**The tutorial exercises start on page 16**. The material leading up to page 16 is an introduction to SQL. Please read through it and then do the exercises.

These are the tables you will be using in the following tutorials:

**EMP**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EMPNO  - - - - - -  7369  7499  7521  7566  7654  7698  7782  7788  7839  7844  7876  7900  7902  7934 | ENAME  - - - - - - -  SMITH  ALLEN  WARD  JONES  MARTIN  BLAKE  CLARK  SCOTT  KING  TURNER  ADAMS  JAMES  FORD  MILLER | JOB  - - - - - - - - - -  CLERK  SALESMAN  SALESMAN  MANAGER  SALESMAN  MANAGER  MANAGER  ANALYST  PRESIDENT  SALESMAN  CLERK  CLERK  ANALYST  CLERK | MGR  - - - -  7902  7698  7698  7839  7698  7839  7839  7566  7698  7788  7698  7566  7782 | HIREDATE  - - - - - - - -  13-JUN-13  15-AUG-13  26-MAR-14  31-OCT-13  05-DEC-13  11-JUN-14  14-MAY-14  05-MAR-14  09-JUL-14  04-JUN-14  04-JUN-14  23-JUL-14  05-DEC-13  21-NOV-13 | SAL  - - - -  800  1600  1250  2975  1250  2850  2450  3000  5000  1500  1100  950  3000  1300 | COMM  - - - - - -  300  500  1400  0 | DEPTNO  - - - - - - -  20  30  30  20  30  30  10  20  10  30  20  30  20  10 |

**DEPT**  **SALGRADE**

|  |  |  |
| --- | --- | --- |
| DEPTNO  - - - - - - -  10  20  30  40 | DNAME  - - - - - - - - - - - -  ACCOUNTING  RESEARCH  SALES  OPERATIONS | LOC  - - - - - - - - - -  NEW YORK  DALLAS  CHICAGO  BOSTON |

|  |  |  |
| --- | --- | --- |
| GRADE  - - - - - -  1  2  3  4  5 | LOSAL  - - - - - -  700  1201  1401  2001  3001 | HISAL  - - - - -  1200  1400  2000  3000  9999 |

**Introduction to SQL**

**Please be aware that MS Access ‘Date’ outputs are formatted slightly differently ‘01/02/2004’ compared to Oracle ’01-FEB-04’**

**The SQL Command Set**

|  |  |
| --- | --- |
| **Command** | **Description** |
| SELECT | The most commonly used command; it is used to retrieve data from the database. It means "list". |
| INSERT  UPDATE  DELETE | These three commands are used to enter new rows, change existing rows, or remove unwanted rows from tables in the database respectively. They are known collectively as DML or Data Manipulation Language commands. |
| CREATE  ALTER  DROP | These three commands are used dynamically to set up, change and remove any data structure e. g. tables, views, indexes. They are known collectively as DDL or Data Definition Language commands. |

**NB.** There are more SQL commands, but this brief summary will do for now.

**Writing SQL Commands**

When writing SQL commands, remember these few rules and guidelines, in order to construct valid statements that are easy to read and edit:

1. SQL commands may be on one or many lines

2. Clauses are usually placed on separate lines

3. Tabulation can be used

4. Command words cannot be split

5. SQL commands are not *case sensitive* (unless indicated otherwise)

5. An SQL command is entered at the SQL prompt, and subsequent lines are numbered. This is called the *SQL buffer* and used with SQL+, not with SQL+ Worksheet

