



GCE

## Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4771**: Decision Mathematics 1

# Mark Scheme for June 2013

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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## 1. Annotations and abbreviations

Annotation in scoris	Meaning
✓ and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	Meaning
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working

## 2. Subject-specific Marking Instructions for GCE Mathematics (MEI) Decision strand

- a Annotations should be used whenever appropriate during your marking.

**The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.**  
It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

- b An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

- c The following types of marks are available.

**M**

A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

**A**

Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

**B**

Mark for a correct result or statement independent of Method marks.

**E**

A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

- d When a part of a question has two or more ‘method’ steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation ‘dep \*’ is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.
- e The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be ‘follow through’. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

- f Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.
- g Rules for replaced work

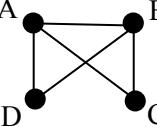
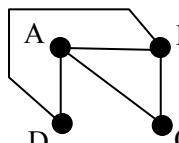
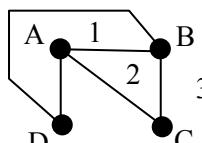
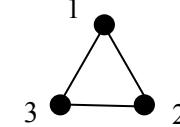
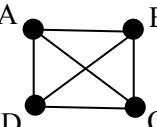
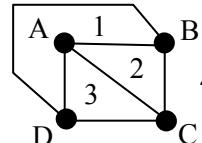
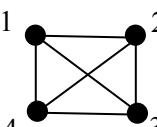
If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

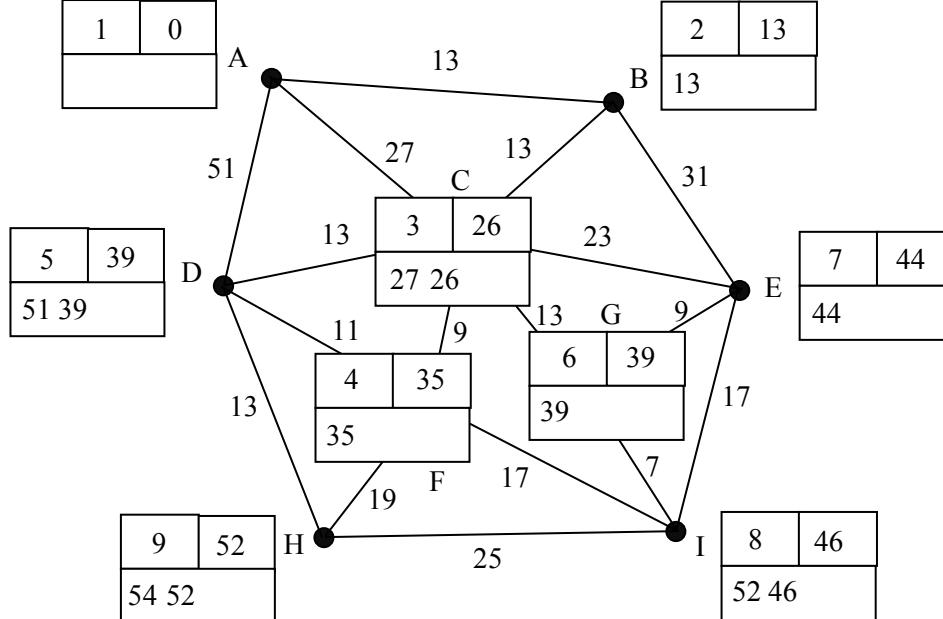
NB Follow these maths-specific instructions rather than those in the assessor handbook.

h For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A mark in the question.

