GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics A
Unit MAS1/W

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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

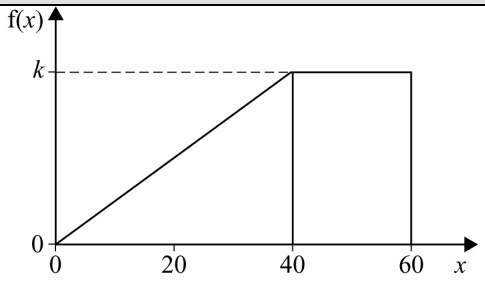
Crossed out work do not mark unless it has not been replaced

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)	$L \sim \text{N}(10.25, \sigma^2)$			
	$\text{P}(L < 10) = \text{P}\left(Z < \dfrac{10-10.25}{\sqrt{0.04}}\right) =$	M1		standardising (9.5, 10 or 10.5) with ($\sqrt{0.04}$, 0.04 or 0.04^2) and/or (10.25 – 10)
	$\text{P}(Z < -1.25) =$	A1		cao; ignore sign
	$1 - \Phi(1.25) =$ $1 - 0.89435 =$	m1		area change
	0.105 to 0.106	A1	4	awfw
(b)	$\text{P}(L > 10) = 0.98$			
	$z_{0.98} = -2.0537$	B1		awfw 2.05 to 2.06; ignore sign
	Also $\quad z = \dfrac{10-10.25}{\sigma}$	M1		standardising (10 or 10.5) with 10.25 and σ; allow (10.25 – 10)
	Thus $\quad \dfrac{10-10.25}{\sigma} = -2.0537$	m1		equating z-term to z-value; not using 0.98, 0.02 or $\lvert 1 - z \rvert$
	Thus $\quad \sigma$ = 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 B1 B1 B1	 4	*x*-axis; (0) to 60 f(*x*)-axis; (0) to *k* or 0.025 +ve slope straight line; 0 to 40 horizontal straight line; 40 to 60 (allow **minor** extensions) (0 for axes reversed)
(b)	Area under graph = 1	M1		use of; may be implied by their area **must** be stated for $k = 0.025$ assumed
	Area = $\left(\frac{1}{2}\times 40\times k\right) + (20\times k)$ or Area = $k\times\left(\frac{60+20}{2}\right)$	M1		area of (triangle + rectangle) [= 0.5 + 0.5 (+A1)] area of (trapezium) [= 1 (+ A1)]
	$= 40k$ (implies $k = 0.025$)	A1	3	cao; or equivalent AG (Area = 40k ⇒ M0 M1 A1)
(c)	At $x = 30$ height = $0.75k$ or 0.0188 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 $1-\left(\frac{1}{2}\times 30\times 0.75k\right)$ $= 28.75k$ or $(1 - 11.25k)$ $= 23/32$ or 0.719	B1 M1 A1	 3	cao/awrt or equivalent 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		Attempted use of in part (a)
	$p_G = \frac{88}{400} (= 0.22)$	B1		cao; may be implied
	$\mathrm{P}(G = 2) = \binom{25}{2}(0.22)^2(0.78)^{23}$ =	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	4	Awfw (0.0478787) [watch for $(0.22)^2 = 0.048(4)$]
(ii)	$p_B = \frac{60}{400}$ (= 0.15)	B1		cao; may be implied by correct answer
	P($B \leq 3$) = 0.4705 to 0.4715	B1	2	Awfw (0.4711(213))
(iii)	$p_R = \frac{160}{400}$ (= 0.4)	B1		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 M1 for ≥ 1 correct term M2 for 5 correct terms added
	– P($R \leq 7$) = 0.8462 – 0.1536	M1		use of – and ≤ 7
	= 0.692 to 0.693	A1	4	Awfw (0.6926(805))
(b)	Number of trials/events or sample size or n is not fixed	B1		B0 for n not constant or decreasing, etc
	P(success) or P(Y) or p is not constant	B1	2	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($X < 200$) = $c \times (200 - 140)$	M1		attempt at area of a rectangle of height c
	$= \frac{2}{3}$ or 0.67	A1	2	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	B1		or equivalent (eg $n \geq 25$)
	$\overline{X}$ is normal with mean = 185	B1√		both; √ on part (c) for mean
	and variance = $\frac{\sigma^2}{75}$	M1		use of their σ^2 ÷ by 75 (may be implied)
	$= 9$	A1	4	cao
	Total		**9**	

MAS1/W (Cont)

Q	Solution	Marks	Total	Comments
5(a)	$\text{Var}(T) = s^2 = \dfrac{279.8929}{49} = 5.71$	B1		awrt (5.7121)
	$\text{SE}(\bar{T}) = \sqrt{\dfrac{\text{Var}(T)}{50}}$	M1		use of
	$= 0.338$	A1	3	Awrt [**cannot** be scored in part (b)(i)]
(b)(i)	$\bar{t} = \dfrac{143.5}{50} = 2.87$	B1		cao; can be scored in part (a)
	99% implies $z = 2.5758$	B1		awfw 2.57 to 2.58
	CI for μ is: $\bar{t} \pm z \times \dfrac{(s \text{ or } \sigma)}{\sqrt{n}}$ 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	5	awrt; accept 2 dependent on ÷ by 49 in part (a) unless subsequently corrected
(ii)	Evidence to suggest that $\mu = 3.5$	B1√		√ on part (b)(i)
	as 3.5 inside CI	B1√	2	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		cao; may be implied by E(A) = 50
	Mean: E(A) = 2 × 5 + 40 = 50	B1		cao
	Variance: Var(A) = 2^2 × Var(S)	M1		use of Var($aX + b$) = a^2Var(X) with $a > 1$ and $b \geq 0$
	= 4 × 33 = 132	A1	4	cao
(b)(i)	s: 1 5 10 20			
	t = 40/s: 40 8 4 2	B1		cao or equivalent
	p: 0.5 0.3 0.1 0.1			
	$\mathrm{E}(T) = \sum t \times \mathrm{P}(S = s) = \sum t \times p$	M1		use of $\sum x \times \mathrm{P}(X = x)$
	= 40 × 0.5 + 8 × 0.3 + 4 × 0.1 + 2 × 0.1 = 20 + 2.4 + 0.4 + 0.2 = 23	A1	3	cao or equivalent AG
(ii)	Perimeter of rectangle is given by: $P = 2 \times (S + (2 + T)) = 2S + 2T + 4$ Mean: E(P) = 2 × 5 + 2 × 23 + 4 = 60	B2	2	cao
	Total		**9**	
	Total		**60**	