Cambridge Assessment International Education

Cambridge International A Level

MATHEMATICS **9709/62**

Paper 6 Probability and Statistics 2 **February/March 2022**

MARK SCHEME

Maximum Mark: 50

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:
Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:
Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:
Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:
Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:
Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Mathematics Specific Marking Principles	
1	Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
2	Unless specified in the question, answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.
3	Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.
4	Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
5	Where a candidate has misread a number in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 mark for the misread.
6	Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

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Question	Answer	Marks	Guidance
1(a)	Est $(\mu) = \frac{1199}{6}$ or 199.833 or 200 or $\frac{2398}{12}$ [mm]	**B1**	Accept in any form
	Est $(\sigma^2) = \frac{12}{11}\left(\frac{479226}{12} - \frac{'1199'^2}{6}\right)$ or $\frac{1}{11}\left('479226' - \frac{'2398'^2}{6}\right)$	**M1**	Use of their values in correct formula (may be implied)
	= 2.33 (3 sf) [mm^2]	**A1**	Accept $\frac{7}{3}$
		3	
1(b)	Small sample	**B1**	Accept not 'not representative' unless qualified.
		1	

Question	Answer	Marks	Guidance
2	B(300, $\frac{1}{5}$) → N(60,48)	**B1**	SOI
	$\frac{45.5-60}{\sqrt{48}}$	**M1**	Condone with wrong or no continuity correction
	= –2.093	**A1**	
	'2.093' > 1.96	**M1**	Valid comparison Note: ϕ('–2.093') (= 0.0182), 0.0182< 0.025
	[Evidence to reject H_0] There is evidence that P(landing on blue) ≠ $\frac{1}{5}$	**A1 FT**	Allow 'There is evidence that the spinner is biased.' In context, not definite, no contradictions Condone critical values method (critical value 46.42 M1 A1 and 45.5 < '46.42' M1 for valid comparison A1 for correct conclusion)
			SC: 0.0182 unsupported: 0.0182 < 0.025 And there is evidence that the spinner is biased. In context, not definite B1 only
		5	

Question	Answer	Marks	Guidance
3	est(p) = 0.4	**B1**	
	$'0.4' + z\sqrt{\frac{'0.4'\times(1-'0.4')}{500}}\ [= 0.445]$	**M1**	OE Use of *their* 0.4 in a correct expression
	$z\left[= 0.045 \div \sqrt{\frac{'0.4'\times(1-'0.4')}{500}}\right] = 2.054$	**A1**	Condone 2.053 and 2.05
	0.98 – (1 – 0.98)	**M1**	
	96% confidence	**A1**	CWO, must be integer
		5	

Question	Answer	Marks	Guidance
4(a)	H_0: $\mu = 25.5$ H_1: $\mu < 25.5$	**B1**	
	$\frac{23.7 - 25.5}{5.2 \div \sqrt{40}}$	**M1**	Must have $\sqrt{40}$
	$= -2.189$	**A1**	
	'2.189' < 2.326	**M1**	For valid comparison For two-tailed test: allow compare 2.576 if H_1: $\mu \neq 25.5$
	[Accept H_0] No evidence that mean time has decreased	**A1 FT**	In context, not definite, no contradictions FT *their* 2.189 but no FT for two-tailed test **N.B.** Use of two-tailed test can score max B0 M1 A1 M1 A0 Condone use of critical value method (23.59 M1 A1 and 23.7 > 23.59 M1 A1 correct conclusion or 25.612 M1 A1 and 25.5 < 25.612 M1 A1 with correct conclusion)
		5	
4(b)	No, because H_0 was not rejected	**B1 FT**	FT *their* conclusion in **(a)**
		1	

Question	Answer	Marks	Guidance
5(a)	Mean = 5×18.3 and Variance = 5×2.5^2 [= N(91.5, 31.25)]	**B1**	SOI
	$\frac{95-'91.5}{\sqrt{'31.25'}}$ [= 0.626]	**M1**	FT *their* mean and variance
	1 – Φ(‘0.626’)	**M1**	For finding area consistent with *their* values
	0.266 (3 sf)	**A1**	
		4	
5(b)	E(*D*) = 0	**B1**	Or E(D – 1) = –1
	Var(*D*) = $2.5^2 \times 2$ [= 12.5]	**B1**	
	$\frac{1-0}{\sqrt{'12.5'}}$ [= 0.283] or $\frac{-1-0}{\sqrt{'12.5'}}$ [= –0.283]	**M1**	FT *their* E and Var
	Φ(‘0.283’) – (1 – ϕ(0.283)) [= 0.6115 – 0.3885]	**M1**	For finding area consistent with *their* values
	0.223 (3 sf)	**A1**	
		5	

