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General Certificate of Education (A-level)
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Mathematics MS/SS1A/W

(Specification 6360)

Statistics 1A/W

Mark Scheme

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Key to mark scheme abbreviations

M	mark is for method
m or dM	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
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
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)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

MS/SS1A/W

Q	Solution	Marks	Total	Comments
1(a)	$r = 0.757$	B3	3	AWRT (0.75708)
	$r = 0.75$ to 0.77	(B2)		AWFW
	$r = 0.65$ to 0.85	(B1)		AWFW
	or			
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ and $\sum xy$			271.5 6142.97 1911.9 304650.01 and 43259.17 (all 5 attempted)
	or	(M1)		
	Attempt at S_{xx} S_{yy} and S_{xy}			0.2825 36.5425 and 2.4325 (all 3 attempted)
	Attempt at substitution into correct corresponding formula for r	(m1)		
	$r = 0.757$	(A1)		AWRT
(b)	Strong/fairly strong/moderate positive (linear) correlation/relationship/ association/link (but not 'trend')	Bdep1		Dependent on $0.65 < r < 0.85$ Or equivalent; must qualify strength and indicate positive Bdep0 for very strong/high/average/ medium/some etc.
	between			
	Circumference/size and weight of (cricket) balls	B1	2	Context; providing $0 < r < 1$
	Total		**5**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
2(a)(i)	$P(M \cap C) = \frac{175}{645} = \frac{35}{129} = 0.271$	B1	1	AWRT; accept either correct fraction
(ii)	$P(M) = \frac{519}{645} = \frac{173}{215} = 0.804$ to 0.805	B1	1	AWFW; accept either correct fraction
(iii)	$P(LD) = \frac{63}{645} = \frac{21}{215} = 0.097$ to 0.098	B1	1	AWFW; accept either correct fraction
(iv)	$P(L\|F) = \frac{94}{126} = \frac{47}{63}$	M1		Accept $\frac{94}{645} \div \frac{126}{645}$
	$= 0.746$	A1	2	AWRT
(b)	$P(L \cap L\|F) = \left(\frac{94}{126} \times \frac{93}{125}\right)$ or $\frac{8742}{15750}$	B1		Or $\left(\frac{47}{63} \times \frac{93}{125}\right)$ or $\frac{4371}{7875}$ or $\frac{1457}{2625}$
	$= 0.555$	B1	2	AWRT
(c)	$P(L \cap C \cap (LD + O))$			
	$= \frac{349}{645} \times \frac{193}{644} \times \frac{63+40}{643}$	M1		Correct numerator
		M1		Correct denominator
	SC The three correct fractions identified but not multiplied $\Rightarrow$ M1 M0 M0 A0			
	$\times 6$ or 3	M1		Note that a denominator of $\binom{645}{3}$ $\Rightarrow$ M2 (second and third M1 marks)
	$= 0.155$ to 0.157	A1	4	AWFW
	NB: 0.026 with no working $\Rightarrow$ M1 only $0.026 \times 6 = 0.156$ with no working $\Rightarrow$ 4 marks			
	Total		**11**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
3(a)	Weight, $W \sim \mathrm{N}(1018, 10^2)$			
(i)	$\mathrm{P}(W < 1025) = \mathrm{P}\left(Z < \dfrac{1025-1018}{10}\right)$	M1		Standardising (1024.5, 1025 or 1025.5) with 1018 and $\left(\sqrt{10}, 10 \text{ or } 10^2\right)$ and/or $(1018 - x)$ May be gained in (a)(i) or (a)(ii)
	$\mathrm{P}(Z < 0.7) = 0.758$	A1	2	AWRT (0.75804)
(ii)	$\mathrm{P}(1015 < W < 1030)$			
	$= \mathrm{P}(W < 1030) - \mathrm{P}(W < 1015)$	M1		Difference of two probabilities May be implied
	$= \mathrm{P}(Z < 1.2) - \mathrm{P}(Z < -0.3)$			
	$= 0.88493 - (1 - 0.61791)$	M1		Area change May be implied by answer
	= 0.502 to 0.504	A1	3	AWFW (0.50284)
(b)	$\bar{W} \sim$ Normal with $\mu = 1018$ and			
	$\sigma^2 = \dfrac{100}{24} = 4.1$ to 4.2			CAO/AWFW (4.16666)
	or	B1		
	$\sigma = \dfrac{\sqrt{100}}{\sqrt{24}} = 2.02$ to 2.05			CAO/AWFW (2.04124)
