Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

AS and A level Further Mathematics
Decision Mathematics 1

Practice Paper
Algorithms

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 9 questions in this question paper. The total mark for this paper is 95.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1.

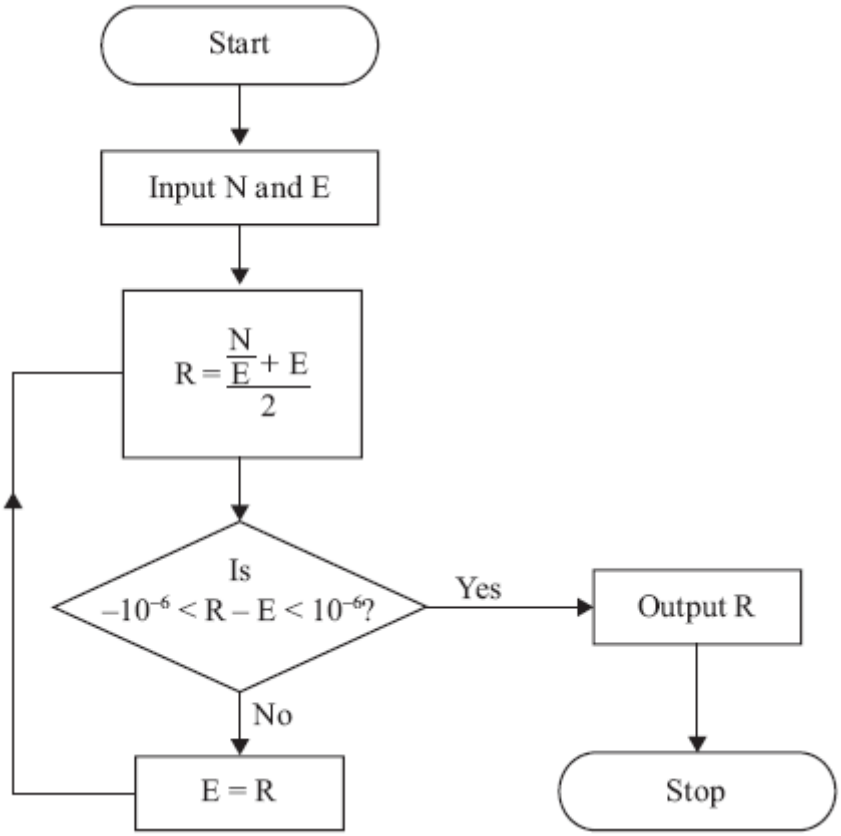

Figure 1

Hero's algorithm for finding a square root is described by the flow chart shown in Figure 1.

Given that N = 72 and E = 8,

(*a*) use the flow chart to complete the table in the answer book, working to at least seven decimal places when necessary. Give the final output correct to seven decimal places.

(4)

The flow chart is used with N = 72 and E = – 8,

(*b*) describe how this would affect the output.

(1)

(*c*) State the value of E which cannot be used when using this flow chart.

(1)

(Total 6 marks)

2.

31 10 38 45 19 47 35 28 12

(*a*) Use the first-fit bin packing algorithm to determine how the numbers listed above can be packed into bins of size 60.

(3)

(*b*) Carry out a quick sort to produce a list of the numbers in **descending** order. You should show the result of each pass and identify your pivots clearly.

(4)

(*c*) Use the first-fit decreasing bin packing algorithm to determine how the numbers listed can be packed into bins of size 60.

(2)

(*d*) Determine whether the number of bins used in (*c*) is optimal. Give a reason for your answer.

(2)

(Total 11 marks)

3.

0.6 1.5 1.6 0.2 0.4 0.5 0.7 0.1 0.9 0.3

(*a*) Use the first-fit bin packing algorithm to determine how the numbers listed above can be packed into bins of size 2.

(3)

(*b*) The list of numbers is to be sorted into **descending order**. Use a quick sort to obtain the sorted list. You must make your pivots clear.

(4)

(*c*) Apply the first-fit decreasing bin packing algorithm to your ordered list to pack the numbers into bins of size 2.

