GCE 2005
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ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics A
(MAS1)

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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

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MAS1

Q	Solution	Marks	Total	Comments
1(a)(i)	Time, $X \sim \mathrm{N}(12,\ 2.5^2)$			
	$\mathrm{P}(X < 15) = \mathrm{P}\left(Z < \dfrac{15-12}{2.5}\right)$	M1		standardising (14.5, 15 or 15.5) with ($\sqrt{2.5}$, 2.5 or 2.5^2) and/or $(12 - x)$
	$\mathrm{P}(Z < 1.2) = 0.885$	A1	2	AWRT (0.88493)
(ii)	$\mathrm{P}(10 < X < 15) = \text{(i)} - \mathrm{P}(X < 10)$ $= 0.88493 - \mathrm{P}(Z < 0.8)$	M1		OE
	$= 0.88493 - (1\Phi(0.8))$	M1		area change
	$= 0.88493 - (1 - 0.78814) = 0.673$	A1	3	AWRT (0.67307)
(b)(i)	$\bar{y} = \dfrac{835.0}{50} = 16.7$	B1		CAO
	$s^2 = \dfrac{533.61}{49} = 10.89$ or $s = 3.3$			CAO; either
	$v = \dfrac{533.61}{50} = 10.6722$ or $\sqrt{v} = 3.2668$	B1		AWRT 10.67 or AWRT 3.27
	$99\% \Rightarrow z = 2.5758$	B1		AWFW 2.57 to 2.58
	CI for μ is $\bar{y} \pm z \times \dfrac{(s \text{ or } \sqrt{v})}{\sqrt{n}}$	M1		use of; must have ($\div\sqrt{n}$) with $n > 1$
	Thus: $16.7 \pm 2.5758 \times \dfrac{(3.3 \text{ or } 3.27)}{\sqrt{50}}$	A1√		√ on $\bar{y}$, z, (s or $\sqrt{v}$); not on n
	Thus: $(15.5,\ 17.9)$	A1	6	AWRT; dependent on ÷ 49 for variance unless subsequently corrected
(ii)	Adding 25% to 12 gives 15	B1		CAO; seen somewhere
	Since 15 is outside/below CI	E1√		√ on (b)(i); must use 15
	Mustafa's suspicion is supported	B1√	3	√ on (b)(i); must use 15
	Total		**14**	

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MAS1(cont)

Q	Solution	Marks	Total	Comments
2(a)	Simple	B1	1	
(b)(i)	Stratified	B1	1	
(ii)	M: 6 P: 64 A: 30	B2, 1	2	CAO any one value ⇒ B1 CAO all three values ⇒ B2
(iii)	Number employees from 00 to 62 or from 01 to 63	B1		condone omission of leading 0
	Obtain 6 (consecutive) 2-digit random numbers	B1		both points
	Reject repeated numbers and numbers above 62 or 63 (or numbers outside range)	B1	3	either point
(iv)	44 51	B1		CAO
	62 50 (62) 27 (80) 30	B1		CAO
	or from New BLUE Formulae Booklet 62 50	(B1)		CAO
	(62) 27 (80) 30 (72) 07 (93) 38	(B1)	2	CAO
	Total		**9**	
3(a) (i)	Binomial: $n = 1000$ and $p = 0.2$ or 20%	B1	1	CAO; or 3 equivalent points
(ii)	Mean (μ) = 200	B1		CAO
	Variance (σ^2) = 160	B1		CAO; (σ = 12.6 to 12.7 AWFW)
	$P(Y \geq 225) = P(Y > 224.5)$	B1		CAO
	$= P\left(Z > \frac{224.5 - 200}{\sqrt{160}}\right)$	M1		standardising (224.5, 225 or 225.5) using √ (μ & σ) not σ^2 for B(1000, 0.2) ⇒ 0.02765 M0 for 0.0276 to 0.0277 stated M0
	$= P(Z > 1.937) = 1 - \Phi(1.937)$	m1		area change
	= 0.0261 to 0.0269	A1	6	AWFW
(b)	The number of drawing pins selected is not fixed	B1		OE *n* not fixed and (ie no context) *p* not constant or trials not independent B1
	The probability of selecting a yellow drawing pin is not constant	B1	2	OE
	Total		**9**	

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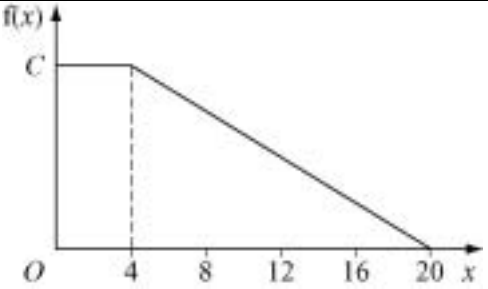
MAS1 (cont)