	$\mathrm{P}(\bar{W} > 1015) = \mathrm{P}\left(Z > \dfrac{1015-1018}{\frac{10}{\sqrt{24}}}\right)$	M1		Standardising 1015 with 1018 and c's $\dfrac{\sigma}{\sqrt{n}}$; not σ
	$= \mathrm{P}(Z > -1.47) = 1 - \mathrm{P}(Z < 1.47)$	m1		Area change May be implied by answer > 0.5
	= 0.927 to 0.932	A1	4	AWFW (0.92918)
	Total		**9**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
4(a)	$R \sim \mathrm{B}(15, 0.45)$			
(i)	$\mathrm{P}(R \leq 5) = 0.26(0)$ to 0.261	B1	1	AWFW (0.2608)
(ii)	$\mathrm{P}(R > 10) = 1 - \mathrm{P}(R \leq 10)$			Requires '1 –' Accept 3dp rounding or truncation
	$= 1 - (0.9745 \text{ or } 0.9231)$	M1		Can be implied by 0.025 to 0.026 but not by 0.0769 to 0.077
	= 0.025 to 0.026	A1	2	AWFW (0.0255)
(iii)	$\mathrm{P}(R = 6) = 0.4522 - $ (a)(i)			
	or $= \binom{15}{6}(0.45)^6(0.55)^9$	M1		Can be implied by a correct answer
	= 0.191 to 0.192	A1	2	AWFW (0.1914)
(iv)	$\mathrm{P}(5 \leq R \leq 10) = 0.9745 \text{ or } 0.9231 \quad (p_1)$	M1		Accept 3dp rounding or truncation $p_2 - p_1 \Rightarrow$ M0 M0 A0 $(1 - p_2) - p_1 \Rightarrow$ M0 M0 A0 $p_1 - (1 - p_2) \Rightarrow$ M1 M0 A0 only providing result > 0
	Minus 0.1204 or 0.2608 (p_2)	M1		Accept 3dp rounding or truncation
	= 0.853 to 0.855	A1	3	AWFW (0.8541)
	Or			
	B (15, 0.45) terms stated for at least 3 values within $4 \leq R \leq 11$ gives probability	(M1)		Can be implied by a correct answer
	= 0.853 to 0.855	(A2)		AWFW (0.8541)
(b)(i)	$\mathrm{P}(S) =$ 0.85 plus 1 minus	B1		CAO; requires 'plus' or 'minus'
	$(0.15 \times 0.80) \quad (0.15 \times 0.20)$	B1	2	CAO; not simply 0.12 or 0.03
	= 0.97			AG
	NB: $(0.85 \times 0.20) + 0.80 \Rightarrow$ B0 B0			
	$(0.85 \times 0.20) + (0.85 \times 0.80)$			
	$+ (0.15 \times 0.80) \Rightarrow$ B0 B1			
(ii)	$P(S \geq 48) = 0.81$ to 0.82 or 0.5553 or 0.9372	M2		Accept 3dp rounding or truncation M2 for the three correctly expressed terms for B (50, 0.03) or B (50, 0.97) added
	= 0.81(0) to 0.811	A1	3	AWFW (0.8108)
	NB: Answer = 0.4447 or 0.1892 or 0.0628 $\Rightarrow$ M1 only			
(iii)	$p = 1 - 0.85 = 0.15$	B1		CAO; may be implied by correct answer or correct expression for mean
	Mean, $\mu = 80 \times 0.15 = 12$	B1	2	CAO
	SC Mean = 9.6 $\Rightarrow$ B1 only			
	Total		**15**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
5(a)	b (gradient) = 1.28 (or 141/110) b (gradient) = 1.25 to 1.35 a (intercept) = 29.95 to 30 (or 659/22) a (intercept) = 29 to 31 Thus $y = 30 + 1.28x$ **or** Attempt at Σx Σx^2 Σy and Σxy $\left(\Sigma y^2\right)$ **or** Attempt at S_{xx} and S_{xy} $\left(S_{yy}\right)$ Attempt at correct formula for b gradient b (gradient) = 1.28 (or 141/110) a (intercept) = 29.95 to 30 (or 659/22) Thus $y = 30 + 1.28x$ Accept a and b interchanged only if identified correctly by a clearly shown equation	B2 (B1) B2 (B1) B1F (M1) (m1) (A1) (A1) (B1F)	5	AWRT; (CAO or equivalent) (1.28182) AWFW Treat rounding of correct answers as ISW AWFW; (CAO or equivalent) (29.95455) AWFW F on a and b 275 9625 682 and 20575 (47494) (All four attempted) 2750 and 3525 (5210) (Both attempted) AWRT; (CAO or equivalent) AWFW; (CAO or equivalent) F on a and b If a and b are not identified anywhere in the question, then: 1.25 to 1.35 $\Rightarrow$ B1 29 to 30 $\Rightarrow$ B1
(b)	7.45 am $\Rightarrow x = 15$ $\Rightarrow y_{15} = 30 + 1.28 \times 15$ = 47 to 52 Time before 9.00 am = 9.00 – (7.45 + c's y_{15}) = 23 to 28 **SC** Answer of 17 CAO (use of c's y_{15} = 58) gains 2 marks	B1 M1 A1 M1 A1	5	CAO; stated, used or implied Use of $10 < x < 20$ AWFW (49.2) May be implied AWFW (25.8) **NB:** An answer of 8.32 to 8.37 gains B1 M1 A1 M0 A0
	Total		**10**	

