṭīya was written in(a) 499 CE (b) 628 CE (c) 300 BCE (d) 1200 CEAnswer: (a) 499 CE

5. In the division method we stop when remainder is(a) 1 (b) 0 (c) equal to divisor (d)

6. gcd(252, 105)(a) 7 (b) 21 (c) 35 (d) 42Answer: (b) 21

7. A step done only if a test is true is(a) loop (b) condition (c) input (d) outputAnswer: (b) condition

8. A list used to store divisors is a(a) data structure (b) theorem (c) proposition (d) graphAnswer: (a) data structure

9. Fastest GCD method among these(a) listing divisors (b) improved listing (c) Euclid's subtraction (d) division by remainderAnswer: (d) division by remainder

10. Euclid wrote his algorithm in(a) Āryabhaṭīya (b) Elements (c) Lilavati (d) SulbasutraAnswer: (b) Elements

Quick Revision Points

- Algorithm: basic steps, repetition, conditions; correctness and efficiency.
- Digit-by-digit addition with carry.
- GCD by listing divisors (slow).
- Euclid: gcd(a, b) = gcd(a – b, b).
- Āryabhaṭa: gcd(a, b) = gcd(b, r); stop at r = 0.
- Count steps to compare algorithms.

Chapter Summary

An algorithm is a systematic procedure made of basic, repeated and conditional steps. Familiar methods like column addition are algorithms, and every algorithm must be shown to be correct and analysed for efficiency.

The GCD can be found by listing divisors, but Euclid's subtraction algorithm – gcd(a, b) = gcd(a – b, b) – and especially Āryabhaṭa's division method – gcd(a, b) = gcd(b, remainder) – are far more efficient, needing steps that grow only with the number of digits.

Exam Tips and PYQ Pattern

- Write each division step on a new line.
- Underline the last non-zero remainder.
- Explain why an algorithm works, not just how.
- Compare step counts when asked about efficiency.
- Practise tracing algorithms on small numbers.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the new NCERT Class 9 Maths textbook "Ganita Manjari" (Part II), prescribed for the 2026-27 session.

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A method for the GCD using gcd(a, b) = gcd(a – b, b), repeated until both numbers are equal.

How is Āryabhaṭa’s method different?

It uses division with remainder, gcd(a, b) = gcd(b, r), which is much faster.

Conclusion

The World of Algorithms shows how mathematicians design efficient procedures. Learn the comparison table, trace the examples here and save the free PDF for revision.

More Notes: Class 9 Maths Chapter 10: How Quantities Combine: Understanding Data notes | Class 9 Maths Chapter 12: Quadrilaterals notes | All Class 9 Maths notes

Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE mathematics educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 9 Maths textbook, Ganita Manjari (Parts I and II, first edition 2026, NCF-SE 2023), and the CBSE syllabus for the 2026-27 session. Last checked on 24 November 2026.