GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics A
Unit MAS2/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

MAS2/W

Q	Solution	Marks	Total	Comments
1(a)(i)	$X \sim \mathrm{P}_0(4.0)$			
	$\mathrm{P}(X>8) = 1 - \mathrm{P}(X \le 8)$	M1		
	$= 1 - 0.9786$			
	$= 0.0214$	A1	2	(0.021 accept)
(ii)	$Y \sim \mathrm{P}_0(3.5)$			
	$\mathrm{P}(Y<2) = \mathrm{e}^{-3.5}(1+3.5)$	M1		
	$= 0.136$	A1	2	(0.13589)
b(i)	$\lambda = \mathrm{E}(T) = 7.5$	B1	1	
(ii)	$\mathrm{P}(T \ge 11) = 1 - \mathrm{P}(T \le 10)$	M1		
	$= 1 - 0.8622$			
	$= 0.1378$	A1ft	2	(on their λ)
	Total		**7**	

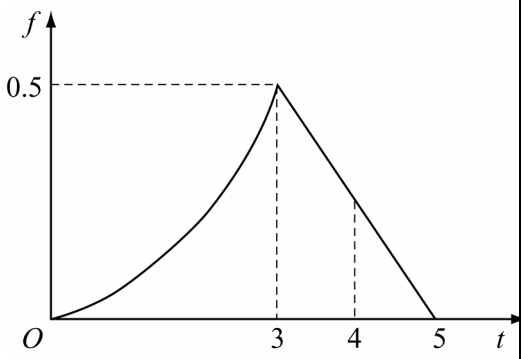
MAS2/W (Cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	Number of attempts = 112	B1	1	
(ii)	Number of goals = 50	B1	1	
(b)	$\mathrm{P}(scoring) = \frac{50}{112} = 0.446\ (3\mathrm{dp})$	B1	1	AG
(c)(i)	$Geo(0.446)$	B1	1	
(ii)	x | O_i | P(x) | E_i 1 | 20 | 0.446 | 22.30 2 | 14 | 0.247 | 12.35 3 | 8 | 0.137 | 6.85 4 | 3 | 0.076 | 3.80 5 | 3 | 0.042 | 2.10 6 | 1 | 0.023 | 1.15 ≥ 7 | 1 | 0.029 | 1.45(6) | 50 | 1.000 | 50	M1 A1		$50\times p(x)$ attempted $\sum p = 1,\ \sum E_i = 50$
	x | O_i | E_i | $(O_i - E_i)^2 / E_i$ 1 | 20 | 22.30 | 0.2372 2 | 14 | 12.35 | 0.2004 3 | 8 | 6.85 | 0.1931 ≥ 4 | 8 | 8.50 | 0.0294	M1 m1		Combining $E_i < 5$ Final column attempted; dependant on **first** M1; based on $50\times p$ used.
	$\sum O_i = 50 = \sum E_i$ 0.680	A1		cao Awfw 0.65 to 0.69 (only if first M1A1 obtained)
	$\nu = 4 - 2 = 2$	B1		
	$\chi^2_{5\%}(2) = 5.991$	B1ft		(on their ν)
	Geo(0.446) is a fairly good model for the given data	Elft	8	on their values
	Total		**12**	

MAS2/W (Cont)

Q	Solution	Marks	Total	Comments
3(a)	$X \sim B\,(900, 0.01)$	B1	1	
(b)	$\mathrm{E}(X) = 900 \times 0.01 = 9$	B1		
	$\mathrm{Var}(X) = 9 \times 0.99 = 8.91$	B1	2	
(c)(i)	$X \sim \mathrm{P}_0(9.0)$	B1		
	$\lambda = \mathrm{E}(X) \approx \mathrm{Var}(X)$	B1	2	Accept n large $(n \geq 30)$ And p small ($p < 0.1$)
(ii)	$\mathrm{P}(X > 15) = 1 - \mathrm{P}(X \leq 15)$	M1		[For $1 - \mathrm{P}(X \leq 15)$ for any dist. approx used]
	$= 1 - 0.9780$ $= 0.022$	A1	2	awrt 0.022
(d)(i)	Unreasonable that p is constant	B1	1	
(ii)	Group of friends are more likely to be excluded	B1	1	
	Total		**9**	

