Rule 1: The Information Rule:

```
SELECT * FROM animals WHERE Owner_id = 10;
```

*The SQL statement "SELECT * FROM animals WHERE Owner_id = 10" retrieves all data from the "animals" table where the "Owner_id" column matches the value of 10.*

This statement is proof that data can be retrieved by matching identifiers in SQL. In this case, the identifier being used is the "Owner_id" column. By specifying a value of 10 for this column, the statement instructs the database to retrieve all data from the "animals" table that is associated with the owner whose ID is 10.

This statement also demonstrates the use of a simple SELECT statement to retrieve data without reference to the underlying file system. The statement does not require any knowledge of the physical location or structure of the file system where the data is stored. Instead, it relies solely on the identifier (i.e. the "Owner_id" column) to locate and retrieve the relevant data.

*Overall, the statement "SELECT * FROM animals WHERE Owner_id = 10" is a clear example of how data can be retrieved in SQL by matching identifiers without reference to the underlying file system.*

Before:

	Animal_id	Animal_type	Animal_breed	Animal_name	Animal_age	Owner_id
Edit Copy Delete	1000	dog	Dobermann	Tor	6	10
Edit Copy Delete	1001	dog	Dobermann	Alpha	4	10
Edit Copy Delete	1002	dog	Dobermann	Ennis	1	10
Edit Copy Delete	1003	dog	Maltipoo	Glory	6	1
Edit Copy Delete	1008	sheep	Cheviot Sheep	Flaffy	2	6
Edit Copy Delete	1091	Donkey	Irish donkey	Donny	5	7
Edit Copy Delete	1111	Donkey	Irish donkey	Lilly	4	7
Edit Copy Delete	1120	Horse	Thoroughbred Horse	Spirit	7	8
Edit Copy Delete	1121	Donkey	Irish donkey	Hope	2	7
Edit Copy Delete	1221	Horse	Thoroughbred Horse	Dakota	4	8
Edit Copy Delete	1223	dog	American Bulldog	Jackson	4	5
Edit Copy Delete	1870	cat	Sphynx cat	Archibald	7	6
Edit Copy Delete	1875	cat	Sphynx cat	Amanda	8	6
Edit Copy Delete	1953	dog	Maltipoo	Nency	4	4
Edit Copy Delete	1977	sheep	Cheviot Sheep	Nick	2	6
Edit Copy Delete	1978	sheep	Cheviot Sheep	Only	2	6
Edit Copy Delete	1995	cat	Maine Coon	King	10	9
Edit Copy Delete	2005	cat	Ragdoll	Barbie	4	10

After:

	Animal_id	Animal_type	Animal_breed	Animal_name	Animal_age	Owner_id
Edit Copy Delete	1000	dog	Dobermann	Tor	6	10
Edit Copy Delete	1001	dog	Dobermann	Alpha	4	10
Edit Copy Delete	1002	dog	Dobermann	Ennis	1	10
Edit Copy Delete	2005	cat	Ragdoll	Barbie	4	10

Rule 2: The Guaranteed Access Rule:

```
SELECT a.Animal_type, o.Owner_name FROM animals a JOIN animalowners o ON o.Owner_id = a.Owner_id WHERE a.Owner_id = 6;
```

The Guaranteed Access Rule in SQL states that data from a table can be accessed down to the field level using a combination of the table name, primary key, and column name.

