B5.
   a) The following represent three broad categories of design patterns. For each one, state an example design pattern and give a detailed description of it, stating the problem it addresses and the basis of the solution they offer:
      i) Creational
      ii) Behavioural
      iii) Structural.
         (15 marks)
   b) Describe why you would use each of the following when developing an object-oriented system. Within your discussion include an example of a real-world scenario:
      i) Object interaction diagram
      ii) Object state transition diagram.
         (10 marks)

B6.
   a) Define the key elements of the **Object Constraint Language** (OCL), explaining what they are used for.
      (10 marks)
   b) Given the following UML class diagram:

   ```
   StudentResults
   -studentNo: string
   -moduleNo: string
   -yearTaken: integer
   -grade: integer
   -addGrade(mark: integer): boolean
   ```

   Explain what the following OCL statement means:

   **context**: StudentResults::addGrade(mark: integer)
   **pre**: mark >= 0
   **post**: if mark > 100 then
              return false
             else
             self.grade = mark
              return true
             endif
   (5 marks)
   
   c) Discuss the advantages and disadvantages of using **accessors** (getters) and **mutators** (setters) for controlling access to the data in an object.
      (10 marks)
Section A
Answer Section A questions in Answer Book A

A1.
a) Describe a real-world practical scenario in which a variable in a class should be set to have protected visibility. 
(10 marks)
b) Write a code fragment that demonstrates an appropriate use of a conversion constructor (i.e., a real-world practical scenario that is well-suited to the use of a conversion constructor). 
(15 marks)

A2.
a) What are the advantages and disadvantages of manual memory management vs automatic memory management (sometimes known as garbage collection) in object-oriented programming? 
(10 marks)
b) Write a code fragment that demonstrates an appropriate use of hybrid inheritance (i.e., a real-world practical scenario that is well-suited to the use of hybrid inheritance). 
(15 marks)

A3.
a) Briefly describe what is meant by the term 'singleton class' and describe a real-world practical scenario that is well-suited to the use of a singleton class. 
(10 marks)
b) Write a code fragment that demonstrates how is-a and has-a inter-class relationships are implemented using real-world practical examples. 
(15 marks)

Section B
Answer Section B questions in Answer Book B

B4. The following class diagram represents a partial design for a major sporting event, such as the Olympic Games:

a) Describe what the diagram represents, include all structural constraints. 
(15 marks)
b) Getting the design correct before implementing a system is important, describe the testing techniques that could be used on the above class diagram. 
(10 marks)