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Cambridge International Advanced Level

MARK SCHEME for the May/June 2015 series

9709 MATHEMATICS

9709/71 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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Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to $\geqslant$ 3sfs, ISW for later rounding. Penalise $<$ 3 sfs only once in paper.

1	$\frac{1}{2}a^2 = 1$	M1	or $\int_0^a x\mathrm{d}x = 1$
	$a = \sqrt{2}$	A1	Allow 1.41 or better
	$\int_0^{\sqrt{2}} x^2\mathrm{d}x$	M1	ignore limits
	$= \left[\frac{x^3}{3}\right]_0^{\sqrt{2}}$	A1f	correct integral and limits, but ft their a
	$= \frac{\left(\sqrt{2}\right)^3}{3} =$ or $\frac{2^{1.5}}{3}$ or $\frac{2.83}{3}$ or 0.9428 (= 0.943 **AG**)	A1 [5]	must see this numerical expression, or equiv SR Equating $\int x\,\mathrm{f}(x)$ to 0.943 scores M1 Solving to find a = 1.41 scores A1
		[Total 5]	
2 **(i)**	H_0: $p = 0.2$ or $\mu = 10$ H_1: $p > 0.2$ or $\mu > 10$	B1 [1]	
(ii)	N(10, 8) seen or implied	B1	or $\mathrm{N}\left(0.2, \frac{0.2\times0.8}{50}\right)$
	$\frac{125-10}{\sqrt{8}}$ or $\frac{\frac{125}{50}-02}{\sqrt{\frac{0.2\times0.8}{50}}}$	M1	For standardising allow with no or wrong cc
	= 0.884	A1	
	comp 1.282	M1f	Allow area comparison with 0.188 or comp 1.645 if H_1 $p \neq 0.2$
	Claim not justified or No evidence to support claim	A1f [5]	Allow accept H_0 provided correctly defined. Follow through their test statistic ;dep 1–tail test No Contradictions SR; Use of B(50,0.2) scores B1 provided at least two probabilities calculated. M1 For finding P($X \geqslant 13$) allow one end error. A1 for 0.186
		[Total: 6]	

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3	**(i)**	34 $2.2^2 + 1.3^2 + 2.6^2$ (=13.29)	B1 B1 [2]	Accept 13.3 or 3.65^2 Allow at early stage
	(ii)	$\frac{33-'34'}{\sqrt{\frac{'13.29'}{70}}}$ (= –2.295) $\frac{35-'34'}{\sqrt{\frac{'13.29'}{70}}}$ (= 2.295) Φ('2.295') – Φ('–2.295') = Φ('2.295') – (1 – Φ('2.295')) oe = 0.978 (3 sf)	M1 M1 M1 A1 [4]	correct standardisation method for either For attempt to use tables to find the probability between two z values ,may be implied by next line For a correct method to find the area between their two z values
			[Total: 6]	
4	**(i)**	H_0: pop mean (or μ) = 12.4 H_1: pop mean (or μ) > 12.4 $\frac{12.9-12.4}{2.1+\sqrt{50}}$ 1.684 comp cv z = 1.96 No evidence that pop mean time has increased	B1 M1 A1 B1f [4]	not just "mean" Allow with 50 instead of √50 or P($z > 1.684$) = 0.0461 $>$ 0.025 Allow accept H_0 if correctly defined. Ft their test statistic. No contradictions
	(ii)	Not reject (or accept) that mean time is unchanged (or is 12.4) oe although mean time has increased (or is more than 12.4) oe	B1 B1 [2]	
	(iii)	True (or new) mean	B1 [1]	
			[Total: 7]	

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5	**(i)**	4200/80 (=52.5)	B1	
		$= \frac{80}{79}\left(\frac{229\,000}{80} - '52.5'^2\right)$ (= 107.595)	M1	
			A1 [3]	
		= 108 (3 sf)		
	(ii)	$'52.5' \pm z\sqrt{\frac{'107.595'}{80}}$	M1	Correct form – must be z-value – allow one side only
		z = 2.326	B1	Seen
		49.8 to 55.2	A1f [3]	ft their 52.5 and 107.595. Must be an interval
	(iii)	49	B1 [1]	
			[Total: 7]	
6	**(i)**	$e^{-\frac{10}{3}} \times \frac{\left(\frac{10}{3}\right)^2}{2}$	M1	P(2), allow any λ
		= 0.198 (3 sf)	A1 [2]	
	(ii)	$1 - e^{-2}\left(1 + 2 + \frac{2^2}{2}\right)$	M1	M1 allow any λ and/<u>or</u> 1end error
			M1	Correct expression , correct λ
		= 0.323 (3 sf)	A1 [3]	
	(iii)	$N\left(\frac{200}{3}, \frac{200}{3}\right)$	M1	seen or implied
		$\frac{49.5 - \frac{200}{3}}{\sqrt{\frac{200}{3}}}$ (= –2.102)	M1	For standardising allow <u>either</u> wrong or no cc No sd/var mix
		$\Phi('-2.102') = 1 - \Phi('2.102')$	M1	For finding area consistent with their working
		= 0.0178 (3 sf)	A1 [4]	
			[Total: 9]	

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7	**(i)**	$7E(X) + 5E(Y) - 2$ $(= 7 \times 8 + 5 \times 3) - 2$ $= 69$	M1 A1 [2]	allow incorrect means
	(ii)	$Var(X) = 1.6$, $Var(Y) = 3$ $16Var(X) + 9Var(Y)$ $(= 16 \times 1.6 + 9 \times 3)$ $= 52.6$	B1 M1 M1 A1 [4]	both M1 for mult by 16 and 9; allow with '+ 3' M1 for add without '+ 3'; allow incorrect multipliers
	(iii)	$X = 10$, $Y = 2$ and $X = 9$, $Y = 0$ $0.8^{10} \times e^{-3} \times \frac{3^2}{2}$ or $10 \times 0.8^9 \times 0.2 \times e^{-3}$ $0.8^{10} \times e^{-3} \times \frac{3^2}{2} + 10 \times 0.8^9 \times 0.2 \times e^{-3}$ $= 0.0374/5$	B1 M1 M1 A1 [4]	both pairs seen or implied or 0.0241 or 0.0134 (3sf) one correct product all correct
			[Total: 10]	

[Total for paper 50]

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