Pearson Edexcel International Advanced Level

Thursday 14 May 2026

Morning (Time: 1 hour 30 minutes)

Paper reference **WDM11/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Decision Mathematics D1

You must have:
Decision Mathematics Answer Book (enclosed), calculator

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of the answer book with your name, centre number and candidate number.
- Do not return the question paper with the answer book.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the D1 answer book 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

- There are 8 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

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.

Turn over ▶

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P 7 9 4 7 8 A

Pearson

Write your answers in the D1 answer book for this paper.

1.

24 16 34 21 38 12 31 5 9 14 23

The eleven numbers above are to be packed into bins of size 60

(a) Calculate a lower bound for the minimum number of bins required.

(2)

(b) Use the first-fit bin packing algorithm to pack the numbers into bins of size 60

(3)

(c) Use bubble sort to sort the list of numbers into descending order, showing the result after each pass.

(4)

(d) Use the first-fit decreasing bin packing algorithm to pack the numbers into bins of size 60

(2)

(Total for Question 1 is 11 marks)

2.

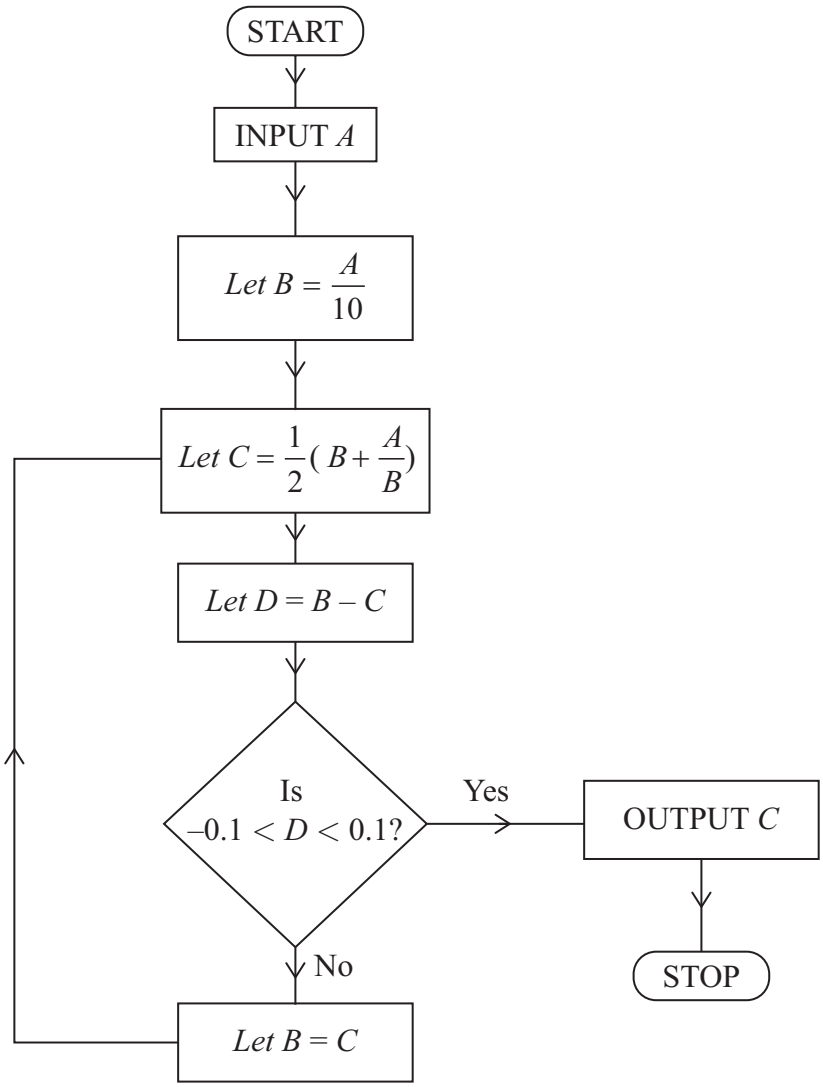

Figure 1

The flowchart for an algorithm is shown above.

