RAJALAKSHMI ENGINEERING COLLEGE

RAJALAKSHMI NAGAR, THANDALAM – 602 105

CS23332
DATABASE MANAGEMENT SYSTEMS LAB

Laboratory Record Note Book

Name :……KAVIARASI M …….

Year / Branch / Section : ……II CSE……

University Register No. : ……2116240701241……

College Roll No. : ……240701241……

Semester : ……III……

Academic Year : ……2025-2026……

RAJALAKSHMI
ENGINEERING COLLEGE

An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

BONAFIDE CERTIFICATE

NAME ..... KAVIARASI M .....

ACADEMIC YEAR ..... 2025 ..... SEMESTER ..... III .....BRANCH..... CSE .....

UNIVERSITY REGISTER No. 2116240701241

Certified that this is the bonafide record of work done by the above student in the

Database Management System ..... *Laboratory during the year* 2025 - 2026

Signature of Faculty - in - Charge

Submitted for the Practical Examination held on .....18.11.2025.....

Internal Examiner **External Examiner**

Definition of a Relational Database

A relational database is a collection of relations or two-dimensional tables.

Terminologies Used in a Relational Database

1. A single ROW or table representing all data required for a particular employee. Each row should be identified by a primary key which allows no duplicate rows.

2. A COLUMN or attribute containing the employee number which identifies a unique employee. Here Employee number is designated as a primary key ,must contain a value and must be unique.

3. A column may contain foreign key. Here Dept_ID is a foreign key in employee table and it is a primary key in Department table.

4. A Field can be found at the intersection of a row and column. There can be only one value in it. Also it may have no value. This is called a null value.

EMP ID	FIRST NAME	LAST NAME	EMAIL
100	King	Steven	Sking
101	John	Smith	Jsmith
102	Neena	Bai	Neenba
103	Eex	De Haan	Ldehaan

Relational Database Properties

A relational database :

- Can be accessed and modified by executing structured query language (SQL) statements. ● Contains a collection of tables with no physical pointers.
- Uses a set of operators

Relational Database Management Systems

RDBMS refers to a relational database plus supporting software for managing users and processing SQL queries, performing backups/restores and associated tasks.
(Relational Database Management System) Software for storing data using SQL (structured query language). A relational database uses SQL to store data in a series of tables that not only record existing relationships between data items, but which also permit the data to be joined in new relationships. SQL (pronounced 'sequel') is based on a system of algebra developed by E F Codd, an IBM scientist who first defined the relational model in 1970. Relational databases are optimized for storing transactional data, and the majority of modern business software applications therefore use an RDBMS as their data store. The leading RDBMS vendors are Oracle, IBM and Microsoft.

The first commercial RDBMS was the Multics Relational Data Store, first sold in 1978. INGRES, Oracle, Sybase, Inc., Microsoft Access, and Microsoft SQL Server are wellknown database products and companies.Others include PostgreSQL, SQL/DS, and RDB. A relational database management system (RDBMS) is a program that lets you create, update, and administer a relational database. Most commercial RDBMS's use the Structured Query Language (SQL) to access the database, although SQL was invented after the development of the relational model and is not necessary for its use.
The leading RDBMS products are Oracle, IBM's DB2 and Microsoft's SQL Server. Despite repeated challenges by competing technologies, as well as the claim by some experts that no current RDBMS has fully implemented relational principles, the majority of new corporate databases are still being created and managed with an RDBMS.

SQL Statements

1. Data Retrieval(DR)
2. Data Manipulation Language(DML)
3. Data Definition Language(DDL)
4. Data Control Language(DCL)
5. Transaction Control Language(TCL)

DATA TYPES

1. Character Data types:

- Char – fixed length character string that can varies between 1-2000 bytes
- Varchar / Varchar2 – variable length character string, size ranges from 1-4000 bytes.it saves the disk space(only length of the entered value will be assigned as the size of column) ▪
Long - variable length character string, maximum size is 2 GB

2. Number Data types : Can store +ve,-ve,zero,fixed point, floating point with 38 precission.

- Number – {p=38,s=0}
- Number(p) - fixed point
- Number(p,s) –floating point (p=1 to 38,s= -84 to 127)

3. Date Time Data type: used to store date and time in the table.

- DB uses its own format of storing in fixed length of 7 bytes for century, date, month, year, hour, minutes, and seconds.
- Default data type is "dd-mon-yy"
- New Date time data types have been introduced. They are

TIMESTAMP-Date with fractional seconds
INTERVAL YEAR TO MONTH-stored as an interval of years and months

INTERVAL DAY TO SECOND-stored as o interval of days to hour's minutes and seconds

4. **Raw Data type:** used to store byte oriented data like binary data and byte string.

5. **Other :**
- CLOB – stores character object with single byte character.
- BLOB – stores large binary objects such as graphics, video, sounds.
- BFILE – stores file pointers to the LOB's.

EXERCISE-1 Creating and Managing Tables

OBJECTIVE

After the completion of this exercise, students should be able to do the following:
- Create tables
- Describing the data types that can be used when specifying column definition
- Alter table definitions
- Drop, rename, and truncate tables

NAMING RULES

Table names and column names:

- Must begin with a letter
- Must be 1-30 characters long
- Must contain only A-Z, a-z, 0-9, _, $, and #
- Must not duplicate the name of another object owned by the same user ● Must not be an oracle server reserve words ● 2 different tables should not have same name.
- Should specify a unique column name.
- Should specify proper data type along with width
- Can include "not null" condition when needed. By default it is 'null'.

The CREATE TABLE Statement

Table: Basic unit of storage; composed of rows and columns

Syntax: 1 Create table table_name (column_name1 data_ type (size)
column_name2 data_ type (size)….);

Syntax: 2 Create table table_name (column_name1 data_ type (size) constraints,

column_name2 data_ type constraints …); **Example:**

Create table employlees (employee_id number(6), first_name varchar2(20), ..job_id varchar2(10), CONSTRAINT emp_emp_id_pk PRIMARY KEY (employlee_id));

Tables Used in this course

Creating a table by using a Sub query

SYNTAX
// CREATE TABLE table_name(column_name type(size)…);

Create table table_name **as** select column_name1,column_name2,……colmn_namen from table_name where predicate;

AS Subquery

Subquery is the select statement that defines the set of rows to be inserted into the new table.

Example

Create table dept80 as select employee_id, last_name, salary*12 Annsal, hire_date
from employees where dept_id=80;

The ALTER TABLE Statement

The ALTER statement is used to

- Add a new column
- Modify an existing column
- Define a default value to the new column ● Drop a column
- To include or drop integrity constraint.

SYNTAX

ALTER TABLE table_name ADD /MODIFY(Column_name type(size));

ALTER TABLE table_name DROP COLUMN (Column_nname);

ALTER TABLE ADD CONSTRAINT Constraint_name PRIMARY KEY (Colum_Name); **Example:**

Alter table dept80 add (jod_id varchar2(9));
Alter table dept80 modify (last_name varchar2(30));
Alter table dept80 drop column job_id;

NOTE: Once the column is dropped it cannot be recovered.

DROPPING A TABLE

- All data and structure in the table is deleted.
- Any pending transactions are committed.
- All indexes are dropped.
- Cannot roll back the drop table statement.

Syntax:

Drop table *tablename;*

Example:

Drop table dept80;

RENAMING A TABLE

To rename a table or view.

Syntax

RENAME old_name to new_name

Example:

Rename dept to detail_dept;

TRUNCATING A TABLE

Removes all rows from the table.

Releases the storage space used by that table.

Syntax
TRUNCATE TABLE *table_name*; E**xample:**

TRUNCATE TABLE copy_emp;

Find the Solution for the following:

Create the following tables with the given structure.

EMPLOYEES TABLE

NAME	NULL?	TYPE
Employee_id	Not null	Number(6)
First_Name		Varchar(20)
Last_Name	Not null	Varchar(25)
Email	Not null	Varchar(25)
Phone_Number		Varchar(20)
Hire_date	Not null	Date
Job_id	Not null	Varchar(10)
Salary		Number(8,2)
Commission_pct		Number(2,2)
Manager_id		Number(6)
Department_id		Number(4)

DEPARTMENT TABLE

NAME	NULL?	TYPE
Dept_id	Not null	Number(6)
Dept_name	Not null	Varchar(20)

Manager_id		Number(6)
Location_id		Number(4)

JOB_GRADE TABLE

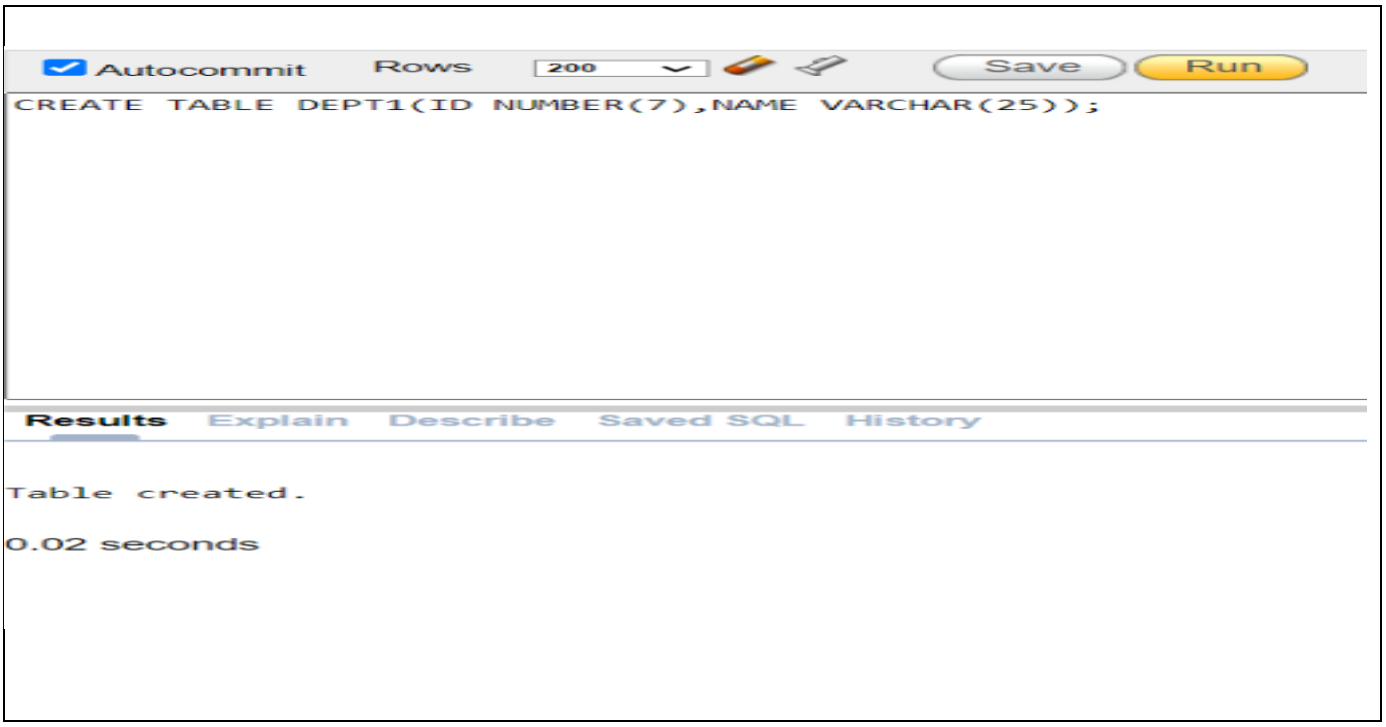
NAME	NULL?	TYPE
Grade_level		Varchar(2)
Lowest_sal		Number
Highest_sal		Number

LOCATION TABLE

NAME	NULL?	TYPE
Location_id	Not null	Number(4)
St_addr		Varchar(40)
Postal_code		Varchar(12)
City	Not null	Varchar(30)
State_province		Varchar(25)
Country_id		Char(2)

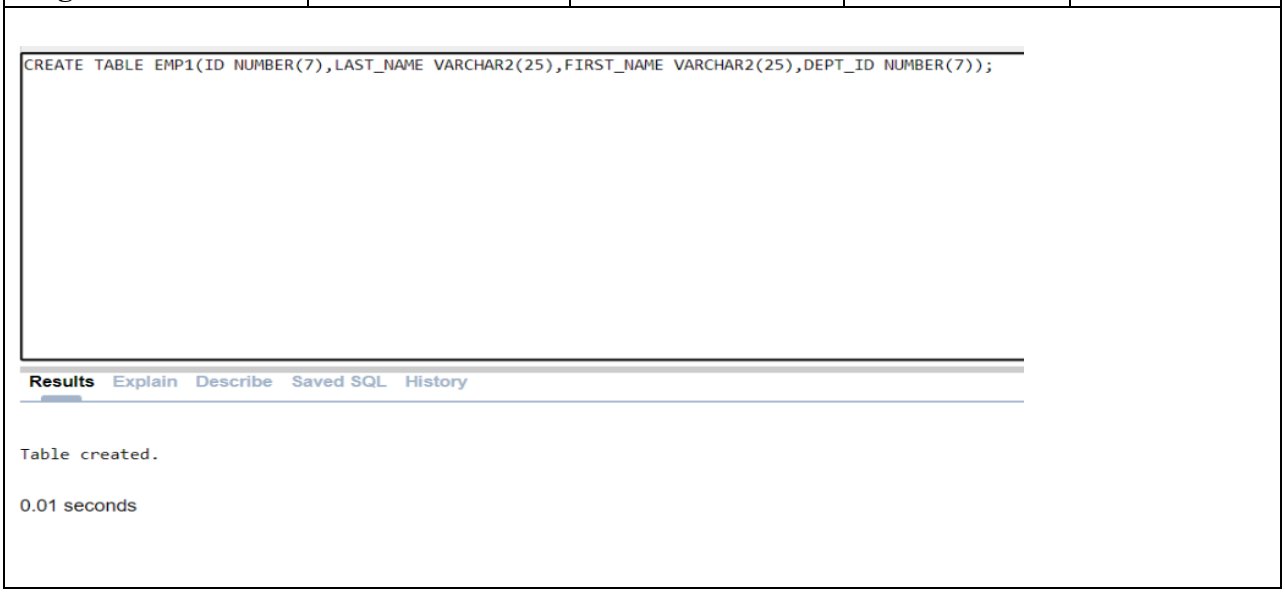
1. Create the DEPT table based on the DEPARTMENT following the table instance chart below. Confirm that the table is created.

Column name	ID	NAME
Key Type		
Nulls/Unique		
FK table		
FK column		
Data Type	Number	Varchar2
Length	7	25



2. Create the EMP table based on the following instance chart. Confirm that the table is created.

Column name	ID	LAST_NAME	FIRST_NAME	DEPT_ID
Key Type				
Nulls/Unique				
FK table				
FK column				
Data Type	Number	Varchar2	Varchar2	Number
Length	7	25	25	7



3. Modify the EMP table to allow for longer employee last names. Confirm the modification.(Hint: Increase the size to 50)

```
ALTER TABLE EMP1 MODIFY LAST_NAME VARCHAR2(50);
```

Results Explain Describe Saved SQL History

```
Table altered.

0.03 seconds
```

4. Create the EMPLOYEES2 table based on the structure of EMPLOYEES table. Include Only the Employee_id, First_name, Last_name, Salary and Dept_id coloumns. Name the columns Id, First_name, Last_name, salary and Dept_id respectively.

```
CREATE TABLE EMPLOYEES2(ID NUMBER(6),First_name VARCHAR2(20),Last_name VARCHAR2(25),Salary NUMBER(8,2),Dept_id NUMBER(4));
```

Results Explain Describe Saved SQL History

```
Table created.

0.00 seconds
```

5. Drop the EMP table.

```
DROP TABLE EMP1;
```

Results Explain Describe Saved SQL History

```
Table dropped.

0.03 seconds
```

6. Rename the EMPLOYEES2 table as EMP.

```
RENAME EMPLOYEES2 TO EMP1;
```

Results Explain Describe Saved SQL History

```
Statement processed.

0.01 seconds
```

7. Add a comment on DEPT and EMP tables. Confirm the modification by describing the table.

```
COMMENT ON TABLE EMP1 IS 'Employees informations are stored';
```

Results Explain Describe Saved SQL History

```
Statement processed.

0.00 seconds
```

8. Drop the First_name column from the EMP table and confirm it.

```
ALTER TABLE EMP1 DROP COLUMN First_name;
```

Results Explain Describe Saved SQL History

```
Table altered.

0.10 seconds
```

Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	

Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-2 MANIPULATING DATA

OBJECTIVE

After, the completion of this exercise the students will be able to do the following

- Describe each DML statement
- Insert rows into tables
- Update rows into table
- Delete rows from table
- Control Transactions

A DML statement is executed when you:

- Add new rows to a table
- Modify existing rows
- Removing existing rows

A transaction consists of a collection of DML statements that form a logical unit of work.

To Add a New Row

INSERT Statement

Syntax

INSERT INTO table_name VALUES (column1 values, column2 values, …, columnn values);

Example:

INSERT INTO department (70, ‘Public relations’, 100,1700);

Inserting rows with null values

Implicit Method: (Omit the column)

INSERT INTO department VALUES (30,’purchasing’);

Explicit Method: (Specify NULL keyword)

INSERT INTO department VALUES (100,’finance’, NULL, NULL);

Inserting Special Values

Example:

Using SYSDATE

INSERT INTO employees VALUES (113,'louis', 'popp', 'lpopp','5151244567',**SYSDATE**, 'ac_account', 6900, NULL, 205, 100);

Inserting Specific Date Values Example:

INSERT INTO employees VALUES (114,'den', 'raphealy', 'drapheal', '5151274561', **TO_DATE('feb 3,1999','mon, dd ,yyyy'),** 'ac_account', 11000,100,30);

To Insert Multiple Rows

& is the placeholder for the variable value **Example:**

INSERT INTO department VALUES (&dept_id, &dept_name, &location);

Copying Rows from another table

- Using Subquery

Example:

INSER INTO sales_reps(id, name, salary, commission_pct)
SELECt employee_id, Last_name, salary, commission_pct
FROM employees
WHERE jod_id LIKE '%REP');

CHANGING DATA IN A TABLE

UPDATE Statement

Syntax1: (to update specific rows**)**

UPDATE table_name SET column=value WHERE condition;

Syntax 2: (To updae all rows)

UPDATE table_name SET column=value;

Updating columns with a subquery

UPDATE employees
SET job_id= (SELECT job_id

FROM employees
WHERE employee_id=205)
WHERE employee_id=114;

REMOVING A ROW FROM A TABLE

DELETE STATEMENT

Syntax

DELETE FROM table_name WHERE conditions;

Example:

DELETE FROM department WHERE dept_name=’finance’’;

Find the Solution for the following:

1. Create MY_EMPLOYEE table with the following structure

NAME	NULL?	TYPE
ID	Not null	Number(4)
Last_name		Varchar(25)
First_name		Varchar(25)
Userid		Varchar(25)
Salary		Number(9,2)

```
CREATE TABLE MY_EMPLOYEE(ID NUMBER(4),Last_name VARCHAR2(25),First_name VARCHAR2(25),Userid VARCHAR2(25),Salary NUMBER(9,2));
```

Results Explain Describe Saved SQL History

```
Table created.
```

0.06 seconds

2. Add the first and second rows data to MY_EMPLOYEE table from the following sample data.

ID	Last_name	First_name	Userid	salary
1	Patel	Ralph	rpatel	895
2	Dancs	Betty	bdancs	860
3	Biri	Ben	bbiri	1100
4	Newman	Chad	Cnewman	750
5	Ropebur	Audrey	aropebur	1550

```
INSERT INTO MY_EMPLOYEE VALUES(1,'Patel','Ralph','rpatel',895);
```

Results Explain Describe Saved SQL History

```
1 row(s) inserted.
```

0.00 seconds

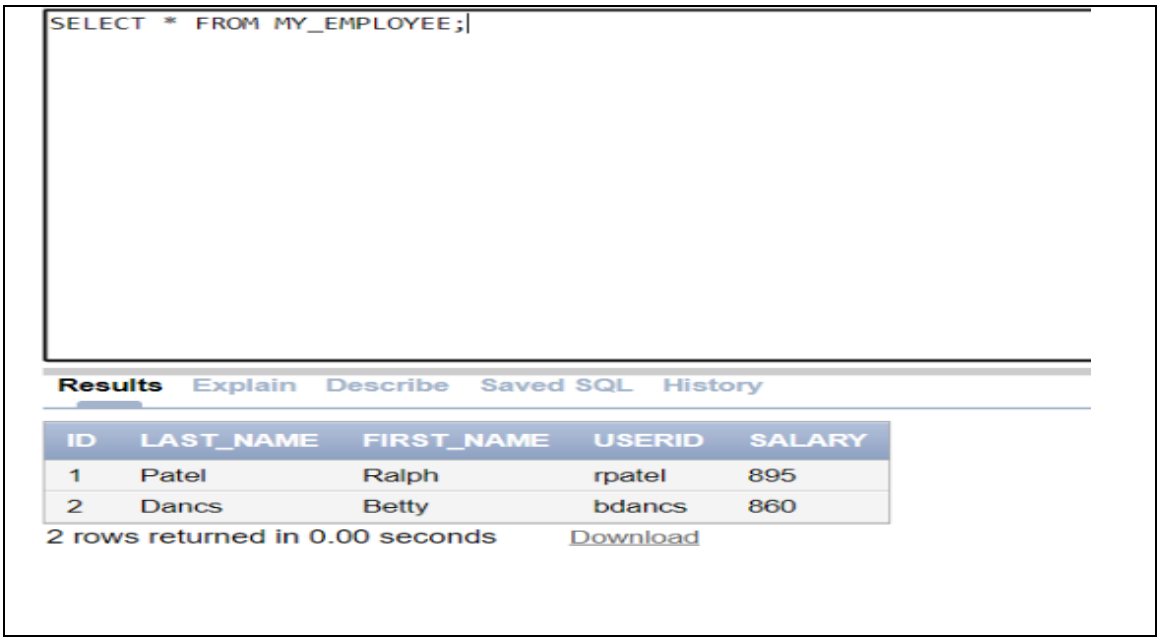
```
INSERT INTO MY_EMPLOYEE VALUES(2,'Dancs','Betty','bdancs',860);
```

Results Explain Describe Saved SQL History

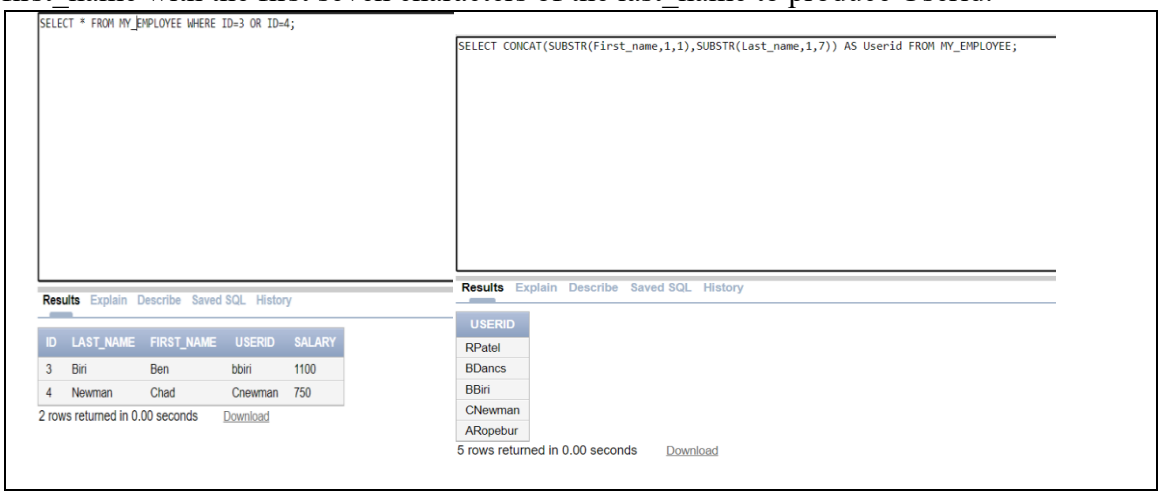
```
1 row(s) inserted.
```

0.00 seconds

3. Display the table with values.



4. Populate the next two rows of data from the sample data. Concatenate the first letter of the first_name with the first seven characters of the last_name to produce Userid.



5. Make the data additions permanent.

```
COMMIT;
```

Results Explain Describe Saved SQL History

```
Statement processed.

0.01 seconds
```

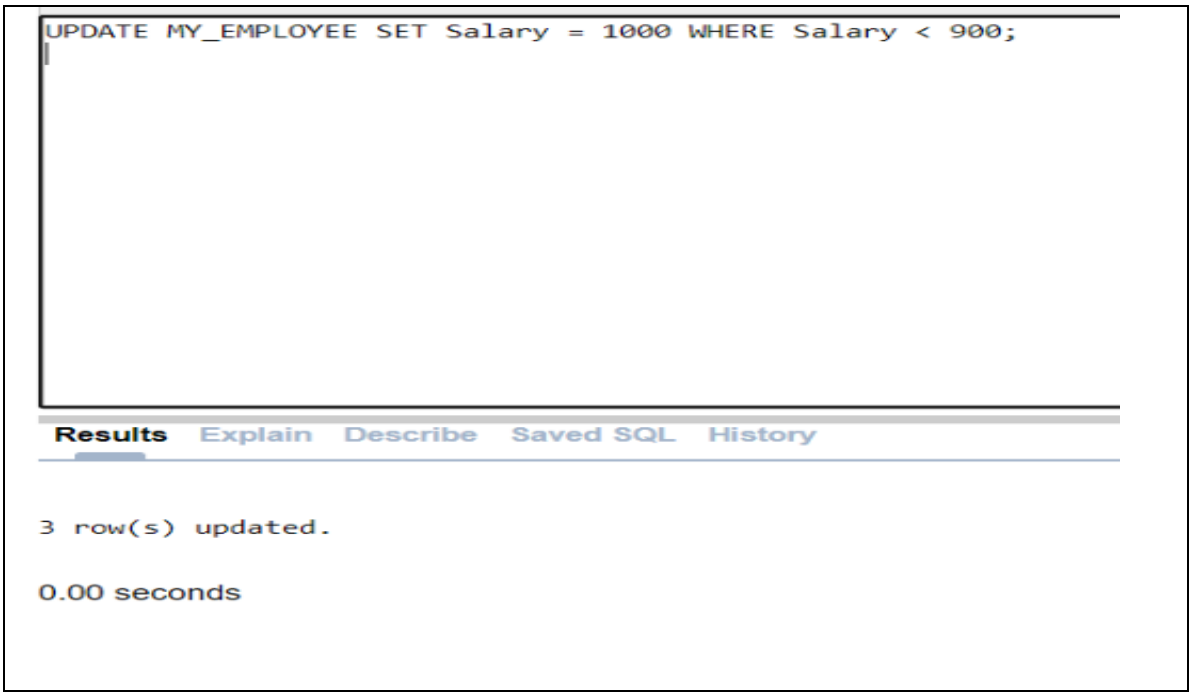
6. Change the last name of employee 3 to Drexler.

```
UPDATE MY_EMPLOYEE SET Last_name = 'Drexler' WHERE ID=3;
```

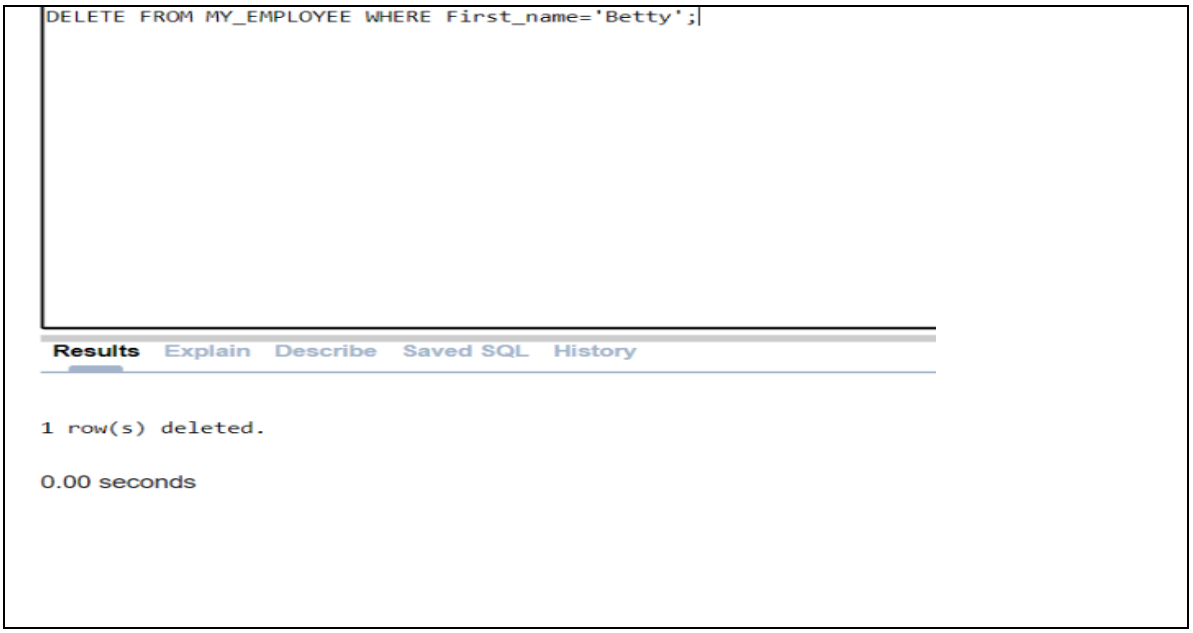
Results Explain Describe Saved SQL History

```
1 row(s) updated.

0.00 seconds
```

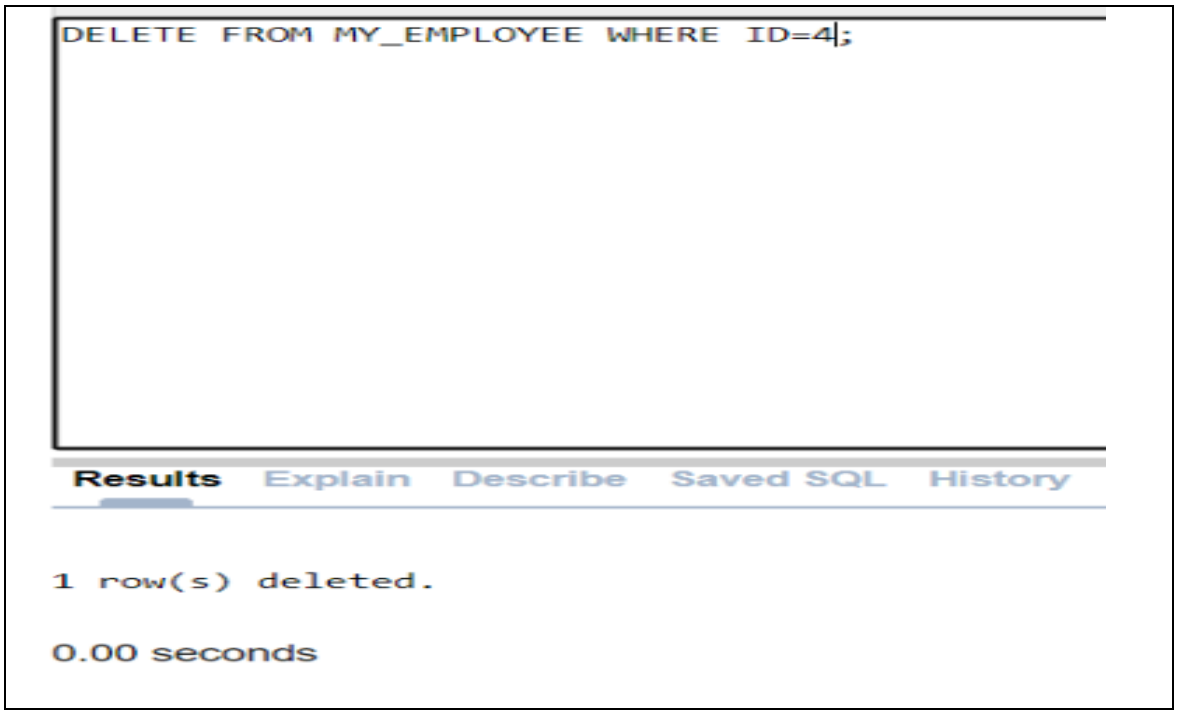
7. Change the salary to 1000 for all the employees with a salary less than 900.



8. Delete Betty dancs from MY _EMPLOYEE table.



9. Empty the fourth row of the emp table.



Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-3

INCLUDING CONSTRAINTS

OBJECTIVE

After the completion of this exercise the students should be able to do the following

- Describe the constraints
- Create and maintain the constraints

What are Integrity constraints?

- Constraints enforce rules at the table level.
- Constraints prevent the deletion of a table if there are dependencies

The following types of integrity constraints are valid

a) **Domain Integrity**

✓ NOT NULL
✓ CHECK

b) **Entity Integrity**

✓ UNIQUE
✓ PRIMARY KEY

c) **Referential Integrity**

✓ FOREIGN KEY

Constraints can be created in either of two ways

1. At the same time as the table is created
2. After the table has been created.

Defining Constraints

Create table tablename (column_name1 data_ type constraints, column_name2 data_ type constraints …); **Example:**

Create table employlees (employee_id number(6), first_name varchar2(20), ..job_id varchar2 (10), CONSTRAINT emp_emp_id_pk PRIMARY KEY (employlee_id));

Domain Integrity

This constraint sets a range and any violations that takes place will prevent the user from performing the manipulation that caused the breach.It includes:

NOT NULL Constraint

While creating tables, by default the rows can have null value.the enforcement of not null constraint in a table ensure that the table contains values.

Principle of null values:

o Setting null value is appropriate when the actual value is unknown, or when a value would not be meaningful. o A null value is not equivalent to a value of zero. o A null value will always evaluate to null in any expression. o When a column name is defined as not null, that column becomes a mandatory i.e., the user has to enter data into it.
o Not null Integrity constraint cannot be defined using the alter table command when the table contain rows.

Example

CREATE TABLE employees (employee_id number (6), last_name varchar2(25) NOT NULL, salary number(8,2), commission_pct number(2,2), hire_date date constraint emp_hire_date_nn NOT NULL'….);

CHECK

Check constraint can be defined to allow only a particular range of values.when the manipulation violates this constraint,the record will be rejected.Check condition cannot contain sub queries.

CREATE TABLE employees (employee_id number (6), last_name varchar2 (25) NOT NULL, salary number(8,2), commission_pct number(2,2), hire_date date constraint emp_hire_date_nn NOT NULL'…,CONSTRAINT emp_salary_mi CHECK(salary > 0));

Entity Integrity

Maintains uniqueness in a record. An entity represents a table and each row of a table represents an instance of that entity. To identify each row in a table uniquely we need to use this constraint. There are 2 entity constraints:

a) Unique key constraint

It is used to ensure that information in the column for each record is unique, as with telephone or driver's license numbers. It prevents the duplication of value with rows of a specified column in a set of column. A column defined with the constraint can allow null value.
If unique key constraint is defined in more than one column i.e., combination of column cannot be specified. Maximum combination of columns that a composite unique key can contain is 16.

Example:

CREATE TABLE employees (employee_id number(6), last_name varchar2(25) NOT NULL,email varchar2(25), salary number(8,2), commission_pct number(2,2), hire_date date constraint emp_hire_date_nn NOT NULL' COSTRAINT emp_email_uk UNIQUE(email));

PRIMARY KEY CONSTRAINT

A primary key avoids duplication of rows and does not allow null values. Can be defined on one or more columns in a table and is used to uniquely identify each row in a table. These values should never be changed and should never be null.
A table should have only one primary key. If a primary key constraint is assigned to more than one column or combination of column is said to be composite primary key, which can contain 16 columns.

Example:

CREATE TABLE employees (employee_id number(6) , last_name varchar2(25) NOT NULL,email varchar2(25), salary number(8,2), commission_pct number(2,2), hire_date date constraint emp_hire_date_nn NOT NULL, Constraint emp_id pk PRIMARY KEY (employee_id),CONSTRAINT emp_email_uk UNIQUE(email));

c) Referential Integrity

It enforces relationship between tables. To establish parent-child relationship between 2 tables having a common column definition, we make use of this constraint. To implement this, we should define the column in the parent table as primary key and same column in the child table as foreign key referring to the corresponding parent entry.

Foreign key

A column or combination of column included in the definition of referential integrity, which would refer to a referenced key.

Referenced key

It is a unique or primary key upon which is defined on a column belonging to the parent table.
Keywords:

FOREIGN KEY: Defines the column in the child table at the table level constraint.

REFERENCES: Identifies the table and column in the parent table.

ON DELETE CASCADE: Deletes the dependent rows in the child table when a row in the parent table is deleted.

ON DELETE SET NULL: converts dependent foreign key values to null when the parent value is removed.

CREATE TABLE employees (employee_id number(6) , last_name varchar2(25) NOT NULL,email varchar2(25), salary number(8,2), commission_pct number(2,2), hire_date date constraint emp_hire_date_nn NOT NULL, Constraint emp_id pk PRIMARY KEY (employee_id),CONSTRAINT emp_email_uk UNIQUE(email),CONSTRAINT emp_dept_fk FOREIGN KEY (department_id) references deparments(dept_id));

ADDING A CONSTRAINT

Use the ALTER to

- Add or Drop a constraint, but not modify the structure
- Enable or Disable the constraints
- Add a not null constraint by using the Modify clause

Syntax

ALTER TABLE table name ADD CONSTRAINT Cons_name type(column name);

Example:

ALTER TABLE employees ADD CONSTRAINT emp_manager_fk FOREIGN KEY (manager_id) REFERENCES employees (employee_id);

DROPPING A CONSTRAINT

Example:

ALTER TABLE employees DROP CONSTRAINT emp_manager_fk;

CASCADE IN DROP

- The CASCADE option of the DROP clause causes any dependent constraints also to be dropped.

Syntax

ALTER TABLE departments DROP PRIMARY KEY|UNIQUE (column)| CONSTRAINT constraint _name CASCADE;

DISABLING CONSTRAINTS

- Execute the DISABLE clause of the ALTER TABLE statement to deactivate an integrity constraint
- Apply the CASCADE option to disable dependent integrity constraints.

Example

ALTER TABLE employees DISABLE CONSTRAINT emp_emp_id_pk CASCADE;

ENABLING CONSTRAINTS

● Activate an integrity constraint currently disabled in the table definition by using the ENABLE clause.

Example

ALTER TABLE employees ENABLE CONSTRAINT emp_emp_id_pk CASCADE;

CASCADING CONSTRAINTS

The CASCADE CONSTRAINTS clause is used along with the DROP column clause.
It drops all referential integrity constraints that refer to the primary and unique keys defined on the dropped Columns.

This clause also drops all multicolumn constraints defined on the dropped column.

Example:

Assume table TEST1 with the following structure

CREATE TABLE test1 (pk number PRIMARY KEY, fk number, col1 number,col2 number, CONTRAINT fk_constraint FOREIGN KEY(fk) references test1, CONSTRAINT ck1 CHECK (pk>0 and col1>0), CONSTRAINT ck2 CHECK (col2>0));

An error is returned for the following statements

ALTER TABLE test1 DROP (pk);

ALTER TABLE test1 DROP (col1);

The above statement can be written with CASCADE CONSTRAINT

ALTER TABLE test 1 DROP(pk) CASCADE CONSTRAINTS;
(OR)
ALTER TABLE test 1 DROP(pk, fk, col1) CASCADE CONSTRAINTS;

VIEWING CONSTRAINTS

Query the USER_CONSTRAINTS table to view all the constraints definition and names.

Example:

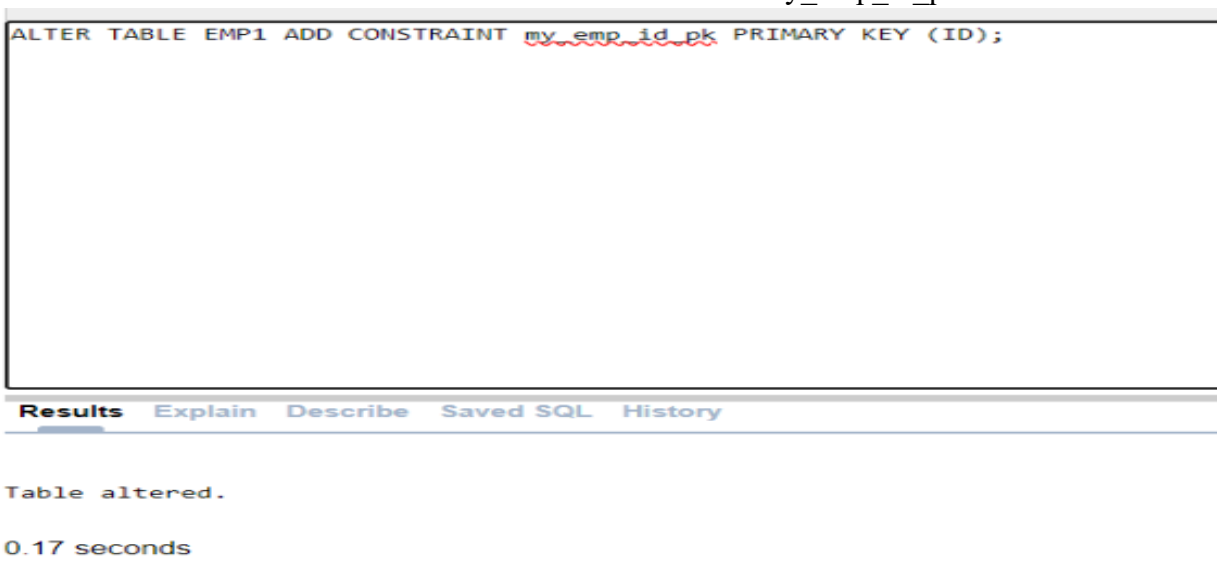
SELECT constraint_name, constraint_type, search_condition FROM user_constraints
WHERE table_name=’employees’;

Viewing the columns associated with constraints

SELECT constraint_name, constraint_type, FROM user_cons_columns
WHERE table_name=’employees’;

Find the Solution for the following:

1. Add a table-level PRIMARY KEY constraint to the EMP table on the ID column.The constraint should be named at creation. Name the constraint my_emp_id_pk.



2. Create a PRIMAY KEY constraint to the DEPT table using the ID colum. The constraint should be named at creation. Name the constraint my_dept_id_pk.

```
ALTER TABLE DEPT1 ADD CONSTRAINT my_dept_id_pk PRIMARY KEY (ID);
```

Results Explain Describe Saved SQL History

```
Table altered.

0.03 seconds
```

3. Add a column DEPT_ID to the EMP table. Add a foreign key reference on the EMP table that ensures that the employee is not assigned to nonexistent deparment. Name the constraint my_emp_dept_id_fk.

```
ALTER TABLE EMP1 ADD CONSTRAINT  my_emp_dept_id_fk FOREIGN KEY (DEPT_ID) REFERENCES DEPT1(ID);
```

Results Explain Describe Saved SQL History

```
Table altered.

0.03 seconds
```

4. Modify the EMP table. Add a COMMISSION column of NUMBER data type, precision 2, scale 2. Add a constraint to the commission column that ensures that a commission value is greater than zero.

```
ALTER TABLE EMP1 ADD (COMMISSION NUMBER (2,2));
```

Results Explain Describe Saved SQL History

```
Table altered.

0.04 seconds
```

Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-4

Writing Basic SQL SELECT Statements

OBJECTIVES

After the completion of this exercise, the students will be able to do the following:

- List the capabilities of SQL SELECT Statement
- Execute a basic SELECT statement

Capabilities of SQL SELECT statement

A SELECT statement retrieves information from the database. Using a select statement, we can perform

✓ Projection: To choose the columns in a table
✓ Selection: To choose the rows in a table
✓ Joining: To bring together the data that is stored in different tables

Basic SELECT Statement

Syntax

SELECT *|DISTINCT Column_ name| alias
` FROM table_name;

NOTE:

DISTINCT—Suppr ess
the duplicates.
Alias—gives selected columns different headings.

Example: 1

SELECT * FROM departments;

Example: 2

SELECT location_id, department_id FROM departments;

Writing SQL Statements

- SQL statements are not case sensitive ● SQL statements can be on one or more lines.
- Keywords cannot be abbreviated or split across lines
- Clauses are usually placed on separate lines
- Indents are sued to enhance readability

Using Arithmetic Expressions

Basic Arithmetic operators like *, /, +, -can be used

Example:1

SELECT last_name, salary, salary+300 FROM employees;

Example:2

SELECT last_name, salary, 12*salary+100 FROM employees;

The statement is not same as

SELECT last_name, salary, 12*(salary+100) FROM employees;

Example:3

SELECT last_name, job_id, salary, commission_pct FROM employees;

Example:4

SELECT last_name, job_id, salary, 12*salary*commission_pct FROM employees;

Using Column Alias

- To rename a column heading with or without AS keyword.

Example:1

SELECT last_name AS Name
FROM employees;

Example: 2

SELECT last_name "Name" salary*12 "Annual Salary "
FROM employees;

Concatenation Operator

- Concatenates columns or character strings to other columns
- Represented by two vertical bars (||)
- Creates a resultant column that is a character expression **Example:**

SELECT last_name||job_id AS "EMPLOYEES JOB" FROM employees;

Using Literal Character String

- A literal is a character, a number, or a date included in the SELECT list.
- Date and character literal values must be enclosed within single quotation marks.

Example:

SELECT last_name||'is a'||job_id AS "EMPLOYEES JOB" FROM employees;

Eliminating Duplicate Rows

- Using DISTINCT keyword.

Example:

SELECT DISTINCT deparment_id FROM employees;

Displaying Table Structure

- Using DESC keyword.

