

GCE 2004

June Series



Mark Scheme

Mathematics A

Unit MAS1/W

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 from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Copyright © 2004 AQA and its licensors

COPYRIGHT

AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX.

Dr Michael Cresswell Director General

Key to Mark Scheme

M	mark is for	method
m	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	
AWFW	anything which falls within	
AWRT	anything which rounds to	
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)	

Abbreviations used in Marking

MC – x	deducted x marks for mis-copy
MR – x	deducted x marks for mis-read
ISW	ignored subsequent working
BOD	given benefit of doubt
WR	work replaced by candidate
FB	formulae booklet

Application of Mark Scheme

No method shown:

Correct answer without working.....	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

More than one method/choice of solution:

2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only

Crossed out work

do not mark unless it has not been replaced

Alternative solution using a correct or partially
correct method

award method and accuracy marks as
appropriate

MAS1/W

Q	Solution	Marks	Total	Comments
1(a)	$L \sim N(10.25, \sigma^2)$			
	$P(L < 10) = P\left(Z < \frac{10 - 10.25}{\sqrt{0.04}}\right) =$	M1		standardising (9.5, 10 or 10.5) with ($\sqrt{0.04}$, 0.04 or 0.04^2) and/or $(10.25 - 10)$
	$P(Z < -1.25) =$	A1		cao; ignore sign
	$1 - \Phi(1.25) =$	m1		area change
	$1 - 0.89435 =$ 0.105 to 0.106	A1	4	awfw
(b)	$P(L > 10) = 0.98$			
	$z_{0.98} = -2.0537$	B1		awfw 2.05 to 2.06; ignore sign
	Also $z = \frac{10 - 10.25}{\sigma}$	M1		standardising (10 or 10.5) with 10.25 and σ ; allow $(10.25 - 10)$
	Thus $\frac{10 - 10.25}{\sigma} = -2.0537$	m1		equating z-term to z-value; not using 0.98, 0.02 or $ 1 - z $
	Thus $\sigma = 0.121$ to 0.122	A1	4	awfw; do not ignore sign (A0 if negative sign dropped)
	Total		8	

MAS1/W(Cont)

Q	Solution	Marks	Total	Comments
2(a)		B1	4	x-axis; (0) to 60
		B1		f(x)-axis; (0) to k or 0.025
		B1		+ve slope straight line; 0 to 40
		B1		horizontal straight line; 40 to 60 (allow minor extensions) (0 for axes reversed)
(b)	Area under graph = 1	M1	3	use of; may be implied by their area must be stated for $k = 0.025$ assumed
	$\text{Area} = \left(\frac{1}{2} \times 40 \times k\right) + (20 \times k)$ or $\text{Area} = k \times \left(\frac{60 + 20}{2}\right) = 40k$ (implies $k = 0.025$)	M1		area of (triangle + rectangle) [= 0.5 + 0.5 (+A1)] area of (trapezium) [= 1 (+A1)]
(c)	At $x = 30$ height = $0.75k$ or 0.0188	B1	3	cao; or equivalent AG (Area = $40k \Rightarrow$ M0 M1 A1) cao/awrt or equivalent
	or $\left[\frac{kx^2}{80}\right]_0^{30}$ $P(X > 30) = \left(10 \times \left(\frac{0.75k + k}{2}\right)\right) + (20 \times k)$ or $1 - \left(\frac{1}{2} \times 30 \times 0.75k\right)$ $= 28.75k \text{ or } (1 - 11.25k)$ $= 23/32 \text{ or } 0.719$	M1		or equivalent area of (trapezium + rectangle) 1 – area of (triangle) $115k/4$ or $(1 - 45k/4)$ cao/awrt (0.71875)
Total			10	

MAS1/W (Cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	Binomial $n = 25$	M1	4	Attempted use of in part (a)
	$p_G = \frac{88}{400} (= 0.22)$	B1		cao; may be implied
	$P(G = 2) = \binom{25}{2} (0.22)^2 (0.78)^{23} =$	M1		correct expression for B(25, p) ($0 < p < 1$) with $x = 2$
	$300 \times 0.0484 \times 0.0032974 =$ 0.0478 to 0.048	A1		Awfw (0.0478787) [watch for $(0.22)^2 = 0.048(4)$]
(ii)	$p_B = \frac{60}{400} (= 0.15)$	B1	2	cao; may be implied by correct answer
	$P(B \leq 3) = 0.4705$ to 0.4715	B1		Awfw (0.4711(213))
(iii)	$p_R = \frac{160}{400} (= 0.4)$	B1	4	cao; may be implied by correct answer or ≥ 1 correct probability
	$P(8 \leq R \leq 12)$ $= P(R \leq 12)$	M1		use of ≤ 12
	$- P(R \leq 7)$ $= 0.8462 - 0.1536$	M1		M1 for ≥ 1 correct term M2 for 5 correct terms added use of $-$ and ≤ 7
	$= 0.692$ to 0.693	A1		Awfw (0.6926(805))
(b)	Number of trials/events or sample size or n is not fixed	B1	2	B0 for n not constant or decreasing, etc
	$P(\text{success})$ or $P(Y)$ or p is not constant	B1		accept trials/events are not independent or are dependent
Total			12	