The input for the algorithm is a positive number.

(a) Apply the algorithm using $A = 1250$. You must complete the table in the answer book, showing the results at each step of the algorithm. Give your values to 3 decimal places where necessary.

(4)

(b) State how the output, C, relates to the input, A

(1)

(Total for Question 2 is 5 marks)

3.

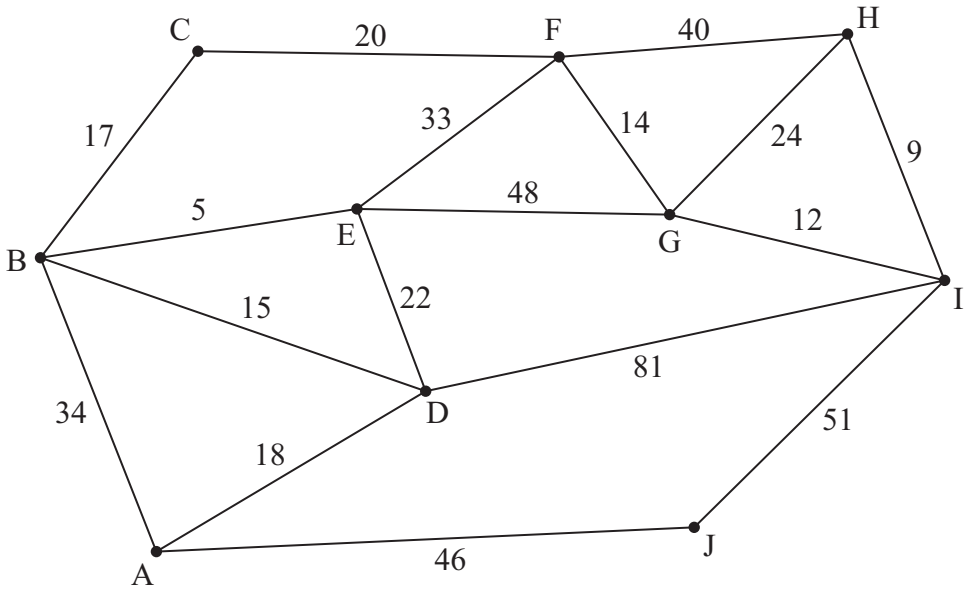

Figure 2

[*The total length of the network is 489*]

Figure 2 represents a network of cycle paths between ten locations, A, B, C. D, E, F, G, H, I and J. The number on each arc is the time, in minutes, to cycle between the corresponding locations.

(a) State, with a reason, whether the network is Eulerian, semi-Eulerian or neither.

(1)

(b) (i) Use Dijkstra's algorithm to determine the shortest time to cycle from A to H

(ii) State the quickest cycle route from A to H

(6)

The paths from A to B, A to J and B to C become blocked and cannot be used.

(c) Determine the increase in the shortest time to cycle from A to H. You must justify your answer.

(2)

(Total for Question 3 is 9 marks)

4.

	A	B	C	D	E	F	G	H
A	–	34	42	29	36	43	28	$6x + 7$
B	34	–	27	40	28	51	43	$8x - 2$
C	42	27	–	31	41	37	32	46
D	29	40	31	–	25	34	43	39
E	36	28	41	25	–	30	38	52
F	43	51	37	34	30	–	31	48
G	28	43	32	43	38	31	–	34
H	$6x + 7$	$8x - 2$	46	39	52	48	34	–

The table shows the shortest distances, in miles, between eight towns, A, B, C, D, E, F, G and H, where x is an unknown positive integer.

Raphael wants to visit all eight towns and needs to find a route that minimises the total distance travelled returning to the starting point.

An initial upper bound for the length of Raphael's route, obtained using the nearest neighbour algorithm starting at H, is 256 miles. This nearest neighbour route starts with arc **HG**.

