

1. Nov/2021//Paper\_31/No.10

(a) State **three** essential features of **recursion**.

1 .....

2 .....

3 .....

[3]

(b) Explain the reasons why a stack is a suitable Abstract Data Type (ADT) to implement recursion.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

[3]

(c) Identify **two** ADTs other than a stack.

1 .....

2 .....

[2]

(a) State **two** factors that may affect the performance of a sorting algorithm.

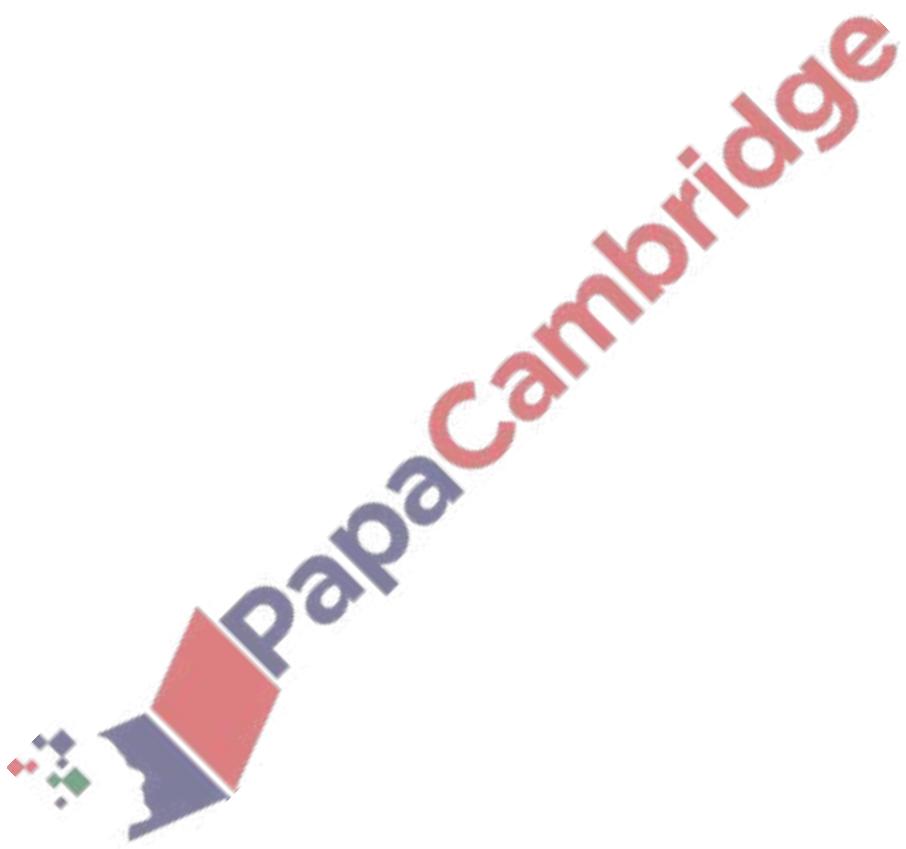
.....

.....

.....

.....

[2]



(b) The given algorithm is a simple bubble sort that arranges a set of scores stored in a one-dimensional array into **descending** order, and orders the corresponding students' names stored into a two-dimensional array in the same order as the scores. All the arrays are indexed from 1.

The contents of both arrays after sorting are shown.

