AQA

A-level
COMPUTER SCIENCE
7517/1

Paper 1

Mark scheme

June 2020

Version: 1.0 Final

206A7517/1/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

A-level Computer Science

Paper 1 (7517/1) – applicable to all programming languages A, B, C, D and E

June 2020

The following annotation is used in the mark scheme:

; - means a single mark
// - means an alternative response
/ - means an alternative word or sub-phrase
A. - means an acceptable creditworthy answer
R. - means reject answer as not creditworthy
NE. - means not enough
I. - means ignore
DPT. - means "Don't penalise twice". In some questions a specific error made by a candidate, if repeated, could result in the loss of more than one mark. The **DPT** label indicates that this mistake should only result in a candidate losing one mark, on the first occasion that the error is made. Provided that the answer remains understandable, subsequent marks should be awarded as if the error was not being repeated.

Examiners are required to assign each of the candidate's responses to the most appropriate level according to **its overall quality**, and then allocate a single mark within the level. When deciding upon a mark in a level examiners should bear in mind the relative weightings of the assessment objectives

eg

In question **05.1**, the marks available for the AO3 elements are as follows:

AO3 (design)	4 marks
AO3 (programming)	8 marks

Where a candidate's answer only reflects one element of the AO, the maximum mark they can receive will be restricted accordingly.

Question			Marks
01	1	**Mark is for AO2 (apply)** 4 // $\sqrt{4^2+0^2}$;	1
01	2	**All marks AO2 (apply)** **2 marks:** 16 **If final answer is incorrect then award a maximum of 1 mark for working:** **1 mark:** for either multiplying 4 by 4 or multiplying 3 by 0 **1 mark:** for adding together the sum of two (incorrect) products	2
01	3	**All marks AO2 (analyse)** The angle will still be the same; **A**. the direction will not change The magnitude will be doubled // the magnitude will now be 10;	2
01	4	**All marks AO2 (analyse)** The angle will be 180 – c // the angle will be 360 – 180 – c // the angle will be 143.13; **A.** the direction of **a** will be the opposite of its current direction The magnitude will still be the same;	2

<table>
<tr><th colspan="2">Question</th><th></th><th>Marks</th></tr>
<tr><td>02</td><td>1</td><td>All marks AO1 (understanding)

<table>
<tr><th>Statement</th><th>True or False?</th></tr>
<tr><td>All regular languages can be represented using a finite state machine without outputs.</td><td>True</td></tr>
<tr><td>The set of strings defined by a regular language is always finite in size.</td><td>False</td></tr>
<tr><td>There are some languages which can be represented in Backus-Naur Form (BNF) that are not regular languages.</td><td>True</td></tr>
</table>

Mark as follows:

1 mark: two rows correct
1 mark: all three rows correct</td><td>2</td></tr>
<tr><td>02</td><td>2</td><td>Mark is for AO2 (analyse)

<pre><sentence> ::= <np><v> | <v><np>
//
<sentence> ::= <v><np> | <np><v></pre>
R. any answers that consist of more than one rule</td><td>1</td></tr>
<tr><td>02</td><td>3</td><td>Mark is for AO2 (apply)

<table>
<tr><th>String</th><th>Valid sentence (Y/N)?</th></tr>
<tr><td>cuddle the cat</td><td>Y</td></tr>
<tr><td>drank a human</td><td>Y</td></tr>
<tr><td>the cat slept</td><td>Y</td></tr>
<tr><td>cat or dog</td><td>N</td></tr>
</table></td><td>1</td></tr>
</table>

Question			Marks

02	4	**Mark is for AO2 (apply)**
		
		Modify the existing rule for `np`:
		`<np> ::= <d><n> | <n>`
		//
		Modify an existing rule for `sentence`:
		`<sentence> ::= <np><v> | <n><v>`
		//
		Modify an existing rule for `sentence`:
		`<sentence> ::= <v><np> | <n><v>`
		//
		Modify an existing rule for `sentence`:
		`<sentence> ::= <np><v> | <v><np> | <n><v>`
		//
		Create a new rule:
		`<sentence> ::= <n><v>`
		//
		Create a new rule:
		`<np> ::= <n>`
			1

02	5	**All marks for AO2 (apply)** **Mark as follows:** **2 marks:** 8x4x3x8x4 // 2x4x4x3x2x4x4 // 3072 **If final answer is incorrect then award a maximum of 1 mark for working:** **1 mark:** for calculating that there are 8 noun phrases // for calculating that there are 4x2 noun phrases **1 mark:** for multiplying an incorrectly calculated number of noun phrases by the number of noun phrases, by 3, by 4 and by 4 again	2
02	6	**Mark is for AO2 (apply)** Infinitely more;	1

Question			Marks
03	1	**Mark is for AO2 (apply)** 4! // 4x3x2x1 // 4x3x2 // 24;	1
03	2	**Mark is for AO2 (apply)** n! // factorial of n; **A.** 1 * 2 *… * n-1 * n (or similar)	1
03	3	**Mark is for AO2 (analyse)** The string could contain more than one occurrence of a character; Each athlete is unique, each character is not (guaranteed to be) unique; There are *n* characters in the string but not *n* distinct characters; Some of the anagrams could be duplicates; **Max 1**	1
03	4	**All marks for AO1 (knowledge)** A problem that can be solved; but not in a reasonable amount of time as the problem size increases // but has an exponential (or worse) time complexity // but there is no polynomial (or less) time solution;	2
03	5	**Mark is for AO1 (understanding)** One;	1
03	6	**One mark is for AO1 (knowledge) and one mark is for AO1 (understanding)** **AO1 knowledge** O(n); **Max 1 for AO1 understanding** As the size of the list increases the time taken increases at the same rate; There is a loop that repeats n times;	2

Question			Marks
03	7	**One mark is for AO1 (knowledge) and one mark is for AO1 (understanding)** **AO1 knowledge** O(log n); **Max 1 for AO1 understanding** Each comparison halves the size of the list that has to be searched through; The time taken increases as the size of the list increases but by smaller and smaller amounts; If the size of the list doubles then the number of comparisons needed only increases by 1;	**2**

Question			Marks
04	1	**All marks for AO1 (understanding)** **Max 2 for advantages of dynamic data structures** No wasted memory; Can grow as more data is added to the data structure // no limit on number of items that can be added (except due to hardware limitations); Resources only allocated as they are needed (with static data structures they are allocated at creation even if not needed until later); **Max 2 for disadvantages of dynamic data structures** Additional memory needed for pointers; Can result in memory leak (if memory that is no longer needed is not returned to the heap); Can take longer to access an item directly (for data structures that allow this); **A.** can take longer to add a new item to the data structure (as memory needs to be allocated)	4
04	2	**All marks for AO1 (understanding)** Check that the queue is not already full; (if it isn't) then add 1 to the value of the rear pointer; then add the new item to the position indicated by the rear pointer; **Alternative answer** Check that the queue is not already full; (if it isn't) then add the new item to the position indicated by the rear pointer; then add 1 to the value of the rear pointer; **Max 2** if any errors **Max 1** if circular queue has been described	3

04	**3**	**All marks for AO1 (understanding)** Starting with the item at the rear of the queue move each item back one place in the array; Until you (reach the start of the queue or) find an item with the same or higher priority than the item to add; **NE.** same priority **NE.** higher priority Add the new item in the position before that item; **A.** answers which have the front of the queue as the last item in the array, start at the front and move each item forward one until the correct insertion point is found. **A.** answers that start from the front of the queue until position to insert item is found and then start at the back and move each item back one until position to insert item is found.	**3**

<table>
<tr><th colspan="2">Question</th><th></th><th>Marks</th></tr>
<tr><td>05</td><td>1</td><td>

4 marks for AO3 (design) and 8 marks for AO3 (programming)

Mark Scheme

<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>4</td><td>A line of reasoning has been followed to arrive at a logically structured working or almost fully working programmed solution that meets most of the requirements. All of the appropriate design decisions have been taken. To award 12 marks, all of the requirements must be met.</td><td>10–12</td></tr>
<tr><td>3</td><td>There is evidence that a line of reasoning has been followed to produce a logically structured program. The program displays relevant prompts, inputs the required numbers, at least one iterative structure and one selection structure and suitable data structure(s) to store the numbers entered and the frequencies. An attempt has been made to determine the modal frequency, although this may not work correctly under all circumstances. The solution demonstrates good design work as most of the correct design decisions have been made.</td><td>7–9</td></tr>
<tr><td>2</td><td>A program has been written and some appropriate, syntactically correct programming language statements have been written. There is evidence that a line of reasoning has been partially followed as although the program may not have the required functionality, it can be seen that the response contains some of the statements that would be needed in a working solution. There is evidence of some appropriate design work as the response recognises at least one appropriate technique that could be used by a working solution, regardless of whether this has been implemented correctly.</td><td>4–6</td></tr>
<tr><td>1</td><td>A program has been written and a few appropriate programming language statements have been written but there is no evidence that a line of reasoning has been followed to arrive at a working solution. The statements written may or may not be syntactically correct. It is unlikely that any of the key design elements of the task have been recognised.</td><td>1–3</td></tr>
</table>

