AQA

AS
COMPUTER SCIENCE
7516/1

Paper 1

Mark scheme

June 2022

Version: 1.0 Final

226A7516/1/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

AS Computer Science

Paper 1 (7516/1) – applicable to all programming languages A, B, C, D and E

June 2022

The following annotation is used in the mark scheme:

; - means a single mark
// - means alternative response
/ - means an alternative word or sub-phrase
A. - means 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.

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.

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**, the marks available are as follows:

AO1 (knowledge)	1 mark
AO2 (analyse)	1 mark

In question **13.1**, the marks available for the AO3 elements are as follows:

AO3 (design)	2 marks
AO3 (programming)	6 marks

In question **14.1**, the marks available for the AO3 elements are as follows:

AO3 (design)	3 marks
AO3 (programming)	9 marks

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

Section A

Qu		Marks	
01		**5 marks for AO2 (apply)** **1 mark** for each correct set of values in the correct sequence (boxed in red); **A.** entries within a boxed area sharing a row (e.g. 9 and 8 on the same row). **Max 4** if any errors	**5**

S	X	Y	P	Z	List[Z]
38	0	18	-1		
				9	51
		8			
				4	25
	5				
				6	36
	7				
				7	42
		6			
Result:					-1

Alternative Answer Layout:
1 mark for each correct set of values in the correct sequence (4 sets boxed in red, 1 set in disjointed boxes in green and shaded light grey);

S	X	Y	P	Z	List[Z]
38	0	18	-1		
				9	51
		8		4	25
	5			6	36
	7			7	42
		6			
Result:					-1

Qu		Marks	
02		**6 marks for AO2 (analyse)**	6

Event / State	Label(s): (A) to (I), (W) to (Z)
Card Payment Mode	X
Enter correct PIN	F
Enter incorrect PIN	D
Insert a coin (except final coin)	H
Insert final coin	I
Insert payment card	G
Paid Mode	Y
Payment Due Mode	Z
Press Accept	E
Press Cancel	C
Press + Button	A, B
Select Hours Mode	W

1 mark per group of correct labels:
X, W
F, D
H, I, G
Y, Z
E, C **A.** € ©
A, B

I. brackets around letters
R. any labels used more than once

Max 5 if any errors

Qu		Marks	
03	1	**8 marks for AO3 (programming)** **Mark as follows:** 1) Correct variable declarations for `C`, `D`, `S`, `T` and initialisation; **Note to examiners:** If a language allows variables to be used without explicit declaration, (eg Python), then this mark should be awarded if the correct variables exist in the program code and the first value they are assigned is of the correct data type. 2) Correct `WHILE` loop syntax allowed by the programming language and correct condition for termination of the loop; 3) Correct generation of two random numbers between 1 and 6 and output within loop; 4) Correct running total assigned to `S` and updating of `T`; 5) Correct condition to increment `C` within the loop; 6) Correct condition to increment `D` with the loop; 7) Correct calculation of `A` outside the loop; 8) Correct output outside loop; **I**. case **Max 7** if code does not function correctly	**8**

03	**2**	**Mark is for AO3 (evaluate)** ****** SCREEN CAPTURE ****** Must match code from **03.1**. Code for **03.1** must be sensible. As this output is from a random number generator, the output from candidates will not be the values below. However: Output should show two digits between 1 and 6 on each line except the final line. On the final line it should show the correct number of lines containing at least one 6, number of doubles and another integer. Number of lines containing at least one 6 and/or number of doubles must be 3 Screen capture showing: 1 5 4 3 3 1 4 2 2 2 3 3 1 6 6 5 3 5 6 3 3 2 3 >>> **I**. missing spaces **A**. each digit on a new line	**1**

Section B

Qu		Marks	
04	**1**	**Mark is for AO1 (knowledge)** `Integer` / `int`;	**1**
04	**2**	**Mark is for AO2 (analyse)** `Line` / `Row` / `Column` / `ErrorCount` / `ResponseNumber`; **A.** `GRID_SIZE` (Python only) **R.** `Digit` **R.** if any additional code **R.** if spelt incorrectly **I.** case and spacing	**1**
05		**1 mark for AO1 (knowledge) and 1 mark for AO2 (analyse)** Identifier (AO2): `OK` / `InputError` / `Finished` / `Solved` / `Correct` / `Incomplete`; Data type (AO1): `Boolean` / `bool`; **R.** if any additional code **R.** if spelt incorrectly **I.** case and spacing	**2**
06	**1**	**Mark is for AO2 (analyse)** (Stores the string equivalent of User's) score;	**1**
06	**2**	**3 marks for AO2 (analyse)** It stores (the string equivalent of) the number of digits/attempts/guesses/answers the player has placed/made // stores (the string equivalent of) the number of steps made (towards a solution); **Max 1** It is incremented every time a digit is accepted / valid; If the user has placed a digit // if the user has placed one or more digits: … the (user's attempted) solution can be checked; … the partial solution can be saved; … the digit is placed into the (`Answer`) array at the correct position; … the user's solution is displayed before exiting the program; … the score is displayed; **Max 2**	**3**

07		**2 marks for AO3 (design)** Row/Column heading numbers need to be extended; Row/Column headers formatted to occupy two positions; Sub-grid lines need to extended horizontally; **I.** vertically Grid lines need to extended horizontally; **I.** vertically Sub-grid lines need to be after 4 rows / columns // column / row need to be divisible by 4 for sub-grid lines // the 3s need to be changed to 4s; **R.** reference to alterations outside the `DisplayGrid` subroutine. **Max 2**	**2**
08		**2 marks for AO1 (understand)** Breaking down a/the problem into a number of sub-problems; So that each sub-problem accomplishes an identifiable task; Each of these sub-problems might be decomposed further; **Max 2**	**2**
09	**1**	**2 marks for AO1 (understand)** Definite iteration: the number of iterations is known (at the time of execution); Indefinite iteration: the number of iterations depends on a condition (that is tested before / after each iteration); **NE.** indefinite iteration: number of iterations not known	**2**
09	**2**	**Mark is for AO2 (analyse)** `ResetDataStructures` / `LoadSolution` / `ResetAnswer` / `TransferAnswerIntoGrid` / `DisplayGrid` / `KeepPuzzle` / `CheckSolution` / `DisplayResults` ; **R.** if any additional code **R.** if spelt incorrectly **I.** case and spacing	**1**
09	**3**	**Mark is for AO2 (analyse)** `LoadPuzzleFile` / `TransferPuzzleIntoGrid` / `LoadPartSolvedPuzzle` / `SolvePuzzle` / `GetMenuOption` / `NumberPuzzle`; **R.** if any additional code **R.** if spelt incorrectly **I.** case and spacing	**1**

10	**1**	**2 marks for AO1 (understand)** To stop a program from crashing; To deal with (an anticipated) run-time error **A.** clear description of an example of a run-time error; To avoid structure of code becoming too complex as a result of trying to check for potential errors before they might occur; **Max 2**	**2**
10	**2**	**2 marks for AO2 (analyse)** **1 mark for identifier and 1 mark for exception** `LoadPuzzleFile` – file does not exist // index error if more lines in file than `Puzzle` can accommodate; `LoadSolution` – file does not exist // not enough lines in file; `TransferPuzzleIntoGrid` – input conversion error // index error if string length < 3; `LoadPartSolvedPuzzle` – file does not exist // index error if more lines in file than `Answer` can accommodate; `SolvePuzzle` – row/column/1st character/2nd character entered not a digit/number/integer // input conversion error; **A.** `KeepPuzzle` – file does not exist (Java only) **A.** `readLine` – end of file (Java only) **A.** other exceptions that could occur **R.** if any additional code **R.** if spelt incorrectly **I.** case and spacing **Max 2**	**2**
11	**1**	**Mark is for AO1 (knowledge)** Named / (reference to) identifier / callable 'out of line' block of code (that may be called by simply writing its name in a program statement); **A.** subroutine is used to give a block of code a name (and this name can be used to execute this group of statements)	**1**
11	**2**	**Mark is for AO2 (analyse)** `LoadPuzzle` is called more than once (from `NumberPuzzle` and also from `LoadPartSolvedPuzzle`) // `DisplayGrid` is called more than once (from within `SolvePuzzle`) `//ResetDataStructures` is called more than once (from `NumberPuzzle` and twice from `LoadPuzzle`); **A.** `readLine / print` is called more than once (Java only) **NE.** 'called more than once' without an appropriate subroutine name	**1**

11	**3**	**Mark is for AO1 (understanding)** Saves time as code can be written once and called in many places; Reduced storage space of (source) code; Reduces testing time as less code to test; Avoids errors because code cannot be written differently if it is used in multiple places; Program code will be easier to understand / maintain; **MAX 1**	**1**

11	**4**	**2 marks for AO2 (analyse)** | **Box**	**Label**
---	---
(a)	`ResetDataStructures`
(b)	`LoadPuzzleFile`
(c)	`LoadSolution`
(d)	`TransferPuzzleIntoGrid`	 **1 mark for 2 correct labels** **2 marks for 4 correct labels** **A.** labels written in different order **I.** case and spacing **R.** if any additional code **R.** if spelt incorrectly	**2**

