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EDUCATION

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Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## SEPTEMBER 2026

# INFORMATION TECHNOLOGY P1

**MARKS:** **150**

**TIME:** **3 hours**

This question paper consists of 27 pages, including 2 data pages and 1 page for planning.

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## INSTRUCTIONS AND INFORMATION

1. This question paper is divided into FOUR sections. Candidates must answer ALL the questions in ALL FOUR sections.

2. Blank pages have been provided at the end of the question paper, which may be used for planning purposes.

3. The duration of this examination is three hours. Because of the nature of this examination, it is important to note that you will not be permitted to leave the examination room before the end of the examination session.

4. This question paper is set with programming terms that are specific to the Delphi programming language. The Delphi programming language must be used to answer the questions.

5. Make sure that you answer the questions according to the specifications that are given in each question. Marks will be awarded according to the set requirements.

6. Answer only what is asked in each question. For example, if the question does not ask for data validation, then no marks will be awarded for data validation.

7. Your programs must be coded in such a way that they will work with any data and not just the sample data supplied or any data extracts that appear in the question paper.

8. Routines, such as search, sort and selection, must be developed from first principles. You may NOT use the built-in features of the Delphi programming language for any of these routines.

9. All data structures must be defined by you, the programmer, unless the data structures are supplied.

10. You must save your work regularly on the disk/CD/DVD/flash disk you have been given, or on the disk space allocated to you for this examination session.

11. Make sure that your name and surname appears as a comment in every program that you code, as well as on every event indicated.

12. If required, print the programming code of all the programs/classes that you completed. Your name and surname must appear on all printouts. You will be given half an hour printing time after the examination session.

13. At the end of this examination session, you must hand in a disk/CD/DVD/ flash disk with all your work saved on it OR you must make sure that all your work has been saved on the disk space allocated to you for this examination session. Ensure that all files can be read.

14. Save your work regularly.

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15. The files that you need to complete this question paper have been provided to you on the disk/CD/DVD/flash disk or on the disk space allocated to you. The files are provided in the form of password-protected executable file.

Do the following:

- Double click on the password-protected executable file: **DataENGSEP2026.exe**
- Click on the 'Extract' button.
- Enter the following password: **SEP2026#LEDS**

Once extracted, the following list of files will be available in the folder **DataENGSEP2026**:

**Question 1:**

Question1_P.dpr
Question1_P.dproj
Question1_P_Icon.ico
Question1_U.dfm
Question1_U.pas

**Question 2:**

dbConnection_U.pas
LEDTechDB.mdb
LEDTechDB_Backup.mdb
Question2_P.dpr
Question2_P.dproj
Question2_P_Icon.ico
Question2_U.dfm
Question2_U.pas

**Question 3:**

LightingTemperatures.txt
Lighting_U.pas
Question3_P.dpr
Question3_P.dproj
Question3_P_Icon.ico
Question3_U.dfm
Question3_U.pas

**Question 4:**

Question4_P.dpr
Question4_P.dproj
Question4_P_Icon.ico
Question4_U.dfm
Question4_U.pas

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## QUESTION 1: GENERAL PROGRAMMING SKILLS

**SCENARIO: THE DEVELOPMENT OF LED TECHNOLOGY**

Light Emitting Diodes (LEDs) have transformed the way the world is illuminated. From household lighting and vehicle headlights to television screens and mobile devices, LEDs have become one of the most important technological developments of the modern era.

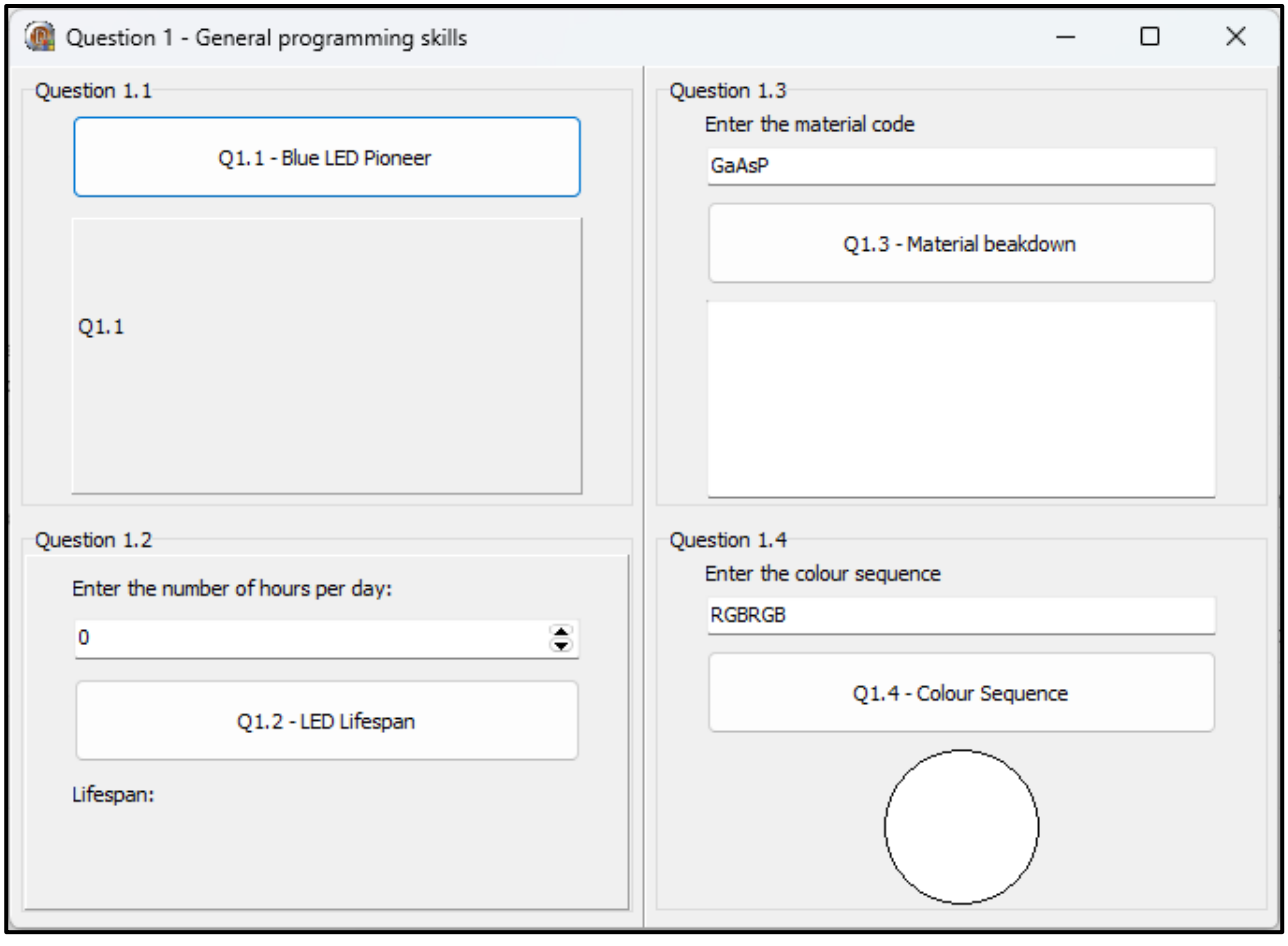
The development of LEDs occurred over many decades. Early LEDs could only produce red light, while green LEDs followed shortly thereafter. However, creating a practical blue LED proved to be an extremely difficult scientific challenge. For many years, researchers around the world attempted to develop a reliable blue LED without success.

