

Cambridge International A Level

MATHEMATICS**9709/61**

Paper 6 Probability & Statistics 2

May/June 2025**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.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **15** printed pages.

PUBLISHED**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 descriptions 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.

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, non-integer 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 or sign 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 A or B 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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	More information required
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

Annotation	Meaning
DM1	Dependent on the previous M1 mark(s)
	Follow through
	Indicate working that is right or wrong
Highlighter	Highlight a key point in the working
	Ignore subsequent work
	Judgement
	Judgement
	Method mark awarded zero
	Method mark awarded one
	Method mark awarded two
	Misread
	Omission or Other solution
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
	Judgment made by the PE
	Premature approximation
	Special case
	Indicates that work/page has been seen

Annotation	Meaning
 SF	Error in number of significant figures
	Correct
 TE	Transcription error
 XP	Correct answer from incorrect working

PUBLISHED**Mark Scheme Notes**

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

- M** Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.
- A** Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).
- B** Mark for a correct result or statement independent of method marks.
- DM or DB** When a part of a question has two or more ‘method’ steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly, when there are several B marks allocated. The notation DM or DB is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
- FT** Implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only.
- A or B marks are given for correct work only (not for results obtained from incorrect working) unless follow through is allowed (see abbreviation FT above).
 - For a numerical answer, allow the A or B mark if the answer is correct to 3 significant figures or would be correct to 3 significant figures if rounded (1 decimal place for angles in degrees).
 - The total number of marks available for each question is shown at the bottom of the Marks column.
 - Wrong or missing units in an answer should not result in loss of marks unless the guidance indicates otherwise.
 - Square brackets [] around text or numbers show extra information not needed for the mark to be awarded.

Abbreviations

AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO	Correct Answer Only (emphasising that no ‘follow through’ from a previous error is allowed)
CWO	Correct Working Only
ISW	Ignore Subsequent Working
SOI	Seen Or Implied
SC	Special Case (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)
WWW	Without Wrong Working
AWRT	Answer Which Rounds To

PUBLISHED

Question	Answer	Marks	Guidance
1	$(\lambda) = 4$	B1	SOI.
	$e^{-4} \left(1 + 4 + \frac{4^2}{2!} + \frac{4^3}{3!} \right) = e^{-4} (1 + 4 + 8 + 10.6666)$ $= 0.018316 + 0.073263 + 0.146525 + 0.19537$	M1	Allow any λ , allow one end error.
	$= 0.433$	A1	SC₁ Unsupported answer of 0.433 scores B1B1 . SC₂ Use of Normal mean = 4 B1 . SC₃ Use Binomial 0.432 or 0.433 scores B1 .
		3	

Question	Answer	Marks	Guidance
2(a)	$N(6, \dots)$	B1	Normal used with a mean of 6.
	$\sigma^2 = \frac{3}{2} = 1.5$ (or $\sigma = \sqrt{1.5}$ or $\frac{\sqrt{6}}{2}$ or 1.22 (3sf))	M1	Var of 1.5 (or sd found).
	$\frac{6.2 - 6}{\sqrt{\frac{1.5}{100}}}$	M1	For standardising. Must have $\sqrt{100}$. Ignore incorrect continuity correction (correct cc if used is 1/2n).
	$= 1.633$	A1	Or accept 1.674 with correct cc.
	$P(\bar{X} > 6.2) = 1 - \Phi(1.633)$	M1	
	$= 0.0512$ or 0.0513 (3sf)	A1	Or accept 0.0471 with correct cc (scores full marks).
		6	

PUBLISHED

Question	Answer	Marks	Guidance
2(b)	Population (X) is not normally distributed / Population (X) is Binomial	B1	OE. Accept underlying distribution.
		1	

Question	Answer	Marks	Guidance
3(a)	$\text{Est}(\mu) = \frac{2750}{60} \text{ or } \frac{275}{6} \text{ or } 45.8 \text{ (3 sf)}$	B1	
	$\text{Est}(\sigma^2) = \frac{60}{59} \left(\frac{127000}{60} - \left(\frac{275}{6} \right)^2 \right)$	M1	Or $\frac{1}{59} \left(127000 - \frac{2750^2}{60} \right)$ Note: σ (4.03) can score M1 for correct expression Use of biased (15.97) M0 .
	$=16.2 \text{ (3 sf) or } \frac{2875}{177}$	A1	
		3	

PUBLISHED

Question	Answer	Marks	Guidance
3(b)	H_0 : Population mean time = 45 H_1 : Population mean time > 45	B1	Allow ' μ ' but not just 'mean'.
	$\frac{\frac{275}{6} - 45}{\sqrt{\frac{16.24294}{60}}}$	M1	Standardise using their values from 3(a) . Must have $\sqrt{60}$ (ignore cc).
	= 1.602 to 1.595	A1	Accept 3sf 1.6(0) if nothing better seen. (or area = 0.0546 to 0.0553). FT Biased in 3(a) scores A1 for 1.608 to 1.615.
	'1.602' < 1.645	M1	Or compare areas. i.e. 0.0546 to 0.0553 > 0.05.
	[Accept H_0] There is insufficient evidence [at 5% level] to reject the company's claim OR There is insufficient evidence to accept the passenger's belief OR There is insufficient evidence that the mean time is more than 45 minutes	A1FT	OE. FT their z-calc. No contradictions, In context, Not definite, e.g. not 'Mean time is more than 45 mins'. Note: accept cv method ($45.856 > 45.83$ or $44.98 < 45$).
		5	

