

## COMPUTER SCIENCE TRIPOS Part IA – 2023 – Paper 1

### 4 Object-Oriented Programming (rgu20)

- (a) Explain the concept of type erasure in Java. [2 marks]
- (b) What do these types erase to?
- (i) `List<List<Integer>>` [1 mark]
- (ii) `List<String>[]` [1 mark]
- (iii) `Map<String, List<Map<String, Integer>>>` [1 mark]
- (c) This question covers the concept of immutability.
- (i) Provide an example of a built-in immutable class in Java. [1 mark]
- (ii) Explain what is required to declare an immutable class in Java. [2 marks]
- (iii) Provide a code example of a declared immutable class called `ProductInfo` which contains two fields storing an `id` and a `description`. [2 marks]
- (d) (i) Explain the meaning of the Liskov-Substitution principle. [1 mark]
- (ii) Explain the meaning of the Single Responsibility principle. [1 mark]
- (iii) Imagine that you are working in the insurance context. You can issue a `Policy` to insure a policy holder. There are two types of policies available: a life insurance policy and a car insurance policy. Both of these policies take into consideration the age of the policy holder. You need to calculate the premium (i.e. the cost) of each policy based on the following guideline:
- The life insurance takes 5 percent of the total sought coverage amount if the policy holder is under 35 of age or 10 percent otherwise
  - For adults only, the car insurance takes 10 percent of the car value if the policy holder is over 30 of age or 20 percent otherwise
- Define four classes `PolicyHolder`, `Policy`, `LifeInsurancePolicy` extends `Policy`, `CarInsurancePolicy` extends `Policy` such that they encapsulate this system and demonstrate a violation of the single Responsibility Principle in the `Policy` class and a Liskov-Substitution pre-condition violation in the `CarInsurancePolicy` class. [6 marks]
- (iv) Describe what steps you would need to take to adhere to both the

Liskov-Substitution and Single Responsibility principle.

[2 marks]