**GCE AS Further Mathematics (8FM0) – Paper 27**

**Decision Mathematics 1**

**Summer 2019 student-friendly mark scheme**

**Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide to good practice, indicating where marks are given for correct answers. As such, it doesn’t show follow-through marks (marks that are awarded despite errors being made) or special cases.**

**It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme.**

**This document is intended for guidance only and may differ significantly from the final mark scheme published in July 2019.**

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| **Guidance on the use of codes within this document** |
| M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.  A1 – accuracy mark. This mark is generally given for a correct answer following correct working.  B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.  Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer). |

**Question 1 (Total 6 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) |  | B1 | This mark is given for a correct graph for K5 drawn |
| (b)(i) | A semi-Eulerian graph contains exactly two nodes of odd order (and any number of nodes of even order) | B1 | This mark is given for a correct explanation which mentions both ‘exactly tow nodes’ and ‘odd order’ |
| (b)(ii) | For example: | B1 | This mark is given for one correct semi-Eulerian subgraph of K5 drawn |
| B1 | This mark is given for a second correct semi-Eulerian subgraph of K5 drawn |
| (c) | A graph with five vertices has  = 6 arcs  but a tree with five nodes would only contain 4 arcs | B1 | This mark is given for deducing the graph has 6 arcs |
| B1 | This mark is given for an explanation that a tree with five modes would only contain 4 arcs |

**Question 2 (Total 7 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a)(i) | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | A | B | N | H | C | D | E | F | | 1 | 3 | 4 | 0.5 | 0.25 | 0 |  |  | |  |  |  |  |  | 82 | 1 |  | |  |  |  |  |  |  | 1.5 |  | |  |  |  |  |  | 92.125 | 2 |  | |  |  |  |  |  | 124.125 | 2.5 |  | |  |  |  |  |  | 202.25 | 3 | 50.5625 | | M1 | This mark is given for at least three rows of cells completed in columns D and E, with a correct first row |
| A1 | This mark is given for the second, third and fourth rows correct |
| A1 | This mark is given for the fifth and sixth rows correct |
| (a)(ii) | Final output = 50.5625 | A1 | This mark is given for the final output stated correctly |
| (b) | = 48.4 | B1 | This mark is given for a correctly evaluated integral |
| × 100 | M1 | This mark is given for a method to find the percentage error |
| 4.47% | A1 | This mark is given for the correct percentage error (to three significant figures) |

**Question 3 (Total 7 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) |  | | |
|  | M1 | This mark is given for at least nine activities (labelled on arc), one start and at least two dummies placed |
| A1 | This mark is given for activities A–G dealt with correctly |
| A1 | This mark is given for the first two dummies and arrows dealt with correctly |
| A1 | This mark is given for activities K–H dealt with correctly |
| A1 | This mark is given for a fully correct solution with all arrows shown and correctly placed, with one finish and no additional dummies. |
| (b) | Activity F requires activity B and the two activities A and C to be completed before F can begin.  The time to complete A and C is double that of B, so B can be delayed waiting for A and C to be completed.  Thus B is not critical | A1 | This mark is given for a correct explanation (G may be used in place of F) |
| (c) | Activities D, E and H | A1 | This mark is given for all three correct with no extra activities mentioned |

**Question 4 (Total 10 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) |  | | |
|  | M1 | This mark is given for a larger number replaced by a smaller one in the working values boxes for C, F or G |
| A1 | This mark is given for all values correct (and the correct order) at A, D, B and C |
| A1 | This mark is given for all values correct (and the correct order) at G and F |
| A1 | This mark is given for all values correct (and the correct order) at E and H |
| 3*x* + *y* = 15  *x* + *y* = 9 | M1 | This mark is given for an attempt to form a pair of simultaneous equations using working values from H |
| A1 | This mark is given for two correct simultaneous equations |
| *x* = 3, *y* = 6 | A1 | This mark is given for correct values of *x* and *y* |
| (b) | Arcs BC and CD need to be traversed twice | B1 | This mark is given for the correct arcs stated |
| (c) | Vertex C would appear 4 times | B1 | This mark is given for the correct number of times stated |
| (d) | 135 + (4 × 3) + (2 × 6) + 12 = 171 | B1 | This mark is given for the correct length |

**Question 5 (Total 10 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | Minimise *P* = *x* + 5*y* + 4*z* | B1 | This mark is given for a correct objective (including reference to ‘minimise’) |
| Subject to *x* ≥ (*x* + *y* + *z*) | B1 | This mark is given for the first constraint correctly stated |
| 3*y* ≥ 2*z* | B1 | This mark is given for the second constraint correctly stated |
| *x* + *y* + *z* = 1000 | B1 | This mark is given for the third constraint correctly stated |
| *z* = 1000 – *x* – *y* | M1 | This mark is given for eliminating *z* from the objective and constraints using *x*+ *y*+ *z* = 1000 |
| Minimise *P* = *y* – 3*x* (+ 4000),  subject to *x* ≥ 600 and 2*x* + 5*y* ≥ 2000 | A1 | This mark is given for any one correct of the objective and two constraints |
| A1 | This mark is given for a fully correct formulation |
| (b)(i) | 600 roses, 160 hydrangeas and 240 peonies | M1 | This mark is given for using the least value of *x* and constraints to find *y* and *z* |
| A1 | This mark is given for a correct answer for the amount of each type of flower |
| (b)(ii) | (1 × 600) + (5 × 160) + (4 × 240) =  £2360 | A1 | This mark is given for the correct total cost of the order |