CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 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.

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)

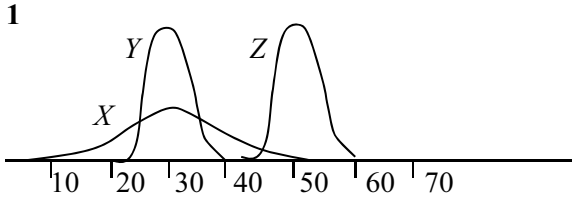
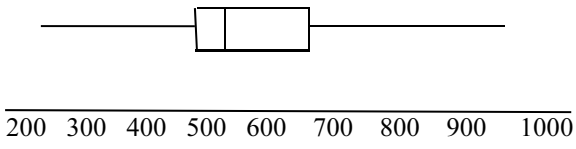
SR Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

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		B1 B1 B1ft	**3**	X mean at 30, roughly from 10 to 50 or 15 – 45 Y same mean as X but higher and thinner Z same shape as Y but mean at 50 ft wrong Y
2	either 55/90 (11/18) or 95/160 (19/32) seen P(M and 18 – 60) = 0.6 × 55/90 = 0.367 (11 / 30) P(18 – 60) = 0.6 × 55/90 + 0.4 × 95/160 (= 29/48 or 0.604) $P(M \mid 18-60) = \frac{P(M \cap 18-60)}{P(18-60)}$ = 88/145 (0.607)	B1 M1 M1 A1 A1	**5**	oe 0.6 mult by 55/90 seen as num / denom of a fraction Summing 2 two-factor products seen anywhere Correct unsimplified answer seen as num/denom of a fraction Correct answer
3	$\Sigma(x-5) = 116 - 18 \times 5 = 26$ $\frac{\Sigma(x-5)^2}{18} - \left(\frac{26}{18}\right)^2 = \frac{967}{18} - \left(\frac{58}{9}\right)^2$ $\Sigma(x-5)^2 = 257$ OR coded mean = 58/9 – 5 = 1.444 $\Sigma(x-5) = 1.444 \times 18 = 26$ $\Sigma(x-5)^2 = \Sigma x^2 - 10\Sigma x + 25 \times 18$ = 967 – 1160 + 450 = 257	M1 A1 M1 M1 A1 M1 A1 M1 A1 A1	**5**	Obtaining Σx and subtracting 18 × 5 Correct answer Subst in correct var formula all coded vals Subst in correct var formula all uncoded Correct answer Subtracting 5 from true mean and mult by 18 Correct answer Expanding $\Sigma(x-5)^2$ 3 terms needed Any 2 terms correct Correct answer
4	**(i)** 	B1 B1 B1 B1	**4**	Linear scale or 5 values shown and labels or in heading, need thousands of dollars, Correct median Correct quartiles Correct end points of whiskers not through box
	(ii) 1.5 × 170 = 255 Expensive houses above 690 + 170 × 1.5 = 945 i.e. 957 and 986 thousands of dollars	M1 A1	**2**	Mult their IQ range by 1.5 Correct answers from correct wkg need thousands of dollars
	(iii) doesn't show all the data items	B1	**1**	Need to see 'individual items' oe

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5	**(i)**	$z = -1.406$	B1	Rounding to ± 1.41 seen
		$\frac{c-14.2}{3.6} = -1.406$	M1	Standardising allow sq rt no cc
		$c = 9.14$	A1 **3**	Correct answer
	(ii)	$P\left(\frac{15-14.2}{3.6}\right) < z < \left(\frac{16-14.2}{3.6}\right)$	M1	2 attempts at standardising no cc no sq rt
		$= \Phi(0.5) - \Phi(0.222)$ $= 0.6915 - 0.5879$	M1	Subt two Φs (indep mark)
		$= 0.1036$	A1	Needn't be entirely accurate, rounding to 0.10
		P(at least 2) = 1 – P(0, 1)	M1	Binomial term with ${}_7C_r p^r(1-p)^{7-r}$ seen $r \neq 0$ any $p < 1$
		$= 1 - (0.8964)^7 - (0.8964)^6(0.1036){}_7C_1$ $= 1 - 0.8413$	M1	1 – P(0), 1 – P(1), 1 – P(0, 1) seen their p
		$= 0.159$	A1 **6**	Correct answer accept 3sf rounding to 0.16
6	**(i)**	M R O		
		3 1 2 = 7C3 × 5C1 × 8C2 = 4900	M1	Summing more than one 3term option involving combs (can be added)
		3 2 1 = 7C3 × 5C2 × 8C1 = 2800	M1	Mult 3 combs only (indep)
		2 2 2 = 7C2 × 5C2 × 8C2 = 5880	A1	1 option correct unsimplified
		Total = 13580	A1 **4**	Correct answer
	(ii)	4 groups in 4! ways 3 mountain in 3! ways	M1	4! seen mult by something
		2 ordinary in 2! ways	M1	Mult by 3! for racing or 2! for ordinary
		4! × 3! × 2 = 288	A1 **3**	Correct answer
	(iii)	e.g. s O x x x x O s s s Ordinary in 2!	M1	2! or 4! seen mult
		Rest of bikes in 4! Bikes and spaces 5 groups in 5 ways	M1	Mult by 5 (ssssb)
		2! × 4! × 5 = 240	A1 **3**	Correct answer

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7 **(i)**	if throw H then smallest score is 2 P(T, 1) = 1/2 × 1/4 = 1/8 **AG**	B1 B1 **2**	Or equivalent
(ii)	P(3) from two dice = 2/16 seen P(H, 3) = 1/2 × 2/16 = 2/32 P(T, 3) = 1/2 × 1/4 = 1/8 So P(3) = 6/32 = 3/16 **AG**	B1 M1 A1 A1 **4**	From (1, 2) and (2, 1) Summing P(H, 3) and P(T, 3) One correct Correct answer must see clear reasoning
(iii)	<table><tr><td>*X*</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>Prob</td><td></td><td>5/32</td><td></td><td>7/32</td><td></td><td>3/16</td><td></td><td></td></tr></table>	B1 B1 B1 **3**	One correct prob A second correct prob A third correct prob
(iv)	P($Q \cap R$) = 0 or 'if you throw a tail you can't get a 7' Yes they are exclusive	M1 A1dep **2**	Stating P($Q \cap R$) = 0 or implying by words Dep on previous M

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