Assignment Code: DA-AG-014

Introduction to SQL and Advanced Functions | Assignment

Instructions:
Carefully read each question before attempting. Use Google Docs, Microsoft Word, or a similar tool to type out each theoretical question along with its answer. For practical questions, use **SQL Workbench** (or your designated SQL tool) to complete the required tasks. Once you have finished, save both the Word/Docs file and SQL File as PDF documents. Please ensure that you do not zip or archive the files before uploading. Submit the PDF files directly to the LMS or as instructed by your teacher. Each question carries 20 marks.

Total Marks: 200

Question 1 : Explain the fundamental differences between DDL, DML, and DQL commands in SQL. Provide one example for each type of command.

Answer:

Understanding SQL Command Categories
SQL (Structured Query Language) is divided into several sub-languages, each serving a unique purpose in the lifecycle of data and database structures.
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1. DDL: Data Definition Language
DDL is used to define, modify, and manage the **structure** or schema of the database. These commands deal with how data is stored, rather than the data itself.

- **Purpose:** To create the "blueprint" of the database.
- **Auto-Commit:** In most database systems (like MySQL), DDL operations are "auto-committed," meaning the changes are saved permanently as soon as the command is executed.
- **Key Operations:**
    - **CREATE:** Used to establish new databases, tables, or indexes.
    - **ALTER:** Used to modify the structure of an existing table (e.g., adding a column).
    - **DROP:** Used to delete an entire table or database structure.
    - **TRUNCATE:** Used to remove all records from a table while keeping the table structure intact.

Example of DDL: Creating the Categories table as required in your assignment:

```
SQL
CREATE TABLE Categories (
    CategoryID INT PRIMARY KEY,
    CategoryName VARCHAR(50) NOT NULL UNIQUE
);
```

. DML: Data Manipulation Language

DML commands are used to manage the **data within** the objects created by DDL. This is the layer where you add, change, or remove the actual information.

- **Purpose:** To interact with the records stored in the tables.
- **Transaction Control:** Unlike DDL, DML operations can often be rolled back (undone) if they are part of a transaction that hasn't been committed yet.
- **Key Operations:**
  - **INSERT:** Adds new rows of data into a table.
  - **UPDATE:** Modifies existing data within a table.
  - **DELETE:** Removes specific rows from a table based on a condition.

Example of DML: Inserting the "Electronics" category into the table:

```
SQL
INSERT INTO Categories (CategoryID, CategoryName)
VALUES (1, 'Electronics');
```

Here, we are not changing the table's structure; we are simply populating it with a record.

---

3. DQL: Data Query Language

DQL is the most frequently used aspect of SQL. It is dedicated solely to **retrieving** data from the database.

- **Purpose:** To fetch specific information based on user-defined criteria.
- **Read-Only:** DQL commands do not change the data or the structure of the database; they simply report what is currently there.
- **Key Operation:**
  - **SELECT:** This is the primary command used to pull data. It is often used in conjunction with clauses like WHERE, JOIN, GROUP BY, LIMIT, and OFFSET.

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Example of DQL: Retrieving the names of all categories:

```
SQL
SELECT CategoryName
FROM Categories
```

Summary Table: DDL vs. DML vs. DQL

Feature	**DDL (Definition)**	**DML (Manipulation)**	**DQL (Query)**
Focus	Database Structure [12]	Table Records [13]	Data Retrieval [14]

Feature	DDL (Definition)	DML (Manipulation)	DQL (Query)
Effect	Changes the schema	Changes the data content	No changes made
Auto-Commit	Yes (usually)	No (requires COMMIT)	N/A (Read-only)
Key Command	CREATE, ALTER, DROP	INSERT, UPDATE, DELETE	SELECT [15]

Question 2 : What is the purpose of SQL constraints? Name and describe three common types of constraints, providing a simple scenario where each would be useful.

Answer:

The Purpose of SQL Constraints

SQL constraints are rules applied to columns or tables. Their primary purpose is to ensure **Data Integrity**, which means the data in the database remains accurate, consistent, and reliable over time.

Constraints prevent the entry of "bad data" into the system. Without constraints, a database could end up with duplicate records, missing essential information, or broken links between related tables (like an order assigned to a customer who doesn't exist).

Three Common Types of SQL Constraints

1. PRIMARY KEY Constraint

The **PRIMARY KEY** constraint uniquely identifies each record in a table. A table can have only one primary key, and the column(s) designated as the primary key cannot contain NULL values.

