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# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**INFORMATION TECHNOLOGY P1**

**NOVEMBER 2016**

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 16 pages.**

**INSTRUCTIONS AND INFORMATION**

1. This paper is divided into THREE sections. Candidates must answer ALL THREE sections.
2. 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.
3. This question paper is set with programming terms that are not specific to any particular programming language (Delphi/Java (using the Netbeans IDE)).
4. 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.
5. 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.
6. 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.
7. Routines, such as search, sort and selection, must be developed from first principles. You may NOT use the built-in features of a programming language for any of these routines.
8. All data structures must be defined by you, the programmer, unless the data structures are supplied.
9. 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.
10. Make sure that your examination number appears as a comment in every program that you code, as well as on every event indicated.
11. If required, print the programming code of all the programs/classes that you completed. You will be given half an hour printing time after the examination session.
12. 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.

13. The files that you need to complete this question paper have been given 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 files.

**NOTE:**

- Delphi candidates must use the file **DelphiDataENGNov2016.exe**.
- Java candidates must use the file **JavaDataENGNov2016.exe**.

Do the following:

- Double click on the password-protected executable file.
- Click on the extract button.
- Enter the following password: **AquaS@&\$16**

Once extracted, the following list of files will be available in the folder **DelphiDataENGNov2016/JavaDataENGNov2016**:

**DELPHI FILES****Question1:**

Question1\_P.dpr  
Question1\_P.res  
Question1\_U.dfm  
Question1\_U.pas

**Question2:**

DataQ2.txt  
Excursion\_U.pas  
Question2\_P.dpr  
Question2\_P.res  
Question2\_U.dfm  
Question2\_U.pas

**Question3:**

Question3\_P.dpr  
Question3\_P.res  
Question3\_U.dfm  
Question3\_U.pas

**JAVA (NETBEANS) FILES****Question1:**

Question1.form  
Question1.java

**Question2:**

DataQ2.txt  
Excursion.java  
Question2.form  
Question2.java

**Question3:**

Question3.form  
Question3.java

**SCENARIO**

Aqua Wonderland is a water theme park that provides entertainment, access to restaurants, shopping, water slides and many more activities. The administrators of Aqua Wonderland are currently working on different techniques and strategies to improve the popularity of the park.

**SECTION A****QUESTION 1: GENERAL PROGRAMMING SKILLS**

The aquarium at Aqua Wonderland is setting up a new rectangular shark tank. The administrators need a software program to manage the income from visitors and the daily expenses of maintaining the tank.

Do the following:

- Compile and execute the program found in the **Question1** folder. The user interface displays five different sections named Question 1\_1 to Question 1\_5. Currently the program has no functionality.

Example of graphical user interface (GUI):

The screenshot displays a graphical user interface titled "Aqua Wonderland Shark Tank". It is divided into five distinct sections for data entry:

- Question 1\_1:** Contains input fields for "Length", "Width", and "Height", each followed by the unit "metres". Below these is a button labeled "Question 1\_1" and a text field for "cubic metres".
- Question 1\_2:** Contains a button labeled "Question 1\_2" and a text field.
- Question 1\_3:** Contains a label "Lifespan in months" followed by a text field, a button labeled "Question 1\_3", and another empty text field below.
- Question 1\_4:** Contains input fields for "Initial cost" and "Income during first year", each followed by a text field. Below these is a button labeled "Question 1\_4" and a large empty rectangular area.
- Question 1\_5:** Contains a button labeled "Question 1\_5\_1" and a large empty rectangular area. At the bottom right, there is a section titled "Select a course" with two radio button options: "Swimming" (which is selected) and "Snorkelling". Below this is a button labeled "Question 1\_5\_2".

- Complete the code for each section of QUESTION 1, as described in QUESTION 1.1 to QUESTION 1.5 on the next page.

**1.1 Button [Question 1\_1]**

Write code to obtain the length, width and height of the tank from the text boxes provided. Calculate and display the volume of the tank, using the following formula:

$$\text{Volume} = \text{length} \times \text{width} \times \text{height}$$

Example of output if the length is 16.5 metres, the width is 14.2 metres and the height is 12.5 metres:

Length	16.5	metres
Width	14.2	metres
Height	12.5	metres
Question 1_1	2928.75	cubic metres

(5)

**1.2 Button [Question 1\_2]**

The aquarium pays for the water that will be used to fill up the tank. Use the volume (in cubic metres) calculated in QUESTION 1.1 to calculate the cost of the water required to fill up the tank.