6. Only one statement can be current at any one time within the buffer, and can be run in a number of ways:

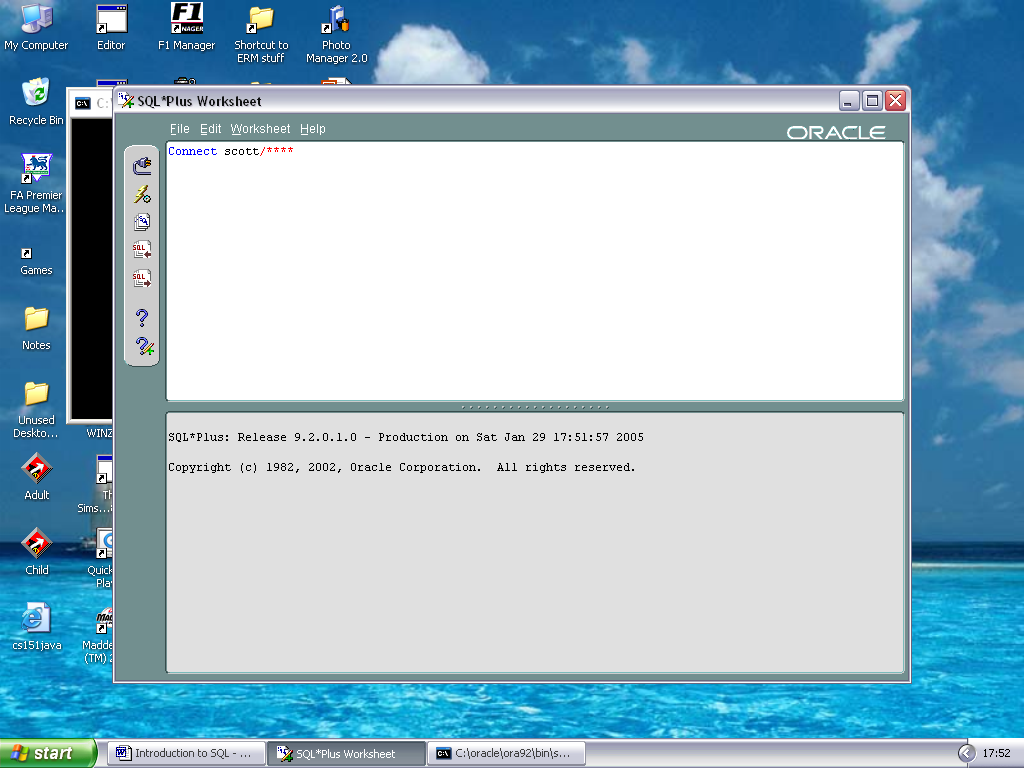
Place a semi-colon (;) at the end of the last clause

Place a ; or / on last line in the buffer

Place a / at SQL prompt

Issue R(un) command at SQL prompt

Or, if using SQL+ Worksheet, click on the execute button



Therefore, any one of the following statements is valid:

SELECT \* FROM EMP;

SELECT

\*

FROM

EMP

;

SELECT \*

FROM EMP;

**Simple SELECT Statements**

We shall now proceed to explain how straightforward queries may be made on a single table.

The basic query block of the SELECT statement is outlined, including the following:

ability to perform *arithmetic calculations*,

handle *null values* correctly,

give alternative *column headings* ,

*concatenate* columns,

include *literals* ,

and *sort rows* .

The WHERE clause is also explained as the means of restricting the rows returned by a query according to specified conditions.

**The Basic QUERY Block**

The SELECT statement retrieves and lists information from the database, implementing all the operators of **Relational Algebra**.

In its simplest form it must include:

1. a SELECT clause, which lists the columns to be displayed

(i.e. it is essentially a PROJECTION);

2. a FROM clause, which specifies the table involved.

To list all department numbers, employee names and manager numbers in the EMP table you may enter the following:

SELECT DEPTNO, ENAME, MGR

FROM EMP;

Note that the column names are separated by a comma. This statement would produce the following result.

|  |  |  |
| --- | --- | --- |
| DEPTNO  - - - - - - -  20  30  30  20  30  30  10  20  10  30  20  30  20  10 | ENAME  - - - - - - -  SMITH  ALLEN  WARD  JONES  MARTIN  BLAKE  CLARK  SCOTT  KING  TURNER  ADAMS  JAMES  FORD  MILLER | MGR  - - - -  7902  7698  7698  7839  7698  7839  7839  7566  7698  7788  7698  7566  7782 |

It is also possible to list all columns from a table, by specifying an \* (asterisk) after the SELECT command word. In the example of the EMP table, for instance, such a command would look like this:

SELECT \*

FROM EMP;

