GENERAL

sql query interview questions and answers

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Introduction

When you're preparing for a role that requires database proficiency, the first line of defense is usually a set of SQL interview questions. Recruiters, hiring managers, and technical interviewers rely on these questions to gauge your understanding of relational databases, query optimization, and problem solving skills. In this guide, we'll walk through a comprehensive list of SQL query interview questions and answers that cover beginner, intermediate, and advanced concepts. By studying these, you'll not only sharpen your technical knowledge but also learn how to articulate your solutions clearly during a live interview.

Why SQL Interview Questions Matter

SQL (Structured Query Language) is the lingua franca of data manipulation and retrieval. Whether you're a data analyst, a backend developer, or a database administrator, mastering SQL is essential. Interviewers use SQL questions to assess:

- Fundamental knowledge of SELECT, JOIN, GROUP BY, and sub queries.
- Ability to write efficient, readable, and maintainable code.
- Understanding of indexing, execution plans, and performance tuning.
- Problem solving skills when faced with real world data scenarios.
- Communication skills—how you explain your approach and reasoning.

Having a solid grasp of these topics will help you stand out among candidates and demonstrate that you can hit the ground running.

Basic SQL Interview Questions

1. What is SQL and what are its primary uses?

SQL is a domain specific language designed for managing relational databases. It allows you to create, read, update, and delete data (CRUD operations). Key uses include:

- Defining and manipulating database schema via DDL (CREATE, ALTER, DROP).
- Querying data with SELECT statements.
- Inserting, updating, and deleting records with INSERT, UPDATE, and DELETE.
- Managing transactions and enforcing constraints.

2. Explain the difference between INNER JOIN and LEFT JOIN.

An INNER JOIN returns only rows that have matching values in both tables. A LEFT JOIN returns all rows from the left table and matching rows from the right table; unmatched rows are filled with NULLs. Use a LEFT JOIN when you need to keep every record from the primary table, even if there's no related data.

3. What is a primary key and why is it important?

A primary key uniquely identifies each row in a table. It ensures data integrity, facilitates indexing, and is essential for establishing relationships between tables. Without a primary key, you risk duplicate rows and ambiguous references.

4. Describe the purpose of the GROUP BY clause.

The GROUP BY clause aggregates rows that share a specified column or set of columns. It's often paired with aggregate functions like COUNT, SUM, AVG, MIN, and MAX to produce summarized results.

5. What does the HAVING clause do?

HAVING filters aggregated results, analogous to WHERE but applied after GROUP BY. It allows you to restrict groups based on aggregate criteria, such as HAVING COUNT(*) > 10.

6. Explain the difference between WHERE and HAVING.

WHERE filters rows before grouping; HAVING filters groups after aggregation. Use WHERE for row level conditions and HAVING for group level conditions.

7. What is a sub query and when would you use one?

A sub query is a query nested inside another query. It's useful when you need to compute a value or filter set that depends on the results of another query. For example, selecting employees whose salaries are above the department average.

8. Define NULL in SQL and explain how it behaves in comparisons.

NULL represents missing or unknown data. Comparisons involving NULL return UNKNOWN, not TRUE or FALSE. Use IS NULL or IS NOT NULL for proper checks.

9. What is a view and why would you create one?

A view is a virtual table defined by a SELECT statement. Views encapsulate complex queries, simplify user access, enforce security by exposing only specific columns, and can be indexed (materialized views) for performance.

10. How do you ensure data integrity in a relational database?

Data integrity is maintained through:

- Primary and foreign key constraints.
- Unique, NOT NULL, CHECK, and DEFAULT constraints.
- Transaction isolation levels and ACID properties.
- Triggers and stored procedures to enforce business rules.

Intermediate SQL Interview Questions

1. Explain the difference between UNION and UNION ALL.

UNION merges two result sets and removes duplicate rows, performing an implicit DISTINCT. UNION ALL concatenates the result sets without deduplication, which is faster and preserves duplicates.

2. What are the common types of indexes, and how do they affect query performance?

Key index types include:

- Clustered: physically orders table rows based on the indexed column(s).
- Non clustered: creates a separate structure pointing to the data rows.
- Unique: enforces uniqueness and improves lookup speed.
- Composite (multi column): optimizes queries that filter on multiple columns.