</td><td>12</td></tr>
</table>

		Guidance **Evidence of AO3 design – 4 points:** Evidence of design to look for in responses: 1. Identifying that data structure(s) are needed to store ten frequencies 2. Identifying that a loop is needed that repeats a number of times determined by the first number entered by the user 3. Identifying that a Boolean (or equivalent) variable is needed to store if the data was multimodal 4. Selection structure that either outputs a calculated number (**I.** incorrectly calculated) or a message saying "`Data was multimodal`" (**A.** any suitable message) Note that AO3 (design) points are for selecting appropriate techniques to use to solve the problem, so should be credited whether the syntax of programming language statements is correct or not and regardless of whether the solution works. **Evidence for AO3 programming – 8 points:** Evidence of programming to look for in response: 5. Suitable prompts asking user to enter the number of digits followed by user inputs being assigned to appropriate variable **R.** if inside or after iterative structure 6. Correct number of numeric digits obtained from the user 7. Adds one to correct frequency count **R**. if only works for one digit 8. Selection structure, inside iterative structure, that correctly compares calculated frequency (**I.** incorrect frequency) of a digit with the highest frequency found so far 9. Boolean (or equivalent) variable that is used to indicate if data is multimodal is set to true under correct circumstances 10. Boolean (or equivalent) variable that is used to indicate if data is multimodal is set to false when new higher frequency is found 11. Program works correctly if the data has more than one modal value **A.** any sensible message 12. Program displays the correct frequency of the modal value under all circumstances and does not say data is multimodal when it is not **I.** frequency being displayed when data is multimodal **Max 11** if code contains any errors	
05	**2**	**Mark is for AO3 (evaluate)** ****** SCREEN CAPTURE ****** *Must match code from **05.1**, including prompts on screen capture matching those in code.* *Code for **05.1** must be sensible.* Screen captures showing:	**1**

		• the number 6 being entered followed by the numbers 0, 1, 2, 1, 2 and 1 (**I.** order of these six numbers) and then a message displayed saying 3
		• the number 5 being entered followed by the numbers 0, 1, 2, 2 and 1 (**I.** order of these five numbers) and then a message displayed saying that the data is multimodal.
		
		`Enter number of digits: 6`
		`Enter a numeric digit: 0`
		`Enter a numeric digit: 1`
		`Enter a numeric digit: 2`
		`Enter a numeric digit: 1`
		`Enter a numeric digit: 2`
		`Enter a numeric digit: 1`
		`The modal digit appeared 3 times`
		
		`Enter number of digits: 5`
		`Enter a numeric digit: 0`
		`Enter a numeric digit: 1`
		`Enter a numeric digit: 2`
		`Enter a numeric digit: 2`
		`Enter a numeric digit: 1`
		`Data was multimodal`	

Question			Marks
06	1	**Mark is for AO2 (analyse)** That the company name being searched for does not exist (in the simulation); **A.** user misspelt the company name	1
06	2	**Marks are for AO2 (analyse)** There is no need for the variable `Index` // no need to assign the value of `-1` to `Index`; If the loop terminates then can just return (the constant value) `-1` // if the company name is not found then can just return (the constant value) `-1`;	2

Question			Marks
07	1	**Mark is for AO2 (analyse)** `GetDetails;` **R.** if spelt incorrectly **R.** if any additional code **I.** case and spacing	1

07	2	**Mark is for AO2 (analyse)**
		
		`Details;`
		`OldCapacity;`
		
		R. if spelt incorrectly
		R. if any additional code
		I. case and spacing
		
		Max 1 mark
			1

07	3	**Mark is for AO1 (understanding)** Private attributes can only be accessed by the class/object they belong to whereas protected attributes can also be accessed by any classes that inherit from the class they belong to; **A.** file instead of class/object (Java only) **NE.** private attribute can only be accessed by the class/object they belong to whereas protected attributes can be accessed by others classes/objects	1
07	4	**Mark is for AO2 (analyse)** The calculation of the daily costs will be inconsistent as it will be different in the `AlterCapacity` method; **A.** it won't have been updated in other locations which use that constant	1

Question			Marks
08	1	**Mark is for AO2 (analyse)** `LargeSettlement`; **R.** if spelt incorrectly **R.** if any additional code **I.** case and spacing	1
08	2	**Mark is for AO2 (analyse)** `Household`; **R.** if spelt incorrectly **R.** if any additional code **I.** case and spacing	1
08	3	**Mark is for AO2 (analyse)** `Company`; **R.** if spelt incorrectly **R.** if any additional code **I.** case and spacing	1
08	4	**Mark is for AO2 (analyse)** Aggregation;	1

Question			Marks
09		**All marks are for AO2 (analyse)** It stores the cumulative reputation for the companies in an array/list; It then generates a random number which is less than the total reputation; **A.** generates a random number based on the total reputation of the companies Finds the first cumulative reputation that the number is less than; The position of this cumulative reputation in the list indicates the company that the household will use;	4

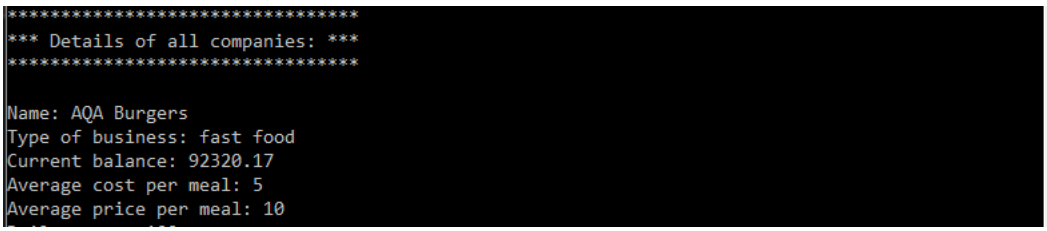
Question			Marks
10	1	**All marks for AO3 (programming)** 1. Indefinite iterative structure contains code that gets the name from the user; 2. One correct condition; 3. Both correct conditions and correct logic for the iterative structure; 4. Displays error message if no name is entered // displays error message if a name that has already been used is entered; 5. Displays error message under all correct circumstances and only under correct circumstances; **Max 4** if code contains errors	5

10	2	**Mark is for AO3 (evaluate)**
		
		****** SCREEN CAPTURE ******
		*Must match code from **10.1**, including prompts on screen capture matching those in code.*
		*Code for **10.1** must be sensible.*
		
		Screen captures showing error message(s) being shown for the two invalid names and then showing the message asking for the starting balance when a valid name is entered;
		
		`Enter L for a large settlement, anything else for a normal size settlement:`
		`Enter D for default companies, anything else to add your own start companies: D`
		
		`**********`
		`**********  MENU  **********`
		`**********`
		`1. Display details of households`
		`2. Display details of companies`
		`3. Modify company`
		`4. Add new company`
		`6. Advance to next day`
		`Q. Quit`
		
		`Enter your choice: 4`
		`Enter a name for the company:`
		`You must enter a name.`
		`Enter a name for the company: AQA Burgers`
		`That name is already being used.`
		`Enter a name for the company: In Jest`
		`Enter the starting balance for the company:`
			1