Question	Answer	Marks	Guidance
4(a)	Mean = 6 [\$]	B1	Ignore units in both parts of question 4.
	Variance = $0.40^2 \times 9$	M1	
	= 1.44 [\$ ²]	A1	
		3	
4(b)	Mean = $35 \times '6' = 210$ [\$]	B1FT	FT their mean in 4(a)

Question	Answer	Marks	Guidance
	Variance = $35 \times '1.44'$	M1	FT their variance of cost for one person.
	= 50.4 [\$ ²]	A1	
		3	

Question	Answer	Marks	Guidance
5(a)(i)	$e^{-3.5} \left(\frac{3.5^3}{3!} + \frac{3.5^4}{4!} + \frac{3.5^5}{5!} \right) = e^{-3.5} (7.1458 + 6.2526 + 4.37682) =$ $0.21579 + 0.18881 + 0.13217$	M1	Any λ , allow one end error. Must see expression or terms.
	= 0.537	A1	SCB1 for unsupported answer of 0.537.
		2	
5(a)(ii)	Use of $N(1.2 \times 100 + 2.3 \times 200, \dots) = N(580, \dots)$	B1	SOI give at early stage.
	$\text{Var}(S) = 1.2 \times 100 + 2.3 \times 200 = 580$	M1	SOI give at early stage.
	$\frac{600.5 - '580'}{\sqrt{'580'}}$	M1	For standardising with their values. Allow with omitted or incorrect continuity correction.
	= 0.851	A1	
	$1 - \Phi('0.581')$	M1	For area consistent with their working
	= 0.197 (3sf)	A1	
		6	

Question	Answer	Marks	Guidance
5(b)	$\frac{5}{2} \times \frac{\lambda^3}{3!} + \frac{\lambda^4}{4!} = \frac{\lambda^5}{5!}$ Or $\left(\frac{5}{2}\right)e^{-\lambda}\left(\frac{\lambda^3}{3!}\right) + e^{-\lambda}\left(\frac{\lambda^4}{4!}\right) = e^{-\lambda}\left(\frac{\lambda^5}{5!}\right)$	B1	Accept with or without each term multiplied by $e^{-\lambda}$.
	$\lambda^2 - 5\lambda - 50 = 0$	M1	Legitimately obtain quadratic in λ .
	$(\lambda - 10)(\lambda + 5) = 0$ or $\lambda = \frac{5 \pm \sqrt{25 + 4 \times 50}}{2}$ $\lambda = 10$	A1	Alone.
		3	

Question	Answer	Marks	Guidance
6(a)	H0: Proportion (at college) owning Pumpkin phone = 0.25 H1: Proportion (at college) owning Pumpkin phone < 0.25	B1	Allow $p = 0.25$, $p < 0.25$. Allow 25%.
		1	
6(b)	B(30, 0.1) and $P(X \geq 5)$ attempted	M1	May be implied.
	$1 - (0.9^{30} + 30 \times 0.9^{29} \times 0.1 + {}^{30}C_2 \times 0.9^{28} \times 0.1^2 + {}^{30}C_3 \times 0.9^{27} \times 0.1^3 + {}^{30}C_4 \times 0.9^{26} \times 0.1^4)$ $= 1 - (0.042391 + 0.141304 + 0.22766 + 0.236088 + 0.177066)$	M1	For expression or terms. No end errors.
	$= 0.175$ (3 sf) accept 0.176	A1	SC Unsupported working and correct answer scores M1B1 .
		3	
6(c)	$\frac{1}{8} \pm z \sqrt{\frac{\frac{1}{8} \times \frac{7}{8}}{40}}$	M1	Any z must be a z . Only one side calculated can score M1 .

Question	Answer	Marks	Guidance
	$z = 1.96$	B1	Seen.
	0.0225 to 0.227 (3 sf)	A1	Must be an interval.
		3	

Question	Answer	Marks	Guidance
7(a)	$\int_0^{\frac{1}{2}} (1 + \cos \pi x) \, dx$	M1	Attempt to integrate $f(x)$. Ignore limits.
	$= \left[x + \frac{\sin \pi x}{\pi} \right]_0^{\frac{1}{2}}$	A1	Correct integration and limits.
	$= \frac{1}{2} + \frac{\sin \frac{\pi}{2}}{\pi} = \frac{1}{2} + \frac{1}{\pi}$	A1	AG. Must see intermediate step. Convincingly obtained. No errors seen.
		3	

Question	Answer	Marks	Guidance
7(b)	$\int_0^1 (x + x \cos \pi x) dx$	M1*	Attempt to integrate $xf(x)$. Ignore limits.
	$= \left[\frac{x^2}{2} + x \times \frac{\sin \pi x}{\pi} - \int \frac{\sin \pi x}{\pi} dx \right]_0^1$	M1*	Attempt to integrate by parts to reach expression with at least two terms correct (must be more than two terms). May be implied by next line.
	$= \left[\frac{x^2}{2} + x \times \frac{\sin \pi x}{\pi} + \frac{\cos \pi x}{\pi^2} \right]_0^1$	A1	
	$= \frac{1}{2} + \frac{\sin \pi}{\pi} + \frac{\cos \pi}{\pi^2} - \frac{\cos 0}{\pi^2}$	DM1	Substitute correct limits, dep M1M1 .
	$= \frac{1}{2} - \frac{2}{\pi^2}$	A1	AG. Legitimately obtained. No errors seen
		5	

Cambridge International A Level

MATHEMATICS**9709/62**

Paper 6 Probability & Statistics 2

May/June 2025**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.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **16** printed pages.