Section C

Qu		Marks	
12	**1**	**7 marks for AO3 (programming)** **Marking guidance:** **Evidence of AO3 programming – 7 points:** Evidence of programming to look for in response: 1. Loop structure; 2. Check through each element of `Puzzle` // check `Puzzle` until end of entries reached // check until a protected cell is found; 3. Compare first two characters of `CellInfo` with first two characters of `Puzzle` line // compare the string values of `Row` and `Column` with the first two characters of the `Puzzle` line; 4. If protected cell found …; 5. … give appropriate error message to user **A.** 'Invalid input' <u>also</u> being output; 6. Only if it is not a protected cell update content of cell; **DPT.** Incorrect identification of a protected cell 7. Code in correct place in `SolvePuzzle`; **Max 6** if any errors	**7**

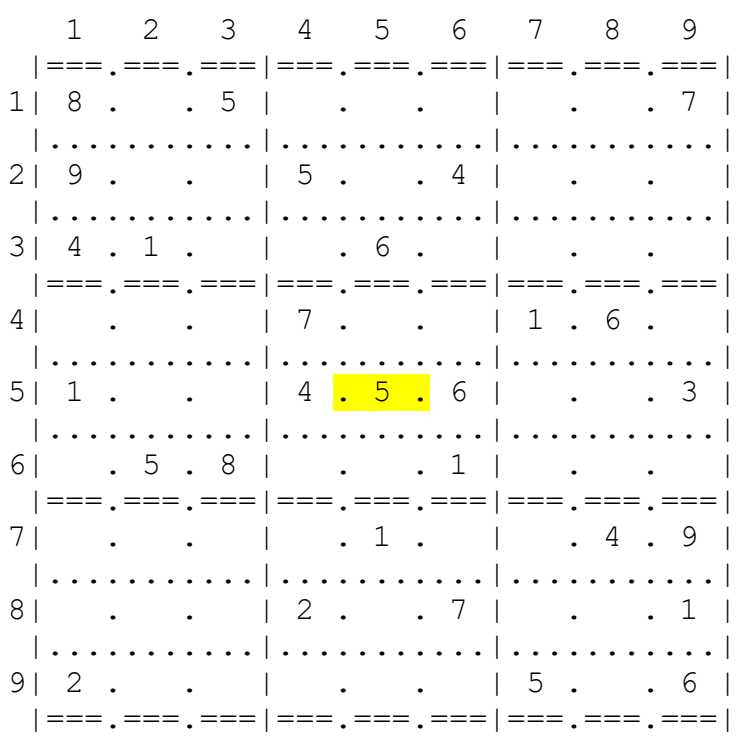
12	**2**	**Mark is for AO3 (evaluate)** ****** SCREEN CAPTURE ****** Must match code from **12.1**, including prompts on screen capture matching those in code. Code for **12.1** must be sensible. Screen capture showing: Enter your choice: S 1 2 3 4 5 6 7 8 9 |===.===.===|===.===.===|===.===.===| 1| 8 . . 5 | . . | . . 7 | |.....|.....|.....| 2| 9 . . | 5 . 7 . 4 | . . | |.....|.....|.....| 3| 4 . 1 . 7 | . 6 . | . . | |===.===.===|===.===.===|===.===.===| 4| . . | 7 . . | 1 . 6 . | |.....|.....|.....| 5| 1 . 7 . | 4 . . 6 | . . 3 | |.....|.....|.....| 6| 6 . 5 . 8 | . . 1 | . . | |===.===.===|===.===.===|===.===.===| 7| . . | . 1 . | . 4 . 9 | |.....|.....|.....| 8| . . | 2 . . 7 | . . 1 | |.....|.....|.....| 9| 2 . . | . . | 5 . . 6 | |===.===.===|===.===.===|===.===.===| Enter row column digit: (Press Enter to stop) 117 You can't change a protected cell Enter row column digit: (Press Enter to stop) 323 You can't change a protected cell Enter row column digit: (Press Enter to stop) 993 You can't change a protected cell Enter row column digit: (Press Enter to stop) 853	**1**

```
   1   2   3   4   5   6   7   8   9
 |===.===.===|===.===.===|===.===.===|
1| 8 .   . 5 |   .   .   |   .   . 7 |
 |...........|...........|...........|
2| 9 .   .   | 5 . 7 . 4 |   .   .   |
 |...........|...........|...........|
3| 4 . 1 . 7 |   . 6 .   |   .   .   |
 |===.===.===|===.===.===|===.===.===|
4|   .   .   | 7 .   .   | 1 . 6 .   |
 |...........|...........|...........|
5| 1 . 7 .   | 4 .   . 6 |   .   . 3 |
 |...........|...........|...........|
6| 6 . 5 . 8 |   .   . 1 |   .   .   |
 |===.===.===|===.===.===|===.===.===|
7|   .   .   |   . 1 .   |   . 4 . 9 |
 |...........|...........|...........|
8|   .   .   | 2 . 3 . 7 |   .   . 1 |
 |...........|...........|...........|
9| 2 .   .   |   .   .   | 5 .   . 6 |
 |===.===.===|===.===.===|===.===.===|

Enter row column digit:
(Press Enter to stop)
854

   1   2   3   4   5   6   7   8   9
 |===.===.===|===.===.===|===.===.===|
1| 8 .   . 5 |   .   .   |   .   . 7 |
 |...........|...........|...........|
2| 9 .   .   | 5 . 7 . 4 |   .   .   |
 |...........|...........|...........|
3| 4 . 1 . 7 |   . 6 .   |   .   .   |
 |===.===.===|===.===.===|===.===.===|
4|   .   .   | 7 .   .   | 1 . 6 .   |
 |...........|...........|...........|
5| 1 . 7 .   | 4 .   . 6 |   .   . 3 |
 |...........|...........|...........|
6| 6 . 5 . 8 |   .   . 1 |   .   .   |
 |===.===.===|===.===.===|===.===.===|
7|   .   .   |   . 1 .   |   . 4 . 9 |
 |...........|...........|...........|
8|   .   .   | 2 . 4 . 7 |   .   . 1 |
 |...........|...........|...........|
9| 2 .   .   |   .   .   | 5 .   . 6 |
 |===.===.===|===.===.===|===.===.===|
```

A. grid displaying between incorrect attempts

Qu		Marks	
13	**1**	**2 marks for AO3 (design) and 6 marks for AO3 (programming)** **Marking guidance:** **Evidence of AO3 design – 2 points:** Evidence of design to look for in response: 1. Identify the need for a loop containing a conditional statement; 2. Recognise that subgrid boundaries need to be considered; **Note: 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 of AO3 programming – 6 points:** Evidence of programming to look for in response: 3. Subroutine heading with correct parameters and return value; 4. Check both row and column for duplicate **I.** failing to check location at which digit is to be placed; 5. Correctly calculate all subgrid boundaries; 6. Check each digit in any subgrid for duplicate *(does not depend on MP5 above)*; 7. Call in correct place in `SolvePuzzle` so that grid updated only under correct circumstances / if digit is valid / if subroutine returns true **R.** if returned value not used; 8. Give appropriate error message (under at least some correct circumstances and is never displayed when it shouldn't be) **A.** error message in `DuplicateDigit`; **Max 7** if any errors	**8**

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 showing: Enter your choice: S 1 2 3 4 5 6 7 8 9 |===.===.===|===.===.===|===.===.===| 1| 8 . . 5 | . . | . . 7 | |...........|...........|...........| 2| 9 . . | 5 . . 4 | . . | |...........|...........|...........| 3| 4 . 1 . | . 6 . | . . | |===.===.===|===.===.===|===.===.===| 4| . . | 7 . . | 1 . 6 . | |...........|...........|...........| 5| 1 . . | 4 . . 6 | . . 3 | |...........|...........|...........| 6| . 5 . 8 | . . 1 | . . | |===.===.===|===.===.===|===.===.===| 7| . . | . 1 . | . 4 . 9 | |...........|...........|...........| 8| . . | 2 . . 7 | . . 1 | |...........|...........|...........| 9| 2 . . | . . | 5 . . 6 | |===.===.===|===.===.===|===.===.===| Enter row column digit: (Press Enter to stop) 178 Duplicate digit Enter row column digit: (Press Enter to stop) 819 Duplicate digit Enter row column digit: (Press Enter to stop) 124 Duplicate digit Enter row column digit: (Press Enter to stop) 989 Duplicate digit Enter row column digit: (Press Enter to stop) 555	**1**

14 **1** **3 marks for AO3 (design) and 9 marks for AO3 (programming)** **12**

Level	Description	Mark Range
3	A line of reasoning has been followed to arrive at a logically structured working or almost fully working programmed solution. All of the appropriate design decisions have been taken.	9–12
2	There is evidence that a line of reasoning has been partially followed. There is evidence of some appropriate design work. This is a partially working programmed solution.	5–8
1	An attempt has been made to write the subroutine `ClearEntries`. Some appropriate programming statements have been written. There is little evidence to suggest that a line of reasoning has been followed or that the solution has been designed. The statements written may or may not be syntactically correct and the subroutines will have very little or none of the extra required functionality. It is unlikely that any of the key design elements of the task have been recognised.	1–4

Marking guidance:

Evidence of AO3 design – 3 marks:

Evidence of design to look for in response:

1) Recognise a loop required that repeats depending on value entered by user.
2) Dealing with non-integer input.
3) Attempt to identify minus sign / negative number in input.