The breakthrough eventually came through the use of Gallium Nitride (GaN), allowing scientists to produce bright blue LEDs. This discovery made it possible to create white LEDs and energy-efficient lighting systems that are now used throughout the world. The achievement was considered so significant that the scientists responsible for the development of blue LEDs were awarded the Nobel Prize in Physics.

Do the following:

- Open the incomplete program in the **Question 1** folder.
- Enter your name and surname as a comment in the first line of the **Question1_U.pas** file.
- Compile and execute the program. Currently the program has no functionality.

Example of graphical user interface (GUI):






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Complete the code for each section of QUESTION 1, as described in QUESTION 1.1 to QUESTION 1.4 that follow.

1.1 **Button [Q1.1 – Blue LED Pioneer]**

For many years, scientists attempted to develop a practical blue LED without success. In the early 1990s, Shuji Nakamura successfully developed a bright blue LED using Gallium Nitride (GaN), solving a problem that had challenged researchers for more than 20 years. His work later contributed to him being awarded the Nobel Prize in Physics.

Code the button **btnQ1_1** to do the following:

- Change the caption of **lblOutput** to:
  Shuji Nakamura
  Blue LED Pioneer
- Change the font size of **lblOutput** to 16.
- Set the font style of **lblOutput** to Bold.
- Change the font colour of **lblOutput** to blue.
- Change the panel colour to white.

Example of output: *You will not see colour in the printed version of the paper.*




(6)

1.2 **Button [Q1.2 – LED Lifespan]**

One of the major advantages of LED technology is its long lifespan. A typical LED can operate for approximately 50 000 hours before it needs to be replaced.

Code the button **btnQ1_2** to do the following:

- Retrieve the average number of hours the LED is used per day from the spin edit, **spnHoursPerDay**.
- Calculate the expected lifespan of the LED in years using the following formula:
  Years = 50 000 ÷ (HoursPerDay × 365).

- Display the result (rounded to TWO decimal places) in the label **lbl1_2** component in the following format:

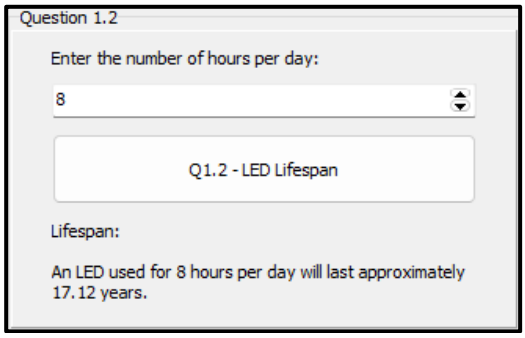
  "An LED used for 8 hours per day will last approximately 17.12 years."



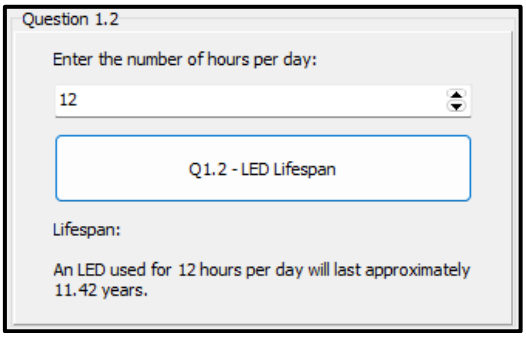
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Example of output:

8 hours per day




12 hours per day




(8)

1.3 **Button [Q1.3 – LED Material Analysis]**

Different LED colours are produced using different semiconductor materials. The table below shows the chemical symbols that may appear in the material code of an LED.

| SYMBOL | ELEMENT |
|---|---|
| Ga | Gallium |
| As | Arsenic |
| P | Phosphorus |
| N | Nitrogen |

Code the button **btnQ1_3** to do the following:

- Retrieve the material code entered in the edit box, **edtMaterial,** component.
- Analyse the material code and identify the chemical elements it contains.
- Display each element on a new line in the **red1_3** component.
- Count the number of elements identified.
- Determine the LED colour using the following material codes:

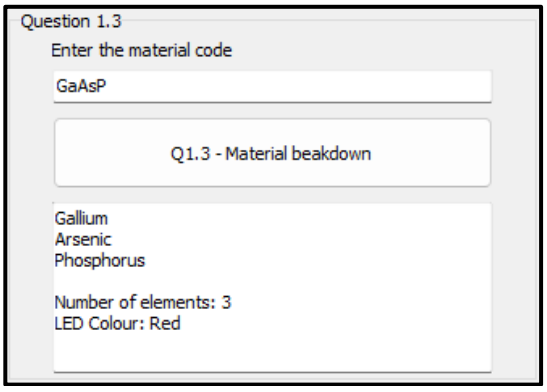
| MATERIAL CODE | LED COLOUR |
|---|---|
| GaAsP | Red |
| GaP | Green |
| GaN | Blue |

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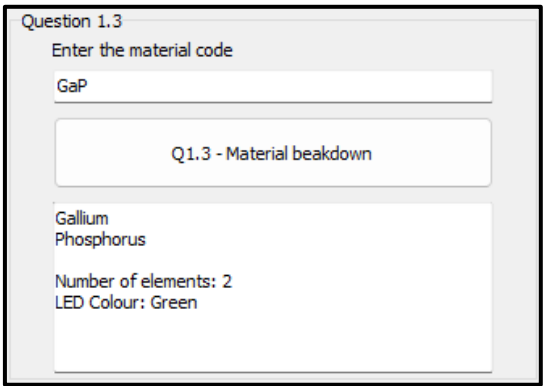
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Example of output:

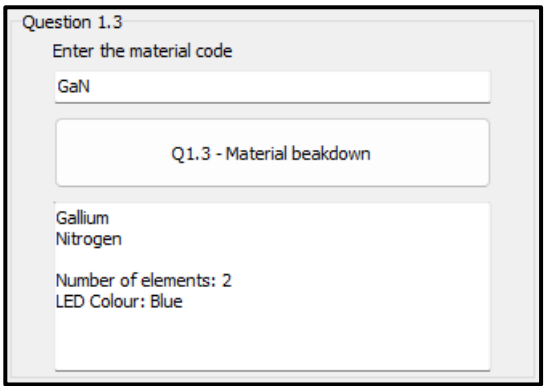
GaAsP - Red



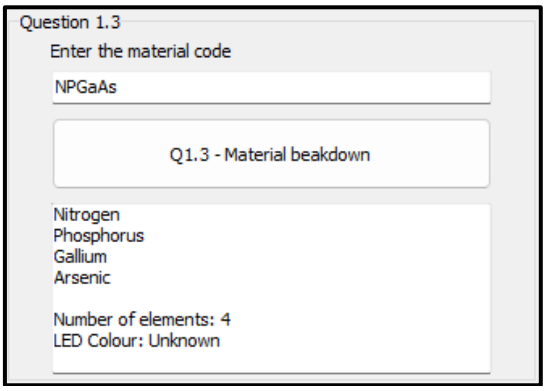

GaP - Green




GaN - Blue




NPGaAs - Unknown




(15)

1.4 **Button [Q1.4 – Colour Sequence]**

Modern RGB LEDs are capable of displaying different colours in rapid succession to create lighting effects and animations.