MS/SS1A/W (cont)

Q	Solution	Marks	Total	Comments
6(a)(i)	Mean, $\bar{x} = 20.4$	B1	1	CAO
(ii)	Standard deviation $s = \sqrt{\dfrac{400.24}{64}}$	M1		Expression must be seen $\left(\sqrt{6.25375}\right)$
	= 2.50	A1	2	AWRT (2.50075)
	NB:			
	$s = \dfrac{400.24}{64 \text{ or } 65}$ $\left(6.15754 \text{ or } 6.25375\right)$	(B1)		No $\sqrt{}$ and/or use of divisor n
	or			
	$s = \sqrt{\dfrac{400.24}{65}}$ $\left(2.48144\right)$	(B1)		Use of divisor n
(b)(i)	$96\%\left(0.96\right) \Rightarrow z = 2.05$ to 2.06	B1		AWFW (2.0537)
	CI for μ is $\bar{x} \pm z \times \dfrac{s}{\sqrt{n}}$	M1		Used Must have $\sqrt{n}$ with $n > 1$
	Thus $20.4 \pm 2.0537 \times \dfrac{2.50}{\sqrt{65 \text{ or } 64}}$	A1F		F on $\bar{x}$ and z
	Hence 20.4 ± 0.6 **or** $\left(19.8, 21\left(.0\right)\right)$	A1	4	AWRT
(ii)	Times/X are not (known to be) normally distributed	B1	1	Or equivalent Not data, values, sample, n large
(c)	CI in (b)(i) contains/includes 20	B1F		Or equivalent Dependent on CI in (b)(i)
	thus			
	no (significant) evidence to support claim	Bdep1	2	Or equivalent Dependent on B1F
	Total		**10**	
	TOTAL		**60**	