NUMBER OF LITRES	COST
The first 500 litres	25 cents per litre
The next 300 litres	35 cents per litre
The remaining litres	45 cents per litre

Example of output if the volume is 2 928.75 cubic metres:

Question 1_2	R 1 187.94
--------------	------------

(9)

**1.3 Button [Question 1\_3]**

A shark can only stay in a tank for a specific period of time before it has to be released. The user has to enter the lifespan of a shark in a tank in months.

Write code to convert the number of months entered into years and months and display the years and months as shown in the example below.

Example of output if the number of months that was entered is 87:

Lifespan in months	87
Question 1_3	7 years and 3 months

(6)

1.4 **Button [Question 1\_4]**

The management wants to know how many years it will take to pay off the initial expense of setting up the shark tank. The annual income earned will be used to pay off the expense. The initial amount that was spent to set up the shark tank and the expected income during the first year must be entered. After the first year of operation it is expected that the income will increase by 10% per year.

Use the values entered to calculate and display the year number, the annual income and the annual balance of the set-up cost. If the initial cost is paid off, display the words 'Paid off' in the 'Balance' column. All monetary values must be formatted to a currency with two decimal places.

Example of output if the cost to set up the tank was R500 000 and the expected income during the first year is R75 000:

Initial cost	500000	
Income during first year	75000	
Question 1_4		
Year	Income	Balance
1	R 75 000.00	R 425 000.00
2	R 82 500.00	R 342 500.00
3	R 90 750.00	R 251 750.00
4	R 99 825.00	R 151 925.00
5	R 109 807.50	R 42 117.50
6	R 120 788.25	Paid off

(14)

1.5 **Button [Question 1\_5\_1]**

There will be an opening day to celebrate the completion of the shark tank. Visitors who attend the opening day will get the opportunity to participate in various fun activities. One of the activities is a dice game, during which the visitor can win a swimming course or a snorkelling course if the numbers on the two dice thrown are consecutive numbers.

**NOTE:** Each dice has six faces.  
Consecutive numbers are numbers that follow each other.

Write code to do the following:

- Generate two random numbers to simulate the throw of each dice and display the numbers in the output area.
- Enable button **Question 1\_5\_2** and the two radio buttons if two consecutive numbers were generated.

Example of output if the numbers generated are not consecutive:

Dice 1 = 3  
Dice 2 = 5

Question 1\_5\_2

Select a course

☒ Swimming  
☐ Snorkelling

Example of output if the numbers generated are consecutive:

Dice 1 = 2  
Dice 2 = 1

Question 1\_5\_2

Select a course

☒ Swimming  
☐ Snorkelling

(8)

### Button [Question 1\_5\_2]

Select one of the courses as a prize and write code to do the following:

- Use a dialog box to enter the visitor's four-digit ticket number. This number can be any four-digit number.
- Extract the system date in any format.
- Create a reference number in the following format:

**<Ticket number>#<date>#<first two letters of the selected course as capital letters>**

Example of output if the ticket number entered is 1028, the date is 19 October 2016 and the course selected is swimming:

Dice 1 = 2  
Dice 2 = 1  
Reference number:  
1028#19/10/2016#SW

Question 1\_5\_2

Select a course

☒ Swimming  
☐ Snorkelling

(8)

- Enter your examination number as a comment in the first line of the program file.
- Save your program.
- Make a printout of the code if required.

**TOTAL SECTION A: 50**



**SECTION B****QUESTION 2: OBJECT-ORIENTATED PROGRAMMING**

Aqua Wonderland is hosting a special five-day educational programme at the aquarium. Schools can arrange with the administrators at the park to take learners on an excursion to the aquarium on any one of the specific days when the programme is hosted. When a school requests to visit the park on a specific date, the administrators will confirm whether the school can attend, depending on the space available to accommodate the group of learners.

Do the following:

Delphi programmers	Java programmers
<ul style="list-style-type: none"> <li>Open the incomplete program in the <b>Question2</b> folder.</li> <li>Open the incomplete object class <b>Excursion_U.pas</b>.</li> <li>Enter your examination number as a comment in the first line of both files <b>Question2_U.pas</b> and <b>Excursion_U.pas</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Open the incomplete program in the <b>Question2</b> folder.</li> <li>Open the incomplete object class <b>Excursion.java</b>.</li> <li>Enter your examination number as a comment in the first line of both classes <b>Question2.java</b> and <b>Excursion.java</b>.</li> </ul>

- Compile and execute the program. Currently, the program has no functionality. A hidden panel called **pnlAvailability** will not be visible when the program is executed and will be used in QUESTION 2.2.2 and QUESTION 2.2.3.