Note: 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 of AO3 programming – 9 marks:

Evidence of programming to look for in response:

4) Create `ClearEntries` subroutine with correct parameters.
5) Extract number of cells to be cleared.
6) Extract row/column from entry in `Answer` within loop.
7) Extract row and column from entry in `Answer` within loop.
8) Replace entry in `PuzzleGrid` with space within loop **DPT.** incorrect row and/or column
9) Correct number of cells cleared if number to clear is less than or equal to number of entries **DPT.** incorrect string used to clear in MP8
10) Correct number of cells cleared in all circumstances.
11) Update answer count in `Answer[2]`.
12) Display grid after subroutine call.

		Max 11 if code does not function correctly	

14	**2**	**Mark is for AO3 (evaluate)**
		
		****** SCREEN CAPTURE ******
		Must match code from **14.1**, including prompts on screen capture matching those in code.
		Code for **14.1** must be sensible.
		
		`Enter your choice: S`
		
		`  1  2  3  4  5  6  7  8  9`
		`  |===.===.===|===.===.===|===.===.===|`
		`1| 8 .  . 5 |  .  .  |  .  . 7 |`
		`  |.....|.....|.....|`
		`2| 9 .  .  | 5 . 7 . 4 |  .  .  |`
		`  |.....|.....|.....|`
		`3| 4 . 1 . 7 |  . 6 .  |  .  .  |`
		`  |===.===.===|===.===.===|===.===.===|`
		`4|  .  .  | 7 .  .  | 1 . 6 .  |`
		`  |.....|.....|.....|`
		`5| 1 . 7 .  | 4 .  . 6 |  .  . 3 |`
		`  |.....|.....|.....|`
		`6| 6 . 5 . 8 |  .  . 1 |  .  .  |`
		`  |===.===.===|===.===.===|===.===.===|`
		`7|  .  .  |  . 1 .  |  . 4 . 9 |`
		`  |.....|.....|.....|`
		`8|  .  .  | 2 .  . 7 |  .  . 1 |`
		`  |.....|.....|.....|`
		`9| 2 .  .  |  .  .  | 5 .  . 6 |`
		`  |===.===.===|===.===.===|===.===.===|`
		
		`Enter row column digit:`
		`(Press Enter to stop)`
		`-x`
		`not a valid integer`
		`Enter row column digit:`
		`(Press Enter to stop)`
		`-1`
			1

```
   1   2   3   4   5   6   7   8   9
 |===.===.===|===.===.===|===.===.===|
1| 8 .   . 5 |   .   .   |   .   . 7 |
 |...........|...........|...........|
2| 9 .   .   | 5 . 7 . 4 |   .   .   |
 |...........|...........|...........|
3| 4 . 1 . 7 |   . 6 .   |   .   .   |
 |===.===.===|===.===.===|===.===.===|
4|   .   .   | 7 .   .   | 1 . 6 .   |
 |...........|...........|...........|
5| 1 .   .   | 4 .   . 6 |   .   . 3 |
 |...........|...........|...........|
6| 6 . 5 . 8 |   .   . 1 |   .   .   |
 |===.===.===|===.===.===|===.===.===|
7|   .   .   |   . 1 .   |   . 4 . 9 |
 |...........|...........|...........|
8|   .   .   | 2 .   . 7 |   .   . 1 |
 |...........|...........|...........|
9| 2 .   .   |   .   .   | 5 .   . 6 |
 |===.===.===|===.===.===|===.===.===|

Enter row column digit:
(Press Enter to stop)
-5

   1   2   3   4   5   6   7   8   9
 |===.===.===|===.===.===|===.===.===|
1| 8 .   . 5 |   .   .   |   .   . 7 |
 |...........|...........|...........|
2| 9 .   .   | 5 .   . 4 |   .   .   |
 |...........|...........|...........|
3| 4 . 1 .   |   . 6 .   |   .   .   |
 |===.===.===|===.===.===|===.===.===|
4|   .   .   | 7 .   .   | 1 . 6 .   |
 |...........|...........|...........|
5| 1 .   .   | 4 .   . 6 |   .   . 3 |
 |...........|...........|...........|
6|   . 5 . 8 |   .   . 1 |   .   .   |
 |===.===.===|===.===.===|===.===.===|
7|   .   .   |   . 1 .   |   . 4 . 9 |
 |...........|...........|...........|
8|   .   .   | 2 .   . 7 |   .   . 1 |
 |...........|...........|...........|
9| 2 .   .   |   .   .   | 5 .   . 6 |
 |===.===.===|===.===.===|===.===.===|
```

VB.Net

03 **1** **8**

```
Sub Main()
  Dim Rnd As Random = New Random()
  Dim C As Integer = 0  '
  Dim D As Integer = 0  '
  Dim S As Integer = 0  '
  Dim T As Integer = 0  ' MP1
  While C < 3 And D < 3 ' MP2
    T += 1              '
    Dim N1 As Integer = Rnd.Next(1, 7) '
    Dim N2 As Integer = Rnd.Next(1, 7) ' MP3
    Console.WriteLine($"{N1}   {N2}")  '
    S = S + N1 + N2    ' MP4
    If N1 = 6 Or N2 = 6 Then '
      C += 1                 ' MP5
    End If
    If N1 = N2 Then     '
      D += 1            ' MP6
    End If
  End While
  Dim A AS Integer = S \ (T * 2)  ' MP7
  Console.WriteLine($"{C}   {D}   {A}")  ' MP8
  Console.ReadLine()
End Sub
```

12 **1** **7**

```
Sub SolvePuzzle(PuzzleGrid(,) As Char, Puzzle() As String, Answer() As String)
  Dim CellInfo As String
  Dim InputError As Boolean
  Dim Digit As Char
  Dim Row, Column As Integer
  DisplayGrid(PuzzleGrid)
  If PuzzleGrid(0, 0) <> "X" Then
    Console.WriteLine("No puzzle loaded")
  Else
    Console.WriteLine("Enter row column digit: ")
    Console.WriteLine("(Press Enter to stop)")
    CellInfo = Console.ReadLine()
    While CellInfo <> EMPTY_STRING
      InputError = False
      If CellInfo.Length <> 3 Then
        InputError = True
      Else
        Digit = CellInfo(2)
        Try
          Row = Int32.Parse(CellInfo(0))
        Catch
          InputError = True
        End Try
        Try
          Column = Int32.Parse(CellInfo(1))
        Catch
          InputError = True
        End Try
        If (Digit < "1") Or (Digit > "9") Then
          InputError = True
        End If
      End If
      If InputError Then
        Console.WriteLine("Invalid input")
      Else
```

```
    ' MP7: code inserted in correct place
        Dim ProtectedCell As Boolean = False
        Dim Line As Integer = 0
        While Not ProtectedCell And Puzzle(Line) <> EMPTY_STRING
            ' MP1                    ' MP2
          If Puzzle(Line)(0) = Row.ToString() And Puzzle(Line)(1) =
Column.ToString() Then    ' MP3
            ProtectedCell = True
          End If
            Line += 1
        End While
        If ProtectedCell Then  ' MP4
          Console.WriteLine("You can't change a protected cell.") ' MP5
        Else  ' MP6
          PuzzleGrid(Row, Column) = Digit
          Answer(2) = (Int32.Parse(Answer(2)) + 1).ToString()
          Answer(Int32.Parse(Answer(2)) + 2) = CellInfo
          DisplayGrid(PuzzleGrid)
        End If
      End If
      Console.WriteLine("Enter row column digit: ")
      Console.WriteLine("(Press Enter to stop)")
      CellInfo = Console.ReadLine()
    End While
  End If
End Sub
```

