

A



AS COMPUTER SCIENCE

Paper 1

7516/1

Tuesday 21 May 2019 Morning

Time allowed: 1 hour 45 minutes

For this paper you must have:

- a computer
- a printer
- appropriate software
- the Electronic Answer Document
- an electronic version and a hard copy of the Skeleton Program
- an electronic version of the Data Files
- an electronic version and a hard copy of the Preliminary Material.

You must NOT use a calculator.

[Turn over]

INSTRUCTIONS

- **Type the information required on the front of your Electronic Answer Document.**
- **Before the start of the examination make sure your CENTRE NUMBER, CANDIDATE NAME and CANDIDATE NUMBER are shown clearly IN THE FOOTER of every page (not the front cover) of your Electronic Answer Document.**
- **Enter your answers into the Electronic Answer Document.**
- **Answer ALL questions.**
- **Save your work at regular intervals.**

INFORMATION

- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 75.**
- **No extra time is allowed for printing and collating.**
- **The question paper is divided into THREE sections.**

ADVICE

You are advised to allocate time to each section as follows:

**SECTION A – 20 minutes; SECTION B – 25 minutes;
SECTION C – 60 minutes.**

AT THE END OF THE EXAMINATION

Tie together all your printed Electronic Answer Document pages and hand them to the Invigilator.

WARNING

It may not be possible to issue a result for this paper if your details are not on every page of your Electronic Answer Document.

DO NOT TURN OVER UNTIL TOLD TO DO SO

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SECTION A

You are advised to spend no more than 20 MINUTES on this section.

Enter your answers to SECTION A in your Electronic Answer Document. You MUST SAVE this document at regular intervals.

QUESTION 3 in this section asks you to write program code starting from a NEW program / project / file.

You are advised to save your program at regular intervals.

0 1

**State ONE difference between local and global variables and give TWO reasons why it is good practice to use local variables.
[3 marks]**

[Turn over]

02

The algorithm, represented using pseudo-code in FIGURE 1, describes a method to rearrange three numbers in a data structure.

FIGURE 1

```
Numbers[0] ← 43
Numbers[1] ← 17
Numbers[2] ← 85
FOR x ← 1 TO 2
  MyValue ← Numbers[x]
  y ← x - 1
  WHILE (y > -1) AND (Numbers[y] < MyValue)
    Numbers[y + 1] ← Numbers[y]
    y ← y - 1
  ENDWHILE
  Numbers[y + 1] ← MyValue
ENDFOR
```

9

02.1

Complete TABLE 1 by hand-tracing the algorithm in FIGURE 1. You may not need to use all the rows in TABLE 1

TABLE 1

x	MyValue	y	y > -1 ? (True/ False)	Numbers [y]	Numbers[y] < MyValue ? (True/ False)	Numbers		
						[0]	[1]	[2]
						43	17	85

Copy the contents of all the unshaded cells in TABLE 1 into your Electronic Answer Document. [4 marks]

0 2 . 2 What type of rearrangement does this algorithm perform? [1 mark]

[Turn over]

03 The algorithm, represented using pseudo-code, in **FIGURE 2** outputs a numeric result. The numeric result depends upon the value entered by the user.

FIGURE 2

```

OUTPUT "Enter a positive whole number: "
INPUT NumberIn
NumberOut ← 0
Count ← 0
WHILE NumberIn > 0
    Count ← Count + 1
    PartValue ← NumberIn MOD 2
    NumberIn ← NumberIn DIV 2
    FOR i ← 1 TO Count - 1
        PartValue ← PartValue * 10
    ENDFOR
    NumberOut ← NumberOut + PartValue
ENDWHILE
OUTPUT "The result is: " NumberOut

```

TABLE 2, on the opposite page, lists the MOD and DIV operators for each of the available programming languages. You should refer to the row for your programming language.

TABLE 2

Programming language	MOD	DIV
C#	%	/
Java	%	/
Pascal	mod	div
Python	%	//
VB.Net	Mod	\

WHAT YOU NEED TO DO:

TASK 1

Write a program to implement the algorithm in FIGURE 2.

TASK 2

Test that your program works:

- run your program, then enter the number 22
- run your program, then enter the number 29
- run your program, then enter the number -1

[Turn over]

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EVIDENCE THAT YOU NEED TO PROVIDE

Include the following evidence in your Electronic Answer Document.

03 . 1 Your **PROGRAM SOURCE CODE** for **TASK 1**.
[11 marks]

03 . 2 **SCREEN CAPTURE(S)** showing the test described in **TASK 2**. [1 mark]

03 . 3 What is the purpose of this algorithm?
[1 mark]

[Turn over]

SECTION B

You are advised to spend no more than 25 MINUTES on this section.

Enter your answers to SECTION B in your Electronic Answer Document. You MUST SAVE this document at regular intervals.

