

Paper 2: Application of Computational Thinking

Question number	Answer	Additional guidance	Mark
1 (a) (i)	myNumbers	Candidates are required to open the file Q01a in the code editor.	(1)

Question number	Answer	Additional guidance	Mark
1 (a) (ii)	Python Lines 3–8/3 Java Lines 7–14/7 C# Lines 10–17/10	Candidates are required to open the file Q01a in the code editor.	(1)

Question number	Answer	Additional guidance	Mark
1 (a) (iii)	Python Lines 5–8/5 Java Lines 10–14/10 C# Lines 13–16/13	Candidates are required to open the file Q01a in the code editor.	(1)

Question number	Answer	Additional guidance	Mark
1 (a) (iv)	myNumbers/i/total	Candidates are required to open the file Q01a in the code editor.	(1)

Question number	Answer	Additional guidance	Mark
1(b)(i)	Any one from: <ul style="list-style-type: none"> • comments/annotations • descriptive variable names. 	Candidates are required to open the file Q01b in the code editor.	(1)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	Any one from: <ul style="list-style-type: none"> • another programmer could understand it • future maintenance would be easier • easier for another programmer to fix bugs/make amendments • less likely to introduce bugs yourself. 		(1)

Question number	Answer	Additional guidance	Mark
1(c)(i)	Any one from: <ul style="list-style-type: none"> • an error in following the rules of the programming language • not following the grammar rules of the programming language • not being able to translate a line of code because of an error in using the language • misspelling command words in the programming language. 		(1)

Question number	Answer	Additional guidance	Mark
1(c)(ii)	<p>Python</p> <ul style="list-style-type: none"> Total is undefined/need to add initialisation for variable total (1). Equals symbol in If statement needs to be replaced with '==' (1). Print ("Odd") needs to be indented (1). <pre> 1 myNumbers = [10, 20, 30, 40, 50, 60, 70, 80, 90, 100] 2 total = 0 3 for theNumber in myNumbers: 4 total = total + theNumber 5 if(theNumber % 2 == 0): 6 print("Even") 7 else: 8 print("Odd") 9 print(total) </pre>	<p>Candidates are required to open the file Q01c in the code editor. Amended code should be saved as Q01cFINISHED.</p> <p>Do not penalise logic errors such as initialising total inside loop.</p>	(3)

Java

- Total is undefined/need to add initialisation for variable total (1).
- Equals symbol in If statement needs to be replaced with '==' (1).
- Missing closed } after Print ("Odd") (1).

```
5      int total = 0;
6      for (int i=10;i<=100;i+=10)
7      {
8          total = total + i;
9          if(i % 2 == 0)
10             System.out.println("Even");
11         else
12         {
13             System.out.println("Odd");
14         }
15     }
16     System.out.println(total);
```

C#

- Total is undefined/need to add initialisation for variable total (1).
- Equals symbol in If statement needs to be replaced with '==' (1).
- Missing End If after Console.WriteLine ("Odd") (1).

```
int total = 0;
for (int i = 10; i <= 100; i += 10)
{
    total = total + i;
    if (i % 2 == 0)
        Console.WriteLine("Even");
    else
    {
        Console.WriteLine("Odd");
    }
}
Console.WriteLine(total);
Console.ReadKey();
```

Question number	Answer	Additional guidance	Mark
2(a)	<p>Award 1 mark for each of:</p> <ul style="list-style-type: none"> • attempting to input country and print country (1) • printing string plus country (1) • attempting to input number of children and number of adults (1) • coercion of at least one data type (1) • attempting to calculate and print a total (1) • calculating a total using the addition operator (1) • using two variables (1) • printing a string plus an integer (1) • compiling without syntax errors (1) • executing and producing the correct output (1). <p>Python</p> <pre> 5 # Print prompt and take country from user 6 country = input ("Enter the country you're visiting from: ") 7 8 # Tell the user their country 9 print ("You are from: ", country) 10 11 # Take number of adults in party from user 12 adult = int (input ("Enter the number of adults in your party: ")) 13 14 # Take number of children in party from user 15 children = int (input ("Enter the number of children in your party: ")) 16 17 # Calculate total number in party 18 total = adult + children 19 20 # Tell the user the total number of people in their party 21 print ("The total in your party is: ", total) </pre>	<p>Candidates are required to open the file Q02a in the code editor. Amended code should be saved as Q02aFINISHED.</p> <p>Logic of algorithm must be followed as set out. Alternatives must address each point.</p> <p>Do not penalise candidates who attempt more than the stated requirements.</p>	(10)