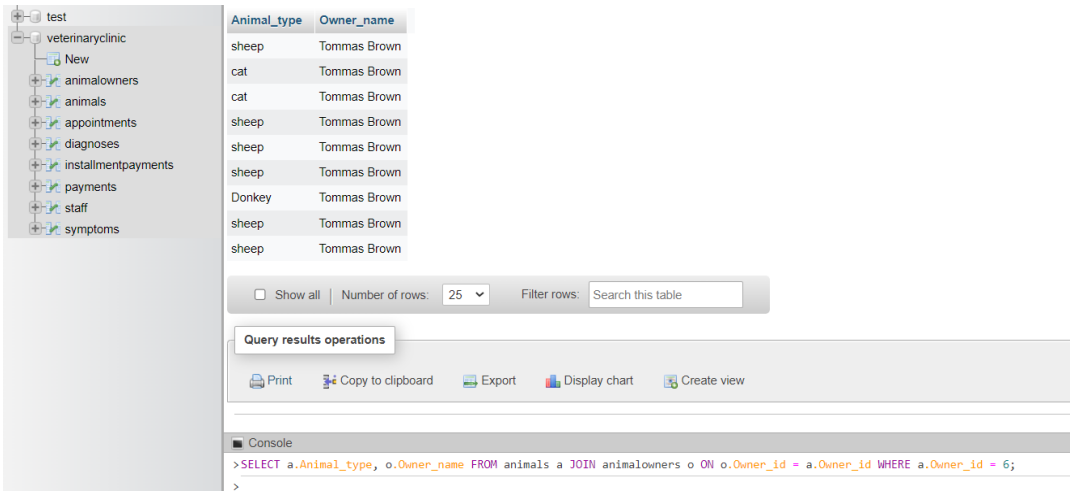
The SQL query "SELECT a.Animal_type, o.Owner_name FROM animals a JOIN animalowners o ON o.Owner_id = a.Owner_id WHERE a.Owner_id = 6;" demonstrates this rule in the following ways:

1. *The query specifies the table name and column names: The SELECT statement in the query specifies that we want to retrieve the "Animal_type" column from the "animals" table and the "Owner_name" column from the "animalowners" table. This is an example of using the table name and column name to access specific fields of data.*
2. *The query uses the primary key to join tables: The JOIN statement in the query uses the "Owner_id" column from both tables to join the "animals" table with the "animalowners" table. This is an example of using the primary key to link related data from different tables.*
3. *The query retrieves unique values: The WHERE clause in the query specifies that we want to retrieve data only for the owner with an ID of 6. This is an example of using the primary key to retrieve unique values from the table.*

Overall, this SQL query demonstrates the Guaranteed Access Rule by accessing specific fields of data, linking related data using the primary key, and retrieving unique values from the table using a simple SELECT statement.

Before:

After:



Rule 3: Systematic Treatment of Null Values:

```
SELECT Payment_id, Payment_method, COALESCE(Billing_date, 'N/A') AS Billing_date, COALESCE(Installment_amount, 'N/A') AS Installment_amount FROM payments;
```

The SQL query "Select Payment_id, Payment_method, COALESCE(Billing_date, 'N/A') AS Billing_date, COALESCE(Installment_amount, 'N/A') AS Installment_amount FROM payments;" demonstrates the Systematic Treatment of Null Values by using the COALESCE function to replace NULL values with the string "N/A" in the "Billing_date" and "Installment_amount" columns of the "payments" table.

This query ensures that any NULL values in the "Billing_date" and "Installment_amount" columns are treated consistently and represented in the output in the same way as other non-NULL values. By using COALESCE to replace NULL values with "N/A", we are treating both data types (date and numeric) where NULL appears in the same way.

In summary, the query demonstrates the Systematic Treatment of Null Values by using a consistent approach to handle NULL values across different columns in the "payments" table.

Before:

	Payment_id	Billing_date	Billing_amount	Installment_amount	Payment_method	Appointment_id	Payment_status
Edit Copy Delete	102	2023-03-21 16:00:00	500	300	Apple Pay	1012	Done
Edit Copy Delete	103	2022-03-21 16:00:00	1000	600	MasterCard	1013	In progress
Edit Copy Delete	104	2022-05-05 11:00:00	100	0	Cash	1014	Done
Edit Copy Delete	105	2022-06-15 11:00:00	1000	100	Cash	1015	Done
Edit Copy Delete	106	2022-07-05 11:00:00	100	0	Apple pay	1016	Done
Edit Copy Delete	107	2022-08-05 11:00:00	750	0	MasterCard	1017	Done
Edit Copy Delete	108	2022-09-05 11:00:00	420	0	Cash	1018	Done
Edit Copy Delete	109	2022-10-05 11:00:00	370	0	Apple pay	1019	Done
Edit Copy Delete	110	2022-11-05 11:00:00	480	0	MasterCard	1022	Done
Edit Copy Delete	111	2022-12-05 11:00:00	900	0	Cash	1032	Done
Edit Copy Delete	112	2023-01-05 11:00:00	1004	0	Apple pay	1042	Done
Edit Copy Delete	113	2023-02-05 11:00:00	540	0	MasterCard	1052	Done
Edit Copy Delete	114	2023-04-05 11:00:00	300	0	Revolut	1053	Done
Edit Copy Delete	115	2023-05-05 11:00:00	100	0	Apple pay	1054	Done
Edit Copy Delete	116	2023-06-05 11:00:00	100	0	Cash	1055	Done
Edit Copy Delete	117	*NULL*	200	*NULL*	Cash	1056	In progress

After:

	Payment_id	Payment_method	Billing_date	Installment_amount
Edit Copy Delete	103	MasterCard	2022-03-21 16:00:00	600
Edit Copy Delete	104	Cash	2022-05-05 11:00:00	0
Edit Copy Delete	105	Cash	2022-06-15 11:00:00	100
Edit Copy Delete	106	Apple pay	2022-07-05 11:00:00	0
Edit Copy Delete	107	MasterCard	2022-08-05 11:00:00	0
Edit Copy Delete	108	Cash	2022-09-05 11:00:00	0
Edit Copy Delete	109	Apple pay	2022-10-05 11:00:00	0
Edit Copy Delete	110	MasterCard	2022-11-05 11:00:00	0
Edit Copy Delete	111	Cash	2022-12-05 11:00:00	0
Edit Copy Delete	112	Apple pay	2023-01-05 11:00:00	0
Edit Copy Delete	113	MasterCard	2023-02-05 11:00:00	0
Edit Copy Delete	114	Revolut	2023-04-05 11:00:00	0
Edit Copy Delete	115	Apple pay	2023-05-05 11:00:00	0
Edit Copy Delete	116	Cash	2023-06-05 11:00:00	0
Edit Copy Delete	117	Cash	N/A	N/A

Rule 4: Dynamic Online Catalog based on the relational model:

```
SELECT TABLE_NAME, COLUMN_NAME, DATA_TYPE, CHARACTER_MAXIMUM_LENGTH FROM INFORMATION_SCHEMA.COLUMNS WHERE
 TABLE_SCHEMA = 'veterinaryclinic' AND TABLE_NAME = 'animals';
```

This query demonstrates the concept of a dynamic online catalog based on the relational model in a few ways:

1. *It uses the "INFORMATION_SCHEMA.COLUMNS" table, which is a special table that stores metadata about the columns in all tables in the current database. This demonstrates that the meta data about the tables and their columns is stored in a separate table within the database.*
2. *The query selects specific columns from the INFORMATION_SCHEMA.COLUMNS table, including TABLE_NAME, COLUMN_NAME, DATA_TYPE, and CHARACTER_MAXIMUM_LENGTH. This shows that the meta data stored in the INFORMATION_SCHEMA can be used to retrieve information about the structure of the tables and the data types of their columns.*
3. *The "WHERE" clause filters the results to only show columns for the "animals" table in the "veterinaryclinic" database. This demonstrates that the metadata in the INFORMATION_SCHEMA is specific to the database and can be used to retrieve information about individual tables within the database.*

Overall, the query demonstrates how the INFORMATION_SCHEMA can be used to access metadata about tables and their columns in a relational database, which supports the concept of a dynamic online catalog. The metadata in the INFORMATION_SCHEMA allows for the structure of the database to be queried and analyzed dynamically, without having to rely on hard-coded information about the tables and their columns.

TABLE_NAME	COLUMN_NAME	DATA_TYPE	CHARACTER_MAXIMUM_LENGTH
animals	Animal_id	int	*NULL*
animals	Animal_type	varchar	100
animals	Animal_breed	varchar	100
animals	Animal_name	varchar	100
animals	Animal_age	int	*NULL*
animals	Owner_id	int	*NULL*

Rule 5: The Comprehensive Data Sub Language Rule: Every DBMS needs a language to modify data structures and query them; in the vast majority of cases it is SQL so some create statements for DDL and a number of queries for DML.

