



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2011

INFORMATION TECHNOLOGY: PAPER II

Time: 3 hours

120 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 9 pages. Please check that your question paper is complete.
2. This question paper is to be answered using Object-Oriented Programming principles. Your program must make sensible use of methods and parameters.
3. This paper is divided into two sections. All candidates must answer both sections.
4. This paper is set in programming terms that are not specific to any particular programming language (Java/Delphi) or database (Access/MySQL).
5. Make sure that you answer the questions in the manner described because marks will be awarded for your solution according to the specifications that are given in the question.
6. Only answer what is asked in each question. For example, if the question does not ask for data validation, then no marks are awarded for it, and therefore no code needs to be written.
7. If you cannot get a section of code to work, comment it out so that it will not be executed and so that you can continue with the examination. If possible, try to explain the error to aid the marker.
8. When accessing files from within your code, DO NOT use full path names of the file, as this will create problems when the program is marked on a computer other than the one you are writing on. Merely refer to the files using their names and extensions, where necessary.
9. 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. You are advised to look at the supplied data files carefully.
10. Make sure that routines such as searches, sorts and selections are developed from first principles, and that you do not use the built-in features of a programming language for any of these routines.

11. All data structures must be defined and declared by you, the programmer. You may not use components provided within the interface to store and later retrieve data.
 12. Read the whole question paper before you choose a data structure. You may find that there could be an alternative method of representing the data which will be more efficient considering the questions that are asked in the paper.
 13. You must save all your work regularly on the disk you have been given, or the disk space allocated to you for this examination.
 14. If there is a technical interruption that prevents you from writing your examination, (e.g. a power failure), when you resume writing your examinations, you will only be given the time that was remaining when the interruption began. No extra time will be given to catch up work that was not saved.
 15. Make sure that your examination number appears as a comment in every program that you code as well as on every page of hard copy that you hand in.
 16. Print a code listing of all the programs/classes that you code. Printing must be done after the examination. You will be given half an hour to print after the examination is finished. Your teacher will tell you what arrangements have been made for the printing of your work.
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THE SUMMER OLYMPICS

The Summer Olympics is a sporting competition that is held every 4 years in one host city from around the world. The last Summer Olympics were held in Beijing, China, in 2008. In 2012, the Summer Olympics will be held in London from 27 July to 12 August. The competition is widely considered to be the ultimate honour and test for any athlete.

After South Africa successfully hosted the 2010 FIFA World Cup, Durban is considering submitting a bid to the International Olympic Committee to host the 2020 Summer Olympics. No African city has ever hosted the Summer Olympics. Amongst the many requirements for a host city, technical expertise is of great importance. The South African Sports Confederation and Olympic Committee (known more commonly as SASCO) is in charge of the bidding process and would like to assess the technical talent of today's school leavers to see whether South Africa will have the required technical skills to host the Summer Olympics.

SECTION A STRUCTURED QUERY LANGUAGE

You are provided with the database **Olympics.mdb** which contains three tables. The data was retrieved from Wikipedia and is based on the 2008 Summer Olympics' results for Swimming and Athletics. The tables are described below:

tblCountries

This table lists the different countries that were awarded medals at the Summer Olympics of 2008. A sample of five rows are shown here for your reference:

code	country	continent
AUS	Australia	Australia and Oceania
AUT	Austria	Europe
BAH	Bahamas	North America
BEL	Belgium	Europe
BLR	Belarus	Europe

The three fields are defined as follows:

code	This field contains a unique code that identifies each country. This is the primary key.
country	This field contains the name of the country.
continent	This field contains the continent in which the country can be found.

tblEvents

This table lists the events in both swimming and athletics. This table contains only individual events and does not include team events such as a relay race. A sample of five rows from the table is shown here for your reference:

eventID	description	gender	category	officials
1	10 km marathon	Male	Swimming	15
2	10,000 metres	Male	Athletics	57
3	100 m backstroke	Male	Swimming	15
4	100 m breaststroke	Male	Swimming	15
5	100 m butterfly	Male	Swimming	15

The five fields are defined as follows:

eventID	This field contains a unique number to identify each event. This is the primary key and an auto-numbering field.
description	This field contains a description of the event.
gender	This field contains the gender of the competitors who will take part in the event.
category	This field contains the category (either 'Swimming' or 'Athletics') to which the event belongs.
officials	This field contains the number of officials that are required to be at the event to keep time, judge places and perform the other tasks involved with running the event.

