Mark Scheme (Results)

Summer 2018

Pearson Edexcel GCE Further Mathematics
AS Further Decision D1 Paper 8FM0_27

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Summer 2018
Publications Code 8FM0_27_1806_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the last candidate in exactly the same way as they mark the first.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification/indicative content will not be exhaustive.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 40.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

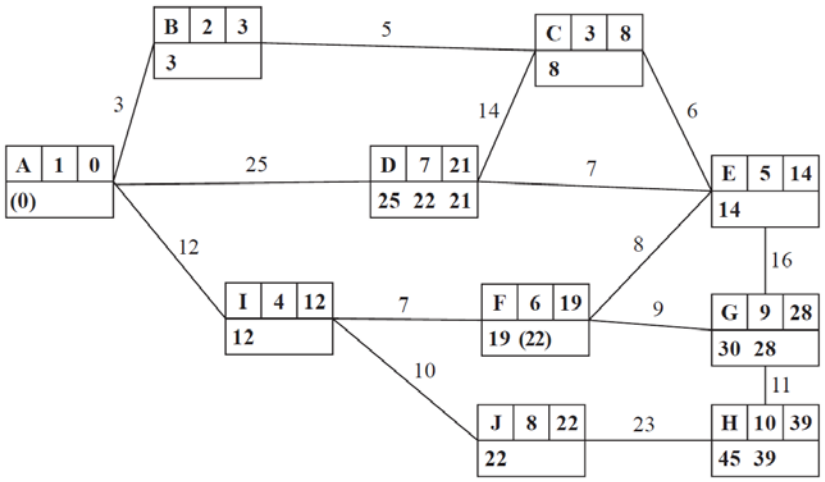
- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- $*$ The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark

4. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

5. Where a candidate has made multiple responses and indicates which response they wish to submit, examiners should mark this response.
   If there are several attempts at a question which have not been crossed out, examiners should mark the final answer which is the answer that is the most complete.

6. Ignore wrong working or incorrect statements following a correct answer.

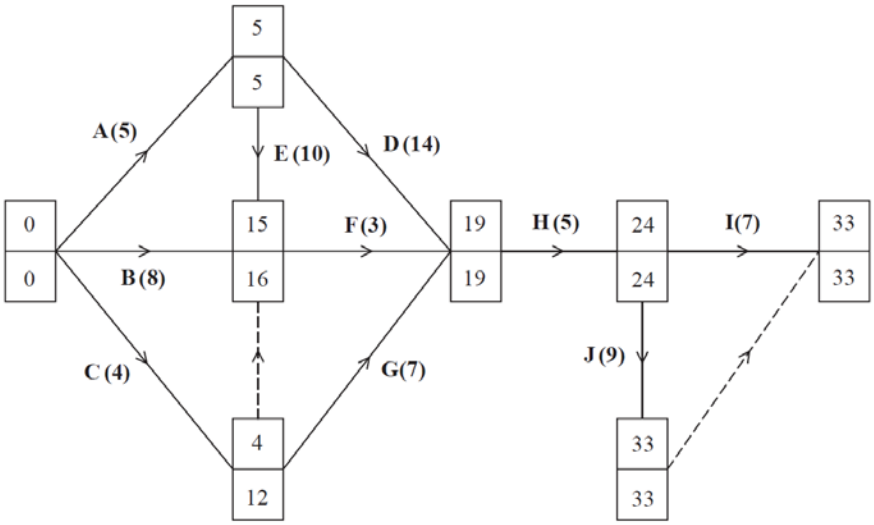
7. Mark schemes will firstly show the solution judged to be the most common response expected from candidates. Where appropriate, alternatives answers are provided in the notes. If examiners are not sure if an answer is acceptable, they will check the mark scheme to see if an alternative answer is given for the method used.

