

Answer **THREE** Questions

1. a) *Outline* the design of a queue template class in C++, including the full set of member functions needed to ensure that queue objects can be created, copied, assigned and deleted correctly. Include exception handling to deal with errors such as the queue being empty or full. (Complete C++ code is not required.)

[16 marks]

- b) Rewrite the class outline in Java, showing how Java deals with the absence of the C++ template mechanism.

[12 marks]

- c) Which of the queue classes can be described as the safest to use, and why?

[5 marks]

[Total 33 marks]

2. a) What are the roles of interfaces and abstract classes in Java? How does the programmer decide which to use?

[8 marks]

- b) Why do design patterns frequently make use of abstract classes? Show the structure of an example pattern to illustrate your answer.

[8 marks]

- c) Identify, and document using a class diagram, a collection of abstract classes and interfaces that capture the core structure of a typical GUI based application. Such applications might support multiple windows, menu and status bars and the idea of documents.

Describe how your framework can be used to implement an example application.

[17 marks]

[Total 33 marks]

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3. Consider how a web browser might be designed, making use of Design Patterns.
- a) Given that a web page should be represented using a hierarchy of objects, outline the pattern or patterns needed to represent a web page, along with those by which the representation is created and displayed in the browser window.

[18 marks]

- b) Outline how a display window, menus, command handling and scrollbars might be provided, showing which patterns can be used.

[15 marks]

[Total 33 marks]

4. a) Compare and contrast the C++ and Java approaches to memory management, object creation and object destruction.

[15 marks]

- b) A C++ program needs to manage large numbers of similar or identical objects while minimising object copying and carefully controlling memory usage. Draw up a set of recommendations to the program designers, outlining how these goals can be achieved.

Does the Java approach to memory management make the design job easier?

[18 marks]

[Total 33 marks]

5. a) What is meant by a 'pattern language'? How does such a language help when designing programs?

[8 marks]

- b) Define the terms architecture pattern, design pattern and idiom, highlighting the distinctions between them.

[10 marks]

- c) Consider the design of a programming language compiler. Describe the high-level design of the compiler in terms of architecture and design patterns.

[15 marks]

[Total 33 marks]

END OF PAPER