Java

```
6 Scanner input = new Scanner(System.in);
7
8 // Print prompt and take country from user
9 System.out.print("Enter the country you are visiting from: ");
10 String country = input.next();
11
12 // Tell the user their country
13 System.out.println("You are from: " + country);
14
15 // Take number of adults in party from user
16 System.out.print("Enter the number of adults in your party: ");
17 int adults = input.nextInt();
18
19 // Take number of children in party from user
20 System.out.print("Enter the number of children in your party: ");
21 int children = input.nextInt();
22
23 // Calculate total number in party
24 int total = adults + children;
25
26 // Tell the user the total number of people in their party
27 System.out.println("The total in your party is: " + total);
28
```

C#

```
8 // Print prompt and take country from user
9 Console.WriteLine("Enter the country you are visiting from: ");
10 String country = Console.ReadLine();
11 Console.WriteLine("You are from: " + country);
12
13 // Tell the user their country
14 Console.WriteLine("Enter the number of adults in your party: ");
15
16 // Take number of adults in party from user
17 int adults = Convert.ToInt32(Console.ReadLine());
18 Console.WriteLine("Enter the number of children in your party: ");
19
20 // Take number of children in party from user
21 int children = Convert.ToInt32(Console.ReadLine());
22
23 // Calculate total number in party
24 int total = adults + children;
25
26 // Tell the user the total number of people in their party
27 Console.WriteLine("The total in your party is: " + total);
28
```


Question number	Answer	Additional guidance	Mark										
2(b)	<p>For up to two tests</p> <p>Award 1 mark for an appropriate validation test and 1 mark for an item of test data that would fail the given test.</p> <table border="1" data-bbox="331 392 1386 724"> <thead> <tr> <th data-bbox="331 392 1084 459">Validation test</th> <th data-bbox="1084 392 1386 459">Invalid data</th> </tr> </thead> <tbody> <tr> <td data-bbox="331 459 1084 526">Is length = 5?</td> <td data-bbox="1084 459 1386 526">ABC-123</td> </tr> <tr> <td data-bbox="331 526 1084 593">Is hyphen in the middle?</td> <td data-bbox="1084 526 1386 593">AB1-2</td> </tr> <tr> <td data-bbox="331 593 1084 660">Are characters 1 and 2 letters?</td> <td data-bbox="1084 593 1386 660">12-34</td> </tr> <tr> <td data-bbox="331 660 1084 724">Are characters 4 and 5 digits?</td> <td data-bbox="1084 660 1386 724">AB-MP</td> </tr> </tbody> </table>	Validation test	Invalid data	Is length = 5?	ABC-123	Is hyphen in the middle?	AB1-2	Are characters 1 and 2 letters?	12-34	Are characters 4 and 5 digits?	AB-MP		(4)
Validation test	Invalid data												
Is length = 5?	ABC-123												
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Are characters 1 and 2 letters?	12-34												
Are characters 4 and 5 digits?	AB-MP												