PUBLISHED**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 descriptions 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.

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, non-integer 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 or sign 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 A or B 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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	More information required
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

Annotation	Meaning
DM1	Dependent on the previous M1 mark(s)
	Follow through
	Indicate working that is right or wrong
Highlighter	Highlight a key point in the working
	Ignore subsequent work
	Judgement
	Judgement
	Method mark awarded zero
	Method mark awarded one
	Method mark awarded two
	Misread
	Omission or Other solution
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
	Judgment made by the PE
	Premature approximation
	Special case
	Indicates that work/page has been seen

Annotation	Meaning
	Error in number of significant figures
	Correct
	Transcription error
	Correct answer from incorrect working

PUBLISHED**Mark Scheme Notes**

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

- M** Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.
- A** Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).
- B** Mark for a correct result or statement independent of method marks.
- DM or DB** When a part of a question has two or more ‘method’ steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly, when there are several B marks allocated. The notation DM or DB is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
- FT** Implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only.
- A or B marks are given for correct work only (not for results obtained from incorrect working) unless follow through is allowed (see abbreviation FT above).
 - For a numerical answer, allow the A or B mark if the answer is correct to 3 significant figures or would be correct to 3 significant figures if rounded (1 decimal place for angles in degrees).
 - The total number of marks available for each question is shown at the bottom of the Marks column.
 - Wrong or missing units in an answer should not result in loss of marks unless the guidance indicates otherwise.
 - Square brackets [] around text or numbers show extra information not needed for the mark to be awarded.

Abbreviations

AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO	Correct Answer Only (emphasising that no ‘follow through’ from a previous error is allowed)
CWO	Correct Working Only
ISW	Ignore Subsequent Working
SOI	Seen Or Implied
SC	Special Case (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)
WWW	Without Wrong Working
AWRT	Answer Which Rounds To

Question	Answer	Marks	Guidance
1(a)	E.g. 1–2: choose student 1; 3–4: choose student 2; 5–6: choose student 3. Must be un-ambiguous i.e. if no example, need to say 2 different numbers per person AND different to the other two people so that all 6 numbers on dice used.	B1	Other correct methods may be seen. Note: must be a single throw.
		1	
1(b)	$E(D) = 0, \text{Var}(D) = 100$	B1	Or $E(D) = \pm 12$.
	$\frac{12-0}{\sqrt{100}}$ [= 1.2]	M1	For standardising with their $E(D)$ and $\text{Var}(D)$ Must be from a combination attempt, ignore cc attempts.
	$1 - \Phi('1.2')$	M1	For finding area consistent with their values.
	$= 0.115$ (3sf)	A1	SOI by correct final answer.
	$P(\text{Difference} > 12 \text{ minutes}) = 0.23[0]$	A1FT	FT their 0.115 (as long as ' 0.115 ' < 0.5 i.e. final prob not bigger than 1).
		5	

Question	Answer	Marks	Guidance
2	$15.6 = \frac{100}{99} \left(\frac{\Sigma h^2}{100} - 80.2^2 \right)$ OR $15.6 = 1/99 (\Sigma h^2 - 8020^2/100)$	M1	For attempt biased or unbiased = 15.6.
		A1	For correct expression = 15.6.
	$\Sigma h^2 = 644748.4$ or 645000 (3 sf) or 3223742/5	A1	
		3	

Question	Answer	Marks	Guidance
3(a)	$e^{-15} \times \frac{15^{12}}{12!}$	B1	Seen.
		1	
3(b)	$e^{-15} \times \frac{15^n}{n!} = e^{-15} \times \frac{15^{n+1}}{(n+1)!}$	B1	If brackets (n+1)! missing allow benefit of doubt.
	$1 = \frac{15}{n+1}$	M1	OE. Attempt to legitimately remove powers and factorials i.e. powers reduced to 15/ λ seen, and factorials reduced to n + 1 seen.
	$n = 14$	A1	Note: Trial and error solutions: B1B2 for 14.
		3	

Question	Answer	Marks	Guidance
4	$2 \times 1.645 \times \sqrt{\frac{a(1-a)}{200}} = 0.1066$	M1	Allow any z and/or omit ' $2 \times$ '. Condone confusion between a and $\frac{a}{200}$. E.g. $2 \times 1.645 \times \sqrt{\frac{\frac{a}{200} \left(1 - \frac{a}{200}\right)}{200}} = 0.1066$
	$z = 1.645$	B1	
	$a^2 - a + 0.20997 = 0$	M1	Or for valid attempt to reach quadratic in a by confusing between a and $\left(\frac{a}{200}\right)$. E.g. $a^2 - 200a + 8398.7 = 0$
	$a = 0.3(00) \text{ 3sf or } 0.7(00) \text{ 3sf}$	A1	Note: Do not ISW $a = 0.3 \times 200$ or 0.7×200 score A0 .
		4	

PUBLISHED

Question	Answer	Marks	Guidance
5	sd (σ) remains at 3.8, or is unchanged	B1	Or Var unchanged.
	= 1.645	M1	Any z (M0 if not a z value) Must have $\sqrt{10}$.
	$z = \frac{\bar{x}-10.5}{\frac{3.8}{\sqrt{10}}} = \pm 1.645$	B1	
	[Smallest value of] $\bar{x} = 12.5$ (3 sf)	A1	ISW after 12.476... or 12.5 seen. Accept $\bar{x} > 12.476$ or $\bar{x} > 12.5$ as final answer.
		4	