Such a command would produce the full complement of columns as shown below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EMPNO  - - - - - -  7369  7499  7521  7566  7654  7698  7782  7788  7839  7844  7876  7900  7902  7934 | ENAME  - - - - - - -  SMITH  ALLEN  WARD  JONES  MARTIN  BLAKE  CLARK  SCOTT  KING  TURNER  ADAMS  JAMES  FORD  MILLER | JOB  - - - - - - - - - -  CLERK  SALESMAN  SALESMAN  MANAGER  SALESMAN  MANAGER  MANAGER  ANALYST  PRESIDENT  SALESMAN  CLERK  CLERK  ANALYST  CLERK | MGR  - - - -  7902  7698  7698  7839  7698  7839  7839  7566  7698  7788  7698  7566  7782 | HIREDATE  - - - - - - - -  13-JUN-13  15-AUG-13  26-MAR-14  31-OCT-13  05-DEC-13  11-JUN-14  14-MAY-14  05-MAR-14  09-JUL-14  04-JUN-14  04-JUN-14  23-JUL-14  05-DEC-13  21-NOV-13 | SAL  - - - -  800  1600  1250  2975  1250  2850  2450  3000  5000  1500  1100  950  3000  1300 | COMM  - - - - - -  300  500  1400  0 | DEPTNO  - - - - - - -  20  30  30  20  30  30  10  20  10  30  20  30  20  10 |

**The WHERE Clause**

The WHERE clause corresponds to the *Restriction* operator of Relational Algebra.

It contains a *condition* which rows must meet in order to be selected and displayed.

The WHERE clause, if used, *must follow the FROM clause*:

SELECT *columns*

FROM *table*

WHERE *certain conditions are met* ;

The WHERE clause may compare values in columns, literal values, arithmetic expressions or functions.

The WHERE clause expects 3 elements:

1. A column name

2. A comparison operator

3. A column name, constant or list of values.

Comparison Operators are used on the WHERE clause and can be divided into two categories, *Logical* and *SQL*.

**Logical Operators**

The following standard logical operators will test the outlined conditions:

**Operator Meaning**

* equal to
* greater than

>= greater than or equal to

* less than

<= less than or equal to

**Character Strings and Dates in the WHERE clause**

ORACLE columns may be: *Character, Number* or *Date*.

Character strings and dates in the WHERE clause must be enclosed in single quotation marks ('). Character strings must match case with the column value unless modified by a function (see later under "Character Functions"). **Be careful if copy/paste is used from this Word document as the apostrophes (‘) do not always paste across as the correct character. Better to manually type in.**

To list the names, numbers, job and departments of all clerks, enter:

SELECT ENAME, EMPNO, JOB, DEPTNO

FROM EMP

WHERE JOB = 'CLERK';

|  |  |  |  |
| --- | --- | --- | --- |
| ENAME  - - - - - - -  SMITH  ADAMS  JAMES  MILLER | EMPNO  - - - - - -  7369  7876  7900  7934 | JOB  - - - - - -  CLERK  CLERK  CLERK  CLERK | DEPTNO  - - - - - - -  20  20  30  10 |

To find all department names with department numbers greater than 20, enter:

SELECT DNAME, DEPTNO

FROM DEPT

WHERE DEPTNO > 20;

|  |  |
| --- | --- |
| DNAME  - - - - - - - -  SALES OPERATIONS | DEPTNO  - - - - - - - -  30  40 |

**Comparing One Column with Another in the Same Row**

You can compare a column with another column in the same row, as well as with a constant value.

For example, suppose you want to find those employees whose commission is greater than their salary, enter:

SELECT ENAME, SAL, COMM

FROM EMP

WHERE COMM > SAL;

|  |  |  |
| --- | --- | --- |
| ENAME  - - - - - - - -  MARTIN | SAL  -- - - -  1250 | COMM  - - - - - -  1400 |

**SQL Operators**

There are four SQL operators which operate with all data types:

**Operator Meaning**

BETWEEN...AND... between two values (inclusive)

IN (list) match any of a list of values

LIKE match a character pattern

IS NULL is a null value

**The BETWEEN Operator**

Tests for values between, and inclusive of, low and high range.

Suppose we want to see those employees whose salary is between 1000 and 2000:

SELECT ENAME, SAL

FROM EMP

WHERE SAL BETWEEN 1000 AND 2000;

|  |  |
| --- | --- |
| ENAME  - - - - - - -  ALLEN  WARD  MARTIN  TURNER  ADAMS  MILLER | SAL  - - - - - - - -  1600  1250  1250  1500  1100  1300 |

Note that values specified are inclusive and the lower limit must be specified first.

