NEWCASTLE UNIVERSITY

SEMESTER 1 2018/2019

PROGRAMMING AND DATA STRUCTURES

PART B

Total time allowed (for Parts A and B) - 3 Hours

Instructions to candidates:

Please read the Instructions to Candidates on the separate sheet carefully.

Answer ALL questions.

Marks shown for sub-sections are indicative only.

Question B1

A fitness enthusiast is writing an application to allow people to log their exercise activities, and to identify their best speeds over time. The following is an incomplete class definition to represent an Activity.

```
public class Activity
{
 private double duration; // in seconds
 private double distance; // in kilometres
 private String comment;  // describe activity

 public Activity(double duration,
                 double distance,
                 String comment)
 {
    this.duration = duration;
    this.distance = distance;
    this.comment = comment;
 }

 /**
   * get average speed for activity, in km/h
   */
 public double averageSpeed()
 {
    // to be completed
 }
}
```

The class `Activity` records details for an individual fitness event. The method `averageSpeed()` is incomplete.

a) Complete the body of the `averageSpeed()` method, noting that seconds can be converted to hours by dividing by 3600. [4 marks]

A separate class, `Log`, will maintain a list of `Activity` objects together with the name of the person who completed the activities. The class has been partially written, as follows:

```
import java.util.ArrayList;

public class Log
{

    private String name;
    private ArrayList<Activity> activities;

    // constructor method to be completed

    public Activity bestSpeed()
    {
        Activity topAct;
        // find activity with highest speed

        return topAct;
    }
}
```

b) Write a constructor for the `Log` class. New `Log` objects will have a name initialised using a parameter to the constructor method, and an empty list of activities. [6 marks]

c) Write a method, `addActivity`, to add an `Activity` object to the `activities` ArrayList. [4 marks]

d) The `bestSpeed()` method will search all recorded activities and return the activity with the highest average speed. This method has been partially written in the class declaration above. Complete the body of the `bestSpeed()` method.

[6 marks]

e) The activities list has the following type declaration:

```
private ArrayList<Activity> activities;
```

Use of an `ArrayList` to store the `Log` entries may be a problem if a large number of activities are to be recorded, for example over the course of several years. Users of the system have said they would like to be able to find an activity using the date when the activity took place.

Suggest an alternative collection type that could be used to store log entries, and access them by date (represented using the `Date` class). Provide a type declaration for your chosen collection type. [5 marks]

Question B2

A local government treasury department is designing software to work out the total yearly tax due on properties in the area. Since there are different rules for taxing residential properties (houses) and commercial properties (shops), it was decided to introduce a hierarchy of classes. At the top is class `Property`, which holds the owner's name and the estimated property value (these are passed as constructor's parameters). There are two sub-classes, `House` and `Shop`, derived from `Property`. Each house is assigned a band, depending on its value: the band is 0 if the value does not exceed 100000, 1 if it is between 100000 and 500000, and 2 if it exceeds 500000. The tax payable on a house is computed as `value*(r1 + r2*band)`, where `r1` and `r2` are two `double` numbers passed as constructor's parameters. The tax payable on a shop is computed as `value*r`, where `r` is a `double` number passed as constructor's parameter.

a) Implement a `Property` class. [3 Marks]

b) Implement a `House` class, including a method called `houseTax`, which returns the tax payable on that house. [8 marks]

c) Implement a `Shop` class, including a method called `shopTax`, which returns the tax payable on that shop. [6 marks]

d) Write a method called `totalTax`, which takes as parameters two `ArrayLists`, one containing houses and the other containing shops, and returns the total tax payable on all those properties. [8 marks]

END OF PART B