(3)

(*d*) Determine whether your answer to part (*c*) uses the minimum number of bins. You must justify your answer.

(1)

(Total 11 marks)

4.

23 29 11 34 10 14 35 17

The numbers represent the sizes, in megabytes (MB), of eight files.

The files are to be stored on 50 MB discs.

(*a*) Calculate a lower bound for the number of discs needed to store all eight files.

(2)

(*b*) Use the first-fit bin packing algorithm to fit the files onto the discs.

(3)

(*c*) Perform a bubble sort on the numbers in the list to sort them into descending order. You need only write down the final result of each pass.

(4)

(*d*) Use the first-fit decreasing bin packing algorithm to fit the files onto the discs.

(3)

(Total 12 marks)

5.

42 21 15 16 35 10 31 11 27 39

(*a*) Use the first-fit bin packing algorithm to determine how the numbers listed above can be packed into bins of size 65.

(3)

(*b*) The list of numbers is to be sorted into descending order. Use a quick sort to obtain the sorted list. You should show the result of each pass and identify your pivots clearly.

(4)

(*c*) Use the first-fit decreasing bin packing algorithm on your ordered list to pack the numbers into bins of size 65.

(3)

The nine distinct numbers below are to be sorted into descending order

23 14 17 $\boldsymbol{x}$ 21 18 8 20 11

A bubble sort, starting at the left-hand end of the list, is to be used to obtain the sorted list. After the first complete pass, the list is

23 17 $\boldsymbol{x}$ 21 18 14 20 11 8

After the second complete pass, the list is

23 17 21 18 $\boldsymbol{x}$ 20 14 11 8

(*d*) Using this information, write down the smallest interval that must contain x. Give your answer as an inequality.

(3)

(Total 13 marks)

6.