Example of user interface:

- Complete the code for this program as specified in QUESTION 2.1 and QUESTION 2.2 below.

2.1 The given incomplete object class (**TExcursion/Excursion**) contains the declaration of four attributes and methods which describe an **Excursion** object.

The attributes for the **Excursion** object are as follows:

NAMES OF ATTRIBUTES		DESCRIPTION
Delphi	Java	
fSchoolName	schoolName	The name of the school
fVisitDate	visitDate	The date the school wants to visit the aquarium in the format YYYY-MM-DD
fGroupSize	groupSize	The number of learners in the group
fTourGuide	tourGuide	A Boolean attribute with the value of 'true' if the school requires a tour guide or 'false' if the school does not require a tour guide

Complete the code in the given **Excursion** object class (**TExcursion/Excursion**) as described in QUESTION 2.1.1 to QUESTION 2.1.5 below.

2.1.1 Write a mutator method called **setVisitDate** to receive a date as parameter and replace the current date to visit the aquarium with the date received. (2)

2.1.2 Write a method called **requireTourGuide** to return the word 'Yes' if a tour guide is required, or 'No' if a tour guide is not required. (4)

2.1.3 A maximum of 500 visitors are allowed to attend the aquarium programme each day. The school will not be allowed to attend the programme if there is no space available on the requested date.

Write a method called **isConfirmed** that will receive the total number of visitors already attending the programme on the requested date as a parameter. The method must use the parameter value to determine whether the maximum value of 500 visitors per day will be exceeded, or not, if this school is allowed to attend the programme on the requested date. Return a Boolean value of 'true' if the school is allowed to attend the programme based on available space, or 'false' if not. (5)

2.1.4 The park wants to encourage schools to attend the aquarium programme by allowing free entrance to one learner for every ten learners in the group.

Write a method called **calcAmount** that will receive the cost per person and the cost of a tour guide as parameters and calculate and return the total amount to be paid. (7)

- 2.1.5 Complete the **toString** method to return the information about the excursion in the following format:

```
School name: <school name>
Date of visit: <visit date>
Number of learners: <size of the group>
Tour guide: <Yes> or <No>
```

Example of output:

```
School name: Forest Manor High
Date of visit: 2016-11-17
Number of learners: 145
Tour guide: Yes
```

(4)

- 2.2 An incomplete class **Question2\_U/Question2** is provided. Details of the school applying to go on an excursion to visit the aquarium must be entered by the user. The program must determine whether the school can be accommodated on the requested date and provide alternative dates if the school cannot be accommodated on the requested date.

A text file called **DataQ2.txt** contains information on all the schools that have been accepted to attend the aquarium's educational programme.

The text file will be used in QUESTION 2.2.2.

The format of each line in the text file is as follows:

```
<School name>#<Date of visit>#<Number of learners>
```

The first four lines of the text file are as follows:

```
Senzani Primary#2016-11-17#250
Florence High#2016-11-14#235
Golden Palm Secondary#2016-11-17#245
Forester Primary#2016-11-15#150
```

### 2.2.1 Button [2.2.1 – Instantiate object]

The user needs to enter the name of the school, select the date on which they want to visit the aquarium from the list box and enter the number of learners in the group.

An **Excursion** object named **objExcursion** has been declared globally. Write code to use the data that was entered to instantiate a new **Excursion** object.

Display a message using a dialog box to indicate that the object has been instantiated successfully.

(7)

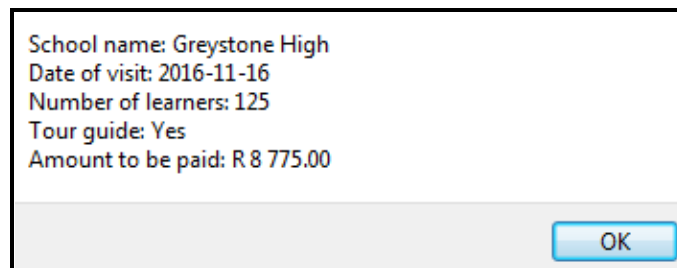
**2.2.2 Button [2.2.2 – Confirm availability]**

- (a) Write a method called **determineDayTotal** that receives the date that the school selected to visit the aquarium as a parameter. Use the data saved in the **DataQ2.txt** text file to determine and return the total number of visitors attending the programme on the date received by the method. (12)
- (b) Use the value of the day total determined by the **determineDayTotal** method as a parameter and call the **isConfirmed** method to determine whether the school can be included for the aquarium programme on the selected date, or not.