(a) Use the nearest neighbour algorithm starting at A, to obtain an expression for a second upper bound for the length of Raphael's route. You must state the route and its length in terms of x.

(3)

Given that the upper bound obtained by starting at A is better than the initial upper bound,

(b) use the answer to part (a) to calculate the value of x

(3)

(c) By deleting A and all its arcs, obtain a lower bound for the length of Raphael's route.

(3)

(d) Write down the smallest interval that must contain the length of Raphael's route.

(1)

(Total for Question 4 is 10 marks)

5.

Activity	Immediately preceding activities
A	–
B	–
C	A
D	A
E	A, B
F	A, B
G	C, D
H	E
I	E
J	F, G, H, I
K	F, I
L	K

(a) Draw the activity network described in the precedence table, using activity on arc and the minimum number of dummies.

(5)

(b) Given that all activities have the same duration, state the critical activities.

(1)

(Total for Question 5 is 6 marks)

6. A clock manufacturer makes two sizes of clock, small and large. The profit on a small clock is £8 and the profit on a large clock is £18. The manufacturer wants to maximise the total profit on the clocks and formulates this as a linear programming problem, including two constraints which are already known.

Let x represent the number of small clocks.

Let y represent the number of large clocks.

$$\text{Maximise} \quad P = 8x + 18y$$

$$\text{subject to} \quad 3y \geqslant x$$
$$y \leqslant 4x$$

The manufacturer also knows that

- the total number of clocks made must be at most 34
- small clocks take 12 minutes to assemble
- large clocks take 30 minutes to assemble
- there is a maximum of 12 hours available to assemble the clocks

(a) Formulate this information as additional constraints written as inequalities, with fully simplified integer coefficients.

(3)

(b) Represent these additional constraints on the graph in the answer book. Hence determine, and label, the feasible region, R

(2)

(c) Use the objective line method to determine the optimal number of each type of clock to be made.

(3)

(d) Hence determine how much available assembly time is not used.

(1)

(Total for Question 6 is 9 marks)

7.

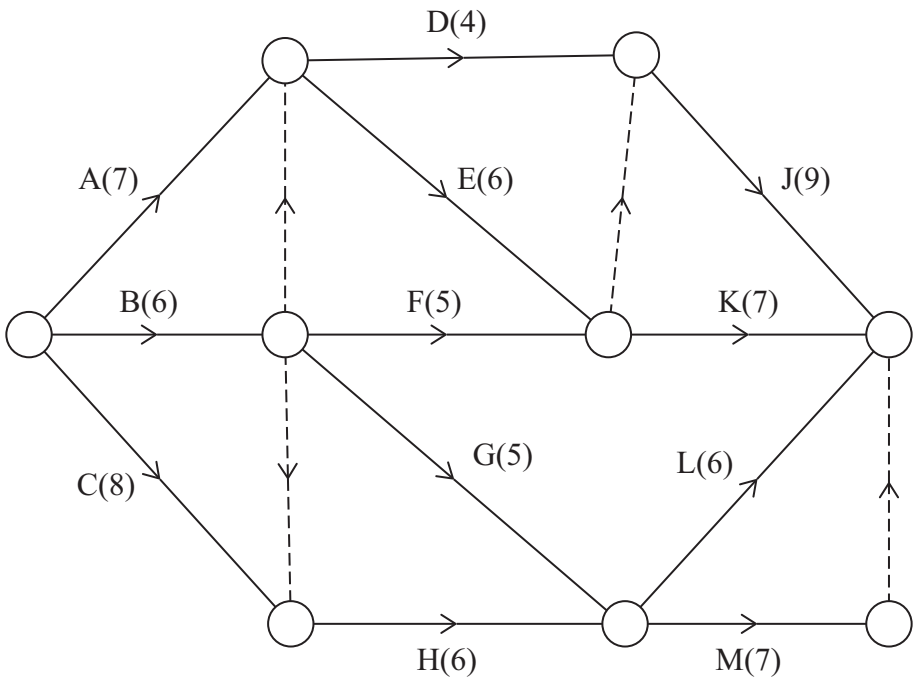

Figure 3

A project is modelled by the activity network shown in Figure 3. The activities are represented by the arcs. The number in brackets on each arc gives the time, in days, to complete the activity. Each activity requires exactly one worker. The project is to be completed in the shortest possible time.