**The IN Operator**

Tests for values in a specified list.

To find all employees who have a given MGR number, enter:

SELECT EMPNO, ENAME, SAL, MGR

FROM EMP

WHERE MGR IN (7902, 7566, 7788);

|  |  |  |  |
| --- | --- | --- | --- |
| EMPNO  - - - - - - -  7369  7788  7876  7902 | ENAME  - - - - - - -  SMITH  SCOTT  ADAMS  FORD | SAL  - - - -  800  3000  1100  3000 | MGR  - - - - -  7902  7566  7788  7566 |

If characters or dates are used in the list they must be enclosed in single quotes (' ').

**The LIKE Operator**

Sometimes you may not know the exact value to search for. Using the LIKE operator it is possible to select rows that match a character pattern. The character pattern matching operation may be referred to as a 'wild-card' search. Two symbols can be used to construct the search string.

**Symbol Represents**

* any sequence of zero or more characters (Access uses an asterisk \*)
* any single character (Access uses a question mark ?)

For example, to list all employees whose names start with an S, enter:

SELECT ENAME

FROM EMP

WHERE ENAME LIKE 'S%';

|  |
| --- |
| ENAME  - - - - - - -  SMITH  SCOTT |

To list all employees who have a name exactly 4 characters in length, enter:

SELECT ENAME

FROM EMP

WHERE ENAME LIKE '\_ \_ \_ \_';

|  |
| --- |
| ENAME  - - - - - - -  WARD  KING  FORD |

Use \_ to search for a specific number of characters.

The % and \_ may be used in any combination with literal characters.

**IS NULL Operator**

The IS NULL operator specifically tests for values that are NULL.

So, to find all employees who have no manager, you are testing for a NULL value :

SELECT ENAME, MGR

FROM EMP

WHERE MGR IS NULL;

|  |  |
| --- | --- |
| ENAME  - - - - - - -  KING | MGR  - - - - - |

**Negating Expressions**

The following operators are negative tests:

**Operator Description**

! = not equal to

< > not equal to

**SQL Operators**

**Operator Description**

NOT BETWEEN not between two given values

NOT IN not in given list of values

NOT LIKE not like string

IS NOT NULL is not a null value

To find all employees whose salary is not between a range, enter:

SELECT ENAME, SAL

FROM EMP

WHERE SAL NOT BETWEEN 1000 AND 2000;

|  |  |
| --- | --- |
| ENAME  - - - - - - - -  SMITH  JONES  BLAKE  CLARK  SCOTT  KING  JAMES  FORD | SAL  - - - -  800  2975  2850  2450  3000  5000  950  3000 |

To find those employees whose job does not start with M, enter:

SELECT ENAME, JOB

FROM EMP

WHERE JOB NOT LIKE ' M% ';

|  |  |
| --- | --- |
| ENAME  - - - - - - -  SMITH  ALLEN  WARD  MARTIN  SCOTT  KING  TURNER  ADAMS  JAMES  FORD  MILLER | JOB  - - - - - - - - - -  CLERK  SALESMAN  SALESMAN  SALESMAN  ANALYST  PRESIDENT  SALESMAN  CLERK  CLERK  ANALYST  CLERK |

To find all employees who have a manager (MGR), enter:

SELECT ENAME, MGR

FROM EMP

WHERE MGR IS NOT NULL;

|  |  |
| --- | --- |
| ENAME  - - - - - - -  SMITH  ALLEN  WARD  JONES  MARTIN  BLAKE  CLARK  SCOTT  TURNER  ADAMS  JAMES  FORD  MILLER | MGR  - - - -  7902  7698  7698  7839  7698  7839  7839  7566  7698  7788  7698  7566  7782 |

**Querying Data with Multiple Conditions**

The AND and OR operators may be used to make compound logical expressions.

The AND predicate will expect *both* conditions to be 'true'; whereas the OR predicate will expect *either* condition to be 'true'.

In the following two examples the conditions are the same, the predicate is different. See how the result is dramatically changed.