Question number	Answer	Additional guidance	Mark																	
2(c)	<p data-bbox="327 229 792 253">Award 1 mark for each logical test.</p> <table border="1" data-bbox="327 288 1397 783"> <thead> <tr> <th data-bbox="327 296 669 352">Condition</th> <th data-bbox="676 296 1061 352">Output message</th> <th data-bbox="1068 296 1397 352">Logical test</th> </tr> </thead> <tbody> <tr> <td data-bbox="327 357 669 421">Attendance is at least 1500</td> <td data-bbox="676 357 1061 421">Sufficient profit made this week</td> <td data-bbox="1068 357 1397 469" rowspan="2">(attendance >= 1500) or (income >= 45000)</td> </tr> <tr> <td data-bbox="327 426 669 489">Income is at least 45000</td> <td data-bbox="676 426 1061 489">Sufficient profit made this week</td> </tr> <tr> <td data-bbox="327 494 669 582">Attendance is at least 750; income is at least 22500</td> <td data-bbox="676 494 1061 582">Income in line with attendance this week</td> <td data-bbox="1068 494 1397 582">(attendance >= 750) and (income >= 22500)</td> </tr> <tr> <td data-bbox="327 587 669 675">Attendance is fewer than 500</td> <td data-bbox="676 587 1061 675">Attendance is very low this week Contact fan club</td> <td data-bbox="1068 587 1397 675">(attendance < 500)</td> </tr> <tr> <td data-bbox="327 679 669 767">All other inputs</td> <td data-bbox="676 679 1061 767">Possible accounting error</td> <td data-bbox="1068 679 1397 767">The print statement needs to be in the 'else' block</td> </tr> </tbody> </table> <p data-bbox="327 820 432 844">Python</p> <pre data-bbox="338 855 1301 1086"> if (attendance >= 1500) or (income >= 45000): print ("Sufficient profit made this week") elif (attendance >= 750) and (income >= 22500): print ("income in line with attendance this week") elif (attendance < 500): print ("Attendance is very low this week. Contact the fan club.") else: print ("Possible accounting error.") </pre> <p data-bbox="327 1129 394 1153">Java</p> <pre data-bbox="338 1165 1346 1345"> if ((attendance >= 1500) (income >= 45000)) System.out.println("Sufficient profit made this week"); else if ((attendance >= 750) && (income >= 22500)) System.out.println("income in line with attendance this week"); else if (attendance < 500) System.out.println("Attendance is very low this week. Contact the fan club."); else System.out.println("Possible accounting error."); </pre>	Condition	Output message	Logical test	Attendance is at least 1500	Sufficient profit made this week	(attendance >= 1500) or (income >= 45000)	Income is at least 45000	Sufficient profit made this week	Attendance is at least 750; income is at least 22500	Income in line with attendance this week	(attendance >= 750) and (income >= 22500)	Attendance is fewer than 500	Attendance is very low this week Contact fan club	(attendance < 500)	All other inputs	Possible accounting error	The print statement needs to be in the 'else' block	<p data-bbox="1431 229 1939 349">Candidates are required to open the file Q02c in the code editor. Amended code should be saved as Q02cFINISHED.</p> <p data-bbox="1431 389 1861 485">Do not penalise candidates who attempt more than the stated requirements.</p>	(4)
Condition	Output message	Logical test																		
Attendance is at least 1500	Sufficient profit made this week	(attendance >= 1500) or (income >= 45000)																		
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Attendance is at least 750; income is at least 22500	Income in line with attendance this week	(attendance >= 750) and (income >= 22500)																		
Attendance is fewer than 500	Attendance is very low this week Contact fan club	(attendance < 500)																		
All other inputs	Possible accounting error	The print statement needs to be in the 'else' block																		

	C# <pre> if ((attendance >= 1500) (income >= 45000)) Console.WriteLine("Sufficient profit made this week"); else if ((attendance >= 750) && (income >= 22500)) Console.WriteLine("income in line with attendance this week"); else if (attendance < 500) Console.WriteLine("Attendance is very low this week. Contact the fan club."); else Console.WriteLine("Possible accounting error."); </pre>	
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Question number	Answer	Additional guidance	Mark
3(a)	Any one from: <ul style="list-style-type: none"> • a subprogram can be written once (1) and called many times (1) • a subprogram can be debugged once (1) and called many times (1) • subprograms can be collected into libraries (1), which can be used by other programs (1). 		(2)

Question number	Answer	Additional guidance	Mark
3(b)(i)	Python time.sleep/print Java Thread.sleep/System.out.println C# System.Threading.Thread.Sleep/Console.WriteLine	Candidates are required to open the file Q03b in the code editor. Accept clear reference to sleep and print built-in subprograms.	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	toCelsius/toFahrenheit/waitTenSeconds/waitTime	Candidates are required to open the file Q03b in the code editor. These are the same across all languages. Accept clear reference to subprogram name.	(1)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	Python inTemp/inSeconds Java and C# inTemp/inMilliseconds	Candidates are required to open the file Q03b in the code editor. Accept clear reference to parameter name.	(1)

Question number	Answer	Additional guidance	Mark
3(b)(iv)	waitTenSeconds	Candidates are required to open the file Q03b in the code editor. This is the same across all languages. Accept clear reference to subprogram name.	(1)

Question number	Answer	Additional guidance	Mark
3(b)(v)	<p>Python inTemp/celsius/fahrenheit/inSeconds</p> <p>Java and C# inTemp/celsius/fahrenheit/inMilliseconds</p>	<p>Candidates are required to open the file Q03b in the code editor.</p> <p>Accept clear reference to variable name.</p>	(1)

Question number	Answer	Additional guidance	Mark
3(b)(vi)	theDate	<p>Candidates are required to open the file Q03b in the code editor.</p> <p>This is the same across all languages.</p> <p>Accept clear reference to variable name.</p>	(1)

