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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MD02 Decision 2

Mark Scheme

2007 examination - June series

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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.

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Key to mark scheme and abbreviations used in marking

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	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	or equivalent	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
–*x* EE	deduct *x* marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	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. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

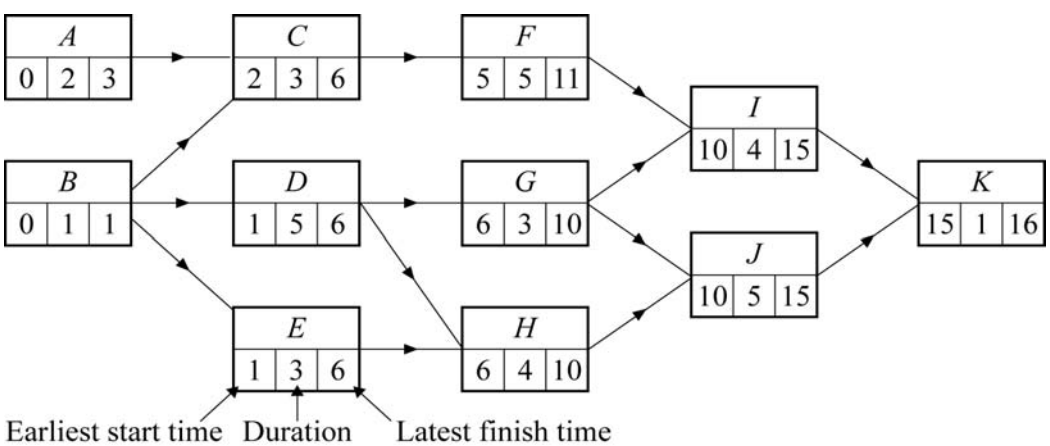
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **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.

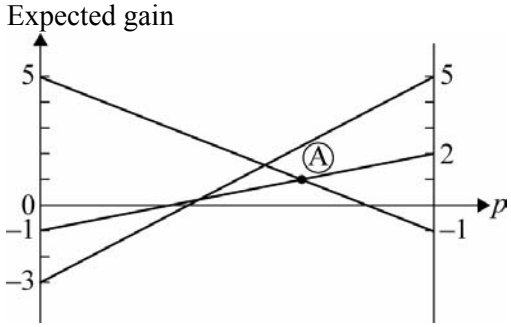
MD02

Q	Solution	Marks	Total	Comments
1(a)				
	Activity / **Immediate Predecessors**: *A* -; *B* -; *C* *A, B*; *D* *B*; *E* *B*; *F* *C*; *G* *D*; *H* *D, E*; *I* *F, G*; *J* *G, H*; *K* *I, J*	M1 A1	2	Up to 2 slips All correct
(b)		M1 A1 M1 A1	4	Start times – up to 1 slip with FT All correct Finish times – up to 1 slip; FT 'their 16' All correct; CSO
(c)	Critical path *B D H J K* Minimum time 16 days	B1 B1	2	
(d)	Greatest float at *E* Value = 2	B1√ B1√	2	
	Total		**10**	

MD02 (cont)

Q	Solution	Marks	Total	Comments
2(a)	10 11 8 12 5 11 5 11 6 7 12 8 7 11 4 10 9 14 10 6 9 9 7 8 9			
	5 6 3 7 0 6 0 6 1 2 8 4 3 7 0 4 3 8 4 0 2 2 0 1 2	M1 A1		Row reduction up to 2 slips Correct
	Printed answer	A1	3	Columns AG
(b)	3 6 3 6 ~~0~~ ~~4 0 6 0 2~~ 6 4 3 6 ~~0~~ 2 3 8 3 ~~0~~ ~~0 2 0 0 2~~	B1		Covering zeros with 3 lines
	1 4 1 4 0 4 0 6 0 4 4 2 1 4 0 0 1 6 1 0 0 2 0 0 4	M1 A1		Subtract 2 from uncovered and add 2 to double covered Table correct
	Can now be covered with 4 lines, so reduce again	M1		Subtract 1 from uncovered; Add 1 to double covered
	1 3 0 3 0 5 0 6 0 5 4 1 0 3 0 0 0 5 0 0 1 2 0 0 5 or 0 3 0 3 0 4 0 6 0 5 3 1 0 3 0 0 1 6 1 1 0 2 0 0 5	A1	5	
(c)	Matching $A-4, B-2, D-5$ And either C – 1, $E-3$ or $C-3, E-1$	B1 B1 B1	3	
(d)	$(10+5+8)+(8+4)=$£35	B1	1	
	Total		**12**	

MD02 (cont)