Syntax DESC
table_name;

Example:
DESC employees;

Find the Solution for the following:

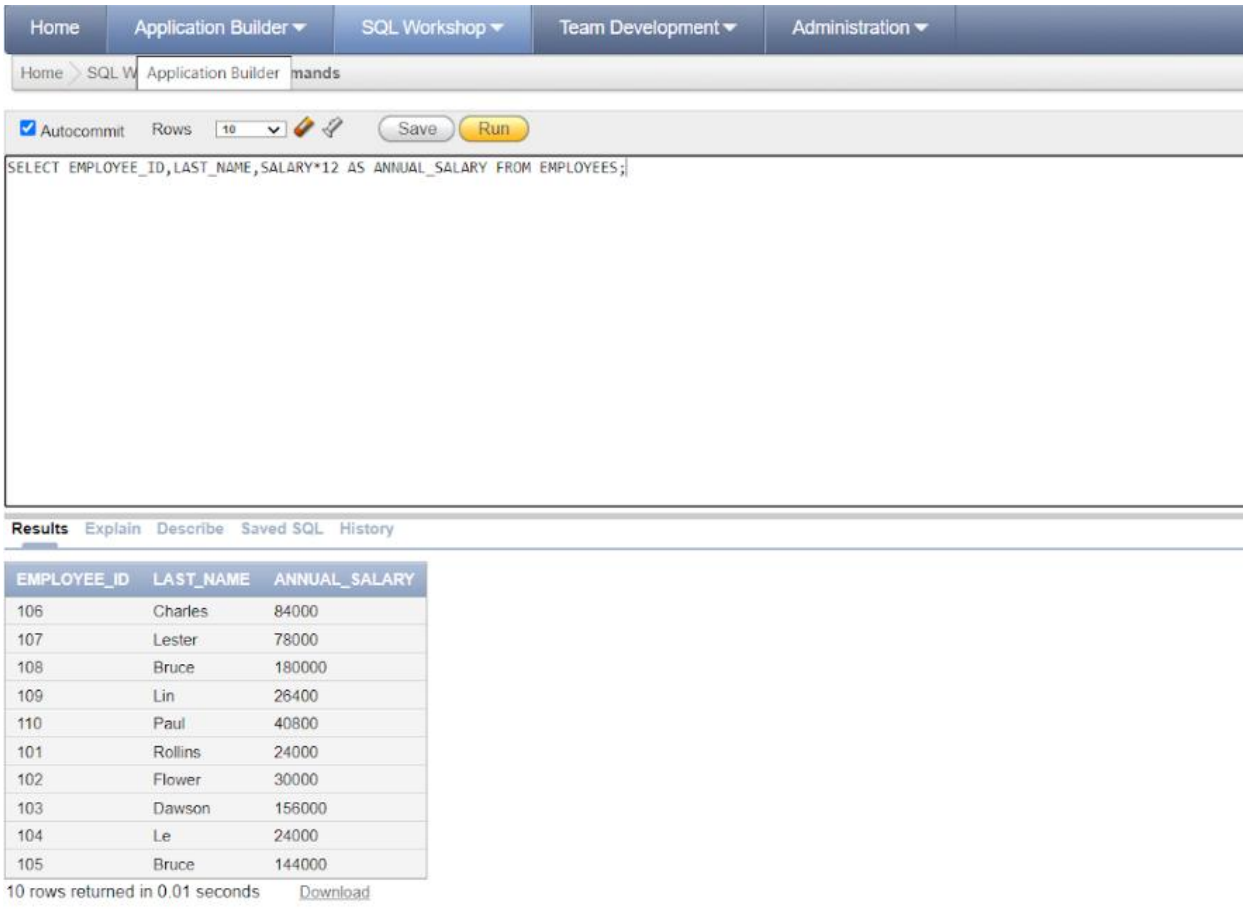
True OR False

1. The following statement executes successfully.

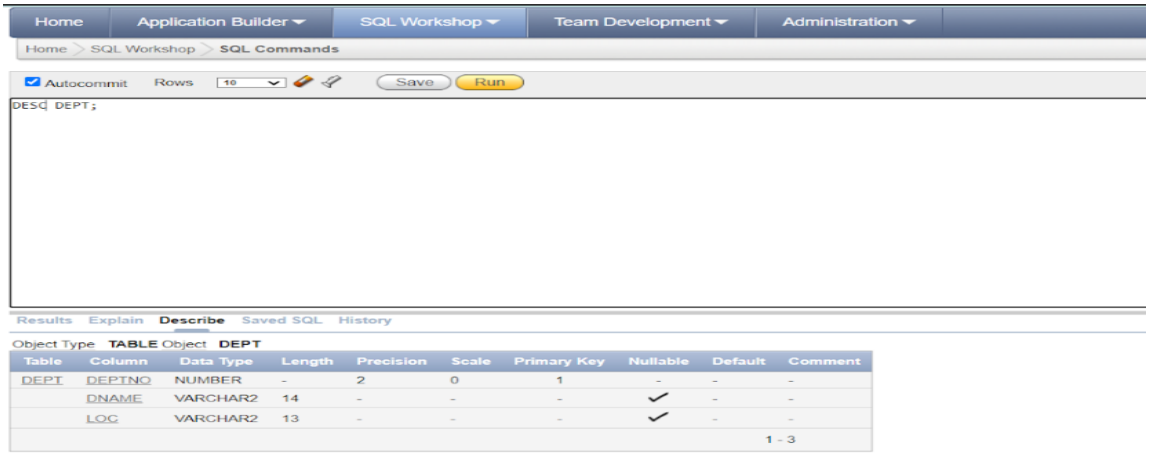
Identify the Errors

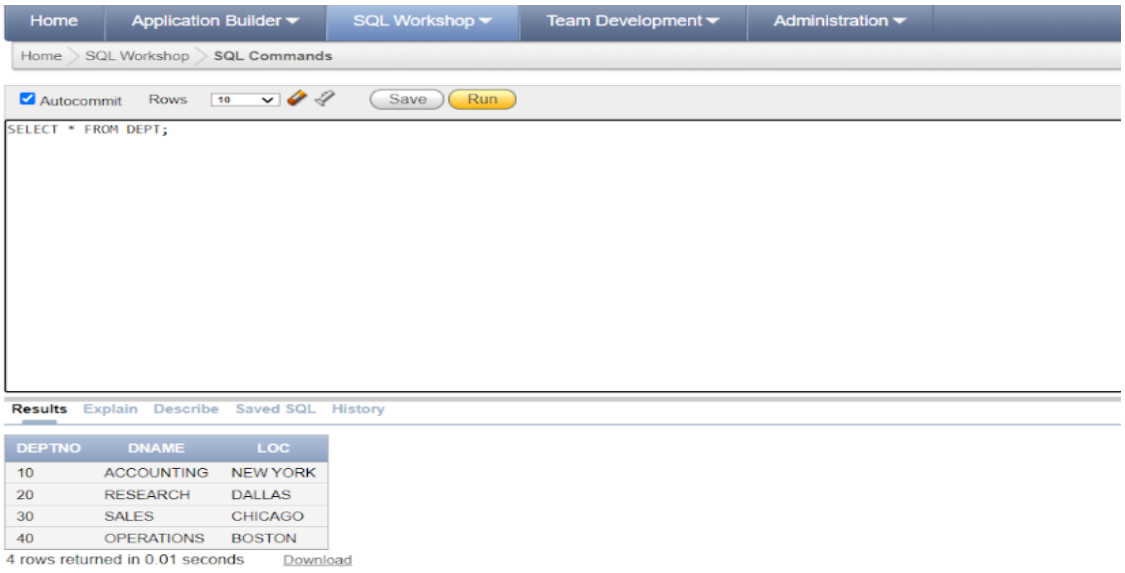
SELECT employee_id, last_name sal*12
ANNUAL SALARY
FROM employees;

Queries

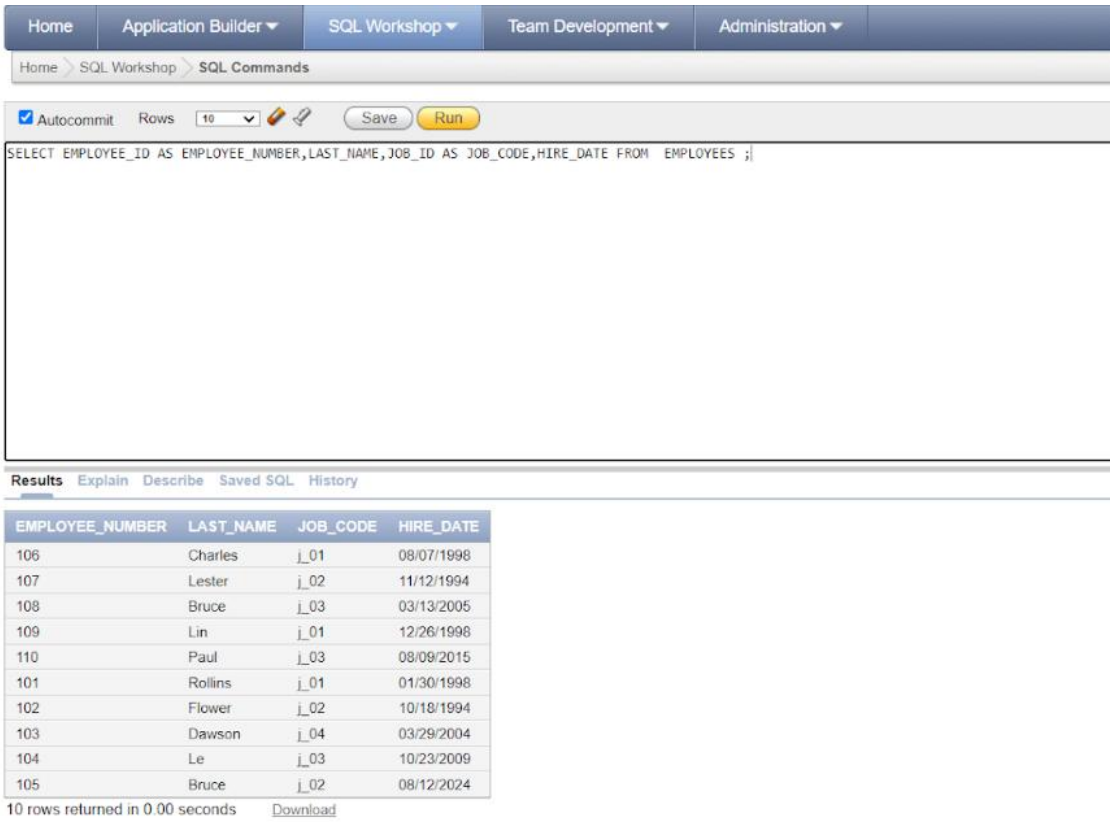


2. Show the structure of departments the table. Select all the data from it.

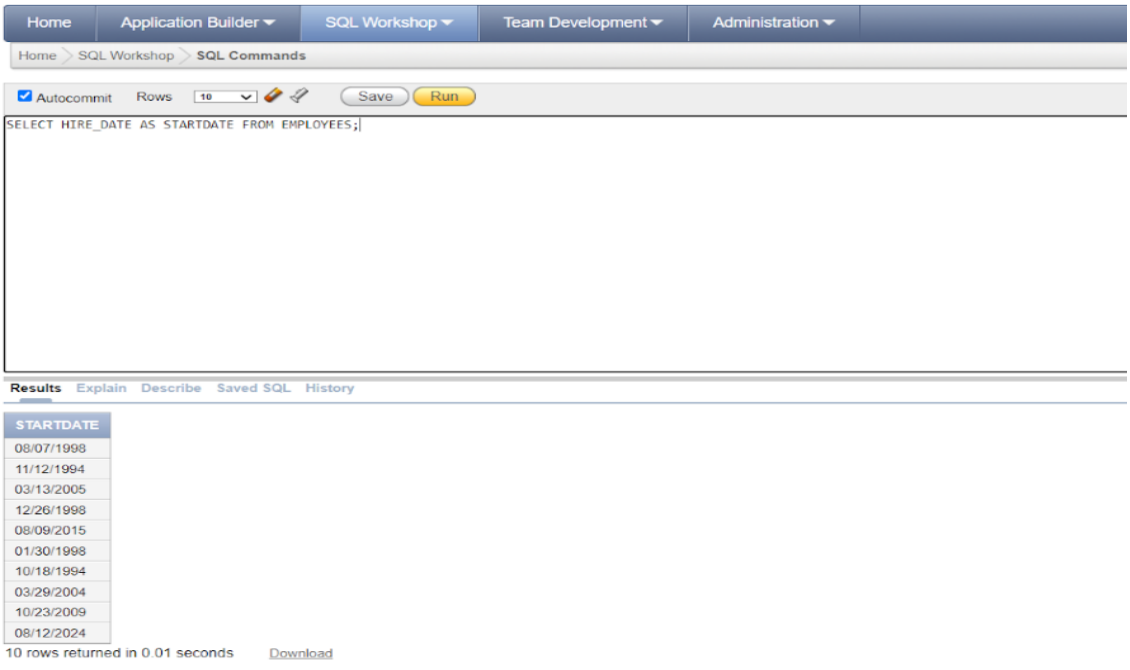




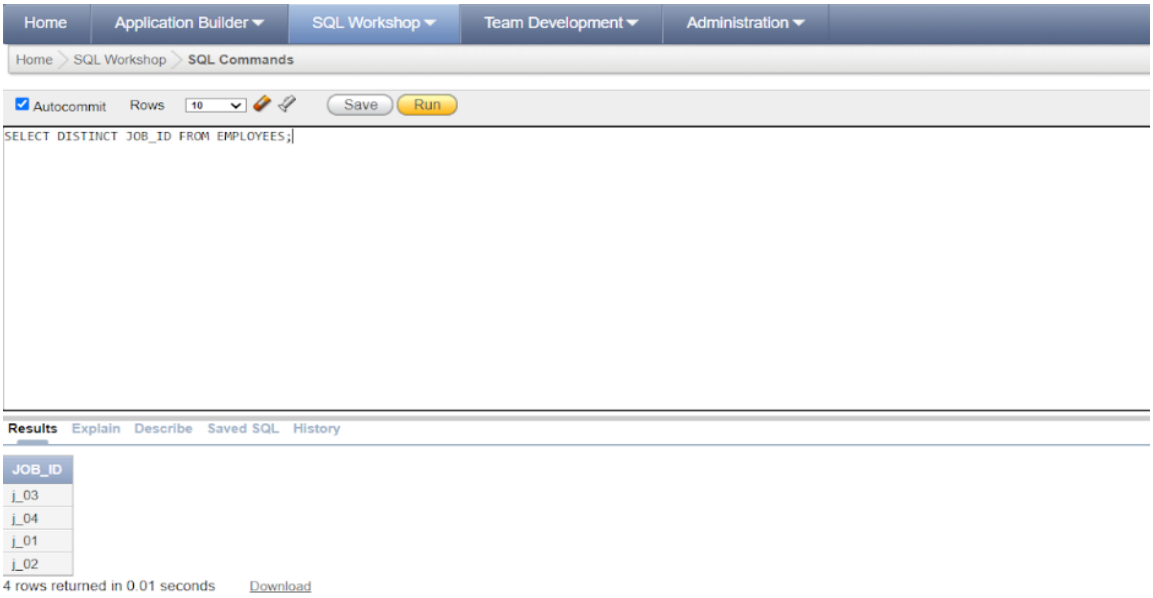
3. Create a query to display the last name, job code, hire date, and employee number for each employee, with employee number appearing first.



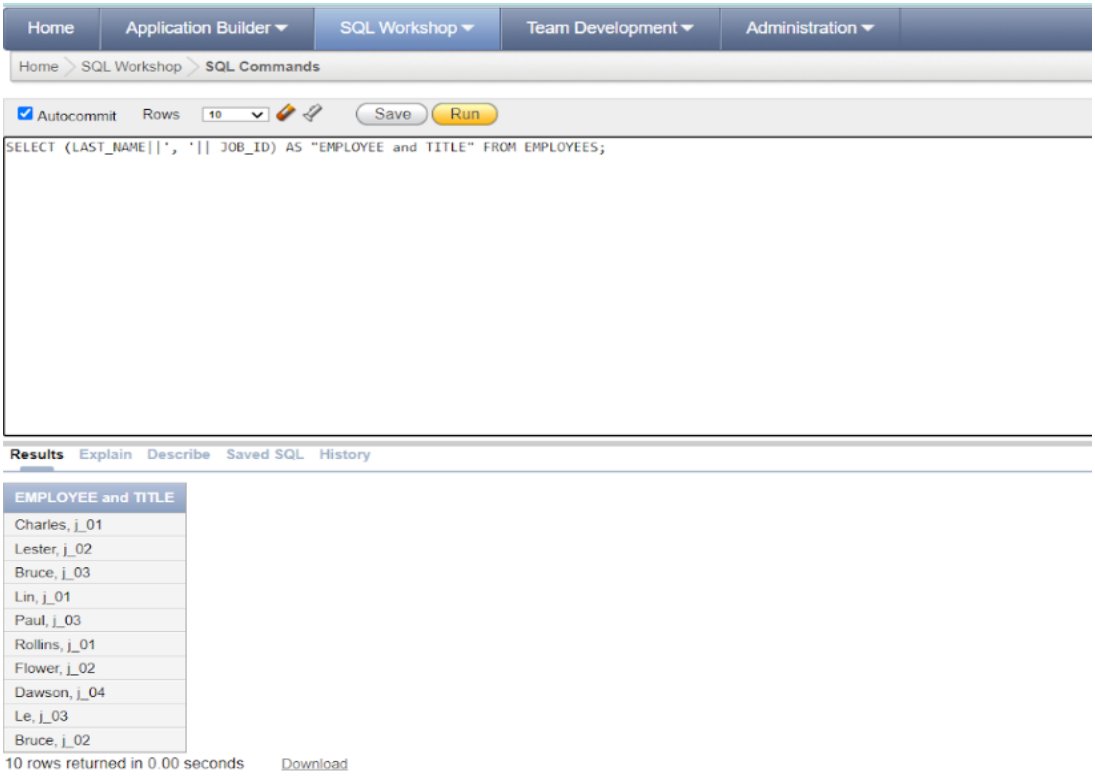
4. Provide an alias STARTDATE for the hire date.



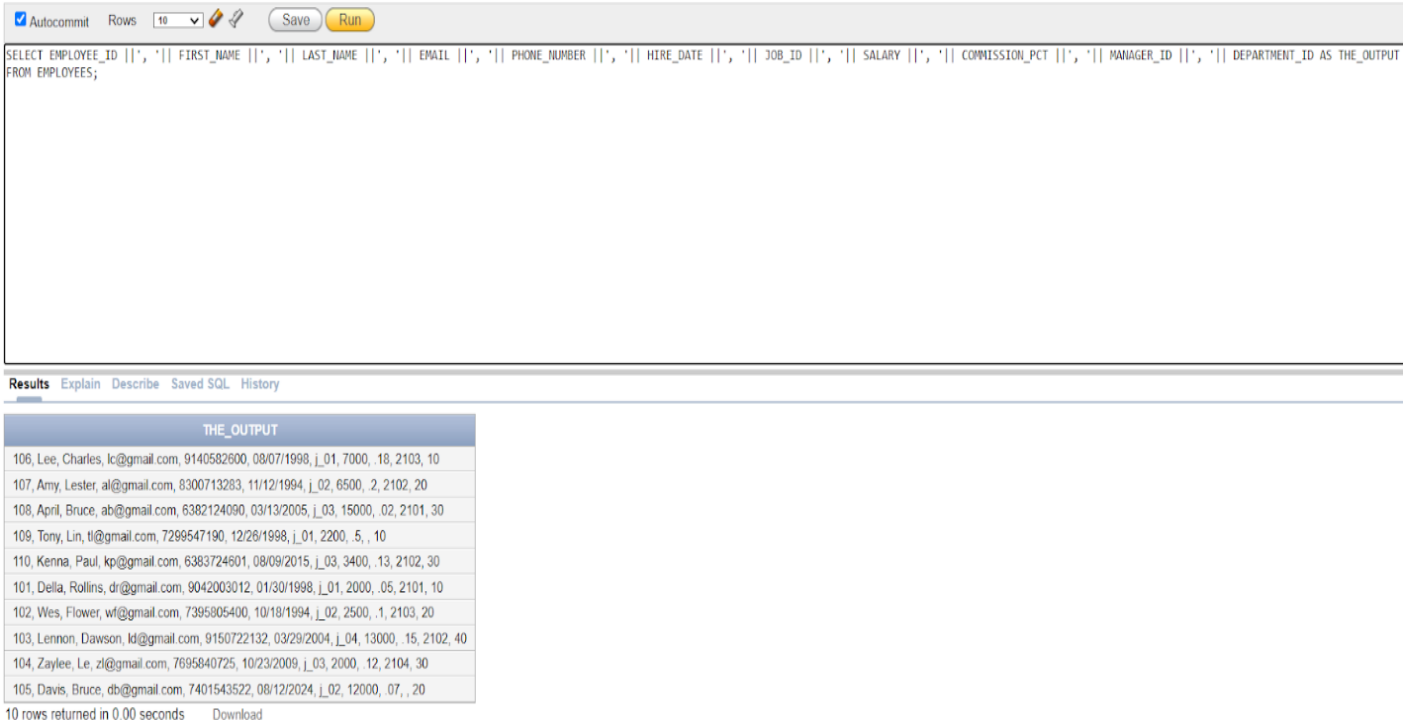
5. Create a query to display unique job codes from the employee table.



6. Display the last name concatenated with the job ID , separated by a comma and space, and name the column EMPLOYEE and TITLE.



7. Create a query to display all the data from the employees table. Separate each column by a comma. Name the column THE_OUTPUT.



Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-5

Restricting and Sorting data

After the completion of this exercise, the students will be able to do the following:

- Limit the rows retrieved by the queries
- Sort the rows retrieved by the queries
-

Limiting the Rows selected

- Using WHERE clause
- Alias cannot used in WHERE clause

Syntax

SELECT----------
FROM---------- WHERE
condition; **Example:**

SELECT employee_id,last_name, job_id, deparment_id FROM employees WHERE department_id=90;

Character strings and Dates

Character strings and date values are enclosed in single quotation marks.

Character values are case sensitive and date values are format sensitive.

Example:
SELECT employee_id,last_name, job_id, deparment_id FROM employees
WHERE last_name='WHALEN";
Comparison Conditions

All relational operators can be used. (=, >, >=, <, <= ,<>,!=)

Example:

SELECT last_name, salary
FROM employees
WHERE salary<=3000;

Other comparison conditions

Operator	Meaning
BETWEEN …AND…	Between two values
IN	Match any of a list of values
LIKE	Match a character pattern
IS NULL	Is a null values

Example:1
SELECT last_name, salary
FROM employees
WHERE salary BETWEEN 2500 AND 3500;

Example:2

```
SELECT employee_id, last_name, salary , manager_id
FROM employees
WHERE manager_id IN (101, 100,201);
```

Example:3

- Use the LIKE condition to perform wildcard searches of valid string values.
- Two symbols can be used to construct the search string
  - % denotes zero or more characters
  - _ denotes one character

```
SELECT first_name, salary
FROM employees
WHERE first_name LIKE '%s';
```

Example:4

```
SELECT last_name, salary  FROM
employees
WHERE last_name LIKE '_o%';
```

Example:5

ESCAPE option-To have an exact match for the actual % and_ characters
To search for the string that contain 'SA_'

```
SELECT employee_id, first_name, salary,job_id  FROM
employees
WHERE job_id LIKE '%sa\_%'ESCAPE'\';
```

Test for NULL

- Using IS NULL operator **Example:**

```
SELECT employee_id, last_name, salary , manager_id
FROM employees
WHERE manager_id  IS NULL;
```

Logical Conditions

All logical operators can be used.(AND,OR,NOT)

Example:1

```
SELECT employee_id, last_name, salary , job_id
FROM employees
WHERE salary>=10000
AND job_id LIKE '%MAN%';
```

Example:2

```
SELECT employee_id, last_name, salary , job_id
FROM employees
WHERE salary>=10000
OR job_id LIKE '%MAN%';
```

Example:3

```
SELECT employee_id, last_name, salary , job_id FROM
employees
WHERE  job_id NOT IN ('it_prog', st_clerk', sa_rep');
```

Rules of Precedence

Order Evaluated	**Operator**
1	Arithmetic
2	Concatenation
3	Comparison
4	IS [NOT] NULL, LIKE, [NOT] IN
5	[NOT] BETWEEN
6	Logical NOT
7	Logical AND
8	Logical OR

Example:1

```
SELECT employee_id, last_name, salary , job_id
FROM employees  WHERE
job_id ='sa_rep'
OR job_id='ad_pres'
AND salary>15000;
```

Example:2

```
SELECT employee_id, last_name, salary , job_id
```

```
FROM employees  WHERE
(job_id =’sa_rep’
OR job_id=’ad_pres’)
AND salary>15000;
```

Sorting the rows

Using ORDER BY Clause

ASC-Ascending Order,Default

DESC-Descending order

Example:1

```
SELECT  last_name, salary , job_id,department_id,hire_date
FROM employees
ORDER BY hire_date;
```

Example:2

```
SELECT  last_name, salary , job_id,department_id,hire_date
FROM employees
ORDER BY hire_date DESC;
```

Example:3 Sorting by column alias

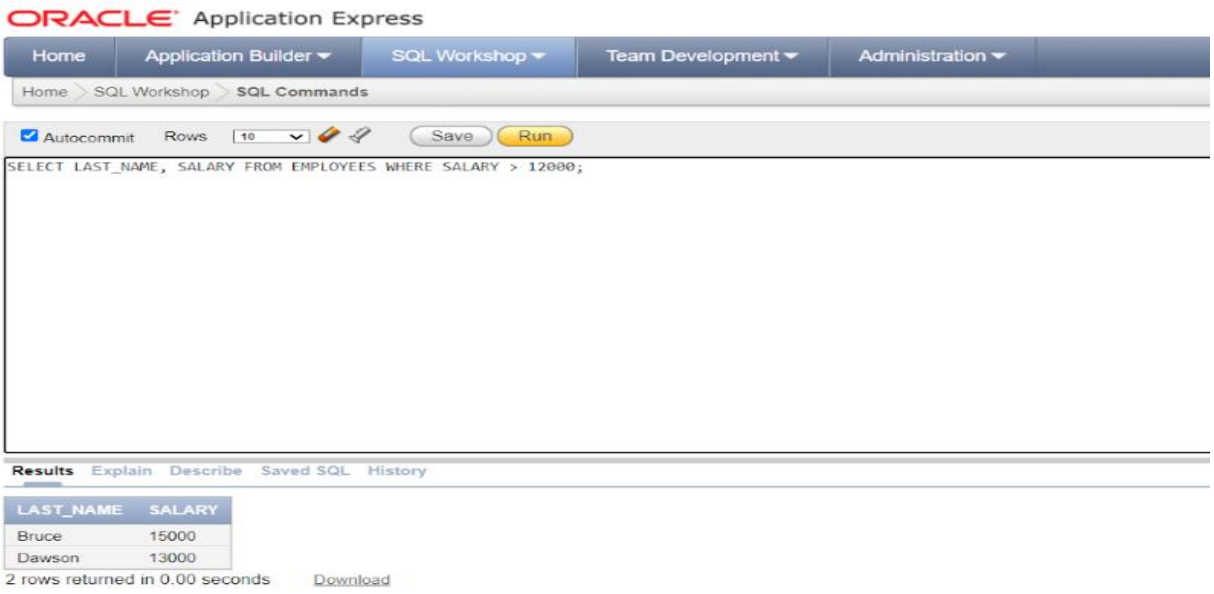
```
SELECT  last_name, salary*12 annsal , job_id,department_id,hire_date
FROM employees
ORDER BY annsal;
```

Example:4 Sorting by Multiple columns

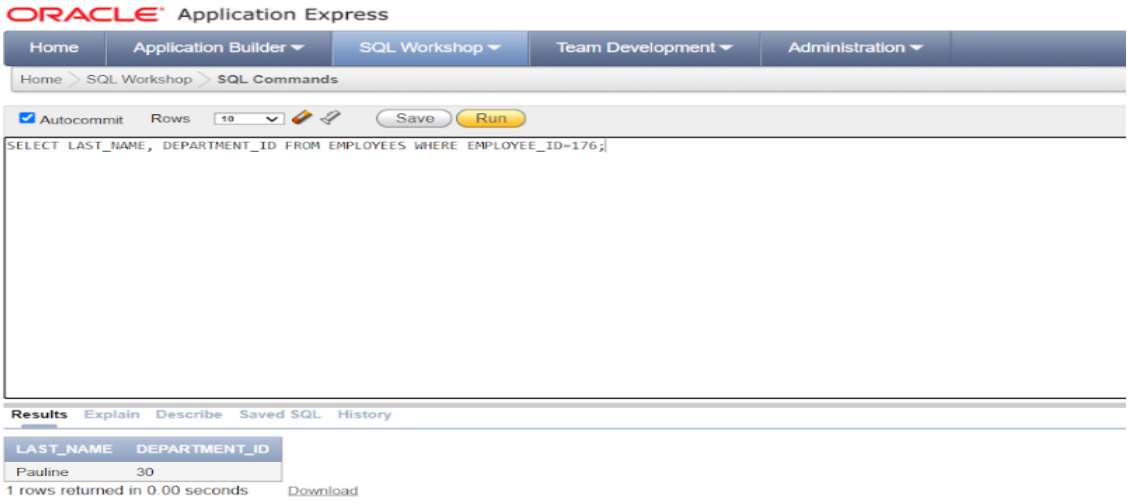
```
SELECT  last_name, salary , job_id,department_id,hire_date
FROM employees
ORDER BY department_id, salary DESC;
```

Find the Solution for the following:

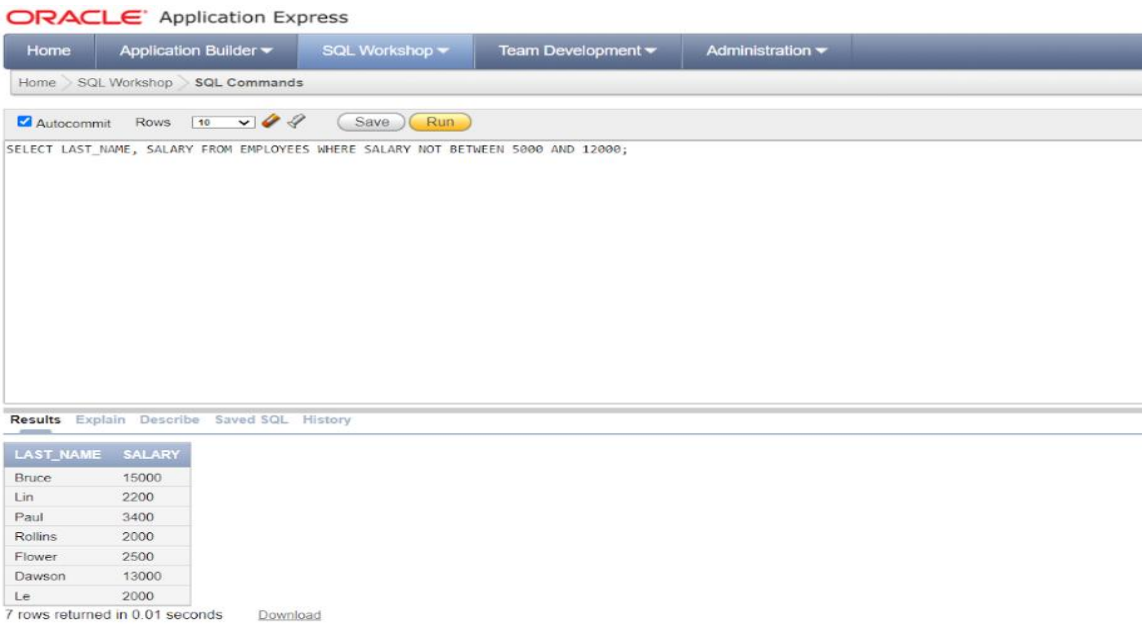
1. Create a query to display the last name and salary of employees earning more than 12000.



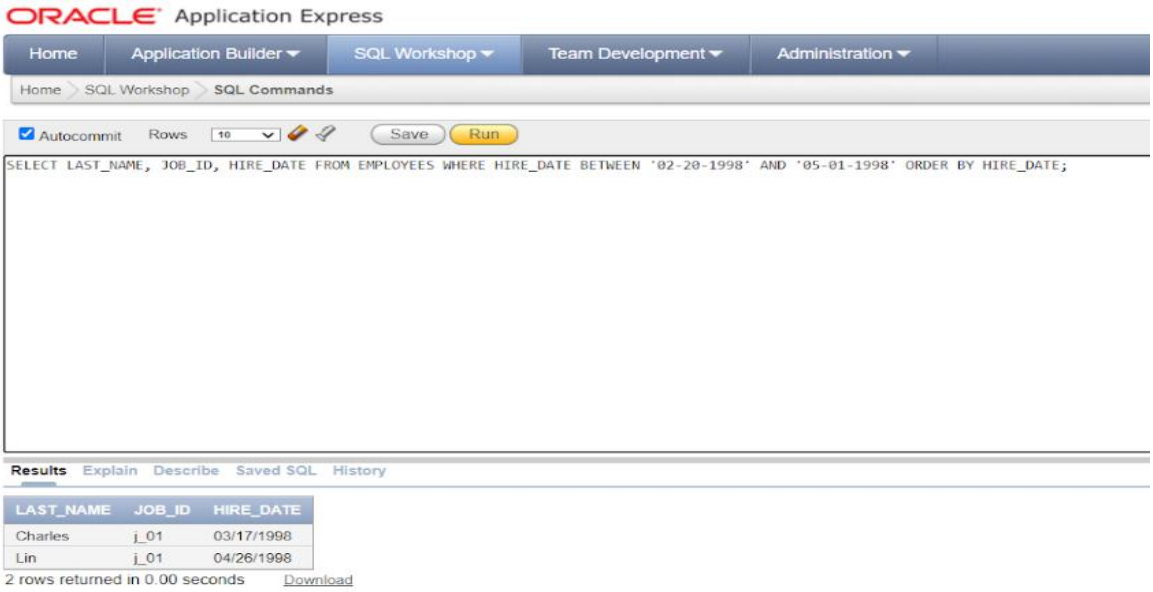
2. Create a query to display the employee last name and department number for employee number 176.



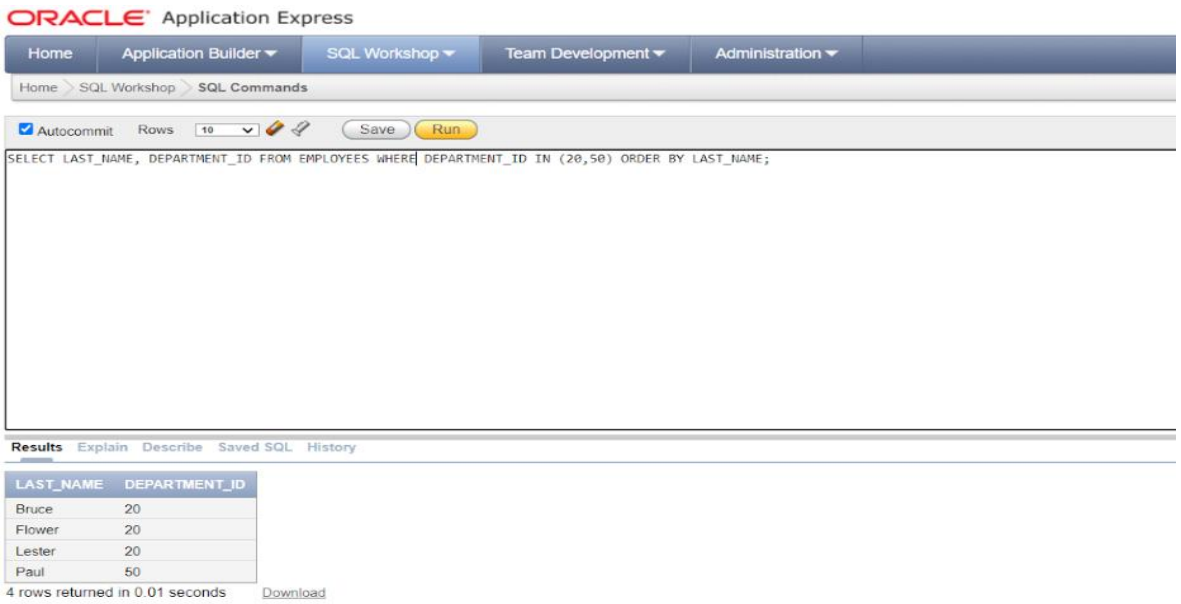
3. Create a query to display the last name and salary of employees whose salary is not in the range of 5000 and 12000. (hints: not between)



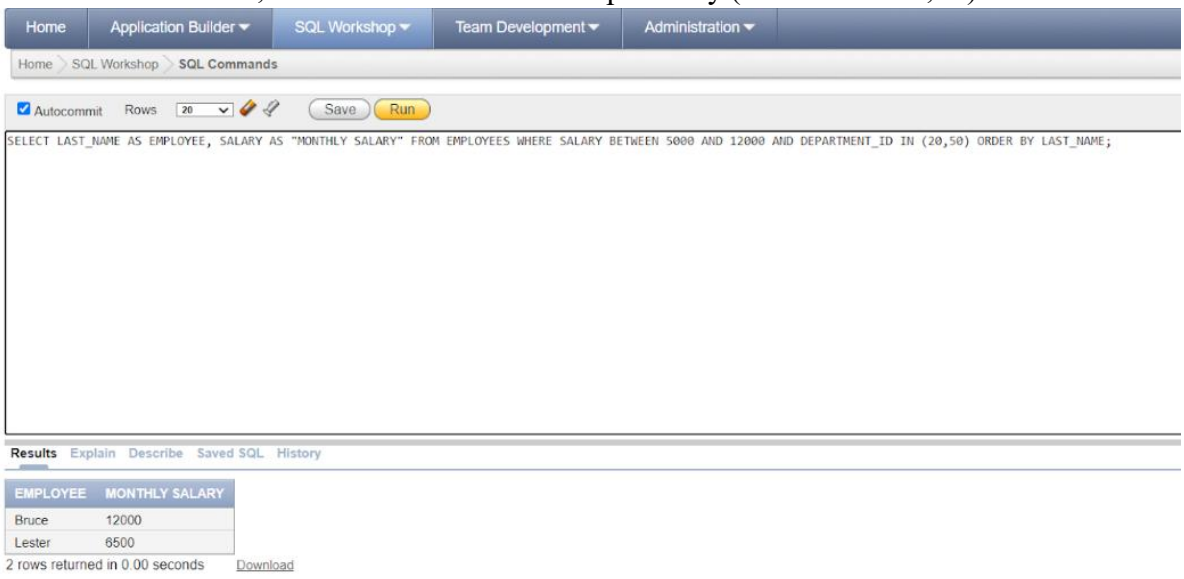
4. Display the employee last name, job ID, and start date of employees hired between February 20,1998 and May 1,1998.order the query in ascending order by start date.(hints: between)



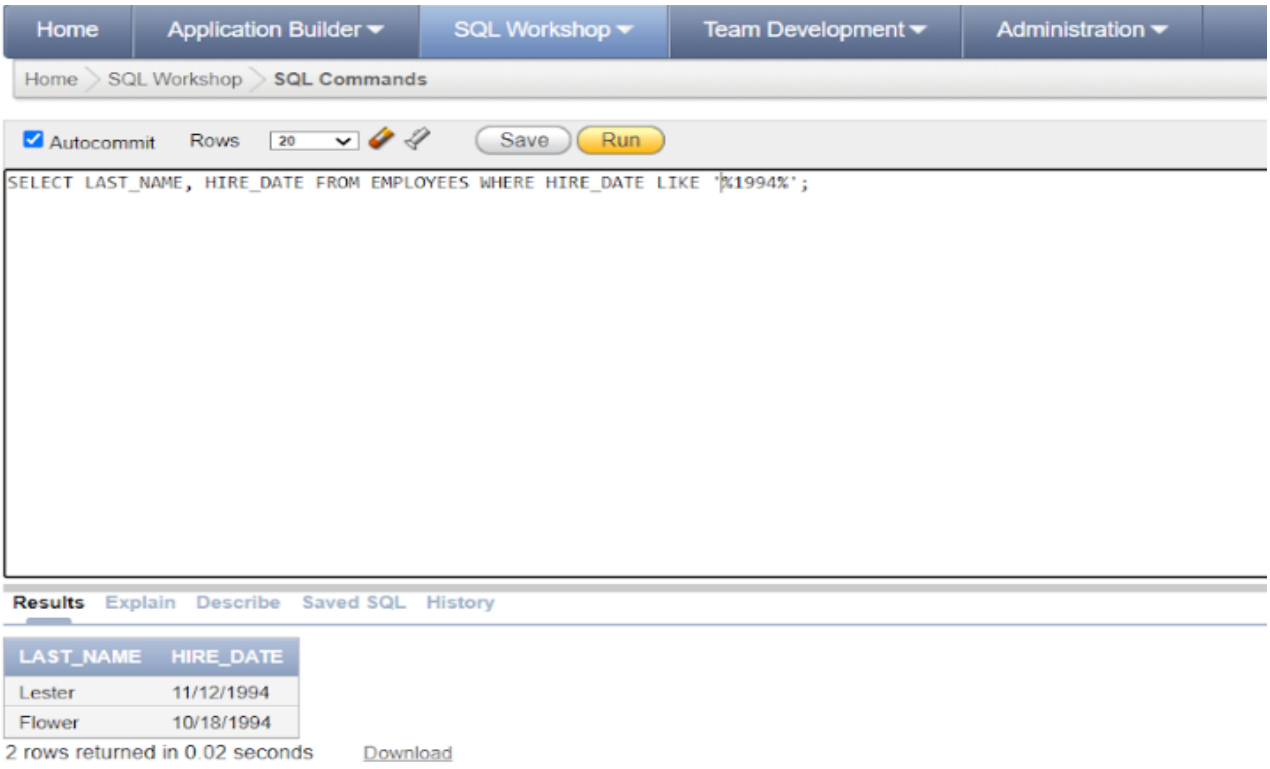
5. Display the last name and department number of all employees in departments 20 and 50 in alphabetical order by name.(hints: in, orderby)



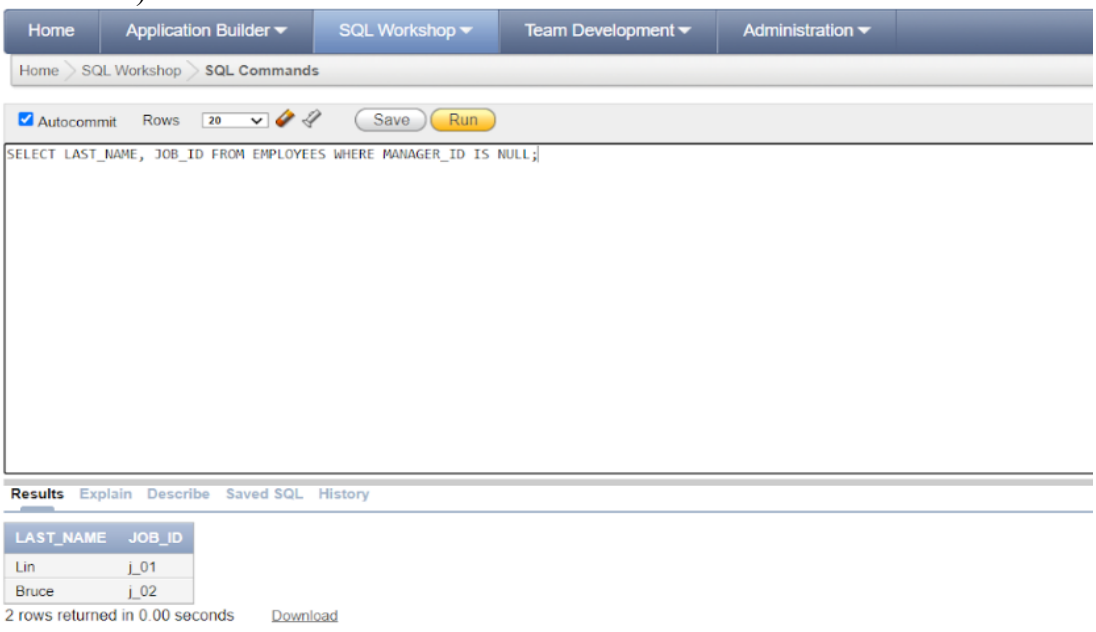
6. Display the last name and salary of all employees who earn between 5000 and 12000 and are in departments 20 and 50 in alphabetical order by name. Label the columns EMPLOYEE, MONTHLY SALARY respectively.(hints: between, in)



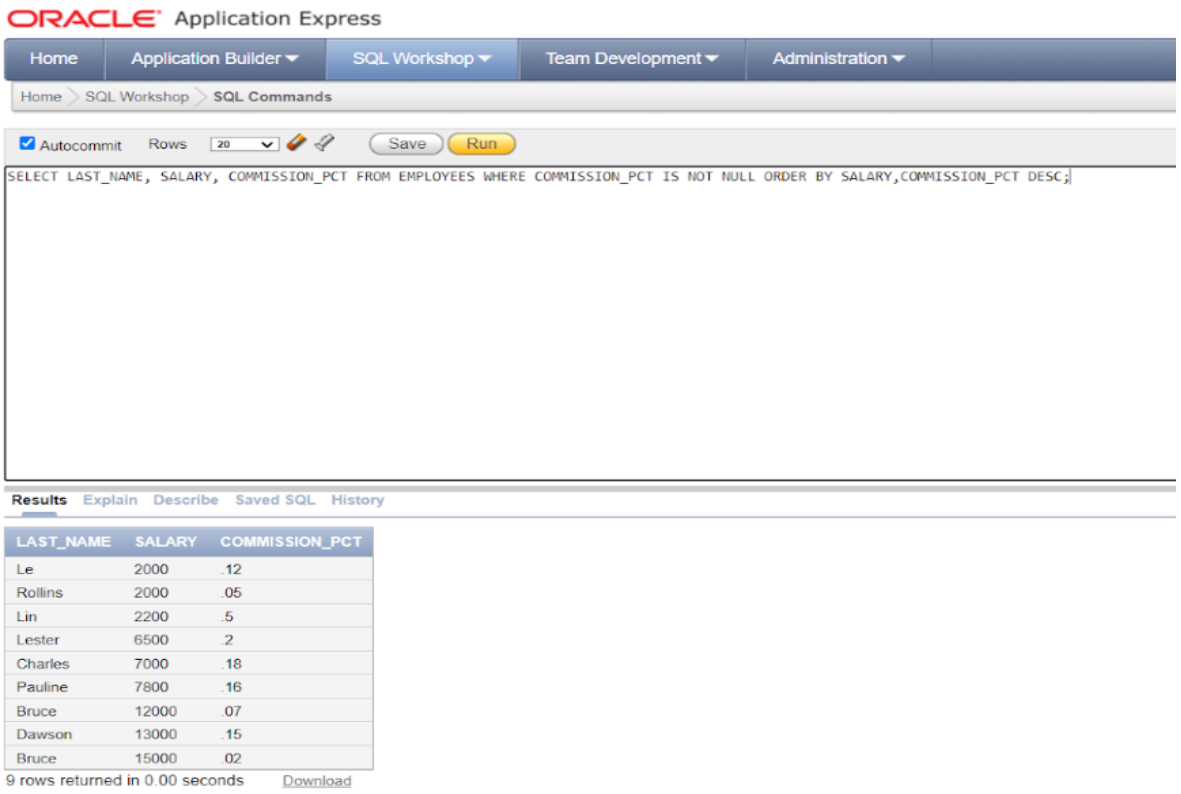
7. Display the last name and hire date of every employee who was hired in 1994.(hints: like)



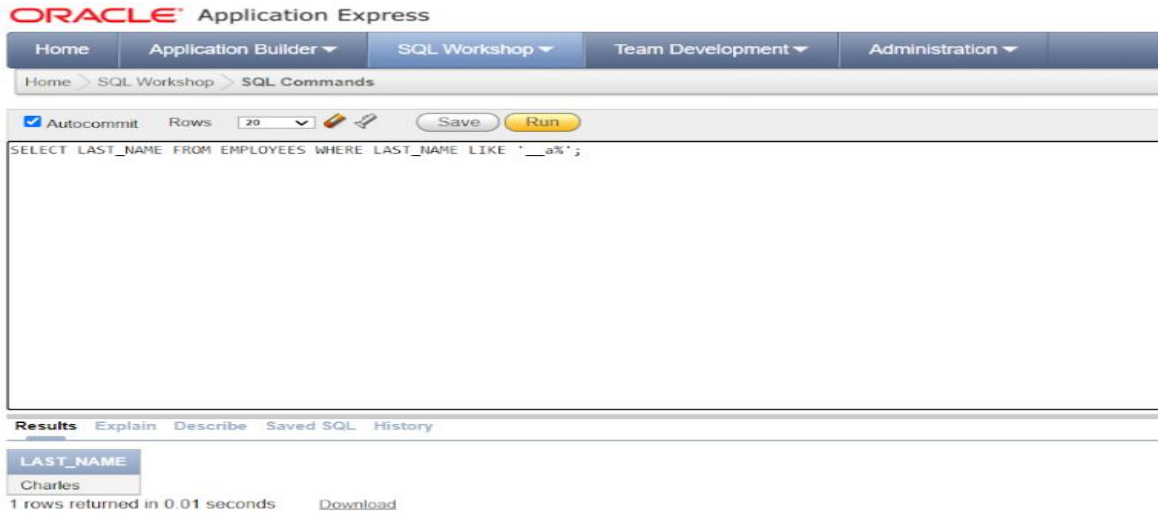
8. Display the last name and job title of all employees who do not have a manager.(hints: is null)



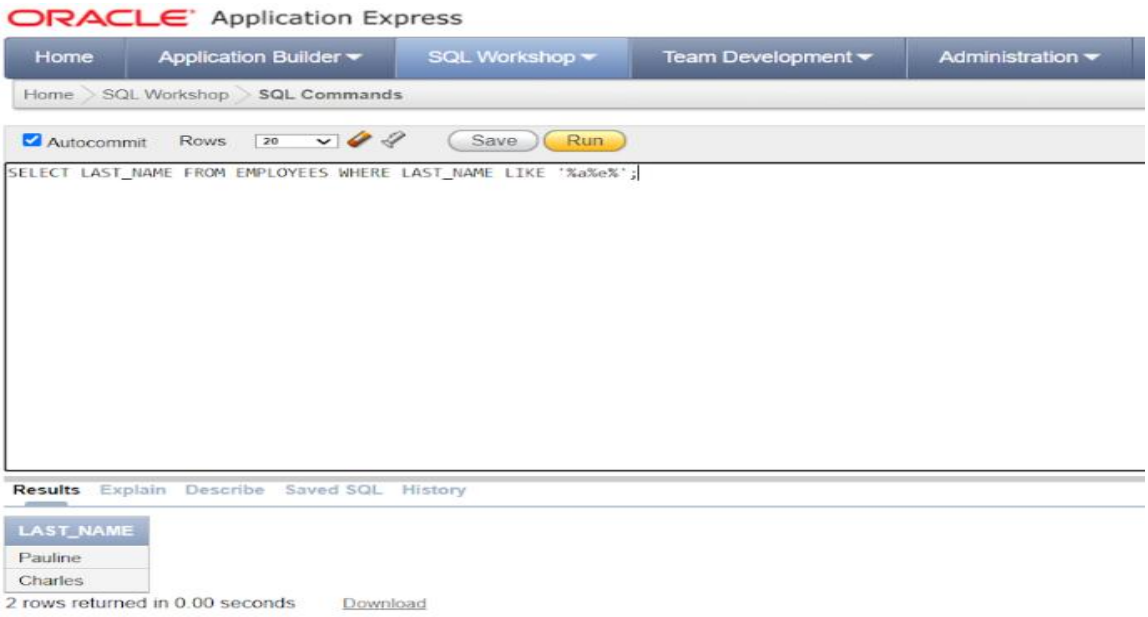
9. Display the last name, salary, and commission for all employees who earn commissions. Sort data in descending order of salary and commissions.(hints: is not nul,orderby)



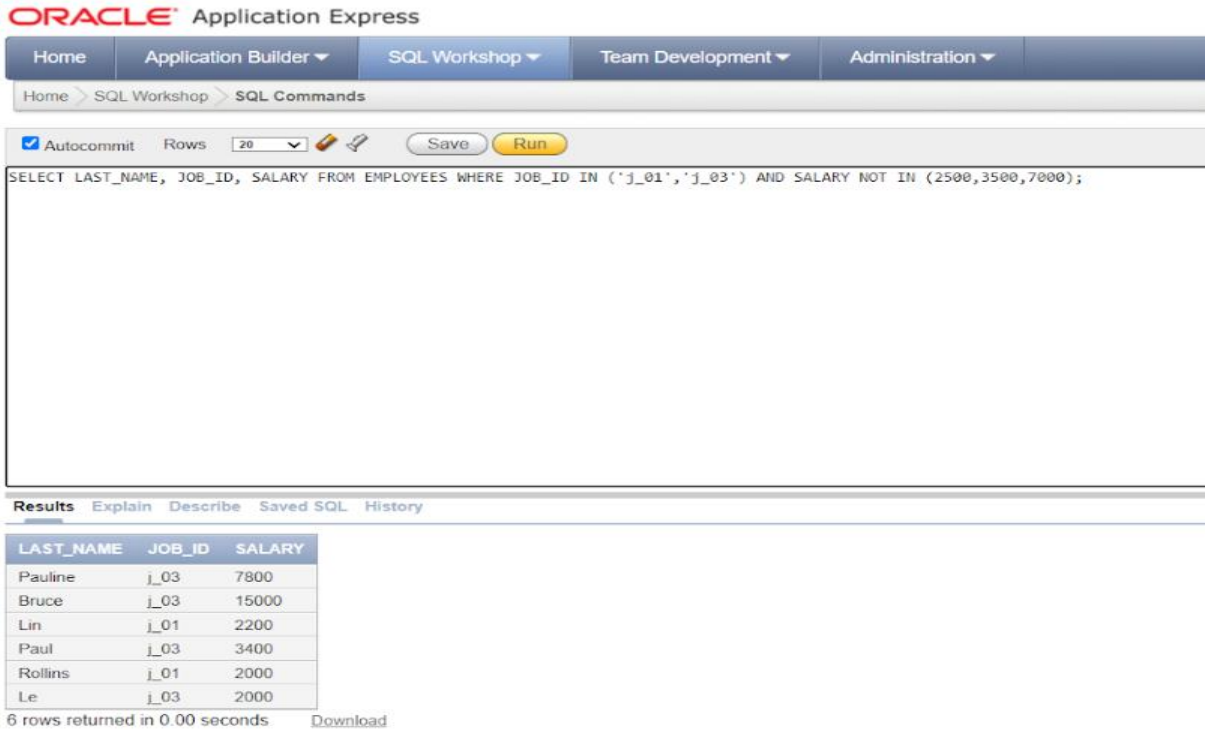
10. Display the last name of all employees where the third letter of the name is ***a***.(hints:like)



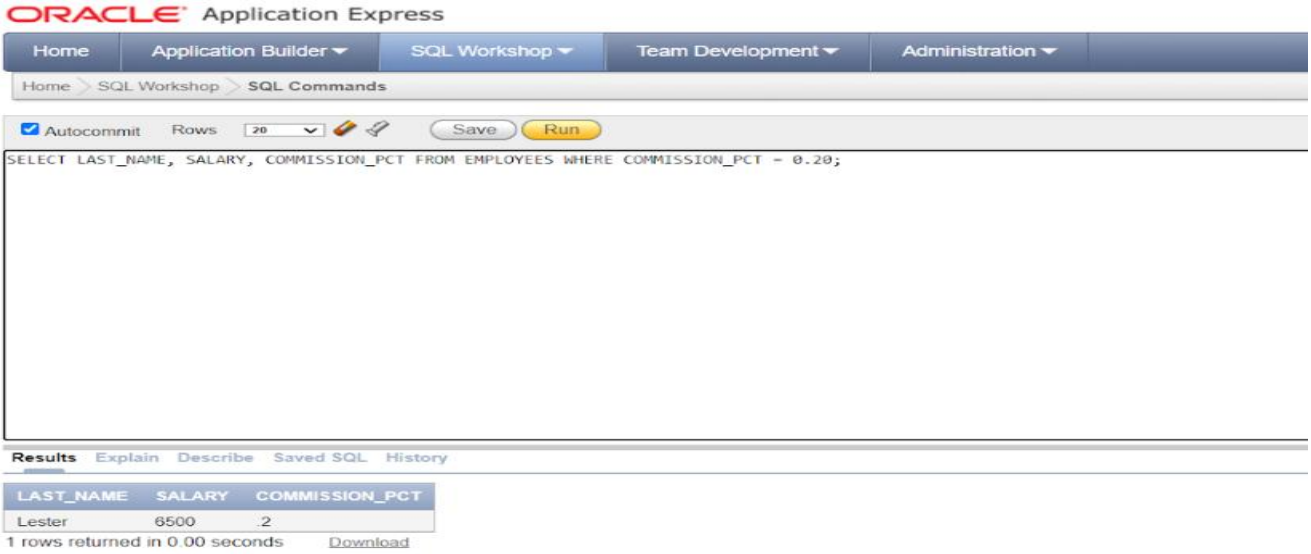
11. Display the last name of all employees who have an a and an ***e*** in their last name.(hints: like)



12. Display the last name and job and salary for all employees whose job is sales representative or stock clerk and whose salary is not equal to 2500 ,3500 or 7000.(hints:in,not in)



13. Display the last name, salary, and commission for all employees whose commission amount is 20%.(hints:use predicate logic)



Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-6

Single Row Functions

Objective

After the completion of this exercise, the students will be able to do the following:

- Describe various types of functions available in SQL.
- Use character, number and date functions in SELECT statement.
- Describe the use of conversion functions.

Single row functions:

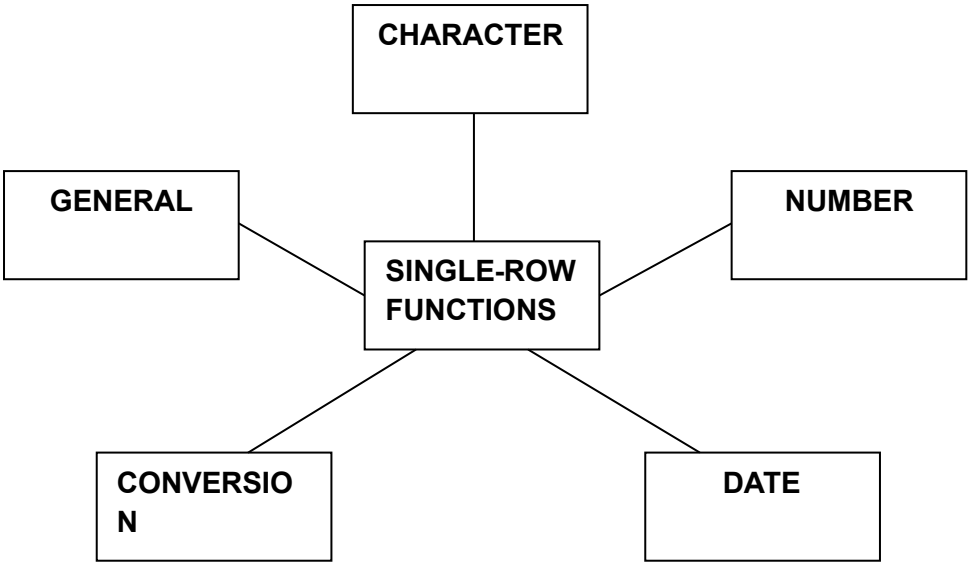
Manipulate data items.
Accept arguments and return one value.
Act on each row returned.
Return one result per row.
May modify the data type.
Can be nested.
Accept arguments which can be a column or an expression

Syntax

Function_name(arg1,…argn)

An argument can be one of the following

- ✓ User-supplied constant
- ✓ Variable value
- ✓ Column name
- ✓ Expression



- Character Functions: Accept character input and can return both character and number values.
- Number functions: Accept numeric input and return numeric values.
- Date Functions: Operate on values of the DATE data type.
- Conversion Functions: Convert a value from one type to another.