To find all clerks who earn between 1000 and 2000, enter:

SELECT EMPNO, ENAME, JOB, SAL

FROM EMP

WHERE SAL BETWEEN 1000 AND 2000

AND JOB = 'CLERK';

|  |  |  |  |
| --- | --- | --- | --- |
| EMPNO  - - - - - - -  7876  7934 | ENAME  - - - - - - -  ADAMS  MILLER | JOB  - - - -  CLERK  CLERK | SAL  - - - -  1100  1300 |

To find all employees who are either clerks and/or all employees who earn between 1000 and 2000, enter:

SELECT EMPNO, ENAME, JOB, SAL

FROM EMP

WHERE SAL BETWEEN 1000 AND 2000

OR JOB = 'CLERK';

|  |  |  |  |
| --- | --- | --- | --- |
| EMPNO | ENAME | JOB | SAL |
| - - - - -- - | - - -- -- - | - - -- - | - - - - |
| 7369 | SMITH | CLERK | 800 |
| 7499 | ALLEN | SALESMAN | 1600 |
| 7521 | WARD | SALESMAN | 1250 |
| 7654 | MARTIN | SALESMAN | 1250 |
| 7844 | TURNER | SALESMAN | 1500 |
| 7876 | ADAMS | CLERK | 1100 |
| 7900 | JAMES | CLERK | 950 |
| 7934 | MILLER | CLERK | 1300 |

You may combine AND and OR in the same logical expression. When AND and OR appear in the same WHERE clause, all the ANDs are performed first then all the ORs are performed. It is said that AND has a higher precedence than OR. Hence the following SQL statement returns all managers with salaries over 1500, and all salesmen:

SELECT EMPNO, ENAME, JOB, SAL, DEPTNO

FROM EMP

WHERE SAL > 1500

AND JOB = 'MANAGER'

OR JOB = 'SALESMAN';

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EMPNO  - - - - - -  7499  7521  7566  7654  7698  7782  7844 | ENAME  - - - - - - -  ALLEN  WARD  JONES  MARTIN  BLAKE  CLARK  TURNER | JOB  - - - - - - - - - -  SALESMAN  SALESMAN  MANAGER  SALESMAN  MANAGER  MANAGER  SALESMAN | SAL  - - - -  1600  1250  2975  1250  2850  2450  1500 | DEPTNO  - - - - - - -  30  30  20  30  30  10  30 |

If you wanted to select all managers and salesmen with salaries over 1500 then you would specify the order by placing brackets as below:

SELECT EMPNO, ENAME, JOB, SAL, DEPTNO

FROM EMP

WHERE SAL > 1500

AND (JOB = 'MANAGER'

OR JOB = 'SALESMAN');

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EMPNO  - - - - - -  7499  7566  7698  7782 | ENAME  - - - - - - -  ALLEN  JONES  BLAKE  CLARK | JOB  - - - - - - - - - -  SALESMAN  MANAGER  MANAGER  MANAGER | SAL  - - - -  1600  2975  2850  2450 | DEPTNO  - - - - - - -  30  20  30  10 |

**Operator Precedence**

All operators are arranged in a hierarchy that determines their precedence. In an expression, operations are performed in order of their precedence, from highest to lowest. Where operators of equal precedence are used next to each other, they are performed from left to right.

1. All of the comparison and SQL operators have equal precedence:

=, ! =, <, >, <=, >=, BETWEEN...AND, IN, LIKE, IS NULL.

2. NOT (to reverse a logical expression's result e.g. WHERE NOT (SAL = 0)).

3. AND

4. OR

Whenever you are in doubt about which of two operations will be performed first when an expression is evaluated, feel free to use parentheses to clarify your meaning and ensure that SQL does what you intended.

Suppose you wanted to find all the managers, in any department, and all the clerks in Department 10 only:

SELECT \*

FROM EMP

WHERE JOB = 'MANAGER'

OR (JOB = 'CLERK' AND DEPTNO = 10);

The above parentheses are unnecessary, since AND has a higher precedence than OR, but they clarify the meaning of the expression.

**SELECT Summary**

We have now met the following clauses in the SELECT command:

SELECT FROM *table*

WHERE *condition (s)*

Let us again remind ourselves of the meaning of the clauses we have covered:

**Clause Meaning**

SELECT selects at least one column

* denotes all columns

FROM *Table* denotes the *table* where the columns originate

WHERE restricts query to rows that meet a *condition*. It may contain column values,

expressions and literals

AND/OR may be used to construct more complex conditions, AND takes priority over OR

( ) can be used to force priority

Clauses may be entered on different lines in the buffer and tabulation used for clarity and ease of editing.

