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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9709 MATHEMATICS

9709/61 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.

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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)

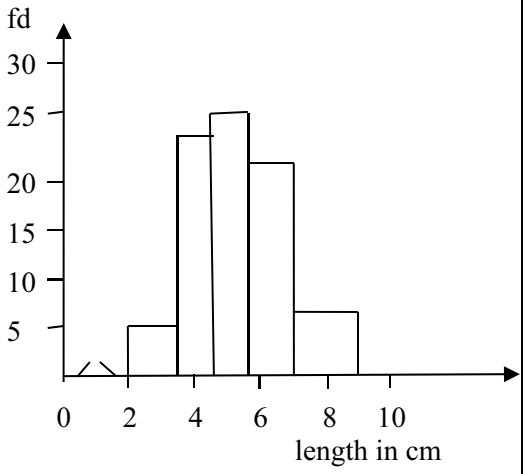
SR Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

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	$P(x < 3.273) = 0.5 - 0.475 = 0.025$ $z = -1.96$ $\frac{3.2 - \mu}{0.714} = -1.96$ $\mu = 4.60$s	**M1** **A1** **M1** **A1 [4]**	Attempt to find z-value using tables in reverse ±1.96 seen Solving their standardised equation z-value not nec Correct ans accept 4.6
2 (i)	UQ 5.5 – 7.0 cm	**B1 [1]**	
(ii)	fd 5.33, 25, 28, 20.7, 6,  	**M1** **A1** **B1** **B1 [4]**	Attempt at fd or scaled freq [fr/cw] Correct heights seen on graph Correct bar widths no gaps Labels (fd and length/cm) and correct bar ends
3 (i)	$P(A) = \frac{1}{3} \times \frac{2}{3} + \frac{2}{3} \times \frac{1}{3} = \frac{4}{9}$ $P(B) = \frac{27}{36} = \frac{3}{4}$ $P(A \cap B) = \frac{12}{36} = \frac{1}{3}$ $P(A) \times P(B) = \frac{4}{9} \times \frac{3}{4} = \frac{1}{3}$ Independent as $P(A \cap B) = P(A) \times P(B)$	**M1** **M1** **B1** **M1** **A1 [5]**	Sensible attempt at $P(A)$ Sensible attempt at $P(B)$ correct $P(A \cap B)$ Cf $P(A \cap B)$ with $P(A) \times P(B)$ need at least 1 correct Correct conclusion following all correct working
(ii)	Not mutually exclusive because $P(A \cap B) \neq 0$ Or give counter example e.g. 1 and 6	**B1√ [1]**	ft their $P(A \cap B)$
4 (i)	$(1 - x)0.9 + x \times 0.24 = 0.801$ $x = 0.15$	**M1** **A1** **A1 [3]**	Eqn with sum of two 2-factor probs = 0.801 Correct equation Correct answer

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(ii)	P(≥100 times given ≤ 3 views) $\frac{P(\geqslant 100 \text{ times} \cap \geqslant 3 \text{ views})}{P(\geqslant 3 \text{ views})} =$ $\frac{0.85\times 0.1}{0.85\times 0.1 + 0.15\times 0.76 \text{ or } 1-0.801}$ $= 0.427$	**B1** **M1** **A1** **A1 [4]**	0.85×0.1 seen on its own as num or denom of a fraction Attempt at P(≥ 3 views) either $(0.85\times p_1 + 0.15\times p_2)$ or 1 – 0.801 seen anywhere Correct unsimplified P(≥ 3 views) as num or denom of a fraction Correct answer
5 (i)	new mean = $\frac{9\times 7.1 + 18\times 5.2}{27}$ $= 5.83$	**M1** **A1 [2]**	Mult by 9 and 18 and dividing by 27 correct answer
(ii)	$1.45^2 =$ so $\frac{\sum x_t^2}{9} = 472.6125$ mm $0.96^2 = \frac{\sum x_g^2}{18} - 5.2^2$ so $\Sigma x_g^2 = 503.3088$ New sd^2 $\frac{472.6\ldots^2 + 503.3\ldots^2}{27} - 5.83\ldots^2 = 2.117$ New sd = 1.46	**M1** **A1** **A1** **M1** **A1 [5]**	subst in a correct variance formula sq rt or not correct Σx_t^2 (rounding to 470) correct Σx_g^2 (rounding to 500) using $\Sigma x_t^2 + \Sigma x_g^2$, dividing by 27 and subt comb mean^2 correct answer
6 (i)	P(5, 6, 7) = $^8C_5(0.68)^5(0.32)^3 +$ $^8C_6(0.68)^6(0.32)^2 + {}^8C_7(0.68)^7(0.32)$ $= 0.722$	M1 M1 A1 A1 [4]	Binomial term $^8C_x\, p^x(1-p)^{8-x}$ seen $0 < p < 1$ Summing 3 binomial terms Correct unsimplified answer Correct answer
(ii)	$np = 340$, $npq = 108.8$ P($x > 337$) = P$\left(z > \frac{337.5 - 340}{\sqrt{108.8}}\right)$ = P($z > -0.2396$) = 0.595	B1 M1 M1 M1 A1 [5]	Correct (unsimplified) mean and var standardising with sq rt must have used 500 cc either 337.5 or 336.5 correct area (> 0.5) must have used 500 correct answer
(iii)	np (340) > 5 and nq(160) > 5	B1 [1]	must have both or at least the smaller, need numerical justification
7 (a) (i)	$\frac{9!}{2!2!3!}$ = 15120 ways	B1 B1 [2]	Dividing by 2!2!3! Correct answer

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(ii)	********3 in $\frac{8!}{2!2!3!}$ = 1680 ways	B1	Correct ways end in 3
	********7 in $\frac{8!}{2!3!}$ = 3360 ways	B1	Correct ways end in 7
	Total even = 15120 – 1680 – 3360	M1	Finding odd and subt from 15120 or their **(i)**
	= 10080 ways	A1 [**4**]	Correct answer
	OR		
	********2 in 8!/2!3! = 3360 ways	B1	One correct way end in even
	********6 in 8!/2!2!3! = 1680 ways	B1	correct way end in another even
	********8 in 8!/2!2!2! = 5040ways	M1	Summing 2 or 3 ways
	Total = 10080 ways	A1	Correct answer
	OR		
	"15120" ×6/9 = 10080	M2	Mult their **(i)** by 2/3 oe
		A2	Correct answer
(b)	T(3) S(6) G(14)		
	1 1 3 in $3\times6\times{}^{14}C_3 = 6552$	M1	Mult 3 (combinations) together assume $6 = {}^{6}C_1$etc
	1 3 1 in $3\times{}^{6}C_3\times14 = 840$		
	3 1 1 in $1\times6\times14 = 84$	M1	Listing at least 4 different options
	2 2 1 in ${}^{3}C_2\times{}^{6}C_2\times14 = 630$	M1	Summing at least 4 different options
	2 1 2 in ${}^{3}C_2\times6\times{}^{14}C_2 = 1638$		
	1 2 2 in $3\times{}^{6}C_2\times{}^{14}C_2 = 4095$	B1	At least 3 correct numerical options
	Total ways = 13839 (13800)	A1 [**5**]	Correct answer

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