

3 Object-Oriented Programming (rkh23)

(a) Give three advantages and one disadvantage of immutable classes. [4 marks]

(b) A programmer has created an `AssetLocation` class to represent the location of company assets. Some assets are mobile and their location must be updated regularly (e.g. vehicles); others are static and will never be updated (e.g. warehouses).

The class contains a `String` describing the asset, an `int` recording a unique identifier, and two `double` values to represent valid latitude ( $-90^\circ \leq \phi \leq 90^\circ$ ) and longitude ( $-180^\circ < \theta \leq 180^\circ$ ) values, respectively. All fields are initially mutable and set by the constructor.

Write Java code that implements `AssetLocation` as described. [5 marks]

(c) The programmer wishes to make the objects representing static assets immutable. They make the class *optionally* immutable using a parameter passed into the constructor.

(i) Write a modified `AssetLocation` class that implements the behaviour as described. [3 marks]

(ii) Explain why this is not a good solution. [3 marks]

(iii) Propose a better structure for the class, and explain your design choices. [5 marks]