Total Marks — 60

Attempt ALL questions

1. The owners of a monthly magazine decide to update the company website. The current website allows users to access online versions of articles printed in the monthly magazines.

(a) Requirements for the updated website are listed below.

The updated website will allow all users to:
• access a maximum of five free articles every month
• search for articles over 12 months old
• subscribe to the full service using a secure payment system

The updated website will allow subscribed users to:
• log-in to gain access to the full service
• access any number of articles
• search for articles without restriction
• renew their subscription at a reduced rate using a secure payment system

Draw a use case diagram to represent these requirements.
1. (continued)

(b) Two designs for the human computer interface (HCI) of the search facility for the updated website are produced. The two designs are shown.

![Diagram of Design 1 and Design 2]

Users must type the topic and then either type the date in the required format or select the date from the calendar.

(i) Discuss the suitability of each design for use with a smartphone or tablet device.

- **Design 1**: Much more user-friendly and easier to search for in calendar, but much more clunky than design 2.

- **Design 2**: Scroll wheel complex for action, with minimum consumer input, therefore is much more suitable for smartphones, also used in scrolling on phones.

(ii) During testing of the search facility, the following list of articles is produced.

<table>
<thead>
<tr>
<th>Article Title</th>
<th>Summary</th>
<th>Date</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processors</td>
<td>Recent processor development</td>
<td>06/05/2016</td>
<td>214</td>
</tr>
<tr>
<td>Printers</td>
<td>Inkjet or Laser?</td>
<td>25/03/2016</td>
<td>208</td>
</tr>
<tr>
<td>Smartphones</td>
<td>Control your phone by thought</td>
<td>13/05/2016</td>
<td>215</td>
</tr>
</tbody>
</table>

Describe how an insertion sort would reorder the three articles above, listing the articles in chronological order with the most recent article first.

The insertion sort would take an item and compare it to the item above it. If the item is bigger, it is swapped with the next item until it is not as big as the number above it or it is bigger than it.
1. (c) (continued)

(ii) Having received the HTML form data, the server-side script “subscription.php” then executes a number of processes. The script:

1. assigns the HTML username and password to server-side variables
2. creates a connection with the database server
3. adds data to “member” table of the “subscribedata” database
4. closes the connection

The name of the database server is “magserver” and the username is “subscribe” with the corresponding password “subpass”.

Using pseudocode or a server-side scripting language with which you are familiar, write code for processes 1, 2, 3 and 4 described above.

```php
<?php
$member = $_POST["member"];  
$query = "INSERT INTO
password = $_POST["password"],
username = $_POST["username"],
$query = "INSERT INTO
(password, $username) INTO
$member"");
$link = mysql("magserver", "subscrib", "subpass");
mysql_db("subscribedata", $link);
mysql_query("$query");
?>
```
2. Radio Lowden plays songs from the years 1990 to 1999 inclusive. The songs played by the radio station must have featured in the official UK top 40 singles chart from these years.

(a) Using the above example, explain the terms scope and constraints.

The scope is what the item should contain and all features (from 1990-1999 and in top 40) whereas the constraints are limitations that stop the scope being achieved.

(b) The management of Radio Lowden has commissioned a developer to create a new website for the radio station. One of the pages of the new website will give access to playlists from recent radio programmes.

(i) The developer suggests that the layout and interface of the website belonging to a rival radio station could be copied and used by Radio Lowden.

Discuss whether this is acceptable practice.

This is not an acceptable practice as the copyright designs and patents are an intellectual property (usefulness and service). If the radio station decides to sue then Lowden could be in serious financial trouble. The radio station might hold since the layout is intellectual property then copying it is a breach.
2. (continued)

(c) A PlayList table is used to store details of all playlists created by Radio Lowden and details of each song are stored in a separate table called Song. These tables are part of a relational database.

