



FSMQ

# MATHEMATICS

6994/2 – Using and Applying Decision Mathematics  
Mark scheme

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6994  
June 2014

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Version/Stage: Final v1

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Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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.

Further copies of this Mark Scheme are available from [aqa.org.uk](http://aqa.org.uk)

## 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		network diagram
		A3	4	– 1 each error
(b)		M1		forward pass
		A1	2	all correct
(c)		M1		backward pass
		A1F		8+ correct
		A1	3	all correct
(d)	B, I, L	B1	1	
(e)		M1		Gantt diagram
		B1		floats
		A1		8 + correct
		A1	4	all correct
(f)	$12 + 5 + 5 = 22$ mins time 2.38 pm	M1		
		A1	2	
(g)	3.10 pm	B1	1	allow '150 mins after start' or '10 mins later'
	<b>Total</b>		<b>17</b>	

Question	Solution	Marks	Total	Comments
<b>2(a)</b>	$AD$	B1		11 edges
	$\begin{pmatrix} HI \\ IJ \end{pmatrix}$ either order	M1		Kruskal
	$\begin{pmatrix} BF \\ CG \\ DH \end{pmatrix}$ any order	A1		1 <sup>st</sup> 6 correct
	$\begin{pmatrix} FL \\ GM \end{pmatrix}$ either order	A1		1 <sup>st</sup> 8 correct
	$BC$ or $FG$ or $LM$ $CD$ or $GH$ $IP$	A1	5	all correct
<b>(b)</b>	2910	B1	1	
<b>(c)</b>		M1		ST 8 + edges
		A1	2	all correct (or other correct ST)
<b>Total</b>			<b>8</b>	

Question	Solution	Marks	Total	Comments
3(a)	<p><i>A D H I P R W V U</i></p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>B1</p> <p>B1</p>	<p>8</p>	<p>use of dijkstra</p> <p>correct at <i>I</i></p> <p>2 values of <i>F</i></p> <p>2 values of <i>O</i> and <i>U</i> correct at <i>X</i></p> <p>all correct</p> <p>24.4 at <i>U</i></p>
(b)	<p><math>A \rightarrow S = 18</math></p> <p><math>S \rightarrow U = 11.8</math></p> <p>total = 29.8</p>	<p>M1</p> <p>A1</p>	<p>2</p>	
	<b>Total</b>		<b>10</b>	

Question	Solution	Marks	Total	Comments
<b>4(a)</b>	$FJ \quad 1335$ $GJ \quad 1785$	B1 B1	2	
<b>(b)(i)</b>	$B F E G A C J B$  = 4545	M1 M1 A1 B1	4	Tour visits all vertices correct order
<b>(ii)</b>	$B F E \underline{G F B A} C J B$	M1 A1	2	any correct expansion of their (b)(i)
<b>(c)(i)</b>	$AB \quad 320$ $BF \quad 210$ $EF \quad 160$ $EG \quad 400$ $AC \quad \underline{460}$ $1550$	M1  A1  B1 B1	4	Prims on matrix  all correct  5 edges
<b>(ii)</b>	$1550 + 1125 + 1210$ = 3885	M1 A1	2	their 1550 + 2 edges front $J$
<b>(d)</b>	$3885 \leq T \leq 4545$	B1 B1	2	
	<b>Total</b>		<b>16</b>	
<b>5(a)</b>	$BJ + FC = 1125 + 450 = 1575$ $BF + JG = 210 + 1785 = 1995$ $BG + JF = 660 + 1335 = 1995$ min = $6185 + 1575$ = 7760	M1 A2,1,0  m1 A1	5	3 correct pairs  6185 + their min
<b>(b)(i)</b>	$C - 1$	B1	1	
<b>(ii)</b>	$G - 2$	B1	1	
<b>(c)(i)</b>	$6185 + 210 = 6395$	M1	1	6185 + their smallest
<b>(ii)</b>	$J/G$	A1	1	
	<b>Total</b>		<b>9</b>	
	<b>TOTAL</b>		<b>60</b>	