Question number	Answer	Additional guidance	Mark
3(b)(vii)	The subprogram (being called on this line) is missing a return statement.	Candidates are required to open the file Q03b in the code editor.	(1)

Question number	Answer	Do not accept	Additional guidance	Mark
3(c)	<p>Award one mark for each of:</p> <ul style="list-style-type: none"> opening 'Cities.txt' for reading only (1) opening/creating 'Numbered.txt' for writing only (1) using for-each/while not EOF to read each line into variable 'theLine' (1) incrementing the count of lines read (1) constructing the output string/coercion as required (1) writing new lines to the output file (1) closing at least one of the text files (1). <p>Python</p> <pre> 5 # Open "Cities.txt" as input 6 theFile = open ("Cities.txt", "r") 7 8 # Open "Numbered.txt" as output 9 outFile = open ("Numbered.txt", "w") 10 11 # Use a for/each loop to read each line of 12 # the input file into a variable named 'theLine' 13 for theLine in theFile: 14 15 # Increment the line count 16 count = count + 1 17 18 # Add the line number to the front of the line followed by a space 19 theLine = str(count) + " " + theLine 20 21 # print the line to the display 22 print (theLine) 23 24 # Write the new line to the output file 25 outFile.writelines (theLine) 26 27 # Close the input file 28 theFile.close() 29 30 # Close the output file 31 outFile.close() </pre>	Data structures such as an array or a list.	Candidates are required to open the file Q03c in the code editor. Amended code should be saved as Q03cFINISHED.	(7)

Java

```
20 // Open "Cities.txt" as input
21 theFile = new Scanner(new BufferedReader(new FileReader("cities.txt")));
22 // Open "Numbered.txt" as output
23 outFile = new PrintWriter("Numbered.txt", "UTF-8");
24 // Use loop to read each line of
25 // the input file into a variable named 'theLine'
26 while (theFile.hasNextLine())
27 {
28     theLine = theFile.nextLine();
29     // Increment the line count variable
30     count++;
31     // Add the line number to the front of the line
32     // followed by a space
33     theLine = (Integer.toString(count) + " " + theLine);
34     // print the line to the display
35     System.out.println(theLine);
36     // Write the new line to the output file
37     outFile.println(theLine);
38 }
39
40 // Close the input file
41 theFile.close();
42 // Close the output file
43 outFile.close();
```

C#

```
13 // open Cities.txt as input
14 System.IO.StreamReader fileReader = new System.IO.StreamReader("Cities.txt");
15 // open Numbered.txt as output
16 System.IO.StreamWriter fileWriter = new System.IO.StreamWriter("Numbered.txt");
17 // use loop to read each line of the input file into a variable named theLine
18 while (fileReader.Peek() >= 0)
19 {
20     theLine = fileReader.ReadLine();
21     // increment the line count variable
22     count = count + 1;
23     // add the line number to the front of the line followed by a space
24     theLine = Convert.ToString(count) + " " + theLine;
25     // print the line to the display
26     Console.WriteLine(theLine);
27     // write new line to the output file
28     fileWriter.WriteLine(theLine);
29 }
30 // close the input file
31 fileReader.Close();
32 // close the output file
33 fileWriter.Close();
34 Console.ReadKey();
```


Question number	Answer	Additional guidance	Mark
4(a)	Any one from: <ul style="list-style-type: none"> a step-by-step procedure (which if followed precisely with a given input produces a predictable output) a list of instructions followed in sequence (to solve a problem) a process or set of rules to be followed (to achieve a predictable result). 		(1)

Question number	Answer	Additional guidance	Mark								
4(b)(i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">7</td> <td style="text-align: center;">26</td> <td style="text-align: center;">21</td> <td style="text-align: center;">28</td> <td style="text-align: center;">18</td> <td style="text-align: center;">16</td> <td style="text-align: center;">9</td> <td style="text-align: center;">34</td> </tr> </table>	7	26	21	28	18	16	9	34		(1)
7	26	21	28	18	16	9	34				

Question number	Answer	Additional guidance	Mark
4(b)(ii)	7		(1)

Question number	Answer	Additional guidance	Mark
4(b)(iii)	6		(1)

Question number	Answer	Additional guidance	Mark
4(c)(i)	Any one from: <ul style="list-style-type: none"> requires many passes to complete the sort requires many comparisons/every number is compared every single pass. 		(1)

