

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.

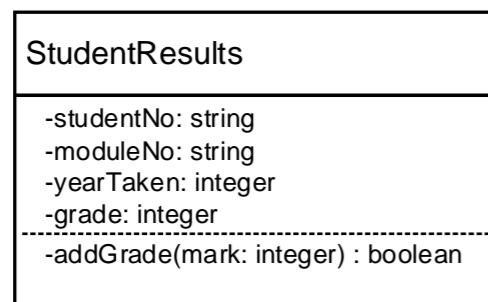
(10 marks)

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:



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)

End of Examination

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OBJECT-ORIENTED PROGRAMMING

Wednesday 5th October 2022 – Afternoon

Answer **any** FOUR questions out of SIX. All questions carry equal marks

Time: TWO hours

Answer any Section A questions you attempt in Answer Book A
Answer any Section B questions you attempt in Answer Book B

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are **NOT** allowed in this examination.

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)**

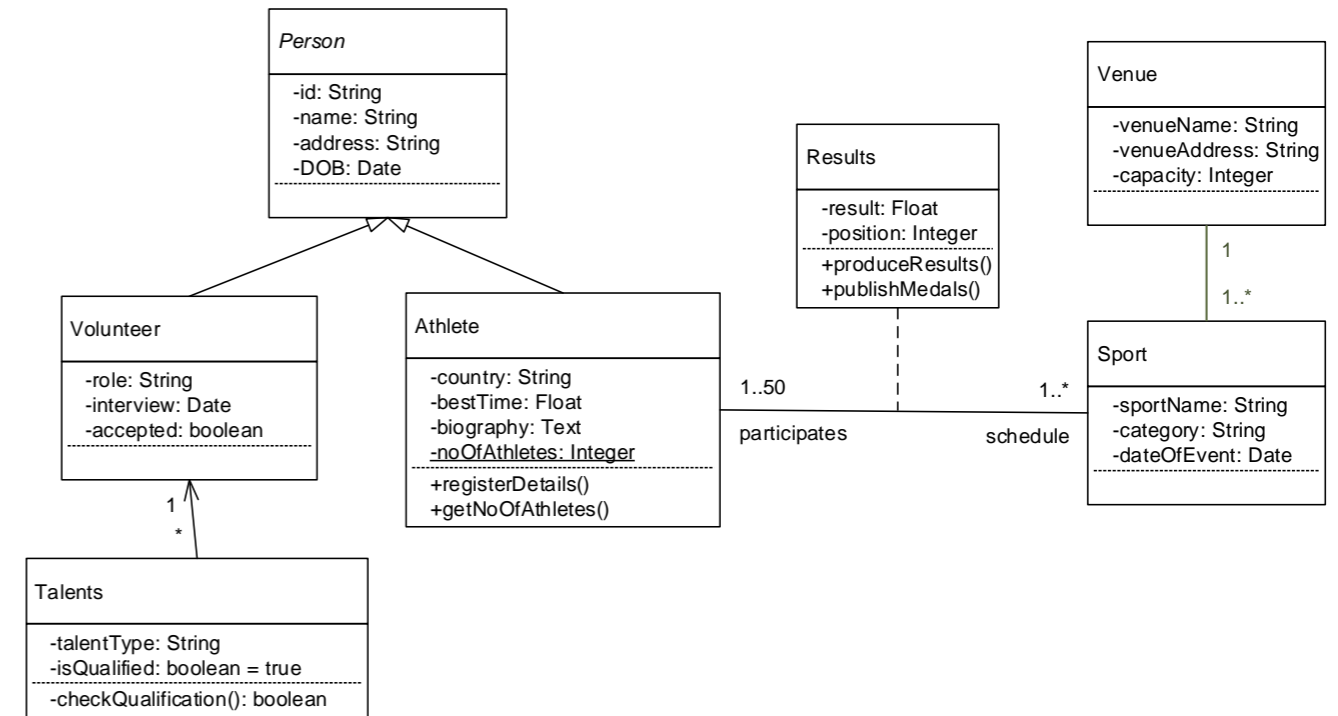
b) Write a code fragment that demonstrates how **is-a** and **has-a** inter-class relationships are implemented using real-world practical examples. **(15 marks)**

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)**