The user will enter a sequence of colour codes in the edit box **edtSequence**. The colour codes are represented as follows:

| CODE | COLOUR |
|---|---|
| R | Red |
| G | Green |
| B | Blue |

Examples of valid sequences:

RGBRGB
RBRBGRGB
GGGBBBRRR
*Or any other sequence that contains: R and/or G and/or B.*

The timer component **tmrLED** has already been configured with an interval of 500 milliseconds. Two global variables have been declared: **iPos** and **sSequence**.

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Code the button **btnQ1_4** and the timer event **tmrLED** to do the following:

- Retrieve the sequence entered in the edit box **edtSequence** component.
- Start (enable) the timer when the button is clicked.
- Every 500 milliseconds, change the colour of the shape **shpLED** according to the next colour code in the sequence.
- Continue until all colour codes in the sequence have been processed.
- Stop (disable) the timer once the sequence has completed.

Example:

Input:

RBRBGRGB

Output:

The shape **shpLED** must display the following colours in sequence:

Red → Blue → Red → Blue → Green → Red → Green → Blue (6)

- Enter your name and surname as a comment in the first line of the program file.
- Save your program.
- A printout of the code may be required.

**TOTAL QUESTION 1: [35]**

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## QUESTION 2: DATABASE PROGRAMMING

Light Emitting Diodes (LEDs) are widely used in modern technology, including lighting, electronic displays and communication devices. Different LED colours are produced using various semiconductor materials, while manufacturers continue to develop more efficient and longer-lasting products.

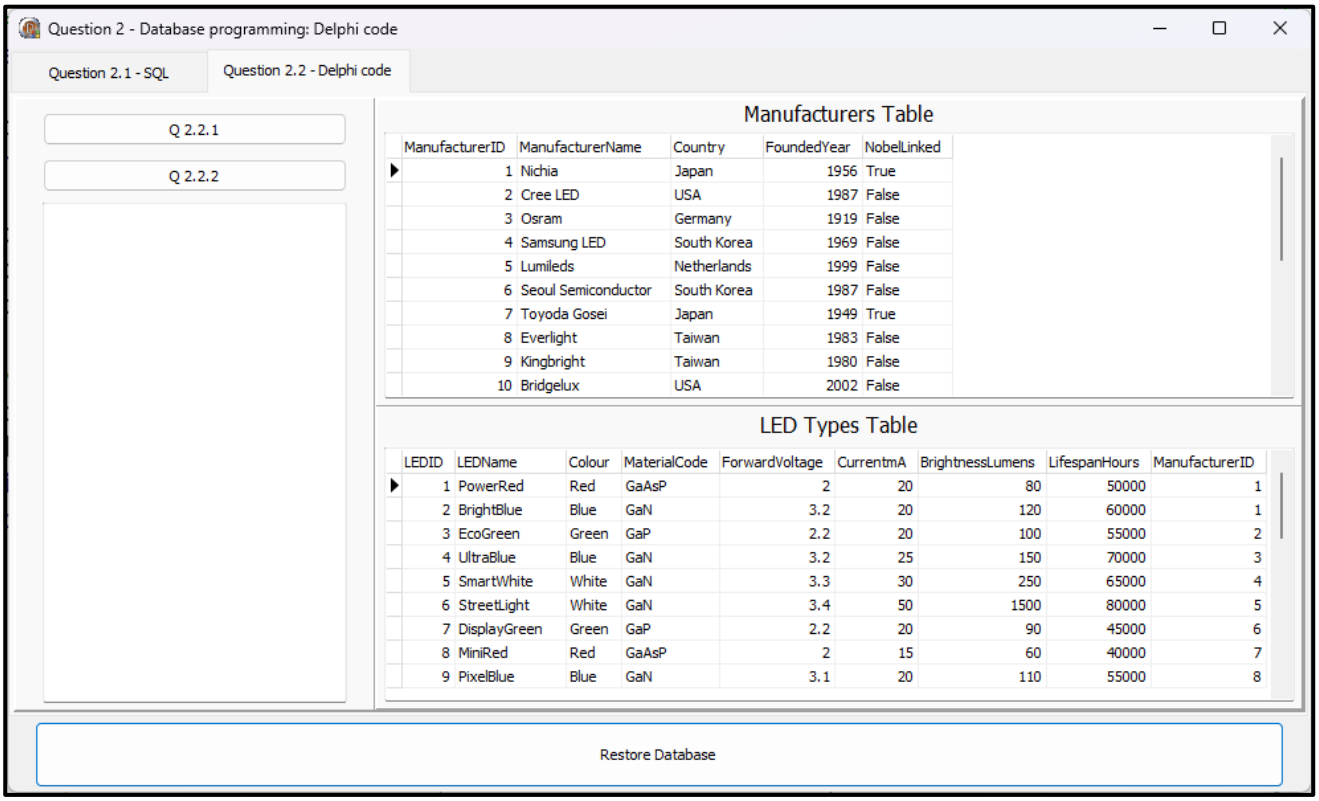
A database of LED manufacturers and LED types has been compiled. You are required to assist in developing a system that allows users to query and manage this data.

A database named **LEDTechDB.mdb** has been provided. It contains two tables: **tblManufacturers** and **tblLEDTypes**.

The data pages attached at the end of the question paper provide information on the design of the database and its contents.

Do the following:

- Open the incomplete program in the **Question 2** folder.
- Enter your name and surname as a comment in the first line of the **Question2_U.pas** unit file**.**
- Compile and execute the program. The program has limited functionality.
- The contents of the tables are displayed as shown below on the selection of tab sheet **Question 2.2 – Delphi code.**




- Follow the instructions below to complete the code for each section as described in QUESTION 2.1 and QUESTION 2.2.
- Use SQL statements to answer QUESTION 2.1 and Delphi code to answer QUESTION 2.2.

