

INTERNATIONAL A-LEVEL MATHEMATICS

MA04

(9660/MA04) Unit S2 Statistics

Mark scheme

June 2026

Version: 1.0 Final

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Key to mark scheme abbreviations

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	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
sf	Significant figure(s)
dp	Decimal place(s)
ISW	Ignore subsequent working

Q	Answer	Marks	Comments
1 (a)(i)	$P(\bar{X} = 120) = 0$	B1	
		1	

Q	Answer	Marks	Comments
1 (a)(ii)	$P(\bar{X} > 115) = P\left(Z > \frac{115 - 120}{\frac{20}{\sqrt{30}}}\right)$ $P(Z > -1.37) \text{ or } P(Z < 1.37)$ $= 0.9145$	<p>M1</p> <p>M1</p> <p>A1</p>	<p>PI standardises</p> <p>oe Allow $\pm \frac{\sqrt{30}}{4}$ in a correct probability statement PI by AWRT 0.915</p> <p>AWFW [0.9145, 0.9147]</p>
		3	

Q	Answer	Marks	Comments
1 (b)	$z = 1.2816$ $1.2816 = \frac{k - 120}{\frac{20}{\sqrt{50}}}$ $k = 123.6$	<p>B1</p> <p>M1</p> <p>A1</p>	<p>AWRT 1.28</p> <p>Attempt to standardise with a z value</p> <p>CAO</p>
		3	

	Question 1 Total	7	
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Q	Answer	Marks	Comments
2 (a)	$\int_3^b \frac{45}{(3+2x)^2} dx = 1$	M1	Sets the integral equal to 1 and makes some attempt to integrate
	$-\frac{45}{2} \left[\frac{1}{(3+2x)} \right]_3^b = 1$	A1	ACF Correct integration
	$-\frac{45}{2} \left(\frac{1}{3+2b} - \frac{1}{9} \right) = 1$	M1	Correct substitution of limits into their integration and attempts to get a single term expression involving '3 + 2b' or b
	$\frac{1}{3+2b} = \frac{1}{15} \Rightarrow 3+2b = 15 \Rightarrow b = 6$	A1	AG Must be convincingly shown
		4	

Q	Answer	Marks	Comments
2 (b)	$\left[\int_3^{3.5} \frac{45}{(3+2x)^2} dx \right] = -\frac{45}{2} \left[\frac{1}{(3+2x)} \right]_3^{3.5}$	M1	PI
	$-\frac{45}{2} \left(\frac{1}{10} - \frac{1}{9} \right) = \frac{1}{4}$	A1	CAO
		2	

	Question 2 Total	6	
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Q	Answer	Marks	Comments
3 (a)	$H_0 : \mu = 280$ $H_1 : \mu > 280$ $\bar{x} = 282$ $s^2 = \frac{1}{49} \left(3980000 - \frac{14100^2}{50} \right)$ $s^2 = 77.6$ $\bar{X} \sim N \left(280, \frac{77.6}{50} \right)$ $z = \frac{282 - 280}{\sqrt{\frac{77.6}{50}}}$ $z = 1.61$ $z_{\text{crit}} = 1.6449$ As $z < z_{\text{crit}}$ or $1.61 < 1.6449$ Fail to reject H_0 Insufficient evidence to suggest the population mean mass of a bread roll has increased	B1 B1 M1 A1 M1 M1 A1 B1 A1ft E1ft	Both hypotheses PI AWRT 77.6 Allow $\frac{3800}{49}$ PI $\bar{X} \sim N \left(280, \frac{s^2}{50} \right)$ Calculates z with their s^2 AWRT 1.61 AWRT 1.64 or AWRT $P(Z > 1.61) = 0.054$ ft their z and z_{crit} providing signs are consistent allow AWRT $0.054 > 0.05$ Must be in context Condone definite statements
		10	

Q	Answer	Marks	Comments
3 (b)	[As the] sample is large [then through the] central limit theorem [$\bar{X}$ can be assumed to be normally distributed]	E1	oe
		1	

	Question 3 Total	11	
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Q	Answer	Marks	Comments
4 (a)	$X \sim B(20, 0.015)$ and $P(X = 2)$	M1	PI
	$\binom{20}{2} \times 0.015^2 \times 0.985^{18}$ $= 0.0326$	A1	AWRT 0.0326
		2	

Q	Answer	Marks	Comments
4 (b)(i)	p needs to be small	B1	oe
	n needs to be large	B1	oe
		2	

Q	Answer	Marks	Comments
4 (b)(ii)	$\lambda = 1.8$	B1	PI
	$[P(X < 3) =] P(X \leq 2)$	M1	PI
	$= 0.731$	A1	AWRT 0.731
		3	

	Question 4 Total	7	
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Q	Answer	Marks	Comments
5 (a)	$5E(X) - 3E(Y)$	M1	PI
	$5(a+b) - \frac{3}{a}$	A1	ACF $\frac{5a^2 + 5ab - 3}{a}$
		2	

Q	Answer	Marks	Comments
5 (b)	$25\text{Var}(X) + 9\text{Var}(Y)$	M1	PI
	$\left[5a + \frac{9a}{4}\right] = \frac{29a}{4}$	A1	
		2	