13 **1** **8**

```
Function DuplicateDigit(PuzzleGrid(,) As Char, Row As Integer, Column As
Integer, Digit As Char) As Boolean   ' MP3
  Dim duplicateFound As Boolean = False
  Dim i As Integer
  For i = 1 To GRID_SIZE  ' MP1
    If PuzzleGrid(i, Column) = Digit Or PuzzleGrid(Row, i) = Digit Then
      duplicateFound = True                    ' MP4
    End If
  Next
  Dim endr As Integer = ((Row - 1) \ 3 + 1) * 3   ' MP2
  Dim endc As Integer = ((Column - 1) \ 3 + 1) * 3
  Dim r, c As Integer
  For r = endr - 2 To endr
    For c = endc - 2 To endc  ‘' MP5
      If PuzzleGrid(r, c) = Digit Then
        duplicateFound = True  ' MP6
      End If
    Next
  Next
  Return duplicateFound
End Function

Sub SolvePuzzle(PuzzleGrid(,) As Char, Puzzle() As String, Answer() As String)
  Dim CellInfo As String
  Dim InputError As Boolean
  Dim Digit As Char
  Dim Row, Column As Integer
  DisplayGrid(PuzzleGrid)
  If PuzzleGrid(0, 0) <> "X" Then
    Console.WriteLine("No puzzle loaded")
  Else
    Console.WriteLine("Enter row column digit: ")
    Console.WriteLine("(Press Enter to stop)")
```

```
    CellInfo = Console.ReadLine()
    While CellInfo <> EMPTY_STRING
      InputError = False
      If CellInfo.Length <> 3 Then
        InputError = True
      Else
        Digit = CellInfo(2)
        Try
          Row = Int32.Parse(CellInfo(0))
        Catch
          InputError = True
        End Try
        Try
          Column = Int32.Parse(CellInfo(1))
        Catch
          InputError = True
        End Try
        If (Digit < "1") Or (Digit > "9") Then
          InputError = True
        End If
      End If
      If InputError Then
        Console.WriteLine("Invalid input")
      Else
        '  MP7: call subroutine in correct place
        If DuplicateDigit(PuzzleGrid, Row, Column, Digit) Then
          Console.WriteLine("Duplicate digit entered.")   '  MP8
        Else
          PuzzleGrid(Row, Column) = Digit
          Answer(2) = (Int32.Parse(Answer(2)) + 1).ToString()
          Answer(Int32.Parse(Answer(2)) + 2) = CellInfo
          DisplayGrid(PuzzleGrid)
        End If
      End If
      Console.WriteLine("Enter row column digit: ")
      Console.WriteLine("(Press Enter to stop)")
      CellInfo = Console.ReadLine()
    End While
  End If
End Sub

Alternative Solution DuplicateDigit subroutine:

Function DuplicateDigit(PuzzleGrid(,) As Char, Row As Integer, Column As Integer,
Digit As Char) As Boolean    ' MP3
    Dim duplicateFound As Boolean = False
    Dim i As Integer
    For i = 1 To GRID_SIZE   ' MP1
      If PuzzleGrid(i, Column) = Digit Or PuzzleGrid(Row, i) = Digit Then
        duplicateFound = True                    ' MP4
      End If
    Next
    Dim startR As Integer = ((Row - 1) \ 3) * 3 + 1     ' MP2
    Dim startC As Integer = ((Column - 1) \ 3) * 3 + 1
    Dim r, c As Integer
    For r = startR To startR + 2
      For c = startC To startC + 2   '' MP5
        If PuzzleGrid(r, c) = Digit Then
          duplicateFound = True   ' MP6
        End If
      Next
    Next
```

```
    Return duplicateFound
  End Function
```

14 **1** **12**

```
Sub ClearEntries(PuzzleGrid(,) As Char, Answer() As String, EntriesToClear As
Integer)  'MP4
  Dim Line, Row, Column As Integer
  Dim CellInfo As String
  If EntriesToClear > Int32.Parse(Answer(2)) Then 'MP9
    EntriesToClear = Int32.Parse(Answer(2))       'MP10
  End If
  For i As Integer = 0 To EntriesToClear - 1      'MP1
      ' loop won't execute if Answer(2) = "0"
    Line = Int32.Parse(Answer(2)) + 2
    CellInfo = Answer(Line)
    Row = Int32.Parse(CellInfo(0))       'MP6
    Column = Int32.Parse(CellInfo(1))    'MP7
    PuzzleGrid(Row, Column) = SPACE      'MP8
    Answer(2) = (Int32.Parse(Answer(2)) - 1).ToString()   'MP11
  Next
End Sub

Sub SolvePuzzle(PuzzleGrid(,) As Char, Puzzle() As String, Answer() As String)
  Dim CellInfo As String
  Dim InputError As Boolean
  Dim Digit As Char
  Dim Row, Column As Integer
  DisplayGrid(PuzzleGrid)
  If PuzzleGrid(0, 0) <> "X" Then
    Console.WriteLine("No puzzle loaded")
  Else
    Console.WriteLine("Enter row column digit: ")
    Console.WriteLine("(Press Enter to stop)")
    CellInfo = Console.ReadLine()
    While CellInfo <> EMPTY_STRING
      InputError = False
      If CellInfo(0) = "-" Then  'MP3
        Try
          Dim EntriesToClear As Integer = Int32.Parse(CellInfo) * - 1 'MP5
          ClearEntries(PuzzleGrid, Answer, EntriesToClear)
          DisplayGrid(PuzzleGrid)  'MP12
        Catch ex As Exception  'MP2
          Console.WriteLine("Invalid number of entries to be cleared.")
        End Try
      Else
        If CellInfo.Length <> 3 Then
          InputError = True
        Else
          Digit = CellInfo(2)
          Try
            Row = Int32.Parse(CellInfo(0))
          Catch
            InputError = True
          End Try
          Try
            Column = Int32.Parse(CellInfo(1))
          Catch
            InputError = True
          End Try
          If (Digit < "1") Or (Digit > "9") Then
            InputError = True
```

```
          End If
          If InputError Then
            Console.WriteLine("Invalid input")
          Else
            PuzzleGrid(Row, Column) = Digit
            Answer(2) = (Int32.Parse(Answer(2)) + 1).ToString()
            Answer(Int32.Parse(Answer(2)) + 2) = CellInfo
            DisplayGrid(PuzzleGrid)
          End If
        End If
      End If
      Console.WriteLine("Enter row column digit: ")
      Console.WriteLine("(Press Enter to stop)")
      CellInfo = Console.ReadLine()
    End While
  End If
End Sub
```

Alternative Solution

```
Sub ClearEntries(PuzzleGrid(,) As Char, Answer() As String, EntriesToClear As
Integer)
  Dim Line, Row, Column As Integer
  Dim CellInfo As String
  Line = Int32.Parse (Answer(2)) + 2
  While EntriesToClear > 0 And Line > 2
    CellInfo = Answer(Line)
    Row = Int32.Parse(CellInfo(0))
    Column = Int32.Parse(CellInfo(1))
    PuzzleGrid(Row, Column) = SPACE
    Answer(2) = (Int32.Parse(Answer(2)) - 1).ToString()
    Line -= 1
    EntriesToClear -= 1
  End While
End Sub
```

Python 3

03	**1**	`import random`
		
		`C = 0 #`
		`D = 0 #`
		`S = 0 #`
		`T = 0 # MP1`
		`while C < 3 and D < 3: # MP2`
		`  T += 1`
		`  N1 = random.randint(1,6) #`
		`  N2 = random.randint(1,6) # MP3`
		`  print(N1, N2)  #`
		`  S = S + N1 + N2 # MP4`
		`  if N1 == 6 or N2 == 6: #`
		`  C += 1  # MP5`
		`  if N1 == N2:  #`
		`  D += 1  # MP6`
		`A = S // (T*2) # MP7`
		`print(C, D, A) # MP8`
			8

12	**1**		**7**

```
def SolvePuzzle(PuzzleGrid, Puzzle, Answer):
  DisplayGrid(PuzzleGrid)
  if PuzzleGrid[0][0] != 'X':
    print("No puzzle loaded")
  else:
    print("Enter row column digit: ")
    print("(Press Enter to stop)")
    CellInfo = input()
    while CellInfo != EMPTY_STRING:
      InputError = False
      if len(CellInfo) != 3:
        InputError = True
      else:
        Digit = CellInfo[2]
        try:
          Row = int(CellInfo[0])
        except:
          InputError = True
        try:
          Column = int(CellInfo[1])
        except:
          InputError = True
        if (Digit < '1' or Digit > '9'):
          InputError = True
      if InputError:
        print("Invalid input")
      else:
       # MP7: code inserted in correct place
        Protected = False
        Line = 0
        while Puzzle[Line] != EMPTY_STRING:
            # MP1           MP2
          if CellInfo[:2] == Puzzle[Line][:2]: # MP3
            Protected = True
          Line += 1
        if Protected: # MP4
          print("You can't change a protected cell")     # MP5
        else: # MP6
          PuzzleGrid[Row][Column] = Digit
          Answer[2] = str(int(Answer[2]) + 1)
          Answer[int(Answer[2]) + 2] = CellInfo
          DisplayGrid(PuzzleGrid)
      print("Enter row column digit: ")
      print("(Press Enter to stop)")
      CellInfo = input()
  return PuzzleGrid, Answer
```