Question			Marks
11	1	**All marks for AO3 (programming)** 1. Creating a new class called `AffluentHousehold`; **R.** other names for class **I.** case and minor typos 2. New class inherits from `Household`; 3. Constructor created that overrides base class constructor with call made to base class constructor; **R.** if incorrect parameters 4. Sets the value of `ChanceEatOutPerDay` to 1; **R.** if before call to base class constructor **R.** If not after attempt at call to base class constructor The following all relate to the `AddHousehold` method: 5. Selection structure with correct condition; 6. Creates an `AffluentHousehold` object; **R.** if it also creates a household 7. Creates an `AffluentHousehold` under the correct circumstances and a `Household` under the correct circumstances; **R.** if new household not added to `Households` **Max 6** if code contains errors	**7**
11	2	**Mark is for AO3 (evaluate)** ****** SCREEN CAPTURE ****** *Must match code from **11.1**, including prompts on screen capture matching those in code.* *Code for **11.1** must be sensible.* Screen capture(s) showing that households with an X value less than 100 have an eat out percentage of 1; 225 Coordinates: (123, 32) Eat out percentage: 0.8259652 226 Coordinates: (317, 914) Eat out percentage: 0.845291 227 Coordinates: (77, 743) Eat out percentage: 1 228 Coordinates: (681, 434) Eat out percentage: 0.3261211 229 Coordinates: (886, 440) Eat out percentage: 0.2608214 230 Coordinates: (786, 939) Eat out percentage: 0.230395 231 Coordinates: (296, 716) Eat out percentage: 0.2893967 232 Coordinates: (6, 735) Eat out percentage: 1 233 Coordinates: (809, 465) Eat out percentage: 0.5536526 234 Coordinates: (560, 411) Eat out percentage: 0.1806425 235 Coordinates: (88, 158) Eat out percentage: 1 236 Coordinates: (999, 865) Eat out percentage: 0.3803484 237 Coordinates: (181, 677) Eat out percentage: 0.6760774 238 Coordinates: (661, 452) Eat out percentage: 0.77483 239 Coordinates: (906, 654) Eat out percentage: 0.6682643 240 Coordinates: (791, 116) Eat out percentage: 0.4946947 241 Coordinates: (988, 561) Eat out percentage: 0.8663161 242 Coordinates: (312, 580) Eat out percentage: 0.8935117 243 Coordinates: (795, 3) Eat out percentage: 0.3254315 244 Coordinates: (458, 950) Eat out percentage: 0.2387292 245 Coordinates: (768, 933) Eat out percentage: 0.3635655 246 Coordinates: (735, 322) Eat out percentage: 0.3908745 247 Coordinates: (880, 768) Eat out percentage: 0.7230505 248 Coordinates: (939, 237) Eat out percentage: 0.9397836 249 Coordinates: (728, 613) Eat out percentage: 0.3923739	**1**

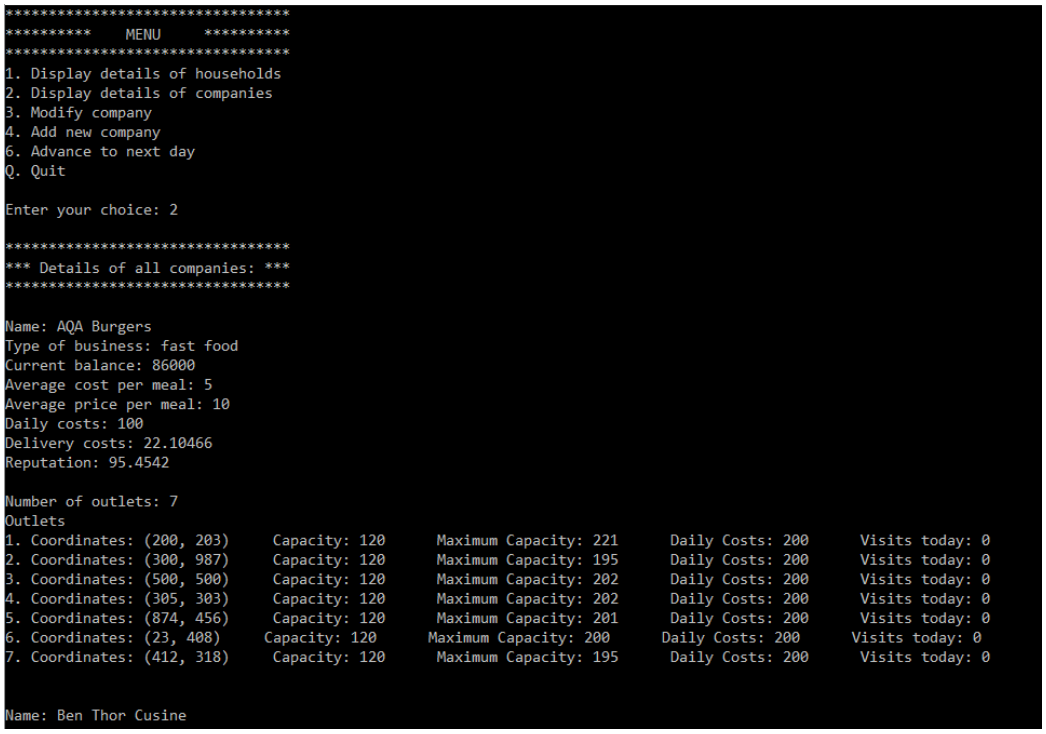
Question			Marks
12	1	**All marks for AO3 (programming)** Marks for changes to the `Simulation` class: 1. Two extra options displayed on the modify company menu using appropriate messages; 2. Selection structures for the new menu options with appropriate condition(s); 3. Gets the user to enter the interest rate when getting a loan and the amount to pay back when paying back under the appropriate circumstances; **A.** done in appropriate places in the `Company` class; 4. Calls to appropriate methods in `Company` class in the selection structures; Marks for changes to the `Company` class: 5. Attributes of appropriate data types created for `LoanBalance` and `InterestRate`; 6. Correct calculation of daily interest payment and new balance in `ProcessDayEnd`; **R.** if the balance is changed before previous balance concatenated with `Details` 7. Selection structure to check if `LoanBalance` is 0 when user chooses to get a loan; **A.** check for less than or equal to 0 8. `Balance`, `LoanBalance` and `InterestRate` set to correct values in the selection structure; 9. `LoanBalance` and `Balance` changed by the correct amount when user chooses to pay back part of the loan; 10. All attributes in `Company` are only accessed and modified by methods in `Company`; **R.** if no attempt to access or modify the attributes used when getting or paying back a loan. **Max 9 marks** if code contains errors	**10**

Question			Marks

12	2	**Mark is for AO3 (evaluate)**
		
		****** SCREEN CAPTURE ******
		*Must match code from **12.1**, including prompts on screen capture matching those in code.*
		*Code for **12.1** must be sensible.*
		
		Screen capture(s) showing that the balance for AQA Burgers is approximately 92 000; **Note for examiners:** due to random numbers in simulation exact balance can vary.
		
		 
		`**********`
		`*** Details of all companies: ***`
		`**********`
		
		`Name: AQA Burgers`
		`Type of business: fast food`
		`Current balance: 92320.17`
		`Average cost per meal: 5`
		`Average price per meal: 10`
			1

Question			Marks
13	1	**All marks for AO3 (programming)** 1. Created new method called `GetOrderedListOfOutlets`; **R**. other names for method **I.** case and minor typos 2. Method returns a list/array; 3. Outlet 0 is added to the route first; 4. Iterative structure that repeats until all outlets have been added to the route; 5. Has variable that is used to store shortest distance found between two nodes so far and a variable to store which outlet results in the shortest distance; 6. Iterative structure that looks at each outlet for which distance from previous outlet in route needs to be calculated; **A.** looks at all outlet except previous outlet 7. No outlet can appear more than once in route created; **R.** if adds or two or fewer outlets to the list only **R.** if no attempt to check if outlet has already been added or equivalent 8. Route created contains all the company's outlets; 9. Shortest distance between two nodes variable set to suitable starting value and reset after each outlet (except last one) is added to route; 10. `GetOrderedListOfOutlets` implements the algorithm described in **Figure 6** in the question; 11. Modified `CalculateDeliveryCost` so that it calls `GetOrderedListOfOutlets` instead of `GetListOfOutlets`; **A.** alternative identifier used as long as match that used for mark point 1 **Max 10** if code contains errors or if other parts of the subroutine no longer work correctly	**11**

Question			Marks

13	2	**Mark is for AO3 (evaluate)**
		
		****** SCREEN CAPTURE ******
		*Must match code from **13.1**, including prompts on screen capture matching those in code.*
		*Code for **13.1** must be sensible.*
		
		Screen capture(s) showing that the delivery cost for AQA Burgers is 22.10446;
		
		 
		`**********`
		`**********  MENU  **********`
		`**********`
		`1. Display details of households`
		`2. Display details of companies`
		`3. Modify company`
		`4. Add new company`
		`6. Advance to next day`
		`Q. Quit`
		
		`Enter your choice: 2`
		
		`**********`
		`*** Details of all companies: ***`
		`**********`
		
		`Name: AQA Burgers`
		`Type of business: fast food`
		`Current balance: 86000`
		`Average cost per meal: 5`
		`Average price per meal: 10`
		`Daily costs: 100`
		`Delivery costs: 22.10466`
		`Reputation: 95.4542`
		