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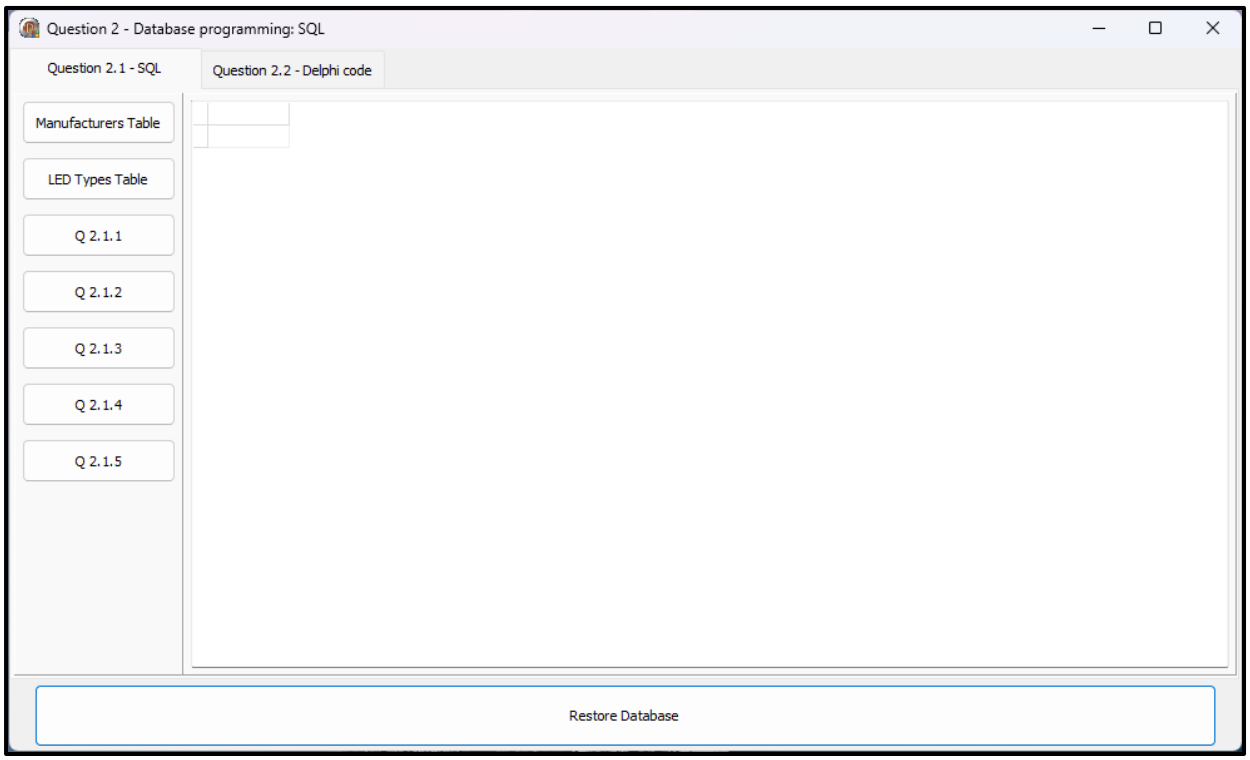
**NOTE:**

- The 'Restore database' button is provided to restore the data contained in the database to the original content.
- The content of the database is password-protected, i.e. you will NOT be able to gain access to the content of the database using Microsoft Access.
- Code is provided to link the GUI components to the database. Do NOT change any of the code provided.
- TWO variables are declared as public variables, as described in the table below:

| VARIABLE | DATA TYPE | DESCRIPTION |
|---|---|---|
| tblManufacturers | TADOTable | Refers to the table tblManufacturers |
| tblLEDTypes | TADOTable | Refers to the table tblLEDTypes |

## 2.1 Tab Sheet [Question 2.1 - SQL]

Example of graphical user interface (GUI) for QUESTION 2.1.




**NOTE:**

- Use ONLY SQL code to answer QUESTION 2.1.1 to QUESTION 2.1.5.
- Code to execute the SQL statements and display the results of the queries is provided. TheSQL statements assigned to the variables **sSQL1, sSQL2, sSQL3, sSQL4** and **sSQL5** are incomplete.

Complete the SQL statements to perform the tasks described in QUESTION 2.1.1 to QUESTION 2.1.5 below.

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2.1.1 **Button [Q2.1.1]**

Write an SQL statement to display the LEDName, Colour, and LifespanHours sorted in descending order according to LifespanHours.

Example of the first 10 records of the output:

| LEDName | Colour | LifespanHours |
|---|---|---|
| FloodWhite | White | 100000 |
| IndustrialWhite | White | 90000 |
| StreetLight | White | 80000 |
| BeaconRed | Red | 75000 |
| UltraBlue | Blue | 70000 |
| TrafficRed | Red | 70000 |
| SignalGreen | Green | 70000 |
| VisionBlue | Blue | 70000 |
| MarineBlue | Blue | 65000 |
| SmartWhite | White | 65000 |

(4)

2.1.2 **Button [Q2.1.2]**

Write an SQL statement to display all the fields of LEDs where the LED name contains the word "Blue".

Example of output:

| LEDID | LEDName | Colour | MaterialCode | ForwardVoltage | CurrentmA | BrightnessLumens | LifespanHours | ManufacturerID |
|---|---|---|---|---|---|---|---|---|
| 2 | BrightBlue | Blue | GaN | 3.2 | 20 | 120 | 60000 | 1 |
| 4 | UltraBlue | Blue | GaN | 3.2 | 25 | 150 | 70000 | 3 |
| 9 | PixelBlue | Blue | GaN | 3.1 | 20 | 110 | 55000 | 8 |
| 13 | MarineBlue | Blue | GaN | 3.2 | 25 | 180 | 65000 | 6 |
| 17 | VisionBlue | Blue | GaN | 3.3 | 35 | 400 | 70000 | 1 |

(4)

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2.1.3 **Button [Q2.1.3]**

Write an SQL statement to display the LEDName, ForwardVoltage, CurrentmA, and PowerMilliWatts.

Calculate the power consumption of each LED using the formula:

Power = ForwardVoltage × CurrentmA

Name the calculated field PowerMilliWatts.

Example of the first 10 records of the output:

| LEDName | ForwardVoltage | CurrentmA | PowerMilliWatts |
|---|---|---|---|
| PowerRed | 2 | 20 | 40 |
| BrightBlue | 3.2 | 20 | 64 |
| EcoGreen | 2.2 | 20 | 44 |
| UltraBlue | 3.2 | 25 | 80 |
| SmartWhite | 3.3 | 30 | 99 |
| StreetLight | 3.4 | 50 | 170 |
| DisplayGreen | 2.2 | 20 | 44 |
| MiniRed | 2 | 15 | 30 |
| PixelBlue | 3.1 | 20 | 62 |
| IndustrialWhite | 3.5 | 60 | 210 |

(5)

2.1.4 **Button [Q2.1.4]**

Write an SQL statement to add the following record to the **tblLEDTypes** table:

- LEDName: QuantumBlue
- Colour: Blue
- MaterialCode: GaN
- ForwardVoltage: 3.4
- CurrentmA: 25
- BrightnessLumens: 500
- LifespanHours: 75000
- ManufacturerID: 10

Example of the output:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 21 | QuantumBlue | Blue | GaN | 3.4 | 25 | 500 | 75000 | 10 |

(4)

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2.1.5 **Button [Q2.1.5]**

Write an SQL statement to display the ManufacturerName and NumberOfLEDs.