(a) Complete the diagram in the answer book to show the early event times and the late event times.

(4)

(b) Calculate the total float for activity M

(1)

(c) Calculate a lower bound for the minimum number of workers required to complete the project in the minimum time.

(2)

(d) Draw a Gantt (cascade) chart on the grid in the answer book.

(4)

(e) Use the Gantt chart to determine the minimum number of workers required to complete the project in the minimum time. You must make specific reference to the number of workers, activities and times.

(2)

The start of activity H is now delayed by 3 days.

(f) Determine what effect this has on the completion time for the project, justifying your answer.

(2)

(Total for Question 7 is 15 marks)

8.

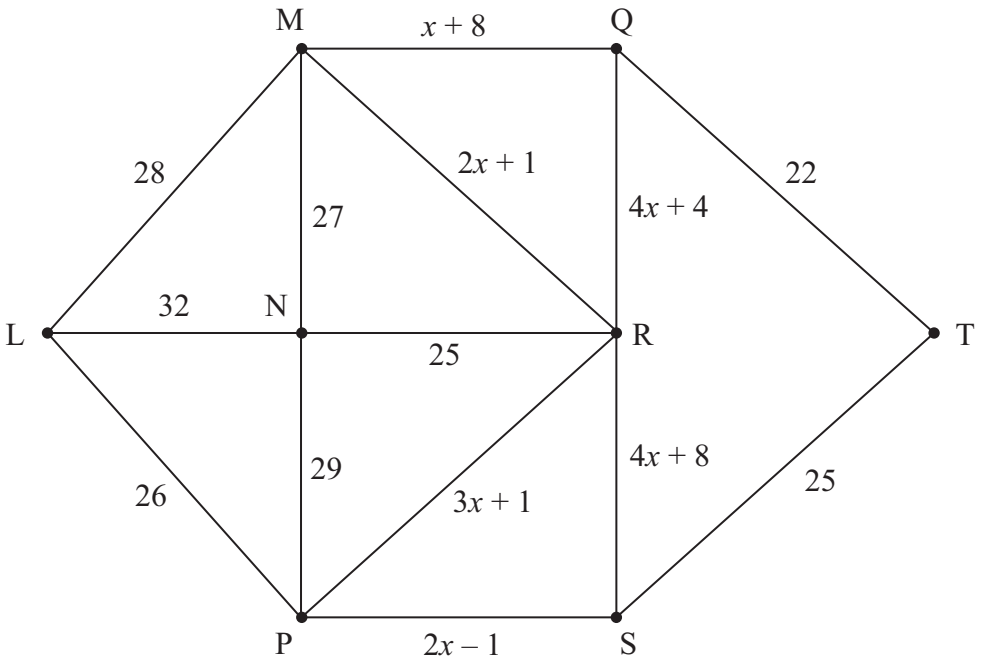

Figure 4

[*The total length of the network is 16x + 235*]

Figure 4 shows a network of cables between eight computer stations, L, M, N, P, Q, R, S and T. The number on each arc is the distance, in metres, between the corresponding nodes, where x is an unknown value less than 12

(a) State whether LMNPRST is an example of a path, giving reasons for your answer.

(2)

An engineer must check every cable for damage. She must find a route of minimum length, which travels along every cable at least once, **starting** at **L** and **finishing** at **T**.

Given that each of the two possible routes repeats exactly 3 arcs,

(b) determine the range of possible values of x

(5)

Given that the two possible routes have the same length,

(c) calculate the length of the route, justifying your answer.

(3)

(Total for Question 8 is 10 marks)

TOTAL FOR PAPER IS 75 MARKS

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