Question	Scheme	Marks	AOs
1(a)(i)		M1 A1 A1 A1ft	1.1b 1.1b 1.1b 1.1b
(a)(ii)	Shortest time to travel from A to H is 39 minutes Quickest route is AIFGH	A1ft A1	1.1b 1.1b
		(6)	
(b)	$1.5\times\left(\frac{9500}{250}\right)^2$ = 2166 seconds	M1 A1	1.1a 1.1b
		(2)	
(c)	order of n^2 does not mean that the order is proportional to n^2 (which is the assumption behind the answer in (b)) but merely means that the dominant term is of order n^2	B1	3.2b
		(1)	
			(9 marks)

Notes
(a)(i) **M1:** For a larger number replaced by a smaller number in the working value boxes at either D, G or H **A1:** For all values correct (and in correct order) at A, B, C, I and E **A1:** For all values correct (and in correct order) at F and D **A1ft:** For all values correct (and in correct order) on the follow through at J, G and H **A1ft:** Follow through their final value at H (condone lack of units) **(a)(ii)** **A1:** Cao (AIFGH)
(b) **M1** Complete method – allow 250/9500 (but must be squared) – allow slips in values e.g. 950 for 9500 **A1:** Cao (accept 2170 but only with correct working) – accept 2166 with no working for M1 only
(c) **B1:** Any indication that the run-time is not <u>exactly</u> proportional to n^2 e.g. may suggest that there are other terms (n^2 + …), or that n^2 is the dominant term, or that order does not imply proportionality. Do not accept only that 'n^2 is not exact'.

Question	Scheme	Marks	AOs
2(a)	Minimum number of arcs is 3	B1	2.2a
	Maximum number of arcs is 6	B1	2.2a
		(2)	
(b)	(i) e.g. 	B1	1.1b
	(ii) The graph has exactly two odd nodes and so the graph is semi-Eulerian	B1 DB1	2.4 2.2a
		(3)	
(c)	The sum of the orders of the vertices = 2(number of arcs) = 10	B1	1.2
	One possibility is that the orders are 1, 3, 3 and 3	M1	2.1
	In a simply connected graph with four vertices each of the vertices of order 3 must connect to the three other vertices therefore it is not possible to have three vertices all with order 3	A1	2.4
	The second possibility is that the orders are 2, 2, 3 and 3	M1	2.1
	There is only one way to make a graph with vertices of orders 2, 2, 3 and 3 as the two vertices of order 2 cannot be connected to each other (note that as the graph is connected no vertex can have order 0). There are no other possible graphs as the maximum order of a vertex is 3 (due to the condition that the graph must be simple)	A1	2.2a
		(5)	
			(10 marks)

Notes
(a) **B1:** Cao **B1:** Cao
(b)(i) **B1:** Cao oe (vertices must be clear) **(b)(ii)** **B1:** Explanation which consists of the graph having two odd nodes (or consistent explanation with their graph in (b)(i)) **DB1:** Exactly (or only) two odd nodes together with the deduction that therefore the graph is semi-Eulerian (from a correct graph only in (b)(i))
(c) **B1:** 10 seen – this mark can be implied if two or more lists of four numbers which sum to 10 are seen **M1:** States that the vertex orders could be 1, 3, 3, 3 or that no vertex can have an order greater than 3 **A1:** Convincing argument that 1, 3, 3, 3 is not possible **M1:** Considers the possibility of the orders being 2, 2, 3, 3 **A1:** Convincing argument that there is only one way of making a graph with vertex orders of 2, 2, 3, 3 (e.g. mention of the fact that the two vertices of order 2 cannot be connected to each other) For full marks in (c) – there must be some mention of the fact that there cannot be a vertex with order greater than 3 (withhold last A mark if this point is not considered)

Question	Scheme	Marks	AOs
3(a) and (b)		M1 A1 A1 **(3)** M1 M1 A1 **(3)**	1.1b 1.1b 1.1b 1.1b 1.1b 1.1b
(c)	The critical activities are A, D, H and J	B1	1.1b
		(1)	
(d)(i)	No effect (as G is not one of the critical activities)	B1	2.4
(d)(ii)	Activity C is the only affected activity and it can now start 4 days later at time 12 (rather than at time 8) or finish as late as time 16	M1 A1	3.4 1.1b
		(3)	
			(10 marks)

