AQA

**Free-Standing Mathematics Qualification
June 2013**

Mathematics Advanced Level   6994

(Specification 6994)

Using and Applying Decision Mathematics

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Key to mark scheme abbreviations

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
B	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
√or ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
–x EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.
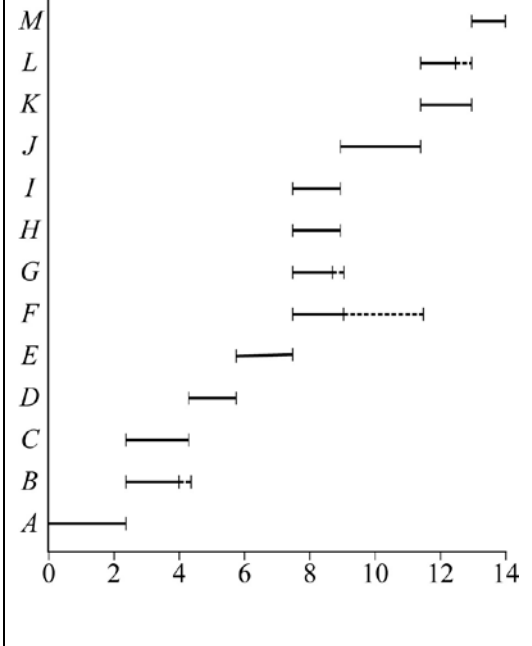
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.
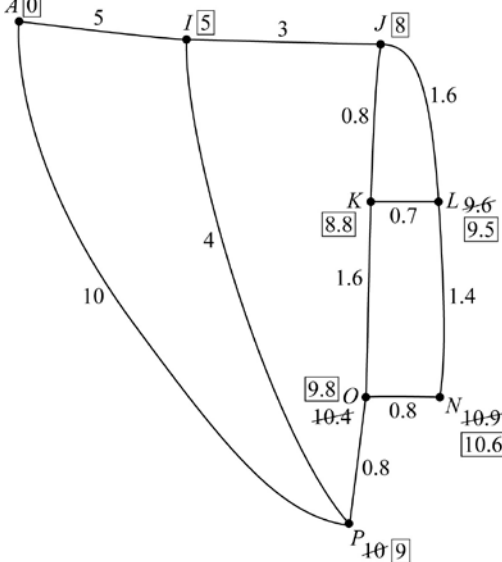
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.
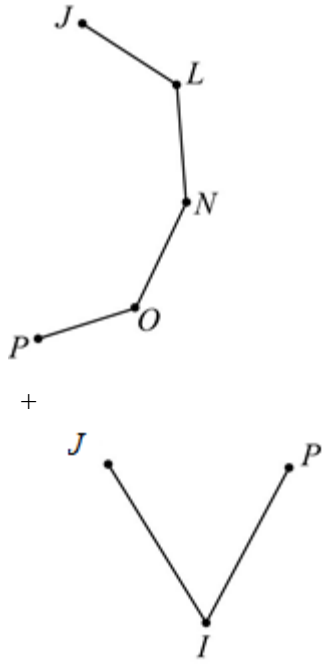
Otherwise we require evidence of a correct method for any marks to be awarded.

Question	Solution	Marks	Total	Comments
1(a)		M1 A3	4	network, −1 for each independent error
(b)		M1 A1	2	forward, correct at *B*, *C*, *D* all correct
(c)		M1 A2	3	backward, correct at *J*, *K*, *L* ft −1 each independent error
(d)	critical *A C D E H I J K M* min 14 days	B1 B1	2	
				Q1 mark scheme continues on next page

Network diagram boxes (activity | early | late):

- *M* 13 | 14
- *K* 11.5 | 13
- *L* 11.5 | 13
- *J* 9 | 11.5
- *F* 7.5 | 11.5
- *G* 7.5 | 9
- *H* 7.5 | 9
- *I* 7.5 | 9
- *E* 6 | 7.5
- *D* 4.5 | 6
- *B* 2.5 | 4.5
- *C* 2.5 | 4.5
- *A* 0 | 2.5

(e)		M1 A2 B1		SCA −1 each error floats
			4	
(f)	Plumber, *C* & *I* *C* - reduce by 0.5 *I* - no effect Joiner, *H* & *J* *H* - no effect *J* - reduce 1 day use Joiner, new time 13 days	 E1 E1 E1 E1 E1	 5	must consider the 2 tasks separately must consider the 2 tasks separately
	Total		**20**	
2(a)	*AF* *AB* (or *FE*) *BE* *ED* (or *BC*) *CD*	M1 A1 A1	 3	Prim's all correct
(b)	3.1 km	B1	1	
(c)		B1	1	oe
	Total		**5**	

Question	Solution	Marks	Total	Comments
3(a)	$99 \times 0.5 \times 2 = 99$	B1		
	$+2$			
	$+0.8$	B1		
	total: 101.8		2	AG
(b)	$49 \times 0.5 \times 4 = 98$	M1		
	$+2$			
	$3 \times 0.8 = 2.4$			
	total: 102.4	A1	2	
(c)	have fewer rows	E1	1	
	oe			
	Total		**5**	
4(a)(i)	odds J, K, L, O			
	$JK + LO = 1.3 + 3.5 = 4.8$	M1		correct 3 pairs of odds
	$JL + KO = 2.4 + 2.7 = 5.1$	A3,2,1		
	$JO + KL = 4 + 1.1 = 5.1$			
	min $22 + 4.8$	m1		
	$= 26.8$	A1	6	22 + their smallest
(ii)	2	B1	1	
(b)	repeats LO	E1		
	dist $= 22 + 3.5$			
	$= 25.5$	B1	2	
	Total		**9**	

Question	Solution	Marks	Total	Comments
5(a)		M1 A1 m1 A1 B1		SCA correct at *D* 2 values at *O* and *L* all correct 10.6 at *N*
	route *A I P O N*	B1	6	
(b)	distance 6.8 + 6 + 1.2 + 1.2 = 15.2	M1 A1	2	
	Total		**8**	

Question	Solution	Marks	Total	Comments
6(a)	*I J L N O P I*	M1		tour
		M1		visits all vertices
		A1		correct order
	= 11.5 (min)	B1	4	
(b)	*N O P L J I N*	M1		as above
		M1		
		A1		
	14.7	B1	4	
(c)				
		M1		ST + 2 edges from *I*
		A1		correct st
	+			
		A1		correct edges from *I*
	= 11.5	B1	4	
(d)	optimal tour = 11.5	E1	1	
	Total		**13**	
	TOTAL		**60**	