Q	Answer	Marks	Comments
5 (c)	$\text{Var}(Y) + E(Y)^2 = E(Y^2)$	M1	PI
	$\frac{a}{4} + \frac{1}{a^2}$	A1	oe $\frac{a^3 + 4}{4a^2}$
		2	

Q	Answer	Marks	Comments
5 (d)	$\frac{a^3 + 4}{4a^2} > \frac{29a}{4}$	M1	PI ft their part (b) and part (c) with an attempt to get to single term inequality
	$\frac{1}{7} > a^3$		
	$a < \sqrt[3]{\frac{1}{7}}$	A1	Allow AWRT $a < 0.523$
	$0 < a < \sqrt[3]{\frac{1}{7}}$	A1	Full range of values, must be exact
		3	
	Question 5 Total	9	

Q	Answer	Marks	Comments
7 (a)	Mean = 20	B1	
	Variance = 400	B1	
		2	

Q	Answer	Marks	Comments
7 (b)	$[P(T < 30)] = 1 - e^{-0.05 \times 30}$	M1	PI
	= 0.777	A1	AWRT 0.777
		2	

Q	Answer	Marks	Comments
7 (c)	$[1 - e^{-0.05k} = 0.98] \Rightarrow e^{-0.05k} = 0.02$		
	$-0.05k = \ln 0.02$	M1	PI
	$k = 78.2$	A1	AWRT 78.2
		2	

Q	Answer	Marks	Comments
7 (d)	$(1 - 0.777)^4$	M1	PI $(e^{-0.05 \times 30})^4$
	= 0.00248	A1	AWFW [0.00247, 0.00248]
		2	

	Question 7 Total	8	
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Q	Answer	Marks	Comments
8 (a)	$\frac{207(4) - 25(4)^2 - 338}{h} = 1$	M1	PI
	$h = 90$	A1	CAO
		2	

Q	Answer	Marks	Comments
8 (b)	$\frac{2(3)^3 + 3(3)}{90} + g = \frac{29}{45}$	M1	Uses $F(3) = \frac{29}{45}$ or uses $F(1) = 0$
	or $\frac{2(1)^3 + 3(1)}{90} + g = 0$		
	$g = -\frac{1}{18}$	A1	CAO
		2	

Q	Answer	Marks	Comments
8 (c)	$\frac{6x^2 + 3}{90}$	M1	ACF
	$\frac{207 - 50x}{90}$	M1	ACF Allow $\frac{207 - 50x}{h}$
	$f(x) = \begin{cases} \frac{1}{15}x^2 + \frac{1}{30} & 1 \leq x < 3 \\ \frac{23}{10} - \frac{5}{9}x & 3 \leq x < 4 \\ 0 & \text{otherwise} \end{cases}$	A1	ACF
		3	

Q	Answer	Marks	Comments
8 (d)	$\int f(x) \times \frac{1}{x} dx$	M1	Attempts to integrate with their $f(x)$ from part (c)
	$\left[\frac{x^2}{30} + \frac{1}{30} \ln x \right]_1^3$	M1	Correct integration for their $f(x)$
	$\frac{4}{15} + \frac{1}{30} \ln 3$	A1	PI ACF
	$\left[\frac{23}{10} \ln x - \frac{5x}{9} \right]_3^4$	M1	Correct integration for their $f(x)$
	$\frac{23}{10} \ln 4 - \frac{23}{10} \ln 3 - \frac{5}{9}$	A1	PI ACF
	$\left(\frac{4}{15} + \frac{1}{30} \ln 3 \right) + \left(\frac{23}{10} \ln 4 - \frac{23}{10} \ln 3 - \frac{5}{9} \right)$	m1	Dependent on all previous M marks awarded
	$= -\frac{34}{15} \ln 3 + \frac{23}{10} \ln 4 - \frac{13}{45}$	A1	CAO
		7	
	Question 8 Total	14	

Q	Answer	Marks	Comments
9 (a)	$[\lambda + 3\lambda] = 4\lambda$	B1	
		1	

	Answer	Marks	Comments
9 (b)	$\frac{e^{-\lambda_T} \times \lambda_T^5}{5!} = 20 \times \frac{e^{-\lambda_T} \times \lambda_T^3}{3!}$ $\lambda_T^2 = \frac{20 \times 5!}{3!}$ $\lambda_T = 20 \text{ or } \lambda_Y = 15 \text{ or } \lambda = 5$ $P(Y \geq 10) = 1 - P(Y \leq 9)$ $= 1 - 0.06985\dots$ $= 0.930$	<p>M1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>m1</p> <p>A1</p>	<p>Forms an equation in terms of λ</p> $\frac{e^{-4\lambda} \times (4\lambda)^5}{5!} = 20 \times \frac{e^{-4\lambda} \times (4\lambda)^3}{3!}$ <p>PI makes λ_T or λ the subject</p> $(4\lambda)^2 = \frac{20 \times 5!}{3!}$ <p>$4\lambda = 20 \Rightarrow \lambda = 5$</p> <p>PI</p> <p>PI must use $\lambda_Y = 15$</p> <p>AWRT 0.930</p>
		6	

Q	Answer	Marks	Comments
9 (c)	$P(T < 8 \mid Y = 5) = P(X < 3)$ $P(X \leq 2) = 0.125$	<p>M1</p> <p>A1</p>	<p>PI</p> <p>AWFW [0.124, 0.125]</p>
		2	

	Question 9 Total	9	
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