Score	
1	98
2	97
...	
248	5
249	3

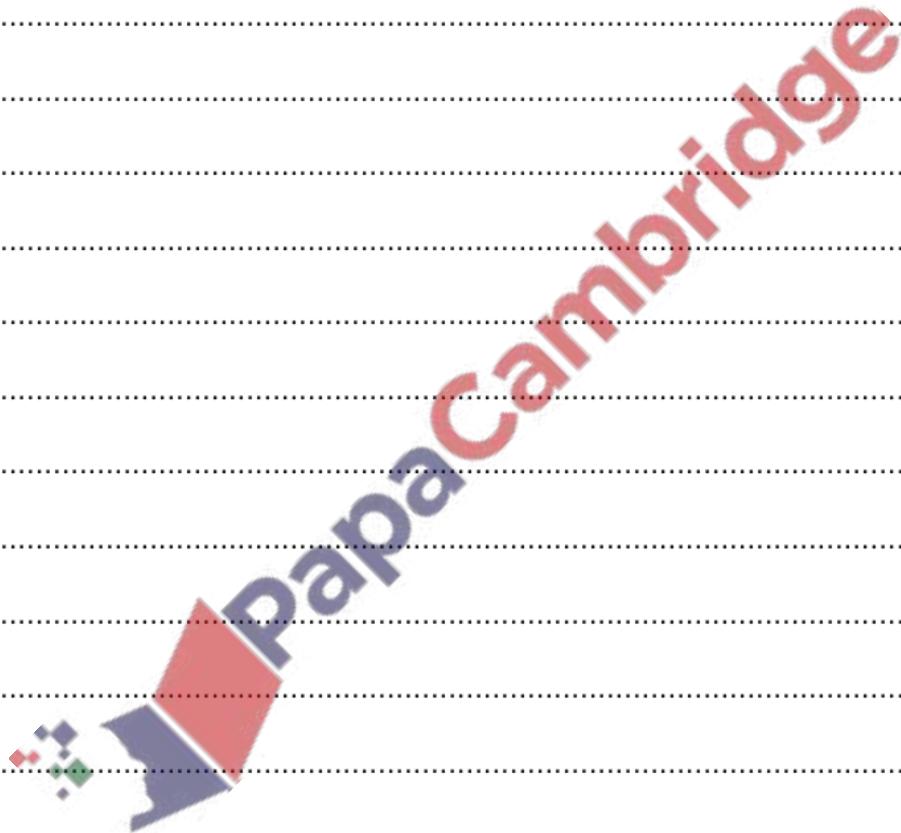
Name	
1	2
Smithfield	Tom
Johnson	Jane
...	
Peters	Jade
Allen	John

```

YearSize ← 249
Flag ← TRUE
WHILE Flag = TRUE
    Flag ← FALSE
    FOR Student ← 1 TO YearSize - 1
        IF Score[Student] < Score[Student + 1] THEN
            Temp1 ← Score[Student]
            Temp2 ← Name[Student,1]
            Temp3 ← Name[Student,2]
            Score[Student] ← Score[Student + 1]
            Name[Student,1] ← Name[Student + 1,1]
            Name[Student,2] ← Name[Student + 1,2]
            Score[Student + 1] ← Temp1
            Name[Student + 1,1] ← Temp2
            Name[Student + 1,2] ← Temp3
            Flag ← TRUE
        ENDIF
    NEXT Student
ENDWHILE

```

Write an algorithm, using pseudocode, that will perform the same task using an insertion sort.



[6]

(d) The function `StackFull()` checks whether a stack is full.

The function uses the variable `TopOfStack` to represent the pointer to the most recent position used on the stack, and the variable `Max` to represent the maximum size of the stack. Assume `TopOfStack` and `Max` are global variables.

```
FUNCTION StackFull() RETURNS BOOLEAN
  IF TopOfStack = Max THEN
    RETURN TRUE
  ELSE
    RETURN FALSE
  ENDIF
ENDFUNCTION
```

An algorithm `AddInteger` is required to add a new integer data element to a stack.

The stack is implemented as an array `ArrayStack`.

The function AddInteger() calls StackFull() and returns an appropriate message.

Complete the pseudocode for the function `AddInteger()`.

FUNCTION AddInteger(NewInteger : INTEGER) RETURNS STRING

The logo for Papa's is displayed on a white background. The word "Papa's" is written in a bold, sans-serif font, with the 'P' in red and the 'a's in blue. The letters are slightly slanted and overlap each other. At the tip of the pencil, there is a small cluster of colored dots in red, green, and blue.

ENDFUNCTION

[5]