		`Number of outlets: 7`
		`Outlets`
		`1. Coordinates: (200, 203)  Capacity: 120  Maximum Capacity: 221  Daily Costs: 200  Visits today: 0`
		`2. Coordinates: (300, 987)  Capacity: 120  Maximum Capacity: 195  Daily Costs: 200  Visits today: 0`
		`3. Coordinates: (500, 500)  Capacity: 120  Maximum Capacity: 202  Daily Costs: 200  Visits today: 0`
		`4. Coordinates: (305, 303)  Capacity: 120  Maximum Capacity: 202  Daily Costs: 200  Visits today: 0`
		`5. Coordinates: (874, 456)  Capacity: 120  Maximum Capacity: 201  Daily Costs: 200  Visits today: 0`
		`6. Coordinates: (23, 408)  Capacity: 120  Maximum Capacity: 200  Daily Costs: 200  Visits today: 0`
		`7. Coordinates: (412, 318)  Capacity: 120  Maximum Capacity: 195  Daily Costs: 200  Visits today: 0`
		
		`Name: Ben Thor Cusine`
			1

VB.Net

Question			Marks

05	1	`Dim Current As Integer`
		`Dim Frequencies(9) As Integer`
		`Dim ModeFrequency As Integer = 0`
		`Dim Multimodal As Boolean = False`
		`Dim NoOfDigits As Integer`
		`Console.Write("Enter number of digits: ")`
		`NoOfDigits = Console.ReadLine`
		`For count = 1 To NoOfDigits`
		`  Console.Write("Enter a numeric digit: ")`
		`  Current = Console.ReadLine`
		`  Frequencies(Current) += 1`
		`Next`
		`For Count = 0 To 9`
		`  If Frequencies(Count) > ModeFrequency Then`
		`  ModeFrequency = Frequencies(Count)`
		`  Multimodal = False`
		`  ElseIf Frequencies(Count) = ModeFrequency Then`
		`  Multimodal = True`
		`  End If`
		`Next`
		`If Multimodal Then`
		`  Console.WriteLine("Data was multimodal")`
		`Else`
		`  Console.WriteLine("The modal digit appeared " & ModeFrequency & " times")`
		`End If`
			12

10	1	`Public Sub AddCompany()`
		`  Dim Balance, X, Y As Integer`
		`  Dim CompanyName, TypeOfCompany As String`
		`  Do`
		`  Console.Write("Enter a name for the company: ")`
		`  CompanyName = Console.ReadLine`
		`  If CompanyName = "" Then`
		`  Console.WriteLine("You must enter a name.")`
		`  End If`
		`  If GetIndexOfCompany(CompanyName) <> -1 Then`
		`  Console.WriteLine("That name is already being used.")`
		`  End If`
		`  Loop While CompanyName = "" Or GetIndexOfCompany(CompanyName) <> -1`
		`  Console.Write("Enter the starting balance for the company: ")`
		
		Alternative answer
		
		`Public Sub AddCompany()`
		`  Dim Balance, X, Y As Integer`
		`  Dim CompanyName, TypeOfCompany As String`
		`  Console.Write("Enter a name for the company: ")`
		`  CompanyName = Console.ReadLine`
		`  While CompanyName = "" Or GetIndexOfCompany(CompanyName) <> -1`
		`  If CompanyName = "" Then`
		`  Console.WriteLine("You have to enter a company name")`
		`  Else`
			5

		Console.WriteLine("Company name already exists, it has to be unique")
		End If
		Console.Write("Enter a name for the company: ")
		CompanyName = Console.ReadLine
		End While
		Console.Write("Enter the starting balance for the company: ")	

11	**1**	Public Sub AddHousehold()
		Dim X, Y As Integer
		GetRandomLocation(X, Y)
		If X < 100 Then
		Dim Temp As New AffluentHousehold(X, Y)
		Households.Add(Temp)
		Else
		Dim Temp As New Household(X, Y)
		Households.Add(Temp)
		End If
		End Sub
		
		Class AffluentHousehold
		Inherits Household
		
		Public Sub New(ByVal X As Integer, ByVal Y As Integer)
		MyBase.New(X, Y)
		ChanceEatOutPerDay = 1
		End Sub
		End Class
			7

12	**1**	**From the simulation class** Public Sub ModifyCompany(ByVal Index As Integer) Dim Choice As String Dim OutletIndex, X, Y As Integer Dim CloseCompany As Boolean Console.WriteLine(Environment.NewLine & "*********************************") Console.WriteLine("******* MODIFY COMPANY *******") Console.WriteLine("*********************************") Console.WriteLine("1. Open new outlet") Console.WriteLine("2. Close outlet") Console.WriteLine("3. Expand outlet") **Console.WriteLine("4. Get Loan")** **Console.WriteLine("5. Pay back loan")** Console.Write(Environment.NewLine & "Enter your choice: ") Choice = Console.ReadLine Console.WriteLine() If Choice = "2" Or Choice = "3" Then ... ElseIf Choice = "1" Then ... **ElseIf Choice = "4" Then** **Console.Write("Enter the interest rate for the loan: ")** **Dim Rate As Single = Console.ReadLine** **Companies(Index).GetLoan(Rate)** **ElseIf Choice = "5" Then** **Console.Write("Enter the amount to pay back: ")** **Dim PayBackAmount As Single = Console.ReadLine** **Companies(Index).PayBackLoan(PayBackAmount)**	**10**

```
  End If
  Console.WriteLine()
End Sub
```

From the `Company` class

```
Class Company
  Protected Name, Category As String
  Protected Balance, ReputationScore, AvgCostPerMeal,
AvgPricePerMeal, DailyCosts, FamilyOutletCost, FastFoodOutletCost,
NamedChefOutletCost, FuelCostPerUnit, BaseCostOfDelivery As Single
  Protected Outlets As New ArrayList
  Protected FamilyFoodOutletCapacity, FastFoodOutletCapacity,
NamedChefOutletCapacity As Integer
  Protected InterestRate As Single
  Protected LoanBalance As Single
...


Public Function ProcessDayEnd() As String
...
  Next
  Details &= "Previous balance for company: " & Balance.ToString &
Environment.NewLine
  Balance += ProfitLossFromOutlets - DailyCosts - DeliveryCosts -
(LoanBalance * InterestRate)
  Details &= "New balance for company: " & Balance.ToString
  Return Details
End Function

Public Sub GetLoan(ByVal Rate As Single)
  If LoanBalance = 0 Then
     Balance += 10000
     LoanBalance = 10000
     InterestRate = Rate
  End If
End Sub

Public Sub PayBackLoan(ByVal Amount As Single)
  LoanBalance -= Amount
  Balance -= Amount
End Sub
```

Alternative answer for taking a loan

In `ModifyCompany` method in `Simulation` class

```
...
ElseIf Choice = "4" Then
  If Companies(Index).GetLoanBalance() <= 0 Then
    Console.Write("Enter Interest Rate: ")
    InterestRate = Console.ReadLine()
    Companies(Index).TakeOutLoan(InterestRate)
  End If
```

Methods in Company Class

```
Public Function GetLoanBalance() As Single
  Return LoanBalance
End Function

Public Sub TakeOutLoan(ByVal InterestRate As Single)
  Me.InterestRate = InterestRate
  LoanBalance = 10000
  Balance += 10000
End Sub
```

13	**1**		**11**

```
Private Function GetOrderedListOfOutlets() As ArrayList
  Dim OrderedList As New ArrayList
  Dim NearestOutlet As Integer
  OrderedList.Add(0)
  While OrderedList.Count < Outlets.Count
    Dim ShortestDistanceSoFar As Single = 1000000
    For Count = 1 To Outlets.Count - 1
      If Not OrderedList.Contains(Count) Then
        Dim Temp As Integer =
GetDistanceBetweenTwoOutlets(OrderedList(OrderedList.Count - 1),
Count)
        If Temp < ShortestDistanceSoFar Then
          NearestOutlet = Count
          ShortestDistanceSoFar = Temp
        End If
      End If
    Next
    OrderedList.Add(NearestOutlet)
  End While
  Return OrderedList
End Function

Public Function CalculateDeliveryCost() As Single
  Dim ListOfOutlets As ArrayList = GetOrderedListOfOutlets()
  Dim TotalDistance As Single = 0
  Dim TotalCost As Single = 0
  For Count = 0 To ListOfOutlets.Count - 2
    TotalDistance +=
GetDistanceBetweenTwoOutlets(ListOfOutlets(Count),
ListOfOutlets(Count + 1))
  Next
  TotalCost += TotalDistance * FuelCostPerUnit
  Return TotalCost
End Function
```