Indexes speed up SELECTs and JOINs but slow down DML operations (INSERT, UPDATE, DELETE) because the index must be updated.

3. What is a composite key and when would you use it?

A composite key combines two or more columns to form a unique identifier. It's useful when a single column cannot uniquely identify a row, such as a StudentID and CourseID combination in a registration table.

4. Describe the concept of normalization. What are the normal forms?

Normalization reduces data redundancy and improves data integrity by organizing tables into logical structures:

- 1NF: eliminates repeating groups; each field contains atomic values.
- 2NF: removes partial dependencies; every non key attribute depends on the entire primary key.
- 3NF: eliminates transitive dependencies; non key attributes depend only on the primary key.
- BCNF, 4NF, 5NF: higher forms addressing more complex dependencies.

5. Explain the difference between INNER JOIN and OUTER JOIN (LEFT, RIGHT, FULL).

INNER JOIN returns only matching rows. OUTER JOINs include unmatched rows from one or both tables:

- LEFT OUTER JOIN: all rows from the left table.
- RIGHT OUTER JOIN: all rows from the right table.
- FULL OUTER JOIN: all rows from both tables, with NULLs where there's no match.

6. What is a self join and give an example?

A self join joins a table to itself to compare rows within the same table. Example: finding managers and their subordinates in an Employees table where ManagerID references EmployeeID.

7. How would you find the second highest salary in an Employees table?

Several approaches exist. One common method uses a sub query with LIMIT or TOP:

```
SELECT MAX(Salary) AS SecondHighestSalary
FROM Employees
WHERE Salary
```

8. What is a correlated sub query?

A correlated sub query references columns from the outer query, causing the sub query to execute once per outer row. It's useful for row level comparisons but can be less efficient.

9. Explain the concept of transaction isolation levels.

Isolation levels determine how transaction changes are visible to others, affecting concurrency and consistency:

- READ UNCOMMITTED: allows dirty reads.
- READ COMMITTED: prevents dirty reads.
- REPEATABLE READ: prevents non repeatable reads.
- SERIALIZABLE: full isolation, preventing phantom reads.

10. What is a deadlock and how can you prevent it?

A deadlock occurs when two or more transactions wait indefinitely for each other's locks. Prevention strategies include:

- Acquiring locks in a consistent order.
- Using the lowest possible isolation level.
- Keeping transactions short.
- Implementing timeout mechanisms.

Advanced SQL Interview Questions

1. How do you optimize a slow query?

Optimization steps:

- Analyze the execution plan to identify bottlenecks.
- Ensure proper indexing on join and filter columns.
- Rewrite sub queries as joins or CTEs if beneficial.
- Avoid SELECT *; specify needed columns.
- Use EXISTS instead of IN when appropriate.
- Consider partitioning large tables.

2. What is a common table expression (CTE) and how does it differ from a sub query?

A CTE, defined with WITH, is a temporary result set that can be referenced multiple times within a query. Unlike sub queries, CTEs improve readability and can be recursive, enabling hierarchical data processing.

3. Explain window functions and provide a practical example.

Window functions perform calculations across a set of rows related to the current row without collapsing the result set. Example: computing a running total of sales:

```
SELECT OrderID, OrderDate, Amount,
    SUM(Amount) OVER (ORDER BY OrderDate) AS RunningTotal
FROM Orders;
```

4. What are materialized views and when would you use them?

A materialized view stores the result of a query physically, refreshing it periodically. Use them when you need fast read access to complex aggregations over large datasets, such as reporting dashboards.

5. Describe the process of denormalization and its trade offs.

Denormalization intentionally introduces redundancy to reduce join complexity and improve read performance. Trade offs include increased storage, potential data anomalies, and more complex update logic.

6. How would you handle a table that grows to billions of rows?

Strategies include:

- Partitioning by date or key.
- Using columnar storage for analytical workloads.
- Implementing sharding across multiple nodes.
- Regularly archiving or purging stale data.
- Optimizing queries with proper indexing and statistics.

7. What is the difference between EXISTS and IN?

Both check for existence, but EXISTS stops scanning once it finds a match, while IN evaluates the entire list. EXISTS is generally more efficient for correlated sub queries.

8. Explain the concept of partitioning in SQL databases.

Partitioning splits a large table into smaller, more manageable pieces based on a key (range, list, or hash). It

improves query performance, simplifies maintenance, and can enhance concurrency

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