tblResults

This table lists the medal winners for each event. A sample of five rows from the table is shown here for your reference:

resultID	eventID	athlete	medal	code
215	7	Richard Thompson	Silver	TRI
216	28	Wilfred Bungei	Gold	KEN
217	57	Natalie Coughlin	Bronze	USA
218	73	Tia Hellebaut	Gold	BEL
219	44	Rebecca Soni	Silver	USA

The five fields are defined as follows:

resultID	This field contains a unique number to identify each result. This is the primary key and an auto-numbering field.
eventID	This field contains the event number. It is a foreign key for the tblEvents table.
athlete	This field contains the full name of the athlete.
medal	This field contains the type of medal that was awarded to the athlete. A first place is awarded a gold medal, a second place is awarded a silver medal and a third place is awarded a bronze medal.
code	This field contains the country code to indicate which country the athlete is competing for. This field is a foreign key for the tblCountries table.

QUESTION 1

- 1.1 Write a query that will list all the information about the countries that are listed in the database, sorted in alphabetical order using the country name. (3)
- 1.2 Write a query that will list all the information about the swimming events. (3)
- 1.3 Write a query that will list only the names of the athletes who were awarded a gold or a silver medal. Your results might contain duplicate names. (4)
- 1.4 Write a query that will display the number of countries from each continent. (4)
- 1.5 Russia is in both Europe and Asia. The IOC has decided that, because Russia's capital city is in Europe, it should be classified as a European country. Write a query that changes Russia (which uses the code 'RUS') to a country in Europe. (3)
- 1.6 Kerron Stewart from Jamaica (which uses the code 'JAM') is missing from the results table. She participated in the female '100 metres' event which has an **eventID** value of 47. She finished in the same time as Sherone Simpson and thus also receives a silver medal. Write a query that will insert this record into the database. (4)
- 1.7 Write a query to list only the names of the athletes in the database who participated in the '100 metres' events. (5)
- 1.8 Write a query that will list the total number of each type of medal won by each country. (7)
- 1.9 Officials are paid R500 per event. Calculate the total amount that would be paid to the officials for all the freestyle swimming events. Ensure that your result shows this amount in a column called 'Cost'. (7)

40 marks

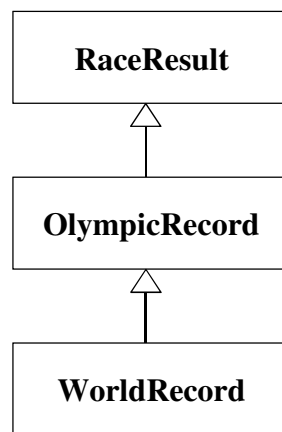
SECTION B OBJECT-ORIENTED PROGRAMMING

Please note that Section B is not dependent on any work you did in Section A.

During the Summer Olympics many athletic and swimming records will probably be broken. The records that are broken will be one of two records. Firstly, it may be an Olympic Record where the competitor has achieved a result that has never before been achieved in the Summer Olympics. Secondly, it may be a World Record where the competitor has achieved a result that has never before been achieved in any formal competition anywhere in the world. If someone achieves a World Record, it follows that they also achieve an Olympic Record. A person who achieves a record must be in position 1.

The program you develop must be able to validate the information in a given file by finding any athletes who have mistakenly been listed with either Olympic or World records. In addition, the athletes' race times must be converted to seconds.

In order to model this in computer terms, we will use the following class structure:



You are also provided with a text file called **ResultData.txt** that contains result data¹. An extract of this file appears below.

```

Carey Blem#ITA#6#---#4m49.8
Tamera Hoesly#POR#1#---#4m6.2
Toi Swauger#FRA#1#OLR#51.3
Moises Mellenthin#ZIM#2#---#4m34
Madelene McClennon#LUX#1#WRC#1m52.7
Lashon Meisenheimer#RSA#1#---#2m31.2
  
```

Each line in the text file has 5 fields that are separated by the '#' character. The fields are:

- The athlete's name
- The athlete's country (represented by a code)
- The position that the athlete finished in
- The type of record, if any, that they achieved. The record is represented by a three character code where '---' represents no record was achieved, 'OLR' indicates that an Olympic Record was achieved and 'WRC' indicates a World Record was achieved.

