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Cambridge International Advanced Level

MARK SCHEME for the May/June 2015 series

9709 MATHEMATICS

9709/73 Paper 7, maximum raw mark 50

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.

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Mark Scheme Notes

Marks are of the following three types:

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.

- 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 (or dep*) 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.

- The symbol √ 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 and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.

- Note: B2 or A2 means that the candidate can earn 2 or 0.
  B2/1/0 means that the candidate can earn anything from 0 to 2.

  The marks indicated in the scheme may not be subdivided. If there is genuine doubt whether a candidate has earned a mark, allow the candidate the benefit of the doubt. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

- Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

- For a numerical answer, allow the A or B mark if a value is obtained which is correct to 3 s.f., or which would be correct to 3 s.f. if rounded (1 d.p. in the case of an angle). As stated above, an A or B mark is not given if a correct numerical answer arises fortuitously from incorrect working. For Mechanics questions, allow A or B marks for correct answers which arise from taking g equal to 9.8 or 9.81 instead of 10.

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The following abbreviations may be used in a mark scheme or used on the scripts:

AEF Any Equivalent Form (of answer is equally acceptable)

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

BOD Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)

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

CWO Correct Working Only – often written by a 'fortuitous' answer

ISW Ignore Subsequent Working

MR Misread

PA Premature Approximation (resulting in basically correct work that is insufficiently accurate)

SOS See Other Solution (the candidate makes a better attempt at the same question)

SR Special Ruling (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)

Penalties

MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy. An MR –2 penalty may be applied in particular cases if agreed at the coordination meeting.

PA –1 This is deducted from A or B marks in the case of premature approximation. The PA –1 penalty is usually discussed at the meeting.

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1	**(i)**	Eg: Only students who use canteen The five will probably be friends	B1 B1 [2]	or any reason that some are excluded B1 each sensible reason must be in context
	(ii)	2–digits ignore > 82 (anything too big) Ignore repeats	B1 B1 B1 [3]	
			[Total 5]	
2	**(i)**	H_0: P(correct) = $\frac{1}{8}$ H_1: P(correct) > $\frac{1}{8}$	 B1 [1]	Or H_0 p = 1/8 H_1p > 1/8
	(ii)	$1-\left(\left(\frac{1}{8}\right)^{10}+10\left(\frac{1}{8}\right)^{9}\left(\frac{7}{8}\right)+{}^{10}\mathrm{C}_2\left(\frac{1}{8}\right)^{8}\left(\frac{7}{8}\right)^{2}\right)$ = 0.120 (3 sf) or 0.119	M1 A1 A1 [3]	M1 for attempt at correct expression accept 1 error only, e.g. 1 term extra, omitted or wrong, or omit "1–" or incorrect p/q Correct expression Note Use of Poisson in (ii) could score M1 only for expression 1 –P(0,1,2) λ =1.25
	(iii)	12%	B1f [1]	ft their (ii) Must be a probability
			Total 5	
3	**(i)**	$\mathrm{Var}(p_s) = \frac{0.22\times(1-0.22)}{100}$ $\left(=\frac{429}{250\,000}\text{ or }0.001716\right)$ $0.22 \pm z\sqrt{'\frac{429}{250\,000}'}$ z = 2.17 or 2.168/9 or 2.171 0.13(0) to 0.31(0) (2 sf)	M1 M1 B1 A1 [4]	pq/100 Expression of correct form with their variance Any z (must be a z value) accept one side only Seen Must be an interval
	(ii)	'2' × (1 – 0.97) × 0.97 = 0.0582	M1 A1 [2]	
			Total 6	