Character Functions

Character Functions

Case-manipulation functions

1. Lower
2. Upper
3. Initcap
4. Instr
5. Lpad/Rpad
6. Trim
7. Repalce

Character-manipulation functions

1. Concat
2. Substr
3. Length

Function	**Purpose**
lower(column/expr)	Converts alpha character values to lowercase
upper(column/expr)	Converts alpha character values to uppercase
initcap(column/expr)	Converts alpha character values the to uppercase for the first letter of each word, all other letters in lowercase
concat(column1/expr1, column2/expr2)	Concatenates the first character to the second character
substr(column/expr,m,n)	Returns specified characters from character value starting at character position m, n characters long

length(column/expr)	Returns the number of characters in the expression
instr(column/expr,'string',m,n)	Returns the numeric position of a named string
lpad(column/expr, n,'string')	Pads the character value right-justified to a total width of n character positions
rpad(column/expr,'string',m,n)	Pads the character value left-justified to a total width of n character positions
trim(leading/trailing/both, trim_character FROM trim_source)	Enables you to trim heading or string. trailing or both from a character
replace(text, search_string, replacement_string)	

Example:

lower('SQL Course')sql course upper('SQL Course')SQL COURSE

initcap('SQL Course')Sql Course

SELECT 'The job id for'|| upper(last_name||'is'||lower(job_id) AS "EMPLOYEE DETAILS" FROM employees;

SELECT employee_id, last_name, department_id FROM employees
WHERE LOWER(last_name)='higgins';

Function	**Result**
CONCAT('hello', 'world')	helloworld
Substr('helloworld',1,5)	Hello
Length('helloworld')	10
Instr('helloworld','w')	6
Lpad(salary,10,'*')	*****24000
Rpad(salary,10,'*')	24000*****
Trim('h' FROM 'helloworld')	elloworld

Command	**Query**	**Output**
initcap(char);	*select initcap("hello") from dual;*	Hello
lower (char); upper (char);	*select lower ('HELLO') from dual; select upper ('hello') from dual;*	Hello HELLO
ltrim (char,[set]);	*select ltrim ('cseit', 'cse') from dual;*	IT
rtrim (char,[set]);	*select rtrim ('cseit', 'it') from dual;*	CSE

replace (char,search string, replace string);	*select replace ('jack and jue', 'j', 'bl') from dual;*	black and blue
substr (char,m,n);	*select substr ('information', 3, 4) from dual;*	form

Example:

SELECT employee_id, CONCAT (first_name,last_name) NAME , job_id,LENGTH(last_name), INSTR(last_name,'a') "contains'a'?"
FROM employees WHERE SUBSTR(job_id,4)='ERP';

NUMBER FUNCTIONS

Function	Purpose
round(column/expr, n)	Rounds the value to specified decimal
trunc(column/expr,n)	Truncates value to specified decimal
mod(m,n)	Returns remainder of division

Example

Function	Result
round(45.926,2)	45.93
trunc(45.926,2)	45.92
mod(1600,300)	100

SELECT ROUND(45.923,2), ROUND(45.923,0), ROUND(45.923,-1) FROM dual;

NOTE: Dual is a dummy table you can use to view results from functions and calculations.

SELECT TRUNC(45.923,2), TRUNC(45.923), TRUNC(45.923,-2) FROM dual;

SELECT last_name,salary,MOD(salary,5000) FROM employees WHERE job_id='sa_rep';

Working with Dates

The Oracle database stores dates in an internal numeric format: century, year, month, day, hours, minutes, and seconds.

• The default date display format is DD-MON-RR.

– Enables you to store 21st-century dates in the 20th century by specifying only the last two digits of the year

– Enables you to store 20th-century dates in the 21st century in the same way

Example

SELECT last_name, hire_date FROM employees WHERE hire_date < '01-FEB-88;

Working with Dates

SYSDATE is a function that returns:

• Date

• Time

Example

Display the current date using the DUAL table.

```
SELECT SYSDATE FROM   DUAL;
```

Arithmetic with Dates

• Add or subtract a number to or from a date for a resultant date value.
• Subtract two dates to find the number of days between those dates.
• Add hours to a date by dividing the number of hours by 24.

Arithmetic with Dates

Because the database stores dates as numbers, you can perform calculations using arithmetic Operators such as addition and subtraction. You can add and subtract number constants as well as dates.
You can perform the following operations:

Operation	Result	Description
date + number	Date	Adds a number of days to a date
date – number	Date	Subtracts a number of days from a date
date – date	Number of days	Subtracts one date from another
date + number/24	Date	Adds a number of hours to a date

Example

```
SELECT last_name, (SYSDATE-hire_date)/7 AS WEEKS
FROM   employees
WHERE  department_id = 90;
```

Date Functions

Function	Result
MONTHS_BETWEEN	Number of months between two dates
ADD_MONTHS	Add calendar months to date
NEXT_DAY	Next day of the date specified
LAST_DAY	Last day of the month
ROUND	Round date
TRUNC	Truncate date

Date Functions

Date functions operate on Oracle dates. All date functions return a value of DATE data type except MONTHS_BETWEEN, which returns a numeric value.

- MONTHS_BETWEEN(date1, date2):::: Finds the number of months between date1 and date2. The result can be positive or negative. If date1 is later than date2, the result is positive; if date1 is earlier than date2, the result is negative. The noninteger part of the result represents a portion of the month.

- ADD_MONTHS(date, n):::: Adds n number of calendar months to date. The value of n must be an integer and can be negative.

- NEXT_DAY(date, 'char'):::: Finds the date of the next specified day of the week ('char') following date. The value of char may be a number representing a day or a character string.

- LAST_DAY(date):::: Finds the date of the last day of the month that contains date
- ROUND(date[,'fmt']):::: Returns date rounded to the unit that is specified by the format model fmt. If the format model fmt is omitted, date is rounded to the nearest day.

- TRUNC(date[, 'fmt']):::: Returns date with the time portion of the day truncated to the unit that is specified by the format model fmt. If the format model fmt is omitted, date is truncated to the nearest day.

Using Date Functions

Function	Result
MONTHS_BETWEEN ('01-SEP-95','11-JAN-94')	19.6774194
ADD_MONTHS ('11-JAN-94',6)	'11-JUL-94'
NEXT_DAY ('01-SEP-95','FRIDAY')	'08-SEP-95'
LAST_DAY ('01-FEB-95')	'28-FEB-95'

Example

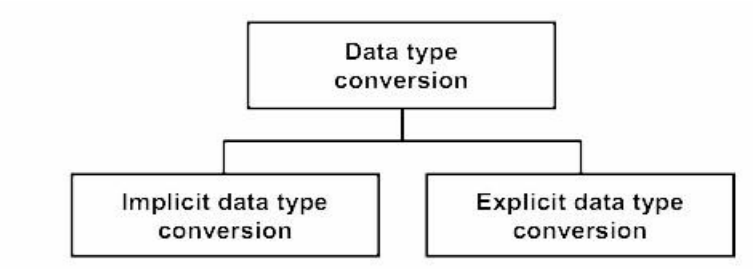
Display the employee number, hire date, number of months employed, sixmonth review date, first Friday after hire date, and last day of the hire month for all employees who have been employed for fewer than 70 months.

```
SELECT employee_id, hire_date,MONTHS_BETWEEN (SYSDATE, hire_date)
TENURE,ADD_MONTHS (hire_date, 6) REVIEW,NEXT_DAY (hire_date, 'FRIDAY'),
LAST_DAY(hire_date)
FROM   employees
WHERE  MONTHS_BETWEEN (SYSDATE, hire_date) < 70;
```

Conversion Functions

This covers the following topics:

- Writing a query that displays the current date
- Creating queries that require the use of numeric, character, and date functions
- Performing calculations of years and months of service for an employee



Implicit Data Type Conversion

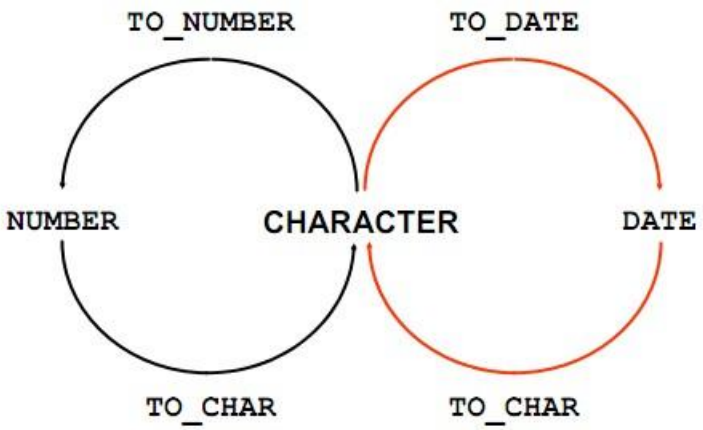
For assignments, the Oracle server can automatically convert the following:

From	To
VARCHAR2 or CHAR	NUMBER
VARCHAR2 or CHAR	DATE
NUMBER	VARCHAR2
DATE	VARCHAR2

For example, the expression hire_date > '01-JAN-90' results in the implicit conversion from the string '01-JAN-90' to a date.
For expression evaluation, the Oracle Server can automatically convert the following:

From	To
VARCHAR2 or CHAR	NUMBER
VARCHAR2 or CHAR	DATE

Explicit Data Type Conversion



SQL provides three functions to convert a value from one data type to another:

Example:

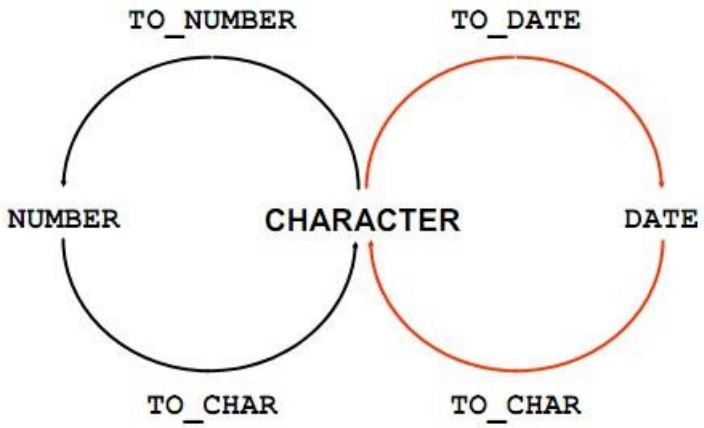
Using the TO_CHAR Function with Dates

TO_CHAR(date, 'format_model') **The format model:**

- Must be enclosed by single quotation marks
- Is case-sensitive
- Can include any valid date format element
- Has an fm element to remove padded blanks or suppress leading zeros
- Is separated from the date value by a comma

```
SELECT employee_id, TO_CHAR(hire_date, 'MM/YY') Month_Hired
FROM   employees  WHERE  last_name = 'Higgins';
```

Elements of the Date Format Model



Sample Format Elements of Valid Date

Element	Description
SCC or CC	Century; server prefixes B.C. date with -
Years in dates YYYY or SYYYY	Year; server prefixes B.C. date with -
YYY or YY or Y	Last three, two, or one digits of year
Y,YYY	Year with comma in this position
IYYY, IYY, IY, I	Four-, three-, two-, or one-digit year based on the ISO standard
SYEAR or YEAR	Year spelled out; server prefixes B.C. date with -
BC or AD	Indicates B.C. or A.D. year
B.C. or A.D.	Indicates B.C. or A.D. year using periods
Q	Quarter of year
MM	Month: two-digit value
MONTH	Name of month padded with blanks to length of nine characters
MON	Name of month, three-letter abbreviation
RM	Roman numeral month
WW or W	Week of year or month
DDD or DD or D	Day of year, month, or week
DAY	Name of day padded with blanks to a length of nine characters
DY	Name of day; three-letter abbreviation
J	Julian day; the number of days since December 31, 4713 B.C.

Date Format Elements: Time Formats

Use the formats that are listed in the following tables to display time information and literals and to change numerals to spelled numbers.

Element	Description
AM or PM	Meridian indicator
A.M. or P.M.	Meridian indicator with periods
HH or HH12 or HH24	Hour of day, or hour (1–12), or hour (0–23)
MI	Minute (0–59)
SS	Second (0–59)
SSSSS	Seconds past midnight (0–86399)

Other Formats

Element	Description
/ . ,	Punctuation is reproduced in the result.
"of the"	Quoted string is reproduced in the result.

Specifying Suffixes to Influence Number Display

Element	Description
TH	Ordinal number (for example, DDTH for 4TH)
SP	Spelled-out number (for example, DDSP for FOUR)
SPTH or THSP	Spelled-out ordinal numbers (for example, DDSPTH for FOURTH)

Example

```
SELECT last_name,
TO_CHAR(hire_date, 'fmDD Month YYYY') AS HIREDATE
FROM   employees;
```

Modify example to display the dates in a format that appears as "Seventeenth of June 1987 12:00:00 AM."

```
SELECT last_name,
TO_CHAR (hire_date, 'fmDdspth "of" Month YYYY fmHH:MI:SS AM') HIREDATE
FROM   employees;
```

Using the TO_CHAR Function with Numbers

TO_CHAR(number, 'format_model')
These are some of the format elements that you can use with the TO_CHAR function to display a number value as a character:

Element	Result
9	Represents a number
0	Forces a zero to be displayed
$	Places a floating dollar sign
L	Uses the floating local currency symbol
.	Prints a decimal point
,	Prints a comma as thousands indicator

Number Format Elements

If you are converting a number to the character data type, you can use the following format elements:

Element	Description	Example	Result
9	Numeric position (number of 9s determine display width)	999999	1234
0	Display leading zeros	099999	001234
$	Floating dollar sign	$999999	$1234
L	Floating local currency symbol	L999999	FF1234
D	Returns in the specified position the decimal character. The default is a period (.).	99D99	99.99
.	Decimal point in position specified	999999.99	1234.00
G	Returns the group separator in the specified position. You can specify multiple group separators in a number format model.	9,999	9G999
,	Comma in position specified	999,999	1,234
MI	Minus signs to right (negative values)	999999MI	1234-
PR	Parenthesize negative numbers	999999PR	<1234>
EEEE	Scientific notation (format must specify four Es)	99.999EEEE	1.234E+03
U	Returns in the specified position the "Euro" (or other) dual currency	U9999	€1234
V	Multiply by 10 *n* times (*n* = number of 9s after V)	9999V99	123400
S	Returns the negative or positive value	S9999	-1234 or +1234
B	Display zero values as blank, not 0	B9999.99	1234.00

```
SELECT TO_CHAR(salary, '$99,999.00') SALARY
FROM   employees
WHERE  last_name = 'Ernst';
```

Using the TO_NUMBER and TO_DATE Functions

• Convert a character string to a number format using the TO_NUMBER function:
TO_NUMBER(char[, 'format_model']

• Convert a character string to a date format using the TO_DATE function:
TO_DATE(char[, 'format_model']

• These functions have an fx modifier. This modifier specifies the exact matching for the character argument and date format model of a TO_DATE function.

The fx modifier specifies exact matching for the character argument and date format model of a TO_DATE function:

• Punctuation and quoted text in the character argument must exactly match (except for case) the corresponding parts of the format model.

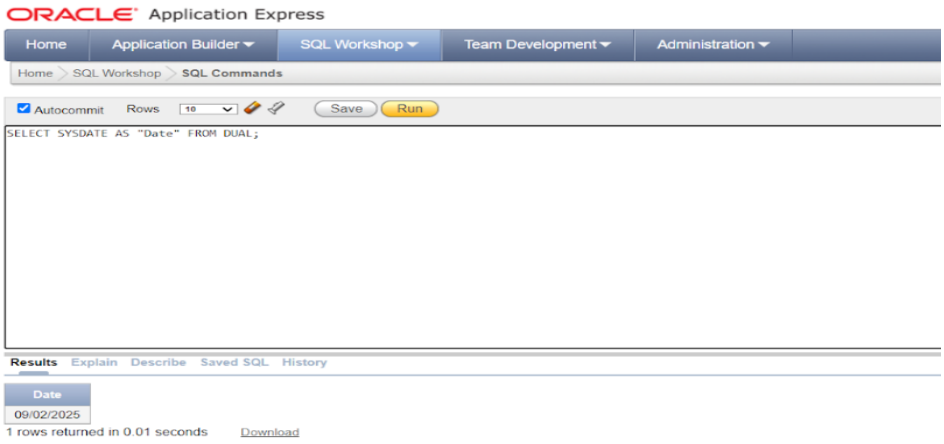
• The character argument cannot have extra blanks. Without fx, Oracle ignores extra blanks.

• Numeric data in the character argument must have the same number of digits as the corresponding element in the format model. Without fx, numbers in the character argument can omit leading zeros.

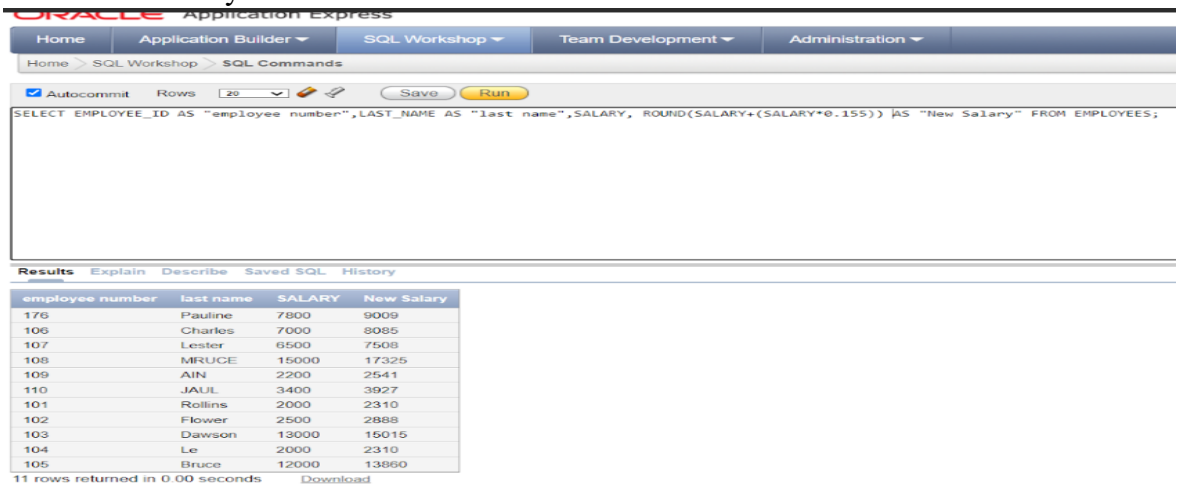
```
SELECT last_name, hire_date
FROM   employees
WHERE  hire_date = TO_DATE('May 24, 1999', 'fxMonth DD, YYYY');
```

Find the Solution for the following:

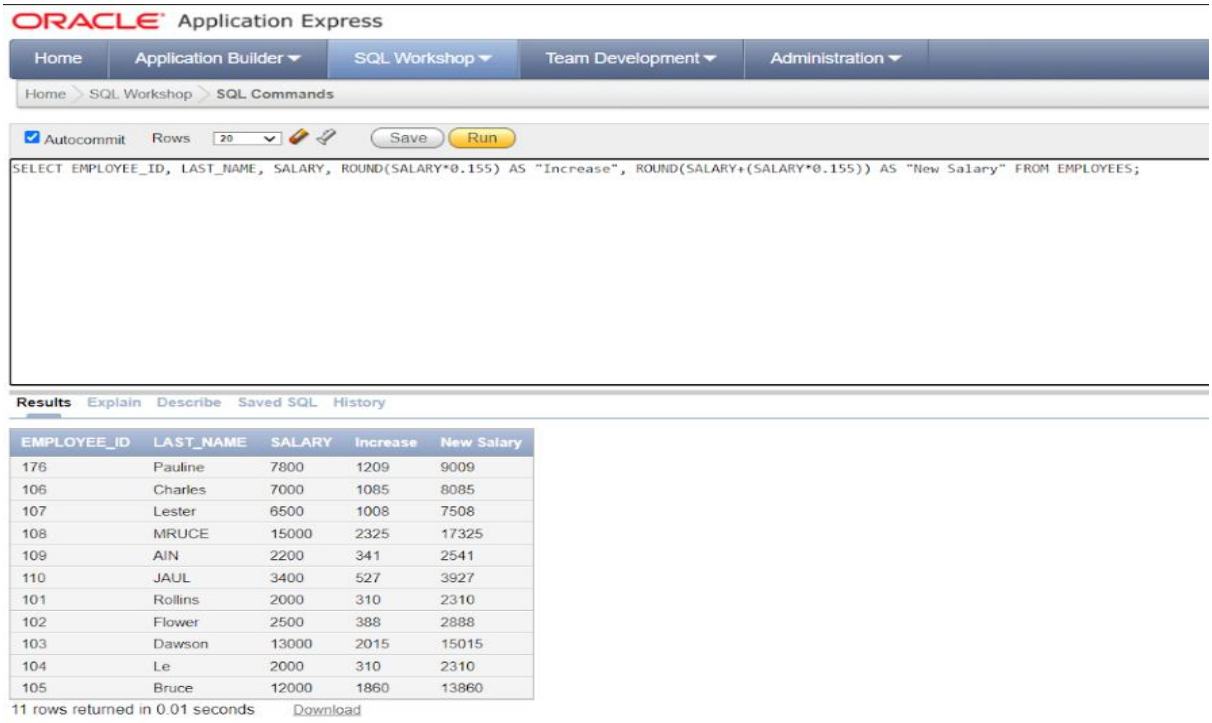
1. Write a query to display the current date. Label the column Date.



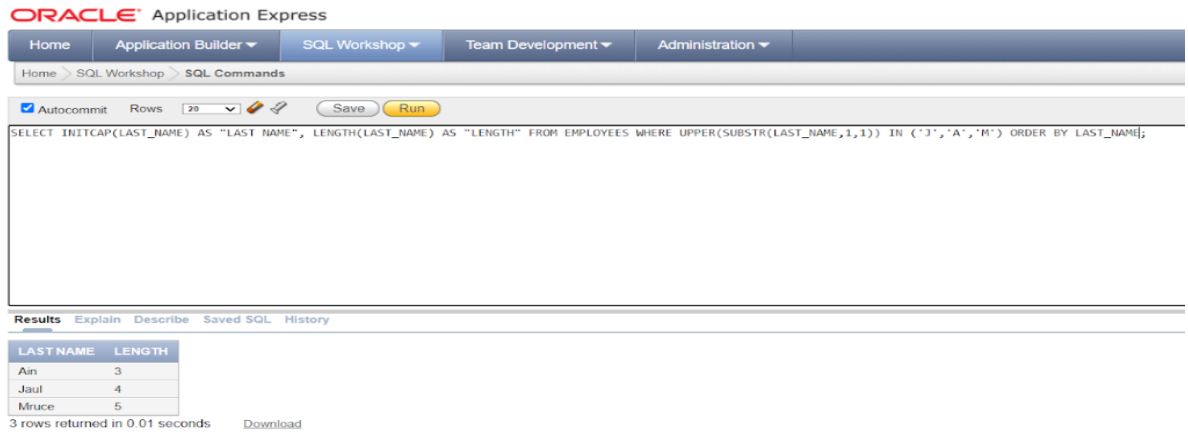
2. The HR department needs a report to display the employee number, last name, salary, and increased by 15.5% (expressed as a whole number) for each employee. Label the column New Salary.



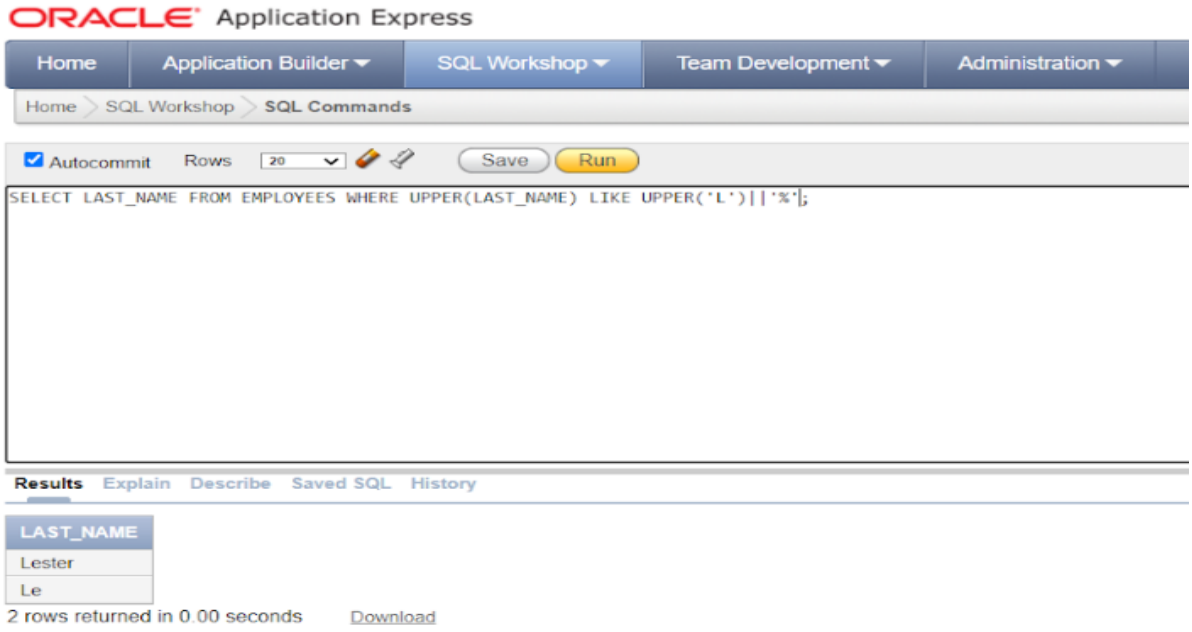
3. Modify your query lab_03_02.sql to add a column that subtracts the old salary from the new salary. Label the column Increase.



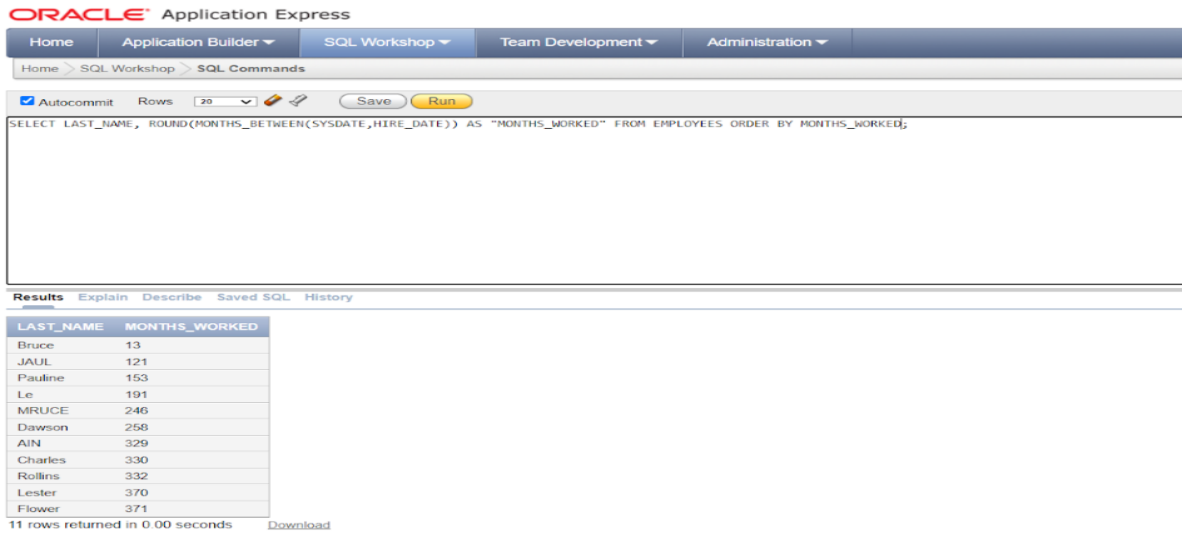
4. Write a query that displays the last name (with the first letter uppercase and all other letters lowercase) and the length of the last name for all employees whose name starts with the letters J, A, or M. Give each column an appropriate label. Sort the results by the employees' last names.



5. Rewrite the query so that the user is prompted to enter a letter that starts the last name. For example, if the user enters H when prompted for a letter, then the output should show all employees whose last name starts with the letter H.

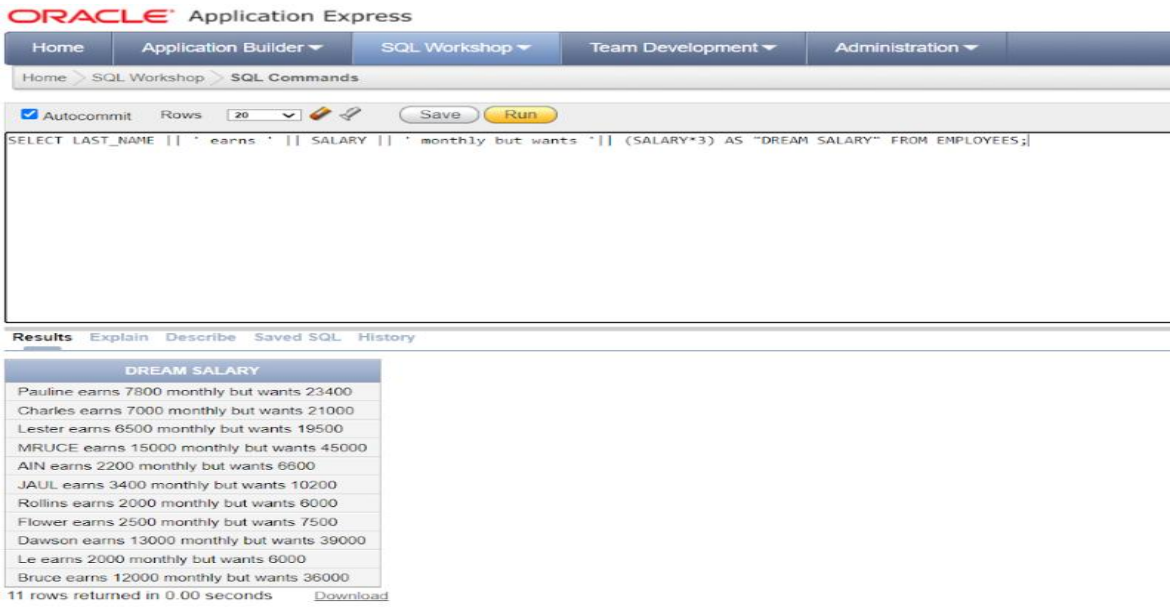


6. The HR department wants to find the length of employment for each employee. For each employee, display the last name and calculate the number of months between today and the date on which the employee was hired. Label the column MONTHS_WORKED. Order your results by the number of months employed. Round the number of months up to the closest whole number.

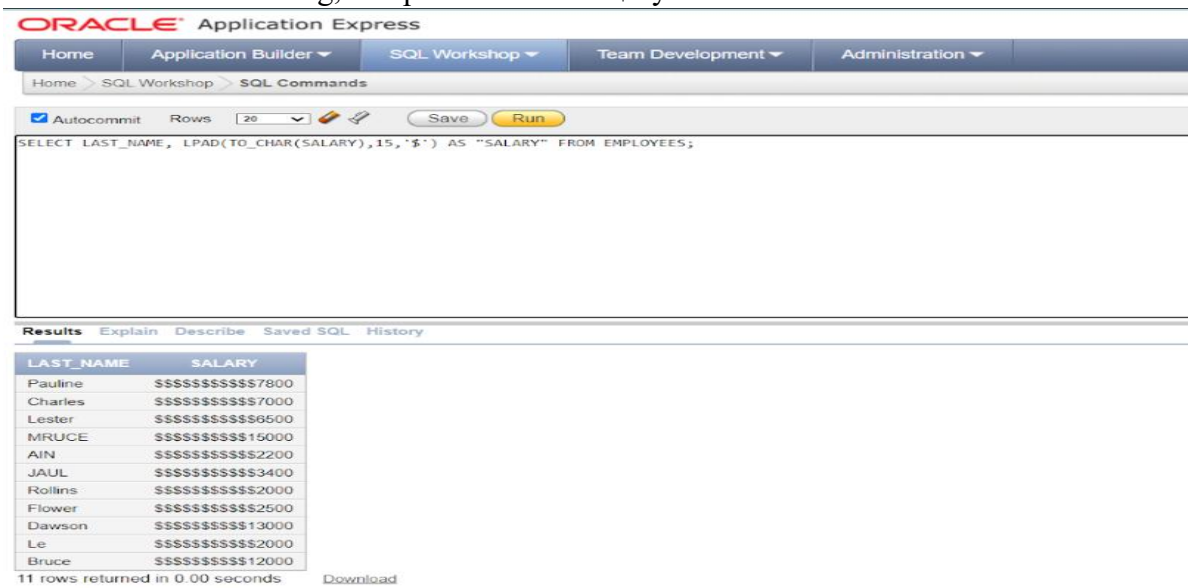


Note: Your results will differ.

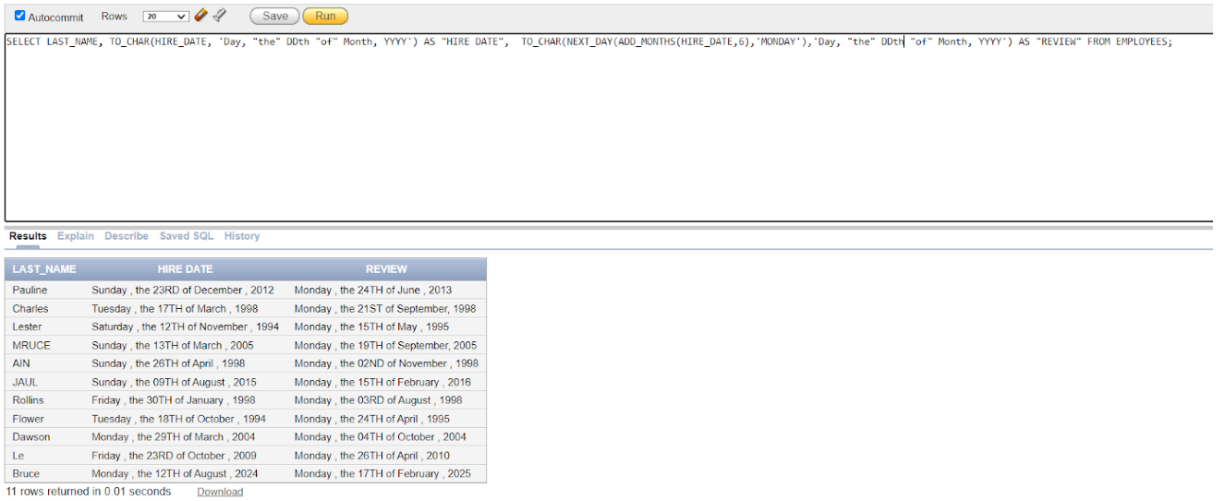
7. Create a report that produces the following for each employee:
<employee last name> earns <salary> monthly but wants <3 times salary>. Label the column Dream Salaries.



8. Create a query to display the last name and salary for all employees. Format the salary to be 15 characters long, left-padded with the $ symbol. Label the column SALARY.



9. Display each employee's last name, hire date, and salary review date, which is the first Monday after six months of service. Label the column REVIEW. Format the dates to appear in the format similar to "Monday, the Thirty-First of July, 2000."



Autocommit Rows 20 Save Run

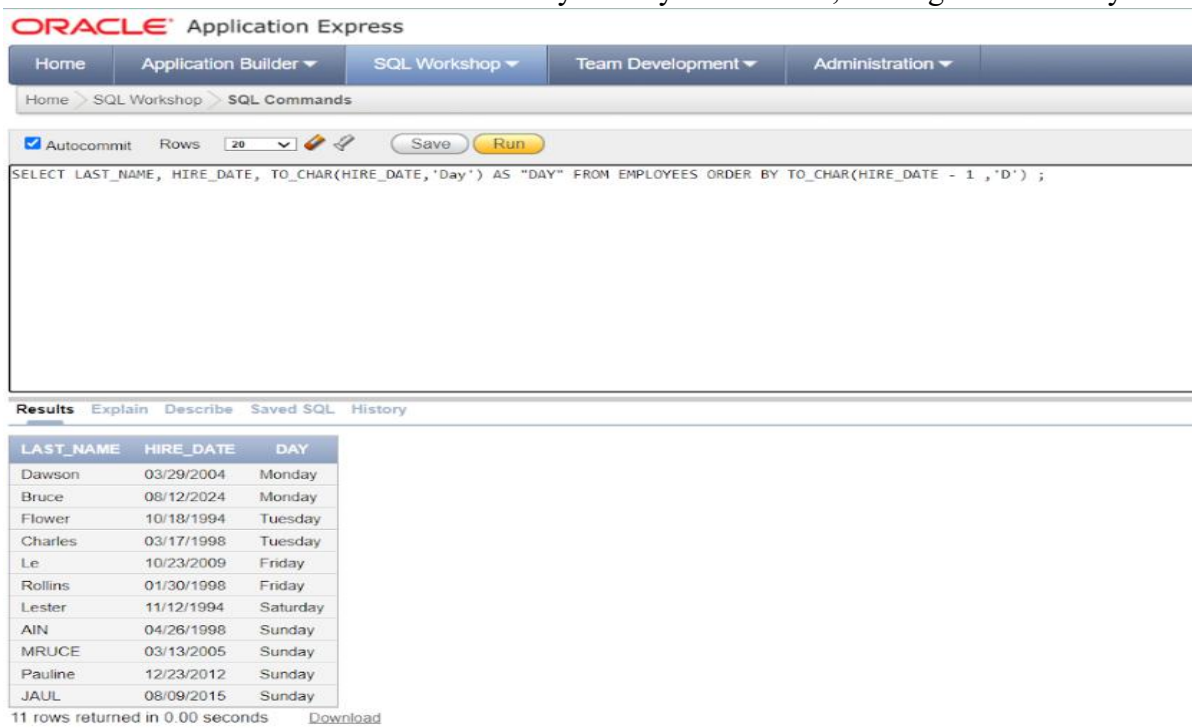
```
SELECT LAST_NAME, TO_CHAR(HIRE_DATE, 'Day, "the" DDth "of" Month, YYYY') AS "HIRE DATE",  TO_CHAR(NEXT_DAY(ADD_MONTHS(HIRE_DATE,6),'MONDAY'),'Day, "the" DDth "of" Month, YYYY') AS "REVIEW" FROM EMPLOYEES;
```

Results Explain Describe Saved SQL History

LAST_NAME	HIRE DATE	REVIEW
Pauline	Sunday , the 23RD of December , 2012	Monday , the 24TH of June , 2013
Charles	Tuesday , the 17TH of March , 1998	Monday , the 21ST of September, 1998
Lester	Saturday , the 12TH of November , 1994	Monday , the 15TH of May , 1995
MRUCE	Sunday , the 13TH of March , 2005	Monday , the 19TH of September, 2005
AIN	Sunday , the 26TH of April , 1998	Monday , the 02ND of November , 1998
JAUL	Sunday , the 09TH of August , 2015	Monday , the 15TH of February , 2016
Rollins	Friday , the 30TH of January , 1998	Monday , the 03RD of August , 1998
Flower	Tuesday , the 18TH of October , 1994	Monday , the 24TH of April , 1995
Dawson	Monday , the 29TH of March , 2004	Monday , the 04TH of October , 2004
Le	Friday , the 23RD of October , 2009	Monday , the 26TH of April , 2010
Bruce	Monday , the 12TH of August , 2024	Monday , the 17TH of February , 2025

11 rows returned in 0.01 seconds Download

10. Display the last name, hire date, and day of the week on which the employee started. Label the column DAY. Order the results by the day of the week, starting with Monday.



ORACLE Application Express

Home | Application Builder | SQL Workshop | Team Development | Administration

Home > SQL Workshop > SQL Commands

Autocommit Rows 20 Save Run

```
SELECT LAST_NAME, HIRE_DATE, TO_CHAR(HIRE_DATE,'Day') AS "DAY" FROM EMPLOYEES ORDER BY TO_CHAR(HIRE_DATE - 1 ,'D') ;
```

Results Explain Describe Saved SQL History

LAST_NAME	HIRE_DATE	DAY
Dawson	03/29/2004	Monday
Bruce	08/12/2024	Monday
Flower	10/18/1994	Tuesday
Charles	03/17/1998	Tuesday
Le	10/23/2009	Friday
Rollins	01/30/1998	Friday
Lester	11/12/1994	Saturday
AIN	04/26/1998	Sunday
MRUCE	03/13/2005	Sunday
Pauline	12/23/2012	Sunday
JAUL	08/09/2015	Sunday

11 rows returned in 0.00 seconds Download

Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-7

Displaying data from multiple tables

Objective

After the completion of this exercise, the students will be able to do the following:

- Write SELECT statements to access data from more than one table using equality and nonequality joins
- View data that generally does not meet a join condition by using outer joins
- Join a table to itself by using a self join

Sometimes you need to use data from more than one table.

Cartesian Products

• A Cartesian product is formed when:
– A join condition is omitted
– A join condition is invalid
– All rows in the first table are joined to all rows in the second table
• To avoid a Cartesian product, always include a valid join condition in a WHERE clause.

A Cartesian product tends to generate a large number of rows, and the result is rarely useful. You should always include a valid join condition in a WHERE clause, unless you have a specific need to combine all rows from all tables.

Cartesian products are useful for some tests when you need to generate a large number of rows to simulate a reasonable amount of data.

Example:

To displays employee last name and department name from the EMPLOYEES and DEPARTMENTS tables.

```
SELECT last_name, department_name dept_name
FROM   employees, departments;
```

Types of Joins

• Equijoin
• Non-equijoin
• Outer join
• Self join
• Cross joins
• Natural joins
• Using clause
• Full or two sided outer joins
• Arbitrary join conditions for outer joins

Joining Tables Using Oracle Syntax

```
SELECT table1.column, table2.column
FROM table1, table2
WHERE table1.column1 = table2.column2;
```

Write the join condition in the WHERE clause.

• Prefix the column name with the table name when the same column name appears in more than one table.

Guidelines

• When writing a SELECT statement that joins tables, precede the column name with the table name for clarity and to enhance database access.
• If the same column name appears in more than one table, the column name must be prefixed with the table name.

• To join n tables together, you need a minimum of n-1 join conditions. For example, to join four tables, a minimum of three joins is required. This rule may not apply if your table has a concatenated primary key, in which case more than one column is required to uniquely identify each row

What is an Equijoin?

To determine an employee's department name, you compare the value in the DEPARTMENT_ID column in the EMPLOYEES table with the DEPARTMENT_ID values in the DEPARTMENTS table.

The relationship between the EMPLOYEES and DEPARTMENTS tables is an equijoin—that is, values

in the DEPARTMENT_ID column on both tables must be equal. Frequently, this type of join involves primary and foreign key complements.

Note: Equijoins are also called simple joins or inner joins

```
SELECTemployees.employee_id,employees.last_name,employees.department_id,
departments.department_id,departments.location_id
FROM   employees, departments
WHERE  employees.department_id = departments.department_id;
```

Additional Search Conditions

Using the AND Operator Example:

To display employee Matos'department number and department name, you need an additional condition in the WHERE clause.

```
SELECT last_name, employees.department_id, department_name
FROM   employees, departments
WHERE  employees.department_id = departments.department_id AND    last_name = 'Matos';
```

Qualifying Ambiguous Column Names

- Use table prefixes to qualify column names that are in multiple tables.
- Improve performance by using table prefixes.
- Distinguish columns that have identical names but reside in different tables by using column aliases.

Using Table Aliases

- Simplify queries by using table aliases.
- Improve performance by using table prefixes **Example:**

```
SELECT e.employee_id, e.last_name, e.department_id,
d.department_id, d.location_id FROM    employees e ,
departments d
WHERE  e.department_id = d.department_id;
```

Joining More than Two Tables

To join n tables together, you need a minimum of n-1 join conditions. For example, to join three tables, a minimum of two joins is required.

Example:

To display the last name, the department name, and the city for each employee, you have to join the EMPLOYEES, DEPARTMENTS, and LOCATIONS tables.

```
SELECT e.last_name, d.department_name, l.city
FROM   employees e, departments d, locations l
WHERE  e.department_id = d.department_id
AND    d.location_id = l.location_id;
```

Non-Equijoins

A non-equijoin is a join condition containing something other than an equality operator.The relationship between the EMPLOYEES table and the JOB_GRADES table has an example of a nonequijoin. A relationship between the two tables is that the SALARY column in the EMPLOYEES table must be between the values in the LOWEST_SALARY and HIGHEST_SALARY columns of the JOB_GRADES table. The relationship is obtained using an operator other than equals (=).

Example:

```
SELECT e.last_name, e.salary, j.grade_level
FROM   employees e, job_grades j
WHERE  e.salary
BETWEEN j.lowest_sal AND j.highest_sal;
```

Outer Joins

Syntax

• You use an outer join to also see rows that do not meet the join condition.
• The Outer join operator is the plus sign (+).

```
SELECT table1.column, table2.column
FROM table1, table2
WHERE table1.column(+) = table2.column;
SELECT table1.column, table2.column
FROM table1, table2
WHERE table1.column = table2.column(+);
```

The missing rows can be returned if an outer join operator is used in the join condition. The operator is a plus sign enclosed in parentheses (+), and it is placed on the "side" of the join that is deficient in information. This operator has the effect of creating one or more null rows, to which one or more rows from the nondeficient table can be joined.

Example:

```
SELECT e.last_name, e.department_id, d.department_name
```

```
FROM   employees e, departments d
WHERE  e.department_id(+) = d.department_id ;
```

Outer Join Restrictions

- The outer join operator can appear on only one side of the expression—the side that has information missing. It returns those rows from one table that have no direct match in the other table.
- A condition involving an outer join cannot use the IN operator or be linked to another condition by the OR operator

Self Join

Sometimes you need to join a table to itself.

Example:

To find the name of each employee's manager, you need to join the EMPLOYEES table to itself, or perform a self join.

```
SELECT worker.last_name || ' works for '  ||
manager.last_name
FROM   employees worker, employees manager
WHERE  worker.manager_id = manager.employee_id ;
```

Use a join to query data from more than one table.

```
SELECT table1.column, table2.column
FROM table1
[CROSS JOIN table2] |
[NATURAL JOIN table2] |
[JOIN table2 USING (column_name)] |
[JOIN table2
ON(table1.column_name = table2.column_name)] |
[LEFT|RIGHT|FULL OUTER JOIN table2
ON (table1.column_name = table2.column_name)];
```

In the syntax: table1.column Denotes the table and column from which
data is retrieved
CROSS JOIN Returns a Cartesian product from the two tables
NATURAL JOIN Joins two tables based on the same column name
JOIN table USING column_name Performs an equijoin based on the column name
JOIN table ON table1.column_name Performs an equijoin based on the condition in the ON clause
= table2.column_name

LEFT/RIGHT/FULL OUTER

Creating Cross Joins

• The CROSS JOIN clause produces the crossproduct of two tables.
• This is the same as a Cartesian product between the two tables.

Example:

```
SELECT last_name, department_name
FROM   employees
CROSS JOIN departments ;
SELECT last_name, department_name
FROM   employees, departments;
```

Creating Natural Joins

• The NATURAL JOIN clause is based on all columns in the two tables that have the same name.
• It selects rows from the two tables that have equal values in all matched columns.
• If the columns having the same names have different data types, an error is returned. **Example:**

```
SELECT department_id, department_name, location_id,
city
FROM   departments
NATURAL JOIN locations ;
```

LOCATIONS table is joined to the DEPARTMENT table by the LOCATION_ID column, which is the only column of the same name in both tables. If other common columns were present, the join would have used them all.

Example:

```
SELECT  department_id, department_name, location_id,
city
FROM    departments
NATURAL JOIN locations
WHERE   department_id IN (20, 50);
```

Creating Joins with the USING Clause

• If several columns have the same names but the data types do not match, the NATURAL JOIN clause can be modified with the USING clause to specify the columns that should be used for an equijoin.
• Use the USING clause to match only one column when more than one column matches.
• Do not use a table name or alias in the referenced columns.
• The NATURAL JOIN and USING clauses are mutually exclusive. **Example:**

```
SELECT l.city, d.department_name
```

FROM locations l JOIN departments d USING (location_id)
WHERE location_id = 1400; EXAMPLE:

SELECT e.employee_id, e.last_name, d.location_id
FROM employees e JOIN departments d
USING (department_id) ;

Creating Joins with the ON Clause

- The join condition for the natural join is basically an equijoin of all columns with the same name.
- To specify arbitrary conditions or specify columns to join, the ON clause is used.
- The join condition is separated from other searchconditions.
- The ON clause makes code easy to understand.

Example:

SELECT e.employee_id, e.last_name, e.department_id, d.department_id,
d.location_id
FROM employees e JOIN departments d ON
(e.department_id = d.department_id);
EXAMPLE:

SELECT e.last_name emp, m.last_name mgr
FROM employees e JOIN employees m
ON (e.manager_id = m.employee_id);
INNER Versus OUTER Joins

- A join between two tables that returns the results of the inner join as well as unmatched rows left (or right) tables is a left (or right) outer join.

- A join between two tables that returns the results of an inner join as well as the results of a left and right join is a full outer join.

LEFT OUTER JOIN Example:

SELECT e.last_name, e.department_id, d.department_name
FROM employees e
LEFT OUTER JOIN departments d
ON (e.department_id = d.department_id) ;

Example of LEFT OUTER JOIN
This query retrieves all rows in the EMPLOYEES table, which is the left table even if there is no match in the DEPARTMENTS table.

This query was completed in earlier releases as follows:

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e, departments d
WHERE  d.department_id (+) = e.department_id;
```

RIGHT OUTER JOIN Example:

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e
RIGHT OUTER JOIN departments d
ON    (e.department_id = d.department_id) ;
```

This query retrieves all rows in the DEPARTMENTS table, which is the right table even if there is no match in the EMPLOYEES table.

This query was completed in earlier releases as follows:

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e, departments d
WHERE  d.department_id = e.department_id  (+);
```

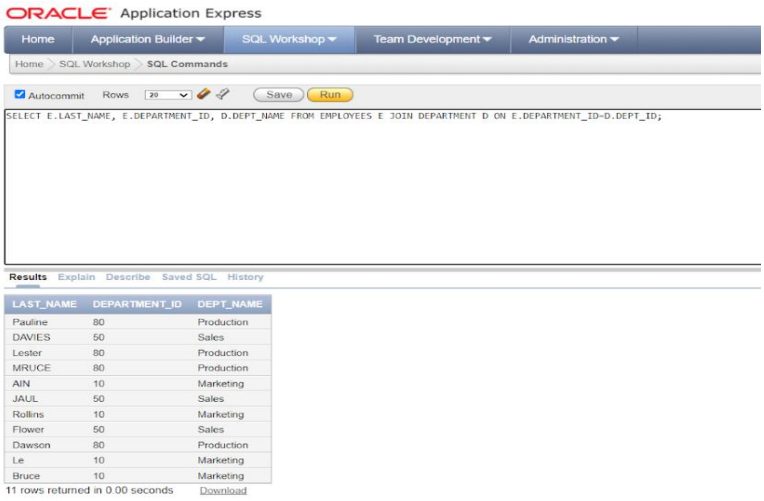
FULL OUTER JOIN Example:

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e
FULL OUTER JOIN departments d
ON   (e.department_id = d.department_id) ;
```

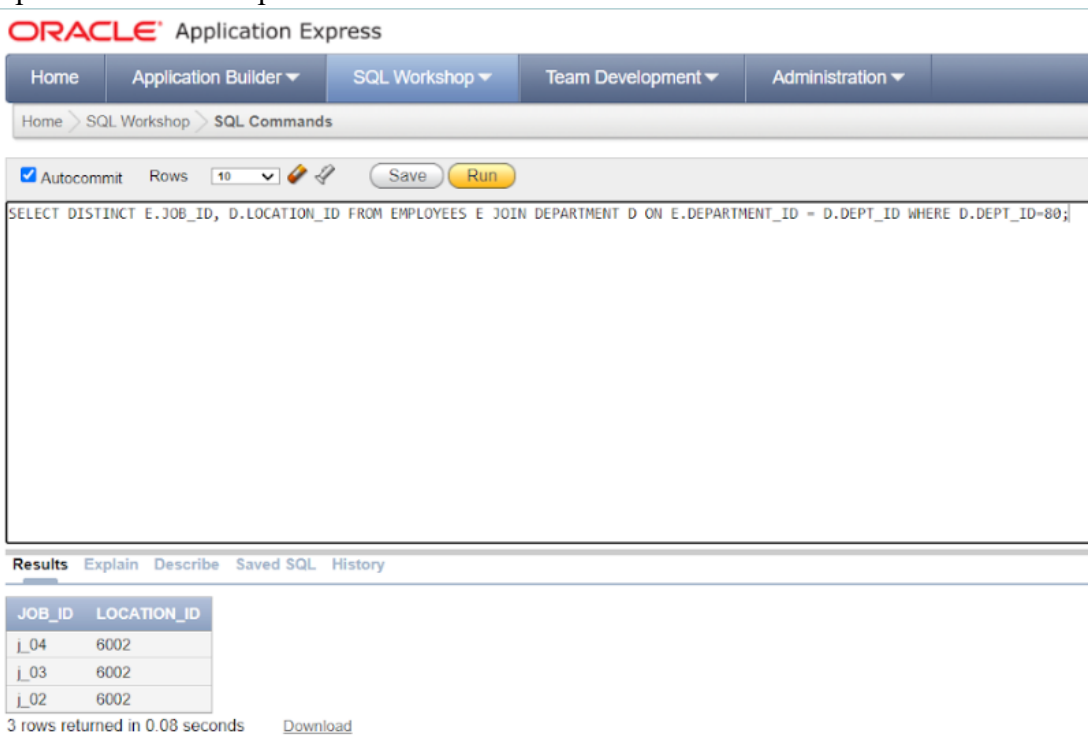
This query retrieves all rows in the EMPLOYEES table, even if there is no match in the DEPARTMENTS table. It alslso retrieves all rows in the DEPARTMENTS table, even if there is no match in the EMPLOYEES table.