If the school is allowed to visit the aquarium on the selected date, use the **calcAmount** method to calculate the amount to be paid.

**NOTE:** The cost per person to visit the park and the cost to hire a tour guide have been declared as constant variables as part of the provided code.

Display the details of the school and the amount to be paid using a message dialog box, as shown in the example below.



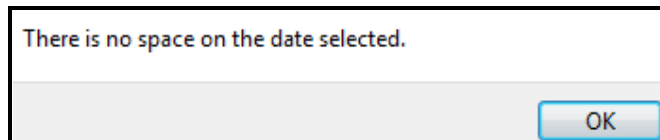
If the school cannot visit the aquarium on the selected date, do the following:

- Display a message in a dialog box indicating no availability.
- Show the panel called **pnlAvailability**, which is currently hidden.
- Test all the dates in the list box for availability using the **determineDayTotal** and the **isConfirmed** method. Populate the combo box in the **pnlAvailability** panel with the dates the school can visit the aquarium.

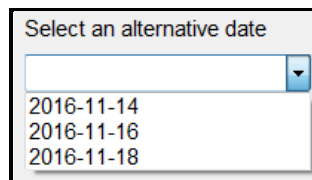
Use the following school details to test the program:

School name: Hovener Secondary  
 Date of visit: 2016-11-15  
 Number of learners: 150  
 Tour guide: Yes

Example of output if the school cannot be included on the selected date of the visit:



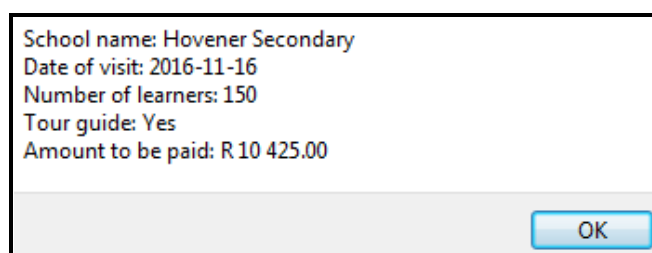
The combo box in the panel **pnlAvailability** populated with all the dates on which the school can visit the aquarium, based on space available:



(16)

### 2.2.3 Button [2.2.3 – Confirm new date]

If alternative dates are displayed in the combo box, the user must select a date. The program must set the date of the object to the selected date and display the school information together with the amount to be paid, using a message dialog box, as shown in the example below.



If there are no alternative dates displayed in the combo box, display a message indicating that the school's request to go on the excursion is unsuccessful.

(5)

- Enter your examination number as a comment in the first line of the class and the form.
- Save all the files.
- Print the code contained in the class and the form (Delphi)/both classes (Java) if required.

**TOTAL SECTION B: 62**

**SECTION C****QUESTION 3: PROBLEM-SOLVING PROGRAMMING****SCENARIO**

Information centres, referred to as 'terminals', have been set up at three different points along the routes in the park. The management requires a software program to provide information to visitors to locate the different activities and facilities at Aqua Wonderland and to be aware of maintenance activities in the park.

Do the following:

- Compile and execute the program in the **Question3** folder. Currently, the program has no functionality.
- Complete the code for each question as described in QUESTION 3.1 to QUESTION 3.4.

**Supplied GUI:**

The supplied GUI represents a self-help interface to assist visitors in reaching various activities and facilities within the park.

Select a terminal

Terminal 1

Terminal 2

Terminal 3

Select a direction

NORTH

SOUTH

EAST

WEST

3.1 - Activity/Facility codes for all terminals and directions

3.2 - Activities/Facilities from a selected terminal and direction

Choose an activity/a facility

Water park

3.3 - Access routes to selected activity/facility

3.4 - Maintenance at selected activity/facility

**Supplied data:**

You are provided with two parallel arrays and one two-dimensional array.