Question	Answer	Marks	Guidance
6(a)(i)	$(\lambda) = 3.5$	B1	
	$1 - e^{-3.5}(1 + 3.5 + \frac{3.5^2}{2!} + \frac{3.5^3}{3!}) = 1 - e^{-3.5}(1 + 3.5 + 6.125 + 7.1458)$ = $1 - (0.030197 + 0.105691 + 0.1849589 + 0.215785)$	M1	Any λ . Expression or terms must be seen. Allow one end error. Accept fully correct Σ notation.
	= 0.463 (3 sf)	A1	SC Unsupported correct answer scores B1B1 SC Use of Binomial scores B1 for 0.464. Note: Use of Normal can score B1 for mean = 3.5.
		3	

Question	Answer	Marks	Guidance
6(a)(ii)	$(\lambda =) 7$	B1	Seen.
	$e^{-7}(1 + 7 + \frac{7^2}{2!}) = e^{-7}(1 + 7 + 24.5) = 0.0009119 + 0.006383 + 0.0223411$	M1	Any λ . Expression or terms must be seen. Allow one end error Accept fully correct Σ notation. Accept combination method for Poisson (6 combinations) allow 6 correct combinations identified B1 , attempt to calculate and combine at least four correct combinations M1 .
	$= 0.0296$ (3 sf)	A1	SC Unsupported correct answer scores B1B1 . SC Use of Bin B1 for 0.0294. Note: Use of Normal can score B1 for mean =7.
		3	
6(b)	$N(200, 200)$	M1	SOI.
	$\frac{205.5-200}{\sqrt{200}} \quad [= 0.38891]$	M1	Allow with omitted or incorrect cc.
	$1 - \Phi("0.38891")$	M1	For finding area consistent with their values.
	$= 0.349$ (3 sf)	A1	
		4	

PUBLISHED

Question	Answer	Marks	Guidance
7(a)	$\frac{k}{a^2} \int_0^a x^2 dx = 1$	M1	Attempt to integrate $f(x)$ and =1 ignore limits.
	$\left[\frac{kx^3}{3a^2} \right]_0^a = 1$	A1	Correct integration and correct limits.
	$\Rightarrow \frac{ka}{3} = 1 \Rightarrow k = \frac{3}{a}$	A1	AG. Must see an intermediate step and answer. Convincingly obtained no errors seen.
		3	
7(b)	$\frac{3}{a^3} \int_0^a x^3 dx$	M1	Attempt to integrate $xf(x)$ with limits 0 and a . Condone k instead of $3/a$ or missing 'k'.
	$\frac{3}{a^3} \left[\frac{x^4}{4} \right]_0^a = 1 \Rightarrow \frac{3}{4}a = 1$	A1	Correct expression after correct integration and = 1. Condone k instead of $\frac{3}{a}$.
	$a = \frac{4}{3}$ or 1.33 (3 sf)	A1	
		3	

PUBLISHED

Question	Answer	Marks	Guidance
7(c)	$\frac{81}{64} \int_0^m x^2 dx = 0.5$	M1	Attempt to integrate $f(x)$, limits 0 and m or limits m and a . and $=0.5$ (accept in terms of a and/or k . Condone missing k . FT their a .
	$\frac{81}{64} \left[\frac{x^3}{3} \right]_0^m = 0.5 \Rightarrow \frac{27}{64} m^3 = 0.5$	A1FT	Correct expression after correct integration with a and k correctly substituted (at some point) not necessarily simplified. FT their a .
	$m = \sqrt[3]{\frac{32}{27}}$ or 1.06 (3 sf)	A1	OE. CWO.
		3	

Question	Answer	Marks	Guidance
8(a)	$H_0: p = \frac{1}{6} \quad H_1: p < \frac{1}{6}$	B1	
	$(\frac{5}{6})^{30} + 30(\frac{5}{6})^{29}(\frac{1}{6}) + {}^{30}C_2(\frac{5}{6})^{28}(\frac{1}{6})^2 = 0.00421272 + 0.0252763 + 0.07330$	M1	Expression or terms must be seen. No end errors.
	$= 0.103$	A1	SC Unsupported correct answer scores B1 .
	$'0.103' > 0.05$	M1	Valid comparison (must be a tail comparison and from a Bin but not necessarily correct Bin).
	[Accept H_0] Insufficient evidence to suggest that the probability is less than $\frac{1}{6}$ Or Insufficient evidence to support Birgitte's suspicion	A1FT	FT their 0.103. No contradictions, in context and non-definite. Note: Condone 'Insufficient evidence to suggest that the dice is biased' scores A1 .
		5	

Question	Answer	Marks	Guidance
8(b)	$P(X \leq 1) = \left(\frac{5}{6}\right)^{30} + 30\left(\frac{5}{6}\right)^{29}\left(\frac{1}{6}\right) (= 0.029489\dots)$	M1	$P(X \leq 1)$ attempted using $B(30, \frac{1}{6})$. No end errors.
	$P(\text{Type I error}) = 0.0295$ (3 sf)	A1	$P(0)$ and $P(1)$ expression or terms may be seen in (a) . If not in (a) unsupported answer of 0.0295 scores B1 .
		2	
8(c)	$P(\text{Type II error}) = 1 - P(X \leq 1 \mid p = 0.02)$	M1	Use of $B(30, 0.02)$ to find $1 - P(X \leq 1)$. May be implied.
	$= 1 - (0.98^{30} + 30 \times 0.98^{29} \times 0.02) = 1 - (0.54548 + 0.33397)$	M1	No end errors. Expression or terms must be seen.
	$= 0.121$ (3 sf)	A1	SC Unsupported correct answer scores M1B1 .
		3	

Cambridge International A Level

MATHEMATICS**9709/63**

Paper 6 Probability & Statistics 2

May/June 2025**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.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **15** printed pages.

