OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4771:** Decision Mathematics 1

Mark Scheme for June 2012

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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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Annotations

Annotation	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

Subject-specific Marking Instructions

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.

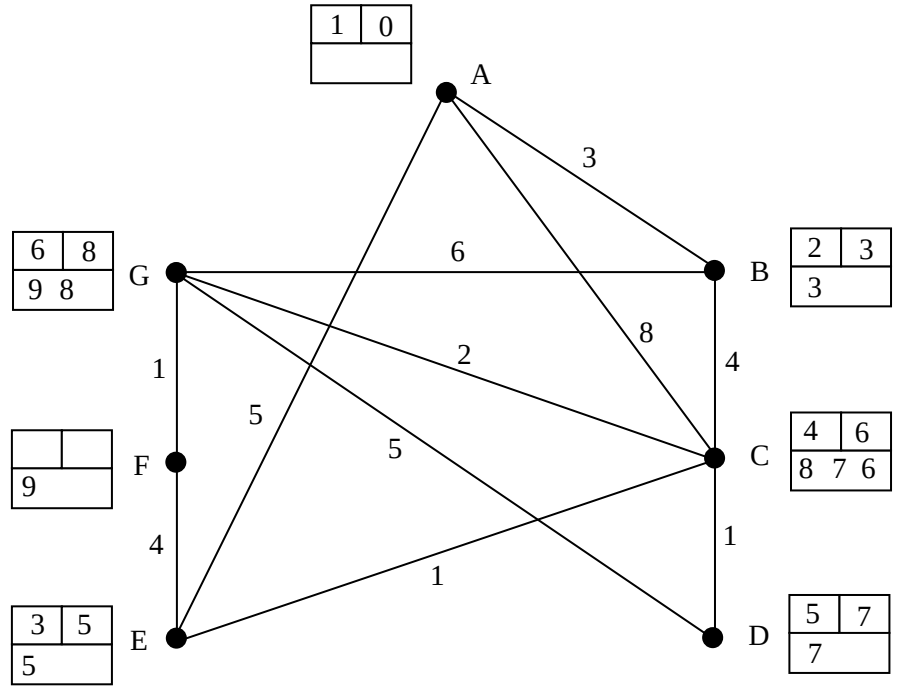
g. Rules for replaced work

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.

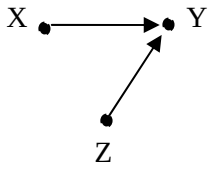
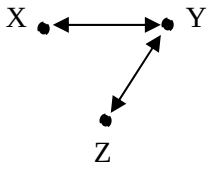
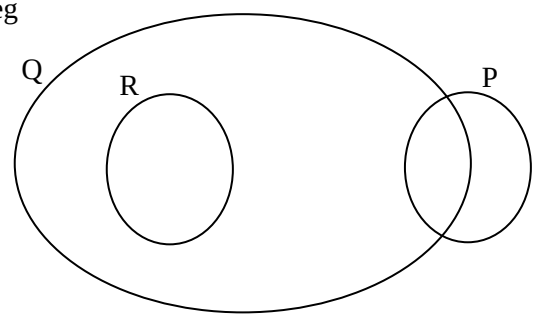
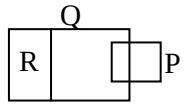
NB Follow these maths-specific instructions rather than those in the assessor handbook.

