

Edexcel IAL D1 Decision Mathematics 1 Practice Exam

Pearson Edexcel International A Level Mathematics · 14 questions · 59 marks

Name _____

Date _____

Score / 59

- Answer every question. Show your working: most marks are for method.
- Calculator allowed.
- Topics: Graphs and networks; Route inspection; Algorithms and flowcharts; Sorting algorithms; Bin-packing algorithms; Minimum spanning trees; Dijkstra's shortest path; Linear programming; Critical path analysis.
- The mark scheme is a separate free PDF: alevelmathrevision.com/alevel-frontend/downloads/practice-exams/ial/edexcel-ial-d1-decision-mathematics-1-practice-exam-mark-scheme.pdf

1. A graph has five vertices with degrees 3, 3, 2, 4 and 2. Find the number of edges in the graph. [2]

2. A graph has vertices A, B, C, D, E, F and edges $AB, AD, AE, BC, BE, CD, CF, DF, EF$. Find a Hamiltonian cycle in the graph, starting and finishing at A . [2]

3. A network has arcs AB (8), AC (6), BC (5), BD (9), CD (7), DE (4), CE (10). A route must traverse every arc at least once. It may start and finish at any vertices. [3]

1. State the vertices at which the route should start and finish, giving a reason. [1]
2. Find the length of the shortest such route. [2]

4. An algorithm converts a positive integer n to binary. [4]

Step 1: Divide n by 2, write down the remainder, and replace n by the whole-number part of the quotient.

Step 2: If $n = 0$, go to Step 3; otherwise go to Step 1.

Step 3: Output the remainders in reverse order.

Apply the algorithm to $n = 45$.



5. A list of 8 distinct numbers is written in descending order and is then sorted into ascending order using a bubble sort. [4]
1. Find the number of comparisons made. [2]
 2. Find the number of swaps made, explaining your answer. [2]
6. Eight items have sizes 9, 6, 8, 7, 5, 10, 4, 11. Use full-bin packing to pack them into bins of capacity 15 [4], and explain why your packing is optimal.
7. The distance matrix of a network with vertices A, B, C, D, E has rows $A: -8 \ 5 \ 9 \ 12$; $B: 8 \ -7 \ 4 \ 10$; $C: 5 \ 7 \ -6 \ 11$; $D: 9 \ 4 \ 6 \ -3$; $E: 12 \ 10 \ 11 \ 3$ -. Use Prim's algorithm, starting at A , to find a minimum spanning tree. State the order in which the vertices join the tree and its total weight. [4]
8. A directed network has arcs (each directed from the first letter to the second) $SA \ (5)$, $SB \ (9)$, $AB \ (3)$, $AC \ (11)$, $BD \ (4)$, $CB \ (2)$, $DC \ (1)$, $CT \ (6)$, $DT \ (10)$. Use Dijkstra's algorithm to find the shortest route from S to T . [4]
9. A garden centre plants x rose bushes and y shrubs in a bed. It must plant at least 30 plants in total, at most 50 shrubs, and the number of rose bushes must be at least 20% of the total number of plants. [4]
Write each condition as an inequality in its simplest form with integer coefficients.



- 10.** For the project A (3); B (5); C (2); D (4, after A); E (6, after A and B); F (3, after C); G (5, after D and E); H (4, after E and F); I (2, after G and H) (durations in hours, minimum duration 18 hours): [5]
1. find the total float of each non-critical activity, [3]
 2. state, with a reason, the effect on the project of a delay of 3 hours to activity *D*, and of a delay of 3 hours to activity *H*. [2]
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- 11.** An algorithm is given below. [5]
- Step 1: Input positive integers *A* and *B*. Let $C = 0$.
- Step 2: If *B* is odd, replace *C* by $C + A$.
- Step 3: Replace *A* by $2A$ and *B* by the whole-number part of $\frac{B}{2}$.
- Step 4: If $B > 0$, go to Step 2.
- Step 5: Output *C*.
- Trace the algorithm with $A = 13$ and $B = 11$, and state what the algorithm does.
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- 12.** A network has arcs SA (6), SB (4), SC (9), AB (1), AD (7), BC (3), BE (10), CE (5), DE (2), DT (8), ET (6). [5]
1. Use Dijkstra's algorithm to find the final values of all the vertices, starting from *S*. [3]
 2. Find the shortest route from *S* to *T*. [1]
 3. Explain how the route is found from the final values. [1]
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- 13.** The items 7, 3, 8, 5, 6, 2, 9, 4, 1, 5 are to be packed into bins of capacity 10. [6]
1. Use full-bin packing to pack the items, and explain why the packing is optimal. [3]
 2. Use the first-fit decreasing algorithm to pack the items. [3]



14. A building job has activities A (6); B (4); C (5, after A); D (3, after A and B); E (7, after B); F (4, after C and D); G (2, after E); H (5, after F and G) (durations in days), with minimum completion time 20 days and critical path $A - C - F - H$. The duration of activity C is reduced to 3 days. [7]
1. Find the new minimum completion time. [3]
 2. Show that every activity is now critical. [3]
 3. Explain why reducing C further would not shorten the job. [1]

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