Find the Solution for the following:

1. Write a query to display the last name, department number, and department name for all employees.

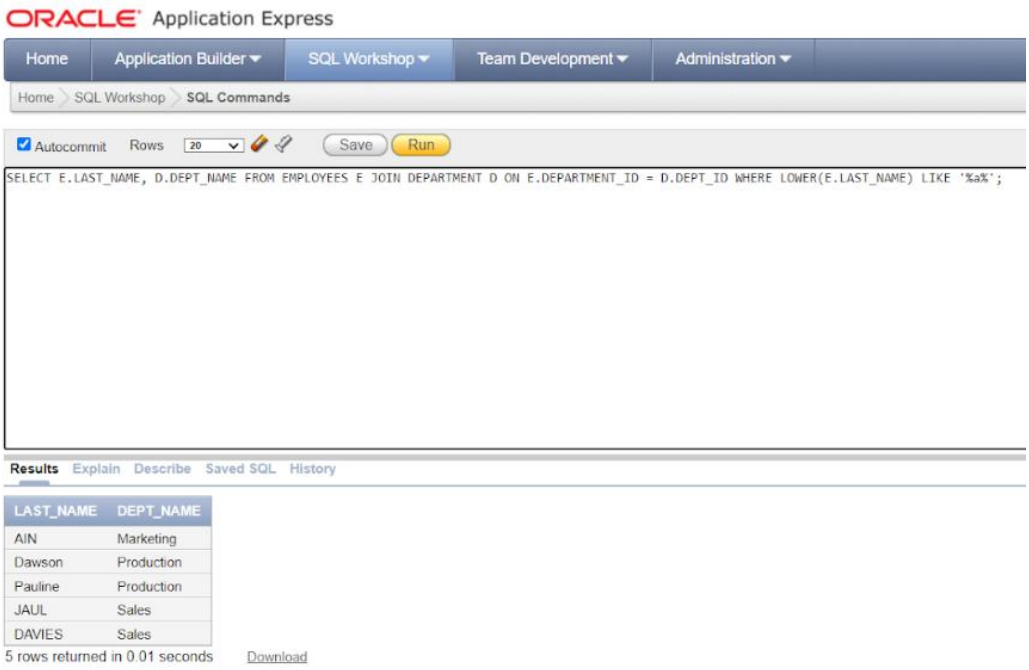


2. Create a unique listing of all jobs that are in department 80. Include the location of the department in the output.

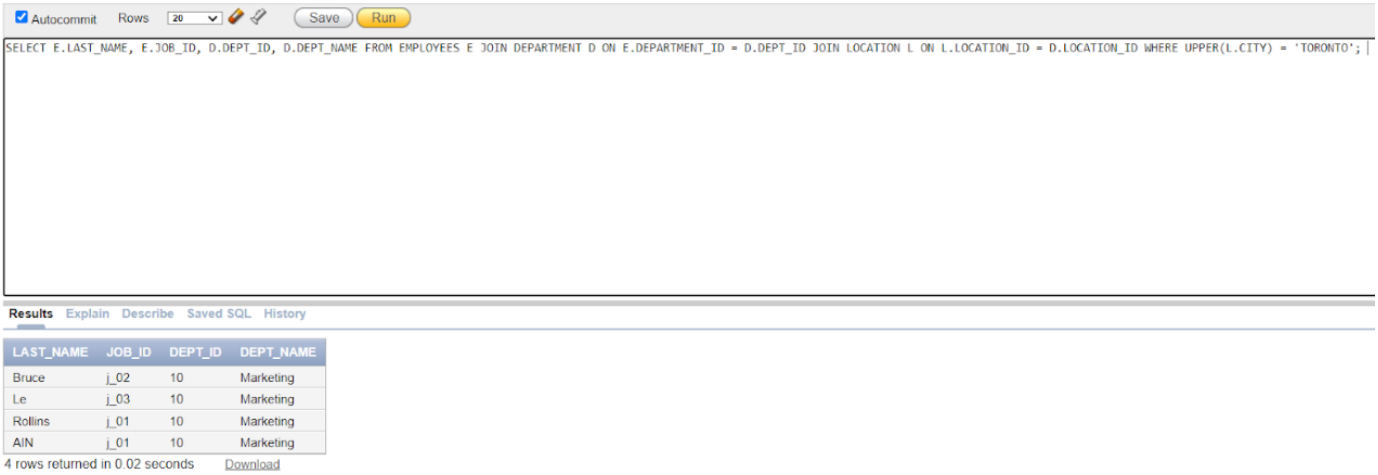


3. Write a query to display the employee last name, department name, location ID, and city of all employees who earn a commission

4.Display the employee last name and department name for all employees who have an a(lowercase) in their last names. P



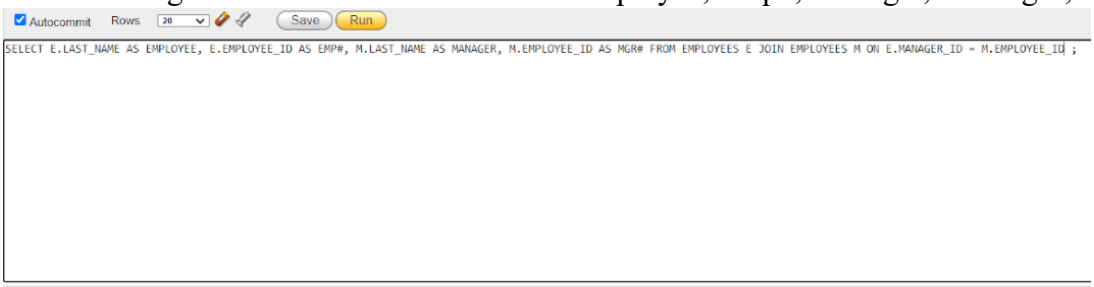
5. Write a query to display the last name, job, department number, and department name for all employees who work in Toronto.



LAST_NAME	JOB_ID	DEPT_ID	DEPT_NAME
Bruce	j_02	10	Marketing
Le	j_03	10	Marketing
Rollins	j_01	10	Marketing
AIN	j_01	10	Marketing

4 rows returned in 0.02 seconds Download

6. Display the employee last name and employee number along with their manager's last name and manager number. Label the columns Employee, Emp#, Manager, and Mgr#, Respectively



EMPLOYEE	EMP#	MANAGER	MGR#
Dawson	103	MRUCE	108
Lester	107	MRUCE	108
Pauline	176	MRUCE	108
JAUL	110	Flower	102
DAVIES	106	Flower	102
Le	104	Bruce	105
Rollins	101	Bruce	105
AIN	109	Bruce	105

8 rows returned in 0.03 seconds Download

7. Modify lab4_6.sql to display all employees including King, who has no manager. Order the results by the employee number.

Autocommit Rows 20 Save Run

```
SELECT E.LAST_NAME AS EMPLOYEE, E.EMPLOYEE_ID AS EMP#, M.LAST_NAME AS MANAGER, M.EMPLOYEE_ID AS MGR# FROM EMPLOYEES E JOIN EMPLOYEES M ON E.MANAGER_ID = M.EMPLOYEE_ID ORDER BY E.EMPLOYEE_ID;
```

Results Explain Describe Saved SQL History

EMPLOYEE	EMP#	MANAGER	MGR#
Rollins	101	Bruce	105
Dawson	103	MRUCE	108
Le	104	Bruce	105
DAVIES	106	Flower	102
Lester	107	MRUCE	108
AIN	109	Bruce	105
JAUL	110	Flower	102
Pauline	176	MRUCE	108

8 rows returned in 0.00 seconds Download

8. Create a query that displays employee last names, department numbers, and all the employees who work in the same department as a given employee. Give each column an appropriate label

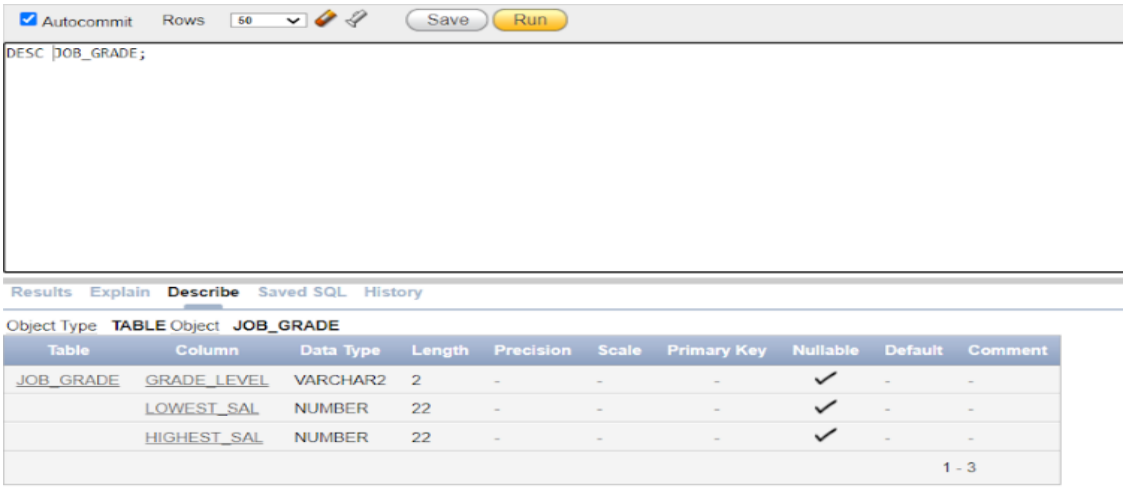
Autocommit Rows 50 Save Run

```
SELECT E1.LAST_NAME AS EMPLOYEE, E1.DEPARTMENT_ID AS DEPT#, E2.LAST_NAME AS COWORKER FROM EMPLOYEES E1 JOIN EMPLOYEES E2 ON E1.DEPARTMENT_ID = E2.DEPARTMENT_ID AND E1.EMPLOYEE_ID <> E2.EMPLOYEE_ID ORDER BY E1.LAST_NAME,E2.LAST_NAME;
```

Results Explain Describe Saved SQL History

EMPLOYEE	DEPT#	COWORKER
AIN	10	Bruce
AIN	10	Le
AIN	10	Rollins
Bruce	10	AIN
Bruce	10	Le
Bruce	10	Rollins
DAVIES	50	Flower
DAVIES	50	JAUL
Dawson	80	Lester
Dawson	80	MRUCE
Dawson	80	Pauline
Flower	50	DAVIES
Flower	50	JAUL
JAUL	50	DAVIES

9. Show the structure of the JOB_GRADES table. Create a query that displays the name, job, department name, salary, and grade for all employees



10. Create a query to display the name and hire date of any employee hired after employee Davies.

ORACLE Application Express

Home | Application Builder | SQL Workshop | Team Development | Administration

Home > SQL Workshop > SQL Commands

Autocommit Rows 10 Save Run

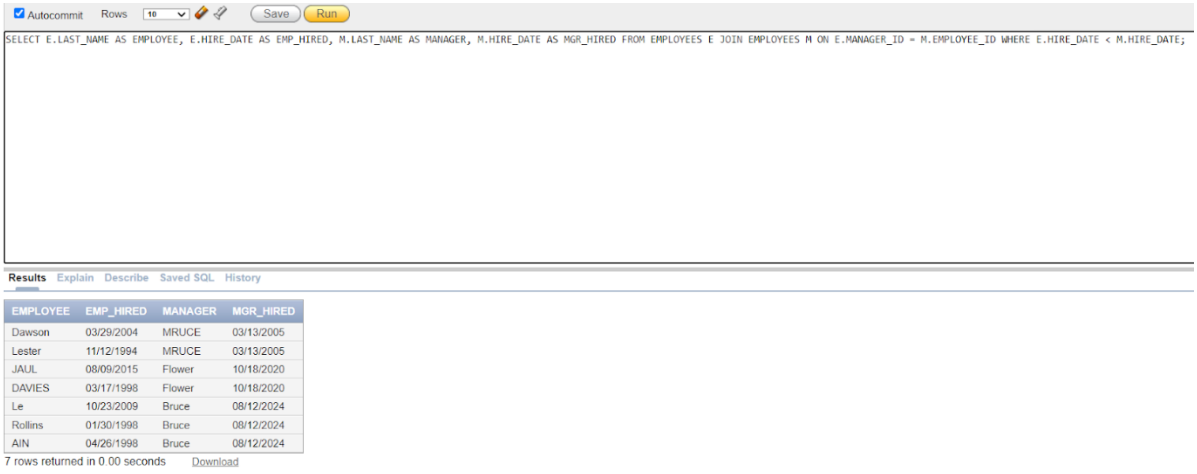
```
SELECT E.LAST_NAME, E.HIRE_DATE FROM EMPLOYEES E WHERE E.HIRE_DATE > (SELECT HIRE_DATE FROM EMPLOYEES WHERE LAST_NAME = 'DAVIES');
```

Results Explain Describe Saved SQL History

LAST_NAME	HIRE_DATE
Pauline	12/23/2012
MRUCE	03/13/2005
AIN	04/26/1998
JAUL	08/09/2015
Dawson	03/29/2004
Le	10/23/2009
Bruce	08/12/2024

7 rows returned in 0.02 seconds Download

11. Display the names and hire dates for all employees who were hired before their managers, along with their manager's names and hire dates. Label the columns Employee, Emp Hired, Manager, and Mgr Hired, respectively.



Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-8

Aggregating Data Using Group Functions

Objectives

After the completion of this exercise, the students be will be able to do the following:

- Identify the available group functions
- Describe the use of group functions
- Group data by using the GROUP BY clause
- Include or exclude grouped rows by using the HAVING clause

What Are Group Functions?

Group functions operate on sets of rows to give one result per group

Types of Group Functions

- AVG
- COUNT
- MAX
- MIN
- STDDEV
- SUM

• VARIANCE

Each of the functions accepts an argument. The following table identifies the options that you can use in the syntax:

Function	Description
AVG([DISTINCT|ALL] n)	Average value of n, ignoring null values
COUNT({*| [DISTINCT|ALL] expr })	Number of rows, where expr evaluates to something other than null (count all selected rows using *, including duplicates and rows with nulls)
MAX([DISTINCT|ALL] expr)	Maximum value of expr, ignoring null values
MIN([DISTINCT|ALL] expr)	Minimum value of expr, ignoring null values
STDDEV([DISTINCT|ALL] x)	Standard deviation of n, ignoring null values
SUM([DISTINCT|ALL] n)	Sum values of n, ignoring null values
VARIANCE([DISTINCT|ALL] x)	Variance of n, ignoring null values

Group Functions: Syntax

SELECT [*column*,] *group_function(column), ...*
FROM *table*
[WHERE *condition*]
[GROUP BY *column*]
[ORDER BY *column*];

Guidelines for Using Group Functions

• DISTINCT makes the function consider only nonduplicate values; ALL makes it consider every value, including duplicates. The default is ALL and therefore does not need to be specified.

• The data types for the functions with an expr argument may be CHAR, VARCHAR2, NUMBER, or DATE.

• All group functions ignore null values.

Using the AVG and SUM Functions

You can use AVG and SUM for numeric data.

```
SELECT AVG(salary), MAX(salary),
MIN(salary), SUM(salary)
FROM employees
WHERE job_id LIKE '%REP%';
```

Using the MIN and MAX Functions

You can use MIN and MAX for numeric, character, and date data types.

```
SELECT MIN(hire_date), MAX(hire_date)
FROM employees;
```

You can use the MAX and MIN functions for numeric, character, and date data types. example displays the most junior and most senior employees.

The following example displays the employee last name that is first and the employee last name that is last in an alphabetized list of all employees:

```
SELECT MIN(last_name), MAX(last_name)
FROM employees;
```

Note: The AVG, SUM, VARIANCE, and STDDEV functions can be used only with numeric data types. MAX and MIN cannot be used with LOB or LONG data types.

Using the COUNT Function

COUNT(*) returns the number of rows in a table:

```
SELECT COUNT(*)
FROM employees
WHERE department_id = 50;
```

COUNT(*expr*) returns the number of rows with nonnull values for the *expr*:

```
SELECT COUNT(commission_pct)
FROM employees
WHERE department_id = 80;
```

Using the DISTINCT Keyword

- COUNT(DISTINCT expr) returns the number of distinct non-null values of the *expr*.

- To display the number of distinct department values in the EMPLOYEES table:

```
SELECT COUNT(DISTINCT department_id) FROM employees;
```

Use the DISTINCT keyword to suppress the counting of any duplicate values in a column.

Group Functions and Null Values

Group functions ignore null values in the column:

```
SELECT AVG(commission_pct)
```

FROM employees;

The NVL function forces group functions to include null values:

SELECT AVG(NVL(commission_pct, 0))
FROM employees;

Creating Groups of Data

To divide the table of information into smaller groups. This can be done by using the GROUP BY clause.

GROUP BY Clause Syntax

SELECT *column*, *group_function(column)*
FROM *table*
[WHERE *condition*]
[GROUP BY *group_by_expression*]
[ORDER BY *column*];

In the syntax: *group_by_expression* specifies columns whose values
determine the basis for grouping rows

Guidelines

- If you include a group function in a SELECT clause, you cannot select individual results as well, *unless* the individual column appears in the GROUP BY clause. You receive an error message if you fail to include the column list in the GROUP BY clause.

- Using a WHERE clause, you can exclude rows before dividing them into groups.

- You must include the *columns* in the GROUP BY clause.

- You cannot use a column alias in the GROUP BY clause.

Using the GROUP BY Clause

All columns in the SELECT list that are not in group functions must be in the GROUP BY clause.

SELECT department_id, AVG(salary)
FROM employees
GROUP BY department_id ;

The GROUP BY column does not have to be in the SELECT list.
SELECT AVG(salary) FROM employees GROUP BY department_id ;

You can use the group function in the ORDER BY clause:

SELECT department_id, AVG(salary) FROM employees GROUP BY department_id ORDER BY AVG(salary);

Grouping by More Than One Column

SELECT department_id dept_id, job_id, SUM(salary) FROM employees
GROUP BY department_id, job_id ;

Illegal Queries Using Group Functions

Any column or expression in the SELECT list that is not an aggregate function must be in the GROUP

BY clause:

SELECT department_id, COUNT(last_name) FROM employees;

You can correct the error by adding the GROUP BY clause:

SELECT department_id, count(last_name) FROM employees GROUP BY department_id;

You cannot use the WHERE clause to restrict groups.

• You use the HAVING clause to restrict groups.

• You cannot use group functions in the WHERE clause.

SELECT department_id, AVG(salary) FROM employees WHERE AVG(salary) > 8000 GROUP BY department_id;
You can correct the error in the example by using the HAVING clause to restrict groups:

SELECT department_id, AVG(salary) FROM employees
HAVING AVG(salary) > 8000 GROUP BY department_id;

Restricting Group Results

With the HAVING Clause .When you use the HAVING clause, the Oracle server restricts groups as follows:
1. Rows are grouped.
2. The group function is applied.
3. Groups matching the HAVING clause are displayed.

Using the HAVING Clause

SELECT department_id, MAX(salary) FROM employees
GROUP BY department_idHAVING MAX(salary)>10000 ;

The following example displays the department numbers and average salaries for those departments with a maximum salary that is greater than $10,000:
SELECT department_id, AVG(salary) FROM employees GROUP BY department_id HAVING max(salary)>10000;

Example displays the job ID and total monthly salary for each job that has a total payroll exceeding $13,000. The example excludes sales representatives and sorts the list by the total monthly salary.

SELECT job_id, SUM(salary) PAYROLL FROM employees WHERE job_id NOT LIKE '%REP%' GROUP BY job_id HAVING SUM(salary) > 13000 ORDER BY SUM(salary);

Nesting Group Functions

Display the maximum average salary:
Group functions can be nested to a depth of two. The slide example displays the maximum average salary.

SELECT MAX(AVG(salary)) FROM employees GROUP BY department_id; **Summary**
In this exercise, students should have learned how to:
- Use the group functions COUNT, MAX, MIN, and AVG
- Write queries that use the GROUP BY clause
- Write queries that use the HAVING clause

SELECT *column*, *group_function*
FROM *table*
[WHERE *condition*]
[GROUP BY *group_by_expression*]
[HAVING *group_condition*] [ORDER
BY *column*];

Find the Solution for the following:

Determine the validity of the following three statements. Circle either True or False.

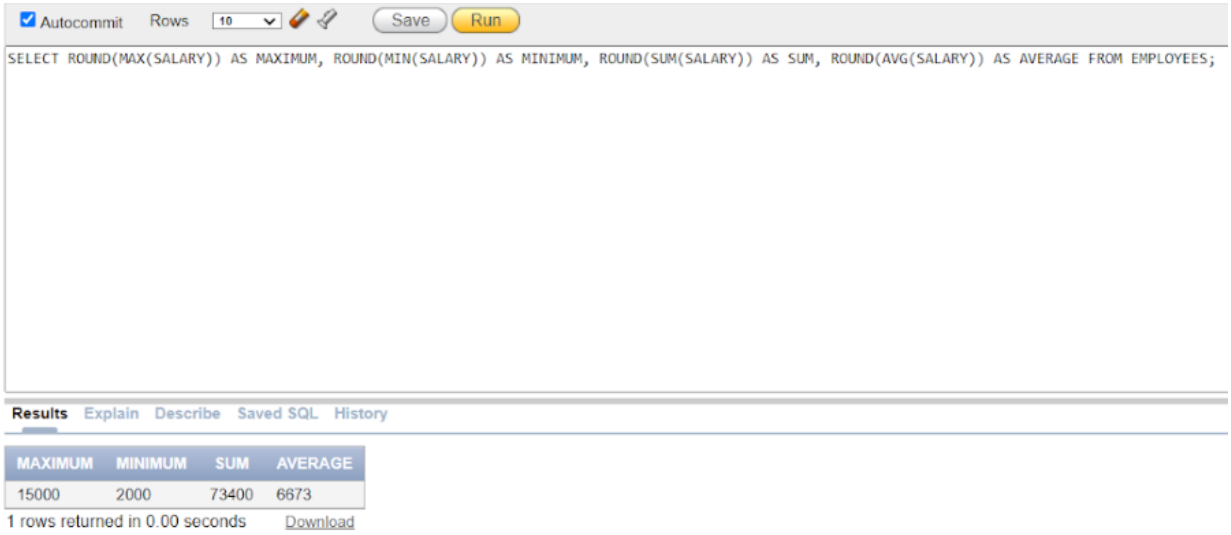
1. Group functions work across many rows to produce one result per group. True/False

2. Group functions include nulls in calculations.
True/False

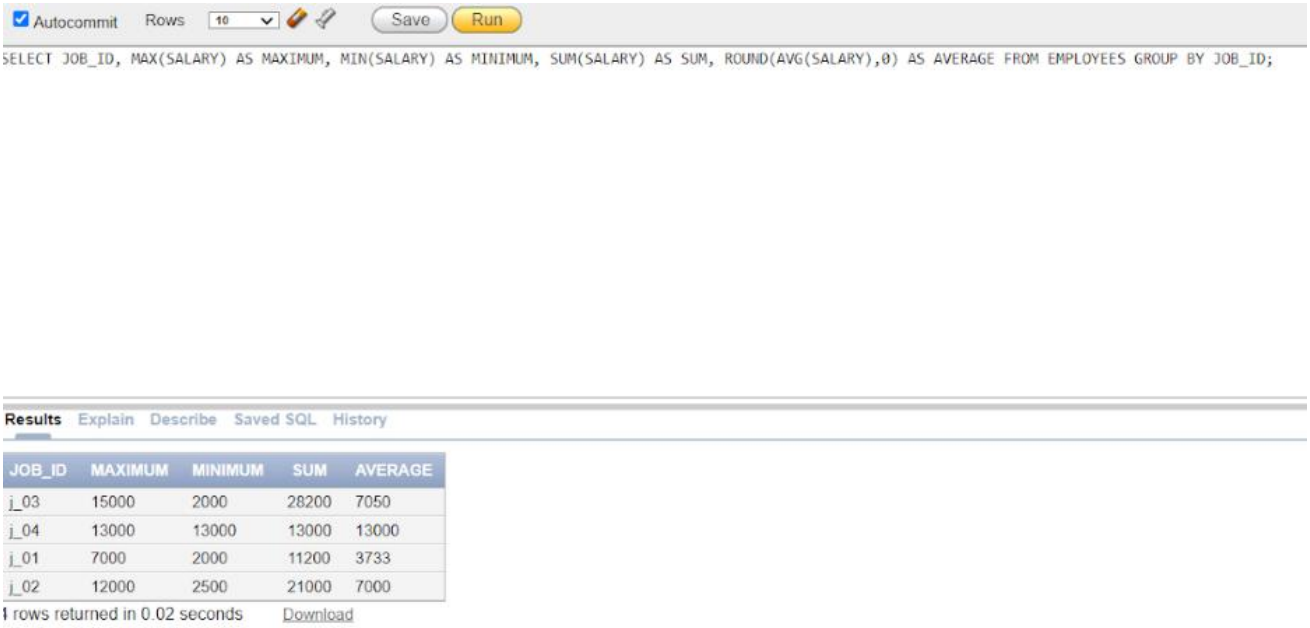
3. The WHERE clause restricts rows prior to inclusion in a group calculation. True/False

The HR department needs the following reports:

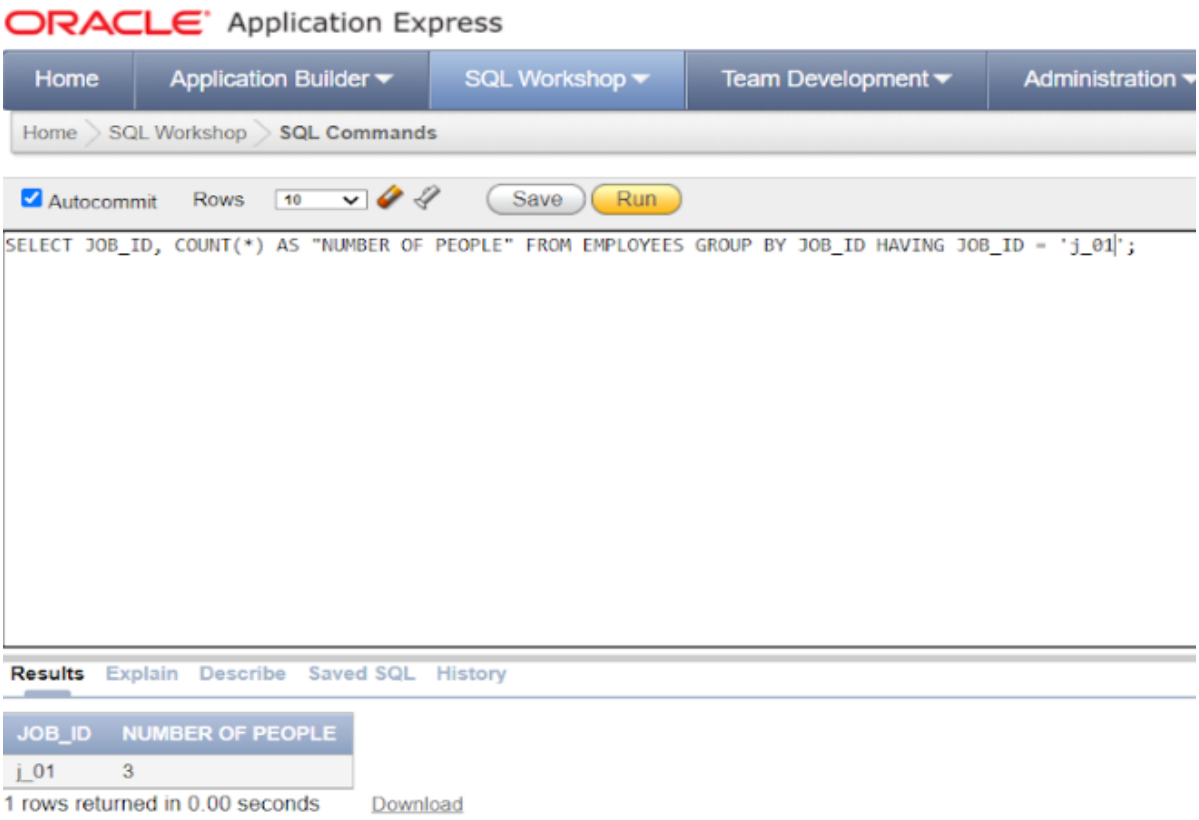
4. Find the highest, lowest, sum, and average salary of all employees. Label the columns Maximum, Minimum, Sum, and Average, respectively. Round your results to the nearest whole number



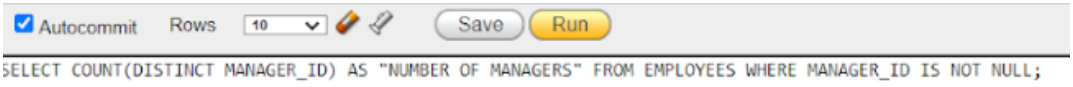
5. Modify the above query to display the minimum, maximum, sum, and average salary for each job type.

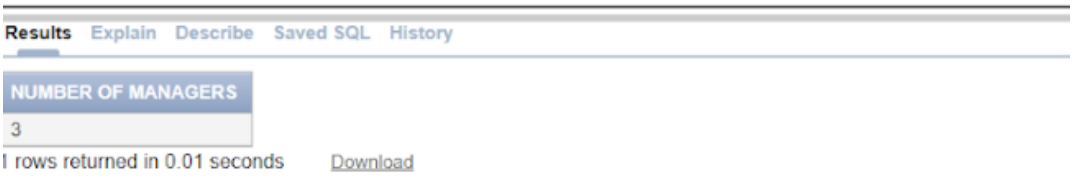


6.Write a query to display the number of people with the same job. Generalize the query so that the user in the HR department is prompted for a job title.

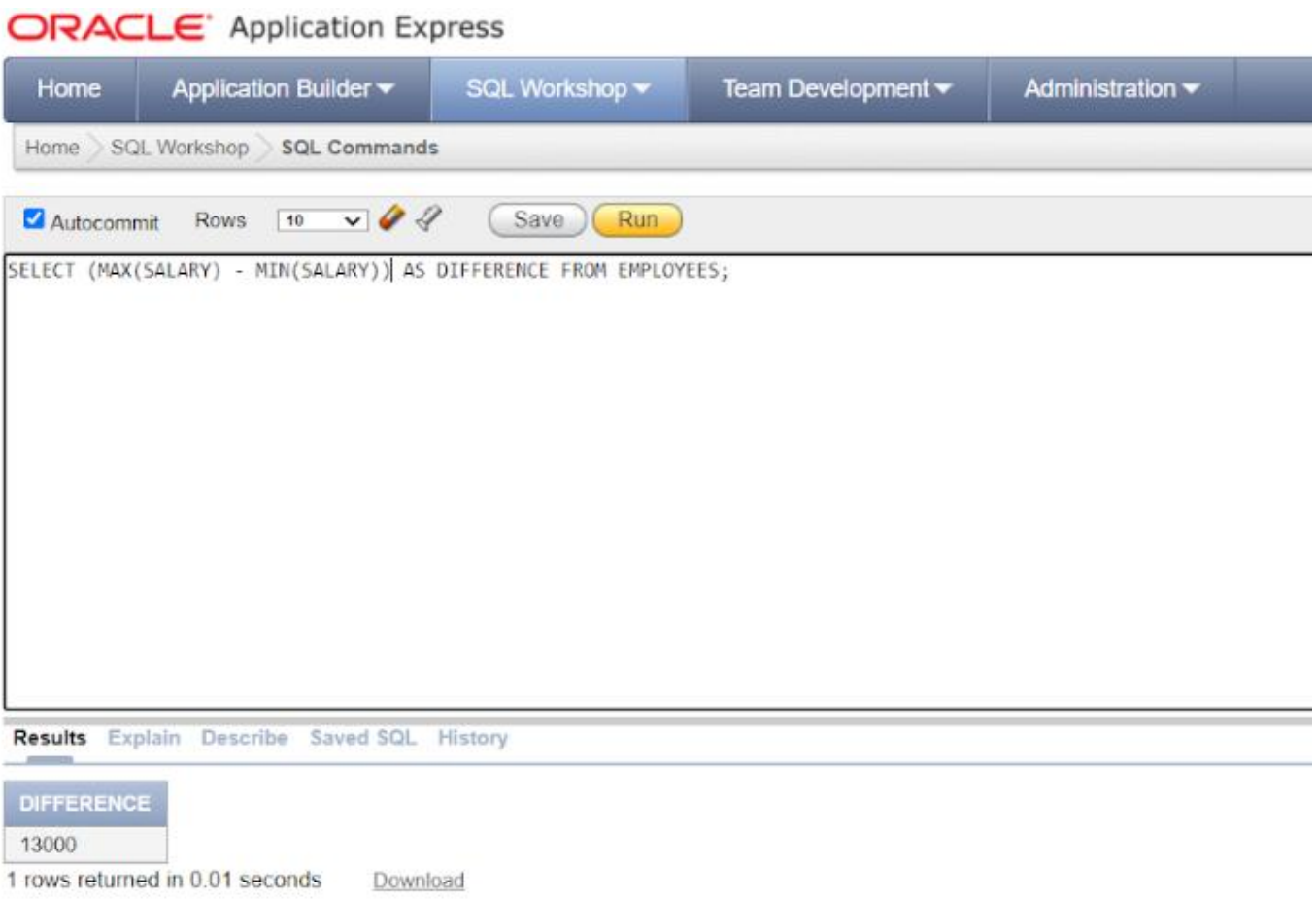


7. Determine the number of managers without listing them. Label the column Number of Managers. *Hint: Use the MANAGER_ID column to determine the number of managers.*

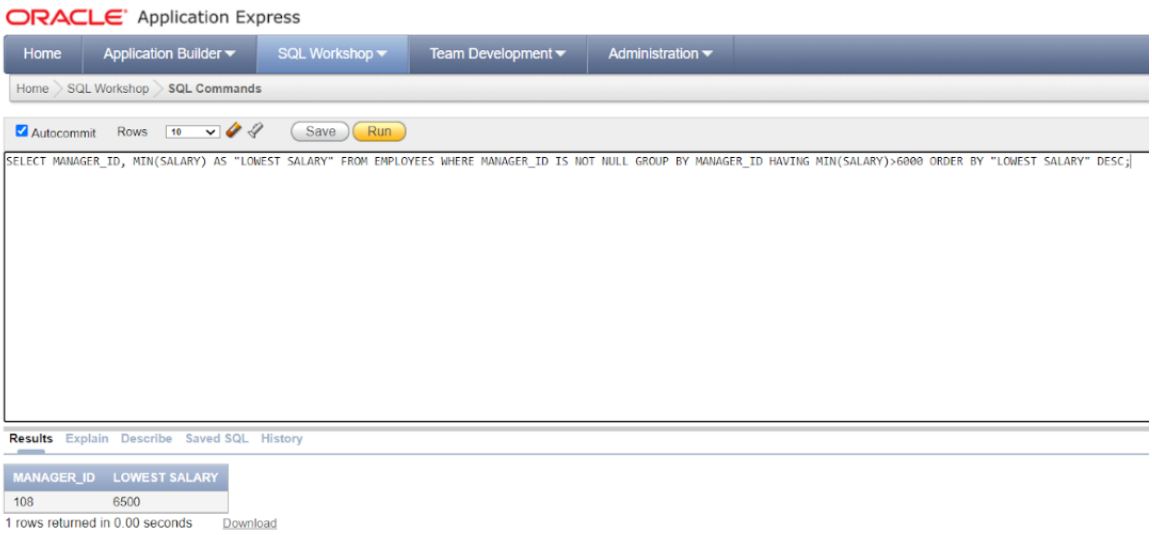




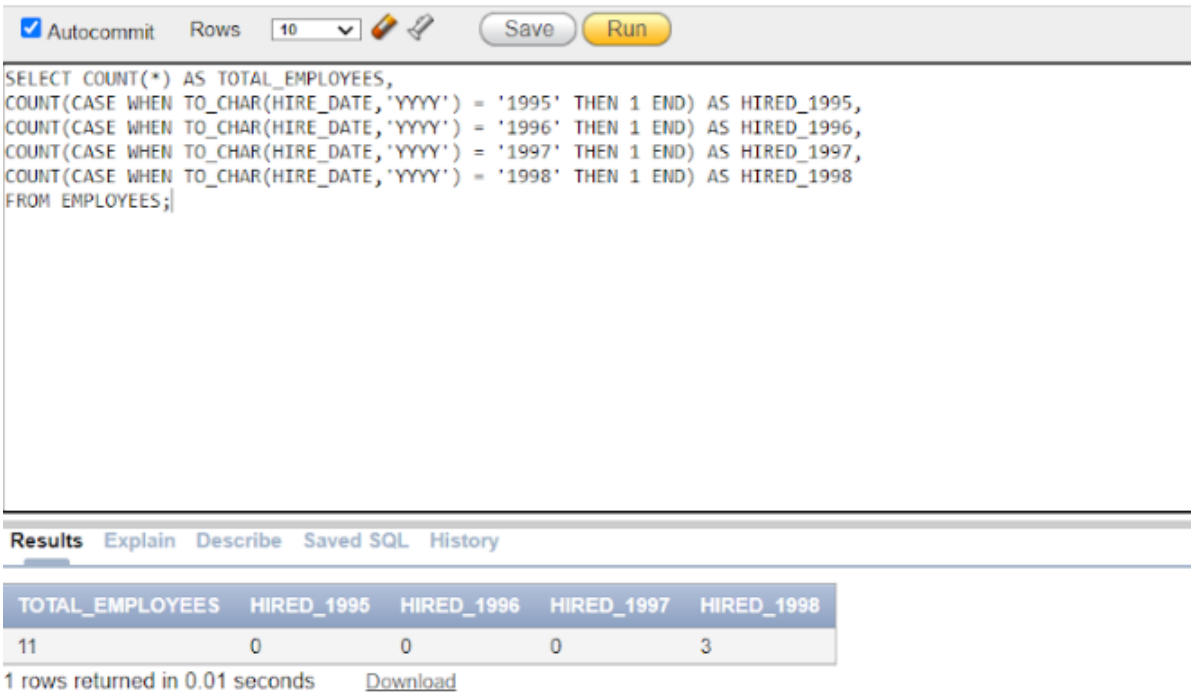
8. Find the difference between the highest and lowest salaries. Label the column DIFFERENCE.



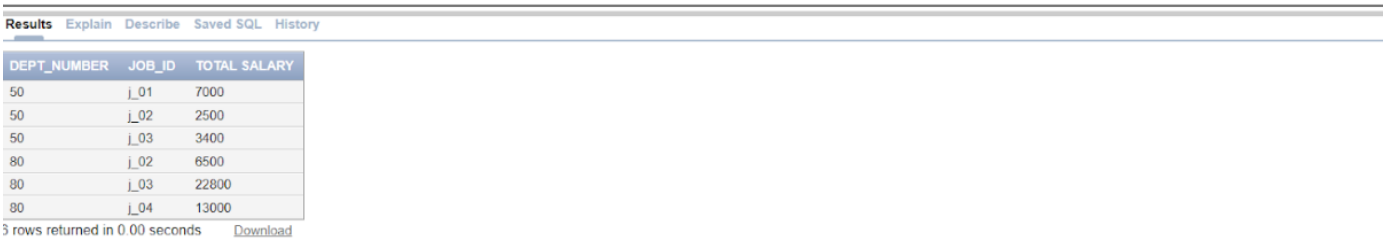
9. Create a report to display the manager number and the salary of the lowest-paid employee for that manager. Exclude anyone whose manager is not known. Exclude any groups where the minimum salary is $6,000 or less. Sort the output in descending order of salary.



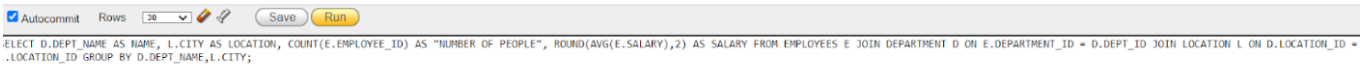
10. Create a query to display the total number of employees and, of that total, the number of employees hired in 1995, 1996, 1997, and 1998. Create appropriate column headings.

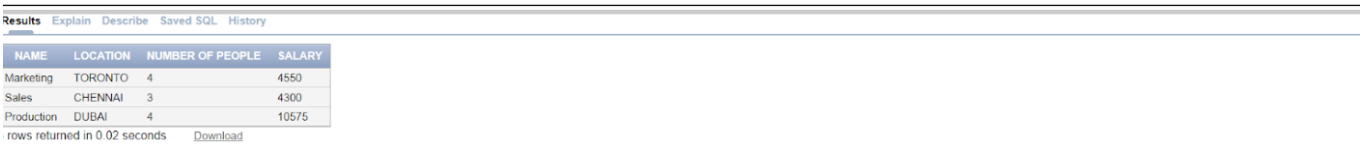


11. Create a matrix query to display the job, the salary for that job based on department number, and the total salary for that job, for departments 20, 50, 80, and 90, giving each column an appropriate heading.



12.Write a query to display each department's name, location, number of employees, and the average salary for all the employees in that department. Label the column name-Location, Number of people, and salary respectively. Round the average salary to two decimal places.





Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-9

Sub queries

Objectives

After completing this lesson, you should be able to do the following:

- Define subqueries
- Describe the types of problems that subqueries can solve

• List the types of subqueries
• Write single-row and multiple-row subqueries

Using a Subquery to Solve a Problem Who has a salary greater than Abel's?

Main query:
Which employees have salaries greater than Abel's salary?

Subquery:
What is Abel's salary?

Subquery Syntax

SELECT *select_list* FROM *table* WHERE *expr operator* (SELECT *select_list* FROM *table*);

• The subquery (inner query) executes once before the main query (outer query).

• The result of the subquery is used by the main query.

A subquery is a SELECT statement that is embedded in a clause of another SELECT statement. You can build powerful statements out of simple ones by using subqueries. They can be very useful when you need to select rows from a table with a condition that depends on the data in the table itself.

You can place the subquery in a number of SQL clauses, including the following:

• WHERE clause
• HAVING clause
• FROM clause

In the syntax:
operator includes a comparison condition such as >, =, or IN

Note: Comparison conditions fall into two classes: single-row operators (>, =, >=, <, <>, <=) and multiple-row operators (IN, ANY, ALL). statement. The subquery generally executes first, and its output is used to complete the query condition for the main (or outer) query

Using a Subquery

SELECT last_name FROM employees WHERE salary > (SELECT salary FROM employees WHERE last_name = 'Abel');
The inner query determines the salary of employee Abel. The outer query takes the result of the inner query and uses this result to display all the employees who earn more than this amount.

Guidelines for Using Subqueries

• Enclose subqueries in parentheses.

• Place subqueries on the right side of the comparison condition.

• The ORDER BY clause in the subquery is not needed unless you are performing Top-N analysis.

• Use single-row operators with single-row

subqueries, and use multiple-row operators with multiple-row subqueries.

Types of Subqueries

• Single-row subqueries: Queries that return only one row from the inner SELECT statement.

• Multiple-row subqueries: Queries that return more than one row from the inner SELECT statement.

Single-Row Subqueries

• Return only one row

• Use single-row comparison operators

Example

Display the employees whose job ID is the same as that of employee 141:

```
SELECT last_name, job_id FROM employees WHERE job_id = (SELECT job_id FROM
employees
WHERE employee_id = 141);
```

Displays employees whose job ID is the same as that of employee 141 and whose salary is greater than that of employee 143.

```
SELECT last_name, job_id, salary FROM employeesWHERE job_id =(SELECT job_id FROM
employees WHERE employee_id = 141) AND salary > (SELECT salary FROM employees
WHERE employee_id = 143);
```

Using Group Functions in a Subquery

Displays the employee last name, job ID, and salary of all employees whose salary is equal to the minimum salary. The MIN group function returns a single value (2500) to the outer query.

SELECT last_name, job_id, salary FROM employees WHERE salary = (SELECT MIN(salary) FROM employees);

The HAVING Clause with Subqueries

• The Oracle server executes subqueries first.

• The Oracle server returns results into the HAVING clause of the main query.

Displays all the departments that have a minimum salary greater than that of department 50.

```
SELECT department_id, MIN(salary)
FROM employees
GROUP BY department_id
HAVING MIN(salary) >
(SELECT MIN(salary)
FROM employees
WHERE department_id = 50);
```

Example

Find the job with the lowest average salary.

```
SELECT job_id, AVG(salary)
FROM employees
GROUP BY job_id
HAVING AVG(salary) = (SELECT MIN(AVG(salary))
FROM employees
GROUP BY job_id);
```

What Is Wrong in this Statements?

SELECT employee_id, last_name
FROM employees
WHERE salary =(SELECT MIN(salary) FROM employees GROUP BY department_id); Will This Statement Return Rows?

```
SELECT last_name, job_id
FROM employees
WHERE job_id =(SELECT job_id FROM employees WHERE last_name = 'Haas');
```

Multiple-Row Subqueries

• Return more than one row

• Use multiple-row comparison operators

Example

Find the employees who earn the same salary as the minimum salary for each department.

SELECT last_name, salary, department_id FROM employees WHERE salary IN (SELECT MIN(salary)
FROM employees GROUP BY department_id);

Using the ANY Operator in Multiple-Row Subqueries

SELECT employee_id, last_name, job_id, salary FROM employees WHERE salary < ANY (SELECT salary FROM employees WHERE job_id = 'IT_PROG') AND job_id <> 'IT_PROG';
Displays employees who are not IT programmers and whose salary is less than that of any IT programmer. The maximum salary that a programmer earns is $9,000.

< ANY means less than the maximum. >ANY means more than the minimum. =ANY is equivalent to IN.

Using the ALL Operator in Multiple-Row Subqueries

SELECT employee_id, last_name, job_id, salary
FROM employees
WHERE salary < ALL (SELECT salary FROM employees WHERE job_id = 'IT_PROG') AND job_id <> 'IT_PROG';
Displays employees whose salary is less than the salary of all employees with a job ID of IT_PROG and whose job is not IT_PROG.

- ALL means more than the maximum, and <ALL means less than the minimum.

The NOT operator can be used with IN, ANY, and ALL operators.

Null Values in a Subquery

SELECT emp.last_name FROM employees emp
WHERE emp.employee_id NOT IN (SELECT mgr.manager_id FROM employees mgr);

Notice that the null value as part of the results set of a subquery is not a problem if you use the IN operator. The IN operator is equivalent to =ANY. For example, to display the employees who have subordinates, use the following SQL statement:

SELECT emp.last_name
FROM employees emp
WHERE emp.employee_id IN (SELECT mgr.manager_id FROM employees mgr);

Display all employees who do not have any subordinates:

SELECT last_name FROM employees
WHERE employee_id NOT IN (SELECT manager_id FROM employees WHERE manager_id IS NOT NULL);

Find the Solution for the following:

1. The HR department needs a query that prompts the user for an employee last name. The query then displays the last name and hire date of any employee in the same department as the employee whose name they supply (excluding that employee). For example, if the user enters Zlotkey, find all employees who work with Zlotkey (excluding Zlotkey).

```
SELECT last_name, hire_date
FROM employees
WHERE department_id = (
        SELECT department_id
        FROM employees
        WHERE last_name = 'Zlotkey'
    )
AND last_name <> 'Zlotkey';
```

Results | Explain | Describe | Saved SQL | History

LAST_NAME	HIRE_DATE
Austin	6/1/2020

1 rows returned in 0.03 seconds Download

2. Create a report that displays the employee number, last name, and salary of all employees who earn more than the average salary. Sort the results in order of ascending salary.

```
SELECT employee_id, last_name, salary
FROM employees
WHERE salary > (SELECT AVG(salary) FROM employees)
ORDER BY salary ASC;
```

Results | Explain | Describe | Saved SQL | History

EMPLOYEE_ID	LAST_NAME	SALARY
102	Kochhar	17000
103	De Haan	17000
101	King	24000

3 rows returned in 0.01 seconds Download

3. Write a query that displays the employee number and last name of all employees who work in a department with any employee whose last name contains a *u*.

```
SELECT employee_id, last_name
FROM employees
WHERE department_id IN (
        SELECT DISTINCT department_id
        FROM employees
        WHERE last_name LIKE '%u%'
    );
```

Results | Explain | Describe | Saved SQL | History

EMPLOYEE_ID	LAST_NAME
104	Hunold
107	Pataballa
108	Lorentz
105	Zlotkey
106	Austin

5 rows returned in 0.01 seconds Download

4. The HR department needs a report that displays the last name, department number, and job ID of all employees whose department location ID is 1700.

```
SELECT e.last_name, e.department_id, e.job_id
FROM employees e
JOIN departments d ON e.department_id = d.department_id
WHERE d.location_id = 1700;
```

Results | Explain | Describe | Saved SQL | History

LAST_NAME	DEPARTMENT_ID	JOB_ID
King	20	AD_PRES
Kochhar	20	AD_VP
De Haan	20	AD_VP
Hunold	10	IT_PROG
Pataballa	10	IT_PROG
Lorentz	10	IT_PROG

5. Create a report for HR that displays the last name and salary of every employee who reports to King.

```sql
SELECT e.last_name, e.salary
FROM employees e
WHERE e.manager_id = (
        SELECT employee_id
        FROM employees
        WHERE last_name = 'King'
    );
```

Results | Explain | Describe | Saved SQL | History

LAST_NAME	SALARY
Kochhar	17000
De Haan	17000

6. Create a report for HR that displays the department number, last name, and job ID for every employee in the Executive department.

```sql
SELECT e.department_id, e.last_name, e.job_id
FROM employees e
JOIN departments d ON e.department_id = d.department_id
WHERE d.department_name = 'Executive';
```

Results | Explain | Describe | Saved SQL | History

DEPARTMENT_ID	LAST_NAME	JOB_ID
20	King	AD_PRES
20	Kochhar	AD_VP
20	De Haan	AD_VP

7. Modify the query 3 to display the employee number, last name, and salary of all employees who earn more than the average salary and who work in a department with any employee whose last name contains a *u*.

```sql
SELECT employee_id, last_name, salary
FROM employees
WHERE salary > (SELECT AVG(salary) FROM employees)
AND department_id IN (
        SELECT DISTINCT department_id
        FROM employees
        WHERE last_name LIKE '%u%'
    );
```

Results | Explain | Describe | Saved SQL | History

no data found

Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-10

USING THE SET OPERATORS

Objectives

After the completion this exercise, the students should be able to do the following:

- Describe set operators
- Use a set operator to combine multiple queries into a single query
- Control the order of rows returned

The set operators combine the results of two or more component queries into one result.

Queries containing set operators are called *compound queries*.

Operator	Returns
UNION	All distinct rows selected by either query
UNION ALL	All rows selected by either query, including all duplicates
INTERSECT	All distinct rows selected by both queries
MINUS	All distinct rows that are selected by the first SELECT statement and not selected in the second SELECT statement

The tables used in this lesson are:

• EMPLOYEES: Provides details regarding all current employees

• JOB_HISTORY: Records the details of the start date and end date of the former job, and the job identification number and department when an employee switches jobs

UNION Operator

Guidelines

• The number of columns and the data types of the columns being selected must be identical in all the SELECT statements used in the query. The names of the columns need not be identical.

• UNION operates over all of the columns being selected.

• NULL values are not ignored during duplicate checking.

• The IN operator has a higher precedence than the UNION operator.

• By default, the output is sorted in ascending order of the first column of the SELECT clause.

Example:

Display the current and previous job details of all employees. Display each employee only once.