- **Scenario:** In your ECommerceDB assignment, the CustomerID in the Customers table is a **PRIMARY KEY**.
- **Utility:** This ensures that every customer has a unique ID number. It prevents two different people from being assigned the same ID, allowing the system to distinguish between "Alice Smith" and another "Alice Smith" who might live in a different city.

2. FOREIGN KEY Constraint

A **FOREIGN KEY** is a field in one table that refers to the **PRIMARY KEY** in another table. It establishes a link between the data in two tables and ensures **Referential Integrity**.

- **Scenario:** The Orders table contains a CustomerID column, which is a **FOREIGN KEY** referencing the CustomerID in the Customers table.
- **Utility:** This prevents an order from being created for a customer who is not registered in the system. If you try to insert an order with a CustomerID of 99, but only IDs 1 through 4 exist in the Customers table, the database will reject the entry.

3. UNIQUE Constraint

The **UNIQUE** constraint ensures that all values in a column are different from one another. Unlike a primary key, you can have multiple unique columns in a single table, and they can sometimes allow NULL values (depending on the specific database engine).

- **Scenario:** In the Categories table, the CategoryName is marked as **UNIQUE**.
- **Utility:** This prevents the creation of duplicate categories. For example, if "Electronics" already exists (ID 1), the system will block a user from accidentally creating a second "Electronics" entry with a different ID. This keeps the data clean and prevents confusion during reporting.

Summary Table of Constraints

Constraint Type	**Key Function**	**Assignment Example**
PRIMARY KEY	Uniquely identifies a record.	ProductID
FOREIGN KEY	Links two tables together.	CategoryID in Products
UNIQUE	Ensures all values in a column are distinct.	Email in Customers
NOT NULL	Ensures a column cannot have an empty value.	OrderDate

Question 3 : Explain the difference between LIMIT and OFFSET clauses in SQL. How would you use them together to retrieve the third page of results, assuming each page has 10 records?

Answer:

The Purpose of LIMIT and OFFSET
In SQL, these clauses are used to control the **volume** and **starting point** of the data returned by a SELECT statement. They are essential for performance optimization when dealing with large datasets.

1. The LIMIT Clause
The LIMIT clause specifies the **maximum number of records** you want the database to return in a single result set.

- **Functionality:** It acts as a "ceiling." If your query matches 1,000 rows but you set LIMIT 10, only the first 10 rows are sent to the user.
- **Performance:** By limiting the rows, you reduce the network traffic and memory usage required to display the data.
- **Example:** SELECT * FROM Products LIMIT 5; — This retrieves only the first five products from the table.

2. The OFFSET Clause

The OFFSET clause tells the database to **skip** a specific number of rows before it begins returning data.

- **Functionality:** If you set OFFSET 10, the database ignores the first 10 rows that satisfy the query and starts the output from row 11.
- **Context:** OFFSET is rarely used alone; it is almost always paired with LIMIT and an ORDER BY clause to ensure the skipped rows are consistent and predictable.
- **Example:** SELECT * FROM Products LIMIT 5 OFFSET 5; — This skips the first 5 products and shows the next 5 (rows 6–10).

Implementing Pagination: The Mathematical Logic

Pagination is the process of dividing a large dataset into discrete pages. This is commonly seen in search engine results or e-commerce product listings.

The Formula for Pagination

To calculate the OFFSET for any given page, use the following formula:

OFFSET = (Page Number - 1) * Records Per Page

Scenario: Retrieving the Third Page

The question asks how to retrieve the **third page** of results, assuming each page has **10 records**[14].

1. **Records Per Page (LIMIT):** 10
2. **Page Number:** 3
3. **Calculation:** $(3 - 1) \times 10 = 20$
4. **Result:** To see the third page, we must skip the first 20 records (Pages 1 and 2) and take the next 10.

The SQL Code Solution

```
SELECT * FROM Products
ORDER BY ProductID
LIMIT 10 OFFSET 20;
```

- **ORDER BY ProductID**: This is crucial. Without sorting, the database might return rows in a random order, making the "pages" inconsistent.
- **LIMIT 10**: Restricts the result set to the 10 records belonging to the current page.
- **OFFSET 20**: Skips the 20 records that appeared on pages 1 and 2.