- The NumberOfLEDs field must indicate the number of LED types produced by each manufacturer.
- Only display manufacturers that produce two or more LED types.
- Sort the output alphabetically according to ManufacturerName.

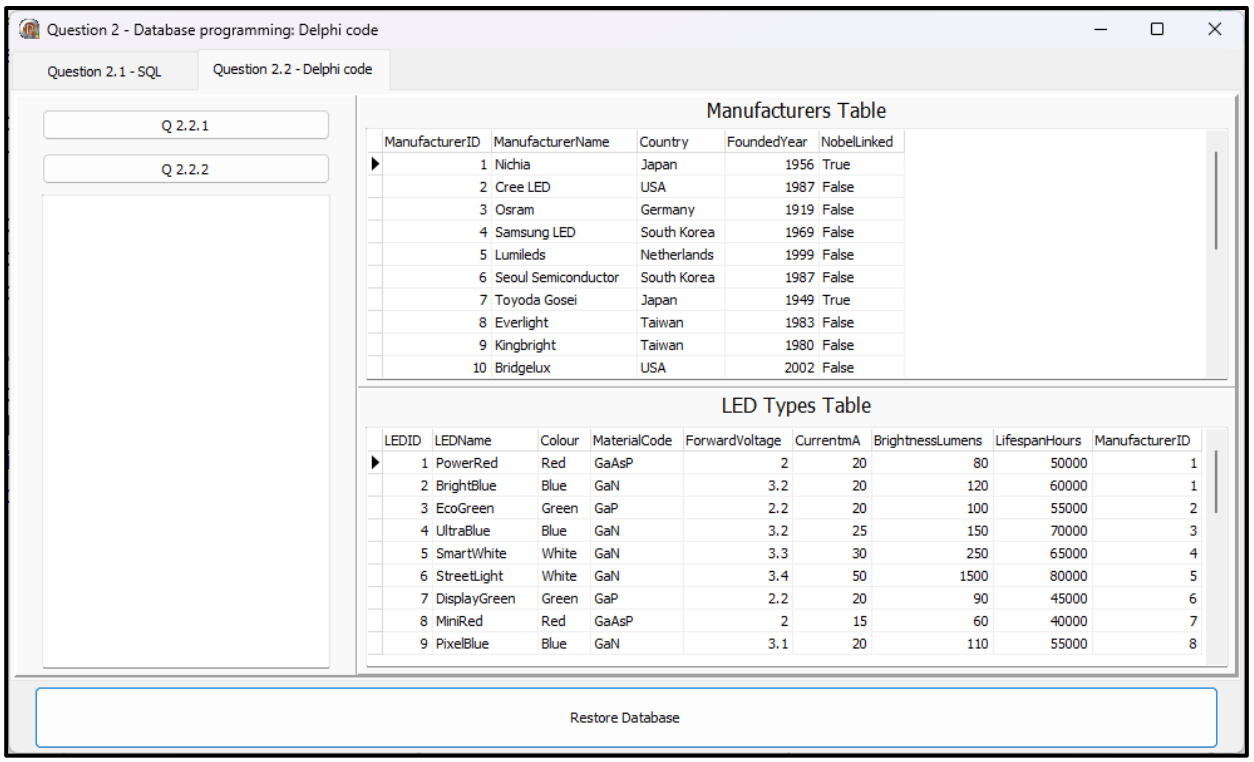
Example of the output:

| ManufacturerName | NumberOfLEDs |
|---|---|
| Cree LED | 2 |
| Everlight | 2 |
| Lumileds | 4 |
| Nichia | 3 |
| Osram | 3 |
| Samsung LED | 2 |
| Seoul Semiconductor | 2 |
| Toyoda Gosei | 2 |

(8)

2.2 **Tab Sheet [Question 2.2 – Delphi Code]**

Example of graphical user interface (GUI) for QUESTION 2.2.




**NOTE:**

- Use ONLY Delphi programming code to answer QUESTION 2.2.1 and QUESTION 2.2.2.
- NO marks will be awarded for SQL statements in QUESTION 2.2.
- Use the global variables provided: tblManufacturers and tblLEDTypes.

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**IMPORTANT:**
Before attempting any code in this section, you must click the "Restore Database" button to reset the data to its original state. Failure to do so may result in incorrect outputs.

### 2.2.1 Button [Q2.2.1 – Increase Brightness]

Blue LEDs are being upgraded with a new lens technology that increases their brightness.

Code the button **btn2_2_1** to do the following:

- Find all LEDs where the Colour field is equal to "Blue".
- Increase the BrightnessLumens value by 50 lumens.
- Save the changes to the database.
- Display the names of all modified LEDs in the **redOutput** component.
- Display the total number of records updated.

Example of the output:

```
The following LEDs were updated:

BrightBlue
UltraBlue
PixelBlue
MarineBlue
VisionBlue

5 record(s) updated.
```

(7)

### 2.2.2 Button [Q2.2.2 – Obsolete LEDs]

Older LEDs with a lifespan of less than 40 000 hours are considered obsolete and must be removed from the database.

Code the button **btn2_2_2** to do the following:

.

- Identify LEDs where the LifespanHours value is less than 40 000.
- Display the names of the LEDs that will be removed in the **redOutput** component.
- Delete the records from the database.
- Display the total number of records deleted.

Example of the output:

```
The following LEDs were removed:

NanoRed

1 record(s) deleted.
```

(8)

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- Enter your name and surname as a comment in the first line of the program file.
- Save your program.
- A printout of the code may be required.

**TOTAL QUESTION 2: [40]**

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## QUESTION 3: OBJECT-ORIENTED PROGRAMMING

You have been tasked by the Global LED Technology Institute to assist with managing and processing information about modern LED lighting solutions.

