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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

AS Use of Mathematics 5351

UOM4/2 Applying Mathematics paper 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.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

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.

June 07

AS Use of Mathematics

Applying Mathematics (UOM4/2)

Answers and Marking Scheme - June 2007

Question 1

(a)(i)	$\frac{160}{40} = 4$ hours	**B1**	Accept 4 or 240
(a)(ii)	$\frac{105}{60} + \frac{75}{50} =$ $1\frac{3}{4} + 1\frac{1}{2} =$ $3\frac{1}{4}$ hours	**M1** **A1** **A1**	For either $\frac{105}{60}$ or $\frac{75}{50}$ For either $1\frac{3}{4}$ or $1\frac{1}{2}$ Accept 3.25, 195 **SC2** no working 3 hr 25 min
(b)(i)	Single straight line joining origin to (4, 160)	**B1**	
(b)(ii)	Line starting at (12.45, 0) Line ending at (4[pm], 180) 2 straight lines Intersection of lines at (2.30pm, 105) i.e. gradient changes at (2.30pm, 105)	**M1** **M1** **M1** **A1**	**SC2** two straight lines, one starting at (0,0) other ending at (3.15, 180) **AND SC1** intersection of 2 lines at (1.45, 105) ie **SC3** for all of the above NB SC above only gives possibility of B1 in (c)(i) and B2 in (c)(ii) Dependent on all 3 M1s
(c)(i)	$b = 60$ when $d_B = 0 \quad t = 0.75$ $0 = a + 60 \times 0.75$ $a = -60 \times 0.75 = -45$	**B1** **M1** **A1**	For $b = 60$ Substituting any correct motorway point e.g. (2.5, 105)
(c)(ii)	(motorway) speed	**B2**	Accept ‘speed’, ‘how fast’ OE
	TOTAL	**14**	

Question 2

(a)	$m = \mathrm{e}^{-0.000121 \times 5730} = 0.4999 = 0.500$	**M1** **A1**	M1 0.000121×5730 or $0.693\ldots$
(b)	$m = \mathrm{e}^{-0.000121 \times 2 \times 5730} = 0.2499 = 0.250$	**M1** **A1**	M1 $0.000121 \times 2 \times 5730$ or $1.386\ldots$ or 1.39
(c)	General shape of exponential decay passing through (0,1) half-life approximately 5700 years	**B1** **B1** **B1**	Can touch but not cut axis
(d)	Answer in terms of gradient only: steeper when $t = 0$ than when t = 20000 Interpreting physical significance: rate of decay greater when $t = 0$	**B1** **B1**	Accept decaying faster when $t = 0$
(e)	$0.75 = \mathrm{e}^{-0.000121\,t}$ $\ln(0.75) = -0.000121t$ $-0.28768 = -0.000121t$ $t = 2377.5 = 2380$	**M1** **M1** **A1** **A1**	Use of logs eg $\ln 0.75 = \ln \mathrm{e}^{-0.000121\,t}$ Eliminating t Use of $\ln 0.75 = -0.287...$ or -0.288. Dependent on first M1 Full marks for answer only **SC3** no working 2370
(f)	More rapid decay OR shorter half life	**B2**	Anything which sensibly indicates this
	TOTAL	**15**	

Question 3

(a)(i)	$R_1 = 0.09(E_1 - 15000) = 0.09(25000 - 15000)$ **M1** $= 0.09 \times 10000$ $= 900$	**A1**	
(a)(ii)	$L_1 = L_0 - R_1 = 10000 - 900 = 9100$	**M1A1**	

(b)

Year, n	Earnings, E	Repaid, R	Loan remaining, L				
0	0	0	10000				
1	25000	900	9100				
2	27000	1080	8020				
3	29000	1260	6760				
4	31000	1440	5320				
5	33000	1620	3700				
6	35000	1800	1900				
7	37000	1980	–80	or	37000	1900	0
8	39000	2160	–2240		39000	0	0

	Earnings column: **B1** for $n = 2,3,4 +$ **B1ft** for $n = 5,6,7,8$	Condone 8 missing
	Repaid column: **B1** for $n = 2,3,4 +$ **B1ft** for $n = 5,6,7,8$	Condone 8 missing ft from E column and from previous value
	Loan column: **B1** for $n = 2,3,4 +$ **B1ft** for $n = 5,6,7,8$	Condone 8 missing ft from R column and from previous value

(c)	Just less than 7 years	**B1**	Accept 7 or less than 7 Do not accept 6
(d)	**B1** for their points plotted correctly for $n = 2,3,4 +$ **B1** for (their) $n = 5,6,7$ (within 1 square)		
(e)	Maria pays back a different amount/more each year Because her earnings increase each year	**B1** **B1**	
	TOTAL	**15**	