**arrActivities** is a one-dimensional array that contains the names of activities and facilities in the park. The data stored in this array are as follows:

Water park, Aquarium, Sea, Restaurants, Shopping, Diving, Help desk,  
Penguin park, Shark tank, Dolphin shows

A corresponding parallel array called **arrCodes** contains letters from the alphabet, each representing the corresponding activity/facility described in the **arrActivities** array.

The **arrCodes** array contains the following elements:

W, A, S, R, X, D, H, P, T, L

The first element (letter W) in the **arrCodes** array represents the first element ('Water park') in the **arrActivities** array, the second element (letter A) in the **arrCodes** array represents the second element ('Aquarium') in the **arrActivities** array, and so on.

**arrActCodes** is a two-dimensional array that contains a combination of codes that represent activities and facilities that are accessible from a specific terminal when the visitor departs in a specific direction. The codes contained in this array are as follows:

	North	South	East	West
Terminal 1	DXWAT	HRDST	STWLP	RDT
Terminal 2	SWA	SRXD	LWXH	SHA
Terminal 3	WLSR	AT	DATX	HW

**NOTE:** The row and column headings are not provided as part of the two-dimensional array.

Example:

The activity code that applies when a visitor walks from Terminal 1 in a northerly direction is DXWAT.

Using the content of the **arrCodes** and **arrActivities** arrays, it can be established that the activities and facilities that the code DXWAT refers to are Diving, Shopping, Water park, Aquarium and Shark tank.

**NOTE:**

- You are NOT allowed to modify supplied data manually. Code must be written to manipulate the supplied data according to the requirements.
- The use of good programming techniques and modular design must be applied in the design and coding of your solution.

**3.1 Button [3.1 – Activity/Facility codes for all terminals and directions]**

The program must display the content of the two-dimensional array **arrActCodes** neatly in rows and columns. Display the directions as column headings and the terminals as row labels.

Example of output:

	North	South	East	West
Terminal 1	DXWAT	HRDST	STWLP	RDT
Terminal 2	SWA	SRXD	LWXH	SHA
Terminal 3	WLSR	AT	DATX	HW

(9)

**3.2 Button [3.2 – Activities/Facilities from a selected terminal and direction]**

The buttons that contain images must be used to select a terminal and direction. Code is provided to assign the selected terminal and direction to variables. The program must then use the supplied arrays to identify all the activities and facilities available on the selected route. Display the selected terminal and direction as a heading and a list of activities and facilities on the route selected.

Example of output if Terminal 2 and South are selected:

Terminal 2, South
Sea
Restaurants
Shopping
Diving

(11)

**3.3 Button [3.3 – Access routes to selected activity/facility]**

Once the user selects a specific activity/facility from the combo box provided, the user must be able to view all access routes to that specific activity/facility. Display the terminal number and the direction for each access route for the visitor to be able to reach the activity/facility selected.

The total number of access routes leading to the activity selected must be determined and displayed.

Example of output if Aquarium was selected from the combo box:

Access routes to Aquarium
Terminal 1, North
Terminal 2, North
Terminal 2, West
Terminal 3, South
Terminal 3, East
Number of access routes: 5

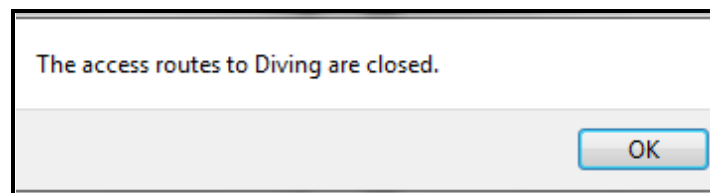
(10)



**3.4 Button [3.4 – Maintenance at selected activity/facility]**

The area where activities take place or facilities are provided may sometimes be closed due to maintenance. The user must select an activity/facility where maintenance must take place from the combo box provided. The program must remove all references to the selected activity/facility from the two-dimensional array and display a suitable message in a dialog box indicating that the information has been updated. The updated content of the two-dimensional array must be displayed in the output area.

Example of output if Diving was selected from the combo box:



Example of output after removing the letter D from the two-dimensional array **arrActCodes** due to maintenance that must be done on the diving facility:

Updated information:				
	North	South	East	West
Terminal 1	XWAT	HRST	STWLP	RT
Terminal 2	SWA	SRX	LWXH	SHA
Terminal 3	WLSR	AT	ATX	HW

(8)

- Enter your examination number as a comment in the first line of the program file.
- Save your program.
- Make a printout of the code if required.

**TOTAL SECTION C: 38**  
**GRAND TOTAL: 150**