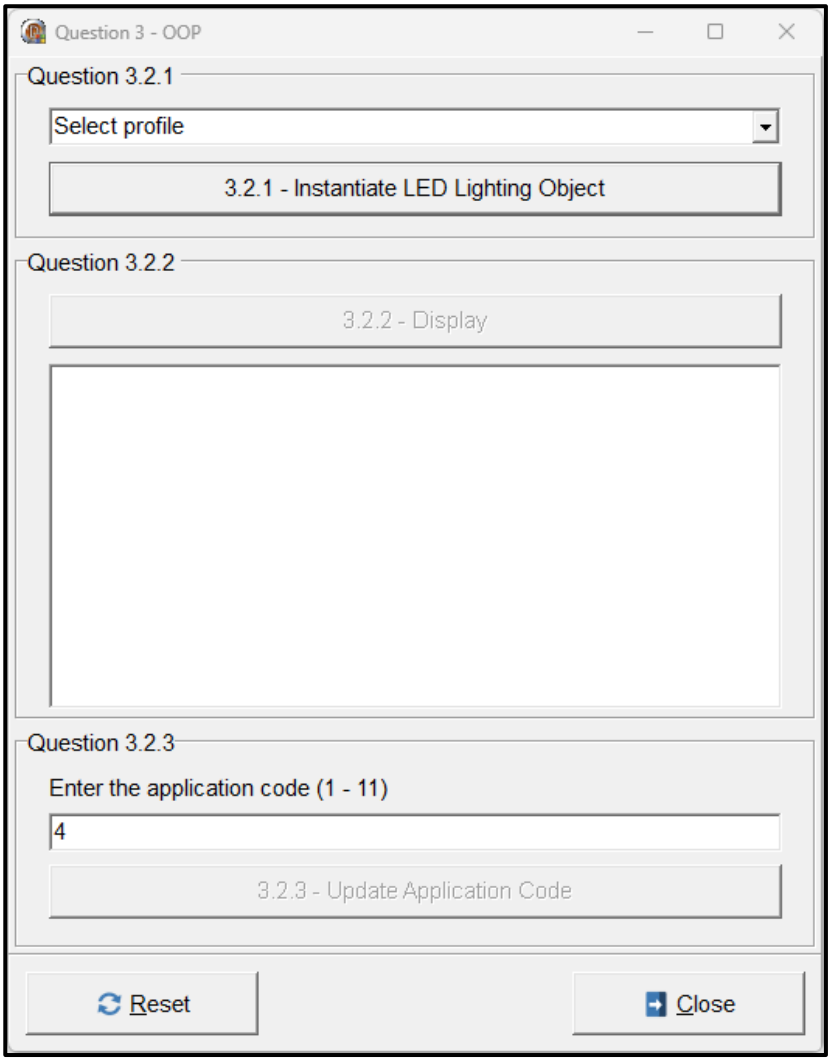
The organisation has provided a data file named **LightingTemperatures.txt** containing information about various lighting profiles, including their colour temperatures, brightness levels and intended applications.

You are required to use object-oriented programming principles in Delphi to represent and manipulate this data using a class named **TLighting**.

Do the following:

- Open the incomplete program in the **Question 3** folder.
- Open the incomplete object class **Lighting_U.pas**.
- Enter your full name as a comment in the first line of both the **Lighting_U.pas** file and the **Question3_U.pas** file.
- Compile and execute the program. The program has limited functionality currently.
- Do NOT remove or change any provided code.

Example of the graphical user interface (GUI):




Complete the code as specified in QUESTION 3.1 and QUESTION 3.2 that follow.

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**NOTE:** You are NOT allowed to add any additional attributes or user-defined methods, unless explicitly stated in the question.

Open the incomplete object class **Lighting_U.pas.**

3.1 The provided incomplete class (**TLighting**) contains the declaration of four attributes that describe the **objLEDLight** object.

| NAME OF ATTRIBUTES | DESCRIPTION |
|---|---|
| fName | String value containing the name of the LED lighting profile. |
| fColourTemp | Integer value containing the LED colour temperature measured in Kelvin (K). |
| fBrightness | Integer value containing the LED brightness measured in Lumens. |
| fApplication | Integer value containing the application code indicating where the LED is best suited for use. |

Complete the code in the object class as described in QUESTION 3.1.1 to QUESTION 3.1.6 below.

3.1.1 Write the code for the constructor **Create** to receive values for all the attributes and assign them to the corresponding class attributes. (4)

3.1.2 The application of a lighting profile is stored as a numeric code.

Write the code for the accessor method **getApplication** to return the full application description according to the following table:

| | |
|---|---|
| 1 | Decorative |
| 2 | Residential |
| 3 | Hospitality |
| 4 | Office |
| 5 | Education |
| 6 | Retail |
| 7 | Healthcare |
| 8 | Industrial |
| 9 | Warehouse |
| 10 | Security Lighting |
| 11 | Specialised Lighting |

(3)

3.1.3 Write the code for the mutator method **setApplication** to receive a new application code and assign it to the application attribute. (2)

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3.1.4 Write the code for the auxiliary method **calcSuitability**.

The method must return a recommendation according to the colour temperature of the lighting profile.

Use the following suitability ratings:

| COLOUR TEMPERATURE | RECOMMENDATION |
|---|---|
| Less than 3500 | Relaxation |
| 3500 to 4999 | General Purpose |
| 5000 and above | Productivity |

The returned string must include both the recommendation and the application description. The layout of the string is as follows:

<Recommendation> lighting suitable for <Application> environments.

Examples:
- Relaxation lighting suitable for Residential environments.
- General Purpose lighting suitable for Office environments.
- Productivity lighting suitable for Industrial environments. (7)

3.1.5 Write code for the Boolean accessor method **isCommercial**.

The method must return TRUE if the lighting profile is intended for any of the following applications:

- Office
- Education
- Retail
- Healthcare
- Industrial
- Warehouse

Otherwise return FALSE. (2)

3.1.6 Write code for a **toString** method that returns a string in the following format:

Lighting Name: <TAB space> [Name]
Colour Temperature: <TAB space> [ColourTemp]
Brightness: <TAB space> [Brightness]
Application: <TAB space> [Application]

See Question 3.2.2 for final output. (3)

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3.2 An incomplete program has been supplied in the **Question 3** folder. The program contains code for the object class to be accessible and declares an object variable named **objLEDLight.**

A text file named **LightingTemperatures.txt** is provided, containing the following fields:

LEDName, ColourTemperature, Brightness, ApplicationCode

Text file contents:

```
Candlelight,2200,100,1
WarmWhite,2700,120,2
SoftWhite,3000,150,2
WarmNeutral,3500,170,3
NeutralWhite,4000,180,4
NaturalWhite,4500,200,5
Daylight,5000,220,6
DaylightDeluxe,5700,240,7
CoolWhite,6500,250,8
ColdWhite,7000,300,9
ArcticWhite,8000,350,10
UltraCoolWhite,10000,400,11
```

Write code to perform the tasks described in QUESTION 3.2.1 to QUESTION 3.2.3 below.

3.2.1 **Button [3.2.1 – Load Lighting Profile]**

The combo box **cmbLighting** contains the names of the available lighting profiles. Some of the names displayed in the combo box contain spaces, while the corresponding names stored in the text file do not.

Example:
Combo Box: Warm White
Text File: WarmWhite

Write code to:

1. Extract the selected lighting profile from the combo box.
2. Remove all spaces from the selected lighting profile.
3. Open the file LightingTemperatures.txt for reading.
4. Display an appropriate error message if the file cannot be opened.
5. Read through the file until the selected lighting profile is found.
6. Extract the following information from the matching record:

   - Lighting Name
   - Colour Temperature
   - Brightness
   - Application Code
   - Convert all necessary values to the correct data types.
   - Create a **TLighting** object named **objLEDLight** using the extracted data.

7. Close the file. (14)

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### 3.2.2 Button [3.2.2 – Display Lighting Analysis]

Write code to display the following information in **redOutput**:

- The result returned by the **ToString** method.
- The suitability recommendation returned by the **calcSuitability** method.
- Whether the lighting profile is intended for commercial use.