Notes
(a) **M1:** Any three activities of D, E, G, J added together with at least one dummy **A1:** D, E, G and first dummy added correctly (with arrows) i.e. first part of the network correct **A1:** J and second dummy added correctly (with arrows) i.e. second part of the network correct **SC:** If M1A0A0 but only error is any missing arrows then award M1A1A0 **SC:** Award M1A1A0 for a 'correct' diagram with more than two dummies
(b) **M1:** All top boxes complete, numbers increasing in the direction of the arrows – dependent on all four activities D, E, G, J added (bod if not labelled) – condone lack of additional event node for J **M1:** All bottom boxes complete, numbers decreasing in the opposite direction of the arrows – dependent on all four activities D, E, G, J added (bod if not labelled) – condone lack of additional event node for J **A1:** Cso (including diagram) - must contain exactly 8 early and late event times and only two correct dummies placed with one finish – note that some candidates may start with e.g. a dummy at the event before the start of activity I which will affect their early and late event times at this node (both values should be 24))
(c) **B1:** Cao (A, D, H and J)
(d)(i) **B1:** Explanation that there is no effect on the completion time (as G is not critical)
(d)(ii)
M1: Use their model to deduce that C is the (only) activity that is affected **A1:** Correct answer that activity C (only – maybe implicit) can e.g. finish at time 16 or start at time 12 – for this mark the explanation must give a relevant time

Question	Scheme	Marks	AOs
4(a)	x is the number of cabinets produced in week 1, y is the number of cabinets produced in week 2 and z is the number of cabinets produced in week 3	B1	2.5
		(1)	
(b)	$x + y \leq z$ $z \leq 2y$ $y + z \leq 125$ $(x, y, z \geq 0)$	 B1 B1	 3.3 3.3
		(2)	
(c)(i)	Objective is $P = 250x + 275y + 200(150 - x - y)$	M1	3.1a
	$P = 50x + 75y$ (+ 30000)	A1	1.1b
	Objective line drawn or at least two vertices tested	M1	3.1a
	Optimal point $\left(25, \frac{125}{3}\right)$	A1	1.1b
	Consideration of integer coordinates around the optimal vertex	M1	1.1b
	Correct integer coordinate (25, 42)	A1	1.1b
(c)(ii)	The production schedule is 25 cabinets in week 1, 42 cabinets in week 2 and 83 cabinets in week 3	B1	3.2a
	Total cost of production is £34 400	B1	1.1b
		(8)	
			(11 marks)

Notes
(a) **B1:** Cao - must contain ‘number of…’ (oe e.g. ‘amount of’, ‘quantity of’,…) at least once
(b) **B1:** Any one correct (accept strict inequalities) **B1:** All three correct
Note that the vertices of the FR are $\left(25,\frac{125}{3}\right),(25,50),\left(\frac{75}{2},\frac{75}{2}\right)$ **(c)(i)** **M1:** Attempt to derive new objective function in terms of x and y only by using $x + y + z = 150$ **or** attempt to calculate all three values of z using $x + y + z = 150$ **A1:** Cao for objective in terms of x and y only **or** all three correct z values $\left(\frac{250}{3},75,75\right)$ **M1:** Objective line drawn consistent with their objective function (or its reciprocal) **or** testing two of the correct vertices (to at least 1 decimal place where applicable) in their objective function involving x and y only **or** testing two of the correct vertices (to at least 1 decimal place where applicable) in $250x+275y+200z$ **A1:** Correct optimal point $\left(25,\frac{125}{3}\right)$ **or** $\left(25,\frac{125}{3},\frac{250}{3}\right)$ **-** accept 41.6 or 41.7 **(**or better) – so at least 1 decimal place (truncated or rounded) if not given exact **M1:** Consideration of integer point(s) (e.g. (25, 41) etc.) around the optimal vertex – must have attempted point testing of the vertices of the feasible region or objective line **A1:** Correct integer coordinate (25, 42) stated <u>and</u> either clear rejection of (26, 41) - by checking in $x+3y\geq 150$ <u>or</u> testing of (27, 41) in a correct objective function **B1:** Cao (in context – so not in terms of x, y and z) **(c)(ii)** **B1:** Cao (£34,400) – condone lack of units

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