**TUTORIAL EXCERCISES**

The following exercise is intended to introduce, in a workshop setting, all topics covered in the lecture sessions on Introduction to SQL. After each question, a sample of the expected output for a correct solution is given in each case as a guideline.

**Please be aware that MS Access ‘Date’ outputs are formatted slightly differently ‘01/02/2004’ compared to Oracle ’01-FEB-04’**

**Workshop**

1. Select all information from the SALGRADE table.

|  |  |  |
| --- | --- | --- |
| GRADE  - - - - - -  1  2  3  4  5 | LOSAL  - - - - - -  700  1201  1401  2001  3001 | HISAL  - - - - -  1200  1400  2000  3000  9999 |

2. Select all information from the EMP table.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EMPNO  - - - - - -  7369  7499  7521  7566  7654  7698  7782  7788  7839  7844  7876  7900  7902  7934 | ENAME  - - - - - - -  SMITH  ALLEN  WARD  JONES  MARTIN  BLAKE  CLARK  SCOTT  KING  TURNER  ADAMS  JAMES  FORD  MILLER | JOB  - - - - - - - - - -  CLERK  SALESMAN  SALESMAN  MANAGER  SALESMAN  MANAGER  MANAGER  ANALYST  PRESIDENT  SALESMAN  CLERK  CLERK  ANALYST  CLERK | MGR  - - - -  7902  7698  7698  7839  7698  7839  7839  7566  7698  7788  7698  7566  7782 | HIREDATE  - - - - - - - -  13-JUN-13  15-AUG-13  26-MAR-14  31-OCT-13  05-DEC-13  11-JUN-14  14-MAY-14  05-MAR-14  09-JUL-14  04-JUN-14  04-JUN-14  23-JUL-14  05-DEC-13  21-NOV-13 | SAL  - - - -  800  1600  1250  2975  1250  2850  2450  3000  5000  1500  1100  950  3000  1300 | COMM  - - - - - -  300  500  1400  0 | DEPTNO  - - - - - - -  20  30  30  20  30  30  10  20  10  30  20  30  20  10 |

3. List all employees who have a salary between 1000 and 2000.

|  |  |  |
| --- | --- | --- |
| ENAME  - - - - - - -  ALLEN  WARD  MARTIN  TURNER  ADAMS  MILLER | DEPTNO  - -- - - - - - -  30  30  30  30  20  10 | SAL  - - - - - - -  1600  1250  1250  1500  1100  1300 |

4. List the names and jobs of all clerks in department 20.

|  |  |
| --- | --- |
| ENAME  - - - - - - - -  SMITH  ADAMS | JOB  **- - - - - - -**  CLERK  CLERK |

5. Display all employees’ names which have TH or LL in them.

|  |
| --- |
| ENAME  - - - - - - - -  SMITH  ALLEN  MILLER |

6. Display name, job and salary for all employees who have a manager.

|  |  |  |
| --- | --- | --- |
| ENAME  - - - - - - -  SMITH  ALLEN  WARD  JONES  MARTIN  BLAKE  CLARK  SCOTT  TURNER  ADAMS  JAMES  FORD  MILLER | JOB  - - - - - - - - - -  CLERK  SALESMAN  SALESMAN  MANAGER  SALESMAN  MANAGER  MANAGER  ANALYST  SALESMAN  CLERK  CLERK  ANALYST  CLERK | SAL  - - - -  800  1600  1250  2975  1250  2850  2450  3000  1500  1100  950  3000  1300 |

7. Display all employees who were hired during 2003.

|  |  |  |
| --- | --- | --- |
| ENAME  - - - - - - - -  SMITH  ALLEN  JONES  MARTIN  FORD  MILLER | DEPTNO  - - - - - - - -  20  30  20  30  20  10 | HIREDATE  - - - - - - - - - -  13-JUN-13  15-AUG-13  31-OCT-13  05-DEC-13  05-DEC-13  21-NOV-13 |

8. List all department numbers and names in department name order.

DEPTNO DNAME

- - - - - - - - - - - - - - - - - - -

10 ACCOUNTING

40 OPERATIONS

20 RESEARCH

30 SALES

---------- END -----------