Question	Answer	Marks	Guidance
6(a)	Quadratic curve, hence symmetrical	**B1**	OE. Allow sketch and 'symmetrical' or just 'curve symmetrical'
		1	
6(b)	$-k\int_1^3 (x^2-4x+3)\mathrm{d}x = 1$	**M1**	Attempt to integrate f(x) and '= 1'. Ignore limits at this stage
	$-k\left[\frac{x^3}{3}-2x^2+3x\right]_1^3$	**A1**	Fully correct expression (correct integration and limits)
	$-k\times\left[0-\frac{4}{3}\right]=1 \quad \text{or} \quad k\times\frac{4}{3}=1$ $\left[k=\frac{3}{4}\right]$	**A1**	AG, OE. Correctly substitute limits and '= 1' and correctly obtain result with no errors seen.
		3	
6(c)	$-\frac{3}{4}\int_1^3 \left(x^4-4x^3+3x^2\right)\mathrm{d}x$	**M1**	Attempt to integrate x^2 f(x) from 1 to 3
	$-\frac{3}{4}\times\left[\frac{x^5}{5}-x^4+x^3\right]_1^3$ $\left[=\frac{3}{4}\times\frac{28}{5}=\frac{21}{5}\right]$	**A1**	Correct integration and limits
	$\left[\frac{21}{5}-2^2\right]=0.2$	**A1**	
		3	

Question	Answer	Marks	Guidance
6(d)	$-\frac{3}{4}\int_{2.5}^{3}\left(x^2-4x+3\right)\mathrm{d}x$	**M1**	OE. Attempt to integrate f(x), from 2.5 to 3 (or 1 to 2.5)
	$=-\frac{3}{4}\times\left[\frac{x^3}{3}-2x^2+3x\right]_{2.5}^{3}=\frac{5}{32}$ or 0.15625	**A1**	
	$1-\left(1-'\frac{5}{32}'\right)^3$	**M1**	OE. FT *their* $\frac{5}{32}$.
	= 0.399 (3 sf)	**A1**	
		4	

Question	Answer	Marks	Guidance
7(a)(i)	0.024 × 50 [= 1.2] and 0.018 × 60 [= 1.08]	**B1**	
	$(1 - e^{-1.2}(1 + 1.2)) \times (1 - e^{-1.08}(1 + 1.08))$	**M1**	For $(1 - e^{-\lambda}(1+\lambda)) \times (1 - e^{-\mu}(1+\mu))$ any λ, μ ($\lambda \neq \mu$) Allow one end error on either or both terms
	= 0.0991 (3 sf)	**A1**	Unsupported answer scores maximum **SC** B1 B1 **SC** Use of binomial 0.0994 scores B1 only
		3	
7(a)(ii)	$\lambda = 0.024 \times 50 + 0.018 \times 60$	**M1**	or *their* 1.2 + 1.08 (NB 0.024+0.018 is M0)
	$1 - e^{-2.28} \times \left(1 + 2.28 + \frac{2.28^2}{2!} + \frac{2.28^3}{3!}\right)$	**M1**	any λ and allow one end error
	= 0.197 (3 sf)	**A1**	Unsupported answer scores maximum **SC** B2
		3	
7(b)	$e^{-\lambda} = \left[e^{-\mu}\right]^2 = e^{-2\mu}$	**M1**	
	$e^{-\lambda} \times \frac{\lambda^2}{2} = k\left[e^{-\mu} \times \mu\right]^2$	**M1**	
	$e^{-2\mu} \times 2\mu^2 = k \times e^{-2\mu} \times \mu^2$	**M1**	OE. Use of $\lambda = 2\mu$ to find equation in μ and k only (or λ and k only)
	$k = 2$	**A1**	
		4	

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