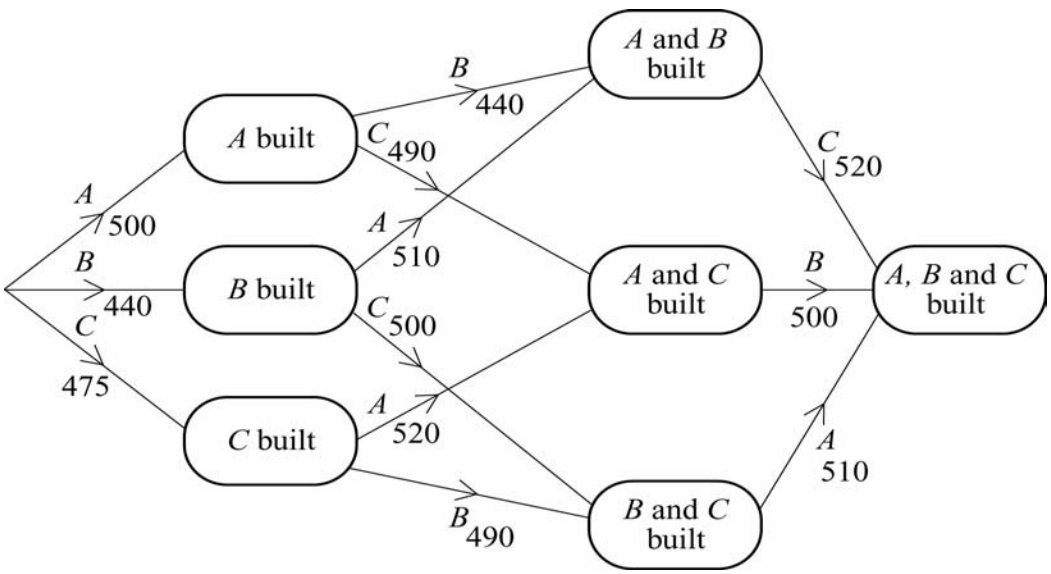
Q	Solution	Marks	Total	Comments
3(a)(i)	Min $R_1(5, 2, -1) = -1$ Min $R_2(-3, -1, 5) = -3$ Min $R_3(4, 1, -2) = -2$ Max min = -1 $\Rightarrow$ Play safe strategy R_1	E1 B1	2	
(ii)	Max $C_1 = 5$; max $C_2 = 2$; max $C_3 = 5$ Min $(5, 2, 5) = 2$ $2 \neq -1 \Rightarrow$ no stable solution	M1 A1	2	
(b)	$R_3(4, 1, -2) < R_1(5, 2, -1)$	E1	1	
(c)(i)	C_1 played, expected gain for Rose: $5p + -3(1-p)$ $= 8p - 3$ $C_2 : 2p - (1-p) = 3p - 1$ $C_3 : -p + 5(1-p) = 5 - 6p$	 M1 A1 A1	 3	 Any correct expected gain unsimplified One correct simplified All correct simplified
(ii)	Expected gain  	 M1 A1	 2	 Plotting at least 2 lines All correct with values at $p = 0$ and $p = 1$ indicated
(iii)	Choosing A – highest point in feasible region $\Rightarrow 3p - 1 = 5 - 6p$ $9p = 6$ $\Rightarrow p = \frac{2}{3}$ $\Rightarrow$ Rose plays R_1 $\frac{2}{3}$ of time and R_2 $\frac{1}{3}$ of time	 M1 A1 E1√	 3	 Solving this equation CSO
(iv)	Value of game $= 3 \times \frac{2}{3} - 1 = 1$	B1	1	Or $5 - 4 = 1$
	Total		**14**	

MD02 (cont)

Q	Solution	Marks	Total	Comments
4(a)	$x + 2y \le 36$ $x + y \le 20$ $4x + y \le 39$	M1 A1	 2	One correct, or all inequalities with < All correct
(b)(i)	Choosing 2 as pivot	M1		And perhaps dividing second row by 2
	P x y s t u value 1 $-\frac{1}{2}$ 0 $2\frac{1}{2}$ 0 0 90 0 $\frac{1}{2}$ 1 $\frac{1}{2}$ 0 0 18 0 $\left(\frac{1}{2}\right)$ 0 $-\frac{1}{2}$ 1 0 2 0 $3\frac{1}{2}$ 0 $-\frac{1}{2}$ 0 1 21	m1 A1 A1	 4	Row operations One row correct All rows correct (condone multiples of rows)
(ii)	Negative value in top row $\Rightarrow$ optimum not yet reached	E1	1	
(c)(i)	New pivot $(x$ – column, 3rd row$)$	M1		And perhaps multiplying by 2
	P x y s t u value 1 0 0 2 1 0 92 0 0 1 1 –1 0 16 0 1 0 –1 2 0 4 0 0 0 3 –7 1 7	m1 A1 A1	 4	Row operations One row correct All rows correct
(ii)	Optimum value reached $P = 92, x = 4, y = 16$ $s = 0, t = 0, u = 7$	E1 B1√ B1	 3	(Or not? – if their tableau wrong) FT 3 values CSO (final tableau must be correct)
	Total		**14**	

MD02 (cont)