Display "Yes" if the lighting profile is commercial, otherwise display "No".

Example output:

Candle Light

```
Lighting Name:          Candlelight
Colour Temperature:     2200
Brightness:             100
Application:            Decorative

Recommendation:
Relaxation lighting suitable for Decorative environments.

Commercial:
No
```

Cool White

```
Lighting Name:          CoolWhite
Colour Temperature:     6500
Brightness:             250
Application:            Industrial

Recommendation:
Productivity lighting suitable for Industrial environments.

Commercial:
Yes
```

(7)

### 3.2.3 Button [3.2.3 – Update Application]

The edit box **edtApplication** contains a valid application code. You do not need to validate the value entered by the user.

Write code to:

- Convert the value entered in **edtApplication** to an integer.
- Update the application code stored in **objLEDLight** using the appropriate mutator method.

*When the button is clicked, the **Display Lighting Analysis** button will automatically execute and display the updated lighting profile.*

Study the screenshots below to see how the output changes when the application code is updated.

Example output using the **WarmNeutral** lighting profile:

Before Updating the Application

```
Lighting Name:          WarmNeutral
Colour Temperature:     3500
Brightness:             170
Application:            Hospitality

Recommendation:
General Purpose lighting suitable for Hospitality environments.

Commercial:
No
```

After entering 4 into **edtApplication**

```
Lighting Name:          WarmNeutral
Colour Temperature:     3500
Brightness:             170
Application:            Office

Recommendation:
General Purpose lighting suitable for Office environments.

Commercial:
Yes
```

(3)

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- Enter your name and surname as a comment in the first line of the program file.
- Save your program.
- A printout of the code may be required.

**TOTAL QUESTION 3: [45]**

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## QUESTION 4: PROBLEM-SOLVING PROGRAMMING

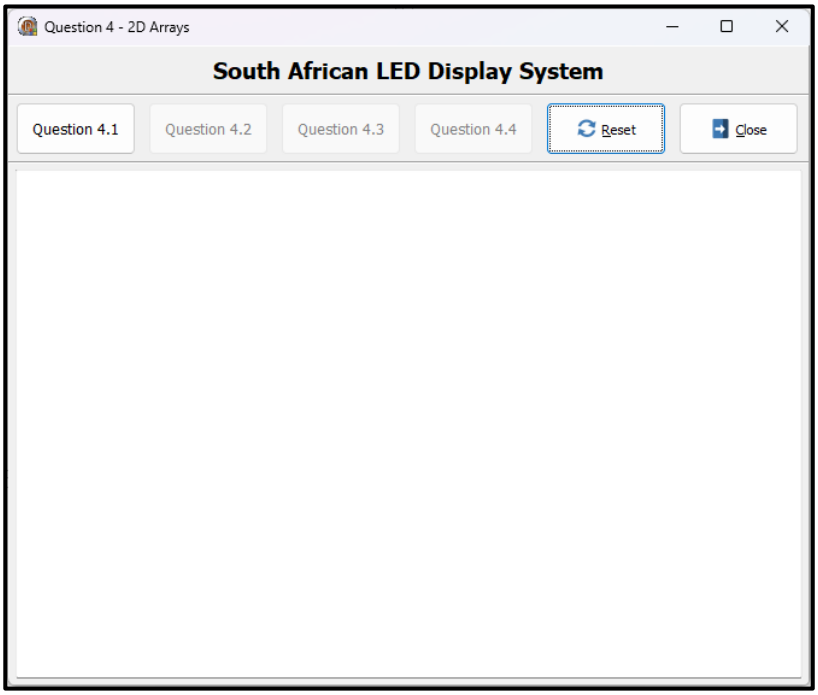
South African LED Display System

A South African technology company has developed a large LED billboard capable of displaying national flags and other graphical patterns.

Do the following:

- Open the incomplete program in the **Question 4** folder.
- Enter your full name as a comment in in the first line of the **Question4_u.pas** file.
- Compile and execute the program. The program has limited functionality currently.
- Do NOT remove or change any provided code.

Example of the graphical user interface (GUI):




The following have been provided in the program:

The colour of each LED is represented by a single character:

| CHARACTER | COLOUR |
|---|---|
| R | Red |
| G | Green |
| B | Blue |
| W | White |
| Y | Yellow |
| K | Black |

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- The design of the South African flag is stored in the single-dimensional array **arrFlag**. Each row of the flag is stored as a string and the colour codes are separated by spaces for readability.

- A two-dimensional array named **ar2Flag** will be used to store the LED colours without the spaces.

Complete the code for each section of QUESTION 4, as described in QUESTION 4.1 to QUESTION 4.4 bellow.

4.1 **Button [Question 4.1]**

Write code to transfer the contents of **arrFlag** to the two-dimensional array **ar2Flag**.

**NOTE***:*
*The spaces between the colour codes are included for readability and must not be stored in the two-dimensional array.* (6)

4.2 **Button [Question 4.2]**

Write code to display the contents of **ar2Flag** in **redOutput** exactly as shown in the example output.

**NOTE:**
*Insert a space between each colour code when displaying the contents of the array.*

```
SOUTH AFRICAN LED FLAG

G G G G G W W R R R R R R R R R R R R R R R R R R R R
Y G G G G G W W R R R R R R R R R R R R R R R R R R R R
Y Y G G G G G W W R R R R R R R R R R R R R R R R R R R
K Y Y G G G G G W W R R R R R R R R R R R R R R R R R R
K K Y Y G G G G G W W R R R R R R R R R R R R R R R R R
K K K Y Y G G G G G W W W W W W W W W W W W W W W W W W
K K K K Y Y G G G G G W W W W W W W W W W W W W W W W W
K K K K K Y Y G G G G G G G G G G G G G G G G G G G G G G
K K K K K K Y Y G G G G G G G G G G G G G G G G G G G G G
K K K K K K Y Y G G G G G G G G G G G G G G G G G G G G G
K K K K K Y Y G G G G G G G G G G G G G G G G G G G G G G
K K K K Y Y G G G G G W W W W W W W W W W W W W W W W W
K K K Y Y G G G G G W W W W W W W W W W W W W W W W W W
K K Y Y G G G G G W W B B B B B B B B B B B B B B B B B
K Y Y G G G G G W W B B B B B B B B B B B B B B B B B B
Y Y G G G G G W W B B B B B B B B B B B B B B B B B B B
Y G G G G G W W B B B B B B B B B B B B B B B B B B B B
G G G G G W W B B B B B B B B B B B B B B B B B B B B B
```

(8)



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4.3 **Button [Question 4.3]**

Write code to determine and display the number of LEDs of each colour contained in **ar2Flag**.

Display the number of LEDs as per example screenshot:

Example output:

```
Red LEDs: 105
Blue LEDs: 105
Green LEDs: 160
White LEDs: 98
Yellow LEDs: 30
Black LEDs: 42
```

(6)

4.4 **Button [Question 4.4]**

Write code to determine which colour occurs most frequently in the flag.