Question number	Answer	Additional guidance	Mark
4(c)(ii)	Top/highest/right-most/last		(1)

Question number	Answer	Additional guidance	Mark																																																								
5(a)	<p data-bbox="360 236 1003 268">Award 1 mark for each correct pass of the loop.</p> <table border="1" data-bbox="360 300 1238 1107"> <thead> <tr> <th data-bbox="360 300 566 432">target</th> <th data-bbox="566 300 790 432">rs</th> <th data-bbox="790 300 1014 432">rm</th> <th data-bbox="1014 300 1238 432">r</th> </tr> </thead> <tbody> <tr> <td data-bbox="360 432 566 483">4</td> <td data-bbox="566 432 790 483">0</td> <td data-bbox="790 432 1014 483">0</td> <td data-bbox="1014 432 1238 483">1</td> </tr> <tr> <td data-bbox="360 483 566 534">4</td> <td data-bbox="566 483 790 534">1</td> <td data-bbox="790 483 1014 534">0</td> <td data-bbox="1014 483 1238 534">1</td> </tr> <tr> <td data-bbox="360 534 566 585">4</td> <td data-bbox="566 534 790 585">1</td> <td data-bbox="790 534 1014 585">1</td> <td data-bbox="1014 534 1238 585">1</td> </tr> <tr> <td data-bbox="360 585 566 636">4</td> <td data-bbox="566 585 790 636">1</td> <td data-bbox="790 585 1014 636">1</td> <td data-bbox="1014 585 1238 636">2</td> </tr> <tr> <td data-bbox="360 636 566 687">4</td> <td data-bbox="566 636 790 687">4</td> <td data-bbox="790 636 1014 687">1</td> <td data-bbox="1014 636 1238 687">2</td> </tr> <tr> <td data-bbox="360 687 566 738">4</td> <td data-bbox="566 687 790 738">4</td> <td data-bbox="790 687 1014 738">2</td> <td data-bbox="1014 687 1238 738">2</td> </tr> <tr> <td data-bbox="360 738 566 790">4</td> <td data-bbox="566 738 790 790">4</td> <td data-bbox="790 738 1014 790">2</td> <td data-bbox="1014 738 1238 790">3</td> </tr> <tr> <td data-bbox="360 790 566 841">4</td> <td data-bbox="566 790 790 841">9</td> <td data-bbox="790 790 1014 841">2</td> <td data-bbox="1014 790 1238 841">3</td> </tr> <tr> <td data-bbox="360 841 566 892">4</td> <td data-bbox="566 841 790 892">9</td> <td data-bbox="790 841 1014 892">3</td> <td data-bbox="1014 841 1238 892">3</td> </tr> <tr> <td data-bbox="360 892 566 943">4</td> <td data-bbox="566 892 790 943">9</td> <td data-bbox="790 892 1014 943">3</td> <td data-bbox="1014 892 1238 943">4</td> </tr> <tr> <td data-bbox="360 943 566 994">4</td> <td data-bbox="566 943 790 994">16</td> <td data-bbox="790 943 1014 994">3</td> <td data-bbox="1014 943 1238 994">4</td> </tr> <tr> <td data-bbox="360 994 566 1045">4</td> <td data-bbox="566 994 790 1045">16</td> <td data-bbox="790 994 1014 1045">0</td> <td data-bbox="1014 994 1238 1045">4</td> </tr> <tr> <td data-bbox="360 1045 566 1107">4</td> <td data-bbox="566 1045 790 1107">16</td> <td data-bbox="790 1045 1014 1107">0</td> <td data-bbox="1014 1045 1238 1107">5</td> </tr> </tbody> </table>	target	rs	rm	r	4	0	0	1	4	1	0	1	4	1	1	1	4	1	1	2	4	4	1	2	4	4	2	2	4	4	2	3	4	9	2	3	4	9	3	3	4	9	3	4	4	16	3	4	4	16	0	4	4	16	0	5	<p data-bbox="1447 236 1935 300">Candidates are required to open the file Q05a in the code editor.</p> <p data-bbox="1447 336 1895 400">Penalise each mathematical error once and then follow through.</p>	(5)
target	rs	rm	r																																																								
4	0	0	1																																																								
4	1	0	1																																																								
4	1	1	1																																																								
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4	16	0	4																																																								
4	16	0	5																																																								