These questions refer to the PRELIMINARY MATERIAL and the SKELETON PROGRAM, but do NOT require any additional programming.

Refer EITHER to the PRELIMINARY MATERIAL issued with this question paper OR your electronic copy.

04 State the name of an identifier for:

04. **1** a variable that is used to store a Boolean value. [1 mark]

04. **2** a user-defined subroutine that returns a single Boolean value. [1 mark]

0 5

The Skeleton Program uses several data structures.

State the identifier of the data structure that stores values of more than one data type.
[1 mark]

0 6

What is the specific purpose of the exception handling construct in the subroutine `SetUpBoard`? [1 mark]

0 7

This question refers to the subroutines `Game` and `ListPossibleMoves`.

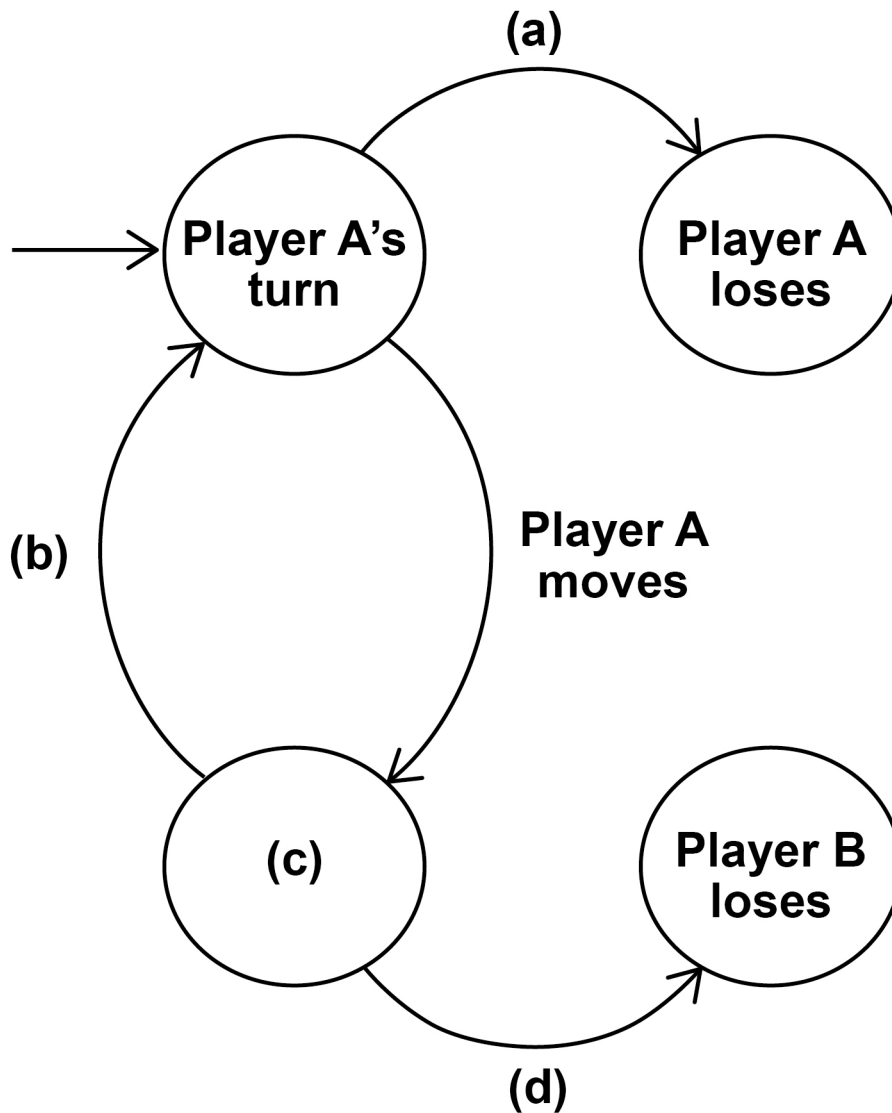
Describe what is contained in the parameter `PlayersPieces` when `ListPossibleMoves` is called for the first time in the subroutine `Game`. [1 mark]

[Turn over]

08

FIGURE 3 shows an incomplete state transition diagram for the AQA Board Game. With reference to the game rules complete TABLE 3, on the opposite page.

FIGURE 3



Complete TABLE 3 by filling in the unshaded cells with the correct description for FIGURE 3.