PUBLISHED**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 descriptions 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.

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, non-integer 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 or sign 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 A or B 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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	More information required
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

Annotation	Meaning
DM1	Dependent on the previous M1 mark(s)
	Follow through
	Indicate working that is right or wrong
Highlighter	Highlight a key point in the working
	Ignore subsequent work
	Judgement
	Judgement
	Method mark awarded zero
	Method mark awarded one
	Method mark awarded two
	Misread
	Omission or Other solution
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
	Judgment made by the PE
	Premature approximation
	Special case
	Indicates that work/page has been seen

Annotation	Meaning
 SF	Error in number of significant figures
	Correct
 TE	Transcription error
 XP	Correct answer from incorrect working

PUBLISHED**Mark Scheme Notes**

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

B Mark for a correct result or statement independent of method marks.

DM or DB When a part of a question has two or more ‘method’ steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly, when there are several B marks allocated. The notation DM or DB is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.

FT Implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only.

A or B marks are given for correct work only (not for results obtained from incorrect working) unless follow through is allowed (see abbreviation FT above). For a numerical answer, allow the A or B mark if the answer is correct to 3 significant figures or would be correct to 3 significant figures if rounded (1 decimal place for angles in degrees).

The total number of marks available for each question is shown at the bottom of the Marks column.

Wrong or missing units in an answer should not result in loss of marks unless the guidance indicates otherwise.

Square brackets [] around text or numbers show extra information not needed for the mark to be awarded.

Abbreviations

AEF/OE Any Equivalent Form (of answer is equally acceptable) / Or Equivalent

AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)

CAO Correct Answer Only (emphasising that no ‘follow through’ from a previous error is allowed)

CWO Correct Working Only

ISW Ignore Subsequent Working

SOI Seen Or Implied

SC Special Case (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

WWW Without Wrong Working

AWRT Answer Which Rounds To

Question	Answer	Marks	Guidance
1(a)	$\lambda = \frac{23.4}{60}$ or 0.39	B1	First B1 only scored if see 0.39.
	$1 - e^{-0.39}(1 + 0.39) = 1 - (0.67706 + 0.26405)$	M1	Any λ . Allow one end error.
	$= 0.0589$ (3 sf)	A1	SC unsupported answer score B1 instead of M1A1 .
		3	
1(b)(i)	$N(23.4, 23.4)$	B1B1	B1 for $N(23.4, \dots)$ B1 for $\text{Var}(X) = 23.4$. Note: marks for (i) cannot be recovered from (ii) .
		2	
1(b)(ii)	$\frac{20.5 - 23.4}{\sqrt{23.4}} [= -0.5995] \quad \frac{29.5 - 23.4}{\sqrt{23.4}} [= 1.2610]$	M1	Attempt to standardise both with their values. Must have square roots. Allow no (or incorrect) continuity correction(s).
	$\Phi(1.2610) - \Phi(-0.5995) (0.8964 - 0.2743)$	M1	For attempt at area between 20 and 30 consistent with their working.
	$= 0.622$ (3 sf)	A1	SC no working seen can score B2 for 0.622.
		3	

Question	Answer	Marks	Guidance
2(a)(i)	$\frac{10.03 - 10}{\frac{\sigma}{\sqrt{50}}} = 1.995$	M1	For standardising. Must have square root 50.
		M1	Equating to 1.995 (not phi 1.995).
	$= 0.106$ (3 sf)	A1	
		3	

PUBLISHED

Question	Answer	Marks	Guidance
2(a)(ii)	$H_0: \mu = 10$ $H_1: \mu > 10$	B1	Accept if seen in part (i) but not in (ii). Accept population mean but not just mean.
	$1.995 > 1.96$	M1	Valid comparison. $0.977 > 0.975$ or $0.023 < 0.025$. Accept 2.00 or $2.001 > 1.96$.
	[Reject H_0] There is sufficient evidence [at 2.5% level] to suggest that mean length is greater than 10 cm. Or There is sufft evidence to support the inspectors thought /claim.	A1	No contradictions. In context. Not definite. Accept ‘..... that mean length has increased’ Note 2 tail test scores B0M1A0 .
		3	
2(b)	No, because population distribution [of lengths] is normal	B1	
		1	

Question	Answer	Marks	Guidance
3(a)(i)	$\text{Est}(\mu) = \frac{46350}{150}$ or 309	B1	
	$\text{Est}(\sigma^2) = \frac{150}{149} \left[\frac{14410800}{150} - \left(\frac{46350}{150} \right)^2 \right] \left[= \frac{150}{149} \times 591 \right]$	M1	Use of correct formula. $\frac{1}{149} (14410800 - \frac{46350^2}{150})$. OE.
	$= 595$ (3 sf) or $88650/149$	A1	
		3	