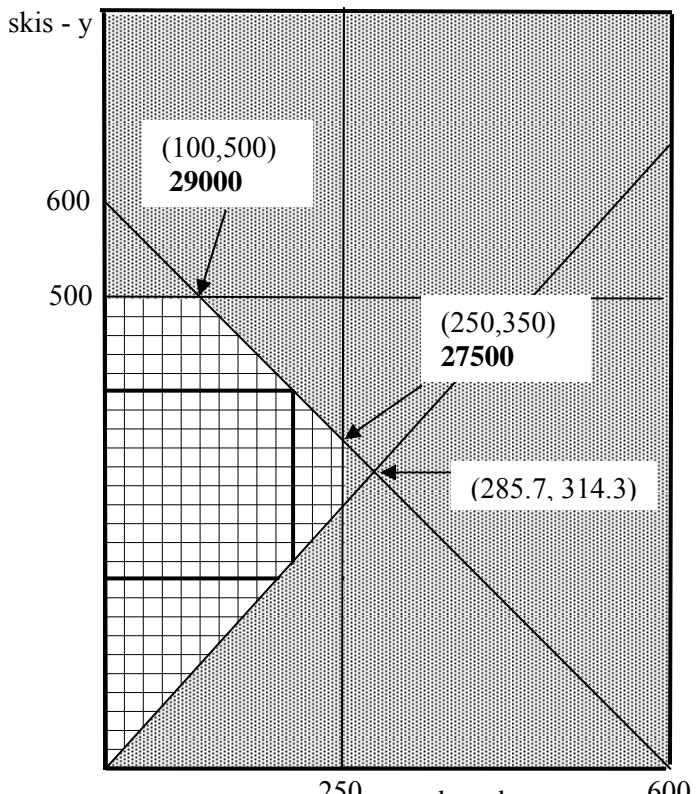
Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

Question	Answer	Marks	Guidance
1 (i)	 e.g. 	M1 A1 B1 [3]	simple and connected but not complete. (Ignore directions) cao  planar - cao
1 (ii)	e.g.  	M1 A1 [2]	exactly 3 vertices cao
1 (iii)	  	B1 M1 A1 [3]	complete graph on 4 letters 4 regions cao (planar OK)

Question	Answer									Marks	Guidance																																																																		
2 (i)	<table border="1"> <thead> <tr> <th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th> <th>comps</th><th>swaps</th></tr> </thead> <tbody> <tr> <td>i=1</td><td>9</td><td>7</td><td>3</td><td>11</td><td>5</td><td>13</td><td></td><td></td><td>5</td><td>3</td></tr> <tr> <td>i=2</td><td>7</td><td>3</td><td>9</td><td>5</td><td>11</td><td>13</td><td></td><td></td><td>4</td><td>3</td></tr> <tr> <td>i=3</td><td>3</td><td>7</td><td>5</td><td>9</td><td>11</td><td>13</td><td></td><td></td><td>3</td><td>2</td></tr> <tr> <td>i=4</td><td>3</td><td>5</td><td>7</td><td>9</td><td>11</td><td>13</td><td></td><td></td><td>2</td><td>1</td></tr> <tr> <td>i=5</td><td>3</td><td>5</td><td>7</td><td>9</td><td>11</td><td>13</td><td></td><td></td><td>1</td><td>0</td></tr> </tbody> </table>																		comps	swaps	i=1	9	7	3	11	5	13			5	3	i=2	7	3	9	5	11	13			4	3	i=3	3	7	5	9	11	13			3	2	i=4	3	5	7	9	11	13			2	1	i=5	3	5	7	9	11	13			1	0	B1 B1 B1 B1 B1 [5]	i=2 row OK i=3 row OK FT i=4 and 5 rows OK cao comparisons swaps
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2 (ii)	comparisons 6 swaps 3									B1 B1 [2]	cao (OK if in 2 parts) cao (OK if in 2 parts)																																																																		
2 (iii)	further swaps 6									B1 [1]	cao																																																																		

Question	Answer	Marks	Guidance
3 (i)	 <p>AB 13 ABC 26 ABCD 39 ABE 44 ABCDF 35 ABCAG 39 ABCDH 52 ABCIG 46</p>	[6]	<p>B1 B1 B1 B1 Dijkstra – C correct other working values order of labelling labels</p> <p>Note that D and G could be labelled in the reverse order.</p>
3 (ii)	<p>Turn distances to times throughout the network. Add 10 mins to every arc incident upon C. (or do Dijkstra twice, once with C deleted, and compare with the adjusted time through C)</p>	[2]	<p>E1 E1 Explanations needed, not answers any correct logic</p>

