Algorithms and sorting

AS Decision Mathematics 1 | Edexcel 8FM0 | 12 questions, 66 marks

Further Maths topic practice

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Name: _____ **Date:** _____ **Score:** _____ **/ 66**

1 Use a bubble sort, starting at the left-hand end of the list, to sort these numbers into ascending order.

34 18 52 27 41 9 30

You should show the state of the list after each pass.

(4 marks)

Answer _____

2 A bubble sort is an algorithm of quadratic order. A laptop takes 0.8 seconds to bubble sort a list of 400 names.

a. Estimate the time it would take to bubble sort a list of 2000 names.

A different algorithm has cubic order. It takes 1.2 seconds when the input has size 50.

b. Estimate the time it would take when the input has size 200.

(4 marks)

Answer _____

3 Use the Euclidean algorithm to find the highest common factor of 4199 and 1547. Show each step of your working.

(3 marks)

Answer _____

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4 Use a quick sort to sort the list below into ascending order. You should show the result of each pass and identify your pivots clearly.

47 12 85 33 60 21 74 9 56 38

(4 marks)

Answer _____

5 The names of nine members of a chess club are listed below.

Priya Callum Zara Mohammed Erin Tomasz Hannah Kofi Beth

Use a quick sort to put the names into alphabetical order. You should show the result of each pass and identify your pivots clearly.

(4 marks)

Answer _____

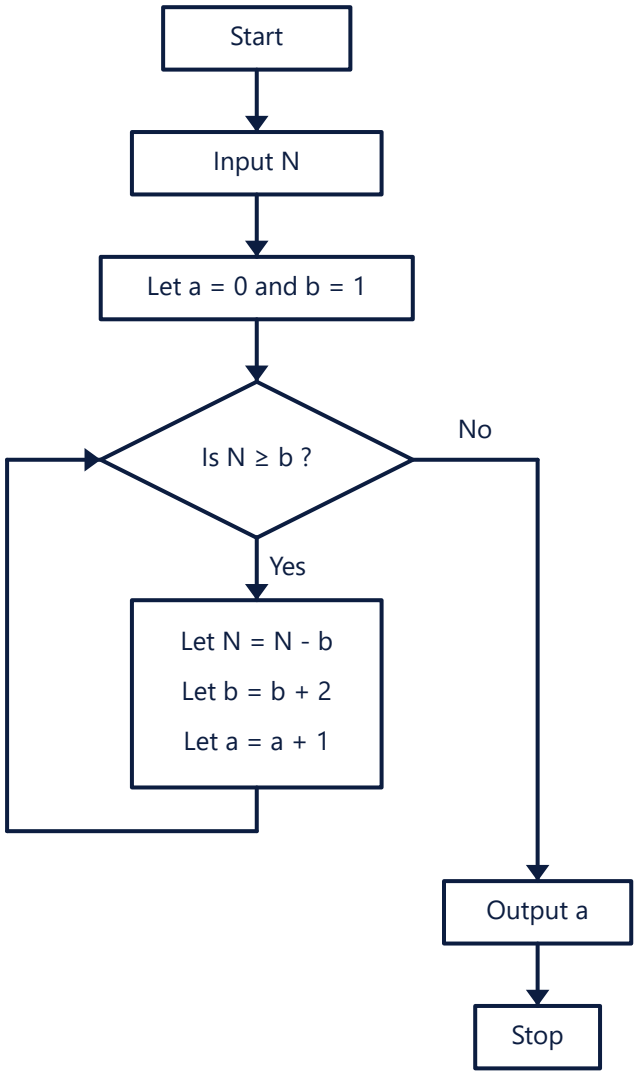
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6 The flow chart describes an algorithm.

a. Trace the algorithm with input $N = 40$, recording the values of N, a and b each time round the loop. State the output.

b. Write down the output when the input is $N = 90$

c. State what the algorithm finds.



(6 marks)

Answer _____

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7 The list below is to be sorted into descending order using a bubble sort, starting at the left-hand end of the list.

15 42 8 27 33 19

a. Carry out the bubble sort, showing the list after each pass.

b. Find the total number of comparisons and the total number of swaps made.

c. Find, in terms of n, the maximum number of comparisons needed to bubble sort a list of n numbers.

(7 marks)

Answer

8 On average a quick sort has order n log n. A computer takes 0.36 seconds to quick sort a list of 1000 numbers.

a. Estimate how long it would take to quick sort a list of 8000 numbers.

An algorithm of cubic order takes 0.05 seconds for an input of size 20.

b. Find the largest input size that the computer can process with this algorithm in one minute.

(5 marks)

Answer

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9 An algorithm is shown below. INT(x) means the integer part of x.

Step 1 Input a positive integer N
Step 2 Let $P = 1$ and $B = 0$
Step 3 Let R be the remainder when N is divided by 2
Step 4 Let $B = B + R \times P$
Step 5 Let $N = \text{INT}(N \div 2)$
Step 6 Let $P = 10P$
Step 7 If $N > 0$ go to Step 3
Step 8 Output B
Step 9 Stop

a. Trace the algorithm for $N = 45$, showing the values of R, B, N and P each time Step 6 is completed. State the output.

b. Explain what the algorithm does.

c. Find how many times Step 3 is carried out when $N = 1000$

(6 marks)

Answer _____

10 The six distinct integers 24, x, 17, 31, 12, 28 are to be sorted into ascending order using a bubble sort, starting at the left-hand end of the list.

After the first pass the list is 24 17 x 12 28 31

a. Explain why $24 < x < 31$

After the second pass the list is 17 24 12 28 x 31

b. Find the possible values of x.

c. Taking the smaller value of x, complete the sort, showing the list after each further pass.

(6 marks)

Answer _____

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11 The list below is to be sorted into descending order.

63 18 45 92 27 71 54 36

a. Use a quick sort to sort the list. You should show the result of each pass and identify your pivots clearly.

b. Find the total number of comparisons made in your quick sort.

c. A bubble sort, starting at the left-hand end, is used on the original list instead. Find the number of passes and the total number of comparisons it makes, and state which method was quicker for this list.

(8 marks)

Answer

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12 An algorithm is shown below.

Step 1 Input a positive integer n
Step 2 Let $i = 1$ and $T = 0$
Step 3 Let $j = i$
Step 4 Let $T = T + j$
Step 5 Let $j = j + 1$
Step 6 If $j \leq n$ go to Step 4
Step 7 Let $i = i + 1$
Step 8 If $i \leq n$ go to Step 3
Step 9 Output T
Step 10 Stop

a. Trace the algorithm with $n = 3$, showing the values of i, j and T each time Step 4 is completed. State the output.

b. Explain why the output is $1^2 + 2^2 + \ldots + n^2$ and hence write down the output in terms of n.

c. Show that Step 4 is carried out $\frac{1}{2}n(n + 1)$ times and state the order of the algorithm.

d. The algorithm takes 0.004 seconds when $n = 500$. Estimate the time it takes when $n = 3000$

(9 marks)

Answer _____

End of questions | Total 66 marks

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