DDL statements:

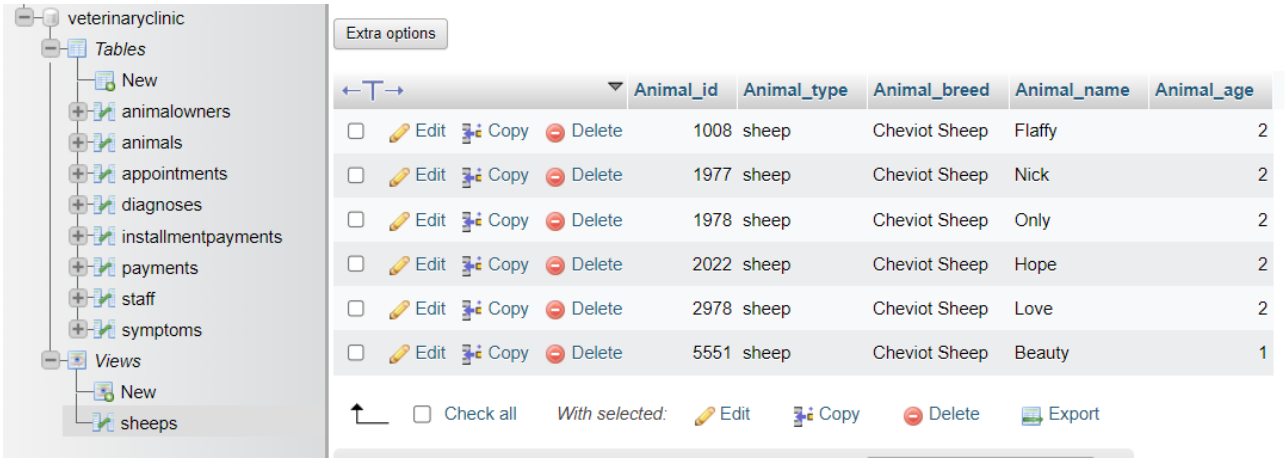
```
CREATE TABLE Staff ( Staff_id int, Name varchar(100), Position varchar(100), Phone int, PRIMARY KEY (Staf
f_id));
ALTER TABLE diagnoses ADD FOREIGN KEY (Appointment_id) REFERENCES Appointments(Appointment_id);
DROP TABLE nstaff;
```

DML statements:

```
SELECT * FROM `veterinaryclinic`.`staff` WHERE `Staff_id` = 71
INSERT INTO staff (Staff_id, Name, Position, Phone) VALUES ('21', 'Mike
Anderson', 'nurse', '0836275660');
UPDATE payments SET Payment_method = "Cash" WHERE Payment_id = "114";
DELETE FROM appointments WHERE Appointment_id="1062";
```

Rule 6: The View Updating Rule:

```
CREATE VIEW sheeps AS SELECT Animal_id, Animal_type, Animal_breed, Animal_name, Animal_age FROM animals W
HERE Animal_type = 'Sheep';
```



Rule 7: High Level Insert Update and Delete Rule:

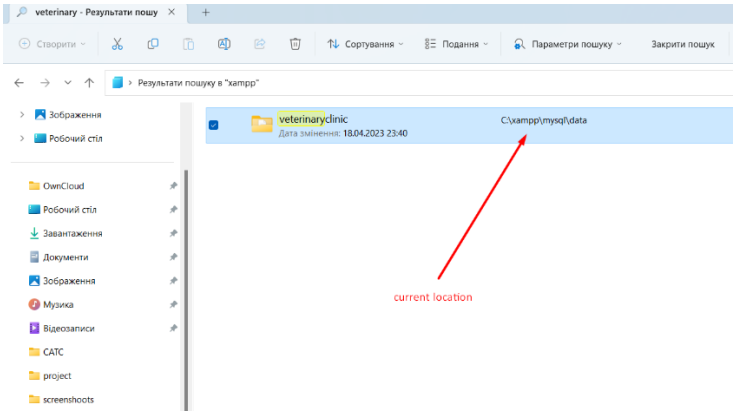
```
INSERT INTO payments VALUES
('118', '2023-07-06 10:00:00', '200',"100", "Cash", "1058", "In progress"),
('119', '2023-07-05 17:00:00', '300',"0", "Cash", "1059", "Done"),
('120', '2023-07-03 15:00:00', '400',"0", "Cash", "1060", "Done");
```