Question	Answer	Marks	Guidance																	
4 (i) & (ii)	<p>Minimum completion time = 100 minutes Critical activities are A, C, D, I, J and L</p>	[5]	M1 activity on arc A1 single start and end A1 A, B, C OK A1 D, F, I OK A1 rest OK 																	
		M1	forward pass (must have at least one join correct)																	
		A1	FT																	
		M1	backward pass (must have at least one burst correct)																	
		A1	FT																	
		B1	cao																	
		B1	cao																	
		[6]																		
4 (iii)	e.g. Critical activities (100 mins) + others. e.g. B has to be done whilst A is underway.	B1 [1]	Needs a comparison of times, possibly implied.																	
4 (iv)	<p>(If L omitted in (i) ignore omission here.)</p> <p>e.g.</p> <table border="1"> <tr> <td>30</td> <td>85</td> <td>95</td> </tr> <tr> <td>Simon</td> <td>A</td> <td>C</td> <td>D</td> <td>I</td> <td>J</td> <td>L</td> </tr> <tr> <td>Friend</td> <td>B</td> <td>E</td> <td>K</td> <td>H</td> <td>F</td> <td>G</td> </tr> </table> <p>10 25 40 50 60 85 95 100</p>	30	85	95	Simon	A	C	D	I	J	L	Friend	B	E	K	H	F	G	M1 A1 A1 A1 [4]	diagram like this or attempted cascade ... no more than 1 omitted activity nowhere needing more than 2 people precedences correct fully correct, inc who does what
30	85	95																		
Simon	A	C	D	I	J	L														
Friend	B	E	K	H	F	G														

Question	Answer	Marks	Guidance
5 (i)	<p>e.g. Let <math>x</math> be the number of snowboards Let <math>y</math> be the number of (pairs of) skis <math>x + y \leq 600</math> <math>x \leq 250</math> and <math>y \leq 500</math> <math>1.1x \leq y</math></p> 	<p>B1 B1 B1 B1 B1</p> <p>B1 B1 B1 B1</p> <p>B1</p>	<p>or vice-versa of course both</p> <p>FT horizontal line FT vertical line FT positive slope line <math>x+y = 600</math></p> <p>Note ... error tolerance of +/- half a small square within feasible region.</p> <p>shading ... follow any pentagon bounded by the y-axis, a horizontal line, a vertical line, a negatively inclined line and a positively inclined line</p>

Question	Answer	Marks	Guidance
5 (ii)	Objective = $40x + 50y$  29000 at (100,500) 27500 at (250,350) Solution ... 100 snowboards and 500 pairs of skis	B1 M1  A1  [3]	objective considering profits at the two indicated points of their pentagon (or using a profit line) cao www
5 (iii)	€10 or more	B1 [1]	cao (allow €51 etc)
5 (iv)	35 snowboards	M1  A1  [2]	moving to appropriate new feasible point on their negatively inclined line cao... integer! (allowing 30 to 40 for graphical inaccuracy)

Question		Answer	Marks	Guidance
6	(i)	e.g. 0, 1, 2 → 1 3, 4, 5, 6, 7 → 2 8 → 3 9 → 4	M1 A1 [2]	either 3 numbers for 1 or 5 numbers for 2 all proportions correct
6	(ii)	random number 5 3 2 4 7 9 1 1 8 time interval (mins) 2 2 1 2 2 4 1 1 3 arrival times 0 2 4 5 7 9 13 14 15 18	M1 A1 B1 [3]	all outcomes achieved with first 2 correct for their rule all correct FT accumulation
6	(iii)	e.g. 00 13 → 0.1 14 41 → 0.25 42 83 → 1 84 97 → 2 98, 99 ignore and “redraw”	M1 A1 A1 [3]	ignore some proportions correct efficient (fewer than 7 rejected)
6	(iv)	random number 23 15 01 32 45 47 86 71 17 83 processing time 0.25 0.25 0.1 0.25 1 1 2 1 0.25 1	M1 A1 [2]	first 4 customers correct for their rule all correct FT
6	(v)	e.g. 0 5 → 1 6 9 → 0.25	B1 [1]	
6	(vi)	random number 8 3 0 1 4 0 2 5 7 6 payment time 0.25 1 1 1 1 1 1 0.25 0.25	B1 [1]	FT
6	(vii)	arrival 0 2 4 5 7 9 13 14 15 18 departure 0.5 3.25 5.1 6.35 9 11 16 18 18.5 19.75	M1 A1 [2]	deals with a wait correctly all correct FT
6	(viii)	arrival 0 2 4 5 7 9 13 14 15 18 departure 0.5 3.25 5.1 6.35 9 11 16 18 15.5 19.25	M1 A1 [2]	deals with last 3 correctly all correct FT

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