MAS2/W (Cont)

Q	Solution	Marks	Total	Comments
4(a)		B1		Curve from (0, 0) to (3, 0.5)
		B1	2	Straight line from (3, 0.5) to (5, 0)
(b)	$F(t) = \begin{cases} \dfrac{t^3}{54} & 0 \le t \le 3 \\ \dfrac{1}{8}(10t - t^2 - 17) & 3 \le t \le 5 \end{cases}$	B1 M1M1 A1	4	
(c)	$P(T < 4) = F(4) = \frac{1}{8}(40 - 16 - 17)$	M1		**Alternative (c):** $1 - \frac{1}{2} \times 1 \times f(4)$
				$1 - \frac{1}{2} \times 1 \times \frac{1}{4}$
	$= \frac{7}{8}$ or 0.875	A1	2	$1 - \frac{1}{8} = \frac{7}{8}$
	Total		**8**	

MAS2/W (Cont)

Q	Solution	Marks	Total	Comments
5(a)	$H_o : \mu = 300$ $H_1 : \mu < 300$	B1		
	$Y \sim N(300, 16)$ $\bar{Y} \sim N\left(300, \frac{16}{20}\right) \sim N(300, 0.8)$	B1		For 0.8
	$z = \frac{298.1 - 300}{\sqrt{0.8}} = -2.124$	M1A1		awrt –2.12
	$z_{crit} = -2.3263$	B1		Allow ± 2.3263
	accept H_o Insufficient evidence at the 1% level to support the members' suspicion.	E1ft	6	on their *z*
(b)	$\frac{\bar{Y} - 300}{\sqrt{0.8}} \leq -2.3263$ $\bar{Y} \leq 300 - \sqrt{0.8} \times 2.3263$	M1		
	$\bar{Y} \leq 297.9$	A1	2	
(c)	P(Type II error)			
	$= P\left(Z > \frac{297.9 - 296.5}{\sqrt{0.8}}\right)$	M1√		M1 and next A1 ft on their (b) $z = 1.5868$ (1.56 – 1.59)
	$= P(Z > -1.59)$	A1ft		
	$= 1 - \Phi(1.59)$			
	$= 1 - 0.94408$			
	$= 0.0559$ (3sf)	A1	3	Awrt 0.055 to 0.060
	Total		**11**	

MAS2/W (Cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	$A_1 \sim \mathrm{N}(12,\ 3)$ $A_2 \sim \mathrm{N}(6, 2)$ $A_3 \sim \mathrm{N}(32, 20)$			
	$T_A = A_1 + A_2 + A_3 \sim \mathrm{N}(50,\ 25)$	B1B1	2	
(ii)	$\mathrm{P}(T_\mathrm{A} < 60) = \mathrm{P}(Z < 2.0)$ $= 0.97725$	M1 A1ft	2	$\left[\frac{60-\mu}{\sigma}\right]$ for their μ, σ
(b)	$T_B \sim \mathrm{N}(53,\ 16)$ $\mathrm{P}(T_B < 60) = \mathrm{P}(Z < 1.75)$ $= 0.95994$	B1	1	
(c)(i)	P(at least one will take > 1 hour) $= 1 - 0.97725 \times 0.95994$ $= 1 - 0.9381$ $= 0.0619$	M1A1√ A1	3	$(0.02275 \times 0.95994) +$ $(0.04006 \times 0.97725) +$ (0.04006×0.02275) $= 0.021839 + 0.03915 + 0.00091$ $= 0.0619$
(ii)	$T_B - T_A \sim \mathrm{N}(3, 41)$ $\mathrm{P}(T_B - T_A > 0) = \mathrm{P}(Z > -0.4685)$ $= \Phi(0.47)$ $= 0.68082$	B1 M1 A1 M1 A1	5	For 3 For adding variances for 41 $\frac{0-3}{\sqrt{41}}$ awfw 0.680 and 0.681
	Total		**13**	
	Total		**60**	