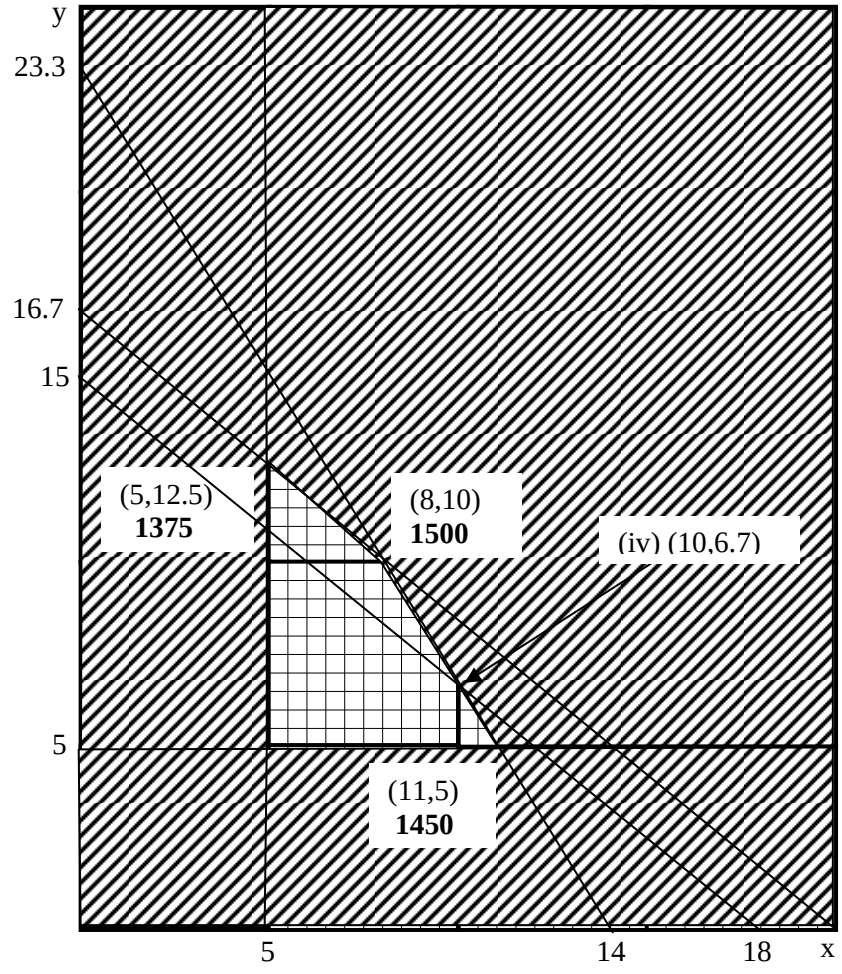
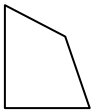
h. For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for 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) & (ii)	 Route: AECG Distance: 8	B1 B1 B1 B1 B1 B1 B1 B1 **[8]**	connectivity lengths Dijkstra working values other than at C order of labelling labels

Question			Answer	Marks	Guidance	
2	(i)		A L R B f(L) f(R) 3 3.382 3.618 4 2.146 1.910 3.382 3.618 3.764 4 1.910 1.875 3.618	B1 B1 B1 B1 B1 B1 **[6]**	R and L f(R) and f(L) A L and R f(L) and F(R) A	-1 once only for incorrect accuracy, but condone 1.91. Surds OK, but lose the accuracy mark. (Q says 3dp.)
2	(ii)		Saves a function evaluation	B1 **[1]**		Has to be a comment about function values.
2	(iii)		eg Setting the control on a gas fire to achieve a room temperature of 20C. Function could be $(temp–20)^2$. (This example shows that optimising can be used to "achieve".) Note that the domain cannot be time based ... i.e finding when something occurred. One cannot go back in time to take a reading!	B1 **[1]**	Optimisation with need to sample at discrete intervals.	"Deepest point in seabed" example seen. This is acceptable, assuming that depth soundings are taken at points, and ignoring the fact that the domain is two dimensional rather than one dimensional.

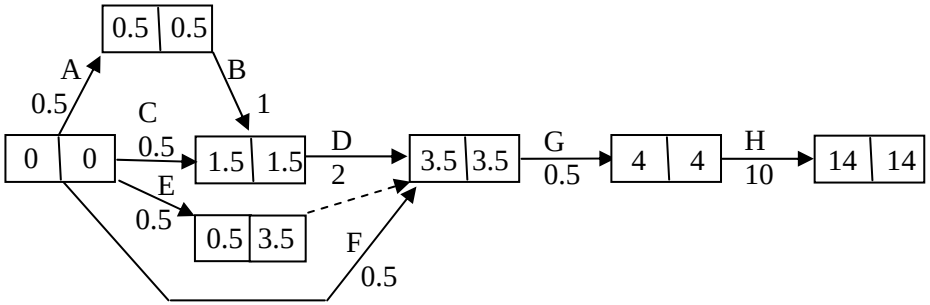
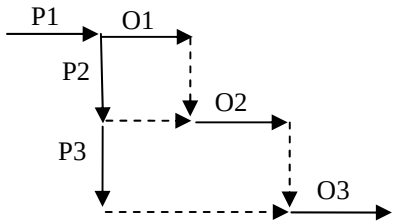
3	**(i)**		"is a subset of"  "shares at least one element with" 	M1 A1 M1 A1 **[4]**	directed graph on 3 vertices all correct undirected on 3 vertices all correct	Arcs must either have an arrow at each end. or no arrows.
3	**(ii)**		eg 	M1 A1 B1 B1 **[4]**	R subset of Q no other subsets P∩Q P∩Q' 	Allow area split in two, with third area. eg  If P and R shown intersecting then can score M1 A1 B0 B0.