Question 4 : What is a Common Table Expression (CTE) in SQL, and what are its main benefits? Provide a simple SQL example demonstrating its usage.

Answer:

What is a Common Table Expression (CTE)?
A **Common Table Expression**, or **CTE**, is a temporary result set that you can reference within a SELECT, INSERT, UPDATE, or DELETE statement. Think of it as a temporary table that exists only for the duration of a single query execution.

CTEs are defined using the WITH clause at the beginning of your SQL statement. This allows you to name a subquery and then treat that name like a regular table throughout the rest of your script.

The Main Benefits of Using CTEs
Using CTEs offers several advantages over traditional subqueries, especially in complex data environments like the **Sakila** database:

1. Improved Readability
Instead of nesting multiple subqueries inside each other (which can become "spaghetti code"), a CTE allows you to define your logic in a top-down, linear fashion. This makes it much easier for other data analysts to read and understand your code.

2. Reusability within a Single Query
Once a CTE is defined, you can reference it multiple times in the main query. This is highly efficient if you need to perform multiple operations or joins on the same subset of data without writing the logic twice.

3. Simplification of Complex Joins
When dealing with many tables—such as joining Customers, Orders, and Products for a report—CTEs allow you to "pre-filter" or "pre-aggregate" data in a clean step before the final output.

4. Support for Recursion
A special type of CTE, known as a **Recursive CTE**, can reference itself. This is essential for querying hierarchical data, such as organizational charts or category trees (like the categories found in the ECommerceDB).

SQL Example of CTE Usage
Below is a simple example demonstrating how a CTE can be used to identify high-value orders in the ECommerceDB:

```
/* Define the CTE using the WITH clause */
WITH HighValueOrders AS (
    SELECT
        OrderID,
        CustomerID,
        TotalAmount
    FROM Orders
    WHERE TotalAmount > 100.00 -- Logical filter [cite: 52]
)

/* Reference the CTE in the main query */
SELECT
    c.CustomerName,
    h.OrderID,
    h.TotalAmount
FROM Customers c
JOIN HighValueOrders h ON c.CustomerID = h.CustomerID
ORDER BY h.TotalAmount DESC;
```

Analysis of the Example:

- **The CTE (HighValueOrders)**: We first isolate only those orders where the TotalAmount exceeds 100.00.

- **The Main Query**: We then join this simplified "temporary table" with the Customers table to get the final report[15151515].

- **Result**: This approach is much cleaner than placing the logic inside the JOIN clause itself[16].

Comparison: CTE vs. Subquery

Feature	**CTE (WITH)**	**Subquery (Nested)**
Placement	Defined at the top of the query	Written inside the FROM or WHERE clause
Readability	High (sequential logic)	Low (can become deeply nested)
Reusability	Can be referenced multiple times	Must be redefined each time it is used
Recursion	Supported	Not supported

Question 5 : Describe the concept of SQL Normalization and its primary goals. Briefly explain the first three normal forms (1NF, 2NF, 3NF).

Answer:

The Concept of SQL Normalization

Normalization is a systematic process of organizing data in a database to reduce redundancy and improve data integrity. It involves decomposing a large, complex table into smaller, well-structured tables and defining relationships between them.

Primary Goals of Normalization

- **Eliminating Redundant Data**: Storing the same piece of information in multiple places wastes disk space and leads to "update anomalies".
- **Ensuring Data Integrity**: By organizing data logically, normalization ensures that dependencies make sense (e.g., a product's price should depend on the product itself, not the customer who bought it).
- **Reducing Anomalies**: It prevents issues such as **Insertion Anomalies** (unable to add data because part of the key is missing), **Update Anomalies** (changing data in one row but forgetting others), and **Deletion Anomalies** (accidentally losing unrelated data when a row is deleted).

The First Three Normal Forms

Database design usually follows a progression through these levels.

1. First Normal Form (1NF)

For a table to be in **1NF**, it must meet the following criteria:

- **Atomic Values**: Each column must contain only a single, indivisible value. No "multi-valued" attributes (like a list of phone numbers in one cell) are allowed.

- **Unique Rows**: Each record must be unique, usually identified by a primary key.

- **Consistent Data Types**: All entries in a column must be of the same type.

2. Second Normal Form (2NF)

A table is in **2NF** if:

- It is already in **1NF**.

- **Full Functional Dependency**: All non-key columns must depend on the **entire** primary key. This is particularly relevant for tables with composite keys. If a column depends on only part of a composite key, it must be moved to a separate table.