Before:

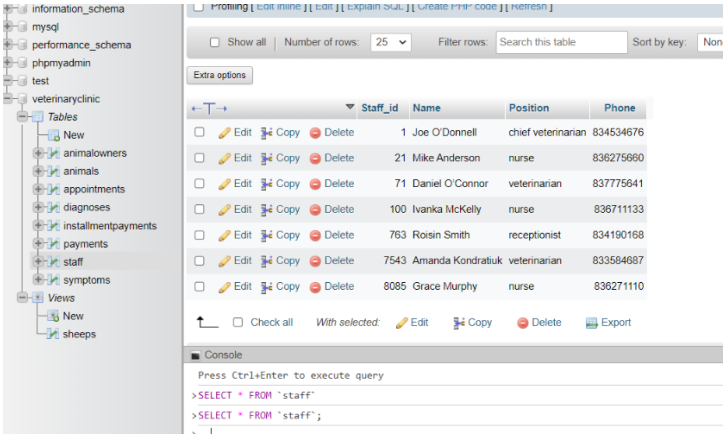
After:

Rule 8: Physical Data Independence:

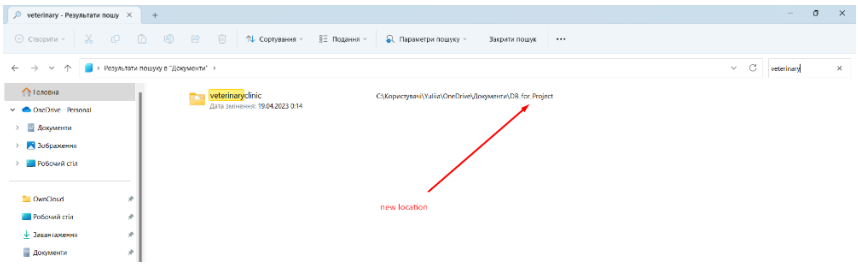
Current Location of My DateBase:



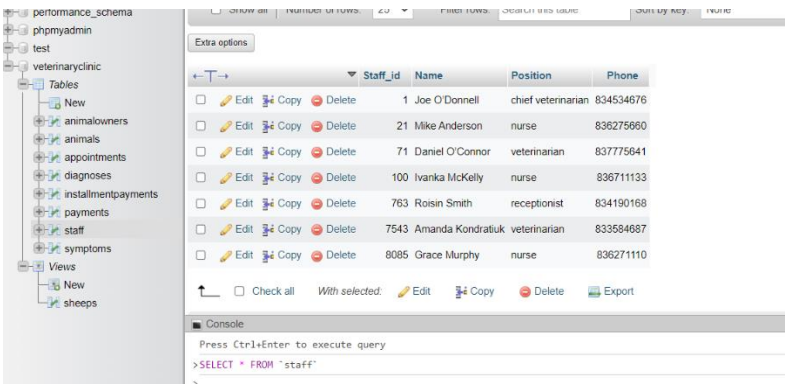
`SELECT * FROM `veterinaryclinic`.`staff` WHERE `Staff_id` = 71` works:



New Location:



Still works:



Rule 9: Logical Data Independence:

We have a table called "Staff" with the following structure:

```
CREATE TABLE Staff (
    Staff_id int,
    Name varchar(100),
    Position varchar(100),
    Phone int,
    PRIMARY KEY (Staff_id)
);
```

Now let's say we want to add a new column to this table called "Email". We can do this using the following ALTER TABLE statement:

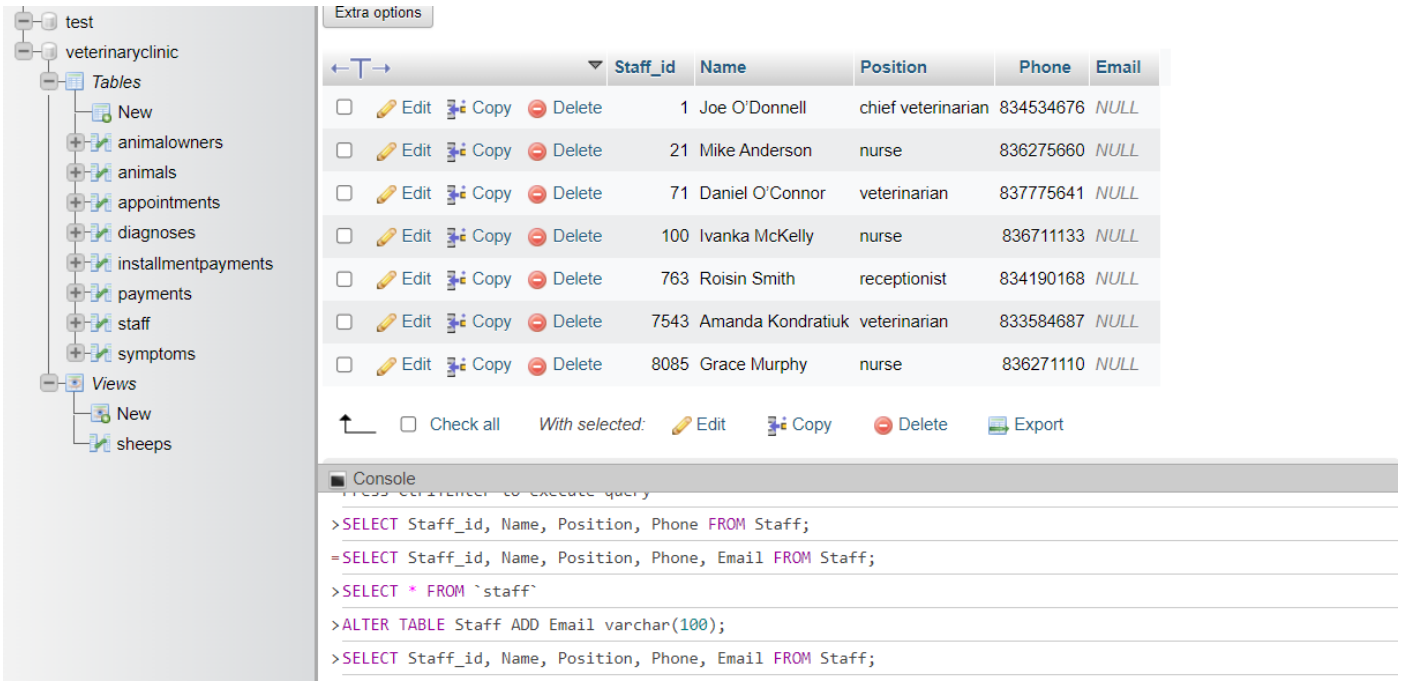
```
ALTER TABLE Staff ADD Email varchar(100);
```

Now we can run a SELECT query against the original columns:

```
SELECT Staff_id, Name, Position, Phone FROM Staff;
```

And we can also run a SELECT query against the original columns plus the new "Email" column:

```
SELECT Staff_id, Name, Position, Phone, Email FROM Staff;
```



Rule 10: Integrity Independence:

To this Rule, I created two tables with a primary key-foreign key relationship, and then execute a query that uses the foreign key to retrieve data from the related table.