Question	Answer	Marks	Guidance
3(a)(ii)	$z = 1.96$	B1	Seen.
	$309 \pm z \times \sqrt{\frac{595}{150}}$	M1	Any z . Use of correct formula.
	= 305 to 313 (3 sf)	A1	Use of biased (591) gives same interval but scores B1M1A0 . Unsupported correct answer scores max B1B1 .
		3	
3(b)	<u>Either</u> Smaller sample means more uncertainty about the value of μ .		OE.
	<u>or</u> $n < 120$ means that $\frac{1}{\sqrt{n}} > \frac{1}{\sqrt{150}}$	B1*	OE.
	Therefore Wider	B1dep	Dep on previous B1 .
		2	

Question	Answer	Marks	Guidance
4(a)	The probabilities are not equal	B1	OE. SOI.
	e.g. $P(n=0) = \frac{1}{4}$ and $P(n=1) = \frac{1}{2}$ or $P(n=1) = 2 \times P(n=0)$ or similar	B1	Numerical justification or there is one way to get 0 but two ways to get 1, or similar B1B1 .
		2	

PUBLISHED

Question	Answer	Marks	Guidance
4(b)	Choose PQ or QR or RP soi or reject R or P or Q soi	B1	Identifying the three correct cases to choose or reject and correctly identifying choosing or rejecting.
	eg 1 or 2 [choose] PQ . 3 or 4 [choose] QR . 5 or 6 [choose] RP		OE.
	or 1 or 2 [reject] R . 3 or 4 [reject] P . 5 or 6 [reject] Q	B1	OE. Using the score on the dice to give each of the three cases equal probability. More than one throw of the dice scores B0B0 .
		2	

Question	Answer	Marks	Guidance
5	Assume the men on the bridge are a random sample	B1	OE. Allow: assume that all the men on the bridge are independent of one another.
	$\frac{1500 - 70.3n}{5.9\sqrt{n}} = 2.326$	M1	Must have square root n . Allow wrong z but must be a z value.
	$70.3n + 13.7234\sqrt{n} - 1500 = 0$ Or $4942.09 n^2 - 211088.33 n + 2250000 = 0$	A1	Correct quadratic equation or inequality in square root n . OE.
	$[\sqrt{n} = 4.5226 \text{ (3 sf)}]$ Max value of n is 20	A1	CWO.
		4	

Question	Answer	Marks	Guidance
6(a)	$\frac{1}{2} \times b \times ab = 1$ or $a \int_0^b x dx = 1$	M1	Attempt triangle area or integrate $f(x)$ (ignore limits) and = 1.
	$a \left[\frac{x^2}{2} \right]_0^b = 1$	A1	Correct integration. $\frac{1}{2} \times b \times ab = 1$.
	$\frac{ab^2}{2} = 1 \Rightarrow a = \frac{2}{b^2}$	A1	Convincingly obtained. No errors seen.
		3	

Question	Answer	Marks	Guidance
6(b)	$E(X) = \frac{2}{b^2} \int_0^b x^2 dx$	M1	Attempt to integrate $xf(x)$. Ignore limits.
	$= \frac{2}{b^2} \left[\frac{x^3}{3} \right]_0^b$	A1	Correct integration and limits.
	$= \frac{2}{3}b$	A1	OE. E.g. $ab^3/3$
	$P(X < E(X)) = \frac{2}{b^2} \int_0^{\frac{2}{3}b} x dx$	M1	OE. Integrate $f(x)$ with limits 0 and their $E(X)$ Condone a instead of $\frac{2}{b^2}$ Or using areas, $\text{prob} = \frac{1}{2} \times \frac{2b}{3} \times \frac{2}{3}ab$
	$= \frac{2}{b^2} \left[\frac{x^2}{2} \right]_0^{\frac{2}{3}b}$	A1FT	Correct integration and limits, FT their $E(X)$. Need $\frac{2}{b^2}$. Or $\text{prob} = \frac{1}{2} \times \frac{2b}{3} \times \frac{2}{3} \times \frac{2b}{b^2}$.
	$= \frac{2}{b^2} \times \frac{\frac{4}{9}b^2}{2} = \frac{4}{9}$	A1	Must see correct expression after substituting limits. Convincingly obtained. No errors seen. Or expression correctly simplified.
		6	

Question	Answer	Marks	Guidance
7(a)	B(35, 0.25)	M1	SOI.
	$0.75^{35} + 35 \times 0.75^{34} \times 0.25 + {}^{35}C_2 \times 0.75^{33} \times 0.25^2 + {}^{35}C_3 \times 0.75^{32} \times 0.25^3$ $= 0.000042378 + 0.0004944 + 0.00280168 + 0.01027283$	M1	Attempt $P(r \leq 3)$ Expressions or terms.
	$= 0.0136$ (3 sf) [< 0.04]	A1	SC unsupported answer 0.0136 B1 .
	$'0.0136' + {}^{35}C_4 \times 0.75^{31} \times 0.25^4 = 0.0136 + 0.0273942$	M1	Attempt $P(r \leq 4)$ Expressions or terms
	$= 0.041[0]$ (2 sf) [> 0.04]	A1	SC unsupported answer 0.041 B1 .
	Maximum value of r is 3	A1	Dep on above two correct probabilities seen and at least one comparison with 0.04.
		6	
7(b)	Concluding proportion has decreased when in fact it hasn't	B1	Or concluding that the director's belief is correct when in fact it isn't.
	0.0136	B1	FT their $P(r \leq 3)$, dep < 0.04 OE.
		2	
7(c)	$1 - (0.95^{35} + 35 \times 0.95^{34} \times 0.05 + {}^{35}C_2 \times 0.95^{33} \times 0.05^2 + {}^{35}C_3 \times 0.95^{32} \times 0.05^3)$ $= 1 - (0.16608 + 0.305943 + 0.2737385 + 0.158480)$	M1	Attempt $1 - P(r \leq 3)$ with B(35, 0.05). Expressions or terms.
	$= 0.0958$ (3 sf)	A1	SC unsupported answer 0.0958 B1 .
		2	

