CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 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 May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

CAMBRIDGE
International Examinations

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.

© Cambridge International Examinations 2013

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.

© Cambridge International Examinations 2013

1	$z = 1.452$ $1.452 = \dfrac{20-\mu}{\mu/5}$ $\mu = 15.5$	B1 B1 B1	**[3]**	Rounding to ± 1.45 $\dfrac{20-\mu}{\mu/5}$ or $\dfrac{20-5\sigma}{\sigma}$ seen oe rounding to correct answer
2	$\bar{x} = 50 + 81.4/22 = 53.7$ var = $671/22 - 3.7^2 = 16.81(16.8)$ $16.81 = \Sigma x^2/22 - 53.7^2$ $= 63811(63800)$ OR $\Sigma x - 22\times50 = 81.4$ ($\Sigma x = 1181.4$) $\Sigma x^2 - 100\Sigma x + 22\times50^2 = 671$ $\Sigma x^2 = 671 + 118140 - 55000 = 63811$ Var = $\Sigma x^2/22 - (\Sigma x/22)^2 = 16.81$	M1 A1 M1 A1 M1 M1 A1 A1	**[4]**	Attempt to find variance using coding in both, correct formula Correct answer using their var and their mean with uncoded formula for both correct answer expanded eqn with 22×50 seen expanded eqn with 2 or 3 terms correct correct answer correct answer
3 **(i)**	P($x < 440$) $= \text{P}\left(z < \dfrac{440-445}{3.6}\right) = 1 - \Phi(1.389)$ $= 1 - 0.9176$ Ans = 0.0824	M1 M1 A1	**[3]**	Standardising no cc no sq or sq rt Correct area (1 – Φ) oe (indep) Rounding to correct answer accept 0.0825
(ii)	$z = 1.881$ $\dfrac{c}{3.6} = 1.881$ $c = 6.77$	M1 M1 A1	**[3]**	±1.88 or 1.881 or 1.882 or 1.555 seen± Equation with ± $c/3.6$ or $2c/3.6$ only = z or prob (can be implied) Correct answer accept 6.78
4 **(i)**	$p = 4/9$ or $5/9$ P(at least 2) = 1 – P(0, 1) $= 1 - (5/9)^5 - (4/9)(5/9)^4\ {}_5C_1$ $= 0.735$	B1 M1 A1	**[3]**	Binomial term ${}_5C_x p^x (1-p)^{5-x}$ seen Correct answer
(ii)	$np = 96$ $npq = 32$ $p = \text{P}(\leq k)$ $p = 2/3$ $q = 1/3$ $n = 144$ $k = 6$ $n = 144$	M1 A1 A1ft A1	**[4]**	Using $np = 96$ $npq = 32$ to obtain eqn in 1 variable 1/3 or 2/3 seen or implied Correct k ft $k = 9p$ correct n

© Cambridge International Examinations 2013

5 **(i)**	Stem | leaf 0 | 1 4 6 8 1 | 0 3 4 4 4 5 5 5 6 6 6 6 7 8 8 2 | 0 1 5 7 8 3 | 1 4 | 5 5 | 7	B1 B1		Correct stem condone a space under the 1 Correct leaves must be single digits and one line for each stem value or 2 lines each stem value
	Key 1 | 4 represents \$140	B1ft	**[3]**	Correct key must have \$, ft 2 special cases
(ii)	Median = 160 LQ = 140 UQ = 210 IQ range = UQ - LQ = 70	B1 M1 A1	 **[3]**	 Subt their LQ from their UQ Correct answer cwo
(iii)	1.5 × IQ range = 105 Lower outlier is below 35 Upper outlier is above 315 Outliers 10, 450, 570	M1 A1ft A1	 **[3]**	Mult their IQ range by 1.5 can be implied Correct limits ft their IQ range and quartiles Correct outliers
6 **(i)**	H J O 1. 2 8 2 = 4C2×9C8×2C2 = 54 3 7 2 = 4C3×9C7×2C2 = 144 4 6 2 = 4C4×9C6×2C2 = 84 Total = 282 ways	 M1 M1 A1 A1	 **[4]**	Mult 3 combs, 2C2 may be implied 4Cx×9Cy×2Cz Summing 2 or 3 three-factor options 2 options correct unsimplified Correct answer
(ii)	4! × 6! × 2! × 3! = 207360 (207000)	M1 M1 A1	 **[3]**	4! × 6! × 2! oe seen multiplied by int ≥ 1 3! seen mult by int ≥ 1 Correct answer
(iii)	8 J and O trees in 8! = 40320 ways 9 gaps × 8 × 7 × 6 = 121,927,680 (122,000,000)	B1 M1 A1	 **[3]**	8! seen mult by int ≥ 1 no division 9P4 oe or 7P4 or 8P4 seen mult by int ≥ 1 no division Correct answer
(i)	SR 4C2×9C2×2C2×9C6	M1		
(ii)	SR $\frac{4!\times6!\times2!}{4!\times6!\times2!}$ or 3! or both M1	M1		

© Cambridge International Examinations 2013

(iii)	SR1 12! – 9! 4! SR2 $\frac{9P4}{4!}$ or $\frac{8!}{6!\,2!}$ or both	M1 M1		
7 **(i)**	$P(T,B) = \frac{5}{12} \times \frac{2}{10} = \frac{1}{12}\ (0.0833)$	M1 A1	**[2]**	Mult their P(T) by 2/9 or 2/10 only Correct answer
(ii)	$P(C_S \cap C_A) = \frac{7}{12} \times \frac{4}{10} = \frac{28}{120}\ (0.2333)$	M1		Mult their P(C_S) by 3/9 or 4/10 seen as num or denom of a fraction
	$P(C_A) = \frac{7}{12} \times \frac{4}{10} + \frac{5}{12} \times \frac{3}{10} = \frac{43}{120}\ (0.3583)$	M1		Summing 2 two-factor products to find P(C_A) seen anywhere
	$P(C_S \mid C_A) = \frac{P(C \cap C)}{P(C_A)} = \frac{28/120}{43/120}$	A1		Correct unsimplified P(C_A) seen as num or denom of a fraction
	$= \frac{28}{43}\ (0.651)$	A1	**[4]**	Correct answer
(iii)	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td></tr><tr><td>Prob</td><td>7/24</td><td>19/40</td><td>7/30</td></tr></table>	B1		x = 0, 1, 2, can be implied from table or working
	$P(X = 0) = P(T, B) + P(T, T)$	M1		1 or 2 two-factor products, denoms 12 and 10 or 12 and 9, implied if ans is correct
	$= \frac{5}{12} \times \frac{2}{10} + \frac{5}{12} \times \frac{5}{10} = \frac{7}{24}\ (0.292)$	A1		One correct unsimplified
	$P(X = 2) = P(C, C) = \frac{7}{12} \times \frac{4}{10} = \frac{28}{120}\ (0.233)$	B1		One other correct unsimplified
	$P(X = 1) = 1 - 7/24 - 28/120 = \frac{19}{40}\ (0.475)$	B1ft	**[5]**	Third correct ft 1 – P(2 of their probs))

© Cambridge International Examinations 2013