UNIVERSITY EXAMINATIONS

UNIVERSITEITSEKSAMENS

UNISA university of south africa

INP1501

Oct/Nov 2021

Introduction to Programming IA

Duration : 2 Hours

75 Marks

EXAMINERS :

FIRST : MS P MVELASE
SECOND : DR MA SCHOEMAN

Use of a non-programmable pocket calculator is permissible.

Closed book examination.

This examination question paper consists of 9 pages.

INSTRUCTIONS:

- Number your answers clearly.
- Marks are awarded for part of an answer, so do whatever you are able to in each question.

ALL THE BEST!

QUESTION 1 **10 MARKS**

1.1 What is the value of `x` after the following code fragment has been executed? (1)

```
int x = 10;
x += x;
x += x+5;
```

1.2 How many times will the following `for` loop iterate? (1)

```
j = 0;
for (int i = 5;j < 10;i++)
{
      j += i;
      cout << i << '\t' << j << endl;
}
```

1.3 Consider the following C++ program. What is the output? (1)

```
#include <iostream>
using namespace std;
int num = 0;
void set_num()
{
   int num = 6;

}
int main()
{
   set_num();
   cout << num;
   return 0;
}
```

1.4 Consider the following code segment. What is the output? (1)

```
int a = 5;
a++;
cout << a++;
```

1.5 An array variable `arr` is declared and initialised as follows. What is the value stored in the array position `arr[2][1]`? (1)

```
int arr[][2] = {{3,2},{4,5},{9,7}};
```

1.6 `size()` is an accessor member function of class `string` used to find the length of a string. Complete the `cout`statement below to display the length of the string `name` used in the code segment. (1)

```
string name = "O R Tambo";
cout << "The length of the string is " << ..... << endl;
```

1.7 What is the value of `sum` after the following code has been executed? (1)

```
int numbers[] = {5,6,0,3,1,2};
int i = 1, sum = 0;
while( i < 5 )
{
      sum += numbers[i] % 3;
      i = i + 2;

 }
```

1.8 Name two fundamental data types in C++. (1)

1.9. What is the value of `word` after the following code fragment is executed? (1)

```
string word = "SouthAfrica";
word.erase(1, 4);
```

1.10 Write the statement that will include the `iostream` header file in a C++ program. (1)

QUESTION 2 **4 MARKS**

In Questions 2.1 and 2.2 you have to write down what the purpose of the segment of code is. Look at the following example before answering the questions:

```
int a,b,c;
cin >> a >> b >> c;
cout << c + b + a;
```

The purpose of the above code segment is to input three integer values and display their sum.

Now answer questions 2.1 and 2.2 below:

2.1 Consider the following code segment. Explain in words what the purpose of the following segment of code is: (2)

```
int num[5] = {4,5,2,1,6};
int i = 0;
int sum = 0;
while (i < 5)
{
   if((num[i] % 2) == 0)
      sum += num[i];
   i++;
}
cout << sum;
```

2.2 Explain the purpose of the following segment of code: (2)

```
int a, b, temp;
cin >> a >> b;
temp = a;
a = b;
b = temp;
cout << a << endl << b;
```

QUESTION 3 **6 MARKS**

3.1 Convert the following `switch` statement to an `if…else` statement. (2)

```
switch(level)
{
      case 1:
      case 2:
            cout << ”Basics”;
            break;
      case 3:
            cout << ”Intermediate”;
            break;
      case 4:
            cout << ”Advanced”;
            break;
      default:
            cout << ”Not a valid level”;
}
```

3.2 Following is a program that successfully outputs all the prime numbers below 10. It uses a nested loop. Rewrite the complete program by replacing both the `for` loops with `while` loops. (4)

```
#include <iostream>
using namespace std;
int main()
{
      //prime numbers below 10
      int i = 2, j;
      bool prime = true;
      for(i = 2; i < 10; i++)
      {
            prime = true;
            for(j = 2; j < i; j++)
            {
                  if(i % j == 0)
                    prime = false;
            }
            if(prime)
                  cout << i << endl;
      }
}
```