13	1	**def DuplicateDigit(PuzzleGrid, Row, Column, Digit): # MP3**
		** Duplicate = False**
		** for X in range(1, GRID_SIZE + 1): # MP1**
		** if PuzzleGrid[X][Column] == Digit: # MP4**
		** Duplicate = True**
		** for Y in range(1, GRID_SIZE + 1):**
		** if PuzzleGrid[Row][Y] == Digit: # MP4**
		** Duplicate = True**
		** SubGridStartX = ((Row - 1) // 3) * 3 + 1 # MP2**
		** SubGridStartY = ((Column - 1) // 3) * 3 + 1**
		** for X in range(SubGridStartX, SubGridStartX + 3):**
		** for Y in range(SubGridStartY, SubGridStartY + 3): # MP5**
		** if PuzzleGrid[X][Y] == Digit:**
		** Duplicate = True # MP6**
		** return Duplicate**
		
		def SolvePuzzle(PuzzleGrid, Puzzle, Answer):
		  DisplayGrid(PuzzleGrid)
		  if PuzzleGrid[0][0] != 'X':
		  print("No puzzle loaded")
		  else:
		  print("Enter row column digit: ")
		  print("(Press Enter to stop)")
		  CellInfo = input()
		  while CellInfo != EMPTY_STRING:
		  InputError = False
		  if len(CellInfo) != 3:
		  InputError = True
		  else:
		  Digit = CellInfo[2]
		  try:
		  Row = int(CellInfo[0])
		  except:
		  InputError = True
		  try:
		  Column = int(CellInfo[1])
		  except:
		  InputError = True
		  if (Digit < '1' or Digit > '9'):
		  InputError = True
		  if InputError:
		  print("Invalid input")
		  else:
		** if DuplicateDigit(PuzzleGrid, Row, Column, Digit): # MP7**
		** print("Duplicate digit") # MP8**
		** else:**
		  PuzzleGrid[Row][Column] = Digit
		  Answer[2] = str(int(Answer[2]) + 1)
		  Answer[int(Answer[2]) + 2] = CellInfo
		  DisplayGrid(PuzzleGrid)
		  print("Enter row column digit: ")
		  print("(Press Enter to stop)")
		  CellInfo = input()
		  return PuzzleGrid, Answer
			8

14	1	**def ClearEntries(PuzzleGrid, Answer, NumberInput): # MP4**
		** StepsDone = int(Answer[2])**
		** if NumberInput > StepsDone:**
		** StepsToRemove = StepsDone # MP10**
		** else:**
		** StepsToRemove = NumberInput # MP9**
		** for Count in range(StepsToRemove): # MP1**
		** PreviousStep = Answer[int(Answer[2]) + 2]**
		** Row = int(PreviousStep[0]) # MP6**
		** Column = int(PreviousStep[1]) # MP7**
		** PuzzleGrid[Row][Column] = SPACE # MP8**
		** Answer[2] = str(int(Answer[2]) - 1) # MP11**
		** return PuzzleGrid, Answer**
		
		def SolvePuzzle(PuzzleGrid, Puzzle, Answer):
		  DisplayGrid(PuzzleGrid)
		  if PuzzleGrid[0][0] != 'X':
		  print("No puzzle loaded")
		  else:
		  print("Enter row column digit: ")
		  print("(Press Enter to stop)")
		  CellInfo = input()
		  while CellInfo != EMPTY_STRING:
		  InputError = False
		  if CellInfo[0] == '-': # MP3
		  try:
		  NumberInput = -int(CellInfo) # MP5
		  PuzzleGrid, Answer = ClearEntries(PuzzleGrid, Answer, NumberInput)
		  DisplayGrid(PuzzleGrid) # MP12
		  except: # MP2
		  print("Not a valid integer")
		  else:
		  if len(CellInfo) != 3:
		  InputError = True
		  else:
		  Digit = CellInfo[2]
		  try:
		  Row = int(CellInfo[0])
		  Column = int(CellInfo[1])
		  except:
		  InputError = True
		  if (Digit < '1' or Digit > '9'):
		  InputError = True
		  if InputError:
		  print("Invalid input")
		  else:
		  PuzzleGrid[Row][Column] = Digit
		  Answer[2] = str(int(Answer[2]) + 1)
		  Answer[int(Answer[2]) + 2] = CellInfo
		  DisplayGrid(PuzzleGrid)
		  print("Enter row column digit: ")
		  print("(Press Enter to stop)")
		  CellInfo = input()
		  return PuzzleGrid, Answer
			12

Alternative solution

```
while CellInfo != EMPTY_STRING:
  if CellInfo[0] == "-":
    if CellInfo[1:].isdigit():
      PuzzleGrid, Answer = ClearEntries(PuzzleGrid, Answer,
CellInfo[1:])
      DisplayGrid(PuzzleGrid)
    else:
      InputError = False

def ClearEntries(PuzzleGrid, Answer, Steps):
  StepsToRemove = int(Steps)
  for Count in range(StepsToRemove):
    if int(Answer[2]) > 0:
      PreviousStep = Answer[int(Answer[2]) + 2]
      Answer[int(Answer[2]) + 2] = EMPTY_STRING
      Answer[2] = str(int(Answer[2]) - 1)
      Row = int(PreviousStep[0])
      Column = int(PreviousStep[1])
      PuzzleGrid[Row][Column] = SPACE
      #DisplayGrid(PuzzleGrid)
  return PuzzleGrid, Answer
```

Python 2

03 **1**

```
import random

C = 0 #
D = 0 #
S = 0 #
T = 0 # MP1
while C < 3 and D < 3: # MP2
  T += 1              #
  N1 = random.randint(1,6) #
  N2 = random.randint(1,6) # MP3
  print N1, N2             #
  S = S + N1 + N2 # MP4
  if N1 == 6 or N2 == 6: #
    C += 1               # MP5
  if N1 == N2:    #
    D += 1        # MP6
A = S // (T*2) # MP7
print C, D, A  # MP8
```

8

12 **1**

```
def SolvePuzzle(PuzzleGrid, Puzzle, Answer):
  DisplayGrid(PuzzleGrid)
  if PuzzleGrid[0][0] != 'X':
    print "No puzzle loaded"
  else:
    print "Enter row column digit: "
    print "(Press Enter to stop)"
    CellInfo = raw_input()
    while CellInfo != EMPTY_STRING:
      InputError = False
      if len(CellInfo) != 3:
        InputError = True
      else:
        Digit = CellInfo[2]
        try:
          Row = int(CellInfo[0])
        except:
          InputError = True
        try:
          Column = int(CellInfo[1])
        except:
          InputError = True
        if (Digit < '1' or Digit > '9'):
          InputError = True
      if InputError:
        print "Invalid input"
      else:
        # MP7: code inserted in correct place
        Protected = False
        Line = 0
        while Puzzle[Line] != EMPTY_STRING:
            # MP1          MP2
          if CellInfo[:2] == Puzzle[Line][:2]: # MP3
            Protected = True
          Line += 1
        if Protected: # MP4
```

7

		print("You can't change a protected cell") # MP5
		else: # MP6
		PuzzleGrid[Row][Column] = Digit
		Answer[2] = str(int(Answer[2]) + 1)
		Answer[int(Answer[2]) + 2] = CellInfo
		DisplayGrid(PuzzleGrid)
		print "Enter row column digit: "
		print "(Press Enter to stop)"
		CellInfo = raw_input()
		return PuzzleGrid, Answer	

13	**1**	**def DuplicateDigit(PuzzleGrid, Row, Column, Digit): # MP3**
		Duplicate = False
		for X in range(1, GRID_SIZE + 1): # MP1
		if PuzzleGrid[X][Column] == Digit: # MP4
		Duplicate = True
		for Y in range(1, GRID_SIZE + 1):
		if PuzzleGrid[Row][Y] == Digit: # MP4
		Duplicate = True
		SubGridStartX = ((Row - 1) // 3) * 3 + 1 # MP2
		SubGridStartY = ((Column - 1) // 3) * 3 + 1
		for X in range(SubGridStartX, SubGridStartX + 3):
		for Y in range(SubGridStartY, SubGridStartY + 3): # MP5
		if PuzzleGrid[X][Y] == Digit:
		Duplicate = True # MP6
		return Duplicate
		
		def SolvePuzzle(PuzzleGrid, Puzzle, Answer):
		DisplayGrid(PuzzleGrid)
		if PuzzleGrid[0][0] != 'X':
		print "No puzzle loaded"
		else:
		print "Enter row column digit: "
		print "(Press Enter to stop)"
		CellInfo = raw_input()
		while CellInfo != EMPTY_STRING:
		InputError = False
		if len(CellInfo) != 3:
		InputError = True
		else:
		Digit = CellInfo[2]
		try:
		Row = int(CellInfo[0])
		except:
		InputError = True
		try:
		Column = int(CellInfo[1])
		except:
		InputError = True
		if (Digit < '1' or Digit > '9'):
		InputError = True
		if InputError:
		print "Invalid input"
		else:
		# MP7: call subroutine in correct place
		if DuplicateDigit(PuzzleGrid, Row, Column, Digit):
		print("Duplicate digit") # MP8
			8

```
          else:
            PuzzleGrid[Row][Column] = Digit
            Answer[2] = str(int(Answer[2]) + 1)
            Answer[int(Answer[2]) + 2] = CellInfo
            DisplayGrid(PuzzleGrid)
        print "Enter row column digit: "
        print "(Press Enter to stop)"
        CellInfo = raw_input()
    return PuzzleGrid, Answer
```

