**General Certificate of Education (A-level)
June 2013**

Use of Mathematics   **UOM4/2**

(Specification 5350)

Applying 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)(i)	8.1 (m)	B1	1	
(ii)	$0.9t^2 = 90$ $t^2 = 100$ $t = 10$ (s)	M1 A1	2	
(b)(i)	50 (m)	B1	1	
(ii)	5 (m/s)	B1	1	
(c)	going through origin and quadratic shape point of intersection going through (0,50) straight line positive gradient labelled axes (y/t)	B1 B1 B1 B1	4	can give B marks if axes wrong way round
(d)(i)	$0.9t^2 = 5t + 50$ $0.9t^2 - 5t - 50 = 0$ $t = (5 \pm \sqrt{(25 + 180)})/1.8$ $t = 10.7$ (s)	M1 M1 M1 A1	4	
(ii)	104 or 103 (m)	B1	1	
(e)	$300 - 4t$ $5t + 50 = 300 - 4t$ $t = 27.8$ (s)	M1 M1 A1	3	alternative method: M1 approach speed 9 (m/s) M1 $\dfrac{250}{9}$ $\left[\dfrac{300-50}{9}\right]$ A1 27.8
	Total		**17**	

Question	Solution	Marks	Total	Comments
2(a)	$A_1 = 0.85 \times 200 + 0.1 \times 100 = 180$	B1		allow $170 + 10$
	$B_1 = 300 - 180$ or $0.15 \times 200 + 0.9 \times 100$			
	$= 120$	B1	2	allow $30 + 90$
(b)	$\begin{array}{ccc} n & A_n & B_n \\ 0 & 200 & 100 \\ 1 & 180 & 120 \\ 2 & 165 & 135 \\ 3 & 154 & 146 \\ 4 & 145 & 155 \end{array}$	B1B1ft B1B1ft B1	5	for $300 -$ 'their' A for $300 -$ 'their' A both allow 146 & 154 for $n = 3$ & 4 accept decimal numbers that round to these whole numbers
(c)	$A_n = 0.85A_{n-1} + 0.1\,(300 - A_{n-1})$	M1		(will probably be done with repeated calculations)
	or $A_n = 0.75\,A_{n-1} + 30$			
	120	A1	2	
(d)(i)	10%	B1	1	
(ii)	90%	B1ft	1	$\big[100 - \mathrm{d(i)}\big]$ do not follow follow through $0\% \rightarrow 100\%$
(e)	$p = 0.15$, $q = 0.9$	B2 B1	3	for either correct for 2nd correct accept embedded $p = 15\%$, $q = 90\%$ B2 max
	Total		**14**	

Question	Solution	Marks	Total	Comments
3(a)(i)	15 degrees Celsius	B1	1	
(ii)	3pm	B1	1	
(iii)	–1 degrees Celsius	B1	1	
(iv)	$t = 12$ 3 am	M1 A1	2	[use of degrees Celsius or ° in (i) or (ii)]
(b)	$C = 8\cos(15 \times 19)° + 7$ $= 9.07$ quite accurate	M1 A1 B1ft	3	
(c)	roughly one period of cos curve max and min at C = 15 & –1 min at $t = 12$ axes labelled	B1 B1 B1	3	
(d)	$8\cos(15t)° + 7 = 3$ $8\cos(15t)° = –4$	M1		and attempt to solve $\left[\text{or } t = 8 \text{ or } t = 16\right]$
	$\cos(15t)° = –0.5$ (inverse cos) $15t = 120$ or 240	M1 A1		(either) On at 11 pm or off at 7 am
	$t = 8$ or 16	M1		(either) 2nd value of t
	on at 11 pm and off at 7 am clear algebra	A1	5	both
	Total		**16**	

Question	Solution	Marks	Total	Comments
4(a)(i)	0.4 oe	B1	1	
(ii)	4 out of 10 random numbers allocated			

See paper for column titles								
A	2	60			0	0	60	0
B	0	30	1	30	30	60	90	30
C	7	120	5	60	90	90	210	0
D	6	90	6	90	180	210	300	30
E	3	**90**	5	**60**	**240**	**300**	**390**	**60**
F	1	**60**	4	**60**	**300**	**390**	**450**	**90**
G	4	**90**	3	**60**	**360**	**450**	**540**	**90**
H	9	**120**	7	**90**	**450**	**540**	**660**	**90**
I	5	**90**	0	**30**	**480**	**660**	**750**	**180**
J	2	**60**	9	**120**	**600**	**750**	**810**	**150**

Question	Solution	Marks	Total	Comments
	(J row)	B1	1	
(b)	column correct	B1	1	
(c)	column correct	B1	1	
(d)	arrival time 1st 3	B1ft		from time between customers
	2nd 3	B1ft		from time between customers and (column G) arrived time
	start 1st 3	B1		
	2nd 3	B1		
	finish 1st 3	B1ft		from service time ⎫ and start of
	2nd 3	B1ft		from service time ⎭ service
	length of wait 1st 3	B1ft		from service time ⎫ from start of ⎬ service
	2nd 3	B1ft	8	from service time ⎭ and arrived time
(e)(i)	customer I	B1ft	1	
(e)(ii)	either No – nobody waits too long or Yes – some customers wait too long	B2	2	(comment without either Yes or No max B1) No or Yes with poor/ no comment B0 **Must** reference simulation
(f)	eg allow for service gaps	B1		
	different lengths of service	B1		
	different lengths of arrival intervals (one mark for each sensible comment)		2	
	Total		**17**	
			64	
	+ up to 3 marks for mathematical arguments			
	+ up to 3 marks for mathematical notation			
	TOTAL		**70**	