QUESTION 4 **13 MARKS**

4.1 Define a variable. (1)

4.2 Differentiate between a global variable and a local variable. (1)

4.3 Declare a C++ variable to store a floating point number. (1)

4.4 What is a function in C++? (1)

4.5 Name any two in-built functions in C++? (1)

4.6 Differentiate between actual parameters and formal parameters. (2)

4.7 Differentiate between value parameters and reference parameters. (2)

4.8 Consider the following code fragment. The main function calls a function `calcInterest` to calculate simple interest. Write the correct function header for `calcInterest`. (2)

```
int years;
float principal, interest;
float rate;
interest = calcInterest(principal,rate,years);
```

4.9 Consider the following code fragment and answer questions 4.9.1 to 4.9.4. (4)

```
void multiply(int & result, int num3, int num4)
{
    //Assume code here
      ……..
}
int main()
{
    //Assume variable declarations and initialisation here
      ……
    multiply(product,num1,num2);
}
```

4.9.1 Identify one formal parameter.

4.9.2 Identify one actual parameter.

4.9.3 Identify one reference parameter.

4.9.4 Identify one value parameter.

QUESTION 5 **5 MARKS**

5.1 Define a structure named `employee` that can be used to record details of an employee in company ABC. The details of the employee to be recorded are `StaffNo`, `DeptID` and `AnnualSalary`. Staff number is made up of numbers only and the department ID is a combination of numbers and characters. Use the given variable names and choose the most appropriate data type for all the members of the structure. (2)

5.2 Using the structure defined in Q 5.1 write the C++ statement that declares an array of type `Employee` for storing the details of fifty employees in the company ABC. (1)

5.3 Use the array declared in Q 5.2 in the following `for` loop to read the details of fifty employees. Complete all the blanks in the code snippet. (2)

```
for(……)
{
  cout << "Enter staff no. of the employee"<<endl;
  cin      >> ……;
  cout << "Enter department ID of the employee"<<endl;
  cin      >> ……;
  cout << "Enter annual salary of the employee"<<endl;
  cin      >> ……;
}
```

QUESTION 6 **20 MARKS**

6.1 Write a C++ program that reads ten integer elements into an array and then display the sum and average of the numbers in the array. Most appropriate data types should be used. Note that the average of the numbers could result in a floating point number. Explicit type conversion should be applied so that average is displayed accurately. (4)

6.2 Write a program that checks for a number in an array of unique integers. You should write a function `checkNumber()` for this purpose. The function returns a boolean value based on whether the number is found in the array or not. The incomplete `main` program is given below. The `main` function displays the output. If the number is found, the position of the number in the array is included in the output. You have to complete the `main` program and write the `checkNumber` function based on what is outlined in the `main` function below. You have to make sure that the array is not modified inside the `checkNumber()`. You are not allowed to add any extra lines or variables in `main()`.

6.2.1 Write the `checkNumber()` function. (6)

6.2.2 Complete the function call. (1)

6.2.3 Complete the `cout` statement. (1)

```
1.    #include <iostream>
2.    using namespace std;
3.    const int size_of_array = 10;
4.    //Q6.2.1-write the complete code for function checkNumber here
5.    int main()
6.    {
7.      int arr[size_of_array], pos = 0, num;
8.      bool yesNo;
9.      //read values into the array
10.     cout << "Enter elements of the array" << endl;
11.     // Assume statements to input the array here
12.     // Do not write these statements
13.     cout << "Enter an integer number";
14.     cin >> num;
15.     //Q6.2.2 - calling the function checkNumber
16.     yesNo = checkNumber(……);
17.     if(yesNo) //Q6.2.3 below
18.       cout << "The integer appears at position " << …… << " of
          the array";
19.     else
20.       cout << "The integer is not found in the array";
21.     return 0;
22.   }
```

6.3 Write a program that reads a name in the format `firstName lastname` and outputs it as `lastName, firstName`. eg: input Raymond Hyde to the program should be displayed as Hyde, Raymond. The program should include the required header files and should work for any name entered in this format. (4)

Hint:-You may find some of the following library functions useful.