Question 4

TABLE 1

<table>
<tr><td>(a)(i)</td><td>$\frac{4}{10}$, $\left(\frac{2}{5}\right)$ or decimal equivalents</td><td>B1</td><td></td></tr>
<tr><td>(a)(ii)</td><td>4 integers are assigned out of a possible 10</td><td>B1</td><td></td></tr>
<tr><td>(a)(iii)</td><td colspan="3">
<table>
<tr><th>Customer</th><th>Time arrives at bank</th><th>Random number</th><th>Time to complete transaction</th></tr>
<tr><td>A</td><td>10:00</td><td>8</td><td>5</td></tr>
<tr><td>B</td><td>10:01</td><td>2</td><td>4</td></tr>
<tr><td>C</td><td>10:02</td><td>7</td><td>5</td></tr>
<tr><td>D</td><td>10:03</td><td>6</td><td>5</td></tr>
<tr><td>E</td><td>10:04</td><td>1</td><td>3</td></tr>
<tr><td>F</td><td>10:05</td><td>9</td><td>6</td></tr>
<tr><td>G</td><td>10:06</td><td>0</td><td>3</td></tr>
<tr><td>H</td><td>10:07</td><td>4</td><td>4</td></tr>
<tr><td>I</td><td>10:08</td><td>3</td><td>4</td></tr>
<tr><td>J</td><td>10:09</td><td>1</td><td>3</td></tr>
<tr><td>K</td><td>10:10</td><td>8</td><td>5</td></tr>
<tr><td>L</td><td>10:11</td><td>7</td><td>5</td></tr>
<tr><td>M</td><td>10:12</td><td>9</td><td>6</td></tr>
<tr><td>N</td><td>10:13</td><td>3</td><td>4</td></tr>
</table>
</td></tr>
<tr><td></td><td>Customers G,H,I,J
Customers K,L,M,N</td><td>B1
B1</td><td></td></tr>
<tr><td>(b)(i)</td><td>Customer D queues and waits and customer E arrives after him/her and is seen at the same time. E does not have to wait as long as D</td><td>B2</td><td>Do not allow customer E finishes before D (D takes longer).
Accept general comment on multiple queue systems</td></tr>
</table>

TABLE 2

(b)(ii)

Time	Cashier 1	Cashier 2	Cashier 3
10:00	A		
10:01	A	B	
10:02	A	B	C
10:03	A D	B	C
10:04	A D	B E	C
10:05	D F	E	C
10:06	D F	E G	C
10:07	D F	E G	H
10:08	D F	G I	H
10:09	D F	G I	H J
10:10	F K	G I	H J
10:11	F K	I L	J
10:12	F K	I L	J M
10:13	F K N	I L	J M
10:14	F K N	I L	M
10:15	F K N	L	M
10:16	K N	L	M
10:17	K N	L	M
10:18	K N	L	M
10:19	K N	L	M
10:20	K N		
10:21	N		
10:22	N		
10:23	N		
10:24	N		
10:25			

Arrival time	**B1**	Each at 1 minute interval correct
Customers G, H	**B1**	
Customers I, J	**B1ft**	**FT** (arrive at correct time)
All table correct	**B1**	

TABLE 3

(c)(i)	Yes, each customer is now dealt with in order of arrival Or No, D still waits the same length of time	**B2**	Comment on its own B2

(c)(ii)

Time	Queue	Cashier 1	Cashier 2	Cashier 3
10:00		A		
10:01		A	B	
10:02		A	B	C
10:03	D	A	B	C
10:04	D E	A	B	C
10:05	F	D	E	C
10:06	F G	D	E	C
10:07	G H	D	E	F
10:08	H I	D	G	F
10:09	H I J	D	G	F
10:10	I J K	H	G	F
10:11	J K L	H	I	F
10:12	J K L M	H	I	F
10:13	K L M N	H	I	J
10:14	L M N	K	I	J
10:15	M N	K	L	J
10:16	N	K	L	M
10:17	N	K	L	M
10:18	N	K	L	M
10:19		N	L	M
10:20		N		M
10:21		N		M
10:22		N		
10:23				
10:24				
10:25				

	Customers G, H Customers I, J All table correct All customers arrive at correct 1 minute interval	**B1** **B1ft** **B1** **B1**	 **FT** arrive at correct time
(d)	No – not worth the effort as it makes little difference in efficiency of customers being seen	**B1**	Allow alternative argument based on fairness for customers e.g. yes, customers perceive a fairer system
	Specific result from table	**B1**	e.g. F, K or N is quicker or H, J or M takes longer
(e)	Any sensible that will improve realism for example < allow for customers to arrive at different times customers take a greater range of time to complete transactions customers to swap queues etc.	**B1** **B1**	
	TOTAL	**20**	

+ up to 3 marks for ability to present information accurately using correct notation.
+ up to 3 marks for mathematical arguments presented clearly and logically.

	TOTAL MARK FOR PAPER	**70**	