SELECT employee_id, job_id FROM employees UNION SELECT employee_id, job_id FROM job_history;

Example:

```
SELECT employee_id, job_id, department_id
FROM employees
```

```
UNION
SELECT employee_id, job_id, department_id
FROM job_history;
```

UNION ALL Operator

Guidelines

The guidelines for UNION and UNION ALL are the same, with the following two exceptions that pertain to UNION ALL:

- Unlike UNION, duplicate rows are not eliminated and the output is not sorted by default.
- The DISTINCT keyword cannot be used. **Example:**

Display the current and previous departments of all employees.

```
SELECT employee_id, job_id, department_id
FROM employees
UNION ALL
SELECT employee_id, job_id, department_id
FROM job_history
ORDER BY employee_id;
```

INTERSECT Operator

Guidelines

- The number of columns and the data types of the columns being selected by the SELECT statements in the queries must be identical in all the SELECT statements used in the query. The names of the columns need not be identical.
- Reversing the order of the intersected tables does not alter the result.
- INTERSECT does not ignore NULL values.

Example:

Display the employee IDs and job IDs of those employees who currently have a job title that is the same as their job title when they were initially hired (that is, they changed jobs but have now gone back to doing their original job).

```
SELECT employee_id, job_id FROM employees
INTERSECT
SELECT employee_id, job_id
FROM job_history;
```

Example

```
SELECT employee_id, job_id, department_id
FROM employees
```

INTERSECT
SELECT employee_id, job_id, department_id
FROM job_history;

MINUS Operator Guidelines

- The number of columns and the data types of the columns being selected by the SELECT statements in the queries must be identical in all the SELECT statements used in the query. The names of the columns need not be identical.
- All of the columns in the WHERE clause must be in the SELECT clause for the MINUS operator to work.

Example:

Display the employee IDs of those employees who have not changed their jobs even once.

```
SELECT employee_id,job_id
FROM employees
MINUS
SELECT employee_id,job_id
FROM job_history;
```

Find the Solution for the following:

1. The HR department needs a list of department IDs for departments that do not contain the job ID ST_CLERK. Use set operators to create this report.

```
1  SELECT department_id
2  FROM departments
3  MINUS
4  SELECT DISTINCT department_id
5  FROM employees
6  WHERE job_id = 'ST_CLERK';
7
```

Results | Explain | Describe | Saved SQL | History

DEPARTMENT_ID
20
30
50
60

2. The HR department needs a list of countries that have no departments located in them. Display the country ID and the name of the countries. Use set operators to create this report.

```
SELECT country_id, country_name
FROM countries
MINUS
SELECT DISTINCT c.country_id, c.country_name
FROM countries c
JOIN locations l ON c.country_id = l.country_id
JOIN departments d ON l.location_id = d.location_id;
```

Results | Explain | Describe | Saved SQL | History

COUNTRY_ID	COUNTRY_NAME
CN	China

rows returned in 0.05 seconds Download

3. Produce a list of jobs for departments 10, 50, and 20, in that order. Display job ID and department ID using set operators.

```
SELECT job_id, department_id
FROM employees
WHERE department_id = 10

UNION ALL

SELECT job_id, department_id
FROM employees
WHERE department_id = 50

UNION ALL

SELECT job_id, department_id
FROM employees
WHERE department_id = 20;
```

Results | Explain | Describe | Saved SQL | History

JOB_ID	DEPARTMENT_ID
ST_CLERK	10
MK_REP	50
AD_PRES	20
AD_VP	20

4 rows returned in 0.01 seconds Download

4. Create a report that lists the employee IDs and job IDs of those employees who currently have a job title that is the same as their job title when they were initially hired by the company (that is, they changed jobs but have now gone back to doing their original job).

```
1  SELECT employee_id, job_id
2  FROM employees
3  WHERE job_id = hire_job_id;
4
```

Results | Explain | Describe | Saved SQL | History

EMPLOYEE_ID	JOB_ID
101	AD_PRES
102	AD_VP
103	ST_CLERK
104	IT_PROG
106	SA_REP
107	MK_REP

5. The HR department needs a report with the following specifications:

- Last name and department ID of all the employees from the EMPLOYEES table, regardless of whether or not they belong to a department.

- Department ID and department name of all the departments from the DEPARTMENTS table, regardless of whether or not they have employees working in them Write a compound query to accomplish this.

-

```
1  SELECT last_name AS name, TO_CHAR(department_id) AS dept_id
2  FROM employees
3
4  UNION
5
6  SELECT department_name AS name, TO_CHAR(department_id) AS dept_id
7  FROM departments;
8
```

Results | Explain | Describe | Saved SQL | History

NAME	DEPT_ID
Administration	10
Austin	30
De Haan	10
Executive	20
Hunold	60

Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-11

CREATING VIEWS

After the completion of this exercise, students will be able to do the following:

- Describe a view
- Create, alter the definition of, and drop a view
- Retrieve data through a view
- Insert, update, and delete data through a view
- Create and use an inline view

View

A view is a logical table based on a table or another view. A view contains no data but is like a window through which data from tables can be viewed or changed.The tables on which a view is based are called base tables.

Advantages of Views

- To restrict data access
- To make complex queries easy
- To provide data independence
- To present different views of the same data

Classification of views

1. Simple view
2. Complex view

Feature	Simple	Complex
No. of tables	One	One or more
Contains functions	No	Yes
Contains groups of data	No	Yes
DML operations thr' view	Yes	Not always

Creating a view

Syntax

CREATE OR REPLACE FORCE/NOFORCE VIEW view_name AS Subquery WITH CHECK OPTION CONSTRAINT constraint WITH READ ONLY CONSTRAINT constraint;

FORCE - Creates the view regardless of whether or not the base tables exist.

NOFORCE - Creates the view only if the ase table exist.

WITH CHECK OPTION CONSTRAINT-specifies that only rows accessible to the view can be inserted or updated.

WITH READ ONLY CONSTRAINT-ensures that no DML operations can be performed on the view.

Example: 1 (Without using Column aliases)

Create a view EMPVU80 that contains details of employees in department80.

Example 2:

```
CREATE VIEW empvu80 AS SELECT employee_id, last_name, salary FROM employees
WHERE department_id=80;
```

Example:1 (**Using column aliases)**

```
CREATE VIEW salvu50
  AS  SELECT employee_id,id_number,  last_name NAME, salary *12 ANN_SALARY
FROM employees
    WHERE department_id=50;
```

Retrieving data from a view

Example:

```
SELECT * from salvu50;
```

Modifying a view

A view can be altered without dropping, re-creating.

Example: (Simple view)

Modify the EMPVU80 view by using CREATE OR REPLACE.

```
CREATE OR REPLACE VIEW empvu80 (id_number, name, sal, department_id)
 AS      SELECT employee_id,first_name, last_name, salary, department_id
FROM employees
WHERE department_id=80;
```

Example: **(complex view)**

```
CREATE VIEW dept_sum_vu (name, minsal, maxsal,avgsal)
AS       SELECT d.department_name, MIN(e.salary), MAX(e.salary), AVG(e.salary)
FROM employees e, department d
WHERE e.deparment_id=d.deparment_id
GROUP BY d.department_name;
```

Rules for performing DML operations on view

- Can perform operations on simple views
- Cannot remove a row if the view contains the following:
  - Group functions
  - Group By clause
  - Distinct keyword

- Cannot modify data in a view if it contains
  - Group functions
  - Group By clause
  - Distinct keyword
  - Columns contain by expressions
  -
- Cannot add data thr' a view if it contains
  - Group functions
  - Group By clause
  - Distinct keyword
  - Columns contain by expressions
  - NOT NULL columns in the base table that are not selected by the view

Example: (Using the WITH CHECK OPTION clause)

```
CREATE OR REPLACE VIEW empvu20
 AS      SELECT *
 FROM employees
 WHERE department_id=20
 WITH CHECK OPTION CONSTRAINT empvu20_ck;
```

Note: Any attempt to change the department number for any row in the view fails because it violates the WITH CHECK OPTION constraint.

Example – (Execute this and note the error)

```
UPDATE empvu20 SET department_id=10 WHERE employee_id=201;
```

Denying DML operations

Use of WITH READ ONLY option.
Any attempt to perform a DML on any row in the view results in an oracle server error.

Try this code:

```
CREATE OR REPLACE VIEW empvu10(employee_number, employee_name,job_title)
AS SELECT employee_id, last_name, job_id
FROM employees
WHERE department_id=10
WITH READ ONLY;
```

Find the Solution for the following:

1. Create a view called EMPLOYEE_VU based on the employee numbers, employee names and department numbers from the EMPLOYEES table. Change the heading for the employee name to EMPLOYEE.

```
1  CREATE OR REPLACE VIEW EMPLOYEE_VU AS
2  SELECT employee_id,
3         last_name || ', ' || first_name AS EMPLOYEE,
4         department_id
5  FROM employees;
6
```

Results | Explain | Describe | Saved SQL | History

```
View created.
```

2. Display the contents of the EMPLOYEES_VU view.

```
1  SELECT * FROM EMPLOYEE_VU;
2
```

Results | Explain | Describe | Saved SQL | History

EMPLOYEE_ID	EMPLOYEE	DEPARTMENT_ID
101	King, Steven	20
102	Kochhar, Neena	20
103	De Haan, Lex	10
104	Hunold, Alexander	60
105	Zlotkey, Bruce	30
106	Austin, David	30

3. Select the view name and text from the USER_VIEWS data dictionary views.

```
1  SELECT view_name, text
2  FROM user_views
3  WHERE view_name = 'EMPLOYEE_VU';
4
```

Results | Explain | Describe | Saved SQL | History

VIEW_NAME	TEXT
EMPLOYEE_VU	SELECT employee_id, last_name || ', ' || first_name AS EMPLOYEE, department_id FROM employees

1 rows returned in 0.06 seconds Download

4. Using your EMPLOYEES_VU view, enter a query to display all employees names and department.

```
SELECT EMPLOYEE, department_id
FROM EMPLOYEE_VU;
```

Results | Explain | Describe | Saved SQL | History

EMPLOYEE	DEPARTMENT_ID
King, Steven	20
Kochhar, Neena	20
De Haan, Lex	10
Hunold, Alexander	60
Zlotkey, Bruce	30

5. Create a view named DEPT50 that contains the employee number, employee last names and department numbers for all employees in department 50.Label the view columns EMPNO, EMPLOYEE and DEPTNO. Do not allow an employee to be reassigned to another department through the view.

```
CREATE OR REPLACE VIEW DEPT50 (EMPNO, EMPLOYEE, DEPTNO) AS
SELECT employee_id,
       last_name || ', ' || first_name,
       department_id
FROM employees
WHERE department_id = 50
WITH READ ONLY;
```

Results | Explain | Describe | Saved SQL | History

```
View created.

0.05 seconds
```

6. Display the structure and contents of the DEPT50 view.

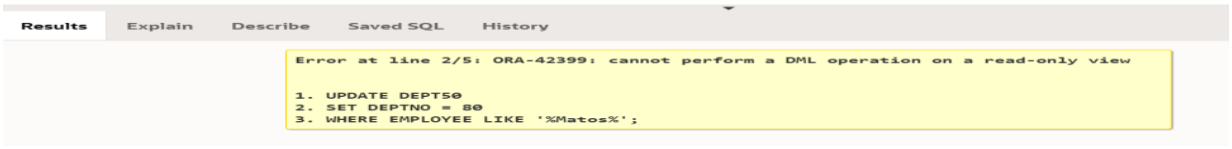
```
SELECT * FROM DEPT50;
```

Results | Explain | Describe | Saved SQL | History

EMPNO	EMPLOYEE	DEPTNO
107	Smith, Alice	50

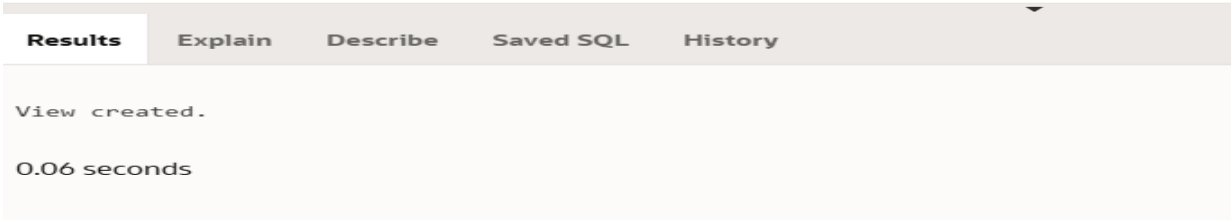
7. Attempt to reassign Matos to department 80.

```
1  UPDATE DEPT50
2  SET DEPTNO = 80
3  WHERE EMPLOYEE LIKE '%Matos%';
4
```



8. Create a view called SALARY_VU based on the employee last names, department names, salaries, and salary grades for all employees. Use the Employees, DEPARTMENTS and JOB_GRADE tables. Label the column Employee, Department, salary, and Grade respectively.

```
1   CREATE OR REPLACE VIEW SALARY_VU AS
2   SELECT e.last_name || ', ' || e.first_name AS Employee,
3          d.department_name AS Department,
4          e.salary AS Salary,
5          j.grade_level AS Grade
6   FROM employees e
7   JOIN departments d ON e.department_id = d.department_id
8   JOIN job_grades j
9       ON e.salary BETWEEN j.lowest_sal AND j.highest_sal;
10
```



Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE 12

Intro to Constraints; NOT NULL and UNIQUE Constraints

Global Fast Foods has been very successful this past year and has opened several new stores. They need to add a table to their database to store information about each of their store's locations. The owners want to make sure that all entries have an identification number, date opened, address, and city and that no other entry in the table can have the same email address. Based on this information, answer the following questions about the global_locations table. Use the table for your answers.

Global Fast Foods global_locations Table						
NAME	**TYPE**	**LENGTH**	**PRECISION**	**SCALE**	**NULLABLE**	**DEFAULT**
Id						
name						
date_opened						
address						
city						
zip/postal code						
phone						
email						
manager_id						
Emergency contact						

1. What is a "constraint" as it relates to data integrity?

A rule that enforces data integrity by restricting allowed data in a table or column.

2. What are the limitations of constraints that may be applied at the column level and at the table level?

Column-level applies to one column only; table-level can handle multiple columns but may be complex.

3. Why is it important to give meaningful names to constraints?

Meaningful names make constraints easier to identify, maintain, and debug.

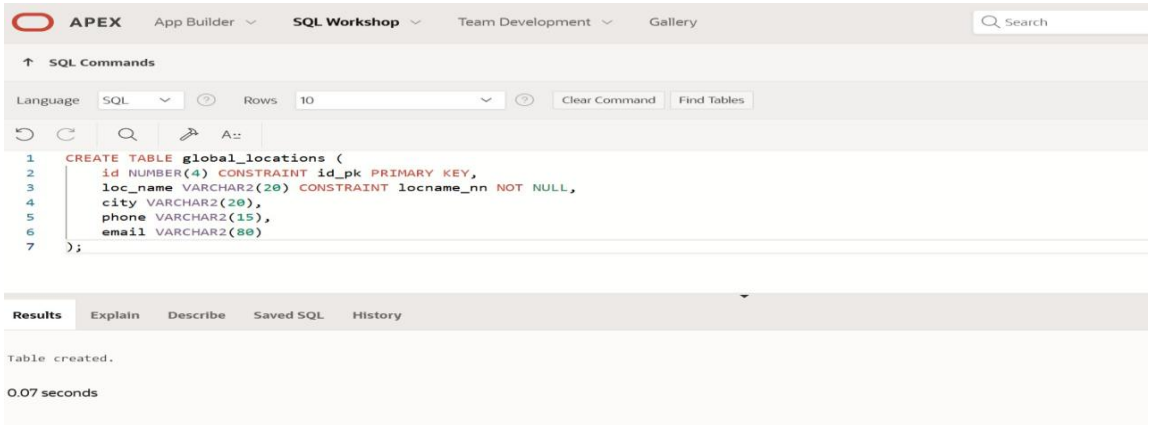
4. Based on the information provided by the owners, choose a datatype for each column. Indicate the length, precision, and scale for each NUMBER datatype.

Use VARCHAR (length) for text, DATE for dates, and NUMBER (precision, scale) for numeric columns based on owners' requirements. Specify length, precision, and scale, and mark (nullable) for columns that can have null values.

5. Use "(nullable)" to indicate those columns that can have null values.

Assign datatypes based on owners' info: VARCHAR (length) for text, DATE for dates, NUMBER (precision, scale) for numbers, and add (nullable) for columns that can contain null values.

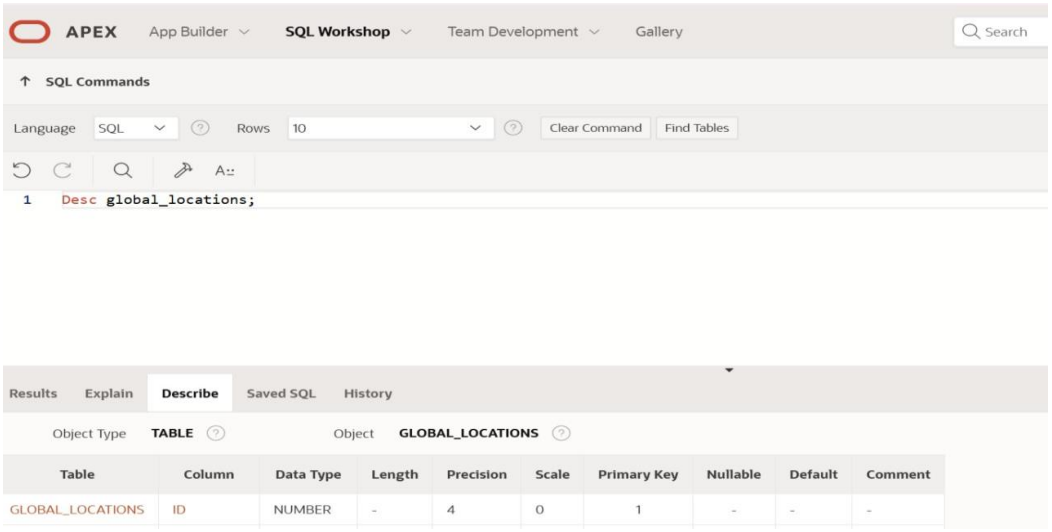
6. Write the CREATE TABLE statement for the Global Fast Foods locations table to define the constraints at the column level.



7. Execute the CREATE TABLE statement in Oracle Application Express.

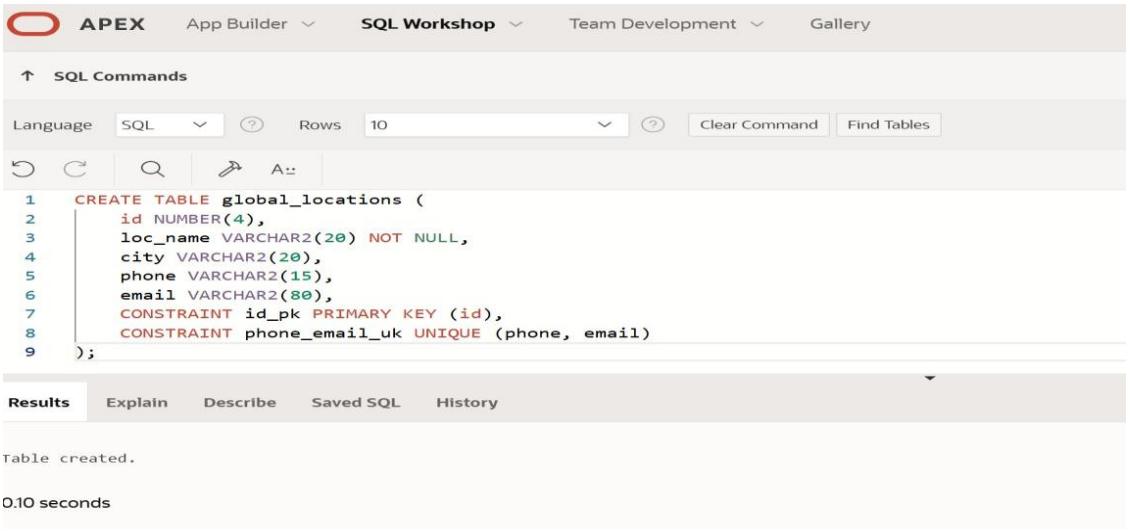
In Oracle APEX, go to **SQL Workshop → SQL Commands**, paste your CREATE TABLE statement, and click **Run**. Verify the table in **Object Browser**.

8. Execute a DESCRIBE command to view the Table Summary information.



9. Rewrite the CREATE TABLE statement for the Global Fast Foods locations table to define the UNIQUE constraints at the table level. Do not execute this statement.

NAME	TYPE	LENGTH	PRECISION	SCALE	NULLABLE	DEFAULT
id	number	4				
loc_name	varchar2	20			X	
	date					
address	varchar2	30				
city	varchar2	20				
zip_postal	varchar2	20			X	
phone	varchar2	15			X	
email	varchar2	80			X	
manager_id	number	4			X	
contact	varchar2	40			X	



PRIMARY KEY, FOREIGN KEY, and CHECK Constraints

1. What is the purpose of a

- PRIMARY KEY
- FOREIGN KEY
- CHECK CONSTRAINT

PRIMARY KEY: Uniquely identifies each row in a table.

FOREIGN KEY: Ensures referential integrity by linking a column to a primary key in another table.

CHECK CONSTRAINT: Enforces a condition on the values in a column.

2. Using the column information for the animals table below, name constraints where applicable at the table level, otherwise name them at the column level. Define the primary key (animal_id). The license_tag_number must be unique. The admit_date and vaccination_date columns cannot contain null values.

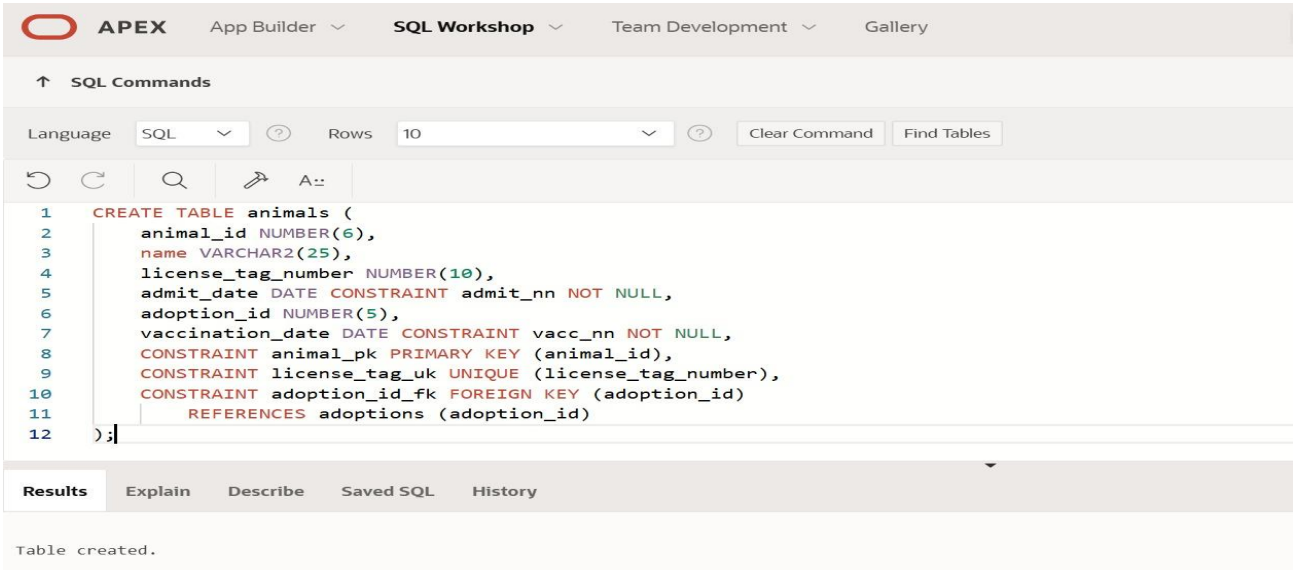
animal_id NUMBER(6) name
VARCHAR2(25)
license_tag_number NUMBER(10)
admit_date DATE adoption_id
NUMBER(5),
vaccination_date DATE

animal_id → **Primary Key** (table/column level).

license_tag_number → **Unique** (table-level name: UQ_License).

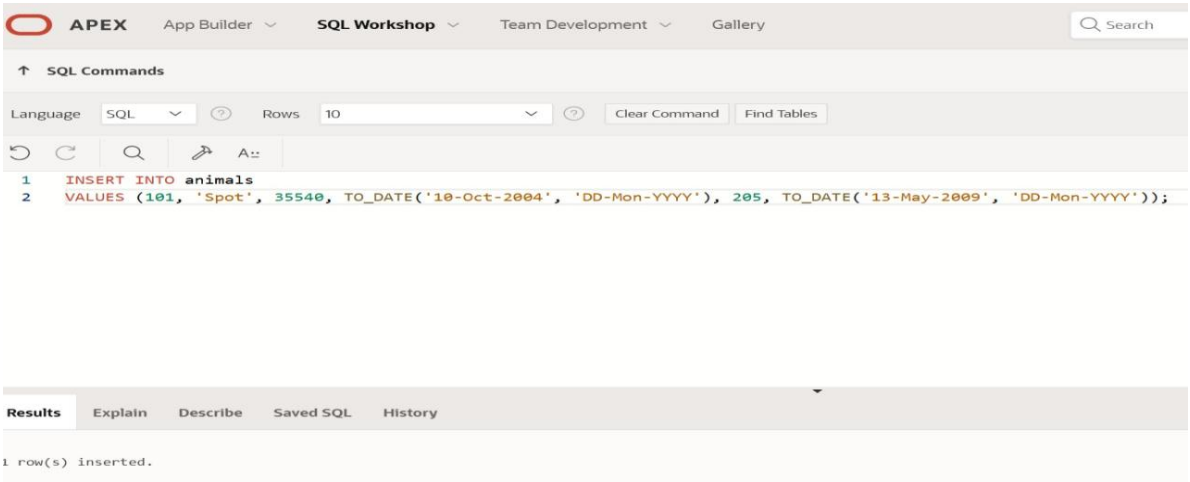
admit_date & vaccination_date → **Not Null** (column-level).

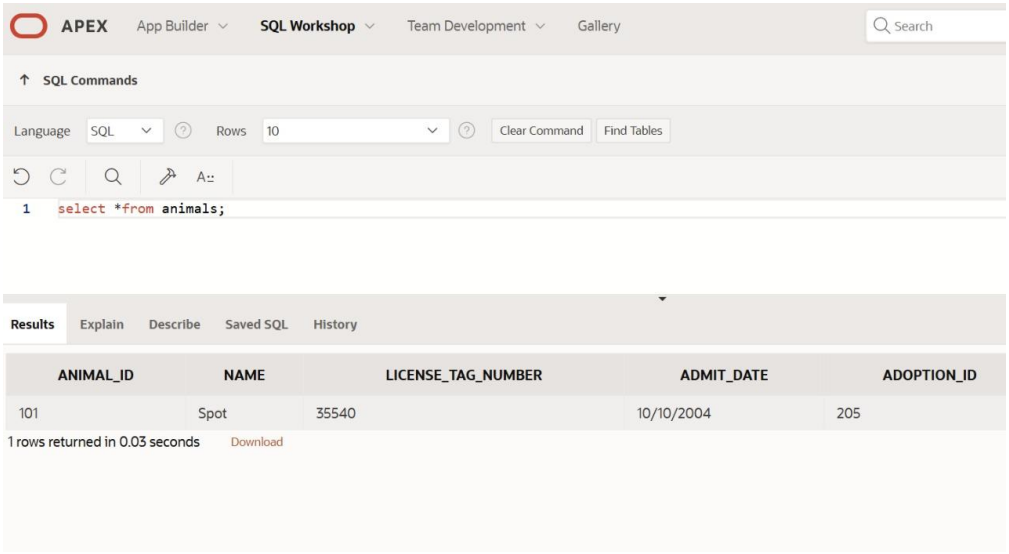
3. Create the animals table. Write the syntax you will use to create the table.



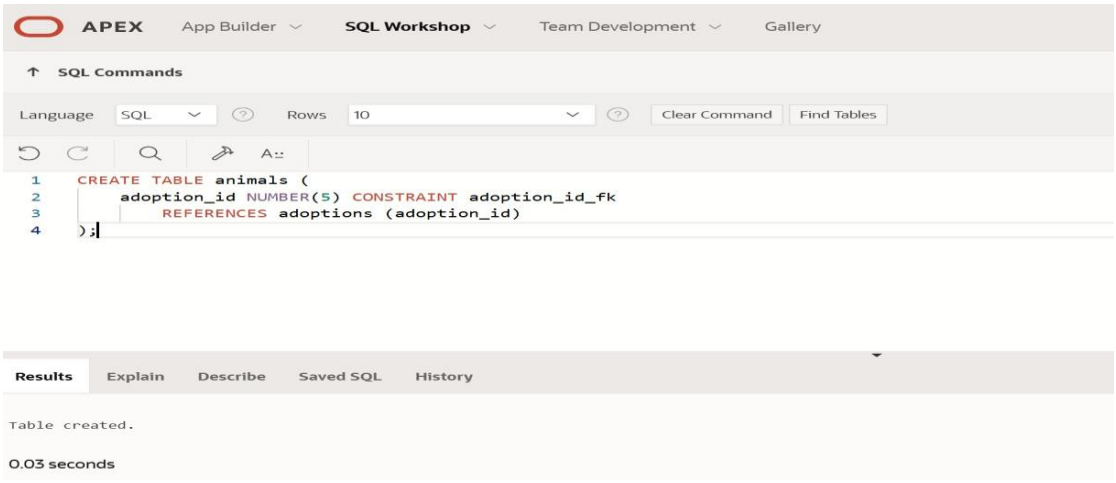
4. Enter one row into the table. Execute a SELECT * statement to verify your input. Refer to the graphic below for input.

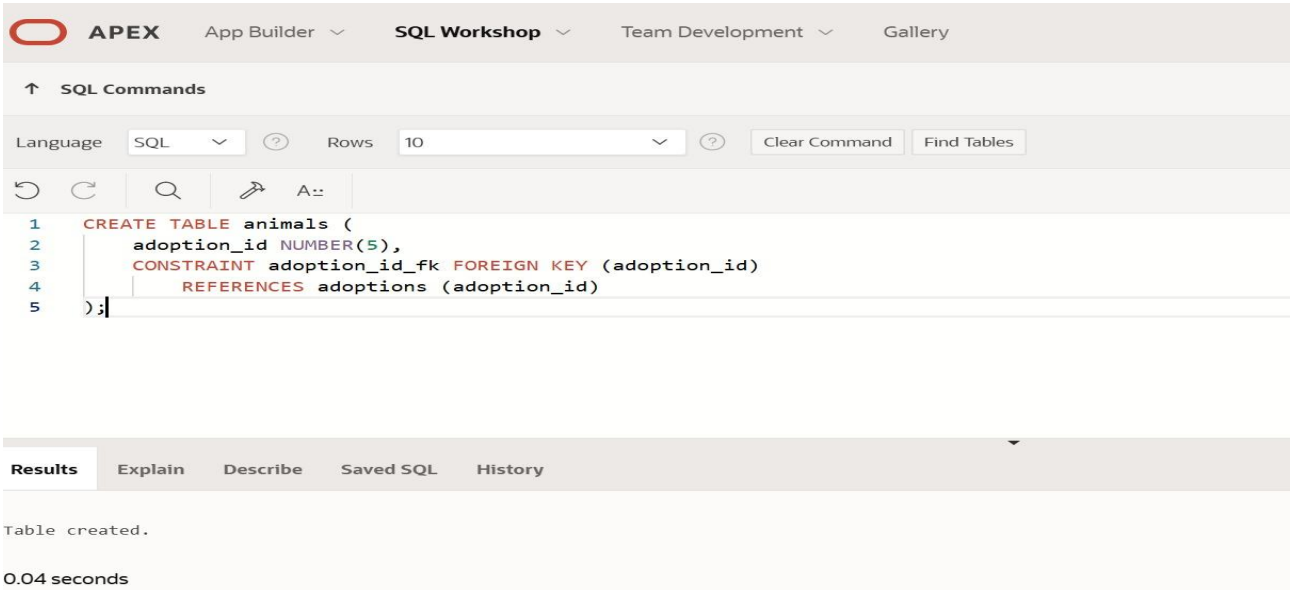
ANIMAL_I D	NAM E	LICENSE_TAG_NUMBE R	ADMIT_DAT E	ADOPTION_I D	VACCINATION_DAT E
101	Spot	35540	10-Oct-2004	205	12-Oct-2004





5. Write the syntax to create a foreign key (adoption_id) in the animals table that has a corresponding primary-key reference in the adoptions table. Show both the column-level and table-level syntax. Note that because you have not actually created an adoptions table, no adoption_id primary key exists, so the foreign key cannot be added to the animals table.





6. What is the effect of setting the foreign key in the ANIMAL table as:

a. ON DELETE CASCADE
b. ON DELETE SET NULL

ON DELETE CASCADE: If the referenced record in the parent table is deleted, all related rows in the ANIMAL table are automatically deleted.

ON DELETE SET NULL: If the referenced record is deleted, the foreign key column in the ANIMAL table is set to NULL instead of deleting the row.

7. What are the restrictions on defining a CHECK constraint?

Can only refer to **columns in the same row**.

Cannot include subqueries, references to other tables, or non-deterministic functions.

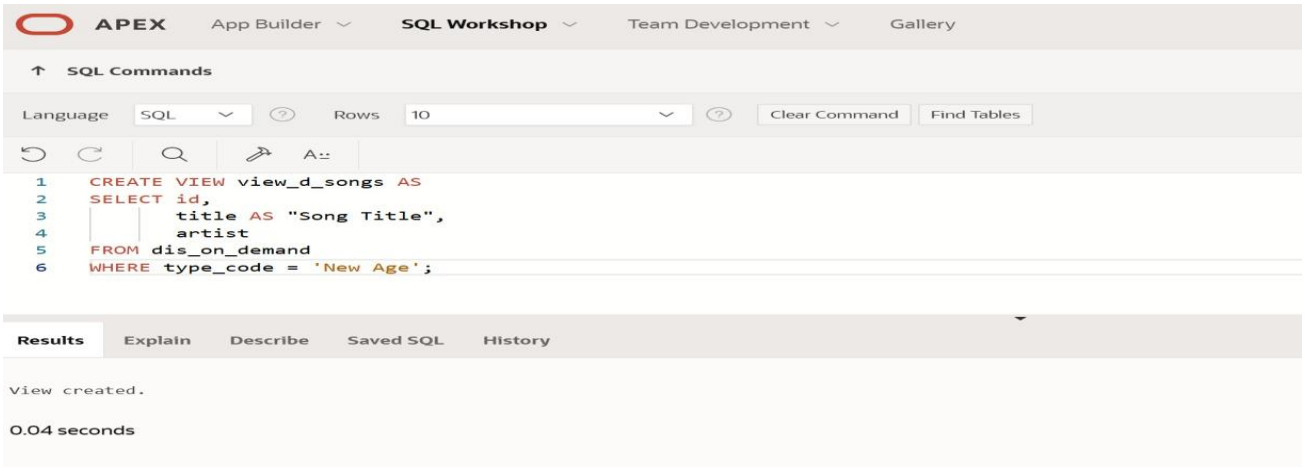
Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE 13 Creating Views

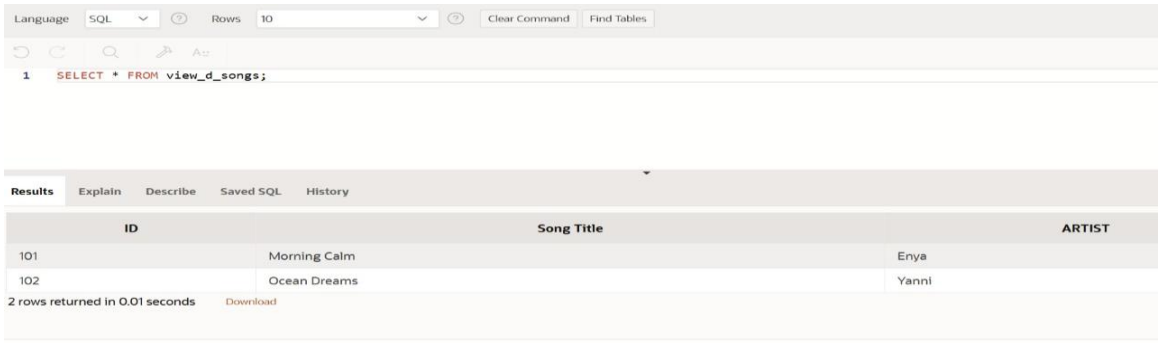
1. What are three uses for a view from a DBA's perspective?

Three uses of a view for a DBA: simplify complex queries, enhance security by restricting access, and provide data abstraction.

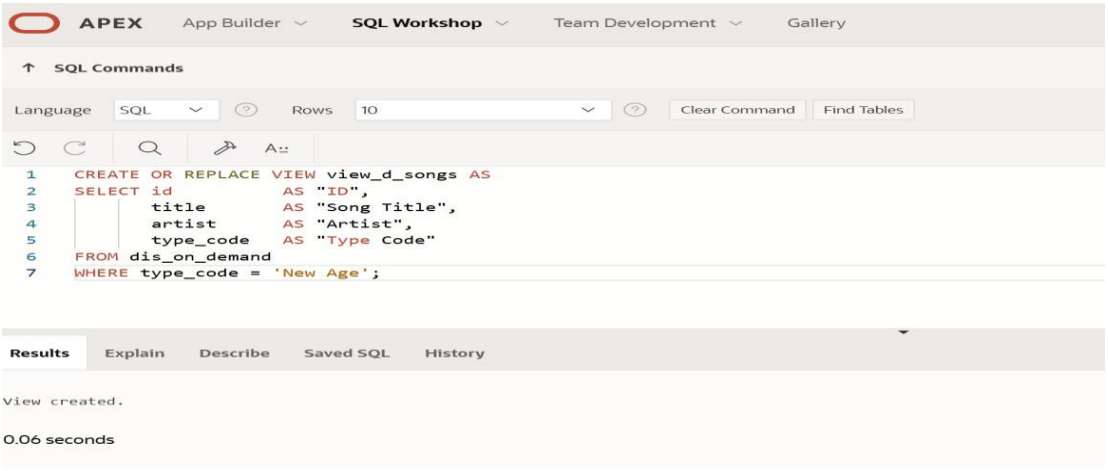
2. Create a simple view called view_d_songs that contains the ID, title and artist from the DJs on Demand table for each “New Age” type code. In the subquery, use the alias “Song Title” for the title column.

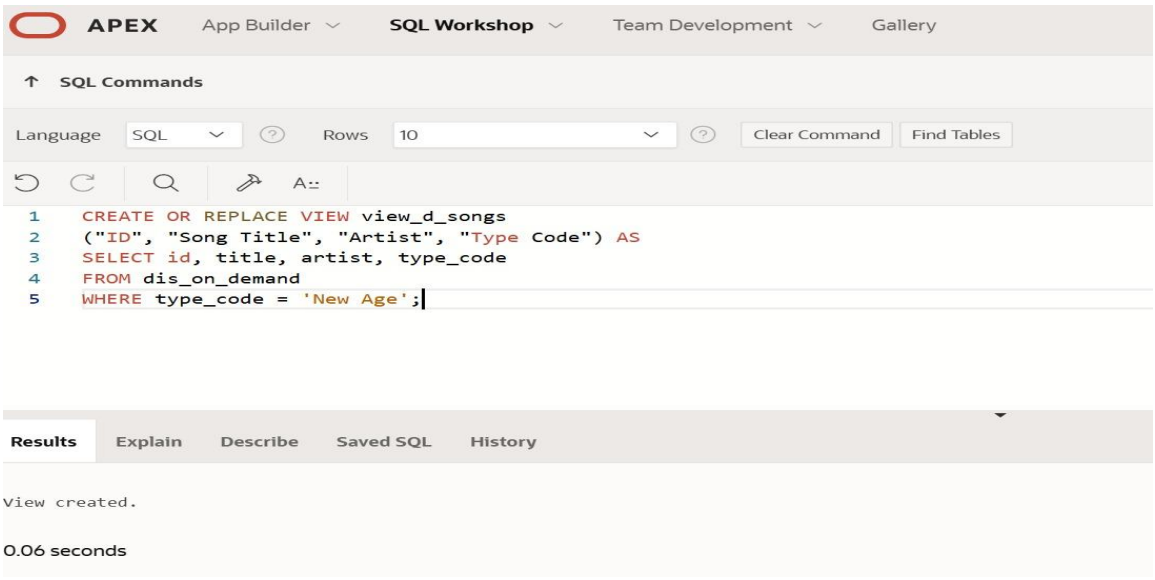


3. SELECT * FROM view_d_songs. What was returned?



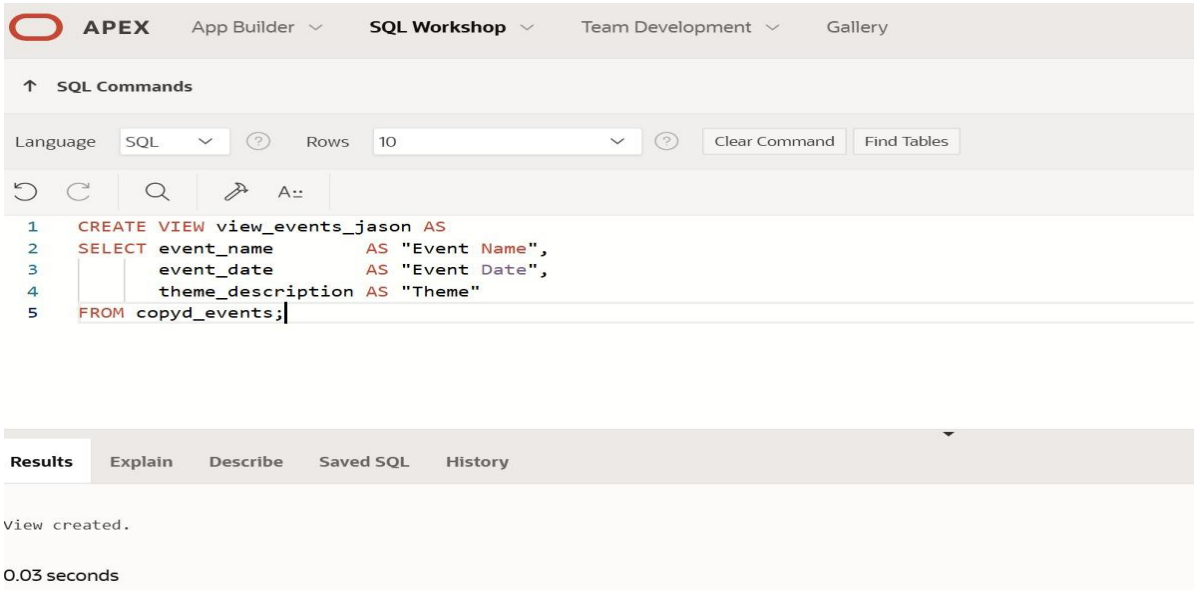
4. REPLACE view_d_songs. Add type_code to the column list. Use aliases for all columns.



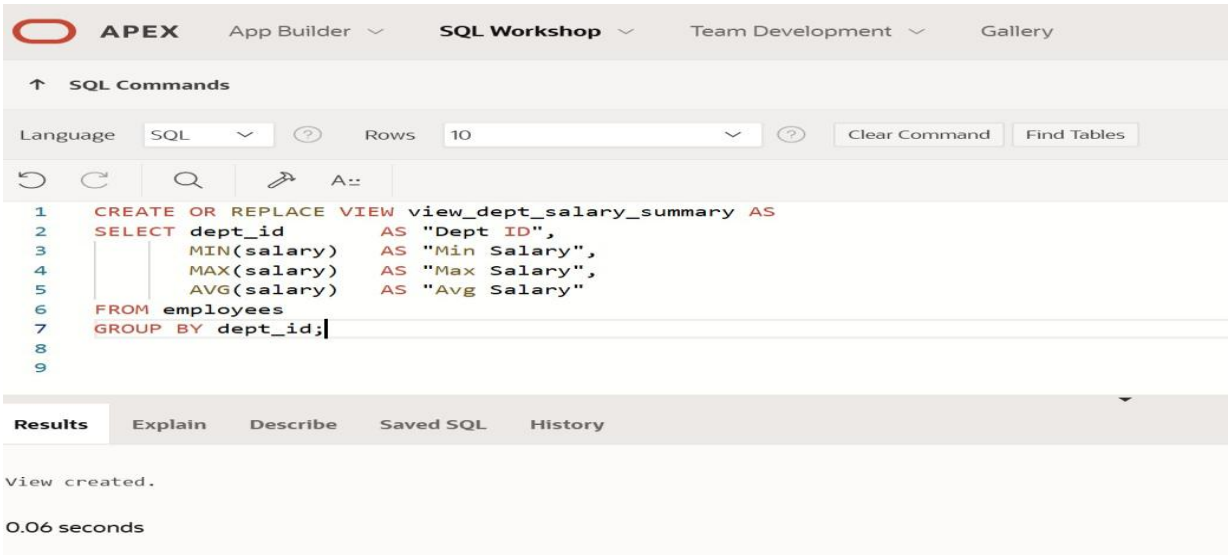


Or use alias after the CREATE statement as shown.

5. Jason Tsang, the disk jockey for DJs on Demand, needs a list of the past events and those planned for the coming months so he can make arrangements for each event's equipment setup. As the company manager, you do not want him to have access to the price that clients paid for their events. Create a view for Jason to use that displays the name of the event, the event date, and the theme description. Use aliases for each column name.



6. It is company policy that only upper-level management be allowed access to individual employee salaries. The department managers, however, need to know the minimum, maximum, and average salaries, grouped by department. Use the Oracle database to prepare a view that displays the needed information for department managers.



DML Operations and Views

Use the DESCRIBE statement to verify that you have tables named copy_d_songs, copy_d_events, copy_d_cds, and copy_d_clients in your schema. If you don't, write a query to create a copy of each.

1. Query the data dictionary USER_UPDATABLE_COLUMNS to make sure the columns in the base tables will allow UPDATE, INSERT, or DELETE. All table names in the data dictionary are stored in uppercase.

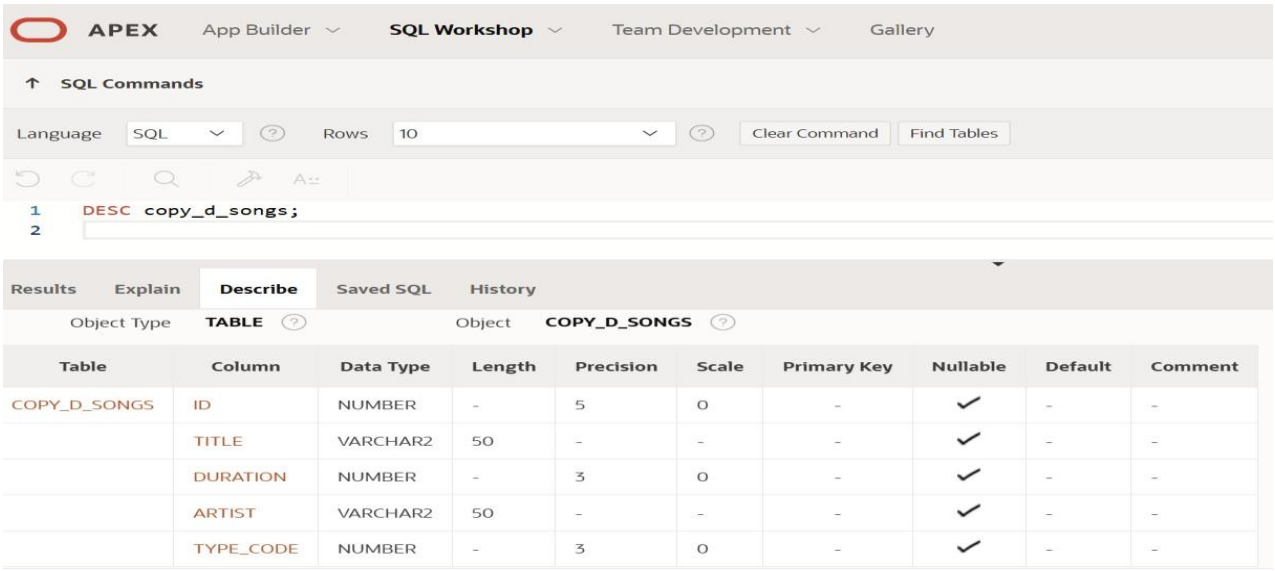
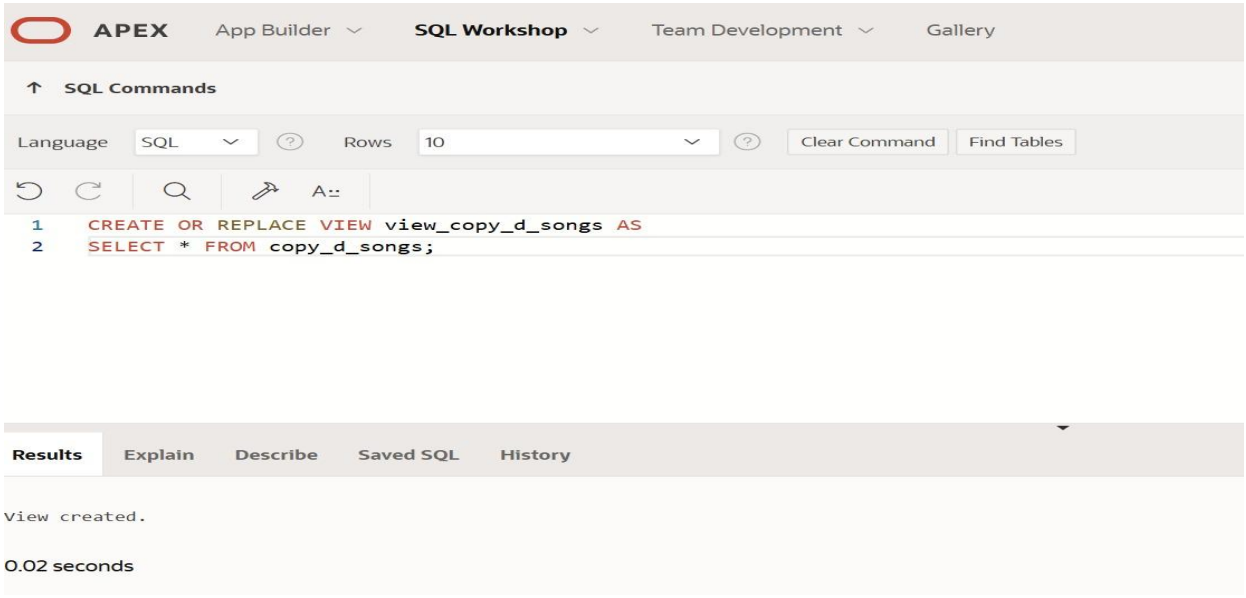


Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
COPY_D_SONGS	ID	NUMBER	-	5	0	-	✓	-	-
	TITLE	VARCHAR2	50	-	-	-	✓	-	-
	DURATION	NUMBER	-	3	0	-	✓	-	-
	ARTIST	VARCHAR2	50	-	-	-	✓	-	-
	TYPE_CODE	NUMBER	-	3	0	-	✓	-	-

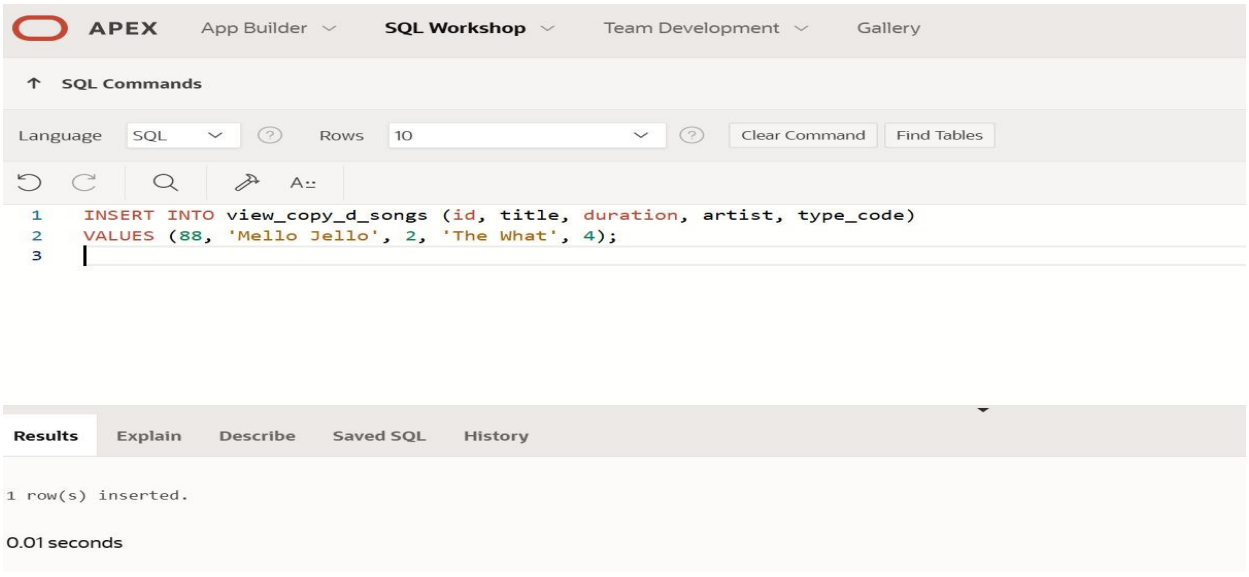
Use the same syntax but change table_name of the other tables.