Cambridge International AS & A Level

MATHEMATICS**9709/65**

Paper 6 Probability & Statistics 2

May/June 2025**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.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **14** printed pages.

PUBLISHED**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 descriptions 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.

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, non-integer 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 or sign 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 A or B 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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	More information required
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

Annotation	Meaning
DM1	Dependent on the previous M1 mark(s)
	Follow through
	Indicate working that is right or wrong
Highlighter	Highlight a key point in the working
	Ignore subsequent work
	Judgement
	Judgement
	Method mark awarded zero
	Method mark awarded one
	Method mark awarded two
	Misread
	Omission or Other solution
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
	Judgment made by the PE
	Premature approximation
	Special case
	Indicates that work/page has been seen

Annotation	Meaning
	Error in number of significant figures
	Correct
	Transcription error
	Correct answer from incorrect working

PUBLISHED

Question	Answer	Marks	Guidance
1(a)	$\lambda = 4.5$	B1	SOI.
	$e^{-4.5}(1 + 4.5 + \frac{4.5^2}{2!} + \frac{4.5^3}{3!}) = e^{-4.5}(1 + 4.5 + 10.125 + 15.1875)$ $= 0.01111 + 0.04999 + 0.11248 + 0.16872$	M1	Allow any λ ; allow one end error; expression or terms must be seen.
	$= 0.342$ (3 sf)	A1	SC Unsupported answer of 0.342 scores B1 .
		3	
1(b)	$P(S \leq 1) = e^{-4.5}(1 + 4.5)$ or $5.5e^{-4.5}$ or $P(S \leq 2) = e^{-4.5}(1 + 4.5 + \frac{4.5^2}{2})$ or $\frac{125}{8}e^{-4.5}$	M1	For either expression. Allow any λ , allow one end error.
	$P(S \leq 2) \div P(S \leq 1) [= \frac{125}{8} \div 5.5]$	M1	Both expressions. No end error, $\lambda = 4.5$. Division attempted. Allow in decimal form for this mark.
	$\frac{P(S \leq 2)}{P(S \leq 1)} = \frac{125}{44}$	A1	AG . Must be exact, not decimal approximation. No decimals seen (condone exact decimals). Convincingly obtained, $1 + 4.5$ and $1 + 4.5 + \frac{4.5^2}{2}$ evaluated.
		3	

PUBLISHED

Question	Answer	Marks	Guidance
2(a)	Unbiased estimate of mean of $x = 2 + \frac{60}{200} = 2.3$	B1	Can be given at an early stage.
	Unbiased estimate of variance of $(x - 2) = \frac{200}{199} \left(\frac{20}{200} - '0.3'^2 \right)$ or $\frac{1}{199} \left(20 - \frac{60^2}{200} \right)$	M1	Biased estimate scores M0 . Accept use of $\sum (x - \bar{x})^2$ correctly substituted.
	$0.01005... = 0.0101$ (3 s.f.) or $\frac{2}{199}$	A1	Condone 0.01, from unbiased estimate.
	CI for x is $'2.3' \pm z \times \sqrt{\frac{'0.01005'}{200}}$	M1	FT their mean and variance. Must be a z value (note: if only one side of the interval still allow M1).
	$z = 1.96$	B1	Seen.
	CI for x is 2.29 to 2.31 (3 sf)	A1	Must be an interval. SC Use of biased variance (0.01) can score A1FT max 4/6.
		6	
2(b)	Use of $z = '1.96'$, or Value of z used [comes from normal distribution].	B1	Must refer to z (i.e. 'value of z ' or '1.96'). Not " X not normally distributed". Not "Assume that $\bar{X}$ is normally distributed".
		1	

PUBLISHED

Question	Answer	Marks	Guidance
3(a)	342	B1	Only.
		1	
3(b)(i)	0.798, 0.799	B1	Only.
		1	
3(b)(ii)	0.998	B1	Only.
		1	
3(c)	680 and 850 are not equally likely to be chosen for the sample.	B1	Or a sample including 680 is more likely to be selected than a sample including 850. Must relate to part (b) . Allow FT if number of solutions in (i) and (ii) are different.
		1	