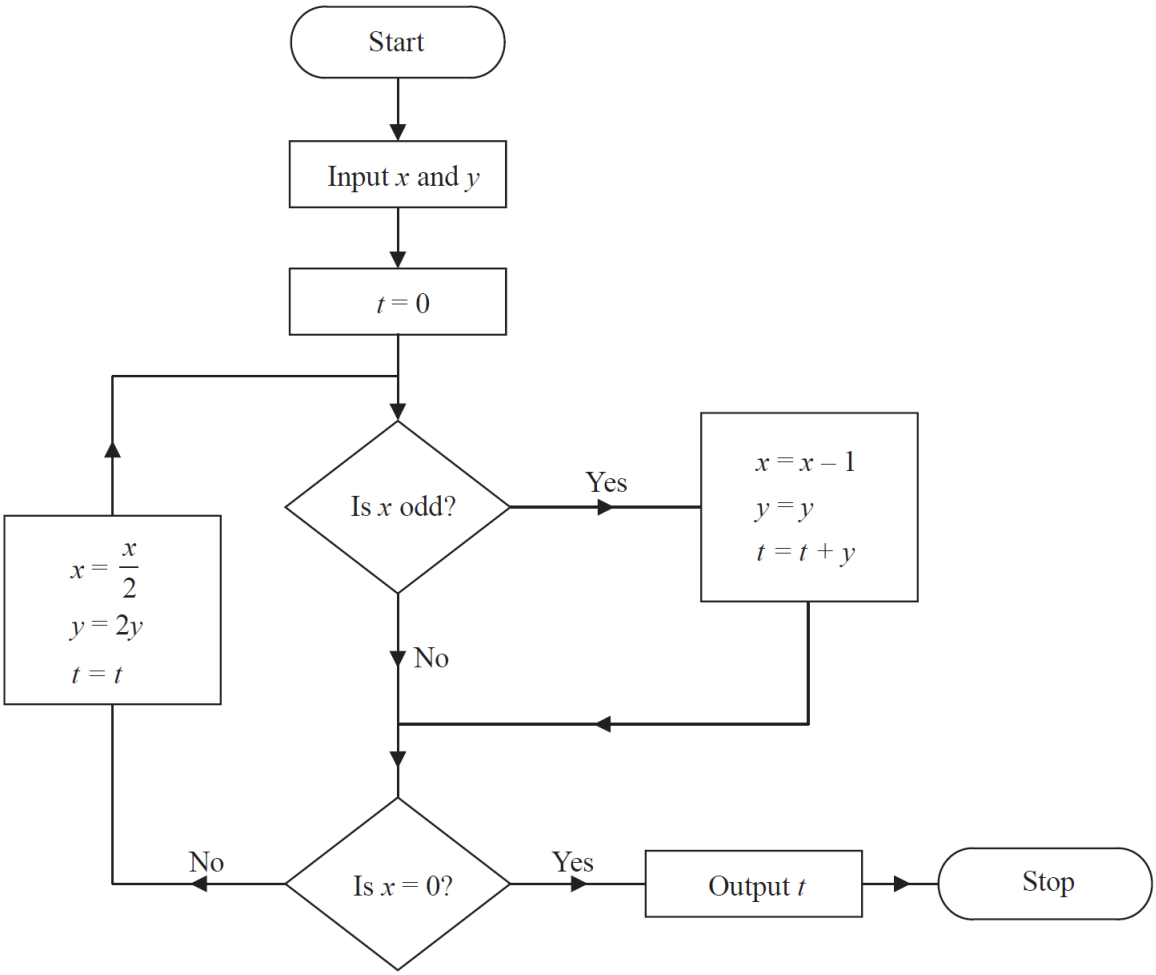

Figure 4

An algorithm is described by the flow chart shown in Figure 4.

Given that $x = 27$ and $y = 5$,

(a) complete the table in the answer book to show the results obtained at each step when the algorithm is applied. Give the final output.

(4)

The numbers 122 and $\frac{1}{2}$ are to be used as inputs for the algorithm described by the flow chart.

(b) (i) State, giving a reason, which number should be input as x.

(ii) State the output.

(3)

(Total 7 marks)

7.

59 45 18 55 47 11 63 17 15 42

(*a*) The list of numbers above is to be sorted into descending order. Perform a quick sort to obtain the sorted list. You should show the result of each pass and identify your pivots clearly.

(4)

The numbers in the list represent the lengths, in cm, of some pieces of copper wire. The copper wire is sold in one metre lengths.

(*b*) Use the first-fit decreasing bin packing algorithm to determine how these pieces could be cut from one metre lengths. (You should ignore wastage due to cutting.)

(3)

(*c*) Determine whether your solution to (*b*) is optimal. Give a reason for your answer.

(2)

(Total 9 marks)

8.

5 1 8 13 16 5 8 2 15 12 10

(*a*) Use the first-fit bin packing algorithm to determine how the numbers listed above can be packed into bins of size 20.

(3)

(*b*) The list of numbers is to be sorted into **descending** order. Use a bubble sort to obtain the sorted list, giving the state of the list after each **complete** pass.

(5)

(*c*) Apply the first-fit decreasing bin packing algorithm to your ordered list to pack the numbers into bins of size 20.

(3)

(*d*) Determine whether your answer to (*c*) uses the minimum number of bins. You must justify your answer.

(2)

(Total 13 marks)

9.

24 14 8 x 19 25 6 17 9

The numbers in the list represent the exact weights, in kilograms, of 9 suitcases. One suitcase is weighed inaccurately and the only information known about the unknown weight, x kg, of this suitcase is that $19 < x \leq 23$. The suitcases are to be transported in containers that can hold a maximum of 50 kilograms.

(*a*) Use the first-fit bin packing algorithm, on the list provided, to allocate the suitcases to containers.

(3)

(*b*) Using the list provided, carry out a quick sort to produce a list of the weights in **descending** order. Show the result of each pass and identify your pivots clearly.

(4)

(*c*) Apply the first-fit decreasing bin packing algorithm to the ordered list to determine the 2 possible allocations of suitcases to containers.

(4)

After the first-fit decreasing bin packing algorithm has been applied to the ordered list, one of the containers is full.

(*d*) Calculate the possible integer values of x. You must show your working.

(2)

(Total 13 marks)

TOTAL FOR PAPER: 95 MARKS