Question			Answer	Marks	Guidance	
4	(i)		Let x be the number of type X motors produced. Let y be the number of type Y motors produced. $10x + 12y \leq 200$ $x \geq 5$ and $y \geq 5$ $0.5x + 0.3y \leq 7$	M1 A1 B1 B1 B1 **[5]**	adequate definition "number of"	Strict inequalities are equally OK
4	(ii)			B1 B1 B1 B1 **[4]**	inclined line inclined line x=5 and y=5 shading follow line errors if shape is 	The guidance level of accuracy throughout this question is ±0.25 on the x coordinate and ±0.25 on the y coordinate. (Look at (8,10) first.) Inaccurate sketch with axis intercepts given is OK.

Question			Answer	Marks	Guidance	
4	(iii)		Profit = 100X + 70Y	B1		
			(5,12.5) or (5,12) 1375 or 1340 (8,10) 1500 (11,5) 1450	M1	optimisation	either profit line or evaluating and comparing at their 3 appropriate points (OK if on graph)
			£1500 profit.	A1	1500 seen cao SC B1 for 1500 without the preceding M mark	
				[3]		
4	(iv)		Solution in range $\left(10 \pm \frac{1}{4},\ 6\frac{2}{3} \pm \frac{1}{4}\right) = \left(9.75 - 10{,}25,\ 6.41\dot{6} - 6.91\dot{6}\right)$	B1	cao	looking for $\left(10,\ 6\frac{2}{3}\right)$
			Identification of one of (9,7), (10,6) and (11,5).	B1	cao	
			Evaluation at all three of (9,7) (10,6) (11,5) **1390 1420 1450**	M1		
			So 11 of X and 5 of Y	A1	cao	
				[4]		

Question			Answer	Marks	Guidance	
5	(i)		eg 0–7 → double 8 → single 9 reject and re-draw	M1 A1 **[2]**	reject correct proportions	Rejection can be implied.
5	(ii)		eg 0–5 → double 6,7 → single 8,9 reject and re-draw	M1 A1 **[2]**	reject correct proportions	Rejection can be implied. Ignore rule for (4,0).
5	(iii)		e.g. day selection / doubles / singles / random number 1 5 0 2 4 1 5 double	M1 A1	allow 5 shown as used on RN list. selection	For the simulation M1's you need to see a random number being used with their rules
			3 3 2 9, 4 double	M1 A1	must show RN(s) explicitly new scenario seen explicitly, not implied by day 4 rule	Follow a candidate who manages correctly to go from (4,1) to (4,0). It will then gain M1 if it correctly goes to (3,1) on day 4, with A1 if shows no simulation needed.
			4 2 3 0 double 5 1 4	M1 A1	a correct day 4 rule selection and new scenario	rule must be seen needs RN explicit. Allow new scenario if seen in subsequent probability calculation.
			Probability of drawing a single bag on day 5 is now 4/6.	M1 A1 **[8]**	denominator = 6 numerator	Can be implied by 2/3 or 1/3 if correct for their simulation.

Question			Answer	Marks	Guidance
5	(iv)		4 simulations, each ending with 6 bags all scenarios correct	M1 A1 **[2]**	Condone one slip. Condone simulating at (4,0) if correctly done. 6 bags can be implied by probs of thirds or sixths.
5	(v)		Either averaging correct probabilities or sum of singles/30	M1 A1 **[2]**	Correct computation, but allow 1 slip or omission. Correct answer for their simulations.

Question			Answer	Marks	Guidance
6	(i) & (ii)		 Minimum completion time = 14 mins Critical activities ... A, B, D, G, H	M1 A1 A1 A1 A1 M1 A1 M1 A1 B1 B1 **[11]**	activity on arc at least 1 dummy for E and F precedences for D precedences for G rest eg. penalise multiple starts forward pass backward pass If OK at start of dummy. If there is no dummy then these two marks are not available.
6	(iii)		2 people	B1 **[1]**	
6	(iv)		1 person ... 15.5 mins	B1 **[1]**	
6	(v)		 time = 35.5 minutes	B1 B1 **[2]**	network time with small oven
6	(vi)		revised time = 26.5 minutes	B1 **[1]**	time with large oven

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