¹ Unlike the data used in Section A (SQL), this data file is filled with fictional data and random names and is not related to any actual Olympic results. However, that is not important when answering Section B (Object-Oriented Programming) and you may simply assume that they are athletes you haven't heard of!

- The time that the athlete achieved in minutes and seconds. Note that finishing times less than one minute may be given without a value for minutes. For example, a time of 19.8 seconds could be represented as either 0m19.8 or 19.8.

Finally, you are given the following class diagram for the **RaceResult** class:

RaceResult
Properties: – athlete : String – country : String – position : integer – raceTime : String
Methods: + constructor (athlete : String; country : String; position : integer; raceTime : String) + getAthlete : String + getCountry : String + getPosition : integer + getTime : String + toString : String

QUESTION 2

Write code to create the **RaceResult** class based on the class diagram provided above. Ensure that the properties and methods are created using the correct access modifiers and return types as presented in the class diagram. The **toString** method should return a String in the format '**athlete (country): position**'. An example of the output from the **toString** method is shown below using the details of the first athlete in the file:

```
Carey Blem (ITA) : 6
```

[15]

QUESTION 3

- 3.1 Write code to create the **OlympicRecord** class which must extend the **RaceResult** class. (2)
- 3.2 Override the constructor method from the parent class. (3)
- 3.3 An athlete can only hold a record if they are placed first. Write code to create a method called **isValid** which will check to see that the position stored in the **OlympicRecord** object is 1. This method must return a Boolean value to indicate whether this is the case or not. (4)

*Note that we are not finished with the **OlympicRecord** class yet. You will be required to add another method to it in Question 6. You may attempt that question now if you wish, but you are advised to continue with the questions in the order that they are presented to you.*

[9]

QUESTION 4

- 4.1 Write code to create the **WorldRecord** class which must extend the **OlympicRecord** class. (1)
- 4.2 Override the constructor method from the parent class. (2)
- 4.3 Override the **toString** method to append the text 'World Record' to the output of the parent class's **toString** method. (3)
- [6]

QUESTION 5

- 5.1 Write code to create a class called **RecordManager**. (1)
- 5.2 Write code to declare an appropriately named, private instance array of 500 **RaceResult** objects in the **RecordManager** class. The class will also need an appropriately typed and initialised instance variable to track the number of objects that are stored in the array at any one point. (4)
- 5.3 Write code to create a default constructor method in the **RecordManager** class. The constructor method must read in the contents of the data file **ResultData.txt**. Once read in, the fields must be extracted and checked to see which of the three **Result** objects should be instantiated. Once instantiated, the object should be appended to the instance array of results. (12)
- 5.4 Write code to create a **toString** method for the **RecordManager** class that will return a String containing the output of all the **toString** methods from the objects contained within the array. Each object's **toString** output should be separated by a newline character. (5)
- 5.5 Write code to create an appropriately named method in the **RecordManager** class that will remove (delete) an element from the instance array of results. The method should accept an integer parameter in order to determine which of the elements should be removed. (5)
- 5.6 Write code to create **TWO** appropriately named methods in the **RecordManager** class that will, in the first method, count the number of Olympic records and, in the second method, count the number of World records that are stored in the array. Use the principles of object oriented design to count the records of each type. These two methods should both return integer values. (6)
- 5.7 Write code to create a method in the **RecordManager** class called **validate** that will iterate through the elements in the instance array of results and check that all the Olympic and World records are valid. If a record is not valid, it must be deleted from the array. Use the methods that you have created already to help you. (6)
- [39]

QUESTION 6

- 6.1 In the **OlympicRecord** class, create a method called **getTimeInSeconds** which will convert the String version of the time into a number of seconds. For example, 2m23.4 is $(2 \times 60) + 23.4 = 143.4$ seconds. Your method should return only the number of seconds as a number with decimal places. (5)
- 6.2 Override the **toString** method in the **OlympicRecord** class to include this time in seconds at the end of the String. (2)
- [7]

QUESTION 7

Create a simple interface for your program that will perform the following functions in this order:

- Instantiate a **RecordManager** object, and using this object:
 - List all the data stored in the array.
 - Display the number of Olympic records with an appropriate heading.
 - Display the number of World records with an appropriate heading.
 - Validate the data in the array.
 - Display again the number of Olympic records with an appropriate heading.
 - Display again the number of World records with an appropriate heading. (4)
- [4]

80 marks

Total: 120 marks