Python 2

Question			Marks

05	1	`ModeFrequency = 0`
		`Multimodal = False`
		`Frequencies = [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]`
		`NoOfDigits = int(input("Enter number of digits: "))`
		`for count in range (1, NoOfDigits + 1):`
		`  Current = int(input("Enter a numeric digit: "))`
		`  Frequencies[Current] += 1`
		`for Count in range (0, 10):`
		`  if Frequencies[Count] > ModeFrequency:`
		`  ModeFrequency = Frequencies[Count]`
		`  Multimodal = False`
		`  elif Frequencies[Count] == ModeFrequency:`
		`  Multimodal = True`
		`if Multimodal:`
		`  print("Data was multimodal")`
		`else:`
		`  print("The modal digit appeared " + str(ModeFrequency) + " times")`
			12

10	1	`def AddCompany(self):`
		`  CompanyName = input("Enter a name for the company: ")`
		`  while CompanyName == "" or self.GetIndexOfCompany(CompanyName) != -1:`
		`  if CompanyName == "":`
		`  print("You have to enter a company name")`
		`  else:`
		`  print("Company name already exists, it has to be unique")`
		`  CompanyName = input("Enter a name for the company: ")`
		`  Balance = int(input("Enter the starting balance for the company: "))`
		`  TypeOfCompany = ""`
		`  while not(TypeOfCompany == "1" or TypeOfCompany == "2" or TypeOfCompany == "3"):`
		`  TypeOfCompany = input("Enter 1 for a fast food company, 2 for a family company or 3 for a named chef company: ")`
		`  if TypeOfCompany == "1":`
		`  TypeOfCompany = "fast food"`
		`  elif TypeOfCompany == "2":`
		`  TypeOfCompany = "family"`
		`  else:`
		`  TypeOfCompany = "named chef"`
		`  X, Y = self._SimulationSettlement.GetRandomLocation()`
		`  NewCompany = Company(CompanyName, TypeOfCompany, Balance, X, Y, self._FuelCostPerUnit, self._BaseCostforDelivery)`
		`  self._Companies.append(NewCompany)`
			5

11	1	`def AddHousehold(self):`
		`  X, Y = self.GetRandomLocation()`
		`  if X < 100:`
		`  Temp = AffluentHousehold(X, Y)`
		`  self._Households.append(Temp)`
		`  else:`
		`  Temp = Household(X, Y)`
		`  self._Households.append(Temp)`
		
		`class AffluentHousehold(Household):`
			7

```
  def __init__(self, X, Y):
    super(AffluentHousehold, self).__init__(X, Y)
    self._ChanceEatOutPerDay = 1
```

12 **1** **10**

From the simulation class

```
def ModifyCompany(self, Index):
  print("\n*********************************")
  print("*******  MODIFY COMPANY   *******")
  print("*********************************")
  print("1. Open new outlet")
  print("2. Close outlet")
  print("3. Expand outlet")
  print("4. Get Loan")
  print("5. Pay back loan")
  Choice = input("\nEnter your choice: ")
  print()
  if Choice == "2" or Choice == "3":
    ...
  elif Choice == "1":
    ...
  elif Choice == "4":
    Rate = float(input("Enter the interest rate for the loan: "))
    self._Companies[Index].GetLoan(Rate)
  elif Choice == "5":
    PayBackAmount = float(input("Enter the amount to pay back: "))
    self._Companies[Index].PayBackLoan(PayBackAmount)
  print()
```

From the `Company` class

```
class Company:
  def __init__(self, Name, Category, Balance, X, Y, FuelCostPerUnit,
BaseCostOfDelivery):
    self._Outlets = []
    ..
    self._DailyCosts = 100
    self._InterestRate = 0.0
    self._LoanBalance = 0.0
    if self._Category == "fast food":
      ...


def ProcessDayEnd(self):
  ...
  Details += "Previous balance for company: " + str(self._Balance) +
"\n"
  self._Balance += ProfitLossFromOutlets - self._DailyCosts -
DeliveryCosts - (self._LoanBalance * self._InterestRate)
  Details += "New balance for company: " + str(self._Balance)
  return Details


def GetLoan(self, Rate):
  if self._LoanBalance == 0:
    self._Balance += 10000
    self._LoanBalance = 10000
```

```
    self._InterestRate = Rate


def PayBackLoan(self, Amount):
  self._LoanBalance -= Amount
  self._Balance -= Amount
```

Alternative answer for taking a loan

In `ModifyCompany` method in `Simulation` class

```
...
elif Choice == "4":
  if Companies[Index].GetLoanBalance() <= 0:
    Rate = float(input("Enter the interest rate for the loan: "))
    self._Companies[Index].TakeOutLoan(Rate)
```

Methods in `Company` Class

```
def GetLoanBalance(self):
  return self._LoanBalance

def TakeOutLoan(self, InterestRate):
  self._InterestRate = InterestRate
  self._LoanBalance = 10000
  self._Balance += 10000
```

13 **1**

```
def __GetOrderedListOfOutlets(self):
  OrderedList = [0]
  while len(OrderedList) < len(self._Outlets):
    ShortestDistanceSoFar = 1000000.0
    for Count in range(1, len(self._Outlets)):
      if not Count in OrderedList:
        Temp =
self.__GetDistanceBetweenTwoOutlets(OrderedList[len(OrderedList) -
1], Count)
        if Temp < ShortestDistanceSoFar:
          NearestOutlet = Count
          ShortestDistanceSoFar = Temp
    OrderedList.append(NearestOutlet)
  return OrderedList

def CalculateDeliveryCost(self):
  ListOfOutlets = self.__GetOrderedListOfOutlets()
  TotalDistance = 0.0
  for Current in range (0, len(ListOfOutlets) - 1):
    TotalDistance +=
self.__GetDistanceBetweenTwoOutlets(ListOfOutlets[Current],
ListOfOutlets[Current + 1])
  TotalCost = TotalDistance * self._FuelCostPerUnit
  return TotalCost
```

11

Python 3

Question			Marks

05	1	`ModeFrequency = 0`
		`Multimodal = False`
		`Frequencies= [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]`
		`NoOfDigits = int(raw_input("Enter number of digits: "))`
		`for count in range (1, NoOfDigits + 1):`
		`  Current = int(raw_input("Enter a numeric digit: "))`
		`  Frequencies[Current] += 1`
		`for Count in range (0, 10):`
		`  if Frequencies[Count] > ModeFrequency:`
		`  ModeFrequency = Frequencies[Count]`
		`  Multimodal = False`
		`  elif Frequencies[Count] == ModeFrequency:`
		`  Multimodal = True`
		`if Multimodal:`
		`  print "Data was multimodal"`
		`else:`
		`  print "The modal digit appeared " + str(ModeFrequency) + " times"`
			12

10	1	`def AddCompany(self):`
		`  CompanyName = raw_input("Enter a name for the company: ")`
		`  while CompanyName == "" or self.GetIndexOfCompany(CompanyName) != -1:`
		`  if CompanyName == "":`
		`  print "You have to enter a company name"`
		`  else:`
		`  print "Company name already exists, it has to be unique"`
		`  CompanyName = raw_input("Enter a name for the company: ")`
		`  Balance = int(raw_input("Enter the starting balance for the company: "))`
		`  TypeOfCompany = ""`
		`  while not(TypeOfCompany == "1" or TypeOfCompany == "2" or TypeOfCompany == "3"):`
		`  TypeOfCompany = raw_input("Enter 1 for a fast food company, 2 for a family company or 3 for a named chef company: ")`
		`  if TypeOfCompany == "1":`
		`  TypeOfCompany = "fast food"`
		`  elif TypeOfCompany == "2":`
		`  TypeOfCompany = "family"`
		`  else:`
		`  TypeOfCompany = "named chef"`
		`  X, Y = self._SimulationSettlement.GetRandomLocation()`
		`  NewCompany = Company(CompanyName, TypeOfCompany, Balance, X, Y, self._FuelCostPerUnit, self._BaseCostforDelivery)`
		`  self._Companies.append(NewCompany)`
			5

11	1	`def AddHousehold(self):`
		`  X, Y = self.GetRandomLocation()`
		`  if X < 100:`
		`  Temp = AffluentHousehold(X, Y)`
		`  self._Households.append(Temp)`
		`  else:`
		`  Temp = Household(X, Y)`
		`  self._Households.append(Temp)`
		
		`class AffluentHousehold(Household):`
			7

```
  def __init__(self, X, Y):
    super(AffluentHousehold, self).__init__(X, Y)
    self._ChanceEatOutPerDay = 1
```

12 **1** **From the simulation class** **10**

```
def ModifyCompany(self, Index):
  print "\n*********************************"
  print "*******  MODIFY COMPANY   *******"
  print "*********************************"
  print "1. Open new outlet"
  print "2. Close outlet"
  print "3. Expand outlet"
  print "4. Get Loan"
  print "5. Pay back loan"
  Choice = raw_input("\nEnter your choice: ")
  print
  if Choice == "2" or Choice == "3":
    ...
  elif Choice == "1":
    ...
  elif Choice == "4":
    Rate = float(raw_input("Enter the interest rate for the loan:
"))
    self._Companies[Index].GetLoan(Rate)
  elif Choice == "5":
    PayBackAmount = float(raw_input("Enter the amount to pay back:
"))
    self._Companies[Index].PayBackLoan(PayBackAmount)
  print
```