Sample data for the PlayList and Song tables are shown.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProgrammeID</td>
<td>1</td>
</tr>
<tr>
<td>SongID</td>
<td>A34213</td>
</tr>
<tr>
<td>DatePlayed</td>
<td>27/05/15</td>
</tr>
<tr>
<td>TimePlayed</td>
<td>09:00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>SongID</td>
<td>A34213</td>
</tr>
<tr>
<td>Title</td>
<td>Jack &amp; Dee</td>
</tr>
<tr>
<td>Artist</td>
<td>Soozie – L</td>
</tr>
<tr>
<td>Year</td>
<td>1997</td>
</tr>
</tbody>
</table>

(i) Write the SQL statement which will create the structure of the PlayList table.

```
CREATE TABLE Playlist (Programme ID, Song ID, Date played, Time played)
VALUES (1, A34213, 27/05/15, 09:00)
```

(ii) Write the SQL query which will list the title of each song played on 26 May 2016.

```
SELECT SongID FROM SongTable
WHERE Dateplayed = '27/05/15'
```

```
SELECT Title FROM SongTable
WHERE SongID = (SELECT SongID FROM Playlist WHERE DatePlayed = '27/05/15')
```
2. (continued)

(d) The titles of the songs in one of the playlists are exported to a program for processing using a queue structure. The queue has been implemented as a 1-D array.

The contents of the queue are shown.

```
front → My Name is Lynnie
           Jack & Dee
           Moviestar Monster
           Draughty Man Blues
```

Use pseudocode to write an algorithm to remove a played song from the top of the playlist queue.

```
define front as integer
define array[11] as string
define back as integer

front = 0
back = 1

if front < end of list
    array(front) = 0
    if front = end of list
        front = 0
    else
        front = front + 1
```
3. A program is to be written to process the results of different events in the 2016 Olympic Games.

(a) A simplified version of the UML class diagram for the program is shown.

(i) By referring to the class diagram above, explain:
   - the difference between a class and an object
   - encapsulation
   - inheritance

   * A class is a blueprint for an object,
   * whereas an object is an instance of a class.
   * Object = Usain Bolt, Class = Athlete
   * Encapsulation means that inside a class, properties and can only be changed by an associated method (eg: class - method).
   * Inheritance is when a class inherits the contents of class above it.
(b) The details of the athletes taking part in individual events will be stored in separate arrays of objects. For example, the longjumpM array will store the details of all 32 male athletes taking part in the long jump event.

Using a programming language with which you are familiar, write the code used to create the array of objects used to store details of the 32 male athletes in the long jump event.
3. (continued)

(c) Two introduce methods have been written for the Member and Athlete classes respectively.

```
# Version in Member class
PROCEDURE introduce()
  SEND "Hello, my name is " & THIS.firstName TO DISPLAY
END PROCEDURE

# Version in Athlete class
OVERRIDE PROCEDURE introduce()
  SEND "Hello, my name is " & THIS.firstName TO DISPLAY
  SEND "I'm an athlete on the team" TO DISPLAY
END PROCEDURE
```

A new Team object called myTeam has been created. The following calls have been made to add Ali, Omar and Nour to the team.

```
myTeam.addMember( Athlete(“Ali”, <only firstName needed here> ) )
myTeam.addMember( Member(“Omar”, <only firstName needed here> ) )
myTeam.addMember( Official(“Nour”, <only firstName needed here> ) )
```

(i) Write down the output displayed by the following procedure call:

```
myTeam.introduceTeam
```

```
"Hello, my name is Omar"
"Hello, my name is Ali"
"I'm an athlete on the team"
```
3. (continued)

(e) The Olympic Games generate a large amount of data. Sources of this big data will include ticket sales, competition and performance data, information gathered from retail and catering outlets and details of sponsorship deals and merchandising. Data analytics will be used to analyse the big data.

Using one of the sources of big data listed above, describe one benefit to the Olympic Games Management Committee of using analytics when preparing for the 2020 Olympic Games.

By measuring ticket sales, the committee can establish how many large stadium capacities should be for the next game. If they consistently sold out then the next Games Olympics should have larger stadiums etc.
4. Dawid Mahyne is studying Advanced Higher Computing Science. His teacher has asked him to compare the computational constructs provided by a procedural programming language with those provided by a database.

Dawid starts by creating a database file called “pupils.db”. The file contains one table called “pupildata” which stores the pupil data shown.