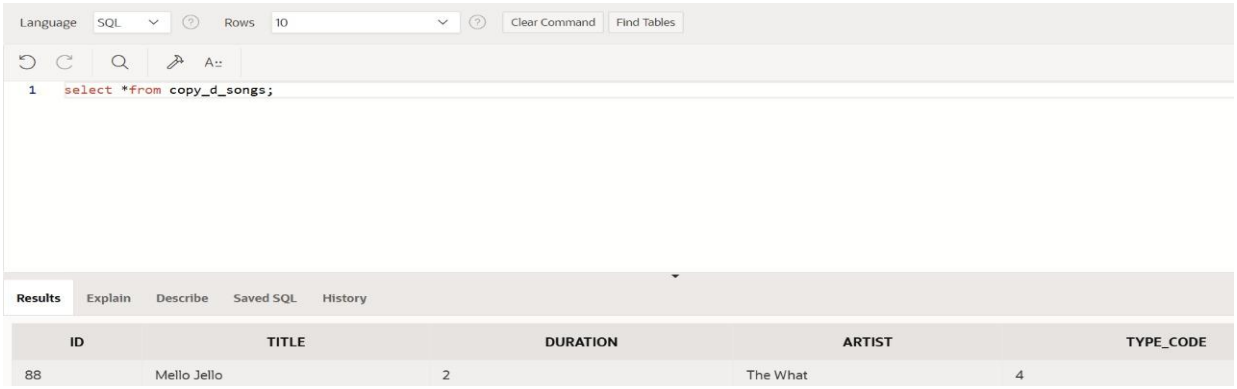
2. Use the CREATE or REPLACE option to create a view of *all* the columns in the copy_d_songs table called view_copy_d_songs.



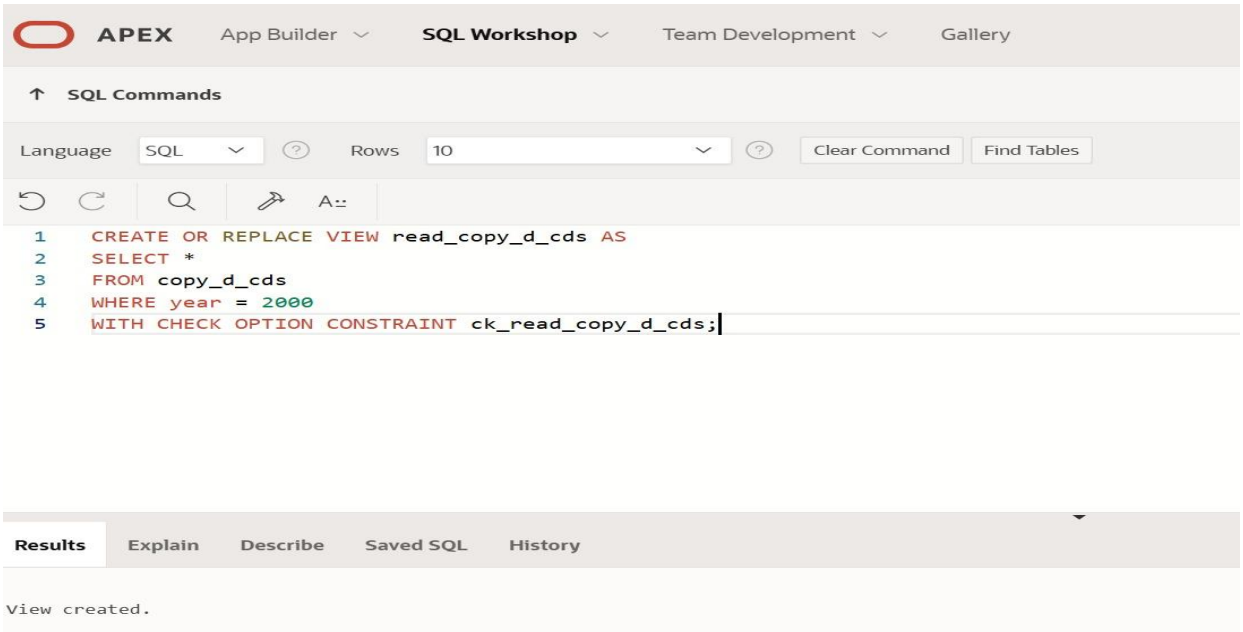
3. Use view_copy_d_songs to INSERT the following data into the underlying copy_d_songs table. Execute a SELECT * from copy_d_songs to verify your DML command. See the graphic.

ID	TITLE	DURATION	ARTIST	TYPE_CODE
88	Mello Jello	2	The What	4

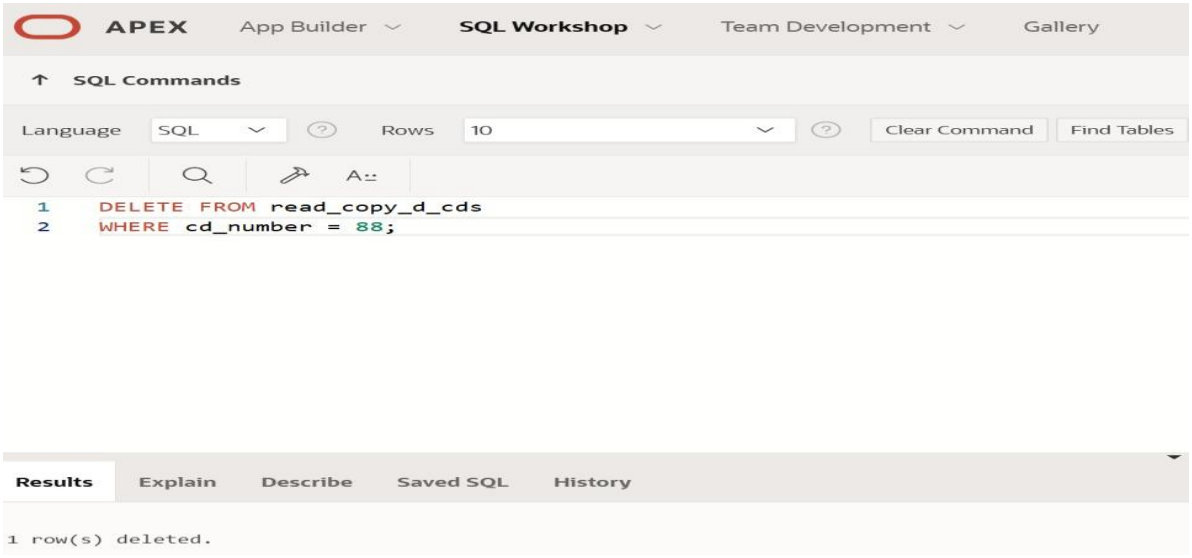




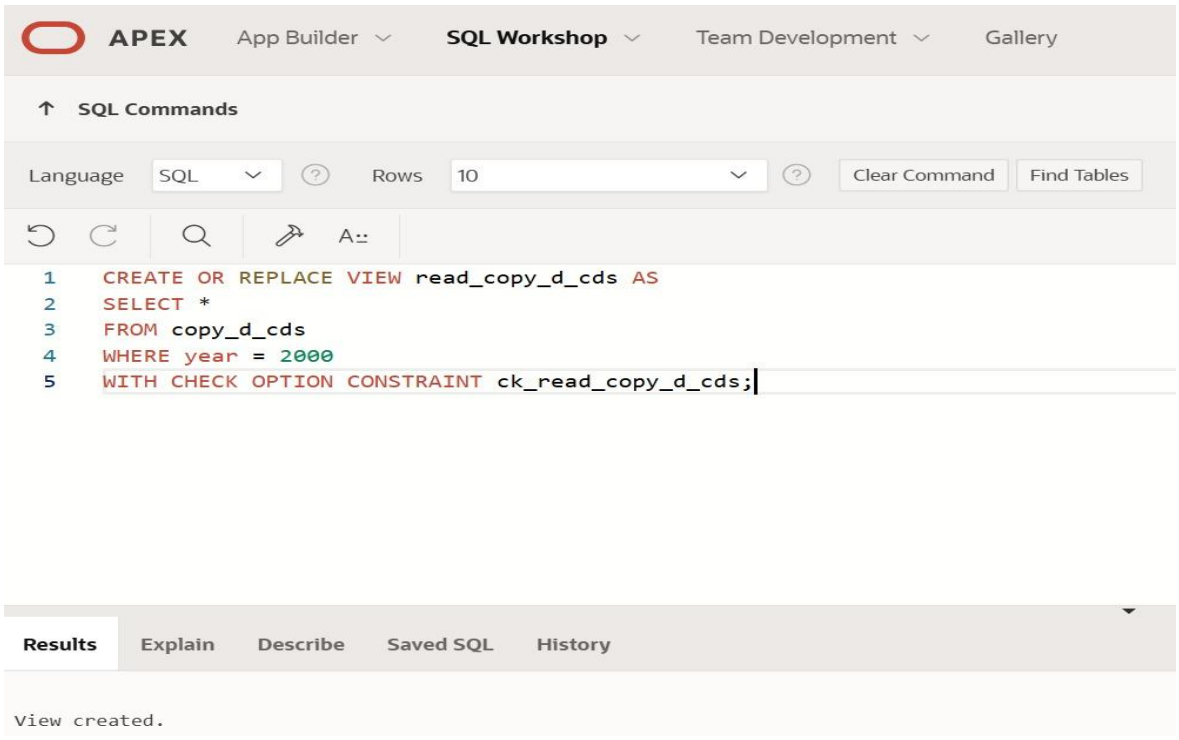
4. Create a view based on the DJs on Demand COPY_D_CDS table. Name the view read_copy_d_cds. Select all columns to be included in the view. Add a WHERE clause to restrict the year to 2000. Add the WITH READ ONLY option.



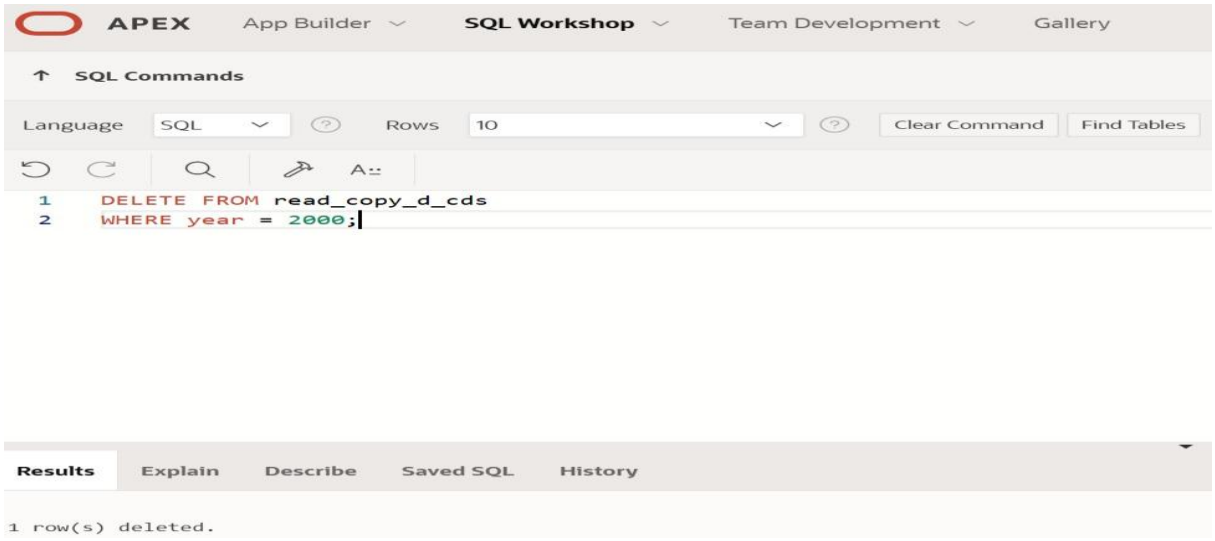
5. Using the read_copy_d_cds view, execute a DELETE FROM read_copy_d_cds WHERE cd_number = 90;



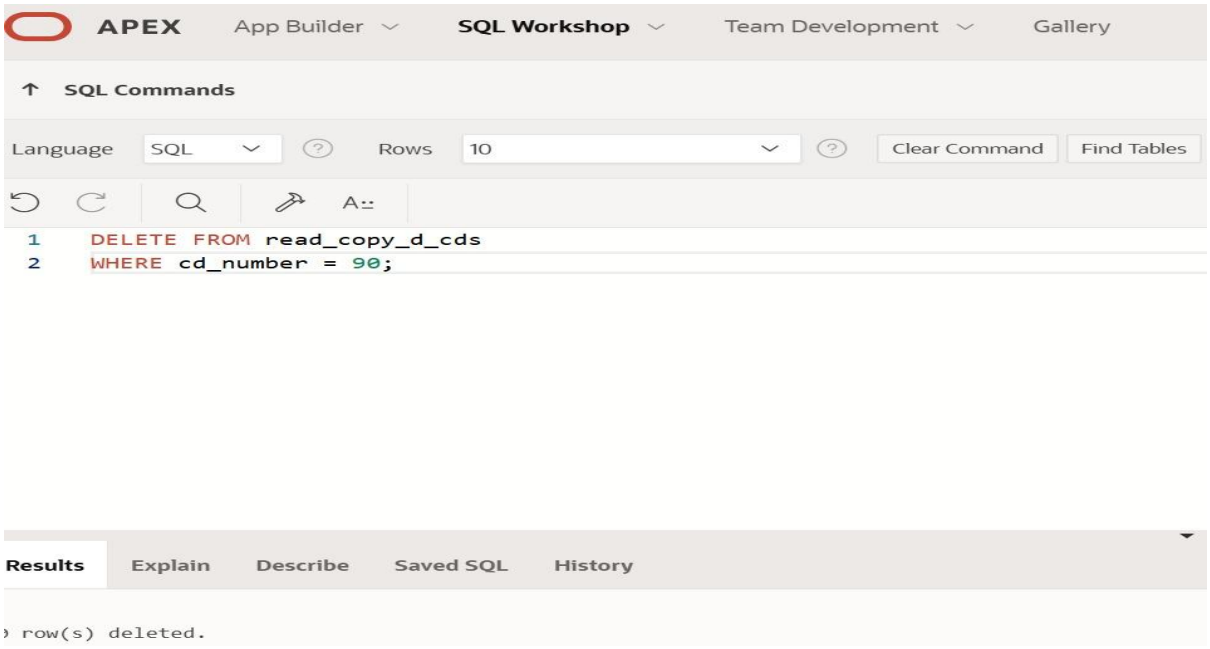
6. Use REPLACE to modify read_copy_d_cds. Replace the READ ONLY option with WITH CHECK OPTION CONSTRAINT ck_read_copy_d_cds. Execute a SELECT * statement to verify that the view exists.



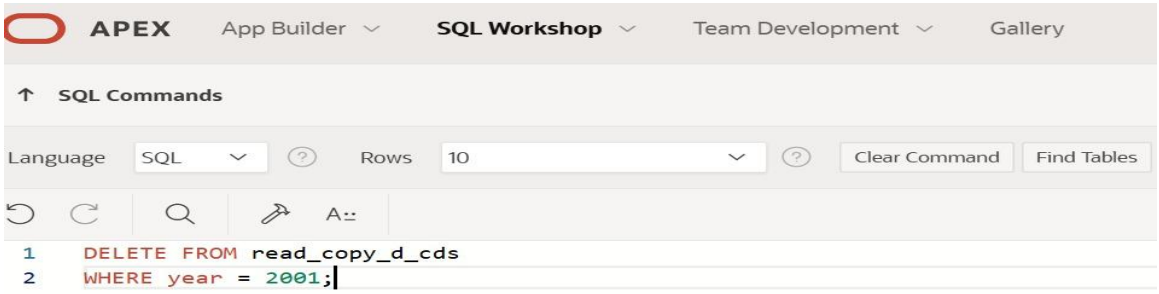
7. Use the read_copy_d_cds view to delete any CD of year 2000 from the underlying copy_d_cds.



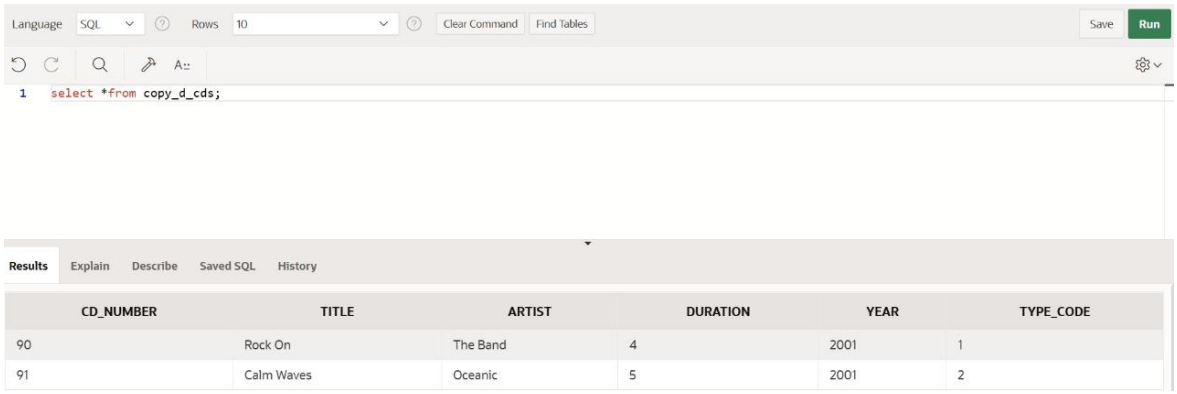
8. Use the read_copy_d_cds view to delete cd_number 90 from the underlying copy_d_cds table.



9. Use the read_copy_d_cds view to delete year 2001 records.



10. Execute a SELECT * statement for the base table copy_d_cds. What rows were deleted?



CD_NUMBER	TITLE	ARTIST	DURATION	YEAR	TYPE_CODE
90	Rock On	The Band	4	2001	1
91	Calm Waves	Oceanic	5	2001	2

11.What are the restrictions on modifying data through a view?

Views that involve **joins, aggregates, GROUP BY, DISTINCT, or set operations** cannot be updated directly.

Columns derived from **expressions or functions** are not updatable.

INSTEAD OF triggers may be needed to allow modifications on complex views.

12. What is Moore's Law? Do you consider that it will continue to apply indefinitely? Support your opinion with research from the internet.

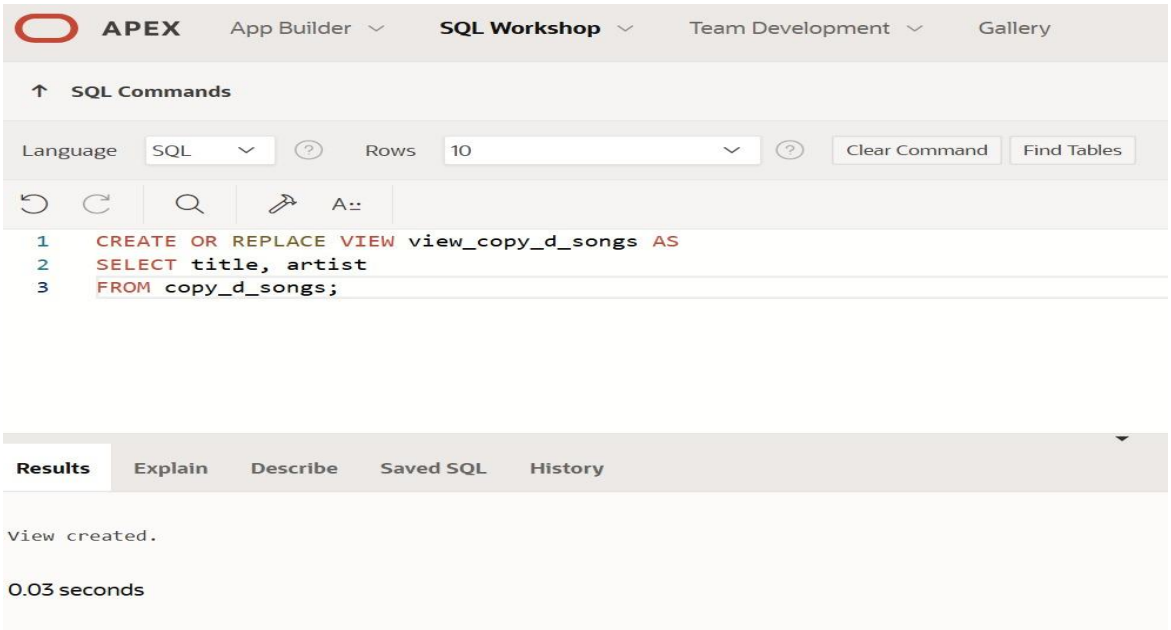
Moore's Law: The observation that the number of transistors on a chip **doubles roughly every 18–24 months**, leading to faster and cheaper computing.

13. What is the "singularity" in terms of computing?

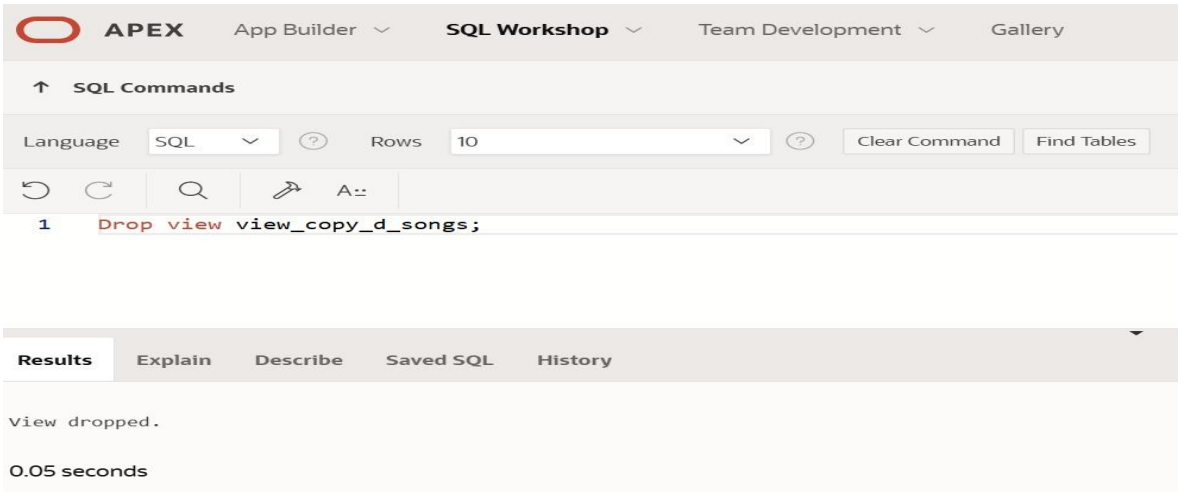
The **singularity** is a hypothetical point when **artificial intelligence surpasses human intelligence**, leading to rapid, unpredictable technological growth and societal change.

Managing Views

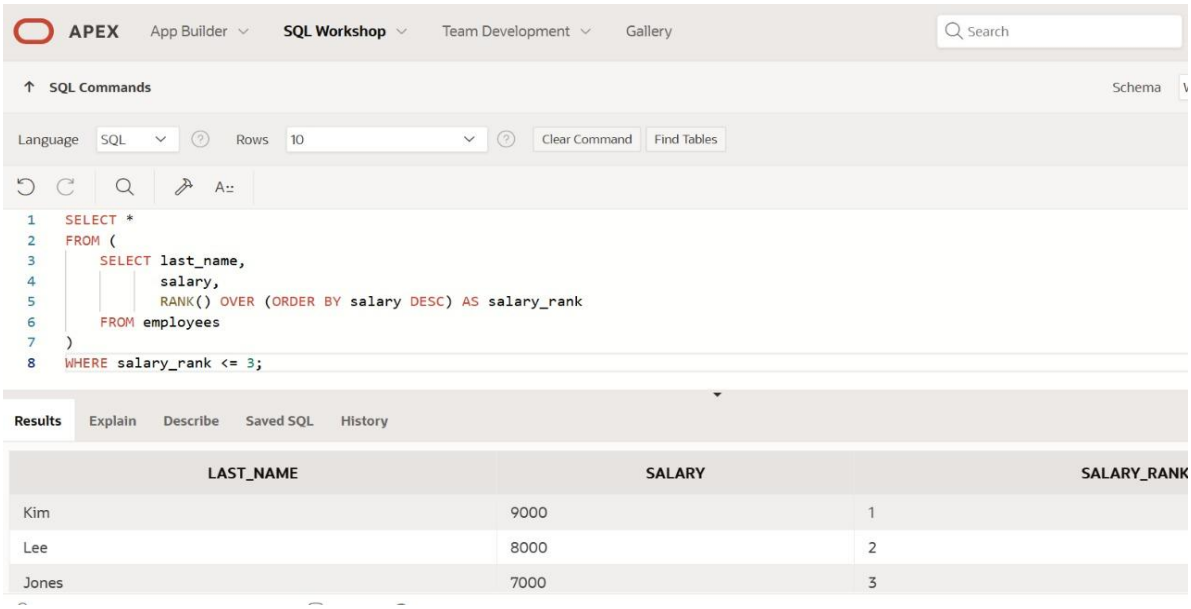
1. Create a view from the copy_d_songs table called view_copy_d_songs that includes only the title and artist. Execute a SELECT * statement to verify that the view exists.



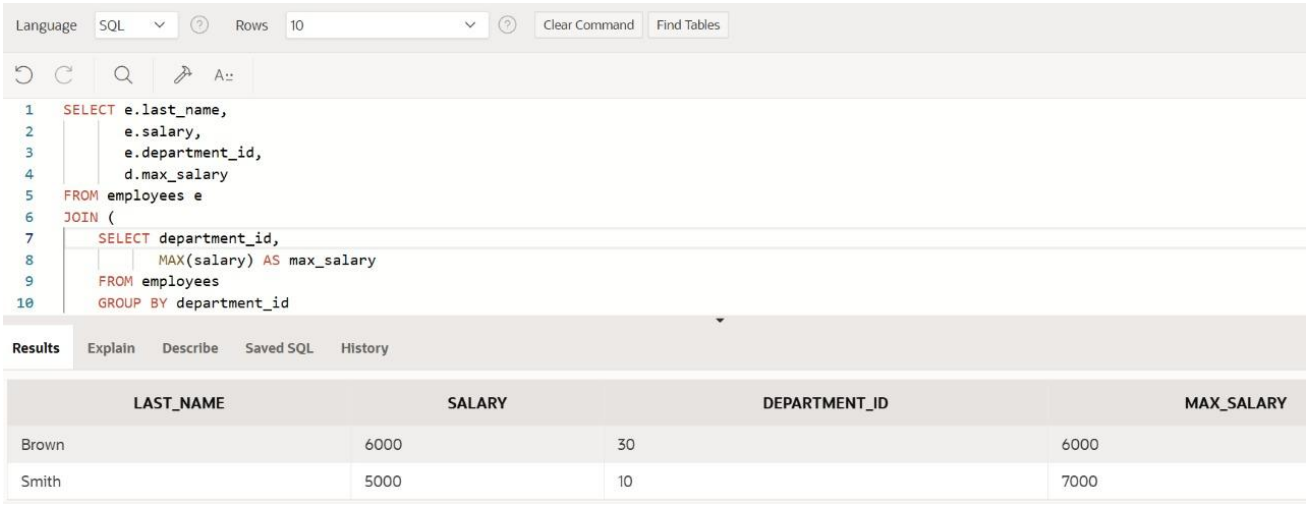
2. Issue a DROP view_copy_d_songs. Execute a SELECT * statement to verify that the view has been deleted.



3. Create a query that selects the last name and salary from the Oracle database. Rank the salaries from highest to lowest for the top three employees.

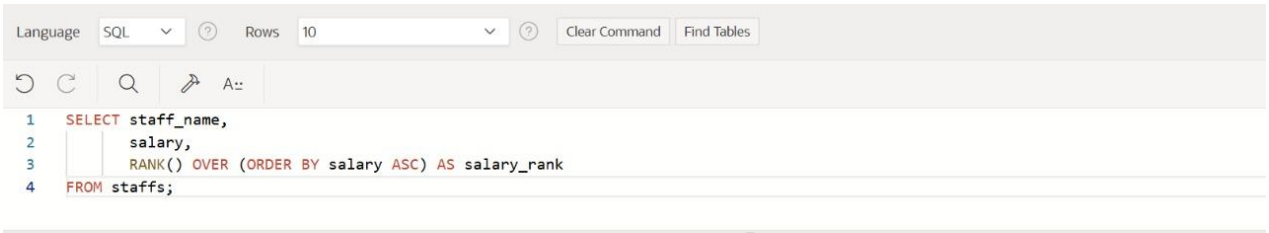


4. Construct an inline view from the Oracle database that lists the last name, salary, department ID, and maximum salary for each department. Hint: One query will need to calculate maximum salary by department ID.



LAST_NAME	SALARY	DEPARTMENT_ID	MAX_SALARY
Brown	6000	30	6000
Smith	5000	10	7000

5. Create a query that will return the staff members of Global Fast Foods ranked by salary from lowest to highest.



STAFF_NAME	SALARY	SALARY_RANK
John Doe	4000	1
Sam Green	5500	2
Jane Roe	6000	3
Lucy White	7000	4

4 rows returned in 0.02 seconds Download

Indexes and Synonyms

1. What is an index and what is it used for?

An **index** is a database structure that improves **query performance** by allowing faster searches on a table column.

2. What is a ROWID, and how is it used?

ROWID is a unique identifier for each row in a table, representing its **physical storage location**.

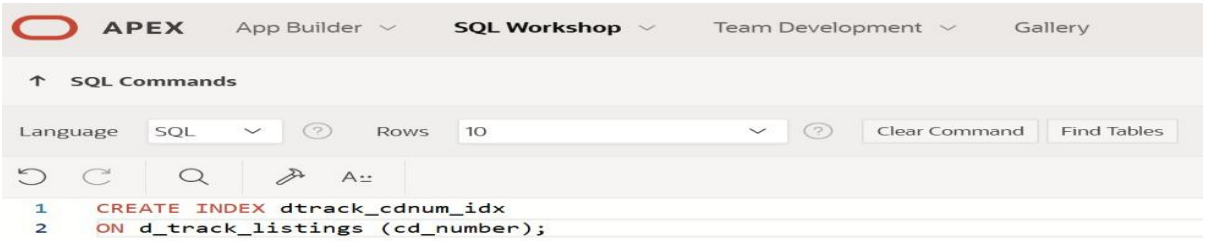
3. When will an index be created automatically?

An index is **automatically created** when:

A **PRIMARY KEY** constraint is defined.

A **UNIQUE** constraint is defined.

4. Create a nonunique index (foreign key) for the DJs on Demand column (cd_number) in the D_TRACK_LISTINGS table. Use the Oracle Application Express SQL Workshop Data Browser to confirm that the index was created.



5. Use the join statement to display the indexes and uniqueness that exist in the data dictionary for the DJs on Demand D_SONGS table.

Language SQL Rows 10 Clear Command Find Tables

```
SELECT i.index_name,
       i.uniqueness,
       c.column_name
FROM user_indexes i
JOIN user_ind_columns c
ON i.index_name = c.index_name
WHERE i.table_name = 'D_SONGS';
```

Results Explain Describe Saved SQL History

INDEX_NAME	UNIQUENESS	COLUMN_NAME
SYS_C00187042324	UNIQUE	SONG_ID

1 rows returned in 0.36 seconds Download

6. Use a SELECT statement to display the index_name, table_name, and uniqueness from the data dictionary USER_INDEXES for the DJs on Demand D_EVENTS table.

Language SQL Rows 10 Clear Command Find Tables

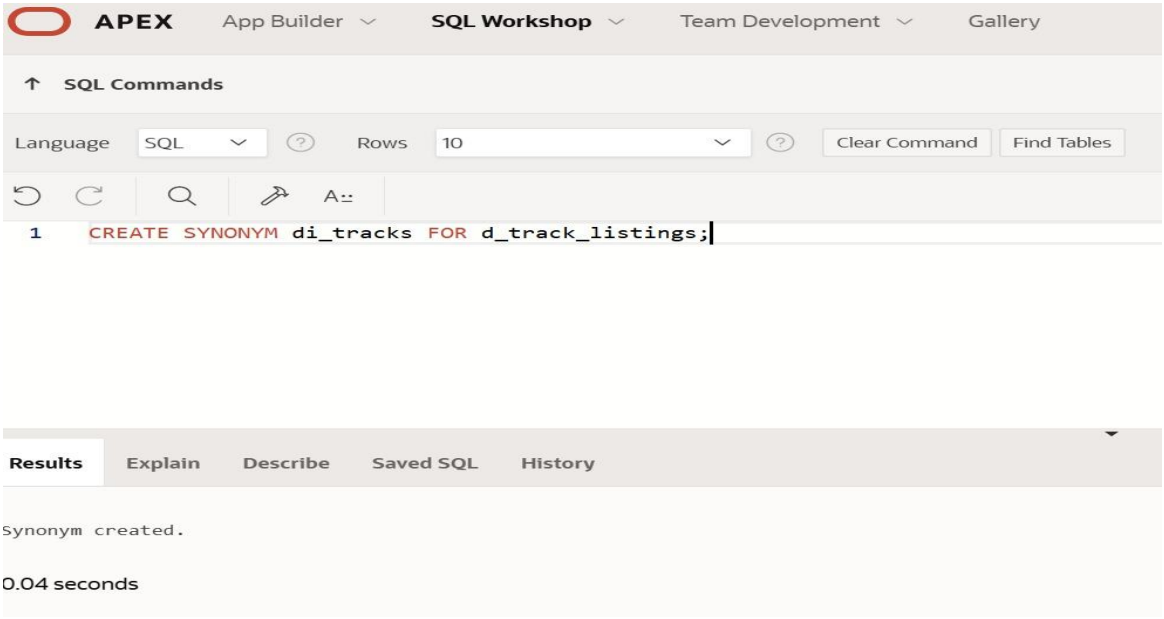
```
SELECT index_name,
       table_name,
       uniqueness
FROM user_indexes
WHERE table_name = 'D_EVENTS';
```

Results Explain Describe Saved SQL History

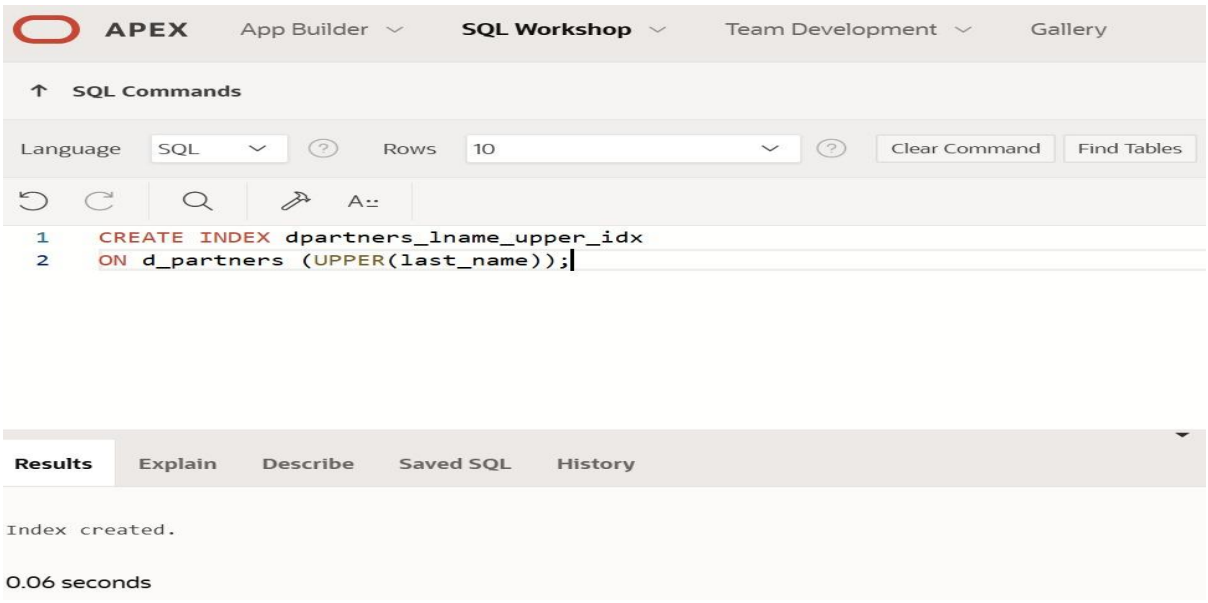
INDEX_NAME	TABLE_NAME	UNIQUENESS
SYS_C00187042428	D_EVENTS	UNIQUE

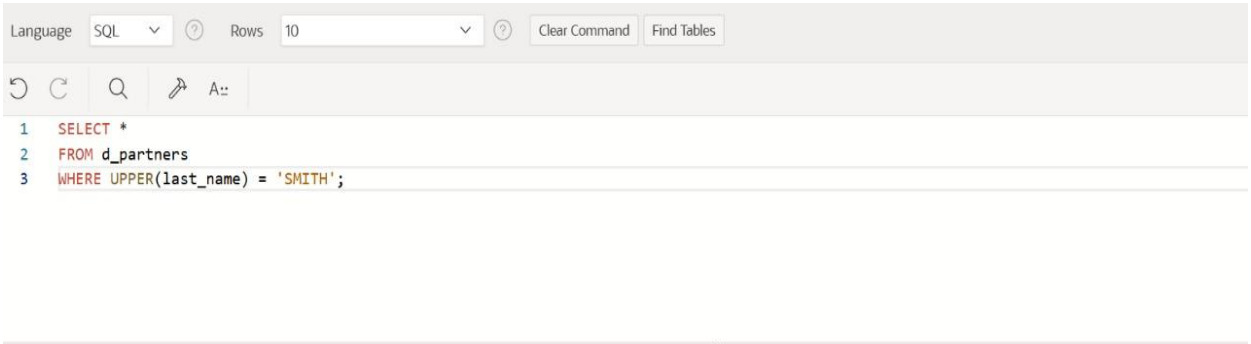
1 rows returned in 0.07 seconds Download

7. Write a query to create a synonym called dj_tracks for the DJs on Demand d_track_listings table.

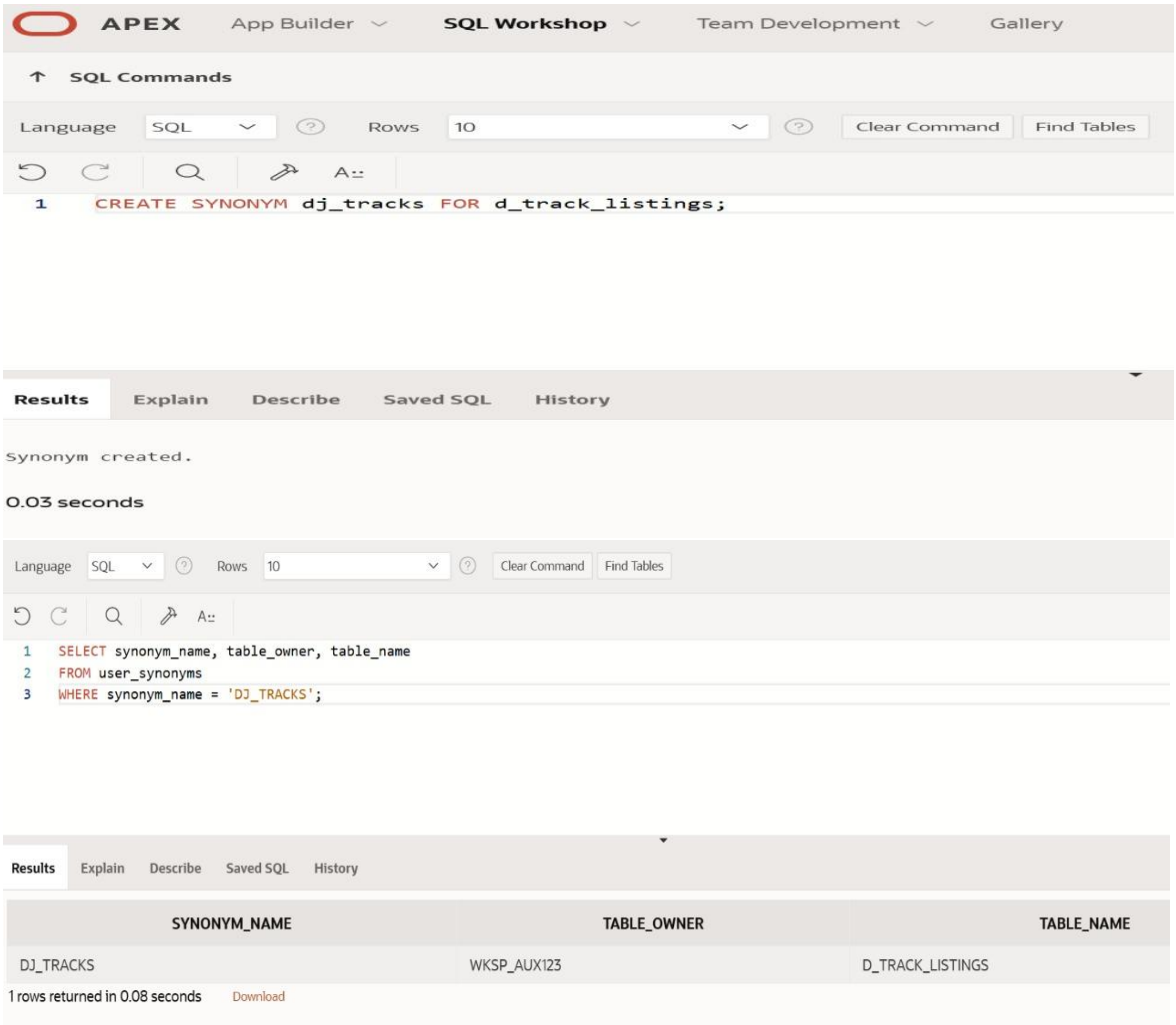


8. Create a function-based index for the last_name column in DJs on Demand D_PARTNERS table that makes it possible not to have to capitalize the table name for searches. Write a SELECT statement that would use this index.

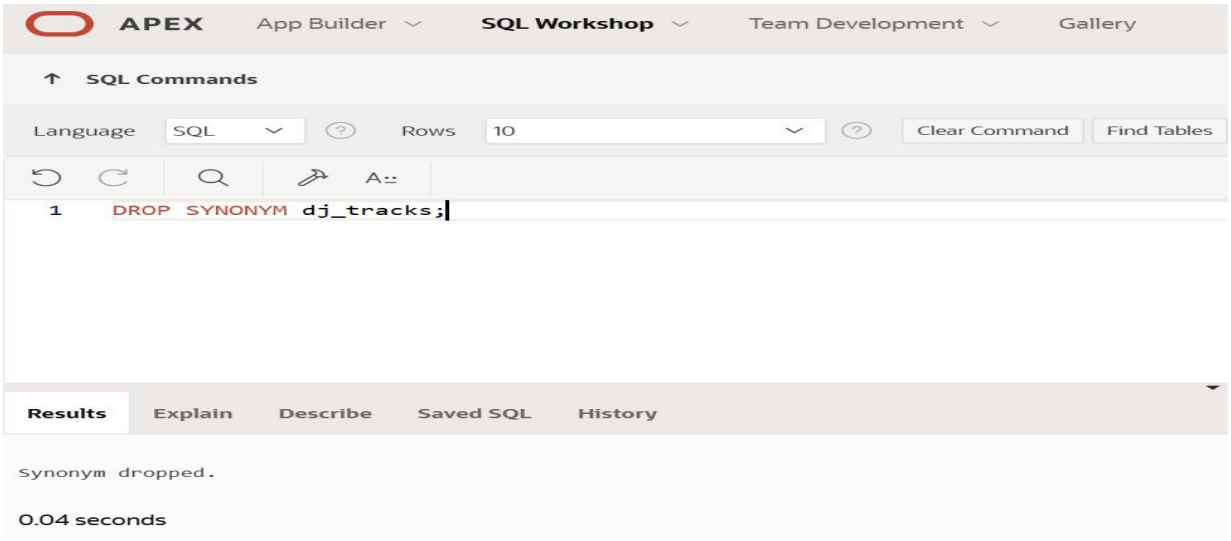




9. Create a synonym for the D_TRACK_LISTINGS table. Confirm that it has been created by querying the data dictionary.



10.Drop the synonym that you created in question



Evaluation Procedure	Marks awarded
Query(5)	
Execution (5)	
Viva(5)	
Total (15)	

Faculty Signature	

EXERCISE-14

OTHER DATABASE OBJECTS

Objectives

After the completion of this exercise, the students will be able to do the following:
• Create, maintain, and use sequences
• Create and maintain indexes

Database Objects

Many applications require the use of unique numbers as primary key values. You can either build code into the application to handle this requirement or use a sequence to generate unique numbers. If you want to improve the performance of some queries, you should consider creating an index. You can also use indexes to enforce uniqueness on a column or a collection of columns.
You can provide alternative names for objects by using synonyms.

What Is a Sequence? A
sequence:
• Automatically generates unique numbers
• Is a sharable object
• Is typically used to create a primary key value
• Replaces application code
• Speeds up the efficiency of accessing sequence values when cached in memory

The CREATE SEQUENCE Statement Syntax

Define a sequence to generate sequential numbers automatically:

CREATE SEQUENCE *sequence*
[INCREMENT BY *n*]

[START WITH *n*]
[{MAXVALUE *n* | NOMAXVALUE}]
[{MINVALUE *n* | NOMINVALUE}]
[{CYCLE | NOCYCLE}] [{CACHE
n | NOCACHE}];

In the syntax:

sequence is the name of the sequence generator
INCREMENT BY *n* specifies the interval between sequence numbers where *n* is an integer (If this clause is omitted, the sequence increments by 1.)

START WITH *n* specifies the first sequence number to be generated (If this clause is omitted, the sequence starts with 1.)

MAXVALUE *n* specifies the maximum value the sequence can generate
NOMAXVALUE specifies a maximum value of 10^27 for an ascending sequence and –1 for a descending sequence (This is the default option.)

MINVALUE *n* specifies the minimum sequence value
NOMINVALUE specifies a minimum value of 1 for an ascending sequence and – (10^26) for a descending sequence (This is the default option.)

CYCLE | NOCYCLE specifies whether the sequence continues to generate values after reaching its maximum or minimum value (NOCYCLE is the default option.)

CACHE *n* | NOCACHE specifies how many values the Oracle server preallocates and keep in memory (By default, the Oracle server caches 20 values.)

Creating a Sequence

- Create a sequence named DEPT_DEPTID_SEQ to be used for the primary key of the DEPARTMENTS table.
- Do not use the CYCLE option.

EXAMPLE:

```
CREATE SEQUENCE dept_deptid_seq
INCREMENT BY 10
START WITH 120
MAXVALUE 9999
NOCACHE
NOCYCLE;
```

Confirming Sequences

- Verify your sequence values in the USER_SEQUENCES data dictionary table.

• The LAST_NUMBER column displays the next available sequence number if NOCACHE is specified.

EXAMPLE:

SELECT sequence_name, min_value, max_value, increment_by, last_number

NEXTVAL and CURRVAL Pseudocolumns

• NEXTVAL returns the next available sequence value. It returns a unique value every time it is referenced, even for different users.

• CURRVAL obtains the current sequence value.

• NEXTVAL must be issued for that sequence before CURRVAL contains a value.

Rules for Using NEXTVAL and CURRVAL

You can use NEXTVAL and CURRVAL in the following contexts:

• The SELECT list of a SELECT statement that is not part of a subquery
• The SELECT list of a subquery in an INSERT statement
• The VALUES clause of an INSERT statement
• The SET clause of an UPDATE statement

You cannot use NEXTVAL and CURRVAL in the following contexts:

• The SELECT list of a view
• A SELECT statement with the DISTINCT keyword
• A SELECT statement with GROUP BY, HAVING, or ORDER BY clauses
• A subquery in a SELECT, DELETE, or UPDATE statement
• The DEFAULT expression in a CREATE TABLE or ALTER TABLE statement

Using a Sequence

• Insert a new department named “Support” in location ID 2500.

• View the current value for the DEPT_DEPTID_SEQ sequence.

EXAMPLE:

INSERT INTO departments(department_id, department_name, location_id)
VALUES (dept_deptid_seq.NEXTVAL, ’Support’, 2500);

SELECT dept_deptid_seq.CURRVAL FROM dual;

The example inserts a new department in the DEPARTMENTS table. It uses the DEPT_DEPTID_SEQ sequence for generating a new department number as follows:
You can view the current value of the sequence:
SELECT dept_deptid_seq.CURRVAL FROM dual; **Removing a Sequence**

• Remove a sequence from the data dictionary by using the DROP SEQUENCE statement.

• Once removed, the sequence can no longer be referenced.

EXAMPLE:

DROP SEQUENCE dept_deptid_seq;

What is an Index?

An index:
• Is a schema object
• Is used by the Oracle server to speed up the retrieval of rows by using a pointer
• Can reduce disk I/O by using a rapid path access method to locate data quickly
• Is independent of the table it indexes
• Is used and maintained automatically by the Oracle server

How Are Indexes Created?

• Automatically: A unique index is created automatically when you define a PRIMARY KEY or UNIQUE constraint in a table definition.
• Manually: Users can create nonunique indexes on columns to speed up access to the rows.

Types of Indexes

Two types of indexes can be created. One type is a unique index: the Oracle server automatically creates this index when you define a column in a table to have a PRIMARY KEY or a UNIQUE key constraint. The name of the index is the name given to the constraint.

The other type of index is a nonunique index, which a user can create. For example, you can create a
FOREIGN KEY column index for a join in a query to improve retrieval speed.

Creating an Index

• Create an index on one or more columns.

• Improve the speed of query access to the LAST_NAME column in the EMPLOYEES table.

CREATE INDEX *index*
ON *table* (*column*[, *column*]...);

EXAMPLE:

CREATE INDEX emp_last_name_idx
ON employees(last_name); **In the**
syntax: *index* is the name of the index
table is the name of the table
column is the name of the column in the table to be indexed

When to Create an Index

You should create an index if:
• A column contains a wide range of values
• A column contains a large number of null values
• One or more columns are frequently used together in a WHERE clause or a join condition
• The table is large and most queries are expected to retrieve less than 2 to 4 percent of the rows

When Not to Create an Index

It is usually not worth creating an index if:
• The table is small
• The columns are not often used as a condition in the query
• Most queries are expected to retrieve more than 2 to 4 percent of the rows in the table • The table is updated frequently
• The indexed columns are referenced as part of an Expression **Confirming Indexes**
• The USER_INDEXES data dictionary view contains the name of the index and its uniqueness.
• The USER_IND_COLUMNS view contains the index name, the table name, and the column name.

EXAMPLE:

SELECT ic.index_name, ic.column_name, ic.column_position col_pos,ix.uniqueness
FROM user_indexes ix, user_ind_columns ic WHERE
ic.index_name = ix.index_name
AND ic.table_name = 'EMPLOYEES';

Removing an Index

• Remove an index from the data dictionary by using the DROP INDEX command.

• Remove the UPPER_LAST_NAME_IDX index from the data dictionary.

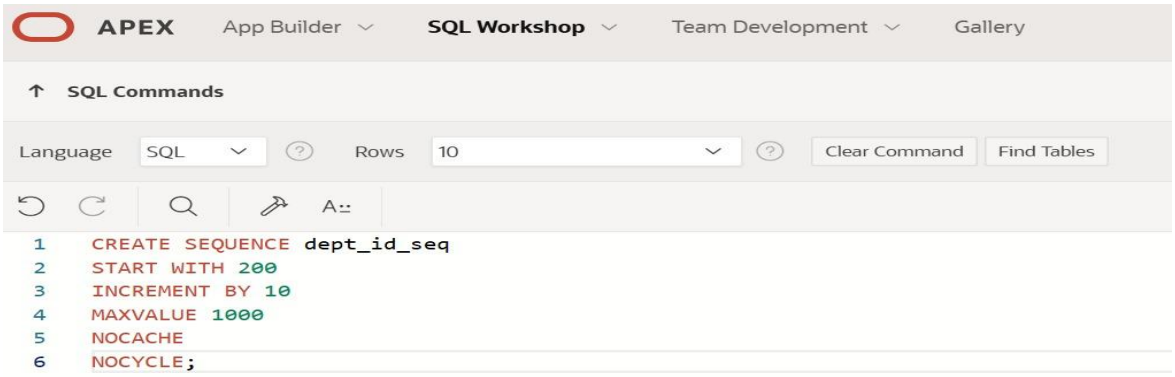
• To drop an index, you must be the owner of the index or have the DROP ANY INDEX privilege.

