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Computer Science

CSC371 Advanced Object Oriented Programming

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Time allowed: 2 Hours

Do not turn over your question paper until instructed to do so.

Exam Paper Information

Answer all questions.

Special Instruction(s)

For Questions 2&3, you should write your answers using bullet points and not in paragraphs. You should aim to have at most one sentence per bullet point.

Specific Items

Dictionaries	- Candidates may only refer to the English and Welsh language dictionaries available
Calculators	- Candidates may NOT use a calculator
Open Book	- This is NOT an Open Book examination

Question 1. This question relates to advanced concepts of object-oriented programming available in C++. (**TOTAL 15 MARKS**)

a. Functions go in which section of a class definition (write one Roman letter only)?

(i) Declaration
(ii) Implementation
(iii) Prototype
(iv) Functioning [**1 mark**]

b. Where you can place template functions (write one Roman letter only)?

(i) At the end of `main()`
(ii) At the start of a program above `main()`
(iii) In two files: one for the definition and one for the function
(iv) Any of the above [**1 mark**]

c. How do you declare the *this pointer* with a member function (write one Roman letter only)?

(i) Declare *this* as static
(ii) Declare *this* as global
(iii) Define *this* as equal to the address of the appropriate object
(iv) Do nothing; it is automatically supplied for you [**1 mark**]

d. When accessing a member of a structure, what is the term used to describe the identifier to the left of the dot operator (write one Roman letter only)?

(i) A structure member
(ii) A structure tag
(iii) A structure variable
(iv) The keyword structure [**1 mark**]

e. Assume a program contains a void function named `displayName`, which requires no formal parameters. Which of the following is a correct function prototype for this function (write one Roman letter only)?

(i) `displayName;`
(ii) `displayName(void);`
(iii) `void displayName;`
(iv) `void displayName();` [**1 mark**]

Question 1 continues on the following page

Question 1 continued.

f. Assume `fee` is an array of structures and the structures contain a member called `amount`. Which of the following will increase the value stored in the member `amount` of the first element of the array `fee` by 2 (write one Roman letter only)?

(i) amount[0] = amount[0] + 2;
(ii) amount, fee[0] = amount, fee[0] + 2;
(iii) feeInfo.amount[0] = feeInfo.amount[0] + 2;
(iv) fee[0].amount = fee[0].amount + 2; [**2 marks**]

g. What does a constructor initialization produce similar results to (write one Roman letter only)?

(i) Function overriding
(ii) Assignment operation
(iii) Function redeclaration
(iv) Output variables [**2 marks**]

h. What do you need to do to instantiate an object of a derived class (write one Roman letter only)?

(i) An object of the parent class must be instantiated first
(ii) An object of the child class must be instantiated first
(iii) An object of the parent class must not be instantiated
(iv) An object of the child class must not be instantiated [**2 marks**]

i. Which functions do not have a *this pointer* (write one Roman letter only)?

(i) Access functions
(ii) Inspector functions
(iii) Member functions
(iv) Static functions [**2 marks**]

j. Which is the most efficient way to sort a large collection of objects or structures (write one Roman letter only)?

(i) Place them in an array and sort the array
(ii) Assign pointers to them in an array and sort the array
(iii) Place them in a linked list and sort the linked list
(iv) Assign references to them in an array and sort the array [**2 marks**]

Question 2. (**TOTAL 15 MARKS**)

a. What is a *virtual function* (write one sentence)? In the context of virtual functions, how does C++ determine which function is to be invoked in runtime (write one sentence)? Write down any three rules of virtual functions. [**5 marks**]

b. A class containing a *pure virtual function* is known as a base class. What cannot a base class do (write one sentence)? What is the main purpose in using a base class (write one sentence)? Write a simple example in C++ showing the use of a pure virtual function (no more than 15 lines of code). [**5 marks**]

c. Explain the RAII idiom in at most 5 sentences. **[5 marks]**

Question 3. (TOTAL 20 MARKS)

a. Write a one-sentence explanation of runtime polymorphism in C++. State three situations in which the use of runtime polymorphism is necessary. **[4 marks]**

b. State two main differences between *references* and *pointers* in C++? **[4 marks]**

c. State two main differences between *shallow copies* and *deep copies in C++*. **[4 marks]**

Question 3 continues on the following page.

Question 3 continued.

d. The *singleton principle* applies if you are dealing with single concrete resources where it does not make sense to allow copy semantics. Assuming that `Areas` is a singleton concrete resource, which involves *copy* and *move* operations for the data data resources in the database, complete the missing copy and move construtors and assignment operators in the code below.

```
1 class Areas {
2 public:
3    Areas();
4    ~ Areas() = default;
5    Areas(…); // Complete this line as copy constructor
6    Areas(…); // Complete this line as copy assignment
operator
7    Areas(…); // Complete this line as move constructor
8    Areas(…); // Complete this line as move assignment
operator
9 }
```

[4 marks]

e. Write one sentence to provide an explanation of *inline functions.* Implement an inline function `int add(int a, int b)` as a member function of a `class A`. The function `int add(int a, int b)` should return the sum of `a` and `b` (no more than 10 lines of code). **[4 marks]**

END OF PAPER