14 **1**

```
def ClearEntries(PuzzleGrid, Answer, NumberInput): # MP4
  StepsDone = int(Answer[2])
  if NumberInput > StepsDone:
    StepsToRemove = StepsDone # MP10
  else:
    StepsToRemove = NumberInput # MP9
  for Count in range(StepsToRemove):  # MP1
    PreviousStep = Answer[int(Answer[2]) + 2]
    Row = int(PreviousStep[0])      # MP6
    Column = int(PreviousStep[1])  # MP7
    PuzzleGrid[Row][Column] = SPACE # MP8
    Answer[2] = str(int(Answer[2]) - 1) # MP11
  return PuzzleGrid, Answer

def SolvePuzzle(PuzzleGrid, Puzzle, Answer):
  DisplayGrid(PuzzleGrid)
  if PuzzleGrid[0][0] != 'X':
    print "No puzzle loaded"
  else:
    print "Enter row column digit: "
    print "(Press Enter to stop)"
    CellInfo = raw_input()
    while CellInfo != EMPTY_STRING:
      InputError = False
      if CellInfo[0] == '-': # MP3
        try:
          NumberInput = -int(CellInfo)  # MP5
          PuzzleGrid, Answer = ClearEntries(PuzzleGrid, Answer,
NumberInput)
          DisplayGrid(PuzzleGrid)   # MP12
        except: # MP2
          print("Not a valid integer")
      else:
        if len(CellInfo) != 3:
          InputError = True
        else:
          Digit = CellInfo[2]
          try:
            Row = int(CellInfo[0])
          except:
            InputError = True
          try:
            Column = int(CellInfo[1])
          except:
            InputError = True
          if (Digit < '1' or Digit > '9'):
            InputError = True
```

12

```
        if InputError:
          print "Invalid input"
        else:
          PuzzleGrid[Row][Column] = Digit
          Answer[2] = str(int(Answer[2]) + 1)
          Answer[int(Answer[2]) + 2] = CellInfo
          DisplayGrid(PuzzleGrid)
      print "Enter row column digit: "
      print "(Press Enter to stop)"
      CellInfo = raw_input()
  return PuzzleGrid, Answer
```

Pascal

03 **1** **8**

```
{$APPTYPE CONSOLE} {$R+}

uses SysUtils;
var A, C, D, S, T, N1, N2: integer;
begin
  C := 0; //
  D := 0; //
  S := 0; //
  T := 0; // MP1
  while (C < 3) and (D < 3) do // MP2
  begin
    T := T + 1;          //
    N1 := random(6) + 1;     //
    N2 := random(6) + 1;     // MP3
    writeln(N1, N2);         //
    S := S + N1 + N2;  // MP4
    if (N1 = 6) or (N2 = 6) then  //
      C := C + 1;                 // MP5
    if N1 = N2 then       //
      D := D + 1;         // MP6
  end;
  A := S div (T*2); // MP7
  writeln(C, D, A); // MP8
  readln;
end.
```

12 **1** **7**

```
procedure SolvePuzzle(var PuzzleGrid: TPuzzleGrid; Puzzle: TPuzzle; var
Answer: TAnswer);
var
  CellInfo: string;
  InputError: boolean;
  Digit: char;
  Line, Row, Column: integer;
  Protected: boolean;
begin
  DisplayGrid(PuzzleGrid);
  if PuzzleGrid[0, 0] <> 'X' then
    writeln('No puzzle loaded')
  else
  begin
    writeln('Enter row column digit: ');
    writeln('(Press Enter to stop)');
    readln(CellInfo);
    while CellInfo <> EMPTY_STRING do
    begin
      InputError := False;
      if length(CellInfo) <> 3 then
        InputError := True
      else
      begin
        Digit := CellInfo[3];
        try
          Row := strToInt(CellInfo[1]);
        except
          InputError := True;
        end;
        try
```

```
          Column := strToInt(CellInfo[2]);
        except
          InputError := True;
        end;
        if (Digit < '1') or (Digit > '9') then
          InputError := True;
      end;
      if InputError then
        writeln('Invalid input')
      else // MP7 code inserted in correct place
      begin
        Protected := False;
        Line := 0;
        while Puzzle[Line] <> EMPTY_STRING do // MP1, MP2
        begin
          if (CellInfo[1] = Puzzle[Line][1]) and (CellInfo[2] =
Puzzle[Line][2]) then  // MP3
            Protected := True;
          Inc(Line);
        end;
        if Protected then // MP4
          writeln('You can''t change a protected cell') // MP5
        else   // MP6
        begin
          PuzzleGrid[Row, Column] := Digit;
          Answer[2] := intToStr(strToInt(Answer[2]) + 1);
          Answer[strToInt(Answer[2]) + 2] := CellInfo;
          DisplayGrid(PuzzleGrid);
        end;
      end;
      writeln('Enter row column digit: ');
      writeln('(Press Enter to stop)');
      readln(CellInfo);
    end;
  end;
end;
```

13 **1** **8**

```
function DuplicateDigit(PuzzleGrid: TPuzzleGrid; Row, Column:
integer; Digit: string): boolean; // MP3
var
  Duplicate: boolean;
  X, Y, SubGridStartX, SubGridStartY: integer;
begin
  Duplicate := False;
  for X := 1 to GRID_SIZE do         // MP1
   if PuzzleGrid[X, Column] = Digit then // MP4
     Duplicate := True;
  for Y := 1 to GRID_SIZE do
   if PuzzleGrid[Row, Y] = Digit then // MP4
     Duplicate := True;
  SubGridStartX := ((Row - 1) div 3) * 3 + 1;  // MP2
  SubGridStartY := ((Column - 1) div 3) * 3 + 1;
  for X := SubGridStartX to SubGridStartX + 2 do
    for Y := SubGridStartY to (SubGridStartY + 2) do // MP5
      if PuzzleGrid[X, Y] = Digit then
        Duplicate := True;  // MP6
  DuplicateDigit := Duplicate;
end;
```

```
procedure SolvePuzzle(var PuzzleGrid: TPuzzleGrid; Puzzle:
TPuzzle; var Answer: TAnswer);
var
  CellInfo: string;
  InputError: boolean;
  Digit: char;
  Row, Column: integer;
begin
  DisplayGrid(PuzzleGrid);
  if PuzzleGrid[0, 0] <> 'X' then
    writeln('No puzzle loaded')
  else
  begin
    writeln('Enter row column digit: ');
    writeln('(Press Enter to stop)');
    readln(CellInfo);
    while CellInfo <> EMPTY_STRING do
    begin
      InputError := False;
      if length(CellInfo) <> 3 then
        InputError := True
      else
      begin
        Digit := CellInfo[3];
        try
          Row := strToInt(CellInfo[1]);
        except
          InputError := True;
        end;
        try
          Column := strToInt(CellInfo[2]);
        except
          InputError := True;
        end;
        if (Digit < '1') or (Digit > '9') then
          InputError := True;
      end;
      if InputError then
        writeln('Invalid input')
      else // MP7: call subroutine in correct place
        if DuplicateDigit(PuzzleGrid, Row, Column, Digit) then
          writeln('Duplicate digit')  // MP8
        else
        begin
          PuzzleGrid[Row, Column] := Digit;
          Answer[2] := intToStr(strToInt(Answer[2]) + 1);
          Answer[strToInt(Answer[2]) + 2] := CellInfo;
          DisplayGrid(PuzzleGrid);
        end;
      writeln('Enter row column digit: ');
      writeln('(Press Enter to stop)');
      readln(CellInfo);
    end;
  end;
end;
```

