CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9709 MATHEMATICS

9709/62 Paper 6 (paper 6), 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.

Cambridge will not enter into discussions about these mark schemes.

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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)

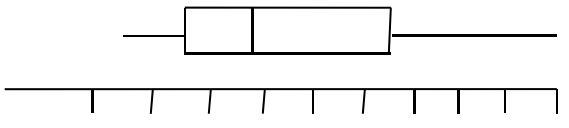
SR Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

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	P(3, 4, 5) =	M1		Bin expression of form ${}^{10}C_x (p)^x (1–p)^{10–x}$ any x any p
	${}^{10}C_3\left(\frac{1}{6}\right)^3 \left(\frac{5}{6}\right)^7 + {}^{10}C_4\left(\frac{1}{6}\right)^4 \left(\frac{5}{6}\right)^6 + {}^{10}C_5\left(\frac{1}{6}\right)^5 \left(\frac{5}{6}\right)^5$	A1		Correct unsimplified answer accept (0.17, 0.83), (0.16, 0.84), (0.16, 0.83), (0.17, 0.84) or more accurate
	= 0.222	A1	**3**	Correct answer
2	mid points 13, 30.5, 40.5, 50.5, 73	M1		Attempt at midpoints at least 3 correct
	Mean = $\frac{4\times13 + 24\times30.5 + 38\times40.5 + 34\times50.5 + 20\times73}{120}$	M1		Using their midpoints i.e. cw, ucb, 1/2 cw and freqs into correct formula must be divided by 120
	$= \frac{5500}{120} = 45.8$	A1		Correct answer from correct working Evaluating
	var = $\frac{4\times13^2 + 24\times30.5^2 + 38\times40.5^2 + 34\times50.5^2 + 20\times73^2}{120} - (45.8\ldots)^2$	M1		$\frac{\Sigma fx^2}{120}$ – their $\bar{x}^2$ must see their 45.8^2 subtracted allow cw etc
	$= \frac{278620}{120} - 45.8\ldots^2$ $= 2321.8333 – 45.8\ldots^2$ sd = 14.9	A1	**5**	Correct answer
3 (i)		B1		LQ = 2.6 med = 3.8– 3.85, UQ = 6.4– 6.6
		B1 √		Correct quartiles and median on graph ft linear from 2–10
		B1		End whiskers correct not through box
		B1	**4**	Label need seconds and linear 2–10 axis or can have 5 values on boxplot no line provided correct
(ii)	1.5 × IQR = 1.5 × 3.8 = 5.7 LQ – 5.7 = –ve, UQ + 5.7 = 12.1 i.e. > 10 So no outliers AG	M1		Attempt to find 1.5 × IQR and add to UQ or subt from LQ OR compare 1.5 × IQR with gap 3.6 between UQ and max 10
		A1	**2**	Correct conclusion from correct working need both
4 (i)	$0.3\times0.72 + 0.7\times x = 0.783$ $x = 0.81$	M1		Eqn with sum of two 2-factor probs =0.783
		A1		Correct equation
		A1	**3**	Correct answer

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(ii)	P(S given not like) $= \dfrac{P(S \cap NL)}{P(NL)}$ $= \dfrac{0.3 \times 0.28}{0.3 \times 0.28 + 0.7 \times 0.19 \text{ or } 1 - 0.783}$ = 0.387 (12/31)	B1 M1 A1 A1	**4**	0.3×0.28 seen on its own as num or denom of a fraction Attempt at P(NL) either ($0.3 \times p_1$) + ($0.7 \times p_2$) or 1 – 0.783 seen anywhere Correct unsimplified P(NL) as num or denom of a fraction Correct answer
5 (i)	P(2Es 1O) = $\dfrac{3}{5} \times \dfrac{2}{4} \times \dfrac{2}{3} \times {}^3C_2 = \dfrac{3}{5}$ (0.6) OR P(2Es 1O) = $\dfrac{{}^3C_2 \times {}^2C_1}{{}^5C_3} = \dfrac{6}{10}$ = 0.6 OR 241, 247, 261, 267, 461, 467 = 6 options 124 126 127 146 147 167 246 247 267 467 Prob = 6/10	M1 M1 A1 M1 M1 A1 M1 M1 A1	**3**	5×4×3 seen in denom Mult a prob by ${}^3C_2$ oe Correct answer ${}^3C_x$ or ${}^yC_2$ or ${}^2C_1$ oe seen mult by $k \geqslant 1$ in num ${}^5C_3$ seen in denom Correct answer List at least 3 of 241, 247, 261, 267, 461, 467 ${}^5C_3$ or list to get all 10 options in denom see below Correct answer
(ii)	124 126 127 146 147 167 246 247 267 467 s | 1 | 2 | 4 P(S = s) | 6/10 | 3/10 | 1/10	M1 A1 B1 B1 B1	**5**	Attempt at listing with at least 7 correct All correct and no others or all 60 1, 2, 4 only seen in top row Any two correct All correct
6 (a) (i)	N*****B Number of ways = $\dfrac{5!}{3!}$ = 20	B1 B1 B1	**3**	5! Seen in num oe or alone mult by $k \geqslant 1$ 3! Seen in denom can be mult by $k \geqslant 1$ Correct final answer
(ii)	B(AAA)NNS Number of ways = $\dfrac{5!}{2!}$ or ${}^5P_3$ = 60	M1 M1 A1	**3**	5! seen as a num can be mult by $k \geqslant 1$ Dividing by 2! Correct final answer
(b)	${}^{14}C_9$ total options = 2002 T and M both in ${}^{12}C_7$ = 792 Ans 2002 – 792 = 1210 OR Neither in ${}^{12}C_9$ = 220 One in ${}^{12}C_8$ = 495 Other in ${}^{12}C_8$ = 495	M1 B1 A1 M1 B1	**3**	${}^{14}C_9$ or ${}^{14}P_9$ in subtraction attempt ${}^{12}C_7$ (792) seen Correct final answer Summing 2 or 3 options at least 1 correct condone ${}^{12}P_9 + {}^{12}P_8 + {}^{12}P_8$ here only Second correct option seen accept another 495 or if M1 not awarded, any correct option

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		total = 1210	A1	Correct final answer
7	(a) (i)	prob = $p\left(z < \frac{30 - 35.2}{4.7}\right)$ $= \text{P}(z < -1.106)$ $= 1 - 0.8655 = 0.1345$ $0.1345 \times 52 = 6.99$	M1 M1 A1 A1 **4**	Standardising no sq rt no cc no sq $1 - \Phi$ Correct ans rounding to 0.13 Correct final answer accept 6 or 7 if 6.99 not seen but previous prob 0,1345 correct
	(ii)	$\Phi(t) = 0.648 \quad z = 0.380$ $0.380 = \frac{t - 35.2}{4.7}$ $t = 37.0$	B1 M1 A1 **3**	0.648 seen standardising allow cc, sq rt,sq, need use of tables not 0.148, 0.648, 0.352, 0.852 correct answer rounding to 37.0
	(b)	$\frac{7 - \mu = -0.8\sigma}{\sigma}$ so $7 - \mu = -0.8\sigma$ $\frac{10 - \mu}{\sigma} = 0.44$ so $10 - \mu = 0.44\sigma$ $\mu = 8.94 \quad \sigma = 2.42$	B1 B1 M1 M1 A1 **5**	± 0.8 seen ± 0.44 seen An eqn with z-value, μ and σ no sq rt no cc no sq Sensible attempt to eliminate μ or σ by subst or subtraction, need at least one value Correct answers

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