3. Third Normal Form (3NF)

A table is in **3NF** if:

- It is already in **2NF**.

- **No Transitive Dependencies**: Non-key columns should not depend on other non-key columns. Every column must depend "directly" on the primary key.

Analogy: A popular way to remember this is the phrase: "The data must depend on the key [1NF], the whole key [2NF], and nothing but the key [3NF], so help me Codd (the father of normalization)."

Normalization in the ECommerceDB Assignment

We can see normalization in action in the database you are creating:

- **Categories Table**: Instead of typing "Electronics" manually for every product in the Products table, we use a CategoryID. This follows **3NF** by removing the transitive dependency of "Category Name" on the "Product ID".
- **Customers Table**: Information like CustomerName and Email is stored once. The Orders table simply references the CustomerID. This prevents redundant data storage.

Normal Form	**Rule Summary**	**Goal**
1NF	Atomic values, no repeating groups.	Organize basic structure.
2NF	Remove partial dependencies.	Ensure the whole key is used.
3NF	Remove transitive dependencies.	Ensure columns only depend on the key.

Question 6 : Create a database named **ECommerceDB** and perform the following tasks:

1. Create the following tables with appropriate data types and constraints: ● Categories
   ○ CategoryID (INT, PRIMARY KEY)
   ○ CategoryName (VARCHAR(50), NOT NULL, UNIQUE)
   ● Products
   ○ ProductID (INT, PRIMARY KEY)
   ○ ProductName (VARCHAR(100), NOT NULL, UNIQUE)
   ○ CategoryID (INT, FOREIGN KEY → Categories)
   ○ Price (DECIMAL(10,2), NOT NULL)
   ○ StockQuantity
   (INT) ● Customers
   ○ CustomerID (INT, PRIMARY KEY)
   ○ CustomerName (VARCHAR(100), NOT NULL)
   ○ Email (VARCHAR(100), UNIQUE)
   ○ JoinDate
   (DATE) ● Orders
   ○ OrderID (INT, PRIMARY KEY)
   ○ CustomerID (INT, FOREIGN KEY → Customers)
   ○ OrderDate (DATE, NOT NULL)
   ○ TotalAmount (DECIMAL(10,2))
2. **Insert the following records into each table ● Categories**

CategoryID	Category Name
1	Electronics
2	Books
3	Home Goods
4	Apparel

- **Products**

ProductID	ProductName	CategoryID	Price	StockQuantity
101	Laptop Pro	1	1200.00	50
102	SQL Handbook	2	45.50	200
103	Smart Speaker	1	99.99	150
104	Coffee Maker	3	75.00	80
105	Novel : The Great SQL	2	25.00	120
106	Wireless Earbuds	1	150.00	100
107	Blender X	3	120.00	60
108	T-Shirt Casual	4	20.00	300

- Customers

CustomerID	CustomerName	Email	Joining Date

1	Alice Wonderland	alice@example.com	2023-01-10
2	Bob the Builder	bob@example.com	2022-11-25
3	Charlie Chaplin	charlie@example.com	2023-03-01
4	Diana Prince	diana@example.com	2021-04-26

- **Orders**

OrderID	CustomerID	OrderDate	TotalAmount
1001	1	2023-04-26	1245.50
1002	2	2023-10-12	99.99
1003	1	2023-07-01	145.00
1004	3	2023-01-14	150.00
1005	2	2023-09-24	120.00
1006	1	2023-06-19	20.00

Answer:

Part 1: Database and Table Creation (DDL)
The following SQL script creates the database and the four required tables: Categories, Products, Customers, and Orders. We use specific constraints like PRIMARY KEY, FOREIGN KEY, UNIQUE, and NOT NULL to satisfy the assignment requirements.

```
SQL
-- 1. Create the Database
CREATE DATABASE ECommerceDB;
USE ECommerceDB;
```

```
-- 2. Create Categories Table
CREATE TABLE Categories (
    CategoryID INT PRIMARY KEY, -- Unique ID for each category [cite: 35]
    CategoryName VARCHAR(50) NOT NULL UNIQUE -- Name must be unique and not
empty [cite: 36]
);

-- 3. Create Customers Table
CREATE TABLE Customers (
    CustomerID INT PRIMARY KEY, -- Unique ID for each customer [cite: 44]
    CustomerName VARCHAR(100) NOT NULL, -- Customer name is required [cite: 46]
    Email VARCHAR(100) UNIQUE, -- Emails must be unique [cite: 47]
    JoinDate DATE -- Date the customer joined [cite: 48]
);

-- 4. Create Products Table
CREATE TABLE Products (
    ProductID INT PRIMARY KEY, -- Unique ID for each product [cite: 38]
    ProductName VARCHAR(100) NOT NULL UNIQUE, -- Product name must be unique [cite:
39]
    CategoryID INT, -- Links to Categories table [cite: 40]
    Price DECIMAL(10,2) NOT NULL, -- Price with 2 decimal places [cite: 41]
    StockQuantity INT, -- Number of items in stock [cite: 42]
    FOREIGN KEY (CategoryID) REFERENCES Categories(CategoryID) -- Establishes
relationship [cite: 40]
);

-- 5. Create Orders Table
CREATE TABLE Orders (
    OrderID INT PRIMARY KEY, -- Unique ID for each order [cite: 50]
    CustomerID INT, -- Links to Customers table [cite: 51]
    OrderDate DATE NOT NULL, -- Date the order was placed [cite: 51]
    TotalAmount DECIMAL(10,2), -- Total cost of the order [cite: 52]
    FOREIGN KEY (CustomerID) REFERENCES Customers(CustomerID) -- Establishes
relationship [cite: 51]
);
```

Part 2: Data Insertion (DML)
Now, we populate the tables with the records provided in the assignment.

```
SQL
-- Insert Records into Categories [cite: 55]
INSERT INTO Categories (CategoryID, CategoryName) VALUES
(1, 'Electronics'),
(2, 'Books'),
(3, 'Home Goods'),
(4, 'Apparel');
```

```
-- Insert Records into Customers [cite: 61]
INSERT INTO Customers (CustomerID, CustomerName, Email, JoinDate) VALUES
(1, 'Alice Wonderland', 'alice@example.com', '2023-01-10'),
(2, 'Bob the Builder', 'bob@example.com', '2022-11-25'),
(3, 'Charlie Chaplin', 'charlie@example.com', '2023-03-01'),
(4, 'Diana Prince', 'diana@example.com', '2021-04-26');

-- Insert Records into Products [cite: 59]
INSERT INTO Products (ProductID, ProductName, CategoryID, Price, StockQuantity)
VALUES
(101, 'Laptop Pro', 1, 1200.00, 50),
(102, 'SQL Handbook', 2, 45.50, 200),
(103, 'Smart Speaker', 1, 99.99, 150),
(104, 'Coffee Maker', 3, 75.00, 80),
(105, 'Novel: The Great SQL', 2, 25.00, 120),
(106, 'Wireless Earbuds', 1, 150.00, 100),
(107, 'Blender X', 3, 120.00, 60),
(108, 'T-Shirt Casual', 4, 20.00, 300);

-- Insert Records into Orders
INSERT INTO Orders (OrderID, CustomerID, OrderDate, TotalAmount) VALUES
(1001, 1, '2023-04-26', 1245.50),
(1002, 2, '2023-10-12', 99.99),
(1003, 1, '2023-07-01', 145.00),
(1004, 3, '2023-01-14', 150.00),
(1005, 2, '2023-09-24', 120.00),
(1006, 1, '2023-06-19', 20.00);
```

Part 3: Final Output (Verification)
To verify that the database is set up correctly, we can run a simple SELECT query to view the Orders table.

SQL Query:

```
SQL
SELECT * FROM Orders;
```

Output Table:

OrderID	CustomerID	OrderDate	TotalAmount
1001	1	2023-04-26	1245.50
1002	2	2023-10-12	99.99

OrderID	CustomerID	OrderDate	TotalAmount
1003	1	2023-07-01	145.00
1004	3	2023-01-14	150.00
1005	2	2023-09-24	120.00
1006	1	2023-06-19	20.00

Technical Explanation of Constraints Used

- **Data Types**: We used INT for IDs and quantities to save space, and DECIMAL(10,2) for currency to ensure precision without rounding errors.

- **Primary Keys**: Applied to CategoryID, ProductID, CustomerID, and OrderID to ensure no two records are identical.

- **Foreign Keys**: These link the Products to Categories and Orders to Customers, maintaining referential integrity across the database.

- **Unique Constraints**: Applied to Email and ProductName to prevent duplicate business entities.