TABLE 3

Label	Description
(a)	
(b)	
(c)	
(d)	

Copy the contents of all the unshaded cells in TABLE 3 into your Electronic Answer Document. [2 marks]

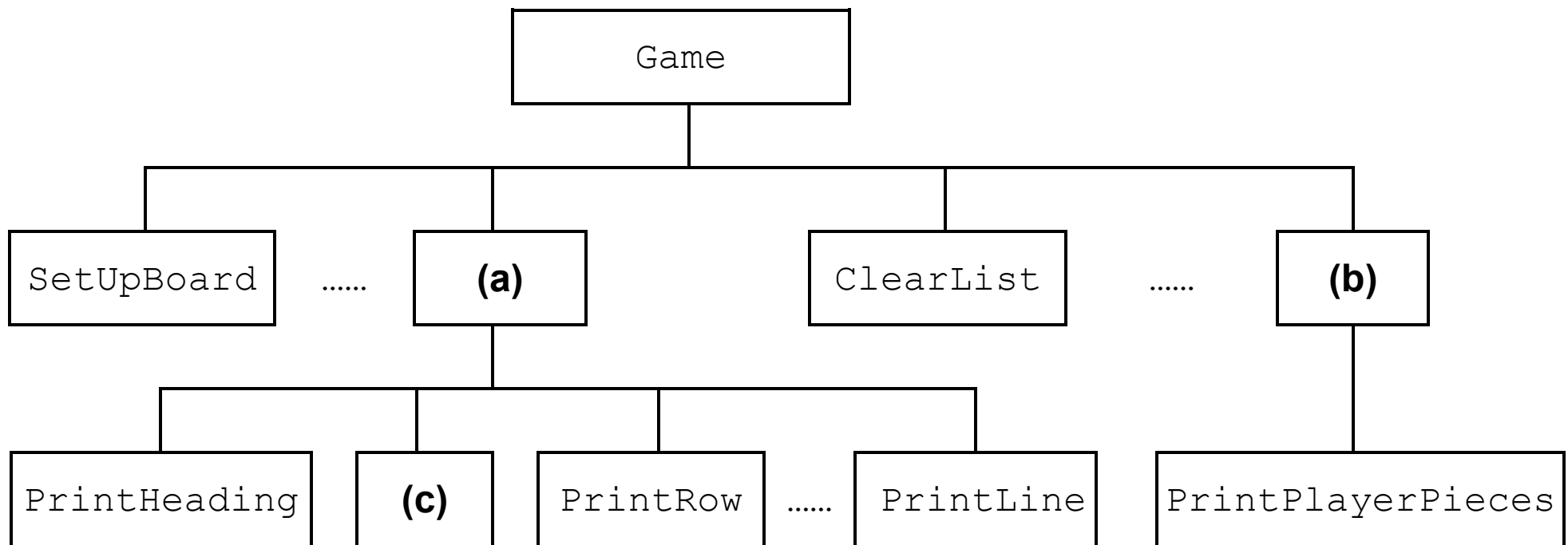
[Turn over]

09

FIGURE 4 shows an incomplete hierarchy chart for part of the SKELETON PROGRAM.

With reference to the SKELETON PROGRAM and FIGURE 4, answer questions 9.1 to 9.3.

FIGURE 4



0 9 . 1 What should be written in box (a) in FIGURE 4? [1 mark]

0 9 . 2 What should be written in box (b) in FIGURE 4? [1 mark]

0 9 . 3 What should be written in box (c) in FIGURE 4? [1 mark]

[Turn over]

- 1 0** This question refers to the data structure `A` defined in the `Game` subroutine.
- 1 0** . **1** Explain the purpose of each of the first two values stored in row 0 in this data structure. [2 marks]
- 1 0** . **2** Explain why there are 12 rows after row 0 in this data structure. [1 mark]
- 1 0** . **3** Explain the purpose of the values stored in these 12 rows. [2 marks]
- 1 1** This question refers to the subroutine `CreateNewBoard`.
Describe what the selection structure in this subroutine does. [3 marks]
- 1 2** This question refers to the subroutine `ListPossibleMoves`.
Explain the uses of the variable `NumberOfMoves`. [2 marks]

1	3
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This question refers to the subroutine
`SelectMove`.

Explain what happens in the first `WHILE` loop that terminates when a valid piece has been found. [5 marks]

[Turn over]

SECTION C

You are advised to spend no more than 60 MINUTES on this section.

Enter your answers to SECTION C in your Electronic Answer Document. You **MUST SAVE** this document at regular intervals.

These questions require you to load the **SKELETON PROGRAM** and to make programming changes to it.

1	4
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This question refers to the subroutine `SelectMove`. This subroutine makes three calls to the subroutine `DisplayErrorCode` to notify the user of errors. The error codes passed as parameters are to be made more informative for the user.

WHAT YOU NEED TO DO:

TASK 1

Modify the subroutine `DisplayErrorCode` so that meaningful error messages are displayed for each type of error explaining the circumstances which caused each error. The error code should also be displayed.