DROP INDEX upper_last_name_idx;

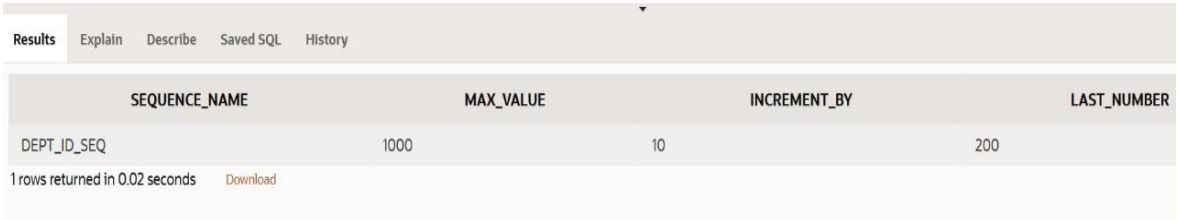
DROP INDEX *index*;

Find the Solution for the following:

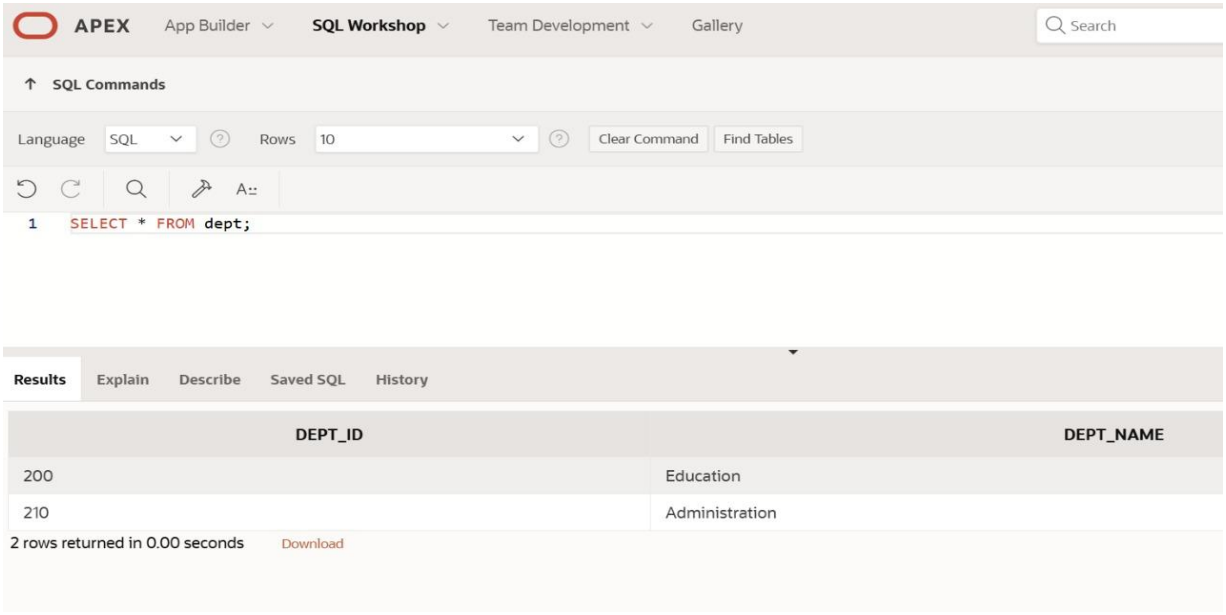
1. Create a sequence to be used with the primary key column of the DEPT table. The sequence should start at 200 and have a maximum value of 1000. Have your sequence increment by ten numbers. Name the sequence DEPT_ID_SEQ.



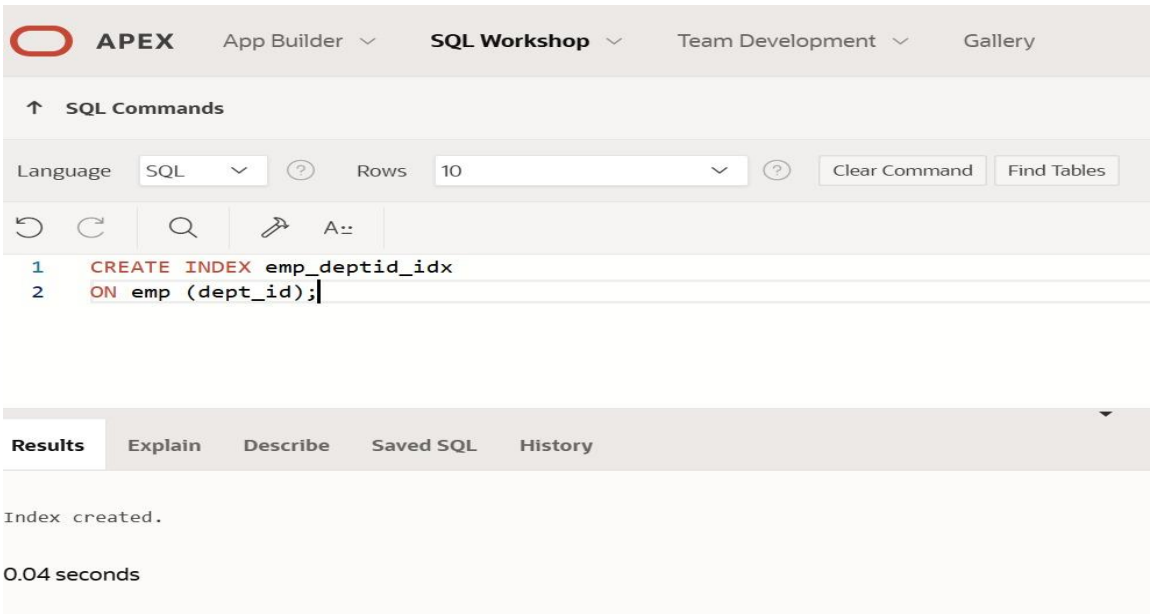
2. Write a query in a script to display the following information about your sequences: sequence name, maximum value, increment size, and last number



3. Write a script to insert two rows into the DEPT table. Name your script lab12_3.sql. Be sure to use the sequence that you created for the ID column. Add two departments named Education and Administration. Confirm your additions. Run the commands in your script.



4. Create a nonunique index on the foreign key column (DEPT_ID) in the EMP table.



5. Display the indexes and uniqueness that exist in the data dictionary for the EMP table.

Language SQL Rows 10 Clear Command Find Tables

```
1  SELECT index_name,
2         table_name,
3         uniqueness
4  FROM user_indexes
5  WHERE table_name = 'EMP';
```

Results Explain Describe Saved SQL History

INDEX_NAME	TABLE_NAME	UNIQUENESS
EMP_DEPTID_IDX	EMP	NONUNIQUE

1 rows returned in 0.08 seconds Download

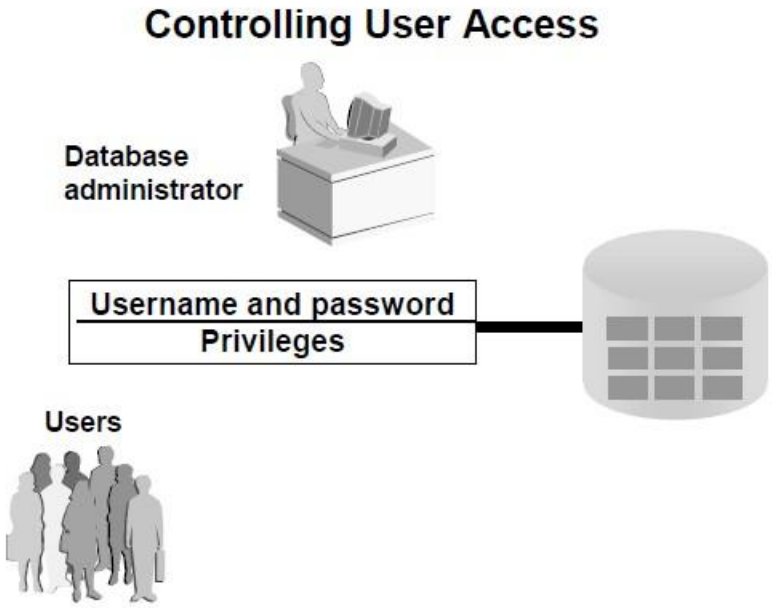
EXERCISE-15

Controlling User Access

Objectives

After the completion of this exercise, the students will be able to do the following:

- Create users
- Create roles to ease setup and maintenance of the security model
- Use the GRANT and REVOKE statements to grant and revoke object privileges
- Create and access database links



Controlling User Access

In a multiple-user environment, you want to maintain security of the database access and use. With Oracle server database security, you can do the following:

• Control database access
• Give access to specific objects in the database
• Confirm given and received *privileges* with the Oracle data dictionary
• Create synonyms for database objects

Privileges

• Database security: –
System security
– Data security
• System privileges: Gaining access to the database
• Object privileges: Manipulating the content of the database objects
• Schemas: Collections of objects, such as tables, views, and sequences

System Privileges

• More than 100 privileges are available.
• The database administrator has high-level system privileges for tasks such as:
– Creating new users
– Removing users
– Removing tables
– Backing up tables

Typical DBA Privileges

System Privilege	Operations Authorized
CREATE USER	Grantee can create other Oracle users (a privilege required for a DBA role).
DROP USER	Grantee can drop another user.
DROP ANY TABLE	Grantee can drop a table in any schema.
BACKUP ANY TABLE	Grantee can back up any table in any schema with the export utility.
SELECT ANY TABLE	Grantee can query tables, views, or snapshots in any schema.
CREATE ANY TABLE	Grantee can create tables in any schema.

Creating Users

The DBA creates users by using the CREATE USER statement.

EXAMPLE:

CREATE USER scott IDENTIFIED BY tiger;

User System Privileges

• Once a user is created, the DBA can grant specific system privileges to a user.
• An application developer, for example, may have the following system privileges:
– CREATE SESSION
– CREATE TABLE
– CREATE SEQUENCE
– CREATE VIEW
– CREATE PROCEDURE

GRANT *privilege* [, *privilege*...]
TO *user* [, *user*| *role, PUBLIC*...];

Typical User Privileges

System Privilege	Operations Authorized
CREATE SESSION	Connect to the database
CREATE TABLE	Create tables in the user's schema
CREATE SEQUENCE	Create a sequence in the user's schema
CREATE VIEW	Create a view in the user's schema
CREATE PROCEDURE	Create a stored procedure, function, or package in the user's schema

.

In the syntax:

privilege is the system privilege to be granted

user |role|PUBLIC is the name of the user, the name of the role, or PUBLIC designates that every user is granted the privilege

Note: Current system privileges can be found in the dictionary view SESSION_PRIVS.

Granting System Privileges

The DBA can grant a user specific system privileges.

GRANT create session, create table, create sequence, create view TO scott;

What is a Role?

A role is a named group of related privileges that can be granted to the user. This method makes it easier to revoke and maintain privileges.

A user can have access to several roles, and several users can be assigned the same role. Roles are typically created for a database application.

Creating and Assigning a Role

First, the DBA must create the role. Then the DBA can assign privileges to the role and users to the role.

Syntax

CREATE ROLE *role*;
In the syntax: *role* is the name of the
role to be created
Now that the role is created, the DBA can use the GRANT statement to assign users to the role as well as assign privileges to the role.

Creating and Granting Privileges to a Role

CREATE ROLE manager;
Role created.

GRANT create table, create view TO manager; Grant
succeeded.

GRANT manager TO DEHAAN, KOCHHAR;
Grant succeeded.

- Create a role
- Grant privileges to a role
- Grant a role to users

Changing Your Password

- The DBA creates your user account and initializes your password.

- You can change your password by using the

ALTER USER statement.
ALTER USER scott IDENTIFIED
BY lion;
User altered**.**

Object Privileges

Object Privilege	Table	View	Sequence	Procedure
ALTER	√		√	
DELETE	√	√		
EXECUTE				√
INDEX	√			
INSERT	√	√		
REFERENCES	√	√		
SELECT	√	√	√	
UPDATE	√	√		

Object Privileges

• Object privileges vary from object to object.

• An owner has all the privileges on the object.

• An owner can give specific privileges on that owner's object. GRANT *object_priv* [(*columns*)]
ON *object*
TO {*user*|*role*|PUBLIC}
[WITH GRANT OPTION];

In the syntax:

object_priv is an object privilege to be granted

ALL specifies all object privileges

columns specifies the column from a table or view on which privileges are granted

ON *object* is the object on which the privileges are granted

TO identifies to whom the privilege is granted

PUBLIC grants object privileges to all users

WITH GRANT OPTION allows the grantee to grant the object privileges to other users and roles

Granting Object Privileges

• Grant query privileges on the EMPLOYEES table.

• Grant privileges to update specific columns to users and roles.

```
GRANT select
ON employees
TO sue, rich;

GRANT update (department_name, location_id)
ON departments
TO scott, manager;
```

Using the WITH GRANT OPTION and PUBLIC Keywords

• Give a user authority to pass along privileges.

• Allow all users on the system to query data from Alice's DEPARTMENTS table.

```
GRANT select, insert
ON departments
TO scott
WITH GRANT OPTION;
 .
GRANT select
ON alice.departments
TO PUBLIC;
```

How to Revoke Object Privileges

• You use the REVOKE statement to revoke privileges granted to other users.

• Privileges granted to others through the WITH GRANT OPTION clause are also revoked.

```
  REVOKE {privilege [, privilege...]|ALL}
ON object
FROM {user[, user...]|role|PUBLIC}
[CASCADE CONSTRAINTS];
```

In the syntax:

CASCADE is required to remove any referential integrity constraints made to the CONSTRAINTS object by means of the REFERENCES privilege

Revoking Object Privileges

As user Alice, revoke the SELECT and INSERT privileges given to user Scott on the DEPARTMENTS table.

```
REVOKE select, insert
ON departments
FROM scott;
```

Find the Solution for the following:

1. What privilege should a user be given to log on to the Oracle Server? Is this a system or an object privilege?

User needs the `CREATE SESSION` privilege to connect to the Oracle server.
It is a System privilege.

---

2. What privilege should a user be given to create tables?

User must have the `CREATE TABLE` privilege.
This is also a System privilege.

---

3. If you create a table, who can pass along privileges to other users on your table?

Only the table owner can grant privileges on their table.
They can use the `GRANT` command to do so.

---

4. You are the DBA. You are creating many users who require the same system privileges. What should you use to make your job easier?

Use a Role to group and assign privileges easily.
This simplifies user privilege management.

---

5. What command do you use to change your password?

Use the command ALTER USER username IDENTIFIED BY new_password;.
Or use PASSWORD command when logged in.

---

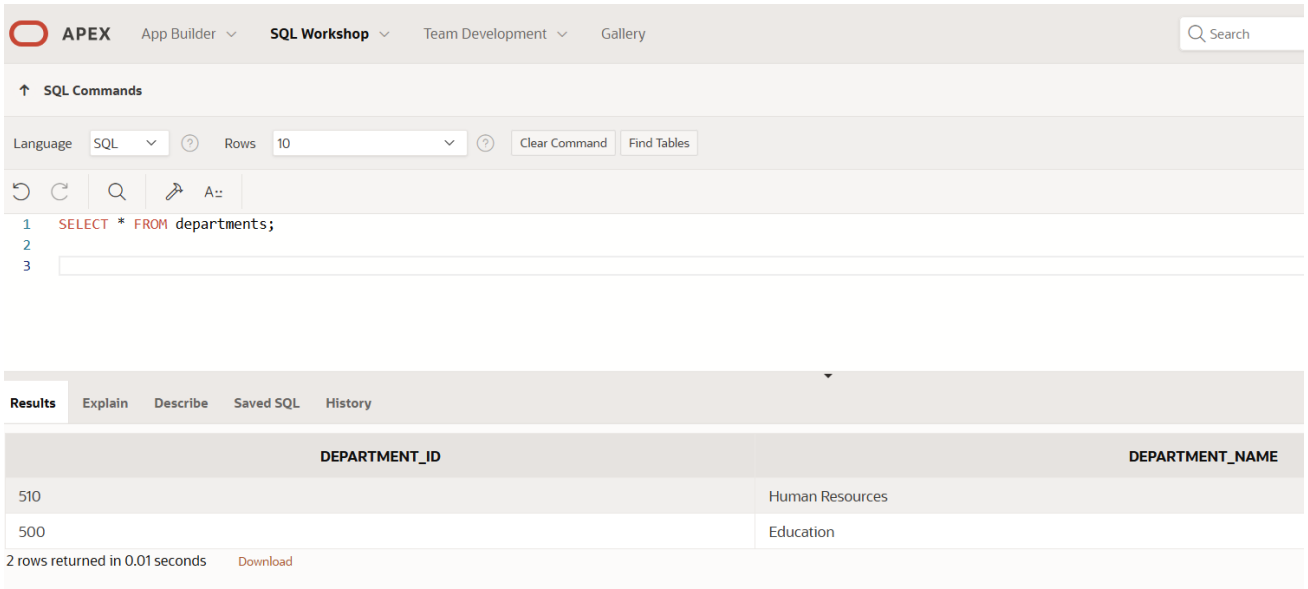
6. Grant another user access to your DEPARTMENTS table. Have the user grant you query access to his or her DEPARTMENTS table.

Use GRANT SELECT ON departments TO other_user;. This allows the other user to query your table.

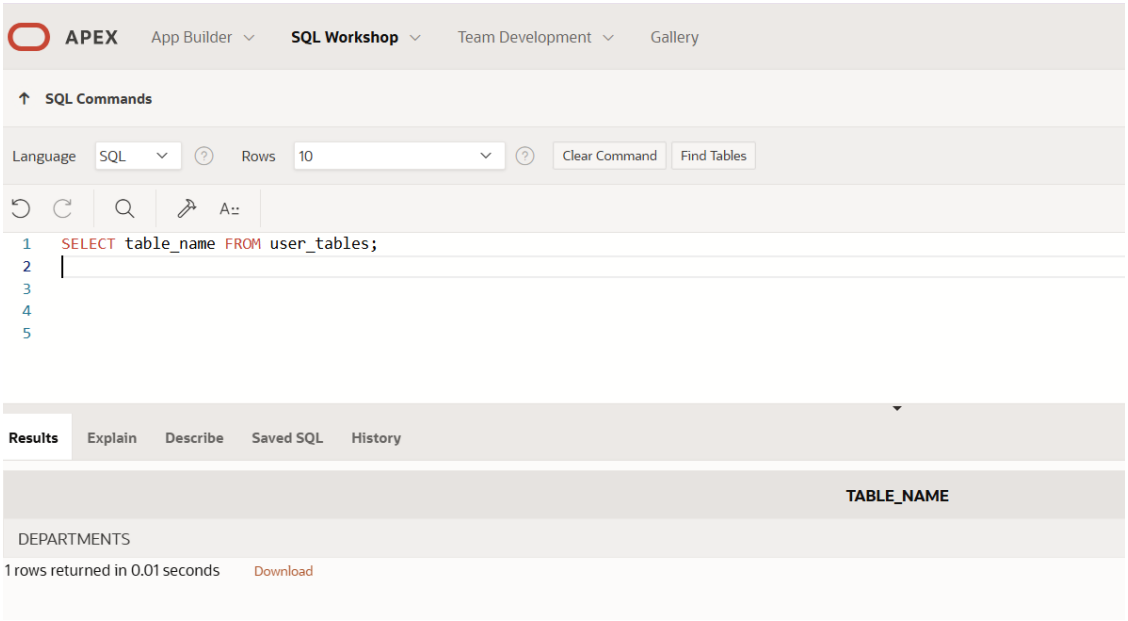
7. Query all the rows in your DEPARTMENTS table.

Use SELECT * FROM departments; It displays all rows from your table.

8. Add a new row to your DEPARTMENTS table. Team 1 should add Education as department number 500. Team 2 should add Human Resources department number 510. Query the other team's table.



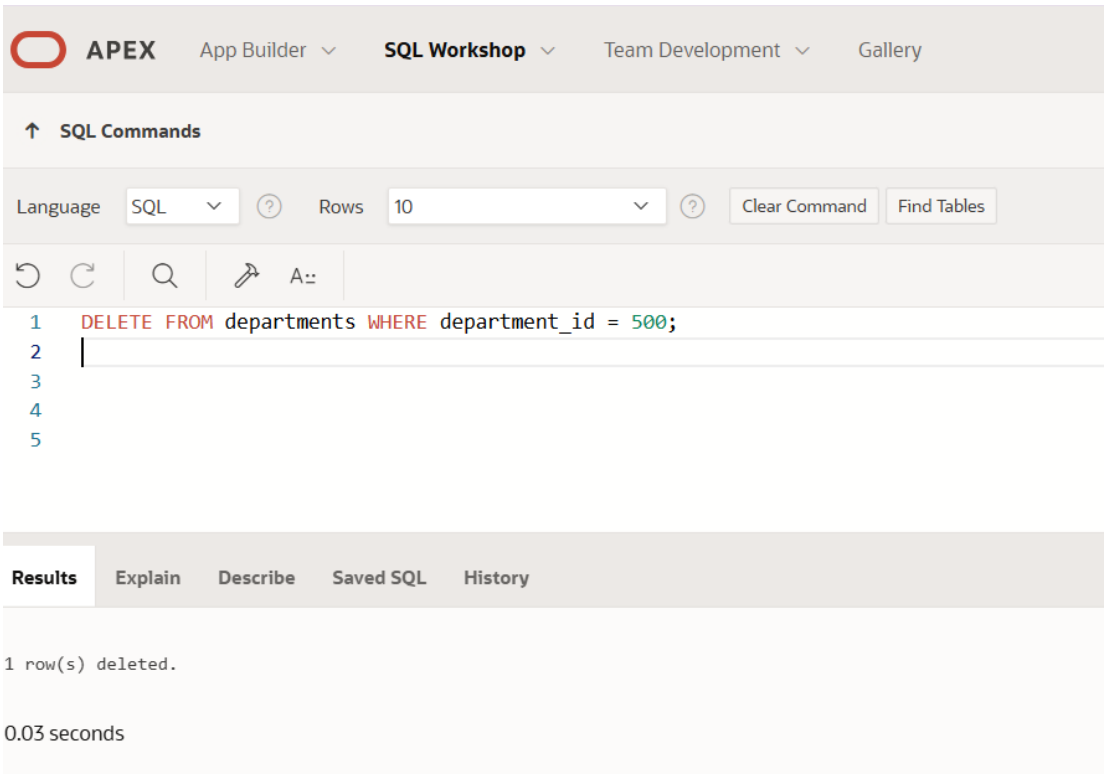
9. Query the USER_TABLES data dictionary to see information about the tables that you own.



10. Revoke the SELECT privilege on your table from the other team.

Use REVOKE SELECT ON departments FROM other_user;. This removes the granted privilege.

11. Remove the row you inserted into the DEPARTMENTS table in step 8 and save the changes.



Evaluation Procedure	Marks awarded
Practice Evaluation (5)	
Viva(5)	
Total (10)	
Faculty Signature	

PL/SQL

Control Structures

In addition to SQL commands,PL/SQL can also process data usin flow of statements.the flow of control statements are classified into the following categories.

- Conditional control -Branching
- Iterative control - looping ● Sequential control

BRANCHING in PL/SQL:

Sequence of statements can be executed on satisfying certain condition .

If statements are being used and different forms of if are:

1.Simple IF

2.ELSIF

3.ELSE IF ***SIMPLE***

IF:

Syntax:

IF condition THEN

statement1;

statement2;

END IF;

IF-THEN-ELSE STATEMENT:

Syntax:

IF condition THEN

statement1;

ELSE

statement2;

END IF;

ELSIF STATEMENTS:

Syntax:

IF condition1 THEN

```
  statement1;
ELSIF condition2 THEN
  statement2;
ELSIF condition3 THEN
  statement3;
ELSE
  statementn;
END IF;
```

NESTED IF :

Syntax: IF

```
condition THEN
   statement1;
ELSE
  IF condition THEN
    statement2;
ELSE
    statement3;
END IF;
END IF; ELSE
  statement3;
END IF;
```

SELECTION IN PL/SQL(Sequential Controls)

SIMPLE CASE

Syntax:

```
CASE SELECTOR
```

WHEN Expr1 THEN statement1;

WHEN Expr2 THEN statement2;

:

ELSE

Statement n;

END CASE;

SEARCHED CASE:

CASE

WHEN searchcondition1 THEN statement1;

WHEN searchcondition2 THEN statement2;

:

:

ELSE

statementn;

END CASE;

ITERATIONS IN PL/SQL

Sequence of statements can be executed any number of times using loop construct.

It is broadly classified into:

- Simple Loop
- For Loop
- While Loop

SIMPLE LOOP

Syntax: LOOP

statement1;

EXIT [WHEN Condition];

END LOOP; ***WHILE***

LOOP

Syntax:

WHILE condition LOOP

statement1; statement2;

END LOOP;

FOR LOOP

Syntax:

FOR counter IN [REVERSE]

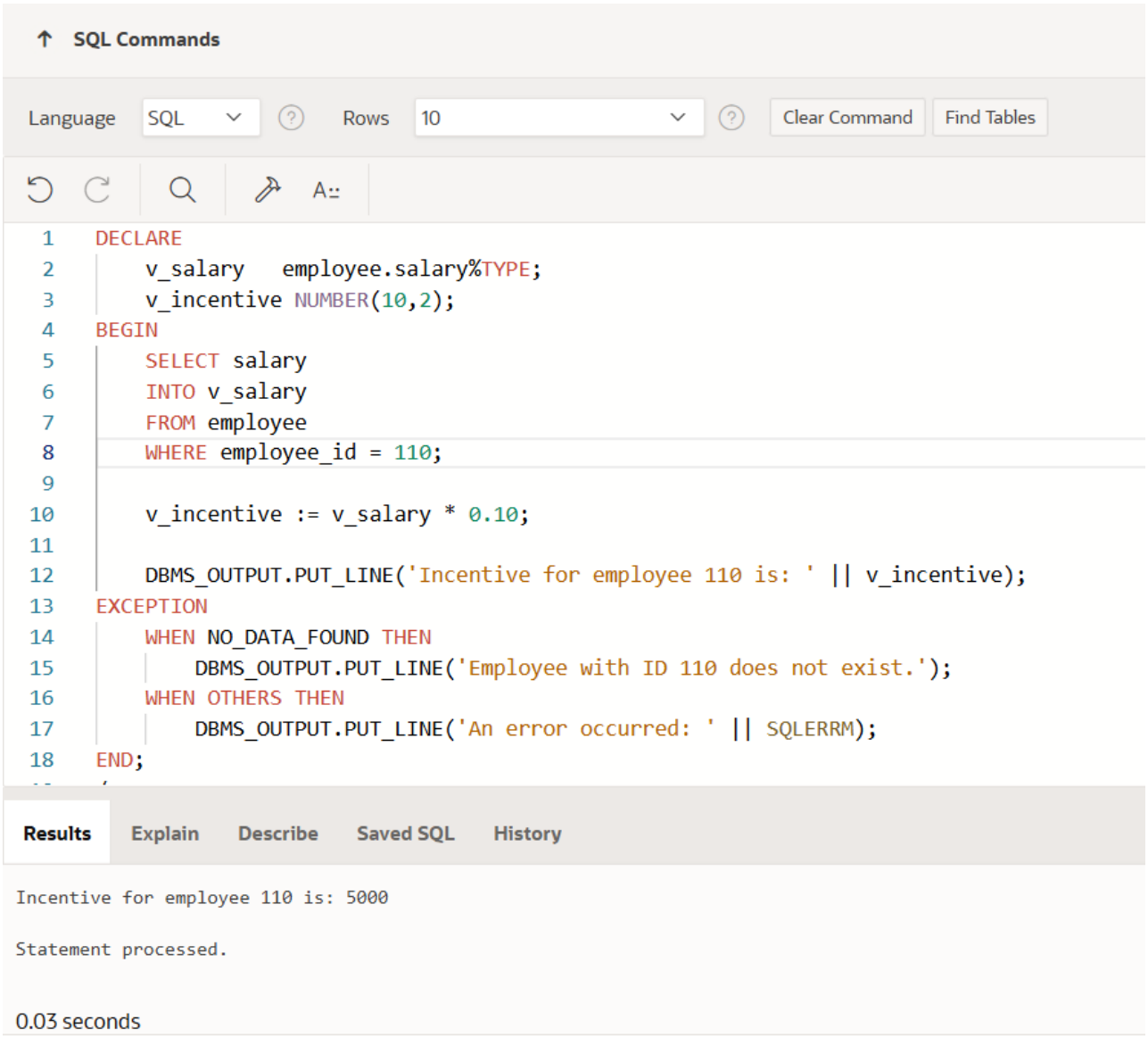
LowerBound..UpperBound LOOP

statement1; statement2;

END LOOP;

PROGRAM 1

Write a PL/SQL block to calculate the incentive of an employee whose ID is 110.



PROGRAM 2

Write a PL/SQL block to show an invalid case-insensitive reference to a quoted and without quoted user-defined identifier.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1   DECLARE
2       v_id   NUMBER;
3       v_name VARCHAR2(50);
4   BEGIN
5       SELECT "EmpId", "EmpName"
6       INTO v_id, v_name
7       FROM "EmpTable";
8
9       DBMS_OUTPUT.PUT_LINE('ID: ' || v_id || ', Name: ' || v_name);
10  EXCEPTION
11      WHEN OTHERS THEN
12          DBMS_OUTPUT.PUT_LINE('Error: ' || SQLERRM);
13  END;
14
```

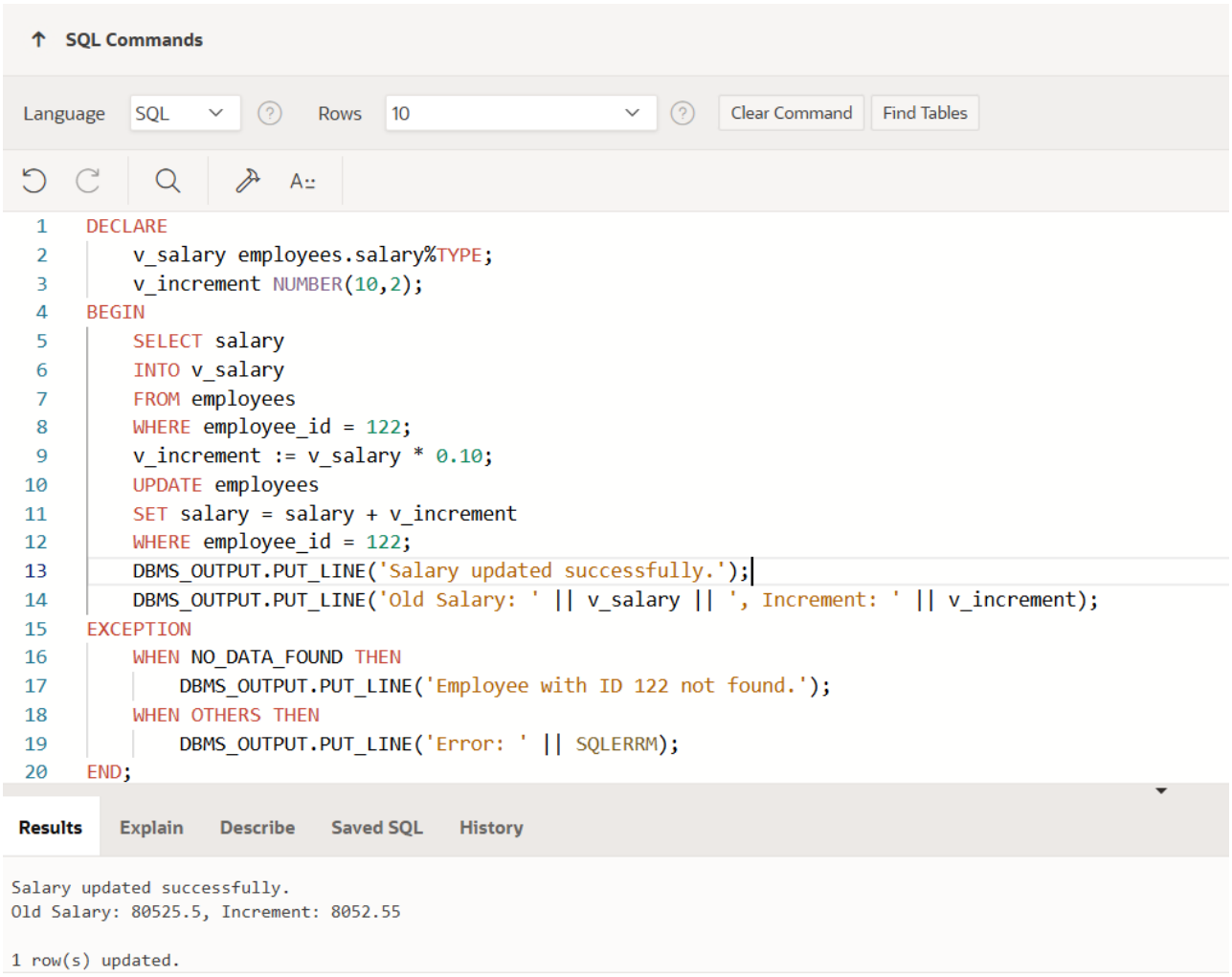
Results Explain Describe Saved SQL History

```
ID: 110, Name: John

Statement processed.

0.00 seconds
```

Write a PL/SQL block to adjust the salary of the employee whose ID 122.

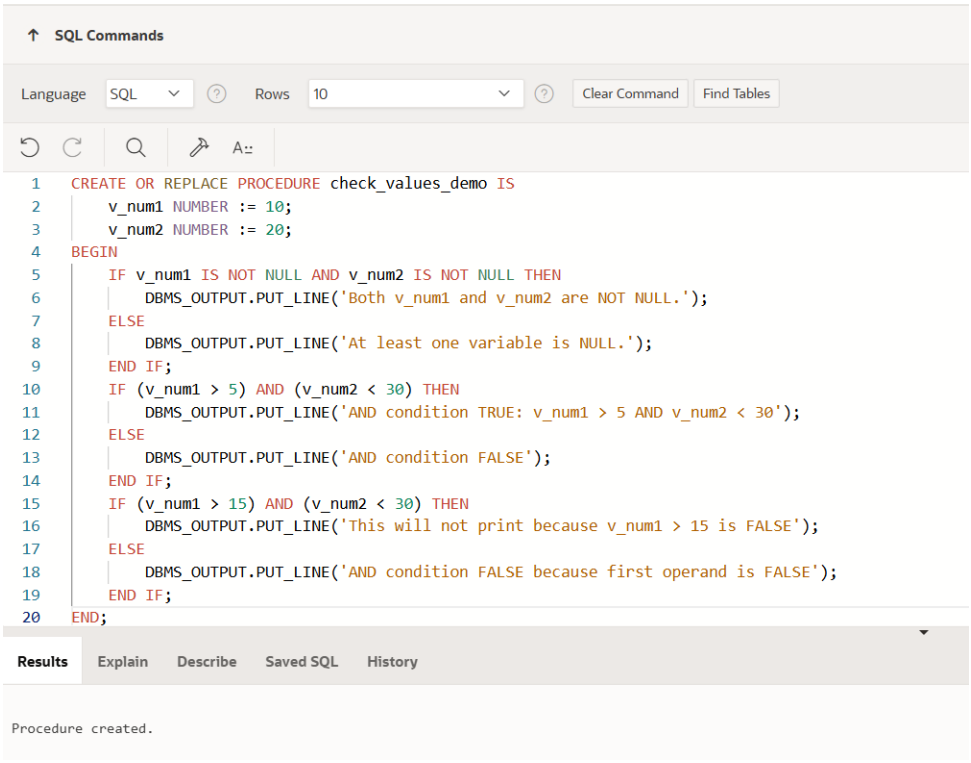
Sample table: employees

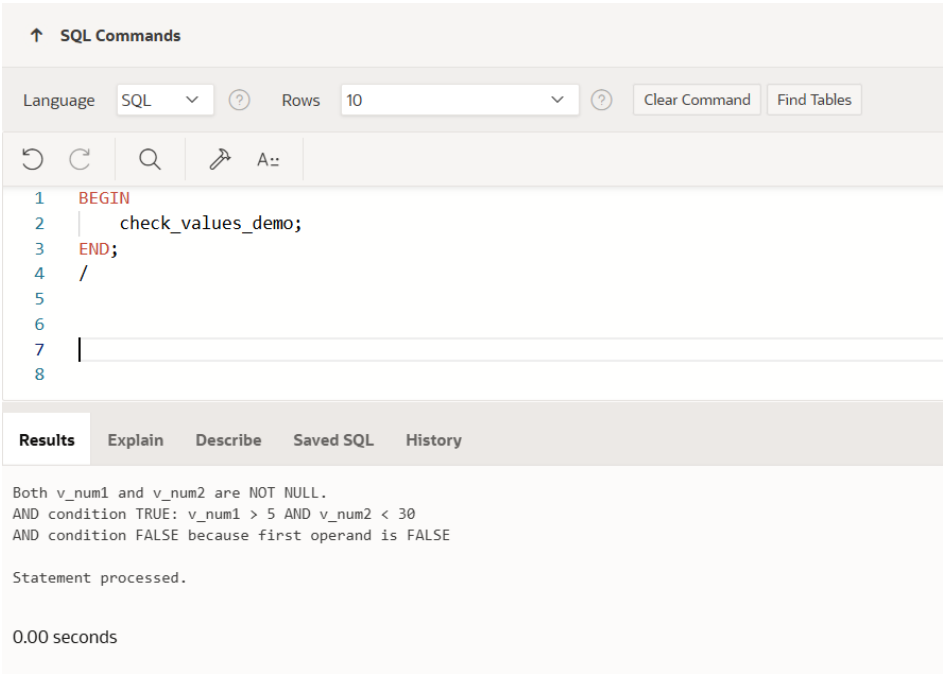
PROGRAM 3



PROGRAM 4

Write a PL/SQL block to create a procedure using the "IS [NOT] NULL Operator" and show AND operator returns TRUE if and only if both operands are TRUE.





Write a PL/SQL block to describe the usage of LIKE operator including wildcard characters and escape character.

PROGRAM 5

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1  DECLARE
2      v_name employees.first_name%TYPE;
3  BEGIN
4      DBMS_OUTPUT.PUT_LINE('--- LIKE Operator Examples ---');
5      FOR emp IN (SELECT first_name FROM employees WHERE first_name LIKE 'J%') LOOP
6          DBMS_OUTPUT.PUT_LINE('Starts with J: ' || emp.first_name);
7      END LOOP;
8      FOR emp IN (SELECT first_name FROM employees WHERE first_name LIKE '____') LOOP
9          DBMS_OUTPUT.PUT_LINE('Exactly 4 letters: ' || emp.first_name);
10     END LOOP;
11     FOR emp IN (SELECT first_name FROM employees WHERE first_name LIKE '%\%%' ESCAPE '\') LOOP
12         DBMS_OUTPUT.PUT_LINE('Contains % literally: ' || emp.first_name);
13     END LOOP;
14     FOR emp IN (SELECT first_name FROM employees WHERE first_name LIKE '%n') LOOP
15         DBMS_OUTPUT.PUT_LINE('Ends with n: ' || emp.first_name);
16     END LOOP;
17 END;
```

Results Explain Describe Saved SQL History

```
--- LIKE Operator Examples ---
Starts with J: John
Exactly 4 letters: John
Ends with n: John

Statement processed.
```

PROGRAM 6

Write a PL/SQL program to arrange the number of two variable in such a way that the small number will store in num_small variable and large number will store in num_large variable.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1   DECLARE
2       num1      NUMBER := 45;
3       num2      NUMBER := 78;
4       num_small NUMBER;
5       num_large NUMBER;
6   BEGIN
7       IF num1 < num2 THEN
8           num_small := num1;
9           num_large := num2;
10      ELSE
11          num_small := num2;
12          num_large := num1;
13      END IF;
14      DBMS_OUTPUT.PUT_LINE('Small number: ' || num_small);
15      DBMS_OUTPUT.PUT_LINE('Large number: ' || num_large);
16  END;
```

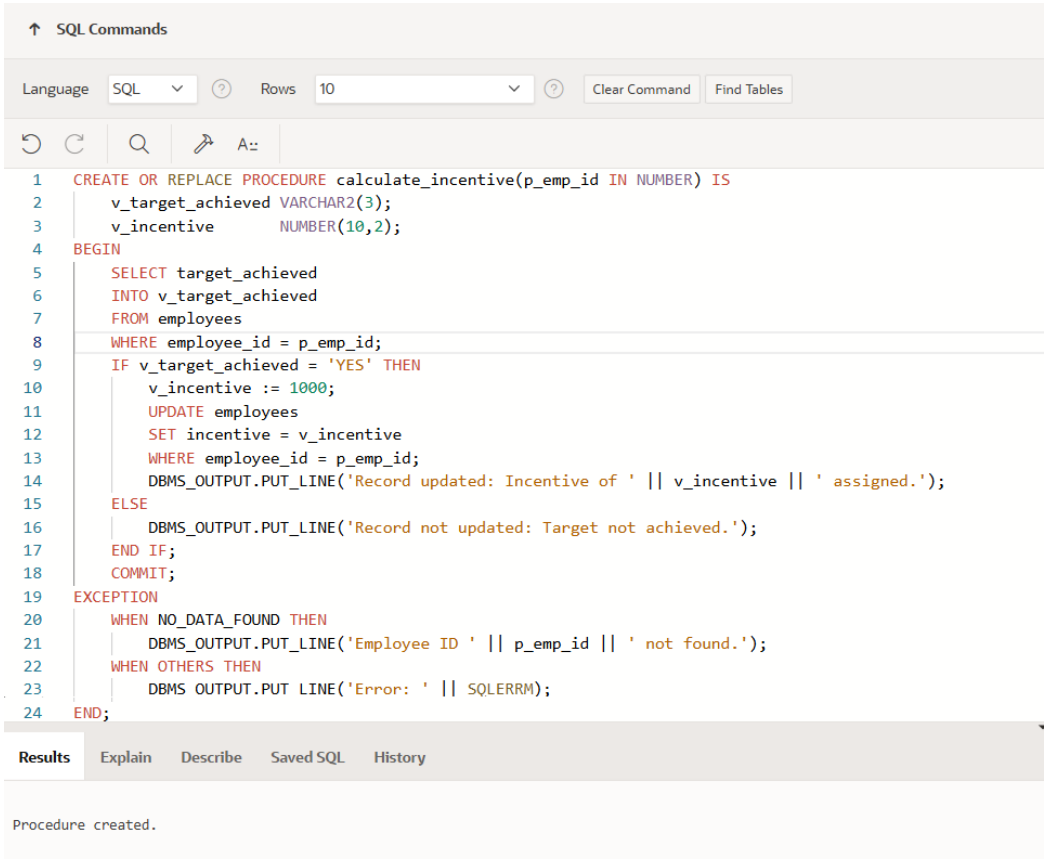
Results Explain Describe Saved SQL History

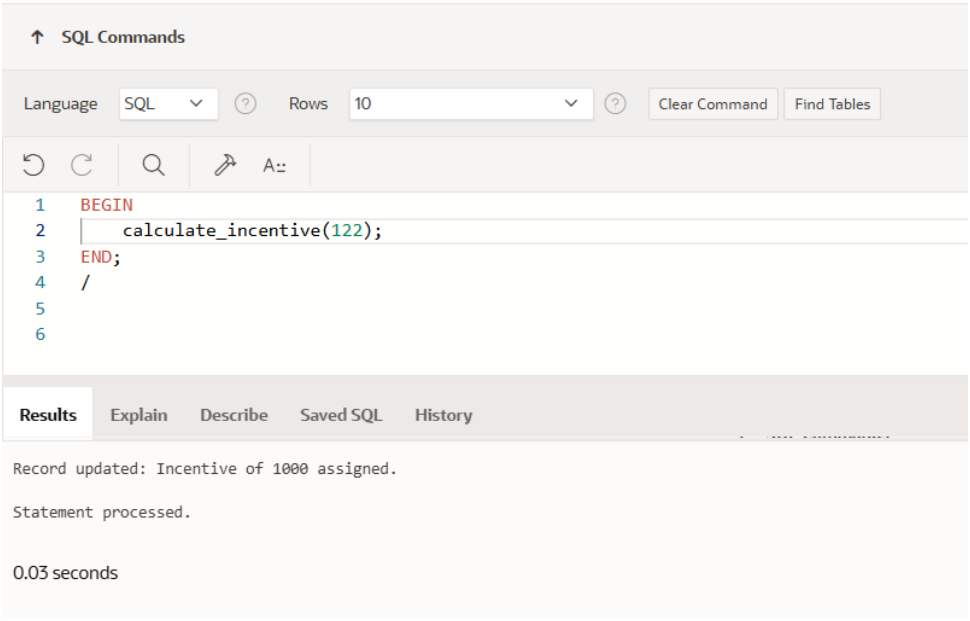
```
Small number: 45
Large number: 78

Statement processed.
```

0.00 seconds

PROGRAM 7

Write a PL/SQL procedure to calculate the incentive on a target achieved and display the message either the record updated or not.





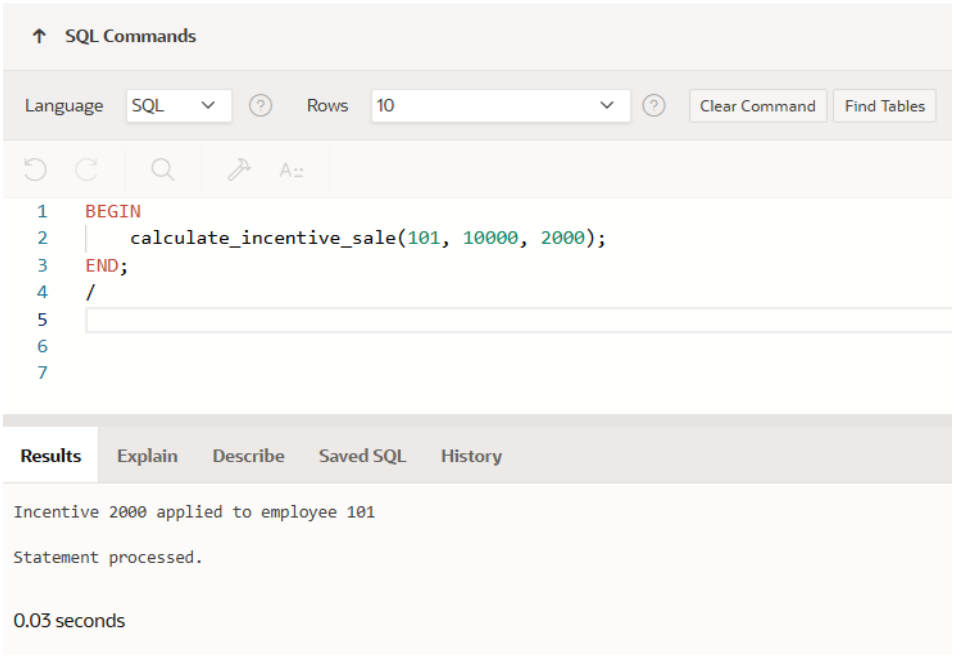
PROGRAM 8

Write a PL/SQL procedure to calculate incentive achieved according to the specific sale limit.

