AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Mathematics A

Unit MAS1

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)	$P(T < 8) = (8-4) \times \left(\frac{0.05+0.1}{2}\right)$	M1		Trapezium Worthwhile attempt at correct area, however divided
	or			
	$\{(8-4)\times 0.05\} + \left\{\frac{1}{2}\times(8-4)\times(0.1-0.05)\right\}$			Rectangle + triangle
	$= 0.3$	A1	2	CAO; OE
(b)(i)	Area under graph = 1	M1		Use of; may be implied by their area; accept $P(T > 8) = 1 - $ (a) must be stated clearly in reverse method
	Area = (a) +			
	$\{(s-8)\times 0.1\} + \left\{\frac{1}{2}\times(20-s)\times 0.1\right\}$	M1		Worthwhile attempt at area under given graph or area above 8, however divided
	or			
	$\left(\frac{(20-8)+(s-8)}{2}\right)\times 0.1$			
	Hence $0.05s = 0.5$	A1	3	CAO; OE
	(implies $s = 10$)			AG NB: In reverse method, assuming $s = 10$ so triangle area = 0.5 then showing $s = 10$ given rectangle area = 0.2, scores max of M1 M1 A0
(ii)	$P(T > 15) = \frac{1}{2}\times(20-15)\times f(15)$	M1		Area of correct triangle or $\int_{15}^{20} y\,dx$
	However using (b)			
	$f(15) = 0.05$	B1		CAO; OE or $y = 0.2 - 0.01x$
	Thus $P(T > 15) = 0.125$	A1	3	CAO; OE
	Total		**8**	

Q	Solution	Marks	Total	Comments
2 (a)	$p = 0.85$			
	$n = 5$			
	$P(X = 4) = \binom{5}{4} (0.85)^4 (0.15)^1 =$	M1		Use of B (5 or 40, 0.85 or 0.15) in (a) or (b); may be implied
	$5 \times 0.52201 \times 0.15 =$ 0.391 to 0.392	A1	2	AWFW (0.8352 – 0.4437 = 0.3915) M0 for normal approximation
(b)	$n = 40$			
	Tables			
	$P(X > 30) = P(X \geq 31) = P(X' \leq x')$	M1		Change to X'
	$P(X' \leq 9) =$	A1		9,10 or 11; 0.970(1) or 0.988
	0.933	A1		AWRT; (0.9328)
	Calculator			
	$P(X > 30) = P(X = 31, 32, \ldots, 40)$ or	(*M1*)		9, 10 or 11 terms
	$P(X' \leq 9) = P(X' = 9, 8, \ldots, 0)$	(*A1*)		At least one 3-part term correct or 0.067
	0.933	(*A1*)	3	AWRT M0 for normal approximation
(c)	$n = 250$			
	Mean ($\mu = np$) = 212.5 or 37.5	B1		CAO; either
	and			
	Variance ($\sigma^2 = np(1-p)$) = 31.875	B1		AWFW 31.8 to 31.9 or σ = 5.64 to 5.65
	$P(X_B < 200) = P(X_N < 199.5) =$	B1		CAO; accept X' and 50.5
	$P\left(Z < \frac{199.5 - 212.5}{\sqrt{31.875}}\right)$	M1		Standardising (199.5, 200, 200.5) or (49.5, 50, 50.5, 51, 51.5) using their μ and their σ (not σ^2) consistently M0 for B (250, 0.85) = 0.0130
	$= P(Z < -2.30)$ or $P(Z > 2.30)$			
	$= 1 - \Phi(2.30)$	m1		Attempt at area change
	= 0.010 to 0.011	A1	6	AWFW; 0.01065
	Total		**11**	

Q	Solution	Marks	Total	Comments
3 (a)	Any two valid distinct reasons suggesting non–random or not representative (or equivalent or any other valid reasons)	B2, 1	2	Omits students not entering SU – (1 or more reasons for this scores B1) Some students more likely to reply Some students will not reply Non random selection by Pina Students arriving in groups
(b)(i)	Number = $\frac{86}{1032} \times 60 = 5$	B1	1	CAO
(ii)	Number students from (0)0 to 85 or from (0)1 to 86	B1		86 consecutive values
	Obtain 5√ (consecutive) 2–digit random numbers to identify sample of students	B1√		5√ and 2–digit √ on (i)
	Reject repeated numbers or Reject numbers outside range	B1	3	Either; OE
(iii)	27 or 52	B1		Either CAO; first value
	52 ~~27~~ ~~95~~ (0)4 (0)6 66 79 33 72 ~~79~~ ~~96~~ 17	B1	2	Either CAO; other 4 values
	Total		**8**	