Question number	Answer	Additional guidance	Mark
5(b)	<ul style="list-style-type: none"> • Accept user input of total spend (1) • Coercion of input (to a numerical data type) (1) • Correct logic for totalSpend greater than 300 leads to printing correct output message (1) • Correct logic for totalSpend greater than 0 leads to printing correct output message (1) • Correct logic for all other input leads to printing correct output message. (1) 	Candidates are required to open the file Q05b in the code editor. Amended code should be saved as Q05bFINISHED.	(5)
	<p>Python</p> <pre style="font-family: monospace; border: 1px solid #ccc; padding: 5px;"> 1 # Write your code below this line 2 totalSpend = int (input ("What is your total spend?")) 3 if (totalSpend > 300): 4 print ("Discount is 10%") 5 elif (totalSpend > 0): 6 print ("No discount") 7 else: 8 print ("Invalid input") </pre>		

Java

```
1 package q05b;
2 import java.util.Scanner;
3 // Write your code here
4 public class Q05b
5 {
6     public static void main(String[] args)
7     {
8         Scanner input = new Scanner(System.in);
9         int totalSpend = 0;
10
11         System.out.println ("What is your total spend?");
12         totalSpend = input.nextInt();
13
14         if (totalSpend > 300)
15             System.out.println ("Discount is 10%");
16         else if (totalSpend > 0)
17             System.out.println ("No discount");
18         else
19             System.out.println ("Invalid input");
20     }
21 }
```

C#

```
1 using System;
2 // Write your code here
3
4 namespace Q05b_cs
5 {
6     class Program
7     {
8         static void Main(string[] args)
9         {
10             int totalSpend = 0;
11
12             Console.WriteLine("What is your total spend?");
13             totalSpend = Convert.ToInt32(Console.ReadLine());
14
15             if (totalSpend > 300)
16                 Console.WriteLine("Discount is 10%");
17             else if (totalSpend > 0)
18                 Console.WriteLine("No discount");
19             else
20                 Console.WriteLine("Invalid input");
21         }
22     }
23 }
24
```

Question number	Answer	Additional guidance	Mark
6	<p>Award one mark for each of the following points up to a maximum of 11 marks:</p> <ul style="list-style-type: none"> • Initialise 'make artist label' loop (1) • Initialise 'find youngest person' loop to cycle through all artists given (1) • Identify / extract initials of artist (1) • Combine/concatenate initials with year of birth to create label (1) • Add the label to the theLabels data structure (1) • Display the label for the artist (1) • Initialise the year of birth variable (for finding youngest artist e.g. maxDate) or initialise oldest person variable (to hold oldest person e.g. maxPerson) (1) • Check date of birth with year of birth variable (1) • Assign younger year to maxDate if necessary (1) • Assign older year to maxPerson if necessary (1) • Display the name and year of birth of artist identified (1) 		(11)

Award up to a maximum of nine marks using the levels-based mark scheme below.				
Band 0	Band 1 (1-3 marks)	Band 2 (4-6 marks)	Band 3 (7-9 marks)	Mark
No rewardable content	Little attempt to decompose the problem into component parts	Some attempt to decompose the problem into component parts	The problem has been decomposed into component parts	
	Some parts of the logic are clear and appropriate to the problem	Most parts of the logic are clear and mostly appropriate to the problem	The logic is clear and appropriate to the problem	
	Some appropriate use and manipulation of data types, variables, data structures and program constructs	The use and manipulation of data types, variables and data structures and program constructs is mostly appropriate	The use and manipulation of data types, variables and data structures and program constructs is appropriate	
	Parts of the code are clear and readable	Code is mostly clear and readable	Code is clear and readable	
	Finished program will not be flexible enough with other data sets or input	Finished program will function with some but not all other data sets or input	Finished program could be used with other data sets or input	
	The program meets some of the given requirements	The program meets most of the given requirements	The program fully meets the given requirements	
				(9)

Example solutions

Python

```

# Make the artist labels
for person in theArtists:
    newRecord = person[1][0] + person[0][0] + str(person[2])
    theLabels.append (newRecord)
print ("The new userIDs are: ", theLabels)

# Find and print the youngest person and their birthdate
maxDate = 0
for person in theArtists:
    if person[2] > maxDate:
        maxDate = person[2]
        maxPerson = person
print (maxPerson[0], maxPerson[1], "is youngest", str(maxPerson[2]))