14	1	**procedure ClearEntries(var PuzzleGrid: TPuzzleGrid; var Answer: TAnswer; NumberInput: integer); // MP4**
		var
		** StepsDone, StepsToRemove, Count, Row, Column: integer;**
		** PreviousStep: string;**
		begin
		** StepsDone := strToInt(Answer[2]);**
		** if NumberInput > StepsDone then**
		** StepsToRemove := StepsDone // MP10**
		** else**
		** StepsToRemove := NumberInput; // MP9**
		** for Count := 1 to StepsToRemove do // MP1**
		** begin**
		** PreviousStep := Answer[strToInt(Answer[2]) + 2];**
		** Row := strToInt(PreviousStep[1]); // MP6**
		** Column := strToInt(PreviousStep[2]); // MP7**
		** PuzzleGrid[Row, Column] := SPACE; // MP8**
		** Answer[2] := intToStr(strToInt(Answer[2]) - 1); // MP11**
		** end;**
		end;
		
		procedure SolvePuzzle(var PuzzleGrid: TPuzzleGrid; Puzzle: TPuzzle; var Answer: TAnswer);
		var
		  CellInfo: string;
		  InputError: boolean;
		  Digit: char;
		  Row, Column, **NumberInput**: integer;
		begin
		  DisplayGrid(PuzzleGrid);
		  if PuzzleGrid[0, 0] <> 'X' then
		    writeln('No puzzle loaded')
		  else
		  begin
		    writeln('Enter row column digit: ');
		    writeln('(Press Enter to stop)');
		    readln(CellInfo);
		    while CellInfo <> EMPTY_STRING do
		    begin
		      InputError := False;
		      if CellInfo[1] = '-' then // MP3
		        try
		          NumberInput := -strToInt(CellInfo); // MP5
		          ClearEntries(PuzzleGrid, Answer, NumberInput);
		          DisplayGrid(PuzzleGrid); // MP12
		        except // MP2
		          writeln('Not a valid integer')
		        end
		      else
		      begin
		      if length(CellInfo) <> 3 then
		        InputError := True
		      else
		      begin
		        writeln('got past new code');
		        readln;
			12

```
        Digit := CellInfo[3];
        try
          Row := strToInt(CellInfo[1]);
        except
          InputError := True;
        end;
        try
          Column := strToInt(CellInfo[2]);
        except
          InputError := True;
        end;
        if (Digit < '1') or (Digit > '9') then
          InputError := True;
      end;
      if InputError then
        writeln('Invalid input')
      else
      begin
        PuzzleGrid[Row, Column] := Digit;
        Answer[2] := intToStr(strToInt(Answer[2]) + 1);
        Answer[strToInt(Answer[2]) + 2] := CellInfo;
        DisplayGrid(PuzzleGrid);
      end;
      end;
      writeln('Enter row column digit: ');
      writeln('(Press Enter to stop)');
      readln(CellInfo);
    end;
  end;
end;
```

C#

03 **1** **8**

```
Random R = new Random();
int C = 0, D = 0, S = 0, T = 0; // MP1
int N1, N2, A;
while ((C < 3) && (D < 3)) // MP2
{
  T++;                //
  N1 = R.Next(1, 7);                //
  N2 = R.Next(1, 7);                // MP3
  Console.WriteLine($"{N1} {N2}"); //
  S = S + N1 + N2;  // MP4
  if ((N1 == 6) || (N2 == 6)) //
  {                           //
    C++;                      // MP5
  }
  if (N1 == N2)    //
  {                //
    D++;           // MP6
  }
}
A = S / (T * 2);  // MP7
Console.WriteLine($"{C} {D} {A}"); // MP8
Console.ReadLine();
```

12 **1** **7**

```
private static void SolvePuzzle(char[,] puzzleGrid, string[]
puzzle, string[] answer)
{
  int row = 0, column = 0;
  char digit = ' ';
  DisplayGrid(puzzleGrid);
  if (puzzleGrid[0, 0] != 'X')
  {
    Console.WriteLine("No puzzle loaded");
  }
  else
  {
    Console.WriteLine("Enter row column digit: ");
    Console.WriteLine("(Press Enter to stop)");
    string cellInfo = Console.ReadLine();
    while (cellInfo != EMPTY_STRING)
    {
      bool inputError = false;
      if (cellInfo.Length != 3)
      {
        inputError = true;
      }
      else
      {
        digit = cellInfo[2];
        try
        {
          row = Convert.ToInt32(cellInfo[0].ToString());
        }
        catch (Exception)
        {
          inputError = true;
```

```
          }
          try
          {
            column = Convert.ToInt32(cellInfo[1].ToString());
          }
          catch (Exception)
          {
            inputError = true;
          }
          if (digit < '1' || digit > '9')
          {
            inputError = true;
          }
        }
        if (inputError)
        {
          Console.WriteLine("Invalid input");
        }
        else
        { // MP7: code inserted in correct place
          bool protectedCell = false;
          int line = 0;
          while (puzzle[line] != EMPTY_STRING) // MP1, MP2
          {
            if (cellInfo[0] == puzzle[line][0] && cellInfo[1] ==
puzzle[line][1]) // MP3
            {
              protectedCell = true;
            }
            line++;
          }
          if (protectedCell)  // MP4
          {
            Console.WriteLine("You can't change a protected
cell");  // MP5
          }
          else
          { // MP6
            puzzleGrid[row, column] = digit;
            answer[2] = (Convert.ToInt32(answer[2]) +
1).ToString();
            answer[Convert.ToInt32(answer[2]) + 2] = cellInfo;
            DisplayGrid(puzzleGrid);
          }
        }
        Console.WriteLine("Enter row column digit: ");
        Console.WriteLine("(Press Enter to stop)");
        cellInfo = Console.ReadLine();
      }
    }
}
```

13	**1**	**private static bool DuplicateDigit(char[,] puzzleGrid, int row, int column, char digit) // MP3**
		{
		bool duplicate = false;
		for (int x = 1; x < GRID_SIZE + 1; x++) // MP1
			8

```
    {
      if (puzzleGrid[x,column] == digit) // MP4
      {
        duplicate = true;
      }
    }
    for (int y = 1; y < GRID_SIZE + 1; y++)
    {
      if (puzzleGrid[row,y] == digit) // MP4
      {
        duplicate = true;
      }
    }
    int subGridStartX = ((row - 1) / 3) * 3 + 1;  // MP2
    int subGridStartY = ((column - 1) / 3) * 3 + 1;
    for (int x = subGridStartX; x < subGridStartX + 3; x++)
    {
      for (int y = subGridStartY; y < subGridStartY + 3; y++)//
MP5
      {
        if (puzzleGrid[x, y] == digit)
        {
          duplicate = true; // MP6
        }
      }
    }
    return duplicate;
}


private static void SolvePuzzle(char[,] puzzleGrid, string[]
puzzle, string[] answer)
{
    int row = 0, column = 0;
    char digit = ' ';
    DisplayGrid(puzzleGrid);
    if (puzzleGrid[0, 0] != 'X')
    {
      Console.WriteLine("No puzzle loaded");
    }
    else
    {
      Console.WriteLine("Enter row column digit: ");
      Console.WriteLine("(Press Enter to stop)");
      string cellInfo = Console.ReadLine();
      while (cellInfo != EMPTY_STRING)
      {
        bool inputError = false;
        if (cellInfo.Length != 3)
        {
          inputError = true;
        }
        else
        {
          digit = cellInfo[2];
          try
```

```
          {
            row = Convert.ToInt32(cellInfo[0].ToString());
          }
          catch (Exception)
          {
            inputError = true;
          }
          try
          {
            column = Convert.ToInt32(cellInfo[1].ToString());
          }
          catch (Exception)
          {
            inputError = true;
          }
          if (digit < '1' || digit > '9')
          {
            inputError = true;
          }
        }
        if (inputError)
        {
          Console.WriteLine("Invalid input");
        }
        else
        {// MP7: call subroutine in correct place
          if (DuplicateDigit(puzzleGrid, row, column, digit))
          {
            Console.WriteLine("Duplicate digit"); // MP8
          }
          else
          {
            puzzleGrid[row, column] = digit;
            answer[2] = (Convert.ToInt32(answer[2]) +
1).ToString();
            answer[Convert.ToInt32(answer[2]) + 2] = cellInfo;
            DisplayGrid(puzzleGrid);
          }
        }
        Console.WriteLine("Enter row column digit: ");
        Console.WriteLine("(Press Enter to stop)");
        cellInfo = Console.ReadLine();
      }
    }
}
```

14	**1**	**private static void ClearEntries(char[,] puzzleGrid, string[] answer, int numberInput) // MP4**
		{
		int stepsToRemove = 0, row, column;
		string previousStep = "";
		int stepsDone = Convert.ToInt32(answer[2]);
		if (numberInput > stepsDone)
		{
		stepsToRemove = stepsDone; // MP10
		}
		else
			12

```
    {
      stepsToRemove = numberInput;  // MP9
    }
    for (int count = 0; count < stepsToRemove; count++) // MP1
    {
      previousStep = answer[Convert.ToInt32(answer[2]) + 2];
      row = Convert.ToInt32(previousStep[0].ToString());// MP6
      column = Convert.ToInt32(previousStep[1].ToString());// MP7
      puzzleGrid[row, column] = SPACE; // MP8
      answer[2] = (Convert.ToInt32(answer[2]) - 1).ToString();//
MP11
    }
}

private static void SolvePuzzle(char[,] puzzleGrid, string[]
puzzle, string[] answer)
{
  int row = 0, column = 0;
  char digit = ' ';
  int numberInput;
  DisplayGrid(puzzleGrid);
  if (puzzleGrid[0, 0] != 'X')
  {
    Console.WriteLine("No puzzle loaded");
  }
  else
  {
    Console.WriteLine("Enter row column digit: ");
    Console.WriteLine("(Press Enter to stop)");
    string cellInfo = Console.ReadLine();
    while (cellInfo != EMPTY_STRING)
    {
      bool inputError = false;
      if (cellInfo[0] == '-') // MP3
      {
        try
        {
          numberInput = -Convert.ToInt32(cellInfo); // MP5
          ClearEntries(puzzleGrid, answer, numberInput);
          DisplayGrid(puzzleGrid); // MP12
        }
        catch (Exception) // MP2
        {
          Console.WriteLine("Not a valid integer");
        }
      }
      else
      {
        if (cellInfo.Length != 3)
        {
          inputError = true;
        }
        else

          digit = cellInfo[2];
          try
```

```
            {
              row = Convert.ToInt32(cellInfo[0].ToString());
            }
            catch (Exception)
            {
              inputError = true;
            }
            try
            {
              column = Convert.ToInt32(cellInfo[1].ToString());
            }
            catch (Exception)
            {
              inputError = true;
            }
            if (digit < '1' || digit > '9')
            {
              inputError = true;
            }
          }
          if (inputError)
          {
            Console.WriteLine("Invalid input");
          }
          else
          {
            puzzleGrid[row, column] = digit;
            answer[2] = (Convert.ToInt32(answer[2]) +
1).ToString();
            answer[Convert.ToInt32(answer[2]) + 2] = cellInfo;
            DisplayGrid(puzzleGrid);
          }
        }
        Console.WriteLine("Enter row column digit: ");
        Console.WriteLine("(Press Enter to stop)");
        cellInfo = Console.ReadLine();
      }
    }
}
```