```
CREATE OR REPLACE PROCEDURE calculate_incentive_sale(
    p_emp_id        IN NUMBER,
    p_sale_limit    IN NUMBER,
    p_incentive_amt IN NUMBER
) IS v_sales NUMBER;
BEGIN SELECT sales_amount INTO v_sales
    FROM employee_sales
    WHERE employee_id = p_emp_id;
    IF v_sales >= p_sale_limit THEN
        UPDATE employee_sales
        SET incentive = p_incentive_amt
        WHERE employee_id = p_emp_id;
        DBMS_OUTPUT.PUT_LINE('Incentive ' || p_incentive_amt || ' applied to employee ' || p_emp_id);
    ELSE
        DBMS_OUTPUT.PUT_LINE('Sales below limit. No incentive for employee ' || p_emp_id);
    END IF;
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        DBMS_OUTPUT.PUT_LINE('Employee ' || p_emp_id || ' not found.');
    WHEN OTHERS THEN
        DBMS_OUTPUT.PUT_LINE('Error: ' || SQLERRM);
END;
```

Results | Explain | Describe | Saved SQL | History

```
Procedure created.
```



PROGRAM 9

Write a PL/SQL program to count number of employees in department 50 and check whether this department have any vacancies or not. There are 45 vacancies in this department.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1  DECLARE
2      v_emp_count NUMBER;
3      v_vacancies NUMBER := 45;
4  BEGIN
5      SELECT COUNT(*)
6      INTO v_emp_count
7      FROM employees
8      WHERE department_id = 50;
9      DBMS_OUTPUT.PUT_LINE('Number of employees in Department 50: ' || v_emp_count);
10     IF v_emp_count < v_vacancies THEN
11         DBMS_OUTPUT.PUT_LINE('Vacancies available: ' || (v_vacancies - v_emp_count));
12     ELSE
13         DBMS_OUTPUT.PUT_LINE('No vacancies available in Department 50.');
14     END IF;
15 END;
```

Results Explain Describe Saved SQL History

```
Number of employees in Department 50: 2
Vacancies available: 43

Statement processed.
```

0.01 seconds

PROGRAM 10

Write a PL/SQL program to count number of employees in a specific department and check whether this department have any vacancies or not. If any vacancies, how many vacancies are in that department.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1   DECLARE
2       v_dept_id         NUMBER := 50;
3       v_total_positions NUMBER := 40;
4       v_emp_count       NUMBER;
5       v_vacancies       NUMBER;
6   BEGIN
7       SELECT COUNT(*)
8       INTO v_emp_count
9       FROM employees
10      WHERE department_id = v_dept_id;
11      DBMS_OUTPUT.PUT_LINE('Department ID: ' || v_dept_id);
12      DBMS_OUTPUT.PUT_LINE('Number of employees: ' || v_emp_count);
13      v_vacancies := v_total_positions - v_emp_count;
14      IF v_vacancies > 0 THEN
15          DBMS_OUTPUT.PUT_LINE('Vacancies available: ' || v_vacancies);
16      ELSE
17          DBMS_OUTPUT.PUT_LINE('No vacancies available in this department.');
18      END IF;
19  END;
```

Results Explain Describe Saved SQL History

```
Department ID: 50
Number of employees: 2
Vacancies available: 38

Statement processed.
```

0.01 seconds

PROGRAM 12

PROGRAM 11

Write a PL/SQL program to display the employee IDs, names, job titles, hire dates, and salaries of all employees.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

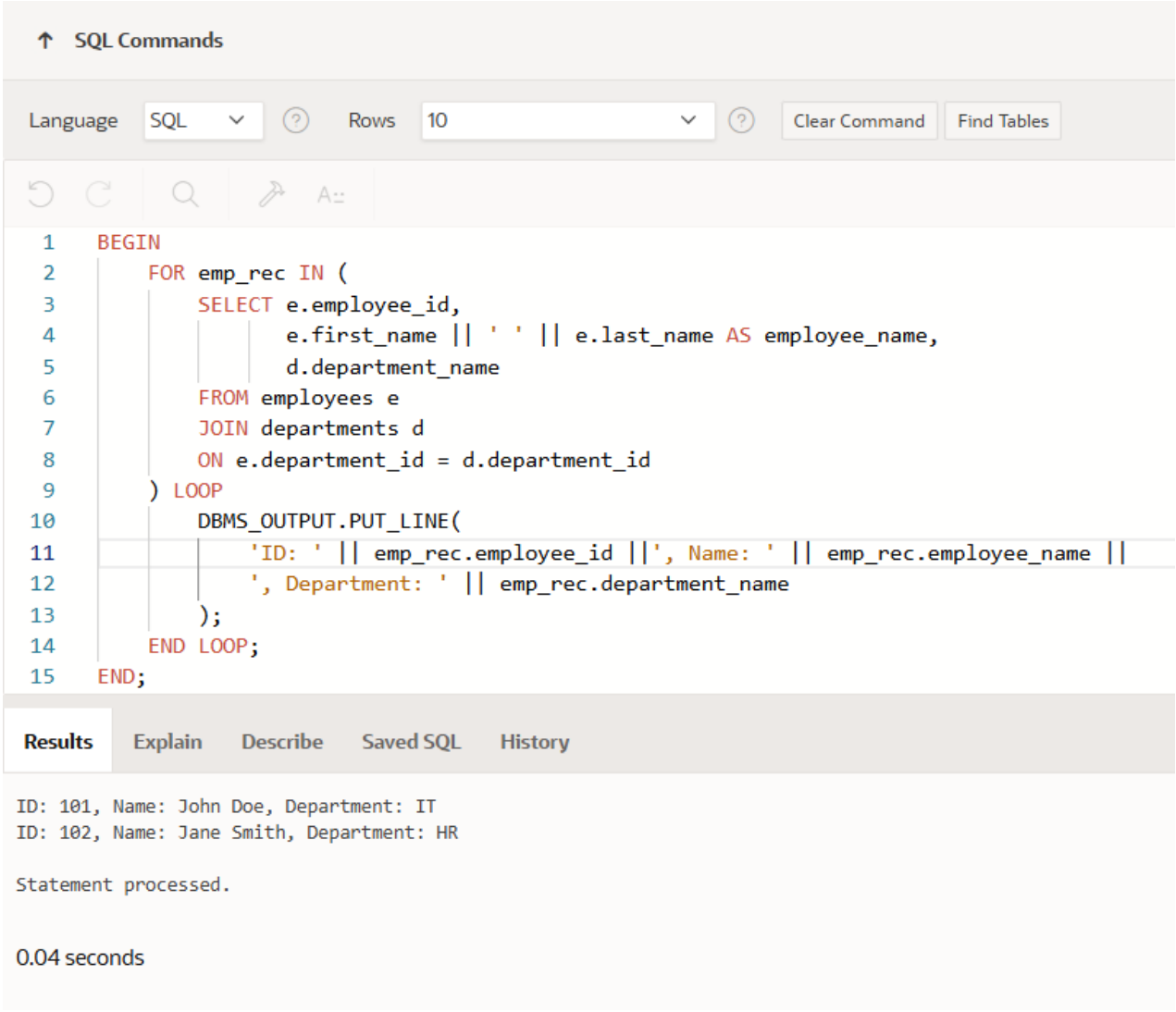
```
1  BEGIN
2      FOR emp_rec IN (SELECT employee_id, first_name, last_name, job_id, hire_date, salary
3                      FROM employees) LOOP
4          DBMS_OUTPUT.PUT_LINE(
5              'ID: ' || emp_rec.employee_id ||
6              ', Name: ' || emp_rec.first_name || ' ' || emp_rec.last_name ||
7              ', Job: ' || emp_rec.job_id ||
8              ', Hire Date: ' || TO_CHAR(emp_rec.hire_date, 'DD-MON-YYYY') ||
9              ', Salary: ' || emp_rec.salary
10         );
11     END LOOP;
12 END;
```

Results Explain Describe Saved SQL History

```
ID: 101, Name: John Doe, Job: IT_PROG, Hire Date: 15-JAN-2020, Salary: 5000
ID: 102, Name: Jane Smith, Job: HR_REP, Hire Date: 10-FEB-2019, Salary: 4000

Statement processed.
```

0.03 seconds

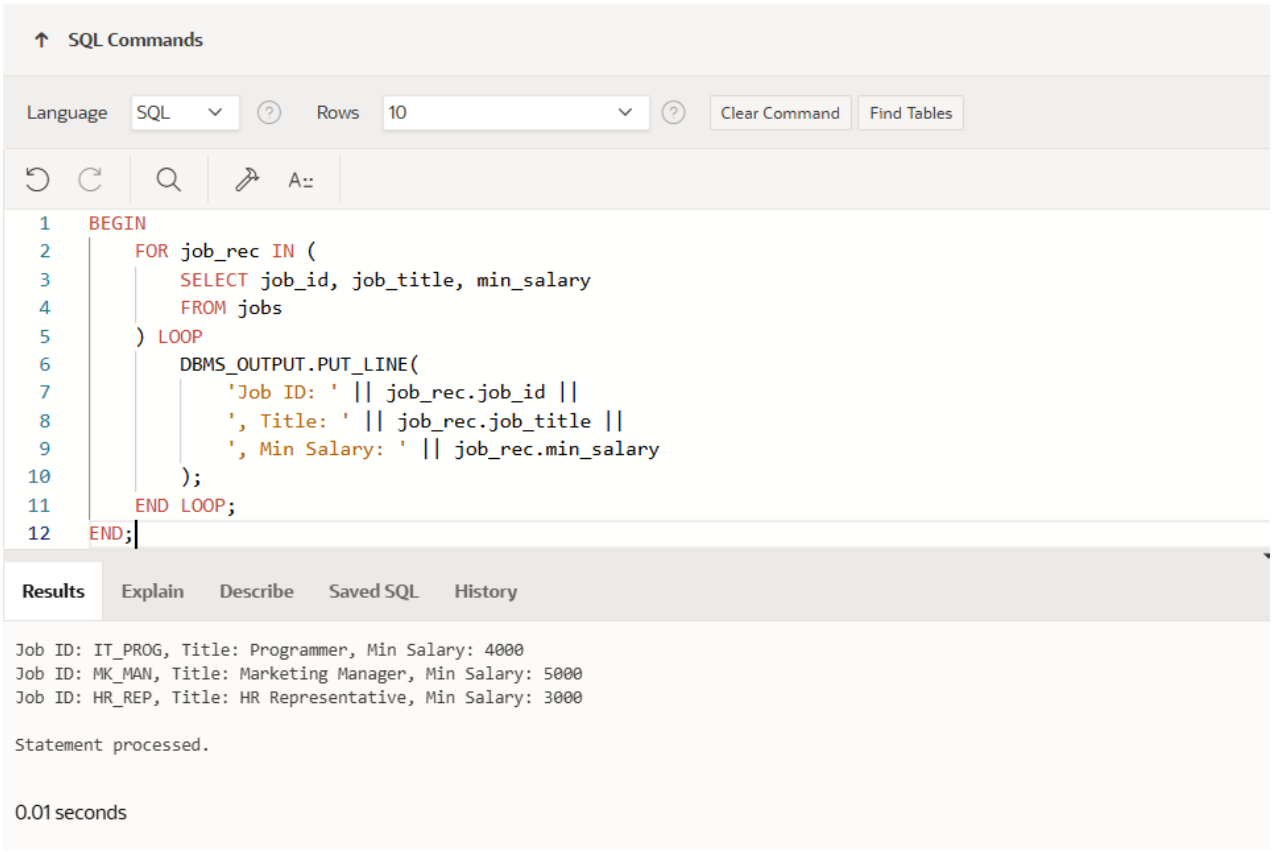
Write a PL/SQL program to display the employee IDs, names, and department names of all employees.



PROGRAM 14

PROGRAM 13

Write a PL/SQL program to display the job IDs, titles, and minimum salaries of all jobs.



PROGRAM 14

Write a PL/SQL program to display the employee IDs, names, and job history start dates of all employees.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
BEGIN
    FOR emp_rec IN (
        SELECT e.employee_id,
               e.first_name || ' ' || e.last_name AS employee_name,
               jh.start_date
        FROM employees e
        JOIN job_history jh
        ON e.employee_id = jh.employee_id
    ) LOOP
        DBMS_OUTPUT.PUT_LINE(
            'ID: ' || emp_rec.employee_id ||
            ', Name: ' || emp_rec.employee_name ||
            ', Job Start Date: ' || TO_CHAR(emp_rec.start_date, 'DD-MON-YYYY')
        );
    END LOOP;
END;
```

Results Explain Describe Saved SQL History

```
ID: 101, Name: John Doe, Job Start Date: 01-JAN-2020
ID: 102, Name: Jane Smith, Job Start Date: 15-FEB-2019

Statement processed.
```

0.04 seconds

PROGRAM 15

Write a PL/SQL program to display the employee IDs, names, and job history end dates of all employees.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
BEGIN
    FOR emp IN (
        SELECT e.employee_id,
               e.first_name || ' ' || e.last_name AS employee_name,
               jh.end_date
        FROM employees e
        JOIN job_history jh
        ON e.employee_id = jh.employee_id
    ) LOOP
        DBMS_OUTPUT.PUT_LINE(
            'ID: ' || emp.employee_id ||
            ', Name: ' || emp.employee_name ||
            ', Job End Date: ' || TO_CHAR(emp.end_date, 'DD-MON-YYYY')
        );
    END LOOP;
END;
```

Results Explain Describe Saved SQL History

```
ID: 101, Name: John Doe, Job End Date: 31-DEC-2020
ID: 102, Name: Jane Smith, Job End Date: 14-FEB-2020

Statement processed.
```

0.02 seconds

Evaluation Procedure	Marks awarded
PL/SQL Procedure(5)	
Program/Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-16

PROCEDURES AND FUNCTIONS

PROCEDURES

DEFINITION

A procedure or function is a logically grouped set of SQL and PL/SQL statements that perform a specific task. They are essentially sub-programs. Procedures and functions are made up of,

- Declarative part
- Executable part
- Optional exception handling part

These procedures and functions do not show the errors.

KEYWORDS AND THEIR PURPOSES

REPLACE: It recreates the procedure if it already exists.

PROCEDURE: It is the name of the procedure to be created.

ARGUMENT: It is the name of the argument to the procedure. Paranthesis can be omitted if no arguments are present.

IN: Specifies that a value for the argument must be specified when calling the procedure ie. used to pass values to a sub-program. This is the default parameter.

OUT: Specifies that the procedure passes a value for this argument back to it's calling environment after execution ie. used to return values to a caller of the sub-program.

INOUT: Specifies that a value for the argument must be specified when calling the procedure and that procedure passes a value for this argument back to it's calling environment after execution.

RETURN: It is the datatype of the function's return value because every function must return a value, this clause is required.

PROCEDURES – SYNTAX

create or replace procedure <procedure name> (argument {in,out,inout} datatype) {is,as}
variable declaration; constant declaration; begin
PL/SQL subprogram body;
exception
exception PL/SQL block;

end;

FUNCTIONS – SYNTAX

create or replace function <function name> (argument in datatype,……) return datatype {is,as}
variable declaration;
constant declaration;
begin
PL/SQL subprogram body;
exception
exception PL/SQL block;
end;

CREATING THE TABLE 'ITITEMS' AND DISPLAYING THE CONTENTS

SQL> create table ititems(itemid number(3), actualprice number(5), ordid number(4), prodid number(4)); Table created.

SQL> insert into ititems values(101, 2000, 500, 201); 1
row created.

SQL> insert into ititems values(102, 3000, 1600, 202); 1
row created.

SQL> insert into ititems values(103, 4000, 600, 202); 1
row created.

SQL> select * from ititems;

ITEMID	ACTUALPRICE	ORDID	PRODID
101	2000	500	201
102	3000	1600	202
103	4000	600	202

PROGRAM FOR GENERAL PROCEDURE – SELECTED RECORD'S PRICE IS INCREMENTED BY 500 , EXECUTING THE PROCEDURE CREATED AND DISPLAYING THE UPDATED TABLE

SQL> create procedure itsum(identity number, total number) is price number;
2 null_price exception;
3 begin
4 select actualprice into price from ititems where itemid=identity;
5 if price is null then

```
6  raise null_price;
7  else
8  update ititems set actualprice=actualprice+total where itemid=identity;   9  end if;
10  exception
11  when null_price then
12  dbms_output.put_line('price is null');
13  end;  14  /
Procedure created.

SQL> exec itsum(101, 500);
PL/SQL procedure successfully completed.

SQL> select * from ititems;
ITEMID   ACTUALPRICE     ORDID     PRODID
---------          -----------          ---------     ---------
         101           2500                500         201
         102           3000               1600         202
         103           4000                600          202
```

PROCEDURE FOR 'IN' PARAMETER – CREATION, EXECUTION

```
SQL> set serveroutput on;

SQL> create procedure yyy (a IN number) is price number;
2  begin
3  select actualprice into price from ititems where itemid=a;
4  dbms_output.put_line('Actual price is ' || price);
5  if price is null then
6  dbms_output.put_line('price is null');
7  end if;
8  end;   9  /
Procedure created.

SQL> exec yyy(103);
Actual price is 4000
PL/SQL procedure successfully completed.
```

PROCEDURE FOR 'OUT' PARAMETER – CREATION, EXECUTION

```
SQL> set serveroutput on;

SQL> create procedure zzz (a in number, b out number) is identity number;
2  begin
3   select ordid into identity from ititems where itemid=a;
4   if identity<1000 then
5   b:=100;
```

```
6   end if;
7   end;   8  /
Procedure created.

SQL> declare
2  a number;
3  b number;
4  begin
5  zzz(101,b);
6  dbms_output.put_line('The value of b is '|| b);
7  end;
8  /
The value of b is 100
PL/SQL procedure successfully completed.
```

PROCEDURE FOR 'INOUT' PARAMETER – CREATION, EXECUTION

```
SQL> create procedure itit ( a in out number) is
2  begin
3  a:=a+1;
4  end;   5  /
  Procedure created.

SQL> declare
2  a number:=7;
3  begin
4  itit(a);
5  dbms_output.put_line('The updated value is '||a);
6  end;
7  /
The updated value is 8
PL/SQL procedure successfully completed.
```

CREATE THE TABLE 'ITTRAIN' TO BE USED FOR FUNCTIONS

```
SQL>create table ittrain ( tno number(10), tfare number(10)); Table
created.

SQL>insert into ittrain values (1001, 550); 1
row created.

SQL>insert into ittrain values (1002, 600); 1
row created.
```

```
SQL>select * from ittrain;
    TNO      TFARE
  ---------   ------------
1001        550
1002        600
```

PROGRAM FOR FUNCTION AND IT'S EXECUTION

```
SQL> create function aaa (trainnumber number) return number is
2  trainfunction ittrain.tfare % type;
3  begin
4  select tfare into trainfunction from ittrain where tno=trainnumber;
5  return(trainfunction);
6  end;
7  /
Function created.

SQL> set serveroutput on;

SQL> declare
2  total number;
3  begin
4  total:=aaa (1001);
5  dbms_output.put_line('Train fare is Rs. '||total);
6  end;
7  /
Train fare is Rs.550
PL/SQL procedure successfully completed.
```

Program 1

FACTORIAL OF A NUMBER USING FUNCTION

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1  CREATE OR REPLACE FUNCTION factorial(n IN NUMBER) RETURN NUMBER IS
2      result NUMBER := 1;
3  BEGIN
4      IF n < 0 THEN
5          RETURN NULL;
6      END IF;
7
8      FOR i IN 1..n LOOP
9          result := result * i;
10     END LOOP;
11
12     RETURN result;
13 END;
```

Results Explain Describe Saved SQL History

```
Function created.
```

0.04 seconds

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1  DECLARE
2      num NUMBER := 5;
3      fact NUMBER;
4  BEGIN
5      fact := factorial(num);
6
7      IF fact IS NOT NULL THEN
8          DBMS_OUTPUT.PUT_LINE('Factorial of ' || num || ' is ' || fact);
9      ELSE
10         DBMS_OUTPUT.PUT_LINE('Factorial not defined for negative numbers');
11     END IF;
12 END;
```

Results Explain Describe Saved SQL History

```
Factorial of 5 is 120

Statement processed.
```

0.01 seconds

Program 2

Write a PL/SQL program using Procedures IN,INOUT,OUT parameters to retrieve the corresponding book information in library

```
CREATE OR REPLACE PROCEDURE get_book_info(
    p_book_id       IN NUMBER,
    p_title         OUT VARCHAR2,
    p_author        OUT VARCHAR2,
    p_available     IN OUT NUMBER
) IS
BEGIN
    SELECT title, author, available_copies
    INTO p_title, p_author, p_available
    FROM books
    WHERE book_id = p_book_id;
    IF p_available > 0 THEN p_available := p_available - 1;
        UPDATE books
        SET available_copies = p_available
        WHERE book_id = p_book_id;
        DBMS_OUTPUT.PUT_LINE('Book issued. Updated available copies: ' || p_available);
    ELSE  DBMS_OUTPUT.PUT_LINE('Book not available.');
    END IF;
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        DBMS_OUTPUT.PUT_LINE('Book ID ' || p_book_id || ' not found.');
    WHEN OTHERS THEN
        DBMS_OUTPUT.PUT_LINE('Error: ' || SQLERRM);
END;
```

Results | Explain | Describe | Saved SQL | History

```
Procedure created.
```

SQL Commands

Language: SQL | Rows: 10 | Clear Command | Find Tables

```
DECLARE
    v_title  VARCHAR2(100);
    v_author VARCHAR2(50);
    v_available NUMBER := 0;
BEGIN
    get_book_info(1, v_title, v_author, v_available);
    DBMS_OUTPUT.PUT_LINE('Title: ' || v_title || ', Author: ' || v_author || ', Available Copies: ' || v_available);
END;
```

Results | Explain | Describe | Saved SQL | History

```
Book issued. Updated available copies: 4
Title: Oracle PL/SQL, Author: John Smith, Available Copies: 4

Statement processed.
```

Evaluation Procedure	Marks awarded
PL/SQL Procedure(5)	
Program/Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	

EXERCISE-17

TRIGGER

DEFINITION

A trigger is a statement that is executed automatically by the system as a side effect of a modification to the database. The parts of a trigger are,

- **Trigger statement**: Specifies the DML statements and fires the trigger body. It also specifies the table to which the trigger is associated.

- **Trigger body or trigger action**: It is a PL/SQL block that is executed when the triggering statement is used.

- **Trigger restriction**: Restrictions on the trigger can be achieved

The different uses of triggers are as follows,

- *To generate data automatically*
- *To enforce complex integrity constraints*
- *To customize complex securing authorizations*
- *To maintain the replicate table*
- To audit data modifications

TYPES OF TRIGGERS

The various types of triggers are as follows,

- **Before**: It fires the trigger before executing the trigger statement.

- **After**: It fires the trigger after executing the trigger statement
- .
- **For each row**: It specifies that the trigger fires once per row
- .
- **For each statement**: This is the default trigger that is invoked. It specifies that the trigger fires once per statement.

VARIABLES USED IN TRIGGERS

- :new
- :old

These two variables retain the new and old values of the column updated in the database. The values in these variables can be used in the database triggers for data manipulation

SYNTAX

```
 create or replace trigger triggername [before/after] {DML statements}
on [tablename] [for each row/statement]  begin
 ------------------------
 ------------------------
 ------------------------
exception end;
```

USER DEFINED ERROR MESSAGE

The package “raise_application_error” is used to issue the user defined error messages

Syntax: raise_application_error(error number,‘error message‘);

The error number can lie between -20000 and -20999.

The error message should be a character string.

TO CREATE THE TABLE ‘ITEMPLS’

```
SQL> create table itempls (ename varchar2(10), eid number(5), salary number(10));
Table created.

SQL> insert into itempls values('xxx',11,10000); 1
row created.

SQL> insert into itempls values('yyy',12,10500); 1
row created.

SQL> insert into itempls values('zzz',13,15500); 1
row created.

SQL> select * from itempls;
ENAME          EID    SALARY
```

---------- --------- --------- xxx
11 10000 yyy 12
10500
zzz 13 15500

TO CREATE A SIMPLE TRIGGER THAT DOES NOT ALLOW INSERT UPDATE AND DELETE OPERATIONS ON THE TABLE

```
SQL> create trigger ittrigg before insert or update or delete on itempls for each row
2  begin
3  raise_application_error(-20010,'You cannot do manipulation');
4  end;
 5
 6  /
Trigger created.

SQL> insert into itempls values('aaa',14,34000);
insert into itempls values('aaa',14,34000)
           *
ERROR at line 1:
ORA-20010: You cannot do manipulation
ORA-06512: at "STUDENT.ITTRIGG", line 2
ORA-04088: error during execution of trigger 'STUDENT.ITTRIGG'

SQL> delete from itempls where ename='xxx';
delete from itempls where ename='xxx'
           *
ERROR at line 1:
ORA-20010: You cannot do manipulation
ORA-06512: at "STUDENT.ITTRIGG", line 2
ORA-04088: error during execution of trigger 'STUDENT.ITTRIGG'

SQL> update itempls set eid=15 where ename='yyy'; update
itempls set eid=15 where ename='yyy'
       *
ERROR at line 1:
ORA-20010: You cannot do manipulation
ORA-06512: at "STUDENT.ITTRIGG", line 2
ORA-04088: error during execution of trigger 'STUDENT.ITTRIGG'
```

TO DROP THE CREATED TRIGGER

```
SQL> drop trigger ittrigg;

Trigger dropped.
```

TO CREATE A TRIGGER THAT RAISES AN USER DEFINED ERROR MESSAGE AND DOES NOT ALLOW UPDATION AND INSERTION

```
SQL> create trigger ittriggs before insert or update of salary on itempls for each row
2  declare
3  triggsal itempls.salary%type;
4  begin
5  select salary into triggsal from itempls where eid=12;
6  if(:new.salary>triggsal or :new.salary<triggsal) then
7  raise_application_error(-20100,'Salary has not been changed');   8  end if;
9    end;
10  /

Trigger created.

SQL> insert into itempls values ('bbb',16,45000);
insert into itempls values ('bbb',16,45000)
          *
ERROR at line 1:
ORA-04098: trigger 'STUDENT.ITTRIGGS' is invalid and failed re-validation

SQL> update itempls set eid=18 where ename='zzz'; update
itempls set eid=18 where ename='zzz'
      *
ERROR at line 1:
ORA-04298: trigger 'STUDENT.ITTRIGGS' is invalid and failed re-validation
```

Cursor for loop

- Explicit cursor
- Implicit cursor

TO CREATE THE TABLE 'SSEMPP'

```
SQL> create table ssempp( eid number(10), ename varchar2(20), job varchar2(20), sal number
(10),dnonumber(5)); Table
created.

SQL> insert into ssempp values(1,'nala','lecturer',34000,11); 1
row created.

SQL> insert into ssempp values(2,'kala',' seniorlecturer',20000,12); 1
row created.
```

```
SQL> insert into ssempp values(5,'ajay','lecturer',30000,11); 1
row created.

SQL> insert into ssempp values(6,'vijay','lecturer',18000,11); 1
row created.

SQL> insert into ssempp values(3,'nila','professor',60000,12); 1
row created.

SQL> select * from ssempp;
   EID    ENAME              JOB                    SAL      DNO
--------- -------------------- --------------------     ---------     ---------
1       nala                 lecturer                34000        11
       2       kala                 seniorlecturer         20000         12
5       ajay                 lecturer                30000        11
6       vijay                lecturer                 18000         11         3      nila
        professor              60000         12
```

EXTRA PROGRAMS

TO WRITE A PL/SQL BLOCK TO DISPLAY THE EMPOYEE ID AND EMPLOYEE NAME USING CURSOR FOR LOOP

```
SQL> set serveroutput on;
SQL> declare
2  begin
3  for emy in (select eid,ename from ssempp)
4  loop
5  dbms_output.put_line('Employee id and employee name  are '|| emy.eid ‘and’||
   emy.ename);   6  end loop;
7  end;
8  /
Employee id and employee name are 1 and nala
Employee id and employee name are 2 and kala
Employee id and employee name are 5 and ajay
Employee id and employee name are 6 and vijay
Employee id and employee name are 3 and nila

PL/SQL procedure successfully completed.
```

TO WRITE A PL/SQL BLOCK TO UPDATE THE SALARY OF ALL EMPLOYEES WHERE DEPARTMENT NO IS 11 BY 5000 USING CURSOR FOR LOOP AND TO DISPLAY THE UPDATED TABLE

```
SQL> set serveroutput on;
```

```
SQL> declare
  2  cursor cem is select eid,ename,sal,dno from ssempp where dno=11;
3  begin
4    --open cem;
5    for rem in cem
6    loop
7    update ssempp set sal=rem.sal+5000 where eid=rem.eid;
8    end loop;
9    --close cem;
10  end;
11  /

PL/SQL procedure successfully completed.

SQL> select * from ssempp;

     EID      ENAME              JOB              SAL       DNO ---------
-------------------- -------------------- --------- ---------
          1       nala                  lecturer           39000        11
          2       kala                seniorlecturer       20000        12
          5       ajay                  lecturer           35000        11
          6       vijay                  lecturer           23000        11         3
                  nila                  professor          60000        12
```

TO WRITE A PL/SQL BLOCK TO DISPLAY THE EMPLOYEE ID AND EMPLOYEE NAME WHERE DEPARTMENT NUMBER IS 11 USING EXPLICIT CURSORS

```
1  declare
2  cursor cenl is select eid,sal from ssempp where dno=11;
3  ecode ssempp.eid%type;
4  esal empp.sal%type;
5  begin
6  open cenl;
7  loop
8  fetch cenl into ecode,esal;
9  exit when cenl%notfound;
10dbms_output.put_line(' Employee code and employee salary are' || ecode ‘and’||
   esal);  11  end loop;
 12  close cenl;
 13* end;

SQL> /
Employee code and employee salary are 1 and 39000
Employee code and employee salary are 5 and 35000
Employee code and employee salary are 6 and 23000
```

PL/SQL procedure successfully completed.

TO WRITE A PL/SQL BLOCK TO UPDATE THE SALARY BY 5000 WHERE THE JOB IS LECTURER , TO CHECK IF UPDATES ARE MADE USING IMPLICIT CURSORS AND TO DISPLAY THE UPDATED TABLE

```
SQL> declare
2  county number;
3  begin
4  update ssempp set sal=sal+10000 where job='lecturer';
5  county:= sql%rowcount;
6  if county > 0 then
7  dbms_output.put_line('The number of rows are '|| county);   8  end if;
9    if sql %found then
10  dbms_output.put_line('Employee record modification successful');
11  else if sql%notfound then
12  dbms_output.put_line('Employee record is not found');
13  end if;
14  end if;
15  end;
16  /
The number of rows are 3

Employee record modification successful

PL/SQL procedure successfully completed.

SQL> select * from ssempp;
```

EID	ENAME	JOB	SAL	DNO -
1	nala	lecturer	44000	11
2	kala	seniorlecturer	20000	12
5	ajay	lecturer	40000	11
6	vijay	lecturer	28000	11
3	nila	professor	60000	12

PROGRAMS

TO DISPLAY HELLO MESSAGE

```
SQL> set serveroutput on;
SQL> declare
2  a varchar2(20);
3  begin
4  a:='Hello';
```

```
5  dbms_output.put_line(a);
6  end;
7  /
Hello

PL/SQL procedure successfully completed.
```

TO INPUT A VALUE FROM THE USER AND DISPLAY IT

```
SQL> set serveroutput on;
SQL> declare
2  a varchar2(20);
3  begin
4  a:=&a;
5  dbms_output.put_line(a);
6  end;
7  /
Enter value for a: 5
old   4: a:=&a; new
4: a:=5;
5

PL/SQL procedure successfully completed.
```

GREATEST OF TWO NUMBERS

```
SQL> set serveroutput on;

SQL> declare
  2  a number(7);
3  b number(7);
4    begin
5    a:=&a;
6    b:=&b;
7    if(a>b) then
8    dbms_output.put_line (' The grerater of the two is'|| a);
9    else
10  dbms_output.put_line (' The grerater of the two is'|| b);
11  end if;
12  end;
13  /
Enter value for a: 5 old
5: a:=&a; new   5: a:=5;
Enter value for b: 9 old
6: b:=&b; new   6: b:=9;
```

```
The grerater of the two
is9

PL/SQL procedure successfully completed.
```

GREATEST OF THREE NUMBERS

```
SQL> set serveroutput on;

SQL> declare
  2  a number(7);
3  b number(7);
4  c number(7);
5    begin
6    a:=&a;
7    b:=&b;
8    c:=&c;
9    if(a>b and a>c) then
10  dbms_output.put_line (' The greatest of the three is ' || a);
11  else if (b>c) then
12  dbms_output.put_line (' The greatest of the three is ' || b);
13  else
14  dbms_output.put_line (' The greatest of the three is ' || c);
15  end if;
16  end if;
17  end;
18  /
Enter value for a: 5
old   6: a:=&a; new
6: a:=5; Enter value
for  b:  7  old      7:
b:=&b;  new      7:
b:=7;  Enter  value
for  c:  1  old      8:
c:=&c;  new      8:
c:=1;
The greatest of the three is 7

PL/SQL procedure successfully completed.
```

PRINT NUMBERS FROM 1 TO 5 USING SIMPLE LOOP

```
SQL> set serveroutput on;
```

```
SQL> declare
2    a number:=1;
3    begin
4    loop
5    dbms_output.put_line (a);
6    a:=a+1;
7    exit when a>5;
8    end loop;
9    end;
10  /
1
2
3
4
5

PL/SQL procedure successfully completed.
```

PRINT NUMBERS FROM 1 TO 4 USING WHILE LOOP

```
SQL> set serveroutput on;

SQL> declare
2    a number:=1;
3    begin
4    while(a<5)
5    loop
6    dbms_output.put_line (a);
7    a:=a+1;
8    end loop;
9    end;
10  /
1
2
3
4
PL/SQL procedure successfully completed.
```

PRINT NUMBERS FROM 1 TO 5 USING FOR LOOP

```
SQL> set serveroutput on;

SQL> declare
2  a number:=1;
3  begin
4  for a in 1..5
```

```
5  loop
6  dbms_output.put_line (a);
7  end loop;
8  end;
9  /
1
2
3
4
5
PL/SQL procedure successfully completed.
```

PRINT NUMBERS FROM 1 TO 5 IN REVERSE ORDER USING FOR LOOP

```
SQL> set serveroutput on;
SQL> declare
2  a number:=1;
3  begin
4  for a in reverse 1..5
5  loop
6  dbms_output.put_line (a);
7  end loop;
8  end;
9  /
5
4
3
2
1
PL/SQL procedure successfully completed.
```

TO CALCULATE AREA OF CIRCLE

```
SQL> set serveroutput on;
SQL> declare
2    pi constant number(4,2):=3.14;
3    a number(20);
4    r number(20);
5    begin
6    r:=&r;
7    a:= pi* power(r,2);
8    dbms_output.put_line (' The area of circle is ' || a);
9    end;
10  /
Enter value for r: 2
old   6: r:=&r; new
6: r:=2;
The area of circle is 13
PL/SQL procedure successfully completed.
```

TO CREATE SACCOUNT TABLE

```
SQL> create table saccount  ( accno number(5), name varchar2(20), bal number(10));
Table created.
SQL> insert into saccount values ( 1,'mala',20000); 1
row created.
SQL> insert into saccount values (2,'kala',30000); 1
row created.
SQL> select * from saccount;

   ACCNO NAME                 BAL
--------- -------------------- ---------
1 mala                  20000
2 kala                 30000
SQL> set serveroutput on;
SQL> declare
2    a_bal number(7);
3    a_no varchar2(20);
4    debit number(7):=2000;
5    minamt number(7):=500;
6    begin
7    a_no:=&a_no;
8    select bal into a_bal from saccount where accno= a_no;
9    a_bal:= a_bal-debit;
10  if (a_bal > minamt) then
11  update  saccount  set bal=bal-debit where accno=a_no;
12  end if;
13  end;
 14
 15  /
Enter value for a_no: 1
old    7: a_no:=&a_no;
new   7: a_no:=1;

PL/SQL procedure successfully completed.
SQL> select * from saccount;
  ACCNO NAME                 BAL
--------- -------------------- ---------
1 mala                  18000
2 kala                 30000
```

TO CREATE TABLE SROUTES

```
SQL> create table sroutes ( rno number(5), origin varchar2(20), destination varchar2(20), fare
numbe
r(10), distance number(10)); Table
created.
```

```
SQL> insert into sroutes values ( 2, 'chennai', 'dindugal', 400,230); 1
row created.
SQL> insert into sroutes values ( 3, 'chennai', 'madurai', 250,300); 1
row created.
SQL> insert into sroutes values ( 6, 'thanjavur', 'palani', 350,370); 1
row created.
SQL> select * from sroutes;

     RNO ORIGIN             DESTINATION             FARE  DISTANCE
--------- -------------------- -------------------- --------- ---------
       2 chennai              dindugal                 400       230
3 chennai              madurai                  250       300
       6 thanjavur            palani                   350       370
SQL> set serveroutput on;

SQL> declare
2    route sroutes.rno % type;
3    fares sroutes.fare % type;
4    dist sroutes.distance % type;
5    begin
6    route:=&route;
7    select fare, distance into fares , dist from sroutes where rno=route;
8    if (dist < 250) then
9    update sroutes set fare=300 where rno=route;
10  else if dist between 250 and 370 then
11  update sroutes set fare=400 where rno=route;
12  else if (dist > 400) then
13  dbms_output.put_line('Sorry');
14  end if;
15  end if;
16  end if;
17  end;
18  /
Enter value for route: 3 old
6: route:=&route;
new   6: route:=3;

PL/SQL procedure successfully completed.

SQL> select * from sroutes;

     RNO ORIGIN             DESTINATION             FARE  DISTANCE
--------- -------------------- -------------------- --------- ---------
       2 chennai              dindugal                 400       230
3 chennai              madurai                  400       300
```

6 thanjavur palani 350 370

TO CREATE SCA LCULATE TABLE

```
SQL> create table scalculate ( radius number(3), area number(5,2)); Table
created.
SQL> desc scalculate;
 Name                                      Null?    Type  ----------------------------------------
----------- -------- -----------------------------------
 RADIUS                                             NUMBER(3)
 AREA                                               NUMBER(5,2)

SQL> set serveroutput on;

SQL> declare
2    pi constant number(4,2):=3.14;
3    area number(5,2);
4    radius number(3);
5    begin
6    radius:=3;
7    while (radius <=7)
8    loop
9    area:= pi* power(radius,2);
10   insert into scalculate values (radius,area);
11   radius:=radius+1;
12   end loop;
13   end;
14   /

PL/SQL procedure successfully completed.

SQL> select * from scalculate;
  RADIUS     AREA
--------- ---------
         3     28.26
         4     50.24
         5     78.5
         6     113.04
         7     153.86
```

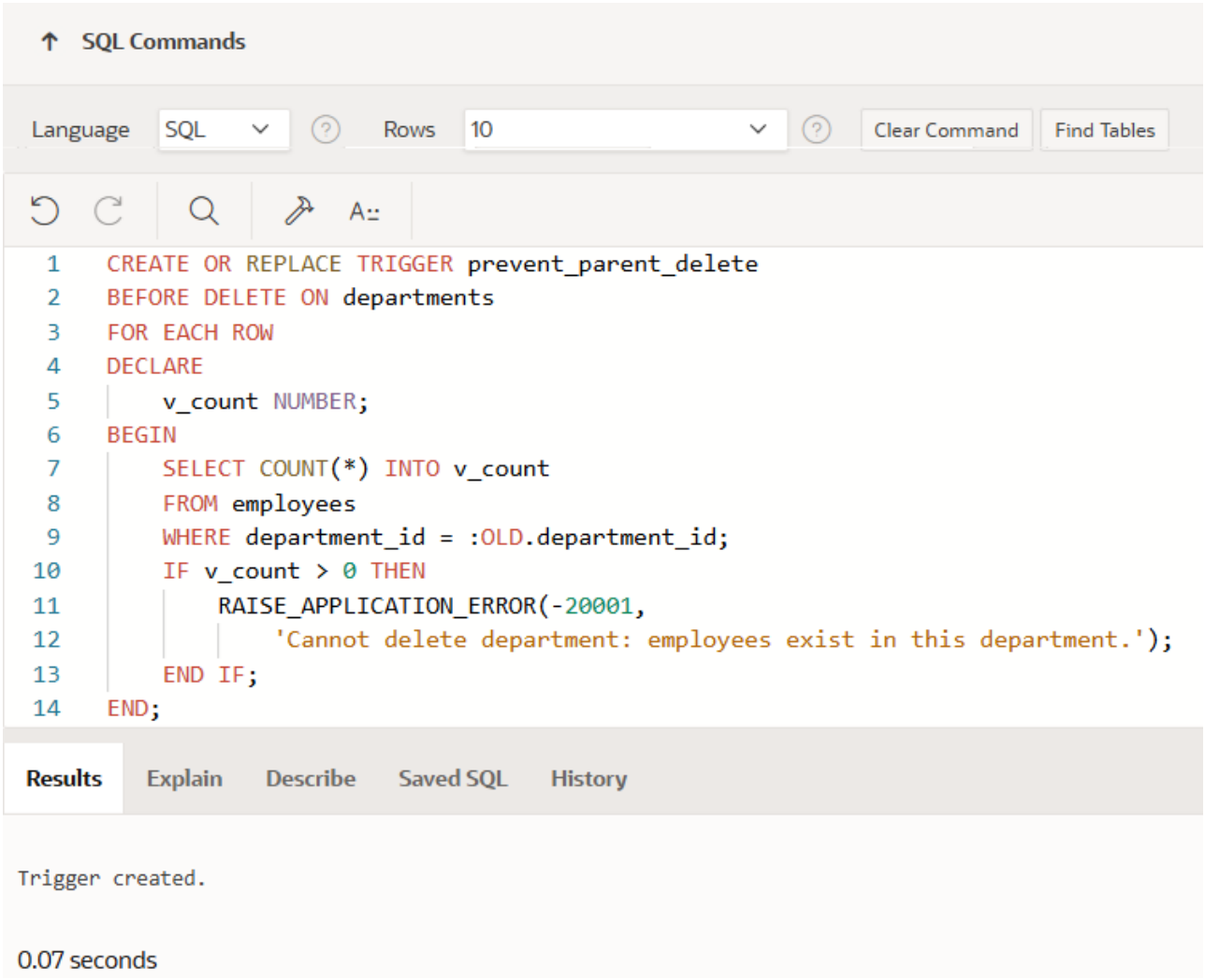
TO CALCULATE FACTORIAL OF A GIVEN NUMBER

```
SQL> set serveroutput on;
SQL> declare
2    f number(4):=1;
3    i number(4);
4    begin
```

```
5    i:=&i;
6    while(i>=1)
7    loop
8    f:=f*i;
9    i:=i-1;
10   end loop;
11   dbms_output.put_line('The value is ' || f);
12   end;
13   /
Enter value for i: 5
old   5: i:=&i; new
5: i:=5; The value
is 120

PL/SQL procedure successfully completed.
```

Program 1

Write a code in PL/SQL to develop a trigger that enforces referential integrity by preventing the deletion of a parent record if child records exist.



Program 2

Write a code in PL/SQL to create a trigger that checks for duplicate values in a specific column and raises an exception if found.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1  CREATE OR REPLACE TRIGGER check_duplicate_rollno
2  BEFORE INSERT OR UPDATE ON students
3  FOR EACH ROW
4  DECLARE
5      v_count NUMBER;
6  BEGIN
7      SELECT COUNT(*) INTO v_count
8      FROM students
9      WHERE roll_no = :NEW.roll_no;
10     IF v_count > 0 THEN
11         RAISE_APPLICATION_ERROR(-20002, 'Duplicate roll number not allowed.');
12     END IF;
13 END;
```

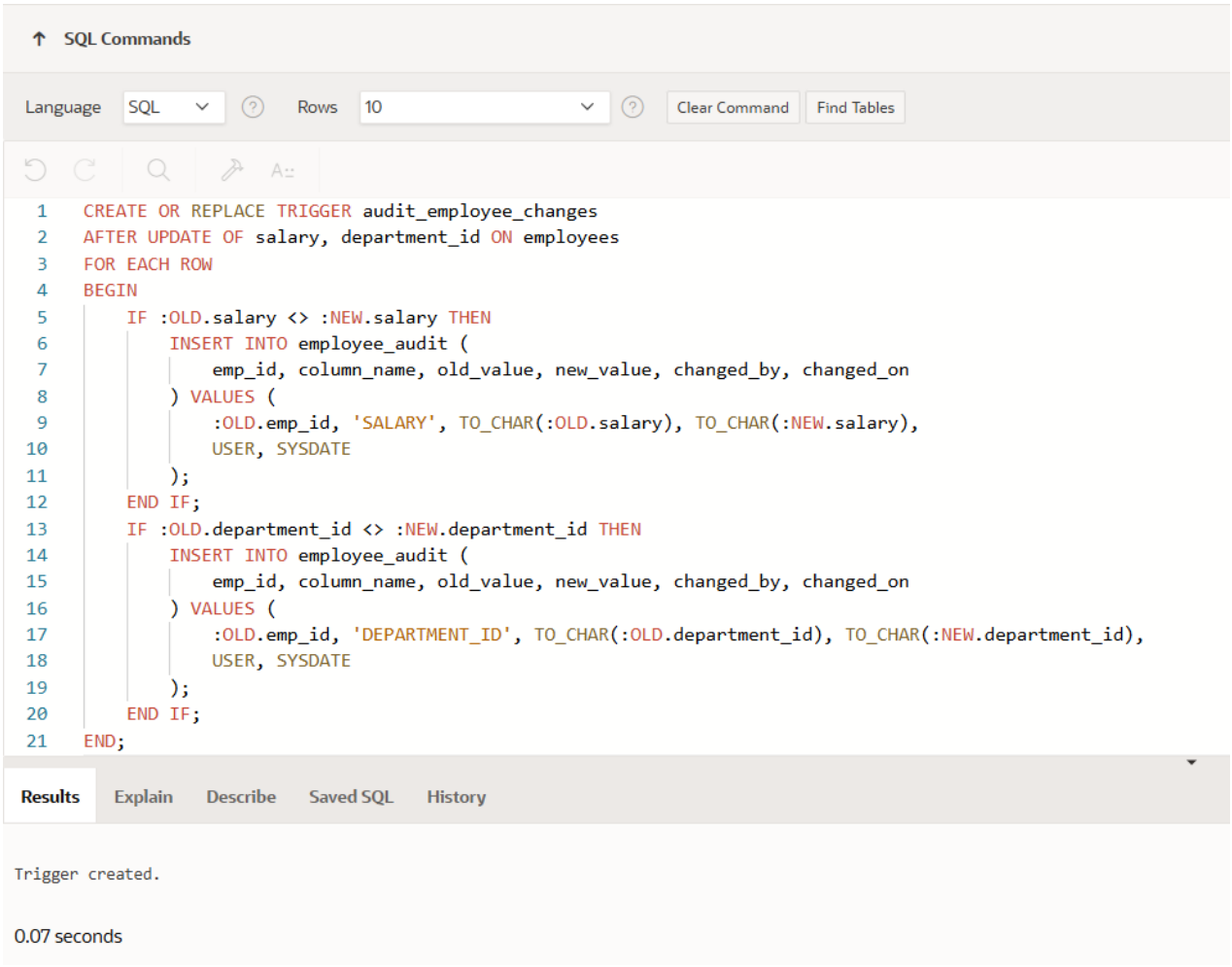
Results Explain Describe Saved SQL History

```
Trigger created.
```

0.08 seconds

Program 3

Write a code in PL/SQL to design a trigger that captures changes made to specific columns and logs them in an audit table.



Program 4

Write a code in PL/SQL to create a trigger that restricts the insertion of new rows if the total of a column's values exceeds a certain threshold.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1  CREATE OR REPLACE TRIGGER limit_total_balance
2  BEFORE INSERT ON accounts
3  FOR EACH ROW
4  DECLARE
5      v_total NUMBER;
6      v_threshold CONSTANT NUMBER := 1000000;
7  BEGIN
8      SELECT NVL(SUM(balance), 0) INTO v_total FROM accounts;
9      IF v_total + :NEW.balance > v_threshold THEN
10         RAISE_APPLICATION_ERROR(-20003,
11             'Cannot insert: Total balance would exceed the allowed limit of 1,000,000.');
12     END IF;
13 END;
```

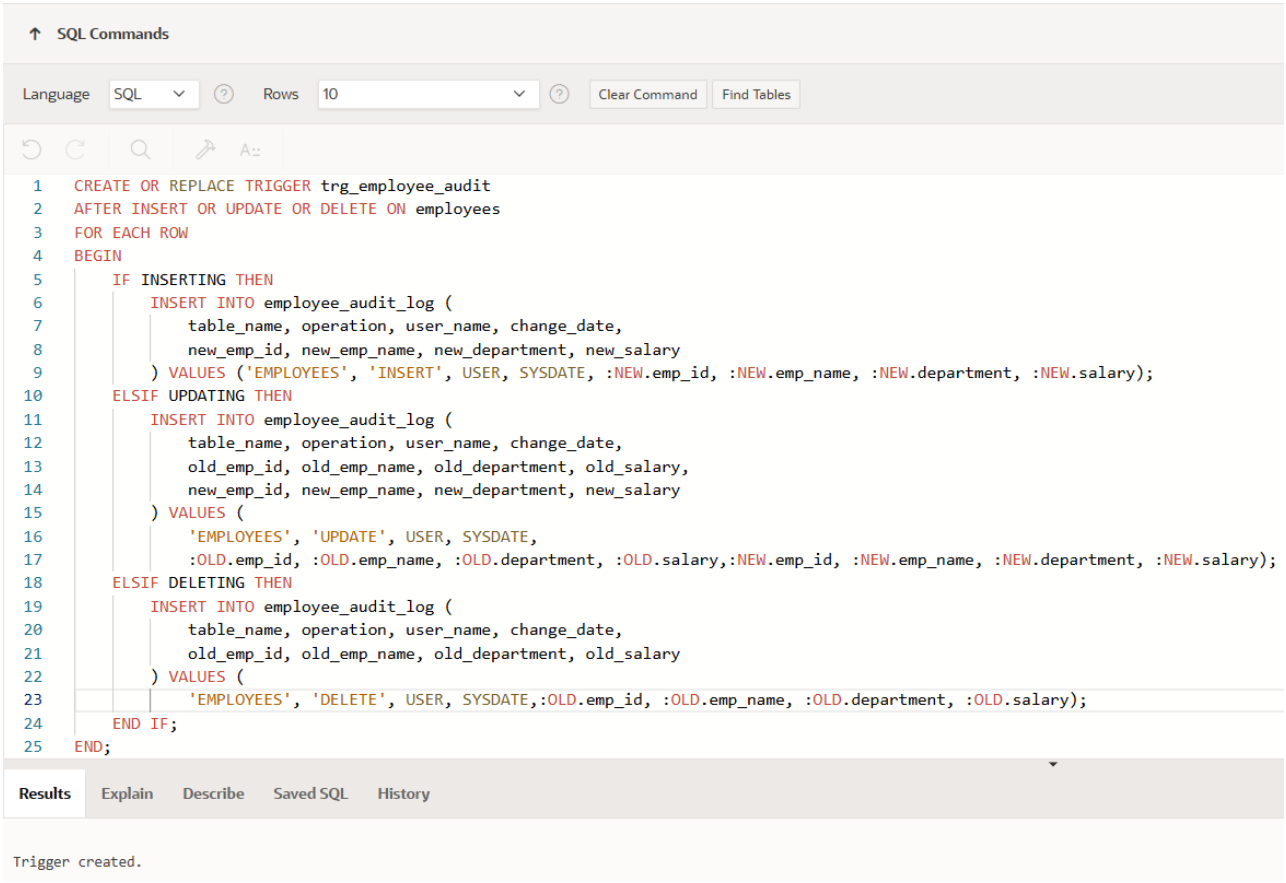
Results Explain Describe Saved SQL History

```
Trigger created.
```

0.07 seconds

Program 5

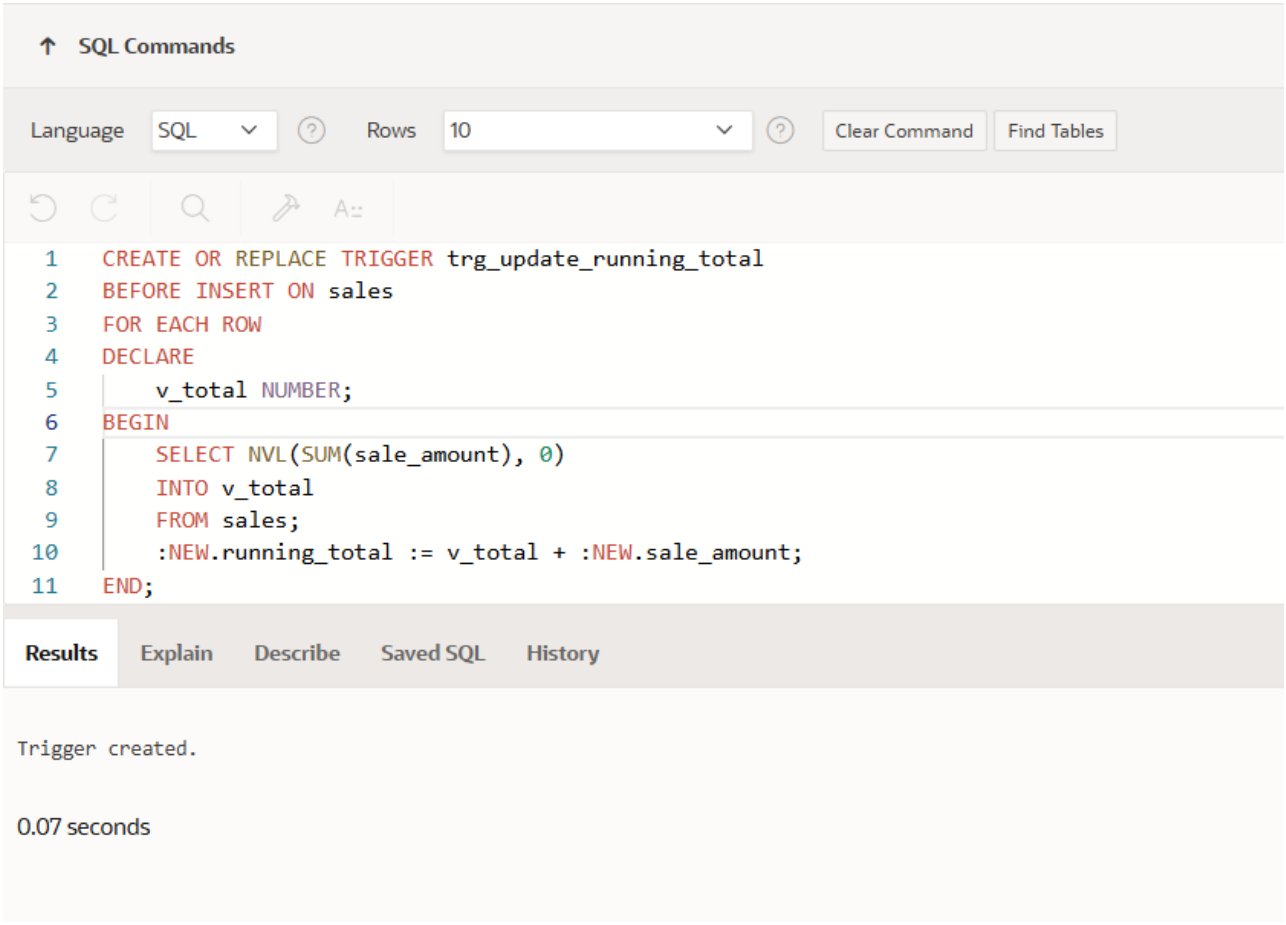
Write a code in PL/SQL to implement a trigger that records user activity (inserts, updates, deletes) in an audit log for a given set of tables.




```
CREATE OR REPLACE TRIGGER trg_employee_audit
AFTER INSERT OR UPDATE OR DELETE ON employees
FOR EACH ROW
BEGIN
    IF INSERTING THEN
        INSERT INTO employee_audit_log (
            table_name, operation, user_name, change_date,
            new_emp_id, new_emp_name, new_department, new_salary
        ) VALUES ('EMPLOYEES', 'INSERT', USER, SYSDATE, :NEW.emp_id, :NEW.emp_name, :NEW.department, :NEW.salary);
    ELSIF UPDATING THEN
        INSERT INTO employee_audit_log (
            table_name, operation, user_name, change_date,
            old_emp_id, old_emp_name, old_department, old_salary,
            new_emp_id, new_emp_name, new_department, new_salary
        ) VALUES (
            'EMPLOYEES', 'UPDATE', USER, SYSDATE,
            :OLD.emp_id, :OLD.emp_name, :OLD.department, :OLD.salary,:NEW.emp_id, :NEW.emp_name, :NEW.department, :NEW.salary);
    ELSIF DELETING THEN
        INSERT INTO employee_audit_log (
            table_name, operation, user_name, change_date,
            old_emp_id, old_emp_name, old_department, old_salary
        ) VALUES (
            'EMPLOYEES', 'DELETE', USER, SYSDATE,:OLD.emp_id, :OLD.emp_name, :OLD.department, :OLD.salary);
    END IF;
END;
```

Program 7

Write a code in PL/SQL to implement a trigger that automatically calculates and updates a running total column for a table whenever new rows are inserted.



Program 8

Write a code in PL/SQL to create a trigger that validates the availability of items before allowing an order to be placed, considering stock levels and pending orders.

SQL Commands

Language SQL Rows 10 Clear Command Find Tables

```
1  CREATE OR REPLACE TRIGGER trg_validate_item_availability
2  BEFORE INSERT ON orders
3  FOR EACH ROW
4  DECLARE
5      v_stock NUMBER;
6      v_pending NUMBER;
7  BEGIN
8      SELECT stock_qty INTO v_stock
9      FROM items
10     WHERE item_id = :NEW.item_id;
11     SELECT NVL(SUM(order_qty), 0)
12     INTO v_pending
13     FROM orders
14     WHERE item_id = :NEW.item_id
15       AND status = 'PENDING';
16     IF :NEW.order_qty > (v_stock - v_pending) THEN
17         RAISE_APPLICATION_ERROR(-20004,
18             'Order cannot be placed: insufficient stock available.');
19     END IF;
20 END;
```

Results Explain Describe Saved SQL History

```
Trigger created.
```

0.07 seconds

Evaluation Procedure	Marks awarded
PL/SQL Procedure(5)	
Program/Execution (5)	
Viva(5)	
Total (15)	
Faculty Signature	