AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Mathematics A

Unit MAS2

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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 mark 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		Perhaps implied
c		Candidate

Abbreviations used in marking

MC – *x*	deducted *x* marks for miscopy
MR – *x*	deducted *x* marks for misread
ISW	ignored subsequent working
BOD	gave benefit of doubt
WR	work replaced by candidate

Application of mark scheme

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

Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Q	Solution	Marks	Total	Comments
1 (a)	$X \sim$ number of bus journeys up to and including the first time she has to stand			
	$X \sim \text{Geo}(0.09)$	B1		
	$\text{P}(X = 10) = (0.91)^9(0.09)$ $= 0.0385$	M1		
		A1	3	AWFW 0.038 to 0.039
(b)	$\text{E}(X) = \frac{1}{p} = \frac{1}{0.09} = 11\frac{1}{9} = 11.1$	M1A1	2	
	Total		**5**	
2 (a)(i)	$X \sim \text{B}(500, 0.01)$	B1	1	
(ii)	$\text{P}(X = 1) = 500 \times (0.01) \times (0.99)^{499}$	M1		Binomial with correct p and q used
	$= 0.0332$	A1	2	AWRT 0.033
(b)	$\text{E}(X) = 500 \times 0.01 = 5$	B1√		
	$\text{Var}(X) = 5 \times 0.99 = 4.95$	B1√	2	on their B (n, p)
(c)	$X \sim \text{P}_0(5)$	B1√		on their B (n, p)
	$\text{P}(X > 10) = 1 - \text{P}(X \leq 10)$ $= -0.9863$	M1		(must use Poisson)
	$= 0.0137$	A1	3	AWFW 0.013 to 0.014
	Total		**8**	

Q	Solution	Marks	Total	Comments
3 (a)	$\mathrm{f}(6)=\frac{2}{5}=0.4$			
	$\mathrm{P}(T\geq 6)=\frac{1}{2}\times\frac{3}{2}\times\frac{2}{5}$	M1		
	$=\frac{3}{10}$ or 0.3	A1	2	
(b)	$\int_3^m \frac{1}{90}t^2\,\mathrm{d}t=0.5$	M1 M1		Correct limits $\int \mathrm{f}(t)\mathrm{d}t=0.5$
	$\therefore\left(\frac{1}{270}t^3\right)_3^m=0.5$	m1 A1		$\int\frac{1}{90}t^2\,\mathrm{d}t$ $=\frac{1}{270}t^3$
	$m^3-27=135$ $m^3=162$	m1		Substitution of correct limits to obtain a cubic
	$m=5.45$	A1√	6	CAO
(c)	$\int_3^6 \frac{1}{90}t^3\,\mathrm{d}t+\int_6^{7.5}\left(2t-\frac{4}{15}t^2\right)\mathrm{d}t$	M1 m1		Attempt at: (i) $t\mathrm{f}(t)$ (ii) two integrals
	$\left[\frac{t^4}{360}\right]_3^6+\left[t^2-\frac{4}{45}t^3\right]_6^{7.5}$	A1A1		(iii) correct integration
	$(3.6-0.225)+(18.75-16.8)$ $3.375-1.95$ $=5.325$	A1	5	$5\frac{13}{40}$ (AWRT 5.33)
	Total		**13**	

Q	Solution	Marks	Total	Comments
4 (a)	$H_0 : \mu = 7.0$ $H_1 : \mu < 7.0$	B1		
	$X \sim$ number failing to turn up per day			
	$\therefore X \sim P_0(7.0)$	M1A1		AWRT 0.082
	$P(X \leq 3) = 0.0818$ (tables)			
	> 0.05 $\therefore$ accept H_0	m1		
	insufficient evidence at the 5% level of significance to support the manager's claim	E1	5	
(b)	$H_0 : \mu = 98$ $H_1 : \mu < 98$	B1		
	$Y \sim P_0(98)$			
	$\approx N(98, 98)$	M1A1√		Correct approximation (on their μ)
	$z = \dfrac{74.5 - 98}{\sqrt{98}}$	M1 A1		Accept 74 ± 0.5
	$z = -2.374$	A1		CAO (–2.37)
	$z_{crit}^{1\%} = -2.3263$	B1		(on their z value)
	reject H_0 at the 1% level	A1√		
	evidence at the 1% level of significance to suggest that there has been a decrease in the number of patients not turning up	E1√	9	
	Total		**14**	

Q	Solution	Marks	Total	Comments
5	H_0 : School & Examination grades are independent (i.e. no association)	B1		
	$v = (2-1)(4-1) = 3$	B1		
	$\chi^2_{5\%} = 7.815$	B1√		on their *v*
	O_i | E_i | $\frac{(O_i - E_i)^2}{E_i}$ 52 | 49.8 | 0.0972 34 | 27.6 | 1.4841 16 | 23.4 | 2.3402 18 | 19.2 | 0.0750	M1		Any correct method for E_i
		A1		All correct
	114 | 116.2 | 0.0417 58 | 64.4 | 0.6360 62 | 54.6 | 1.0029 46 | 44.6 | 0.0321 400 400	M1		Attempt at $\sum \frac{(0_i - E_i)^2}{E_i}$
	$X^2 = 5.709$	A1		AWFW 5.70 to 5.71
	$5.709 < 7.815$ $\therefore$ do not reject H_0	M1√		(Accept H_0)
	insufficient evidence at the 5% level of significance to suggest an association between school and examination grades	A1√	9	follow through on their values of X^2 and χ^2
		Total	**9**	

Q	Solution	Marks	Total	Comments
6 (a)(i)	$X = W - D_1 \sim N(1, 0.36)$	B1B1	2	
(ii)	$\mathrm{P}(X \geq 0) = \mathrm{P}\left(Z > \frac{0-1}{0.6}\right)$	M1		on their σ
	$= \mathrm{P}(Z > -1.67)$	A1		CAO
	$= \Phi(1.67)$			
	$= 0.953$	A1	3	AWFW 0.952 to 0.953 (calculator 0.95221)
(b)(i)	$Y = \mathrm{L} - (\mathrm{D}_1 + \mathrm{D}_2 + \mathrm{D}_3)$			Use of $\sum \mathrm{D}_i \sim \mathrm{N}(24, 0.48)$
	$Y \sim \mathrm{N}(3,\ 1.69)$	B1B1	2	and $\mathrm{L} \sim \mathrm{N}(27, 1.21)$
(ii)	$\mathrm{P}(0 < Y < 1) = \mathrm{P}(-2.31 < Z < -1.54)$	M1		$z = \frac{0-\mu}{\sigma}$ and $z = \frac{1-\mu}{\sigma}$ on their μ and σ
	$z = -2.31$ and $z = -1.54$	A1		CAO
	$= \Phi(2.31) - \Phi(1.54)$ $= 0.986856 - 0.93822$	A1√		on their z-values
	$= 0.0513$	A1	4	AWFW (0.051 to 0.052)
	Total		**11**	
	Total		**60**	