Day 4: Learning Summary & Detailed Notes

1. Aptitude: Speed, Time & Distance

The relationship between distance, speed, and time is the foundation of kinematics and motion-based aptitude problems.

Core Formula

$$\text{Distance} = \text{Speed} \times \text{Time}$$

Key Conversions

- **km/hr to m/s:** Multiply by $\frac{5}{18}$
- **m/s to km/hr:** Multiply by $\frac{18}{5}$

Concepts to Remember

- **Average Speed:** For a journey with different speeds, $\text{Avg Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$.
  - *Special Case:* If distances are equal, $\text{Avg Speed} = \frac{2xy}{x+y}$ (where x and y are the two speeds).
- **Relative Speed:**
  - Same direction: $S_1 - S_2$
  - Opposite direction: $S_1 + S_2$

2. Programming: Count Vowels in a String

Counting vowels is a fundamental exercise in string manipulation that tests your ability to handle character encoding and iterative logic.

Detailed Logic

1. **Normalization:** Start by converting the input string to a uniform case (usually lowercase). This simplifies the conditional check from 10 possibilities (`A, E, I, O, U, a, e, i, o, u`) to just 5.
2. **Storage:** Use a string or a set (e.g., `vowels = "aeiou"`) to store target characters for efficient lookup.
3. **Iteration:** Use a loop to visit every index of the string.
4. **Comparison:** For every character `c` , check if `c` exists in your `vowels` storage.

3. Python Concept: Loops (`for` & `while`)

Python loops are designed for readability and "Pythonic" iteration over objects.

The `for` Loop (Iterator-based)

Unlike C/C++, Python's `for` loop is actually a "for-each" loop. It traverses any iterable object (like a list or a range).

- `range(start, stop, step)` : Generates a sequence. `range(1, 10, 2)` gives `1, 3, 5, 7, 9` .
- **Else clause**: Python loops can have an `else` block that executes only if the loop completed naturally (without hitting a `break`).

The `while` Loop (Condition-based)

Used when you don't know how many times the code should run, but you know when it should stop.

- **Infinite Loops:** Occur if the condition never becomes `False` . Always ensure the variables within the condition are updated inside the loop body.

4. C/C++ Concept: Loop Constructs

C++ loops provide high performance and low-level control over memory and pointers during iteration.

Comparison Table

Loop Type	Characteristics	Use Case
`for`	Initialization, condition, and update are in one line.	When the range is fixed (e.g., arrays).
`while`	Only the condition is checked at the start.	When the end-point depends on user input or a flag.
`do-while`	**Exit-controlled.** The body runs before the condition is checked.	Menu-driven programs where the menu must show once.

The `break` and `continue` keywords

- `break` : Immediately terminates the loop and jumps to the code following the loop.
- `continue` : Skips the remaining code in the current iteration and jumps to the next update/check.

5. SQL: INSERT Operations

The `INSERT` statement is the "C" (Create) in CRUD operations, allowing you to persist data in a database.

Technical Nuances

- **NULL Values:** If a column allows NULLs and you omit it from the `INSERT` list, SQL automatically inserts `NULL`.
- **Identity/Auto-Increment:** You usually do not provide values for Primary Key columns marked as `AUTO_INCREMENT`; the database generates them for you.
- **Data Types:** Strings and Dates must be enclosed in single quotes (`'`), while numbers are not.

Security Note: SQL Injection

In real-world applications, never concatenate user input directly into an `INSERT` string. Always use **Parameterized Queries** or **Prepared Statements** to prevent hackers from executing malicious commands.

6. Practice Questions

Aptitude: Speed, Time & Distance

1. **Basic Conversion:** A car travels at a speed of 108 km/hr. What is its speed in meters per second?
2. **Average Speed:** A man covers half of his journey at 40 km/hr and the remaining half at 60 km/hr. What is his average speed for the entire journey?
3. **Train Problem:** A train 150 meters long passes a pole in 15 seconds. What is the speed of the train in km/hr?
4. **Relative Speed:** Two trains, 100m and 120m long, are running in opposite directions with speeds of 36 km/hr and 54 km/hr respectively. In how much time will they pass each other?
5. **SQL Scenario:** You have a table `Employees` with columns `EmpID`, `Name`, and `Salary`. Write a query to add a user named "John Doe" with a salary of 50000.
6. **SQL Syntax:** How do you insert a record into a table if one of the values contains a single quote (e.g., Name = "O'Reilly")?
7. **C++ Loop Logic:** Convert a `for` loop that prints numbers 1 to 10 into a `do-while` loop.
8. **C++ Trace:** What is the output of a `for(int i=0; i<5; i++)` loop if you call `continue` when `i == 3`?
9. **Python/Logic:** Write a function that not only counts vowels but also returns a new string where all vowels are replaced with the character `*`.
10. How does your vowel counting program handle a string full of numbers or special characters?