Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

MATHEMATICS **9709/62**

Paper 6 Probability and Statistics **March 2017**

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.

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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/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 – often written by a 'fortuitous' answer

ISW Ignore Subsequent Working

SOI Seen or implied

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.

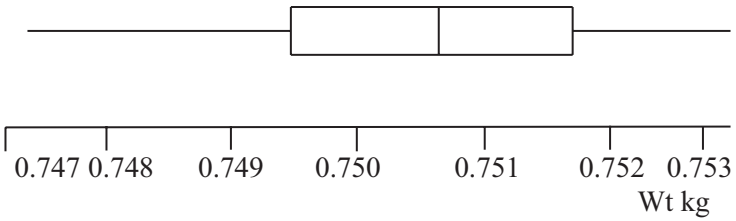
PA –1 This is deducted from A or B marks in the case of premature approximation. The PA –1 penalty is usually discussed at the meeting.

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Question	Answer	Marks	Guidance
1	1.6 –1.5 2.3 1.4 –0.6 –0.9 2.5 1.9 2.4 1.9 2.8 1.0	**M1**	Subtracting 1760, allow max 2 slips
	Mean = 1.23	**A1**	
	sd = 1.39	**A1**	
	Mean of x = 1761.23 , sd of x = 1.39	**A1**√	ft their coded mean and sd.
			SR B1 correct mean and sd without use of coded process
	Total:	**4**	

Question	Answer	Marks	Guidance
2	$\frac{{}^{12}C_3 \times {}^{28}C_4}{{}^{40}C_7}$	**M1**	Using combinations with attempt to evaluate 2 terms in num. and 1 in denom.
		M1	Correct numerator or denominator unsimplified
	= 0.242	**A1**	
	OR		
	$\text{P(GGG)} = \frac{12}{40} \times \frac{11}{39} \times \frac{10}{38} \times \frac{28}{37} \times \frac{27}{36} \times \frac{26}{35} \times \frac{25}{34} \times {}^{7}C_3$	**M1**	Multiplying 3 green probs with 4 non-green probs, without replacement
		M1	Multiplying by $^7C_3$
	= 0.242	**A1**	
	Total:	**3**	

Question	Answer	Marks	Guidance
3	$np = 160\times0.1$ (16) $npq = 160\times0.1\times0.9$ (14.4)	**B1**	Correct unsimplified np and npq
	$P(> 17) = P\left(z > \frac{17.5-16}{\sqrt{14.4}}\right) = P(z > 0.3953)$	**M1**	Standardising need √
		M1	16.5 or 17.5 seen in standardised eqn for continuity correction
	$= 1 - 0.6536$	**M1**	Correct area from their mean $(1 - \Phi)$, final solution
	$= 0.346$	**A1**	
	Total:	**5**	

Question	Answer	Marks	Guidance
4(i)	LQ = 0.7495 Med = 0.7507 UQ = 0.7517	**M1**	Attempt to find all 3 quartiles can be implied, Condone LQ=0.7496, Med=0.7506, UQ=0.7515
		**B1**	Correct median line in box using their scale
		A1	Correct quartiles in box
		B1	Correct end whiskers(not dots or boxes), lines not through box,
		B1	Correct uniform scale from at least 0.7473 to 0.7532, and label (wt) kg oe can be seen in title or scale
	Total:	**5**	

Question	Answer	Marks	Guidance
4(ii)	Normal	**B1**	
	Symmetrical/peaks in middle or tails off quickly	**B1**	Need symm + another reason
	Total:	**2**	

Question	Answer	Marks	Guidance
5(i)	${}^{12}C_1 + {}^{12}C_3 + {}^{12}C_5 + {}^{12}C_7 + {}^{12}C_9 + {}^{12}C_{11}$	**M1**	Summing at least 4 ${}^{12}C_x$ combinations with x = odd numbers
		A1	Correct unsimplified answer (can be implied by final answer)
	= 2048	**A1**	Correct answer
	Total:	**3**	
5(ii)	$7! \times {}^{8}P_4$	**B1**	7! seen alone or multiplied only (cupcakes ordered)
		M1	multiplying by ${}^{8}P_4$ o.e (placing brownies)
	= 8467200	**A1**	correct answer
	Total:	**3**	
5(iii)	9! / (6! × 2!)	**B1**	9! oe seen alone or as numerator
		M1	dividing by at least one of 6!,2! (removing repeated shortbread or gingerbread biscuits) ignore 4! if present
	= 252	**A1**	correct answer
	Total:	**3**	

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Question	Answer	Marks	Guidance
6(i)	P(2) = P(0,2) = $2/10 \times 4/6$	**M1**	Mult 2 probs seen (or complete listing of all options)
	= 2/15 **AG**	**A1**	Correct answer legit obtained
	Total:	**2**	
6(ii)	x: 0 | 1 | 2 | 3 | 5 P(X=x): 2/30 | 5/30 | 4/30 | 13/30 | 6/30	**B1**	Correct values for x in table. Any additional values must have P(x)=0 stated
		B1	One correct prob other than P(2) or P(3)
		B1	Correct P(3)
		B1	All correct
	Total:	**4**	
6(iii)	$P(A1 \mid \text{Sum } 3) = \frac{P(A1 \cap \text{Sum3})}{P(\text{Sum3})} = \frac{5/10 \times 4/6}{13/30}$	**M1**	Attempt at P(A1∩ Sum 3) as num or denom of a fraction, can be by counting
		M1	Their P(3) from **(ii)** as num or denom of a fraction
	= 10/13(0.769)	**A1**	
	Total:	**3**	

Question	Answer	Marks	Guidance
7(a)(i)	$0.674 = \frac{8.8 - \mu}{\sigma} \Rightarrow 0.674\sigma = 8.8 - \mu$	**B1**	±0.674 seen
	$-0.935 = \frac{7.7 - \mu}{\sigma} \Rightarrow -0.935\sigma = 7.7 - \mu$	**B1**	±0.935 seen (condone ±0.934)
		M1	An eqn with a z-value, μ and σ allow sq rt, sq cc
		M1	sensible attempt to eliminate μ or σ by substitution or subtraction
	$\sigma = 0.684$ $\mu = 8.34$	**A1**	correct answers (from –0.935)
	Total:	**5**	
7(a)(ii)	$P(< 8.2) = P\left(z < \frac{8.2 - 7.9}{0.44}\right)$	**M1**	Standardising no cc no sq rt no sq
		M1	Correct area ie Φ, final solution
	$= P(z < 0.6818) = 0.7524$	**A1**	Correct prob rounding to 0.752
	$P(3) = {}^5C_3\,(0.7524)^3(0.2476)^2$	**M1**	Binomial ${}^5C_x$ powers summing to 5, any p, $\Sigma p = 1$
	$= 0.261$	**A1**	
	Total:	**5**	

Question	Answer	Marks	Guidance
7(b)	$P(< 1.5\mu) = P\left(z < \frac{1.5\mu - \mu}{\mu}\right) = P(z < 0.5)$	***M1**	standardising with μ and σ (σ may be replaced by μ)
		DM1	just one variable
	= 0.692	**A1**	
	Total:	**3**	