TASK 2

Test that the changes you have made work by conducting the following test:

- run the program
- enter Y
- load `game1.txt`
- enter the string `a4`
- enter the string `a9`
- enter 3
- enter 4
- enter a
- enter 9
- enter 3
- enter 0

EVIDENCE THAT YOU NEED TO PROVIDE

Include the following evidence in your Electronic Answer Document.

1 4 . 1 Your **PROGRAM SOURCE CODE** for the entire subroutine `DisplayErrorCode`. **[3 marks]**

1 4 . 2 **SCREEN CAPTURE(S)** showing the requested test including the list of possible moves for Player A. **[1 mark]**

[Turn over]

1	5
---	---

This question refers to the subroutine `ValidJump`. The rules of the game are to be amended. Instead of jumping over their own piece, a player can only jump over an opponent's piece.

WHAT YOU NEED TO DO:

TASK 1

Amend the subroutine `ValidJump` so that a jump is only possible if the middle piece belongs to the opponent.

TASK 2

Test that the changes you have made work by conducting the following test:

- run the program
- enter `Y`
- load `game3.txt`
- enter the string `a5`
- enter `5`
- enter `0`

EVIDENCE THAT YOU NEED TO PROVIDE

Include the following evidence in your Electronic Answer Document.

1 5 . 1 Your **PROGRAM SOURCE CODE** for the entire subroutine `ValidJump`. **[2 marks]**

1 5 . 2 **SCREEN CAPTURE(S)** showing the requested test including the list of possible moves **BEFORE** the jump and your test input, and then the board display **AFTER** the jump. **[1 mark]**

[Turn over]

1	6
---	---

This question refers to the subroutine `PrintResult`. The rules of the game are to be amended. The game still ends when a player cannot make a move, but the winner is to be determined using a formula that calculates a score for each player. The winner is the player with the **LOWEST** score. The formula to calculate the score is shown in **FIGURE 5**.

FIGURE 5

Player's score = Number of that player's moves MINUS total number of player's pieces on the board MINUS number of that player's dames MULTIPLIED BY 10

For example, if Player A made 40 moves and has 12 pieces on the board, and 3 of them are dames, then Player A's score is
 $40 - 12 - (3 \times 10) = -2$

Note that a dame is also considered to be a piece.

WHAT YOU NEED TO DO:

TASK 1

Create a new subroutine `CountNumberOfPieces`. This subroutine is to count the number of pieces a player has on the board.

TASK 2

Amend the subroutine `PrintResult` to implement the formula given in FIGURE 5 and output the score for each player and display the winner.

You must consider the possibility of a draw.

TASK 3

- **run the program**
- **enter `Y`**
- **load `game4.txt`**

EVIDENCE THAT YOU NEED TO PROVIDE

Include the following evidence in your Electronic Answer Document.

1 | 6 | . | 1 Your **PROGRAM SOURCE CODE** for the entire subroutine `CountNumberOfPieces` and the entire subroutine `PrintResult`. **[9 marks]**

1 | 6 | . | 2 **SCREEN CAPTURE(S)** showing all the output from the requested test including the board display. **[1 mark]**

[Turn over]

17

This question will further change the rules of the game.

When a piece is promoted to a dame, the player who the new dame belongs to now chooses ONE of the opponent's pieces. This piece is removed from the board and the dame is placed in the square the removed piece was in.

17**1**

State the identifier of the data structure that now needs to be passed as a parameter into the subroutine `MoveDame`. [1 mark]

WHAT YOU NEED TO DO:

TASK 1

Amend the subroutine `MoveDame`.

This subroutine is to:

- ask the player the piece ID of the opponent's piece they want to remove
- check that the piece is an opponent's piece and is on the board
- remove the opponent's piece
- return the coordinates for the new dame.

TASK 2

Amend the calls to `MoveDame` from within the subroutine `MovePiece`.

You will need to amend the parameter list of the subroutine heading of `MovePiece` and the call to `MovePiece` from within the subroutine `MakeMove`.

TASK 3

Test that the changes you have made work by conducting the following test:

- **run the program**
- **enter `Y`**
- **load `game3.txt`**
- **move `a2` to row 7, column 0**
- **take piece `b1`**

TASK 4

- **move `b5` to row 0, column 3**
- **take piece `a6`**

[Turn over]

EVIDENCE THAT YOU NEED TO PROVIDE

Include the following evidence in your Electronic Answer Document.

- 17 . 2** Your **PROGRAM SOURCE CODE** for the entire subroutine `MoveDame` and the entire subroutine `MakeMove`. **[9 marks]**
- 17 . 3** **SCREEN CAPTURE(S)** showing the requested test including the board display after piece `b1` has been taken. **[1 mark]**
- 17 . 4** **SCREEN CAPTURE(S)** showing the requested test including the board display after piece `a6` has been taken. **[1 mark]**

END OF QUESTIONS

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