Display as per example screenshot:
- The dominant colour.
- The number of LEDs of that colour.

Example output:

```
Dominant Colour: Green
Number of LEDs: 160
```

(10)

- Enter your name and surname as a comment in the first line of the program file.
- Save your program.
- A printout of the code may be required.

**TOTAL QUESTION 4: [30]**

**GRAND TOTAL: 150**

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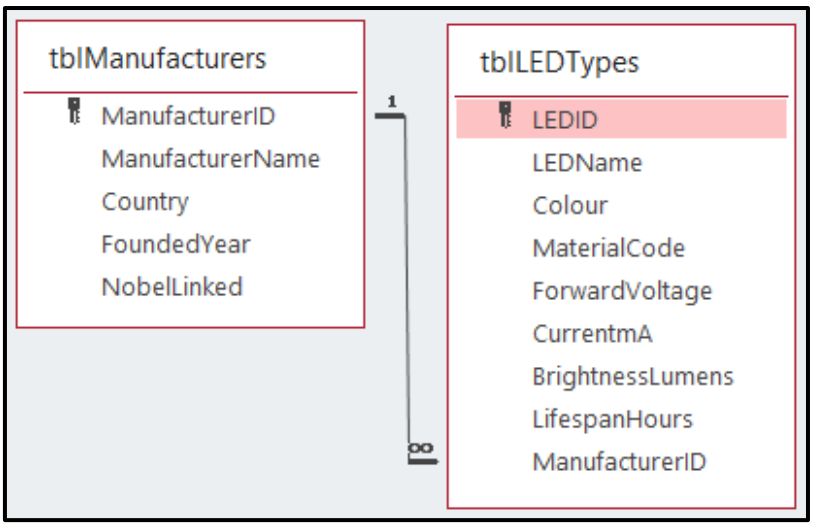
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## INFORMATION TECHNOLOGY P1

### DATABASE INFORMATION QUESTION 2:

The database **LEDTechDB** consists of the tables: **tblManufacturers** and **tblLEDTypes**.

The following one-to-many relationship with referential integrity exists between the two tables in the database:




The design of the database tables is as follows:

Table: **tblManufacturers** – This table contains details of the various manufacturers that produce LED products.

| Field Name | Data Type | Description |
|---|---|---|
| ManufacturerID | Number (PK) | Unique identifier for each manufacturer |
| ManufacturerName | Text (100) | Name of the manufacturer |
| Country | Text (50) | Country in which the manufacturer is based |
| FoundedYear | Number | Year in which the manufacturer was founded |
| NobelLinked | Yes/No | Indicates whether the manufacturer is associated with Nobel Prize-winning LED research |

Example of the records in the **tblManufacturers** table:

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| ManufacturerID | ManufacturerName | Country | FoundedYear | NobelLinked |
|---|---|---|---|---|
| 1 | Nichia | Japan | 1956 | ☑ |
| 2 | Cree LED | USA | 1987 | ☐ |
| 3 | Osram | Germany | 1919 | ☐ |
| 4 | Samsung LED | South Korea | 1969 | ☐ |
| 5 | Lumileds | Netherlands | 1999 | ☐ |
| 6 | Seoul Semiconductor | South Korea | 1987 | ☐ |
| 7 | Toyoda Gosei | Japan | 1949 | ☑ |
| 8 | Everlight | Taiwan | 1983 | ☐ |
| 9 | Kingbright | Taiwan | 1980 | ☐ |
| 10 | Bridgelux | USA | 2002 | ☐ |
| 11 | Sharp Devices Europe | Japan | 1912 | ☐ |
| 12 | Citizen Electronics | Japan | 1970 | ☐ |

Table: **tblLEDTypes** – This table contains information about the different types of LEDs.

| Field Name | Data Type | Description |
|---|---|---|
| LEDID | Number (PK) | Unique identifier for each LED |
| LEDName | Text (30) | Name of the LED |
| Colour | Text (30) | Colour emitted by the LED |
| MaterialCode | Text (50) | Semiconductor material composition of the LED |
| ForwardVoltage | Number | Operating voltage of the LED measured in volts (V) |
| CurrentmA | Number | Current draw of the LED measured in milliamperes (mA) |
| BrightnessLumens | Number | Brightness of the LED measured in lumens |
| LifespanHours | Number | Expected lifespan of the LED measured in hours |
| ManufacturerID | Number (FK) | Identifies the manufacturer that produces the LED |

Example of the records in the **tblLEDTypes** table:

| LEDID | LEDName | Colour | MaterialCode | ForwardVoltage | CurrentmA | BrightnessLumens | LifespanHours | ManufacturerID |
|---|---|---|---|---|---|---|---|---|
| 1 | PowerRed | Red | GaAsP | 2 | 20 | 80 | 50000 | 1 |
| 2 | BrightBlue | Blue | GaN | 3.2 | 20 | 120 | 60000 | 1 |
| 3 | EcoGreen | Green | GaP | 2.2 | 20 | 100 | 55000 | 2 |
| 4 | UltraBlue | Blue | GaN | 3.2 | 25 | 150 | 70000 | 3 |
| 5 | SmartWhite | White | GaN | 3.3 | 30 | 250 | 65000 | 4 |
| 6 | StreetLight | White | GaN | 3.4 | 50 | 1500 | 80000 | 5 |
| 7 | DisplayGreen | Green | GaP | 2.2 | 20 | 90 | 45000 | 6 |
| 8 | MiniRed | Red | GaAsP | 2 | 15 | 60 | 40000 | 7 |
| 9 | PixelBlue | Blue | GaN | 3.1 | 20 | 110 | 55000 | 8 |
| 10 | IndustrialWhite | White | GaN | 3.5 | 60 | 2000 | 90000 | 3 |
| 11 | TrafficRed | Red | GaAsP | 2.1 | 30 | 250 | 70000 | 5 |
| 12 | SignalGreen | Green | GaP | 2.3 | 30 | 280 | 70000 | 5 |
| 13 | MarineBlue | Blue | GaN | 3.2 | 25 | 180 | 65000 | 6 |
| 14 | AccentWhite | White | GaN | 3.2 | 20 | 350 | 60000 | 4 |
| 15 | PanelGreen | Green | GaP | 2.1 | 15 | 70 | 45000 | 2 |
| 16 | BeaconRed | Red | GaAsP | 2.2 | 40 | 500 | 75000 | 3 |
| 17 | VisionBlue | Blue | GaN | 3.3 | 35 | 400 | 70000 | 1 |
| 18 | FloodWhite | White | GaN | 3.6 | 80 | 3000 | 100000 | 5 |
| 19 | CompactGreen | Green | GaP | 2.2 | 20 | 120 | 50000 | 7 |
| 20 | NanoRed | Red | GaAsP | 2 | 10 | 40 | 35000 | 8 |

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## PLANNING PAGE

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