<table>
<thead>
<tr>
<th>PupilID</th>
<th>FirstName</th>
<th>LastName</th>
<th>DateOfBirth</th>
<th>RegClass</th>
</tr>
</thead>
<tbody>
<tr>
<td>112211</td>
<td>Joan</td>
<td>Simpson</td>
<td>23/02/1999</td>
<td>6A</td>
</tr>
<tr>
<td>112212</td>
<td>John</td>
<td>Adam</td>
<td>12/04/1998</td>
<td>6B</td>
</tr>
<tr>
<td>112213</td>
<td>Alison</td>
<td>Brown</td>
<td>30/10/1998</td>
<td>6A</td>
</tr>
<tr>
<td>112214</td>
<td>Brian</td>
<td>Morgan</td>
<td>18/11/1998</td>
<td>6C</td>
</tr>
<tr>
<td>112216</td>
<td>Lian</td>
<td>Wong</td>
<td>27/05/1998</td>
<td>6A</td>
</tr>
<tr>
<td>112217</td>
<td>Charles</td>
<td>West</td>
<td>23/06/1998</td>
<td>6B</td>
</tr>
<tr>
<td>112218</td>
<td>Janet</td>
<td>Smith</td>
<td>18/02/1999</td>
<td>6B</td>
</tr>
<tr>
<td>112219</td>
<td>Raymond</td>
<td>Thomas</td>
<td>07/12/1998</td>
<td>6B</td>
</tr>
<tr>
<td>112220</td>
<td>Theresa</td>
<td>Cameron</td>
<td>29/01/1999</td>
<td>6A</td>
</tr>
</tbody>
</table>

Dawid writes a program to import the pupil data from the database file and store it in an array of records called “details”. His program then applies a binary search to the array of records to display the details of the pupil with PupilID 112213.

(a) (i) Use pseudocode to create the top level design for the program. Your top level design should define the required data structure and call all necessary modules.

```
Structure pupil_data
    pupil_data. PupilID = Integer
    pupil_data. FirstName = String
    pupil_data. LastName = String
    pupil_data. DateOfBirth = Date
    pupil_data. RegClass = String
End Structure

Declare pupils as pupil_data.
Binary search (pupils)
Binary search (Pupils(4)).
```
4. (a) (continued)

(ii) Use pseudocode to refine the binary search used to display the details of the pupil with PupilID 112213.

```plaintext
found := false
min := 0
max := 9

DO
mid := (min + max) / 2
IF search > mid THEN
    min := mid + 1
ELSE
    max := mid - 1
ENDIF
UNTIL found = true or min > max

DISPLAY (pupil(ID=mid)).first
DISPLAY pupils(mid).pupilID, pupils(mid).firstName,
pupils(mid).lastName, pupils(mid).DOB,
pupils(mid).keyClass.
```
4. (continued)

(b) During testing of the program, Dawid changes the registration class of the pupil with PupilID 112213 from 6A to 6B.

Using pseudocode or a language you are familiar with, write the code needed to edit the required details in the external database file called “pupil.db”.

```
UPDATE pupil db
WHERE pupilID = 112213 and RegClass = 6A
SET RegClass to 6B.
```
4. (continued)

(c) Dawid decides to add a new module to his program. This module sorts the data in the array of records into ascending order of registration class. Part of Dawid’s code is shown.

<table>
<thead>
<tr>
<th>Line</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td># Name of Sort Algorithm Used: ____________________________</td>
</tr>
<tr>
<td>2</td>
<td>REPEAT</td>
</tr>
<tr>
<td>3</td>
<td>SET swapped TO false</td>
</tr>
<tr>
<td>4</td>
<td>FOR counter FROM 1 TO 9</td>
</tr>
<tr>
<td>5</td>
<td>IF</td>
</tr>
<tr>
<td>6</td>
<td>SET swapped TO true</td>
</tr>
<tr>
<td>7</td>
<td>&lt; swap data &gt;</td>
</tr>
<tr>
<td>8</td>
<td>END IF</td>
</tr>
<tr>
<td>9</td>
<td>END FOR</td>
</tr>
<tr>
<td>10</td>
<td>UNTIL swapped = false</td>
</tr>
</tbody>
</table>

Line 1 and Line 5 of the code are incomplete. Provide the missing details by rewriting both lines of code.

```
Line 1: false bubble sort
Line 5: registration(counter) < registration(counter-1)
```

(d) Dawid’s school has 2000 pupils.

Explain why it may be more appropriate to use a quick sort rather than the sort algorithm used in part (c) above.

Quick sorts divide and conquer and use less primary memory than bubble sort. Also, quick sorts are more appropriate due to the nature of repeating data.