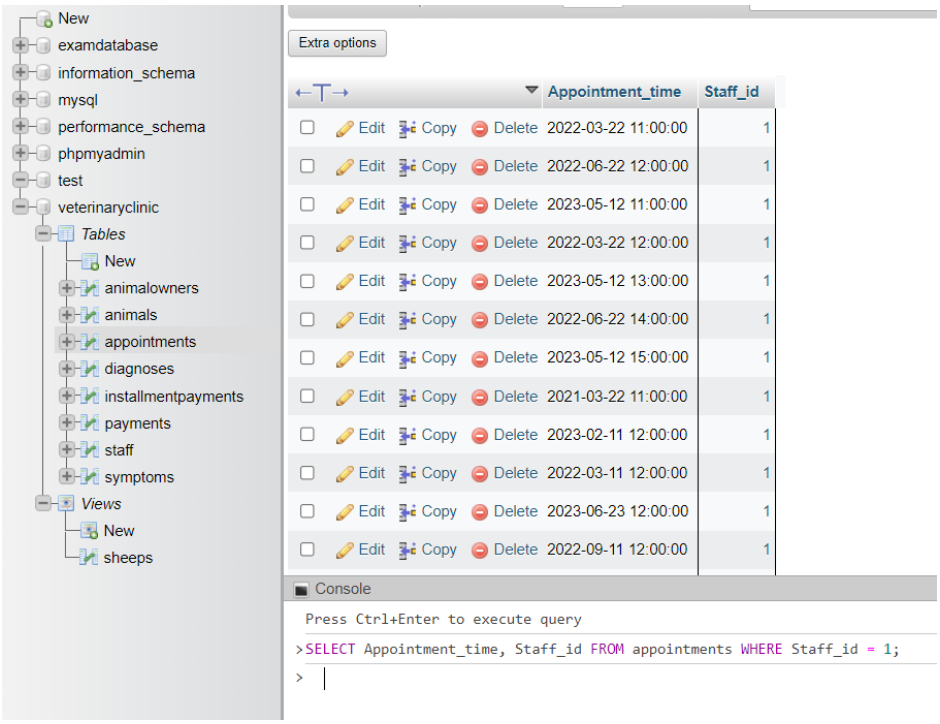
```
CREATE TABLE Staff ( Staff_id int, Name varchar(100), Position varchar(100), Phone int, PRIMARY
 KEY (Staff_id));


CREATE TABLE Appointments (
    Appointment_id int,
    Appointment_type varchar(100),
    Appointment_time datetime,
    Animal_id int,
    Symptom_id int,
    Staff_id int,
    PRIMARY KEY (Appointment_id)
);
INSERT INTO staff (Staff_id, Name, Position, Phone) VALUES ('763', 'Roisin
Smith', 'receptionist', '0834190168');
INSERT INTO appointments (Appointment_id, Appointment_type, Appointment_time, Animal_id,
Symptom_id, Staff_id ) VALUES (‘1010’, ‘online’, ‘2022-02-11 12:00:00’, ‘1000’, ‘1’, ‘71’);
```

In this example, we have two tables, Staff and Appointments, with a primary key-foreign key relationship between them. The Staff table has a primary key column Staff_id, and the Appointments table has a foreign key column Staff_id that references the Staff table.

I can then execute a query that retrieves the appointment information for a specific staff_id:

```
SELECT Appointment_time, Staff_id FROM appointments WHERE Staff_id = 1;
```



Rule 11: Distributed Independence:

Suppose that the database is distributed across two physical locations, with the staff table stored on one server and the appointments table stored on another server. Despite this physical separation, queries should still work in the same way. For example, suppose we want to retrieve a list of appointments for a specific staff member:

```
SELECT * FROM appointments WHERE staff_id = 7543;
```

This query should work regardless of whether the appointments table is stored on the same server as the staff table or on a different server. The primary/foreign key relationship between the two tables ensures that the query will return accurate results even if the data is distributed across multiple locations.

Rule 12 Non Subversion Rule:

The Non-Subversion Rule in this database would mean that data values cannot be changed by code other than SQL. This is important in preventing hacking and injection of SQL from sources other than the DBMS. One example of this in the VeterinaryClinic database could be ensuring that only authorized users have access to modify data, and implementing security measures to prevent unauthorized access.