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4 (i)	$\left(\frac{1508}{50}\right) = 30.16\ (30.2)$	B1	Allow any form
	$\frac{50}{49}\left(\frac{51\,825}{50} - (\text{'}30.16\text{'}^2)\right)$	M1	(129.46367)
	= 129 (3 sf) Or 130	A1 [3]	
(ii)	(1.5 × '30.16' + 10) = 55.24	B1ft	ft their 30.16
	(1.5^2 × '129….')	M1	1.5^2 × their(129) with nothing added at any stage
	= 291 (3 sf)	A1ft [3]	Allow 290
		Total 6	
5 (i)	Cables broken or not all cables can be accessed oe or Too many cables oe or too time consuming oe	B1 [1]	e.g. previous days' stocks may have gone
(ii)	H_0: Pop mean brk str (or μ) = 5 H_1: Pop mean brk str (or μ) < 5	B1	Not just "mean"
	$(\pm)\frac{4.95-5}{\frac{0.15}{\sqrt{60}}}$	M1	Allow 60 instead of √60
	(= ±2.582)	A1	
	comp ±2.326 There is evidence that mean breaking strength is less than it should be Or reject H_0 (H_0 correctly defined)	B1 ft [4]	Ft their –2.582 (No ft 2 tailed test) Correct comparison shown, no errors seen. Accept area comparison 0.0049 with 0.01 [CR method (x – 5)/(0.15/√60) = –2.326 M1 A1 leading to x = 4.955 compared to 4.95and correct conclusion B1ft OR ((x – 4.95)/0.15/√60) leading to 4.995 M1 A1 compared to 5and correct conclusion B1ft]
(iii)	Population not necessarily normal so yes	B1 B1dep [2]	SR B1 For "it" is not necc normal (no mention of population) AND Yes
		Total 7	

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6	**(i)**	$e^{-3.5} \times \frac{3.5^3}{3!}$	M1	P($X = 3$) any λ
		= 0.216 (3 sf)	A1 [2]	
	(ii)	N(42, 42) stated or implied	B1	
		$\frac{29.5 - 42}{\sqrt{42}}$ (= –1.929)	M1	Allow with wrong or no cc <u>OR</u> without √
		P(z > '–1.929') = Φ('1.929') = 0.973 (3 sf)	M1 A1 [4]	For correct area consistent with their working
	(iii)	(λ) = 2.4	B1	
		$1 - e^{-2.4}\left(1 + 2.4 + \frac{2.4^2}{2} + \frac{2.4^3}{3!}\right)$	M1 M1	for 1 – P($X \leqslant 3$), any λ allow one end error Correct expression any λ
		= 0.221 (3 sf)	A1 4	NB For combination method B1 attempting 10 combinations with λ=1, λ=1.4 M1 6 expressions M1 10 expressions 0.221 A1
			Total 10	
7	**(i)**	$\frac{3}{4}\int_0^c (cx - x^2)dx = 1$	M1	Attempt integ f(x) and = 1. Ignore limits
		$\frac{3}{4}\left[\frac{cx^2}{2} - \frac{x^3}{3}\right]_0^c = 1$	A1	Correct integration and limits (condone c = 2
		$\frac{3}{4}\left(\frac{c^3}{2} - \frac{c^3}{3}\right) = 1$ or $\frac{3}{4} \times \frac{c^3}{6} = 1$ or $\frac{c^3}{8} = 1$	A1 [3]	No errors seen
		(c = 2 **AG**)		
	(ii)	Inverted parabola Through (0, 0) and (2, 0) and zero elsewhere Median = 1	B1 B1 B1 [3]	Must not extend beyond [0,2]
	(iii)	$\frac{3}{4}\int_0^{1.5} (2x - x^2)dx$	M1	Attempt integ f(x) ignore limits
		$= \frac{3}{4}\left[x^2 - \frac{x^3}{3}\right]_0^{1.5}$	A1	Correct integration ignore limits
		$\frac{3}{4}\left(1.5^2 - \frac{1.5^3}{3}\right)$	B1	Use of correct limits [0,1.5] or 1–[1.5,2]
		$= \frac{27}{32}$ or 0.844 (3 sf)	A1 [4]	

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(iv)	$\left(\frac{27}{32} - \frac{1}{2} \text{ or } 0.844 - 0.5\right)$ $= \frac{11}{32}$ or 0.344 (3 sf)	B1f [1]	ft their (iii) For use of symmetry Note If do not use "hence" and start again B1 for cwo
		Total 11	

Total for paper 50

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