Q1. Check if a Number is Power of 2

Problem:
Write a function to check whether a given number is a power of 2 using bit manipulation.

Example:
Input: 16
Output: true

Input: 18
Output: false

Focus:
- n & (n - 1) trick
- Binary representation thinking
- O(1) solution

Q2. Count Set Bits

Problem:
Write a function to count the number of 1s in the binary representation of a number.

Example:
Input: 13
Output: 3
(13 → 1101)

Focus:
- Right shift operator
- n & 1 check
- Brian Kernighan's Algorithm

Q3. Find Unique Element

Problem:
In an array where every element appears twice except one, find the unique element.

Example:
Input: [4, 1, 2, 1, 2]
Output: 4

Focus:
- XOR properties
- a ^ a = 0
- O(n) time, O(1) space

Q4. Generate All Subsets using Bit Masking

Problem:
Given an array of n elements, generate all possible subsets using bit masking.

Example:
Input: [1, 2]
Output:
[]
[1]
[2]
[1,2]

Focus:
- 2^n subsets
- Bit representation of numbers from 0 to (2^n - 1)
- Mask checking

Q5. Merge Two Sorted Arrays

Problem:
Write a function to merge two sorted arrays into one sorted array.

Example:
Input:
[1, 3, 5]
[2, 4, 6]

Output:
[1, 2, 3, 4, 5, 6]

Focus:
- Two pointer technique
- Stability of Merge Sort
- O(n) merging logic

Q6. Implement Merge Sort

Problem:
Implement Merge Sort to sort an array.

Example:
Input: [5, 2, 4, 1]
Output: [1, 2, 4, 5]

Focus:
- Divide array into halves
- Recursion
- Time Complexity: O(n log n)
- Space Complexity: O(n)

Q7. Implement Quick Sort

Problem:
Implement Quick Sort to sort an array using partition logic.

Example:
Input: [10, 7, 8, 9, 1, 5]
Output: [1, 5, 7, 8, 9, 10]

Focus:
- Pivot selection
- Partition algorithm
- Average: O(n log n)
- Worst Case: $O(n^2)$

Q8. Kth Smallest Element using Quick Sort Partition

Problem:
Find the kth smallest element in an array using Quick Select (partition logic).

Example:
Input: [7, 10, 4, 3, 20, 15], k = 3
Output: 7

Focus:
- Partition logic reuse
- Quick Select
- Average O(n)

Q9. Count Inversions in an Array

Problem:
Count the number of inversions in an array.

Example:
Input: [2, 4, 1, 3, 5]
Output: 3

Focus:
- Modified merge step
- Counting during merge
- O(n log n) solution

Q10. Check if Two Numbers Differ by Exactly One Bit

Problem:
Write a function to check if two numbers differ by exactly one bit.

Example:
Input: a = 5, b = 4
Binary: 101, 100
Output: true

Focus:
- XOR usage
- Count set bits in (a ^ b)
- Bit difference logic