Q	Solution	Marks	Total	Comments
4(a)		B1 B1 B1 B1	4	horizontal axis; 0 to 20 vertical axis; 0 to c or 1/12 horizontal line @ c from 0 to 4 line from (4, c) to (20, 0)
(b)	Area under graph = 1 Area under graph =	M1		use of
	$4c+\frac{1}{2}(20-4)c=12c$ or	M1		area of (rectangle + triangle)
	$=\frac{c}{2}(4+20)=12c$			area of (trapezium)
	Hence $12c=1$ so $c=\frac{1}{12}$	A1	3	CAO; not decimal equivalent (but accept $0.08\dot{3}$)
(c)	P(Length < 2.01) = P(X < 10)	B1		CAO
	$f(10) = \frac{5c}{8} = \frac{5}{96} = 0.0521$	B1√		CAO/AWRT; √on c only
	$P(X<10)=4c+\frac{1}{2}\left(c+\frac{5c}{8}\right)6$ or	M1		area of (rectangle + trapezium) or $\int_2^4 c\,dx+\int_4^{10}\frac{c}{16}(20-x)\,dx$ etc 1 – area of (triangle)
	$=1-\frac{1}{2}(20-10)\frac{5c}{8}$			
	$=\frac{71c}{8}$ or $1-\frac{25c}{8}$			$\left[cx\right]_0^4+\left[\frac{c}{16}\left(20x-\frac{x^2}{2}\right)\right]_4^{10}$ A1
	$=\frac{71}{96}$ or 0.739 to 0.740	A1	4	CAO/AWRT; accept 0.74
	Total		**11**	

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MAS1 (cont)

Q	Solution	Marks	Total	Comments
5 (a)	$n = 16$ $p = 0.85$			
	$\mathrm{P}(D = d) = \binom{n}{d}(0.85)^{d}(0.15)^{n-d}$	M1		correct expression for B(n, 0.85) with any values of n and d
	$\mathrm{P}(D = 12) = \binom{16}{12}(0.85)^{12}(0.15)^{4}$	A1		fully correct expression; may be implied
	$= 1820 \times 0.14224 \times 0.00050625$			
	$= 0.130$ to 0.132	A1	3	AWFW; accept 0.13
(b)	$n = 30$ $p = 0.85$			M0 for normal approximation
	$\mathrm{P}(21 < D < 28) = \mathrm{P}(22 \le D \le 27) =$			
	$\mathrm{P}(4 < D' < 9) = \mathrm{P}(3 \le \mathrm{D}' \le 8) =$	M1		attempt at switching to D' (working with $p = 0.15$)
	$\mathrm{P}(D' \le / < 8)$ or $\mathrm{P}(D' \le / < 9)$	A1		less than or equal to 8 or 9 less than 8 or 9 (0.9903)
	$-\mathrm{P}(D' \le / < 2)$ or $\mathrm{P}(D' \le / < 3)$	A1		minus (less than or equal to 2 or 3) (less than 2 or 3) (0.3217)
	$= 0.9722 - 0.1514 = 0.820$ to 0.822	A1		AWFW; accept 0.82
	OR			
	At least 3 terms for B(30, 0.85) or At least 3 terms for B(30, 0.15)	(M1)		attempted; may be implied
	6 to 8 terms (21 to 28) for B(30, 0.85) or 6 to 8 terms (2 to 9) for B(30, 0.15)	(M1)		attempted; may be implied
	$= 0.820$ to 0.822	(A2)	4	AWFW; accept 0.82
	Total		**7**	

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MAS1 (cont)

Q	Solution	Marks	Total	Comments
6(a)	$\mathrm{E}(X) = 4 \qquad \mathrm{E}(X^2) = 17.2$			
	$\mathrm{Var}(X) = \mathrm{E}(X^2) \ (\mathrm{E}(X))^2$	M1		use of
	$= 17.2 - 4^2$			
	$= 1.2$	A1	2	CAO
(b)	$C = 2\pi(X+8)$			OE
				Either
	or $\mathrm{E}(X+8) = 12$	B1		CAO
	Thus $\mathrm{E}(C) = 24\pi$	B1		CAO
	$\mathrm{Var}(C) = 4\pi^2 \times \mathrm{Var}(X)$	M1		use of $\mathrm{V}(aX+b) = a^2 \times \mathrm{V}(X)$ with $a > 1$ and $b > 0$
	Thus $\mathrm{Var}(C) = 4.8\pi^2$	A1√	4	√ on V(X); but must include π^2
(c)(i)	Area, $S = \pi(X+8)^2$	M1		use of πr^2
	$= \pi(X^2 + 16X + 64)$			
	Thus $a = 16$ and $b = 64$	A1	2	CAO both
(ii)				
	$\mathrm{E}(S) = \pi(\mathrm{E}(X^2) + 16\mathrm{E}(X) + 64)$	M1		attempted application of E to expanded expression in (c)(i) M0 for use of $\mathrm{E}(X^2) = 4^2 = 16$
	$= \pi(17.2 + 64 + 64) = 145.2\pi$	A1	2	CAO
	Total		**10**	
	Total		**60**	

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