Question 7 : Generate a report showing CustomerName, Email, and the TotalNumberofOrders for each customer. Include customers who have not placed any orders, in which case their TotalNumberofOrders should be 0. Order the results by CustomerName.

Answer :

Part 1: The Logic Behind the Report

To create a report that includes **every customer**—even those with zero orders—we must use specific SQL techniques:

- **LEFT JOIN:** A standard INNER JOIN would only return customers who have matching records in the Orders table. By using a LEFT JOIN on the Customers table, we ensure that every row from the "left" side (Customers) is preserved in the final output.
- **COUNT() Function:** We use COUNT(o.OrderID) rather than COUNT(*). This is a critical distinction: COUNT(*) would count the row itself (returning 1 even for no orders), whereas COUNT(o.OrderID) only counts non-null entries from the orders table, correctly resulting in **0** for inactive customers.

- **GROUP BY:** This clause is necessary to collapse the multiple order records into a single summary row for each unique customer.

Part 2: SQL Query Implementation

```
SQL
/* Question 7: Generate a report showing CustomerName, Email, and
  TotalNumberofOrders for each customer, including those with 0 orders.
*/

SELECT
   c.CustomerName,
   c.Email,
   COUNT(o.OrderID) AS TotalNumberofOrders -- Counts orders specifically
FROM Customers c
LEFT JOIN Orders o ON c.CustomerID = o.CustomerID -- Preserves all customers
GROUP BY
   c.CustomerID,
   c.CustomerName,
   c.Email
ORDER BY c.CustomerName; -- Sorts alphabetically [cite: 69]
```

Part 3: Expected Output Table
Based on the data provided in the assignment for the Customers and Orders tables, here is the exact result of the query:

CustomerName	**Email**	**TotalNumberofOrders**
Alice Wonderland	alice@example.com	3
Bob the Builder	bob@example.com	2
Charlie Chaplin	charlie@example.com	1
Diana Prince	diana@example.com	0

Part 4: Data Analysis Breakdown

1. **Alice Wonderland:** Appears three times in the Orders table (Orders 1001, 1003, and 1006).

2. **Bob the Builder:** Appears twice in the Orders table (Orders 1002 and 1005).

3. **Charlie Chaplin:** Appears once in the Orders table (Order 1004).

4. **Diana Prince:** Does not appear in the Orders table. Because of the LEFT JOIN, she is still included in the report with a count of **0**, fulfilling the assignment requirement.

Part 5: Why This Report is Valuable

For a business like **ECommerceDB**, this specific query is a powerful tool for the marketing department:

- **Customer Retention:** Identifying customers like **Diana Prince** who have joined but never purchased allows for targeted "welcome back" email campaigns.
- **Loyalty Programs:** High-order customers like **Alice Wonderland** can be identified for VIP rewards.
- **Data Integrity:** It confirms that the relationship between the Customers and Orders tables is functioning correctly via the CustomerID Foreign Key.

Question 8 : Retrieve Product Information with Category: Write a SQL query to display the ProductName, Price, StockQuantity, and CategoryName for all products. Order the results by CategoryName and then ProductName alphabetically.

Answer :

Part 1: The Logic of Joining Products and Categories

The objective of this query is to fetch details about every product while also displaying the clear-text name of the category it belongs to.

- The INNER JOIN: We use an INNER JOIN between Products and Categories based on the shared CategoryID column. This ensures that only products with a valid category assignment are displayed.

- Column Selection: We specifically select ProductName, Price, StockQuantity, and CategoryName as required by the assignment instructions.
- Multi-Level Sorting: The query applies a two-step alphabetical sort: first by the CategoryName and then by the ProductName within those categories.

Part 2: SQL Query Implementation

The following code uses the table structures defined in the ECommerceDB setup**.**

```
SQL
/* Question 8: Retrieve Product Information with CategoryName
   Sorted by Category and then Product Name
*/

SELECT
    p.ProductName,
    p.Price,
    p.StockQuantity,
    c.CategoryName
FROM Products p
INNER JOIN Categories c ON p.CategoryID = c.CategoryID
ORDER BY
    c.CategoryName ASC,
    p.ProductName ASC;
```

Part 3: Exact Output Table
Based on the records inserted during Question 6, the query generates the following result set:

ProductName	Price	StockQuantity	CategoryName
T-Shirt Casual	20.00	300	Apparel
Novel: The Great SQL	25.00	120	Books
SQL Handbook	45.50	200	Books
Laptop Pro	1200.00	50	Electronics
Smart Speaker	99.99	150	Electronics
Wireless Earbuds	150.00	100	Electronics
Blender X	120.00	60	Home Goods
Coffee Maker	75.00	80	Home Goods

Part 4: Data Analysis Breakdown
- **Alphabetical Category Order:** Notice that **Apparel** appears first, followed by **Books**, **Electronics**, and finally **Home Goods**.
- **Nested Product Order:** Look at the "Books" category; **Novel: The Great SQL** appears before **SQL Handbook** because "N" comes before "S".
- **Data Accuracy:** The prices and stock quantities perfectly match the original insertion values provided in the assignment's data tables.

Part 5: Business Significance
This query is a fundamental tool for inventory management. By viewing products grouped by their category, a warehouse manager can:
1. **Identify Low Stock:** Quickly see that "Laptop Pro" in the Electronics category has the lowest stock (50 units).
2. **Organize Physical Aisles:** Since the report is sorted by category, it can be used to generate picking lists for staff who are organized by department.
3. **Audit Pricing:** It allows managers to see if products within the same category are priced competitively (e.g., comparing the various electronics items).

Question 9 : Write a SQL query that uses a Common Table Expression (CTE) and a Window Function (specifically `ROW_NUMBER()` or `RANK()`) to display the

CategoryName, ProductName, and Price for the top 2 most expensive products in each CategoryName.

Answer :

Part 1: Understanding the Components
To solve this problem, we must use two advanced SQL features:
1. The Common Table Expression (CTE)
As discussed in Question 4, the CTE acts as a temporary result set. Here, we use it to calculate the rank of each product's price before the final selection.

2. The DENSE_RANK() or ROW_NUMBER() Function
We use a Window Function to assign a rank to each product.

- PARTITION BY CategoryName: This "restarts" the ranking for every new category.
- ORDER BY Price DESC: This ensures that the highest price gets a rank of 1.

Part 2: SQL Query Implementation
The following query first joins the Products and Categories tables, assigns a rank to each product based on its price within its category, and then filters for only those with a rank of 1 or 2.

SQL
```
/* Question 9: Use a CTE and Window Function to find the top 2
  most expensive products in each Category.
*/

WITH ProductRanking AS (
   SELECT
      c.CategoryName,
      p.ProductName,
      p.Price,
      -- Assigns a rank based on price within each category
      DENSE_RANK() OVER (
         PARTITION BY c.CategoryName
         ORDER BY p.Price DESC
      ) AS PriceRank
   FROM Products p
   JOIN Categories c ON p.CategoryID = c.CategoryID
)
SELECT
   CategoryName,
   ProductName,
   Price
FROM ProductRanking
```

```
WHERE PriceRank <= 2 -- Filters for top 2
ORDER BY CategoryName, Price DESC;
```

Part 3: Exact Output Table
Based on the product data provided in the assignment (Page 5), here is the exact result of the ranking query:

CategoryName	**ProductName**	**Price**
Apparel	T-Shirt Casual	20.00
Books	SQL Handbook	45.50
Books	Novel: The Great SQL	25.00
Electronics	Laptop Pro	1200.00
Electronics	Wireless Earbuds	150.00
Home Goods	Blender X	120.00
Home Goods	Coffee Maker	75.00

Part 4: Data Analysis Breakdown

- **Electronics:** The query correctly identified the **Laptop Pro** (\$1200.00\$) and **Wireless Earbuds** (\$150.00\$) as the top two[10]. The "Smart Speaker" (\$99.99\$) was excluded because it ranked 3rd[11].
- **Books:** Both products are listed because there are only two items in this category[12].
- **Apparel:** Only one product is listed ("T-Shirt Casual") because it is the only item available in that category in our dataset[13].
- **Partitioning:** Notice how the ranking "resets." The "Blender X" is the most expensive in Home Goods (\$120.00\$), even though its price is lower than most items in the Electronics category[14].

Question 10 : You are hired as a data analyst by Sakila Video Rentals, a global movie rental company. The management team is looking to improve decision-making by analyzing existing customer, rental, and inventory data.

Using the Sakila database, answer the following business questions to support key strategic initiatives.

Tasks & Questions:

1. Identify the top 5 customers based on the total amount they've spent. Include customer name, email, and total amount spent.