From the `Company` class

```
class Company:
  def __init__(self, Name, Category, Balance, X, Y, FuelCostPerUnit,
BaseCostOfDelivery):
    self._Outlets = []
    ..
    self._DailyCosts = 100
    self._InterestRate = 0.0
    self._LoanBalance = 0.0
    if self._Category == "fast food":
      ...


def ProcessDayEnd(self):
  ...
  Details += "Previous balance for company: " + str(self._Balance) +
"\n"
  self._Balance += ProfitLossFromOutlets - self._DailyCosts -
DeliveryCosts - (self._LoanBalance * self._InterestRate)
  Details += "New balance for company: " + str(self._Balance)
  return Details

def GetLoan(self, Rate):
  if self._LoanBalance == 0:
    self._Balance += 10000
    self._LoanBalance = 10000
    self._InterestRate = Rate
```

```
def PayBackLoan(self, Amount):
  self._LoanBalance -= Amount
  self._Balance -= Amount
```

Alternative answer for taking a loan

In `ModifyCompany` method in `Simulation` class

```
...
elif Choice == "4":
  if Companies[Index].GetLoanBalance() <= 0:
    Rate = float(raw_input("Enter the interest rate for the loan:
"))
    self._Companies[Index].TakeOutLoan(Rate)
```

Methods in `Company` Class

```
def GetLoanBalance(self):
  return self._LoanBalance

def TakeOutLoan(self, InterestRate):
  self._InterestRate = InterestRate
  self._LoanBalance = 10000
  self._Balance += 10000
```

13	**1**	`def __GetOrderedListOfOutlets(self):`
		`  OrderedList = [0]`
		`  while len(OrderedList) < len(self._Outlets):`
		`  ShortestDistanceSoFar = 1000000.0`
		`  for Count in range(1, len(self._Outlets)):`
		`  if not Count in OrderedList:`
		`  Temp =`
		`self.__GetDistanceBetweenTwoOutlets(OrderedList[len(OrderedList) -`
		`1], Count)`
		`  if Temp < ShortestDistanceSoFar:`
		`  NearestOutlet = Count`
		`  ShortestDistanceSoFar = Temp`
		`  OrderedList.append(NearestOutlet)`
		`  return OrderedList`
		
		`def CalculateDeliveryCost(self):`
		`  ListOfOutlets = self.__GetOrderedListOfOutlets()`
		`  TotalDistance = 0.0`
		`  for Current in range (0, len(ListOfOutlets) - 1):`
		`  TotalDistance +=`
		`self.__GetDistanceBetweenTwoOutlets(ListOfOutlets[Current],`
		`ListOfOutlets[Current + 1])`
		`  TotalCost = TotalDistance * self._FuelCostPerUnit`
		`  return TotalCost`
			11

C#

Question			Marks

05	1	`int current;`
		`int[] frequencies = new int[10];`
		`int modeFrequency = 0;`
		`bool multimodal = false;`
		`int noOfDigits;`
		`Console.Write("Enter number of digits: ");`
		`noOfDigits = Convert.ToInt32(Console.ReadLine());`
		`for (int i = 0; i < noOfDigits; i++)`
		`{`
		`  Console.Write("Enter a numeric digit: ");`
		`  current = Convert.ToInt32(Console.ReadLine());`
		`  frequencies[current] += 1;`
		`}`
		`for (int i = 0; i < 10; i++)`
		`{`
		`  if (frequencies[i] > modeFrequency)`
		`  {`
		`  modeFrequency = frequencies[i];`
		`  multimodal = false;`
		`  }`
		`  else if (frequencies[i] == modeFrequency )`
		`  {`
		`  multimodal = true;`
		`  }`
		`}`
		`if (multimodal)`
		`{`
		`  Console.WriteLine("Data was multimodal");`
		`}`
		`else`
		`{`
		`  Console.WriteLine("The modal digit appeared " + modeFrequency + " times");`
		`}`
		`Console.ReadLine();`
			12

10	1	`private void AddCompany()`
		`{`
		`  int balance, x = 0, y = 0;`
		`  string companyName, typeOfCompany = "9";`
		`  do`
		`  {`
		`  Console.Write("Enter a name for the company: ");`
		`  companyName = Console.ReadLine();`
		`  if (companyName == "")`
		`  {`
		`  Console.WriteLine("You must enter a name.");`
		`  }`
		`  else if (GetIndexOfCompany(companyName) != -1)`
		`  {`
		`  Console.WriteLine("That name is already being used.");`
		`  }`
		`  } while (companyName == "" || GetIndexOfCompany(companyName) != -1);`
		`Console.Write("Enter the starting balance for the company: ");`
			5

Alternative answer

```
private void AddCompany()
{
    int balance, x = 0, y = 0;
    string companyName, typeOfCompany = "9";
    Console.Write("Enter a name for the company: ");
    companyName = Console.ReadLine();
    while (companyName == "" || GetIndexOfCompany(companyName) != -
1)
    {
        if (companyName == "")
        {
            Console.WriteLine("You must enter a name.");
        }
        else if (GetIndexOfCompany(companyName) != -1)
        {
            Console.WriteLine("That name is already being used.");
        }
        Console.Write("Enter a name for the company: ");
        companyName = Console.ReadLine();
    }
    Console.Write("Enter the starting balance for the company: ");
```

11 **1** **7**

```
public void AddHousehold()
{
    int x = 0, y = 0;
    GetRandomLocation(ref x, ref y);
    if (x < 100)
    {
        AffluentHousehold temp = new AffluentHousehold(x, y);
        households.Add(temp);
    }
    else
    {
        Household temp = new Household(x, y);
        households.Add(temp);
    }
}

class AffluentHousehold : Household
{
    public AffluentHousehold(int x, int y)
        :base(x, y)
    {
        chanceEatOutPerDay = 1;
    }
}
```

12 **1** **10**

From the simulation class

```
public void ModifyCompany(int index)
{
    string choice;
    int outletIndex, x, y;
    bool closeCompany;
    Console.WriteLine("\n*********************************");
    Console.WriteLine("*******  MODIFY COMPANY   *******");
    Console.WriteLine("*********************************");
```

```
    Console.WriteLine("1. Open new outlet");
    Console.WriteLine("2. Close outlet");
    Console.WriteLine("3. Expand outlet");
    Console.WriteLine("4. Get Loan");
    Console.WriteLine("5. Pay back loan");
    Console.Write("\nEnter your choice: ");
    choice = Console.ReadLine();
    if (choice == "2" || choice == "3")
    ...
    else if (choice == "1")
    ...
    else if (choice == "4")
    {
        Console.Write("Enter the interest rate for the loan: ");
        double rate = Convert.ToDouble(Console.ReadLine());
        companies[index].GetLoan(rate);

    }
    else if (choice == "5")
    {
        Console.Write("Enter the amount to pay back: ");
        double payBackAmount = Convert.ToDouble(Console.ReadLine());
        companies[index].PayBackLoan(payBackAmount);
    }
    Console.WriteLine();
}
```

From the company class

```
class Company
{
    private static Random rnd = new Random();
    protected string name, category;
    protected double balance, reputationScore, avgCostPerMeal,
avgPricePerMeal, dailyCosts, familyOutletCost, fastFoodOutletCost,
namedChefOutletCost, fuelCostPerUnit, baseCostOfDelivery;
    protected List<Outlet> outlets = new List<Outlet>();
    protected int familyFoodOutletCapacity, fastFoodOutletCapacity,
namedChefOutletCapacity;
    protected double loanBalance;
    protected double interestRate;
...

public string ProcessDayEnd()
...
    }
    details += "Previous balance for company: " + balance.ToString()
+ "\n";
    balance += profitLossFromOutlets - dailyCosts - deliveryCosts -
(loanBalance * interestRate);
    details += "New balance for company: " + balance.ToString();
    return details;
}

public void GetLoan(double rate)
{
    if (loanBalance == 0)
    {
        balance += 10000;
```

```
        interestRate = rate;
    }
}

public void PayBackLoan(double amount)
{
    loanBalance -= amount;
    balance -= amount;
}
```

Alternative answer for taking a loan

In `ModifyCompany` method in `Simulation` class

```
...
else if (choice == "4")
                {
                    if (companies[index].GetLoanBalance() <= 0)
                    {
                        Console.Write("Enter the interest rate for
the loan: ");
                        double rate =
Convert.ToDouble(Console.ReadLine());
                        companies[index].TakeOutLoan(rate);
                    }
                }
```