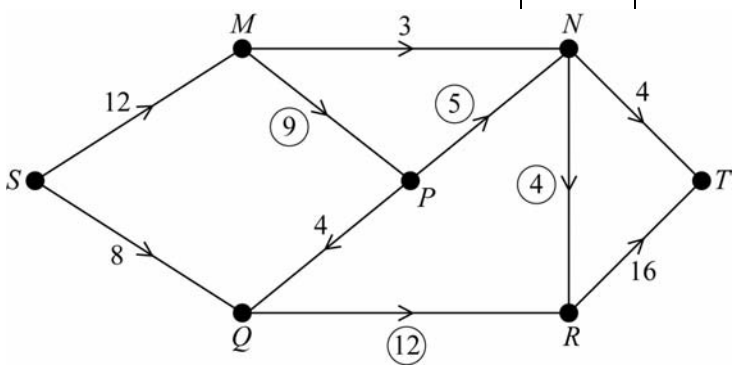
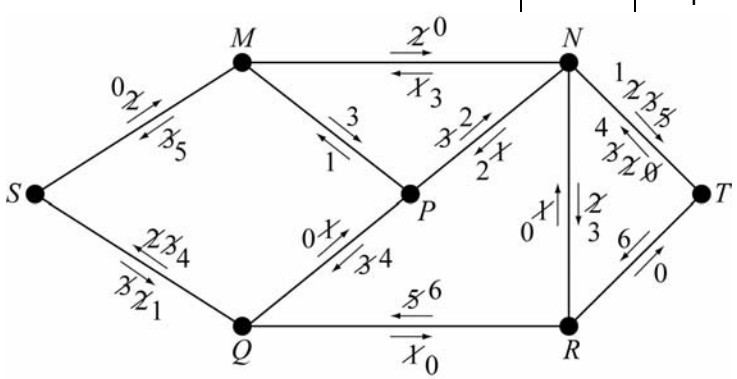
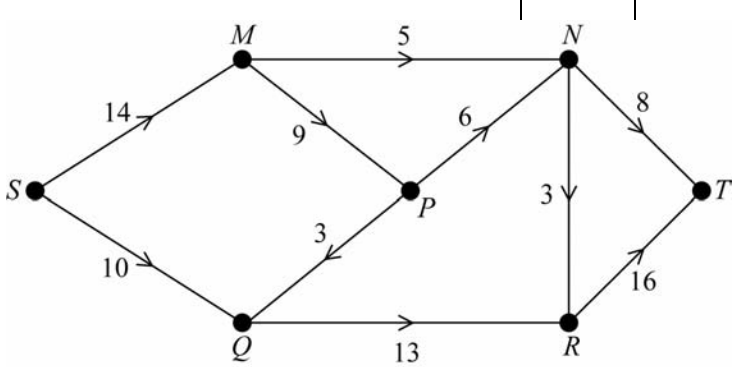
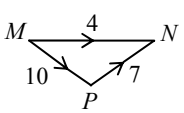
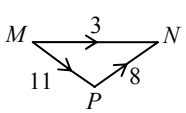
Q	Solution	Marks	Total	Comments
5(a)	(May use correct network instead of table but **must** work backwards through network)			



Month	Already Built	Machine Built	Cost (£)	Total Cost (* = min)
3	*A* and *B*	*C*	520	520*
	A and *C*	*B*	500	500*
	B and C	A	510	510*
2	*A*	*B*	440	440 + 520 = 960*
		C	500	490 + 500 = 990
	B	*A*	510	510 + 520 = 1030
		C	500	500 + 510= 1010*
	C	*A*	520	520 + 500 = 1020
		B	490	490 + 510 = 1000*
1	-	*A*	500	500 + 960 = 1460
	-	*B*	440	440 + 1010= 1450*
	-	*C*	475	475 + 1000= 1475

	B1		Month 3 costs correct
	M1		6 values in month 2 (4 correct)
	A1		All correct
	M1		3 values using minimum from month 2
	A1		All correct and asterisks correct
Order is *BCA*	B1	6	
(b) Choosing other values at stage 2	B1√		990*, 1030*, 1020*
New totals at stage 1	M1 A1		500 + 990 = 1490 440 + 1030 = 1470 475 + 1020 = 1495*
Maximum profit *CAB*	B1	4	
Total		**10**	

MD02 (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	5 + 8 + 16 – 3 = 26	B1	1	
(ii)	Max flow ≤ 26	E1√	1	
(b)				B1 *MP* – 9 B1 *PN* – 5 B1 *NR* – 4 B1 *QR* – 12
			4	
(c)(i)				M1 initial flow – forward and backward 6 pairs correct A1 correct *OM* 2 & 3; *MN* 2 & 1 *NT* 5 & 0; *MP* 3 & 1 *SQ* 3 & 2; *PQ* 3 & 1 *PN* 3 & 1; *QR* 1 & 5 *NR* 2 & 1; *RT* 0 & 6
			2	
(ii)	Adjusting flows on network	M1A1		
	Path / **Flow** *SMNT* / 2 *SQPNT* / 1 *SQRNT* / 1	B1 B1 B1	5	First correct path and flow Second correct Rest
(iii)				M1 6 flows correct A1 all correct Or  or 
			2	
	Total		**15**	
	TOTAL		**75**	