MAS1/W (Cont)

Q	Solution	Marks	Total	Comments
4(a)	$c = \frac{1}{230-140} = \frac{1}{90}$ or 0.011	B1	1	cao/awrt
(b)	$P(X < 200) = c \times (200 - 140)$ $= \frac{2}{3}$ or 0.67	M1 A1	2	attempt at area of a rectangle of height c cao/awrt
(c)	Mean: $\mu = \frac{230+140}{2} = 185$	B1		cao
	Variance $\sigma^2 = \frac{(230-140)^2}{12} = 675$	B1	2	cao
(d)	Large sample or Central Limit Theorem \bar{X} is normal with mean = 185 and variance = $\frac{\sigma^2}{75}$ $= 9$	B1 B1 \checkmark M1 A1	4	or equivalent (eg $n \geq 25$) both; \checkmark on part (c) for mean use of their $\sigma^2 \div$ by 75 (may be implied) cao
Total			9	

MAS1/W (Cont)

Q	Solution	Marks	Total	Comments
5(a)	$\text{Var}(T) = s^2 = \frac{279.8929}{49} = 5.71$	B1	3	awrt (5.7121)
	$\text{SE}(\bar{T}) = \sqrt{\frac{\text{Var}(T)}{50}}$	M1		use of
	$= 0.338$	A1		Awrt cannot be scored in part (b)(i)]
(b)(i)	$\bar{t} = \frac{143.5}{50} = 2.87$	B1	5	cao; can be scored in part (a)
	99% implies $z = 2.5758$	B1		awfw 2.57 to 2.58
	CI for μ is: $\bar{t} \pm z \times \frac{(s \text{ or } \sigma)}{\sqrt{n}}$ or $\bar{t} \pm z \times \text{SE}(\bar{t})$	M1		use of; must have \sqrt{n} with $n > 1$ or equivalent or \sqrt{n} in $\text{SE}(\bar{t})$
	Thus: $2.87 \pm (2.5758 \times 0.338)$	A1✓		✓ on \bar{t} , z and $\text{SE}(\bar{t}) > 0$; accept $\bar{t} = 143.5$ only if clearly stated
	Thus: (2.00, 3.74)	A1		awrt; accept 2 dependent on ÷ by 49 in part (a) unless subsequently corrected
(ii)	Evidence to suggest that $\mu = 3.5$ as 3.5 inside CI	B1✓ B1✓	2	✓ on part (b)(i) clearly stated; ✓ on part (b)(i)
(c)	Now evidence to suggest that μ has changed/increased from 3.5 (as 3.5 outside/below CI)	B1		reason not required
	Also evidence (to suggest μ has increased during three months) as CIs do not overlap	B1	2	reason required
Total			12	

MAS1/W (Cont)

Q	Solution	Marks	Total	Comments
6(a)	Area of rectangle is given by: $A = S \times \left(2 + \frac{40}{S}\right) = 2S + 40$	B1	4	cao; may be implied by $E(A) = 50$
	Mean: $E(A) = 2 \times 5 + 40 = 50$	B1		cao
	Variance: $Var(A) = 2^2 \times Var(S)$	M1		use of $Var(aX + b) = a^2 Var(X)$ with $a > 1$ and $b \geq 0$
	$= 4 \times 33 = 132$	A1		cao
(b)(i)	$s:$ 1 5 10 20		3	cao or equivalent use of $\sum x \times P(X = x)$
	$t = 40/s:$ 40 8 4 2	B1		
	$p:$ 0.5 0.3 0.1 0.1			
	$E(T) = \sum t \times P(S = s) = \sum t \times p$ $= 40 \times 0.5 + 8 \times 0.3 + 4 \times 0.1 + 2 \times 0.1$ $= 20 + 2.4 + 0.4 + 0.2$ $= 23$	M1 A1		
(ii)	Perimeter of rectangle is given by: $P = 2 \times (S + (2 + T)) = 2S + 2T + 4$		2	cao
	Mean: $E(P) = 2 \times 5 + 2 \times 23 + 4$ $= 60$	B2		
	Total		9	
	Total		60	