Methods in `Company` Class

```
public double GetLoanBalance()
{
    return loanBalance;
}

public void TakeOutLoan(double interestRate)
{
    this.interestRate = interestRate;
    loanBalance = 10000;
    balance += 10000;
}
```

13	**1**	`private List<int> GetOrderedListOfOutlets()`
		`{`
		`  List<int> orderedList = new List<int>();`
		`  int nearestOutlet = 0; ;`
		`  orderedList.Add(0);`
		`  while (orderedList.Count < outlets.Count)`
		`  {`
		`  double shortestDistanceSoFar = 1000000;`
		`  for (int count = 1; count < outlets.Count ; count++)`
		`  {`
		`  if (!orderedList.Contains(count))`
		`  {`
		`  double temp =`
		`GetDistanceBetweenTwoOutlets(orderedList[orderedList.Count - 1],`
		`count);`
			11

```
                    if (temp < shortestDistanceSoFar)
                    {
                        nearestOutlet = count;
                        shortestDistanceSoFar = temp;
                    }
                }
            }
            orderedList.Add(nearestOutlet);
        }
        return orderedList;
}

public double CalculateDeliveryCost()
{
    List<int> listOfOutlets = new
List<int>(GetOrderedListOfOutlets());
    double totalDistance = 0;
    double totalCost = 0;
    for (int current = 0; current < listOfOutlets.Count - 1;
current++)
    {
        totalDistance +=
GetDistanceBetweenTwoOutlets(listOfOutlets[current],
listOfOutlets[current + 1]);
    }
    totalCost = totalDistance * fuelCostPerUnit;
    return totalCost;
}
```

PASCAL/Delphi

Question			Marks

05	1	var
		  Current, ModeFrequency, NoOfDigits, Count : Integer;
		  Frequencies : array of Integer;
		  Multimodal : Boolean;
		begin
		  SetLength(Frequencies, 10);
		  ModeFrequency := 0;
		  MultiModal := False;
		  for Count := 0 to 9 do
		  Frequencies[Count] := 0;
		  write('Enter number of digits: ');
		  readln(NoOfDigits);
		  for Count := 1 to NoOfDigits do
		  begin
		  write('Enter a numberic digit: ');
		  readln(Current);
		  Frequencies[Current] += 1;
		  end;
		  for Count := 0 to 9 do
		  begin
		  if Frequencies[Count] > ModeFrequency then
		  begin
		  ModeFrequency := Frequencies[Count];
		  MultiModal := False;
		  end
		  else if Frequencies[Count] = ModeFrequency then
		  MultiModal := True;
		  end;
		  if MultiModal = True then
		  writeln('Data was multimodal')
		  else
		  writeln('The modal digit appeared ' + inttostr(ModeFrequency) + ' times');
		  readln;
		end.
			12

10	1	procedure Simulation.AddCompany();
		var
		  Balance, X, Y : Integer;
		  CompanyName, TypeOfCompany : String;
		  NewCompany : Company;
		begin
		  repeat
		  write('Enter a name for the company: ');
		  readln(CompanyName);
		  if CompanyName = '' then
		  writeln('You must enter a name');
		  if GetIndexOfCompany(CompanyName) <> - 1 then
		  writeln('That name is already being used');
		  until (CompanyName <> '') and (GetIndexOfCompany(CompanyName) = -1);
		  write('Enter the starting balance for the company: ');
		
		Alternative Answer
		
		write('Enter a name for the company: ');
			5

```
readln(CompanyName);
while (CompanyName = '') or (GetIndexOfCompany(CompanyName) <> -1)
do
  begin
    if CompanyName = '' then
      writeln('You have to enter a company name')
    else
      writeln('Company name already exists - it has to be unique');
    write('Enter a name for the company: ');
    readln(CompanyName);
  end;
```

11 **1** **7**

```
type
  AffluentHousehold = class(Household)
    constructor New(X : Integer; Y : Integer);
  end;

constructor AffluentHousehold.New(X : Integer; Y : Integer);
begin
  XCoord := X;
  YCoord := Y;
  ChanceEatOutPerDay := 1;
  ID := NextID;
  inc(NextID);
end;

procedure Settlement.AddHousehold();
var
  X, Y : Integer;
  Temp : Household;
  TempAff : AffluentHousehold;
begin
  SetLength(Households,length(Households) + 1);
  GetRandomLocation(X, Y);
  if X < 100 then
    begin
      TempAff := AffluentHousehold.New(X, Y);
      Households[length(Households) - 1] := TempAff;
    end
  else
    begin
      Temp := Household.New(X, Y);
      Households[length(Households) - 1] := Temp;
    end;
end;
```

12 **1** **10**

From the simulation class

```
procedure Simulation.ModifyCompany(Index : Integer);
var
  Choice : String;
  OutletIndex, CompIndex, X, Y : Integer;
  CloseCompany : Boolean;
  Rate, PayBackAmount : Real;
begin
  writeln;
  writeln('*********************************');
  writeln('*******  MODIFY COMPANY   *******');
  writeln('*********************************');
  writeln('1. Open new outlet');
  writeln('2. Close outlet');
  writeln('3. Expand outlet');
```

```
  writeln('4. Get loan');
  writeln('5. Pay back loan');
  writeln;
  write('Enter your choice: ');
  readln(Choice);
  writeln;
  if (Choice = '2') or (Choice = '3') then
  ...
  else if Choice = '1' then
  ...
  else if Choice = '4' then
    begin
      write('Enter the interest rate for the loan: ');
      readln(Rate);
      Self.Companies[Index].GetLoan(Rate);
    end
  else if Choice = '5' then
    begin
      write('Enter the amount to pay back: ');
      readln(PayBackAmount);
      Companies[Index].PayBackLoan(PayBackAmount);
    end;
  writeln;
end;
```

From the `Company` class

```
type
  Company = class
    protected
      Name, Category : String;
      Balance, ReputationScore, AvgCostPerMeal, AvgPricePerMeal,
DailyCosts, FamilyOutletCost, FastFoodOutletCost,
NamedChefOutletCost, FuelCostPerUnit, BaseCostOfDelivery,
InterestRate, LoanBalance : Real;
      Outlets: TOutletArray;
      ...
      function CalculateDeliveryCost() : Real;
      procedure GetLoan(Rate : Real);
      procedure PayBackLoan(Amount : Real);


constructor Company.New(NameInput : String; CategoryInput : String;
BalanceInput : Real; X : Integer; Y : Integer; FuelCostPerUnitInput
: Real; BaseCostOfDeliveryInput : Real);
begin
  Self.FamilyOutletCost := 1000;
  Self.FastFoodOutletCost := 2000;
  Self.NamedChefOutletCost:= 15000;
  Self.FamilyFoodOutletCapacity := 150;
  Self.FastFoodOutletCapacity := 200;
  Self.NamedChefOutletCapacity := 50;
  Self.LoanBalance := 0;
  Self.Name := NameInput;

procedure Company.GetLoan(Rate : Real);
begin
  if Self.LoanBalance = 0 then
    begin
```

```
      Self.Balance += 10000;
      Self.LoanBalance := 10000;
      Self.InterestRate := Rate;
    end;
end;

procedure Company.PayBackLoan(Amount : Real);
begin
  Self.LoanBalance -= Amount;
  Self.Balance -= Amount;
end;


function Company.ProcessDayEnd() : String;
...
  Details += 'Previous balance for company: ' +
floattostr(self.Balance) + #13#10;
  Self.Balance += ProfitLossFromOutlets - Self.DailyCosts -
DeliveryCosts - (Self.LoanBalance * Self.InterestRate);
  Details += 'New balance for company: ' + floattostr(Self.Balance);
  ProcessDayEnd := Details;
end;
```

Alternative answer for taking a loan

In `ModifyCompany` method in `Simulation` class

```
  ...
  else if Choice = '4' then
    if Companies[Index].GetLoanBalance() <= 0 then
      begin
        write('Enter the interest rate for the loan: ');
        readln(Rate);
        Self.Companies[Index].GetLoan(Rate);
      end
  ...
```

`Company` Class

```
function GetLoanBalance(): Real;

...

function Company.GetLoanBalance() : Real;
begin
  GetLoanBalance := LoanBalance;
end;

procedure Company.GetLoan(InterestRate : Real);
begin
  Self.Balance += 10000;
  Self.LoanBalance := 10000;
  Self.InterestRate := Rate;
end;
```