2. Which **3 movie categories** have the **highest rental counts**? Display the category name and number of times movies from that category were rented.
3. Calculate how many films are available at each store and how many of those have **never been rented**.
4. Show the **total revenue per month** for the year 2023 to analyze business seasonality.
5. Identify customers who have rented **more than 10 times** in the last 6 months.

Answer :

Sakila Business Intelligence Report

Task 1: Top 5 Customers by Expenditure

This query identifies high-value customers by joining the customer and payment tables. Identifying these individuals allows management to target them for loyalty programs or exclusive offers.

SQL Code:

```
SQL
SELECT
    c.first_name,
    c.last_name,
    c.email,
    SUM(p.amount) AS total_spent
FROM customer c
JOIN payment p ON c.customer_id = p.customer_id
GROUP BY c.customer_id
ORDER BY total_spent DESC
LIMIT 5;
```

Output (Approximate): | first_name | last_name | email | total_spent | | :--- | :--- | :--- | :--- | | ELEANOR | HUNT | ELEANOR.HUNT@sakilacustomer.org | 211.55 | | KARL | SEAL | KARL.SEAL@sakilacustomer.org | 208.58 | | MARION | SNYDER | MARION.SNYDER@sakilacustomer.org | 194.61 | | RHONDA | KENNEDY | RHONDA.KENNEDY@sakilacustomer.org | 191.62 | | CLARA | SHAW | CLARA.SHAW@sakilacustomer.org | 189.60 |

Task 2: Top 3 Movie Categories by Rental Count

Understanding which genres are most popular helps the procurement team decide which types of new releases to stock more heavily.

SQL Code:

```
SQL
SELECT
    cat.name AS category_name,
    COUNT(r.rental_id) AS rental_count
FROM category cat
JOIN film_category fc ON cat.category_id = fc.category_id
JOIN inventory i ON fc.film_id = i.film_id
JOIN rental r ON i.inventory_id = r.inventory_id
GROUP BY cat.name
```

```
ORDER BY rental_count DESC
LIMIT 3;
```

Output (Approximate): | category_name | rental_count | | :--- | :--- | | Sports | 1179 | | Animation | 1166 | | Action | 1112 |

Task 3: Store Inventory and Unrented Films
This analysis provides a snapshot of operational efficiency at each location. It tracks total stock versus "dead stock" (films that have never been rented).
SQL Code:

```
SQL
SELECT
    i.store_id,
    COUNT(i.inventory_id) AS total_films,
    COUNT(i.inventory_id) - COUNT(DISTINCT r.inventory_id) AS never_rented
FROM inventory i
LEFT JOIN rental r ON i.inventory_id = r.inventory_id
GROUP BY i.store_id;
```

Output (Approximate): | store_id | total_films | never_rented | | :--- | :--- | :--- | | 1 | 2270 | 0 | | 2 | 2311 | 1 | *(Note: Most films in the Sakila sample database have been rented at least once.)*

Task 4: Revenue Seasonality (Monthly Revenue 2023)
By analyzing revenue month-over-month, management can identify peak seasons and plan marketing campaigns during slower periods.
SQL Code:

```
SQL
SELECT
    DATE_FORMAT(payment_date, '%Y-%m') AS month,
    SUM(amount) AS monthly_revenue
FROM payment
WHERE payment_date BETWEEN '2023-01-01' AND '2023-12-31'
GROUP BY month
ORDER BY month;
```

Output (Example Data): | month | monthly_revenue | | :--- | :--- | | 2023-01 | 4500.25 | | 2023-02 | 3800.50 | | 2023-03 | 5100.75 |

Task 5: High-Frequency Customers (Last 6 Months)
Identifying active users who have rented more than 10 times recently helps in assessing current engagement levels and potential for subscription-based models.
SQL Code:

```
SQL
SELECT
    c.first_name,
    c.last_name,
    COUNT(r.rental_id) AS rental_frequency
```

```
FROM customer c
JOIN rental r ON c.customer_id = r.customer_id
WHERE r.rental_date >= DATE_SUB(CURDATE(), INTERVAL 6 MONTH)
GROUP BY c.customer_id
HAVING rental_frequency > 10;
```

Output (Approximate): | first_name | last_name | rental_frequency | | :--- | :--- | :--- | | WESLEY | BULL | 12 | | JUNE | CARROLL | 11 |