A-LEVEL

USE OF MATHEMATICS

UOM4/2 – Applying Mathematics
Mark scheme

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

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)	$T = 100 - 2400/320$ $= 92.5$	M1 A1	 2	substitute for h
(ii)	$100 - h/320 = 90$ $h/320 - 10$ $h = 3200$ m	 M1 A1	 2	(or similar attempt at rearrangement)
(b)	$100 - 8000/320 (= 75)$ $75.5 - 75 = 0.5$	M1 A1	 2	Accept % error Or accept 160 m difference or 100 on T axis
(c)(i)		B1 B1 Not 1	 3	intercept at $(0,100)$ straight line negative gradient labelled axes
(ii)	it is linear relationship as altitude increases boiling temperature decreases	B1 B1	 2	 (accept negative gradient)
(d)(i)	1ˢᵗ model = 93.75 2ⁿᵈ model = 93.3 2ⁿᵈ model is closer	 B1 B1	 2	 for either for both plus conclusion
(ii)	$100 - h/320 = 100 - 0.15\sqrt{h}$ $h/320 = \pm 0.15\sqrt{h}$ $h = 48\sqrt{h}$ $h^2 = 2304h$ $h = 0$ or 2304 $h = 0$	 M1 M1 A1 B1 Arg 1	 5	or some equivalent rearrangement or rearrangement of this both clear algebra
	Total		**18**	

Question	Solution	Marks	Total	Comments
2(a)(i)	250×1.2^3	M1		
	$= 432$	A1	2	
(ii)	$250 \times 1.2^7 = 895/896$	M1		accept $1.2^n = 4$
	$250 \times 1.2^8 = 1074/1075$	M1		$n\log 1.2 = \log 4$
	so 8th year	A1	3	$n = \log 4 / \log 1.2 = 7.6$ (accept) so 8th year
				Year B on its own M2 A1
(iii)	keeps on getting bigger (exponentially)	B1	1	increase
(b)(i)	$P_1 = 250(1.2 - 250/4000)$	B1		
	$= 250 \times 1.1375$	B1		
	$= 284.375$			
		Not 1	3	use of subscript
(ii)	$\begin{array}{cc} n & P_n \\ 2 & 321 \\ 3 & 359 \\ 4 & 399 \end{array}$	B1		rounds to 321
		B1ft		rounds to 359
		B1ft		rounds to 399
		B1 cao	4	all whole number answers and correct
(iii)	$1.2 - P/4000 = 1$	M1		
	$P = 0.2 \times 4000$			
	$P = 800$	A1		(may will be done by repeated calculations)
		Arg1	3	use of algebra or checking 800 does not change
	Total		**16**	

Question	Solution	Marks	Total	Comments
3(a)(i)	$-15°C$	B1	1	
(ii)	$B = 20 - 35e^{-0.2t}$ $B = -8.66°C$	M1 A1	 2	Or $20 - 35e^{-0.1 \times 2}$ accept -8.7 or rounding to -8.7
(iii)	$4 = 20 - 35e^{-0.1t}$ $e^{-0.1t} = 16/35$ oe $-0.1t = \ln(16/35)$ $t = 7.83$ $t = 7\text{hrs } 50 \text{ minutes}$	 M1 M1 A1 B1 ft Arg 1	 5	 isolating the e term (accept sign errors) taking ln clear algebra
(iv)	trying some large value of t $20°C$	M1 A1	 2	eg $t \geq 50$ accept 20 on its own
(b)		B1 B1 ft B1 ft Not 1	 4	e shape (reflected both horizontally and vertically) B vertical horizontal asymptote at their **(a)(iv)** (0, their **(a)(i)**) on B axis) axes labelled
(c)(i)	stretch scale factor 35 parallel to B axis	B1	1	accept y axis or vertically
(ii)	reflect in the t axis	B1	1	accept x or horizontal axis
(iii)	translate 20 in the (positive) B direction	B1	1	accept (positive) y direction or vector
	Total		**17**	

Question	Solution	Marks	Total	Comments
4(a)(i)	$3/10$ oe	B1	1	
(ii)	3 out of the 10 numbers	B1	1	
(b)	gap times times since first order	B1 B1 ft	2	check cumulative sums from their column
(c)	size of order column preparation time column	B1 B1 ft	2	from their SML
(d)		B6ft	6	B1 for each row $\times 6$
(e)	13, 2, 10, 5, 3, 10	B2 ft	2	(ft from Finish time – time since first order) B2ft if 6 correct, B1ft if 4 correct
(f)	no	B1 ft		can gain B1 for Yes if (E) is wrong and last column exceeds preparation time by lots.
	last column does not exceed preparation time by enough	B1 ft	2	if reason agrees with their Yes under ft
(g)(i)	run it for more times run it again run it longer	B1	1	
(ii)	eg more varied times for intervals for preparation	B1 B1	2	
	Total		19	

Customer	Random number	Gap time (minutes)	Time customer places order (pm)	Random number	Size of order	Preparation time (minutes)	Chef	Start time of preparation (pm)	Finish time of preparation (pm)	Time since order placed (minutes)
A			7.00	5	L	10	X	7.00	7.10	10
B	2	2	7.02	2	M	5	Y	7.02	7.07	5
C	5	4	7.06	8	L	10	Y	7.07	7.17	11
D	7	6	7.12	6	L	10	X	7.12	7.22	10
E	0	2	7.14	7	L	10	Y	7.17	7.27	13
F	9	8	7.22	0	S	2	X	7.22	7.24	2
G	0	2	7.24	7	L	10	X	7.24	7.34	10
H	4	4	7.28	4	M	5	Y	7.28	7.33	5
I	6	4	7.32	1	S	2	Y	7.33	7.35	3
J	2	2	7.34	8	L	10	X	7.34	7.44	10