13	**1**	`function Company.GetOrderedListOfOutlets() : TIntegerArray;`
		`var`
		`  OrderedList : TIntegerArray;`
			11

```
  NearestOutlet, Count, Index, Temp : Integer;
  ShortestDistanceSoFar : Real;
  ItemInList : Boolean;
begin
  SetLength(OrderedList, 1);
  OrderedList[0] := 0;
  while length(OrderedList) < length(Self.Outlets) do
    begin
      ShortestDistanceSoFar := 1000000;
      for Count := 1 to length(Self.Outlets) - 1 do
        begin
          ItemInList := False;
          for Index := low(OrderedList) to high(OrderedList) do
            begin
              if OrderedList[Index] = Count then
                ItemInList := True;
            end;
          if ItemInList = false then
            begin
              Temp :=
trunc(GetDistanceBetweenTwoOutlets(OrderedList[length(OrderedList) -
1], Count));
              if Temp < ShortestDistanceSoFar then
                begin
                  NearestOutlet := Count;
                  ShortestDistanceSoFar := Temp;
                end;
            end;
        end;
      SetLength(OrderedList, length(OrderedList) + 1);
      OrderedList[high(OrderedList)] := NearestOutlet;
    end;
  GetOrderedListOfOutlets := OrderedList;
end;

function Company.CalculateDeliveryCost() : Real;
var
  ListOfOutlets : TIntegerArray;
  TotalDistance, TotalCost : Real;
  Current : Integer;
begin
  ListOfOutlets := GetOrderedListOfOutlets();
  TotalDistance := 0;
  for Current := 0 to length(ListOfOutlets) - 2 do
    TotalDistance +=
GetDistanceBetweenTwoOutlets(ListOfOutlets[Current],
ListOfOutlets[Current + 1]);
  TotalCost := TotalDistance * Self.FuelCostPerUnit;
  CalculateDeliveryCost := TotalCost;
end;
```

JAVA

Question			Marks

05	1	`int modeFrequency = 0, input;`
		`int[] frequencies  = new int[10];`
		`boolean multimodal = false;`
		`Console.writeLine("Enter the number of digits you would like to enter:");`
		`int numOfDigits = Integer.parseInt(Console.readLine());`
		`for (int i = 0; i < numOfDigits; i++) {`
		`    Console.writeLine("Enter a digit:");`
		`    input = Integer.parseInt(Console.readLine());`
		`    frequencies [input]++;`
		`}`
		`modeFrequency = frequencies [0];`
		`for (int i = 1; i < 10; i++) {`
		`    if (modeFrequency == frequencies [i]) {`
		`        multimodal = true;`
		`    } else if (frequencies [i] > modeFrequency) {`
		`        multimodal = false;`
		`        modeFrequency = frequencies [i];`
		`    }`
		`}`
		`if (multimodal) {`
		`    Console.writeLine("Data was multimodal");`
		`} else {`
		`    Console.writeLine("The modal digit appeared " + modeFrequency + " times");`
			12

10	1	`public void addCompany() {`
		`    int balance, x, y;`
		`    String companyName, typeOfCompany;`
		`    do {`
		`        Console.write("Enter a name for the company: ");`
		`        companyName = Console.readLine();`
		`        if (companyName.equals("")) {`
		`            Console.writeLine("You must enter a name.");`
		`        } else if (getIndexOfCompany(companyName) != -1) {`
		`            Console.writeLine("That name is already being used.");`
		`        }`
		`    } while (companyName.equals("") ||`
		`getIndexOfCompany(companyName) != -1);`
		
		Alternative answer
		
		`public void addCompany() {`
		`    int balance, x, y;`
		`    String companyName, typeOfCompany;`
		`    Console.write("Enter a name for the company: ");`
		`    companyName = Console.readLine();`
		`    while (companyName.equals("") || getIndexOfCompany(companyName) != -1){`
		`        if (companyName.equals("")) {`
		`            Console.writeLine("You must enter a name.");`
		`        } else if (getIndexOfCompany(companyName) != -1) {`
		`            Console.writeLine("That name is already being used.");`
		`        }`
			5

		Console.write("Enter a name for the company: "); **companyName = Console.readLine();** **}**	

11	**1**	**class AffluentHousehold extends Household**
		{
		public AffluentHousehold(int x, int y)
		{
		super(x, y);
		chanceEatOutPerDay = 1;
		}
		}
		
		public void addHousehold() {
		int x, y;
		int[] tempLocation = getRandomLocation();
		x = tempLocation[0];
		y = tempLocation[1];
		if (x < 100) {
		AffluentHousehold temp = new AffluentHousehold(x, y);
		households.add(temp);
		} else {
		Household temp = new Household(x, y);
		households.add(temp);
		}
		}
			7

12	**1**	**From the simulation class**
		
		public void modifyCompany(int index) {
		String choice;
		int outletIndex, x, y;
		boolean closeCompany;
		Console.writeLine(System.lineSeparator() +
		"*********************************");
		Console.writeLine("******* MODIFY COMPANY *******");
		Console.writeLine("*********************************");
		Console.writeLine("1. Open new outlet");
		Console.writeLine("2. Close outlet");
		Console.writeLine("3. Expand outlet");
		Console.writeLine("4. Get Loan");
		Console.writeLine("5. Pay back loan");
		Console.write(System.lineSeparator() + "Enter your choice: ");
		choice = Console.readLine();
		Console.writeLine();
		if (choice.equals("2") || choice.equals("3")) {
		...
		} else if (choice.equals("1")) {
		...
		} else if (choice.equals("4")) {
		Console.write("Enter the interest rate for the loan: ");
		float rate = Float.parseFloat(Console.readLine());
		companies.get(index).getLoan(rate);
		} else if (choice.equals("5")) {
		Console.write("Enter the amount to pay back: ");
		float payBackAmount = Float.parseFloat(Console.readLine());
		companies.get(index).payBackLoan(payBackAmount);
		}
		Console.writeLine();
			10

```
}
```

From the company class

```
class Company {
    protected String name, category;
    protected float balance, reputationScore, avgCostPerMeal,
avgPricePerMeal, dailyCosts, familyOutletCost, fastFoodOutletCost,
namedChefOutletCost, fuelCostPerUnit, baseCostOfDelivery,
loanBalance, interestRate;
    protected List<Outlet> outlets = new ArrayList();
    protected int familyFoodOutletCapacity, fastFoodOutletCapacity,
namedChefOutletCapacity;
    private static Random rnd = new Random();
    ...


public String processDayEnd() {
    ...
    }
    details += "Previous balance for company: " + balance +
System.lineSeparator();
    balance += profitLossFromOutlets - dailyCosts - deliveryCosts -
(loanBalance * interestRate);
    details += "New balance for company: " + balance;
    return details;
}


public void getLoan(float rate)
{
    if (loanBalance == 0)
    {
        balance += 10000;
        loanBalance = 10000;
        interestRate = rate;
    }
}

public void payBackLoan(float amount)
{
    loanBalance -= amount;
    balance -= amount;
}
```

Alternative answer for taking a loan

In `modifyCompany` method in `Simulation` class

```
...
} else if (choice.equals("4")) {
    if (companies.get(index).getLoanBalance() <= 0) {
        Console.write("Enter the interest rate for the loan: ");
        float rate = Float.parseFloat(Console.readLine());
        companies.get(index).takeOutLoan(rate);
    }
}
```

Methods in `Company` Class

```
public float getLoanBalance()
{
    return loanBalance;
}

public void takeOutLoan(float rate)
{
    balance += 10000;
    loanBalance = 10000;
    interestRate = rate;
}
```

13 **1** **11**

```
public List<Integer> getOrderedListOfOutlets()
{
    List<Integer> orderedList = new ArrayList();
    int nearestOutlet = 0;
    orderedList.add(nearestOutlet);
    while (orderedList.size() < outlets.size()) {
        float shortestDistanceSoFar = 1000000f;
        for (int count = 1; count < outlets.size(); count++) {
            if (!orderedList.contains(count)) {
                float temp =
getDistanceBetweenTwoOutlets(orderedList.get(orderedList.size()-1),
count);
                if (temp < shortestDistanceSoFar) {
                    nearestOutlet = count;
                    shortestDistanceSoFar = temp;
                }
            }
        }
        orderedList.add(nearestOutlet);
    }
    return orderedList;
}

public float calculateDeliveryCost() {
    List<Integer> listOfOutlets = getOrderedListOfOutlets();
    float totalDistance = 0;
    float totalCost;
    for (int current = 0; current < listOfOutlets.size() - 1;
current++) {
        totalDistance +=
getDistanceBetweenTwoOutlets(listOfOutlets.get(current),
listOfOutlets.get(current + 1));
    }
    totalCost = totalDistance * fuelCostPerUnit;
    return totalCost;
}
```