Function Signature	**Description**
`int size()`	Returns the size (i.e. length) of a string object.
`string substr(int,int)`	Returns a substring of a string object. The first parameter specifies the starting position (i.e. the position from which the substring should be copied) and the second parameter specifies how long the substring should be (i.e. how many characters should be copied). The second parameter may be omitted, in which case the sub-string consisting of all the characters from the starting position (specified by the first and only parameter) to the end of the string are returned.

`int find(string,int)`	Returns the position of a string (specified as the first parameter) within a string object. The second parameter is optional, and can be used to specify where the search has to be commenced. If omitted, the search commences at the beginning of the string object. If the string being sought is not found, -1 is returned.
`void insert(int,string)`	Inserts a string (specified as the second parameter) into a string object at a particular position (specified as the first parameter) Erases a substring from a string object. The substring that is to be erased is determined by the two parameters: from the position specified by the first parameter, as many characters as specified by the second parameter
`void erase(int,int)`	Erases a substring from a string object. The substring that is to be erased is determined by the two parameters: from the position specified by the first parameter, as many characters as specified by the second parameter
`void replace(int,int,string`	Replaces specified characters of a string object with another string. The characters to be replaced are determined by the first two parameters: from the position specified by the first parameter, as many characters as specified by the second parameter. The string to be inserted in their place is specified by the third parameter.
`getline(istream, string &, char)`	Extracts characters from an input stream up to the first occurrence of a delimiting character and copies them to a string.

6.4 Assuming the following declarations, write a nested `for` loop to add 5 to every element of the array that is completely divisible by 5. Write only the `for` loop. (4)

```
const int row_size = 4;
const int col_size = 3;
int arr[row_size][col_size] = {7,17,8,52,4,15,25,6,14,30,2,10};
```

QUESTION 7 **11 MARKS**

7.1 What is value of `x` after the following code fragment has been executed? (2)

```
bool p = true, q = false;
int x = 5;
if( !(p  && !(p || q) ) )
      ++x;
x++;
```

7.2 What is the output of the following program? (2)

```
#include <iostream>
using namespace std;
void multiply1(int & p, int & q)
{
    int r = p * q++;
}
void multiply2(int & p, int  q)
{
    int r = ++p * q;
}
int main()
{
    int p = 2, q = 3;
    multiply1(p,q);
    multiply2(p,q);
    cout << p * q << endl;
    return 0;
}
```

7.3 Draw variable diagrams for the following. (7)
Remember the following conventions used for variable diagrams:

- A question mark ? shows an uninitialised value for a variable.
- The notation 25 ->5 means that execution jumps from line 25 to line 5.
- Use square brackets [ ] around the name of a variable to show that it is inaccessible while the current function is being executed.

```
1. #include <iostream>
2. using namespace std;
3. void func1(int & x, int & y, int z)
4. {
5.    z += (++x) + (y++);
6. }
7. void func2(int x, int y, int & sum)
8. {
9.     sum = x + y;
10.}
11.
12. int main()
13. {
14.    int a = 4, b = 5, c = 0;
15.    func1(a,b,c);
16.    cout << a << b << c << endl;
17.    func2(a,b,c);
18.    cout << a << b << c << endl;
19.    return 0;
20. }
```

QUESTION 8 **6 MARKS**

8.1 Define a structure named `sales` with two data members. The first member stores the ID of a sales person. The second member is a floating point array of size four that stores the sales amounts for four quarters of the year for this sales person. (2)

8.2 Declare a variable of type `sales`. (1)

8.3 Using the structure defined and declared in Q 8.1 & Q 8.2 write a function `calcSales` with return type `void` that calculates and displays the total sales for the year for a sales person. Assume that the main program is written and the details of the sales person are passed to the function `calcSales` as a structure variable. Write only the code for function `calcSales`.

(3)