```

Java

```

33 // Make the artist labels
34 for (int i = 0; i < theArtists.length; i++) {
35     String newRecord = String.valueOf(theArtists[i][1].charAt(0))
36         + String.valueOf(theArtists[i][0].charAt(0))
37         + theArtists[i][2];
38     theLabels.add (newRecord);
39     System.out.println(newRecord);
40     System.out.println("The new userIDs are: " + theLabels.get(theLabels.size() - 1));
41 }
42 // Find and print the youngest person and their birthdate
43 int maxDate = 0;
44 String maxPerson = "";
45 for (String[] person : theArtists) {
46     if (Integer.parseInt(person[2]) > maxDate) {
47         maxDate = Integer.parseInt(person[2]);
48         maxPerson = person[0] + " " + person[1];
49     }
50 }
51 System.out.println(maxPerson + " is youngest " + maxDate);

```


C#

```
for (int i = 0; i < theLabels.Length; i++)
{
    String newRecord = Convert.ToString(theArtists[i,1][0]) +
        Convert.ToString(theArtists[i,0][0]) +
        theArtists[i,2];
    theLabels[i] = newRecord;
    Console.WriteLine(newRecord);
    Console.WriteLine("The new userIDs are: " + theLabels[i]);
}
// Find and print the youngest person and their birthdate
int maxDate = 0;
String maxPerson = "";
for (int i = 0; i < theLabels.Length; i++)
{
    if (Convert.ToInt32(theArtists[i,2]) > maxDate)
    {
        maxDate = Convert.ToInt32(theArtists[i,2]);
        maxPerson = theArtists[i,0] + " " + theArtists[i,1];
    }
}
Console.WriteLine(maxPerson + " is youngest " + maxDate);
Console.ReadKey();
```

Pseudocode reference

Questions in the written examination that involve code will use this pseudocode for clarity and consistency. However, students may answer questions using any valid method.

Data types

INTEGER
 REAL
 BOOLEAN
 CHARACTER

Type coercion

Type coercion is automatic if indicated by context. For example $3 + 8.25 = 11.25$
 (integer + real = real)

Mixed mode arithmetic is coerced like this:

	INTEGER	REAL
INTEGER	INTEGER	REAL
REAL	REAL	REAL

Coercion can be made explicit. For example, RECEIVE age FROM (INTEGER) KEYBOARD assumes that the input from the keyboard is interpreted as an INTEGER, not a STRING.

Constants

The value of constants can only ever be set once. They are identified by the keyword CONST. Two examples of using a constant are shown.

```
CONST REAL PI
SET PI TO 3.14159
SET circumference TO radius * PI * 2
```

Data structures

ARRAY
 STRING

Indices start at zero (0) for all data structures.

All data structures have an append operator, indicated by &.

Using & with a STRING and a non-STRING will coerce to STRING. For example, SEND 'Fred' & age TO DISPLAY, will display a single STRING of 'Fred18'.

Identifiers

Identifiers are sequences of letters, digits and '_', starting with a letter, for example: MyValue, myValue, My_Value, Counter2

Functions

LENGTH()

For data structures consisting of an array or string.

RANDOM(n)

This generates a random number from 0 to n.

Comments

Comments are indicated by the # symbol, followed by any text.

A comment can be on a line by itself or at the end of a line.

Devices

Use of KEYBOARD and DISPLAY are suitable for input and output.

Additional devices may be required, but their function will be obvious from the context.

For example, CARD_READER and MOTOR are two such devices.

Notes

In the following pseudocode, the < > indicates where expressions or values need to be supplied. The < > symbols are not part of the pseudocode.

Variables and arrays		
Syntax	Explanation of syntax	Example
SET Variable TO <value>	Assigns a value to a variable.	SET Counter TO 0 SET MyString TO 'Hello world'
SET Variable TO <expression>	Computes the value of an expression and assigns to a variable.	SET Sum TO Score + 10 SET Size to LENGTH(Word)
SET Array[index] TO <value>	Assigns a value to an element of a one-dimensional array.	SET ArrayClass[1] TO 'Ann' SET ArrayMarks[3] TO 56
SET Array TO [<value>, ...]	Initialises a one-dimensional array with a set of values.	SET ArrayValues TO [1, 2, 3, 4, 5]
SET Array [RowIndex, ColumnIndex] TO <value>	Assigns a value to an element of a two-dimensional array.	SET ArrayClassMarks[2,4] TO 92