PUBLISHED

Question	Answer	Marks	Guidance
4(a)	$1 - e^{-4} \left(1 + 4 + \frac{4^2}{2!} + \frac{4^3}{3!} \right) 1 - e^{-4} \left(1 + 4 + 8 + \frac{32}{3} \right)$ $= 1 - (0.018316 + 0.073263 + 0.14653 + 0.19537) [= 0.56653]$	M1	Any λ . Allow one end error. Must see full expression or terms.
	$1 - e^{-2.5}(1 + 2.5) = 1 - (0.08208 + 0.20521) [= 0.71270]$	M1	Any λ . Allow one end error. Must see full expression or terms.
	'0.56653' $\times$ '0.71270'	M1	Multiply <i>their</i> values.
	= 0.404 (3 sf)	A1	SC ₁ Unsupported answer of 0.404 scores B3 . SC ₂ Unsupported 0.567 and 0.713 scores B1 , leading to M1A1 as per scheme.
		4	
4(b)	$\lambda = 156$	B1	
	N(156, 156)	B1FT	Seen or implied.
	$\frac{144.5 - '156'}{\sqrt{156}} [= -0.921]$	M1	For standardising with their values. Allow with wrong or no cc.
	$\Phi(' -0.921') = 1 - \Phi('0.921')$	M1	Finding the area consistent with their value.
	= 0.179 or 0.178 (3 sf)	A1	
		5	

PUBLISHED

Question	Answer	Marks	Guidance
5	$E(F) = 140.2$	B1	
	$\text{Var}(F) = 4 \times 3.8^2 + 6.1^2$ [= 94.97]	M1	Must be a combination of 3.8 and 6.1.
	$\frac{143 - '140.2'}{\sqrt{\frac{94.97}{25}}} (= 1.437)$ or $\frac{143 + \frac{1}{30} - '140.2'}{\sqrt{\frac{94.97}{25}}} [= 1.447]$	M1	For standardising with their values. Must have $\sqrt{25}$. Allow incorrect continuity correction.
	$1 - \Phi('1.437')$ or $1 - \Phi('1.447')$	M1	Finding the area consistent with their value. Allow attempted continuity correction
	$= 0.0754$ (3 sf) or $= 0.0739$ or 0.0740 (3 sf)	A1	Allow 0.074.
		5	

Question	Answer	Marks	Guidance
6(a)	$H_0: p = 0.28 \quad H_1: p < 0.28$	B1	
	$P(X \leq 4) = 0.72^{30} + 30 \times 0.72^{29} \times 0.28 + {}^{30}C_2 \times 0.72^{28} \times 0.28^2 + {}^{30}C_3 \times 0.72^{27} \times 0.28^3 + {}^{30}C_4 \times 0.72^{26} \times 0.28^4$ $= 0.0000525 + 0.0006122 + 0.0034524 + 0.012531 + 0.03893$	M1	For attempting to find $P(X \leq 4)$ using $B(30, 0.28)$, no end errors. Expression or terms must be seen.
	$= 0.0495$ (3 sf)	A1	SC 0.0495, no working: B1 .
	$'0.0495' < 0.1$	M1	Valid comparison of <i>their</i> 0.0495 (must be a tail probability) with 0.1.
	[Reject H_0] There is sufficient evidence [at 10% level] to suggest that the percentage [who support Forward Now] is less than 28%.	A1FT	FT <i>their</i> 0.0495. No contradictions, in context, not definite.
		5	

PUBLISHED

Question	Answer	Marks	Guidance
6(b)	Yes, because H_0 was rejected.	B1FT	OE. FT their conclusion from 6(a) .
		1	
6(c)	$P(X \leq 5) = 0.116$ (3 sf)	B1	
	$P(\text{Type I}) = 0.0495$	B1	
		2	

Question	Answer	Marks	Guidance
7(a)	H_0 : Population mean (or μ) = 12 H_1 : Population mean (or μ) < 12	B1	Accept population mean, but not just mean.
		1	
7(b)	$\frac{11.4-12}{2.3\div\sqrt{50}} [= -1.845]$	M1	For standardising. Must have $\sqrt{50}$.
	$-1.845 < -1.645$ or $1.845 > 1.645$ or $0.0325 < 0.05$ [Hence H_0 is rejected]	A1	OE. Correct comparison seen. No contradictions.
		2	

PUBLISHED

Question	Answer	Marks	Guidance
7(c)	$1 - \Phi('1.845') [= 0.0325 \text{ 3 sf}]$	M1	Or $P(X < 11.4) = 0.0325$ or 3.25% (3 sf). May be implied.
	$\alpha > 3.25$ (3 sf)	A1	Or $\alpha \geq 3.25$ (3 sf). Allow $\alpha > 3$ with correct working. 0.0325 scores M1A0 . Condone 3.25%.
		2	

Question	Answer	Marks	Guidance
8(a)	$\frac{1}{2} \times \sqrt{2} \times k\sqrt{2} = \frac{1}{2}$ or $\int_0^{\sqrt{2}} kx dx = \frac{1}{2}$	M1	Using the median = 0.5. Must attempt integration for ‘or’ method. Correct limits and = 0.5 for ‘or’ method. For a method involving k and a , M0 until a is evaluated.
	$k = \frac{1}{2}$	A1	
		2	

PUBLISHED

Question	Answer	Marks	Guidance
8(b)	$\frac{1}{2} \times a \times \frac{1}{2}a = 1$ or $\int_0^a \frac{1}{2}x \, dx = 1$	M1	FT their k .
	$a = 2$	A1FT	FT their k . Can be seen in 8(a) .
	$\int_0^2 \frac{1}{2}x^2 \, dx = \left[\frac{x^3}{6} \right]_0^2$	M1	Attempt to integrate $x \times (\text{their } k)x$, limits 0 to their a . Allow $\int_0^a kx^2 \, dx$ with integration attempted.
	$= \frac{4}{3}$ or 1.33 (3 sf)	A1	
		4	