Mathematics — Ganita Manjari

Chapter 11 Test 8

The World of Algorithms

Class IX | 2026–27

Time Allowed: 45 Minutes | Maximum Marks: 25

General Instructions

1. All 13 questions are compulsory. Choose one option in A; show working in B–D.
2. No calculators. Give exact answers unless an approximation is requested.
3. Unless stated otherwise, inputs are positive integers. Give precise algorithm steps.

SECTION A

(5 questions × 1 mark = 5 marks)

1. A positive integer is prime precisely when it has how many distinct positive divisors?

(A) 1 (B) 2

(C) 3 (D) Any even number

2. Which list of (prime, exponent) pairs represents 180?

(A) [(2, 1), (3, 1), (5, 1)] (B) [(2, 3), (3, 2)]

(C) [(2, 2), (3, 2), (5, 1)] (D) [(2, 2), (3, 1), (5, 2)]

3. If $m = 2^4 \times 3$ and $n = 2^2 \times 3^3$, then $gcd(m, n)$ equals:

(A) 12 (B) 48

(C) 108 (D) 432

4. When comparing prime factorisations, the exponent of a prime absent from one input is treated as:

(A) 1 (B) The prime itself

(C) The other exponent (D) 0

5. A factorisation routine divides 40 by 2 once and leaves 20. What should it do next to retain all copies of the factor 2?

(A) Immediately move to 3

(B) Test 2 again

(C) Return only [2]

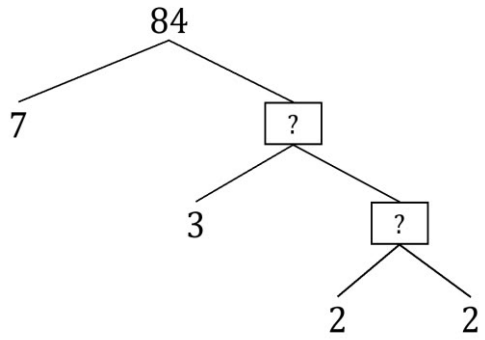
(D) Declare 20 prime

SECTION B

(4 questions × 2 marks = 8 marks)

6. For 72, distinguish the list of distinct prime divisors from the list of prime factors with repetitions. Show that only the second list reconstructs 72 by multiplication.

7. Complete the two blank nodes in figure, then write the prime factorisation of 84.



8. A routine declares every odd integer greater than 1 prime. Give a counterexample less than 20 and show why it is rejected by a divisor test.

9. To test whether 23 is prime, examine integers $j \geq 2$ only while $j^2 \leq 23$. List the tested candidates and give the conclusion.

SECTION C

(3 questions × 3 marks = 9 marks)

10. Describe an algorithm $prime(n)$ for an integer $n \geq 1$ using its divisor list. Specify the output for $n = 1$, and justify the decision rule.

11. Write an algorithm to produce the prime factors of $n \geq 2$, including repetitions, by trial division. Explain when to move to the next trial divisor.

12. Explain why the GCD algorithm based on prime factorisations selects the smaller exponent of each prime. Why does the larger exponent generally fail?

SECTION D

(1 application question × 3 marks = 3 marks)

13. An archive stores 420 as the distinct-prime list [2, 3, 5, 7] and reconstructs a number by multiplying its entries. What goes wrong? Replace the record by (prime, exponent) pairs that reconstruct 420 exactly.