Selection		
Syntax	Explanation of syntax	Example
IF <expression> THEN <command> END IF	If <expression> is true then command is executed.	IF Answer = 10 THEN SET Score TO Score + 1 END IF
IF <expression> THEN <command> ELSE <command> END IF	If <expression> is true then first <command> is executed, otherwise second <command> is executed.	IF Answer = 'correct' THEN SEND 'Well done' TO DISPLAY ELSE SEND 'Try again' TO DISPLAY END IF

Repetition		
Syntax	Explanation of syntax	Example
<pre>WHILE <condition> DO <command> END WHILE</pre>	<p>Pre-conditioned loop. Executes <command> whilst <condition> is true.</p>	<pre>WHILE Flag = 0 DO SEND 'All well' TO DISPLAY END WHILE</pre>
<pre>REPEAT <command> UNTIL <expression></pre>	<p>Post-conditioned loop. Executes <command> until <condition> is true. The loop must execute at least once.</p>	<pre>REPEAT SET Go TO Go + 1 UNTIL Go = 10</pre>
<pre>REPEAT <expression> TIMES <command> END REPEAT</pre>	<p>Count controlled loop. The number of times <command> is executed is determined by the expression.</p>	<pre>REPEAT 100-Number TIMES SEND '*' TO DISPLAY END REPEAT</pre>
<pre>FOR <id> FROM <expression> TO <expression> DO <command> END FOR</pre>	<p>Count controlled loop. Executes <command> a fixed number of times.</p>	<pre>FOR Index FROM 1 TO 10 DO SEND ArrayNumbers[Index] TO DISPLAY END FOR</pre>
<pre>FOR <id> FROM <expression> TO <expression> STEP <expression> DO <command> END FOR</pre>	<p>Count controlled loop using a step.</p>	<pre>FOR Index FROM 1 TO 500 STEP 25 DO SEND Index TO DISPLAY END FOR</pre>
<pre>FOR EACH <id> FROM <expression> DO <command> END FOREACH</pre>	<p>Count controlled loop. Executes for each element of an array.</p>	<pre>SET WordsArray TO ['The', 'Sky', 'is', 'grey'] SET Sentence to '' FOR EACH Word FROM WordsUArray DO SET Sentence TO Sentence & Word & ' ' END FOREACH</pre>

Input/output		
Syntax	Explanation of syntax	Example
SEND <expression> TO DISPLAY	Sends output to the screen.	SEND 'Have a good day.' TO DISPLAY
RECEIVE <identifier> FROM (type) <device>	Reads input of specified type.	RECEIVE Name FROM (STRING) KEYBOARD RECEIVE LengthOfJourney FROM (INTEGER) CARD_READER RECEIVE YesNo FROM (CHARACTER) CARD_READER

File handling		
Syntax	Explanation of syntax	Example
READ <File> <record>	Reads in a record from a <file> and assigns to a <variable>. Each READ statement reads a record from the file.	READ MyFile.doc Record
WRITE <File> <record>	Writes a record to a file. Each WRITE statement writes a record to the file.	WRITE MyFile.doc Answer1, Answer2, 'xyz 01'

Subprograms		
Syntax	Explanation of syntax	Example
PROCEDURE <id> (<parameter>, ...) BEGIN PROCEDURE <command> END PROCEDURE	Defines a procedure.	PROCEDURE CalculateAverage (Mark1, Mark2, Mark3) BEGIN PROCEDURE SET Avg to (Mark1 + Mark2 + Mark3)/3 END PROCEDURE
FUNCTION <id> (<parameter>, ...) BEGIN FUNCTION <command> RETURN <expression> END FUNCTION	Defines a function.	FUNCTION AddMarks (Mark1, Mark2, Mark3) BEGIN FUNCTION SET Total to (Mark1 + Mark2 + Mark3)/3 RETURN Total END FUNCTION

Subprograms		
Syntax	Explanation of syntax	Example
<id> (<parameter>, ...)	Calls a procedure or a function.	Add (FirstMark, SecondMark)

Arithmetic operators	
Symbol	Description
+	Add
-	Subtract
/	Divide
*	Multiply
^	Exponent
MOD	Modulo
DIV	Integer division

Relational operators	
Symbol	Description
=	equal to
<>	not equal to
>	greater than
>=	greater than or equal to
<	less than
<=	less than or equal to

Logical operators	
Symbol	Description
AND	Returns true if both conditions are true.
OR	Returns true if any of the conditions are true.
NOT	Reverses the outcome of the expression; true becomes false, false becomes true.