Java

03 **1** **8**

```
Random r = new Random();
int c = 0; //
int d = 0; //
int s = 0; //
int t = 0; // MP1
int n1, n2, a;
while ((c < 3) && (d < 3)) // MP2
{
  t++;                //
  n1 = r.nextInt(6) + 1;              //
  n2 = r.nextInt(6) + 1;              // MP3
  Console.writeLine(n1 + " " + n2); //
  s = s + n1 + n2; // MP4
  if ((n1 == 6) || (n2 == 6)) //
  {                                   //
    c++;                              // MP5
  }
  if (n1 == n2) //
  {               //
    d++;          // MP6
  }
}
a = s / (t * 2); // MP7
Console.writeLine(c + " " + d + " " + a); // MP8
```

12 **1** **7**

```
void solvePuzzle(char[][] puzzleGrid, String[] puzzle, String[]
answer)
{
    String cellInfo;
    boolean inputError;
    char digit = ' ';
    int row = 0, column = 0;
    displayGrid(puzzleGrid);
    if (puzzleGrid[0][0] != 'X')
    {
        Console.writeLine("No puzzle loaded");
    }
    else
    {
        Console.writeLine("Enter row column digit: ");
        Console.writeLine("(Press Enter to stop)");
        cellInfo = Console.readLine();
        while (!cellInfo.equals(EMPTY_STRING))
        {
            inputError = false;
            if (cellInfo.length() != 3)
            {
                inputError = true;
            }
            else
            {
                digit = cellInfo.charAt(2);
                try
                {
```

```
                    row = Integer.parseInt(cellInfo.charAt(0) +
EMPTY_STRING);
                }
                catch (Exception ex)
                {
                    inputError = true;
                }
                try
                {
                    column = Integer.parseInt(cellInfo.charAt(1)
+ EMPTY_STRING);
                }
                catch (Exception ex)
                {
                    inputError = true;
                }
                if ((digit < '1') || (digit > '9'))
                {
                    inputError = true;
                }
            }
            if (inputError)
            {
                Console.writeLine("Invalid input");
            }
            else
            {   // MP7: code inserted in correct place
                boolean protectedValue = false;
                int line = 0;
                while (!puzzle[line].equals(EMPTY_STRING)) { //
MP1, MP2
                    if (cellInfo.charAt(0) ==
puzzle[line].charAt(0) &&
                            cellInfo.charAt(1) ==
puzzle[line].charAt(1)) { // MP3
                        protectedValue = true;
                    }
                    line++;
                }
                if (protectedValue) { // MP4
                    Console.writeLine("You can't change a
protected cell");// MP5
                }
                else
                {// MP6
                    puzzleGrid[row][column] = digit;
                    answer[2] = (Integer.parseInt(answer[2]) +
1) + EMPTY_STRING;
                    answer[Integer.parseInt(answer[2]) + 2] =
cellInfo;
                    displayGrid(puzzleGrid);
                }
            }
            Console.writeLine("Enter row column digit: ");
            Console.writeLine("(Press Enter to stop)");
            cellInfo = Console.readLine();
```

```
            }
        }
    }
```

13 **1** **8**

```
boolean duplicateDigit(char [][] puzzleGrid, int row, int
column, char digit) // MP3
{
    boolean duplicate = false;
    for (int x = 1; x <= GRID_SIZE; x++) {// MP1
        if (puzzleGrid[x][column] == digit) {// MP4
            duplicate = true;
        }
    }
    for (int y = 1; y <= GRID_SIZE; y++) {
        if (puzzleGrid[row][y] == digit) {// MP4
            duplicate = true;
        }
    }
    int subGridStartX = ((row - 1) / 3) * 3 + 1; // MP2
    int subGridStartY = ((column - 1) / 3) * 3 + 1;
    for (int x = subGridStartX; x < subGridStartX + 3; x++) {
        for (int y = subGridStartY; y < subGridStartY + 3; y++)
{// MP5
            if (puzzleGrid[x][y] == digit) {
                duplicate = true; // MP6
            }
        }
    }
    return duplicate;
}

void solvePuzzle(char[][] puzzleGrid, String[] puzzle, String[]
answer)
{
    String cellInfo;
    boolean inputError;
    char digit = ' ';
    int row = 0, column = 0;
    displayGrid(puzzleGrid);
    if (puzzleGrid[0][0] != 'X')
    {
        Console.writeLine("No puzzle loaded");
    }
    else
    {
        Console.writeLine("Enter row column digit: ");
        Console.writeLine("(Press Enter to stop)");
        cellInfo = Console.readLine();
        while (!cellInfo.equals(EMPTY_STRING))
        {
            inputError = false;
            if (cellInfo.length() != 3)
            {
                inputError = true;
            }
            else
            {
```

```
                    digit = cellInfo.charAt(2);
                    try
                    {
                        row = Integer.parseInt(cellInfo.charAt(0) +
EMPTY_STRING);
                    }
                    catch (Exception ex)
                    {
                        inputError = true;
                    }
                    try
                    {
                        column = Integer.parseInt(cellInfo.charAt(1)
+ EMPTY_STRING);
                    }
                    catch (Exception ex)
                    {
                        inputError = true;
                    }
                    if ((digit < '1') || (digit > '9'))
                    {
                        inputError = true;
                    }
                }
                if (inputError)
                {
                    Console.writeLine("Invalid input");
                }
                else
                {// MP7: call subroutine in correct place
                    if (duplicateDigit(puzzleGrid, row, column,
digit)) {
                        Console.writeLine("Duplicate digit");// MP8
                    }
                    else
                    {
…
```

14	1		12

```
void clearEntries(char [][] puzzleGrid, String[] answer, int
numberInput) // MP 4
{
    int stepsToRemove = 0;
    int stepsDone = Integer.parseInt(answer[2]);
    if (numberInput > stepsDone) {
        stepsToRemove = stepsDone; // MP 10
    }
    else
    {
        stepsToRemove = numberInput; // MP 9
    }
    for (int count = 0; count < stepsToRemove; count++) {// MP 1
        String previousStep =
answer[Integer.parseInt(answer[2])+2];
        int row = Integer.parseInt(previousStep.charAt(0) +
EMPTY_STRING); // MP 6
        int column = Integer.parseInt(previousStep.charAt(1) +
EMPTY_STRING); // MP 7
        puzzleGrid[row][column] = SPACE; // MP 8
        answer[2] = (Integer.parseInt(answer[2]) - 1) +
EMPTY_STRING; // MP 11
    }
}

    void solvePuzzle(char[][] puzzleGrid, String[] puzzle,
String[] answer)
    {
        String cellInfo;
        boolean inputError;
        char digit = ' ';
        int row = 0, column = 0, numberInput;
        displayGrid(puzzleGrid);
        if (puzzleGrid[0][0] != 'X')
        {
            Console.writeLine("No puzzle loaded");
        }
        else
        {
            Console.writeLine("Enter row column digit: ");
            Console.writeLine("(Press Enter to stop)");
            cellInfo = Console.readLine();
            while (!cellInfo.equals(EMPTY_STRING))
            {
                inputError = false;
                if (cellInfo.charAt(0) == '-') {// MP 3
                    try {
                        numberInput = -
Integer.parseInt(cellInfo); // MP 5
                        clearEntries(puzzleGrid, answer,
numberInput);
                        displayGrid(puzzleGrid); // MP 12
                    } catch (Exception e) {// MP 2
                        Console.writeLine("Not a valid
integer");
                    }
```

```
                    }
                    else
                    {
                        if (cellInfo.length() != 3)
                        {
                            inputError = true;
                        }
                        else
                        {
                            digit = cellInfo.charAt(2);
…
```