Q	Solution	Marks	Total	Comments
4(a)(i)	$X \sim \mathrm{N}(\mu_X\ 3^2)$			
	$\mathrm{P}(X<1010) = \mathrm{P}\left(Z < \frac{1010-1005}{3}\right) =$	M1		Standardising (1009.5, 1010 or 1010.5) with $\left(\sqrt{3}, 3 \text{ or } 3^2\right)$ and/or (1005 – 1010)
	$\mathrm{P}(Z < 1.67) =$	A1		AWRT; ignore sign
	0.951 to 0.953	A1	3	AWFW; (0.95221)
(ii)	$\mathrm{P}(X<1000) = 1\%$			
	$z_{0.01} = -2.3263$	B1		AWFW 2.32 to 2.33; ignore sign
	Also $z = \frac{1000-\mu_X}{3}$	M1		Standardising 1000 with μ_X and 3 but allow $(\mu_X - 1000)$
	Thus $\frac{1000-\mu_X}{3} = -2.3263$	m1		Equating z–value to z–term; not using 0.01, 0.99 or $\lvert 1-z \rvert$
	Thus $\mu_X = 1007$	A1	4	AWRT
(b)	$\bar{y} = \frac{16136}{16} = 1008.5$	B1		CAO
	95% implies $z = 1.96$	B1		CAO
	CI for μ is $\bar{y} \pm z \times \frac{\sigma}{\sqrt{n}}$	M1		Use of; must have $\sqrt{n}$ with $n > 1$ M0 for attempt at using s
	Thus $1008.5 \pm 1.96 \times \frac{3}{\sqrt{16}}$	A1√		√ on $\bar{y}$ and z only
	Thus (1007, 1010)	A1dep	5	AWRT; dependent upon fully correct expression for CI
	Total		**12**	

Q	Solution	Marks	Total	Comments
5 (a)	Mean, $\mu = 21 = \frac{a+b}{2}$	B1		CAO; stated or used
	Variance, $\sigma^2 = 27 = \frac{(b-a)^2}{12}$	B1		CAO; stated or used
	so $((42-a)-a)^2 = 12 \times 27 = 324$ or $b - a = (\pm)\,18$	M1		Substitution of μ into σ^2 or $\sqrt{}$ of equation involving σ^2
	Thus $(42 - 2a) = (\pm)18$ or $a + b = 42$ and $b - a = (\pm)\,18$ Thus $a = 30$ or 12 and $b = 12$ or 30	M1		Solving quadratic or two simultaneous equations
	As $a < b$ so $a = 12$ and $b = 30$	A1	5	CAO; must state $a < b$ B1 for $(12, 30) \Rightarrow \mu = 21$ B1 for $(12, 30) \Rightarrow \sigma^2 = 27$
(b)(i)	$P(5 < X < 20) = P(12 < X < 20) =$	B1		Lower limit of 12 or 20 to 30
	$\frac{20-l}{b-a}$ *or* $1 - \frac{30-20}{b-a}$	M1		Attempt at area of a rectangle of height $\frac{1}{b-a}$ or $\frac{1}{18}$ Can be scored in (ii)
	= 8/18 or 4/9 or 0.44	A1	3	CAO/AWRT; OE
(ii)	$P\left(X < \mu - \frac{\sigma\sqrt{3}}{2}\right) =$			
	$P\left(X < 21 - \frac{\sqrt{27}\,\sqrt{3}}{2}\right) =$	M1		Substitution of $\mu = 21$ and $\sigma = \sqrt{27}$; OE
	$P(X < 16.5)$	A1		CAO
	= 4.5/18 or 1/4 or 0.25	A1	3	CAO; OE
	Total		**11**	

Q	Solution	Marks	Total	Comments
6 (a)	r : 0 1 2 3 4 P($R = r$): 0.1 0.2 0.4 0.2 0.1			
(i)	E(R) = 0 + 0.2 + 0.8 + 0.6 + 0.4 = 2	M1	1	AG; use of $\sum r \times p_r$ or symmetrical argument
(ii)	E(R^2) = 0 + 0.2 + 1.6 + 1.8 + 1.6 = 5.2	B1		CAO; must be some evidence of use of $\sum r^2 \times p_r$
	Var(R) = E (R^2) – (E(R))^2 = 1.2 or	M1		AG; use of a formula for Var(R)
	= 0.4 + 0.2 + 0 + 0.2 + 0.4 = 1.2	(*B1*)	2	CAO; ≥ 4 terms correct
(b)	E(P) = 3×2 + 4 = 10	B1		CAO
	Var(P) = 3^2 × Var(R)	M1		Use of Var($aX + b$) = a^2 Var(X) with $a > 1$ and $b \geq 0$
	= 10.8	A1	3	CAO
(c)(i)	$C = 200 - R - P$ $= 200 - R - (3R + 4)$	M1		Use of ; may be implied
	Hence $C = 196 - 4R$	A1	2	CAO
(ii)	E(C) = 196 – 4 ×2 = 188	B1		CAO
	Var(C) = 4^2 × Var(R) = 19.2	B1dep	2	CAO; dependent on A1 in (c)(i)
	Total		**10**	
	Total		**60**	