CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9709 MATHEMATICS

9709/62 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.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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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		$P(x < -2.4) = P\left(z < \frac{-2.4-1.5}{3.2}\right)$	M1		Standardising no cc can have sq
		$= P(z < -1.219)$ $= 1 - 0.8886$	M1		Correct area, i.e. < 0.5
		$= 0.111$	A1	**[3]**	Correct answer rounding to 0.111
2	**(i)**	$P(C \cap < 50) = 0.35 \times 0.2 = 0.07$	B1	**[1]**	
	(ii)	$P(C \mid < 50) = \frac{P(C \cap < 50)}{P(< 50)}$	M1	**[4]**	Summing three 2-factor products seen anywhere (can omit the 1)
		$= \frac{0.35 \times 0.2}{0.25 \times 0.3 + 0.35 \times 0.2 + 0.4(\times 1)}$	A1		0.545 (unsimplified) seen as num or denom of a fraction
		$= \frac{0.07}{0.545}$	M1		Attempt at $P(C \cap < 50)$ as 2-factor prod only seen as num or denom of a fraction
		$= 0.128$ (14/109)	A1		Correct answer
3	**(i)**	$z = 0.878$	B1		± 0.878, 0.88, rounding to 0.88 seen
		$\frac{190-160}{\sigma} = 0.878$	M1		(190 – 160)/σ = something
		$\sigma = 34.2$	A1	**[3]**	Correct answer
	(ii)	P(at least 1) = 1 – P(0)	M1		Using 1 – P(0), 1 – P(0, 1), P(1,2 … 12) or P(2, … 12) with $p = 0.19$ or 0.81, terms must be evaluated to get the M1
		$= 1 - (0.81)^{12} = 0.920$	A1	**[2]**	Correct answer accept 0.92
4	**(i)**	number = 1.5 × 50 = 75 (AG)	B1	**[1]**	Must see 1.5 × 50
	(ii)	freqs are 10, 25, 50, 75, 30 (15, 15)	M1 A1		Attempt at freqs not fd Correct freqs
		Mean = (10 × 125 + 25 × 162.5 + 50 × 187.5 + 75 × 225 + 30 × 300)/190	M1		attempt at mid points not cw or ucb or lcb
		= 40562.5/190 = 213 (213.48 …)	A1		correct mean
		$sd^2 = 10 \times 125^2 + 25 \times 162.5^2 + 50 \times 187.5^2 + 75 \times 225^2 + 30 \times 300^2)/190 - (213.48 \ldots)^2$	M1		subst their Σfx^2 in correct variance formula
		sd = 46.5 or 46.6	A1	**[6]**	
	(iii)	have used the mid-point of each interval and not the raw data	B1	**[1]**	

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5	**(i)**	$P(4, 5, 6) = (0.22)^4(0.78)^4 8C4 + (0.22)^5(0.78)^3 8C5 + (0.22)^6(0.78)^2 8C6$	M1 M1		Bin term with ${}_8C_r\, p^r\, (1-p)^{8-r}$ seen $r \neq 0$ any $p < 1$ Summing 2 or 3 bin probs $p = 0.22$, $n = 8$
		$= 0.0763$	A1	**[3]**	Correct answer
	(ii)	prob = 0.13 mean = $300 \times 0.13 = 39$ var = $300 \times 0.13 \times 0.87 = 33.93$	B1 B1ft		Correct prob can be implied Correct unsimplified np and npq ft wrong 0.13
		$P(30 < x < 50) = P\left(\frac{30.5 - 39}{\sqrt{33.93}} < z < \frac{49.5 - 39}{\sqrt{33.93}}\right)$	M1 M1		Standardising a value need sq rt Cont correction 30.5 / 31.5 or 48.5/49.5 only
		$= P(-1.4592 < z < 1.8026)$ $= \Phi(1.8026) + \Phi(1.4592) - 1$ $= 0.9643 + 0.9278 - 1 = 0.892$	M1 A1	 **[6]**	Correct area $\Phi_1 + \Phi_2 - 1$ oe Rounding to correct answer SC $P(31,..49) = 300C31(0.13)^{31}(0.87)^{269}$ + … +300C49 etc.) B1B1
6	**(i)**	1663200	B1	**[1]**	
	(ii)	M xxxxxxxxx M	M1		9! or 9P9 seen
		Number of ways = $\frac{9!}{3!2!} = 30240$	A1	**[2]**	Correct answer
	(iii)	4 vowels together = $8! \times 4/2!2!$ $= 40320$	M1 M1		8!/2!2! seen mult by something 4 oe 4!/3! or 4C1 etc. seen mult by something
		$1663200 - 40320 = 1622880$	B1	**[3]**	Correct answer SC 7!/2!2! × 8P4 or 7! × 8P4/3! Or 7!/2!2! × 8P4/3! M1
	(iv)	Exactly 2 Es 4C2 = 6 Exactly 3 Es 4C1 = 4 Total = 10 ways	M1 B1 A1	 **[3]**	Summing 2 options One option correct Correct answer
		OR 5C2 = 10	M2 A1		M1 for k5C2 Correct ans

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7	**(i)**	options (3, 4, 4,) or (4, 3, 4) or (4, 4, 3) Probs (4/10 × 6/9 × 5/8) ×3C1 = 360/720 = ½ AG	M1 M1 A1	**[3]**	Summing three 3-factor options oe 10 × 9 × 8 seen in denom Correct answer
		OR $\frac{{}_6C_2 \times {}_4C_1}{{}_{10}C_3} = \frac{1}{2}$ AG	M1 M1 A1		One of 6C2 or 4C1 seen in num 10C3 in denom Correct answer
	(ii)		B1	**[4]**	9, 10, 11, 12 only seen
		P(3, 3, 3) = 4/10 × 3/9 × 2/8 = 24/720 (1/30) P(3, 3, 4) = 4/10 × 3/9 × 6/8 × 3C1 = 216/720 (3/10) P(4, 4, 4) = 6/10 × 5/9 × 4/8 = 120/720(1/6)	B1 B1 B1		One correct prob other than P(11), with or without replacement Another correct prob Σ all 4 probs = 1
	(iii)	P(R) = 0.5 P(S) = 0.4 P($R \cap S$) = 120/720 P($R \cap S$) = 120/720 ≠ P(R) × P(S) Not indep	B1 M1 A1ft	**[3]**	P($R \cap S$) = 120/720 (1/6) Numerical attempt to compare P(R and S) with P(R) × P(S) provided P($R \cap S$) ≠ 1/5 Correct conclusion ft wrong P($R \cap S$) ≠ 1/5, P(S) correct
	(iv)	P($R \cap S$) ≠ 0 or there is an overlap between R and S (34,4) Not exclusive Σxf/Σf	B1ft	**[1]**	Correct answer following correct reasoning ft wrong non zero P($R \cap S$)

sum	9	10	11	12
Prob	24/720	216/720	360/720	120/720

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