CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9709 MATHEMATICS

9709/63 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.

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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

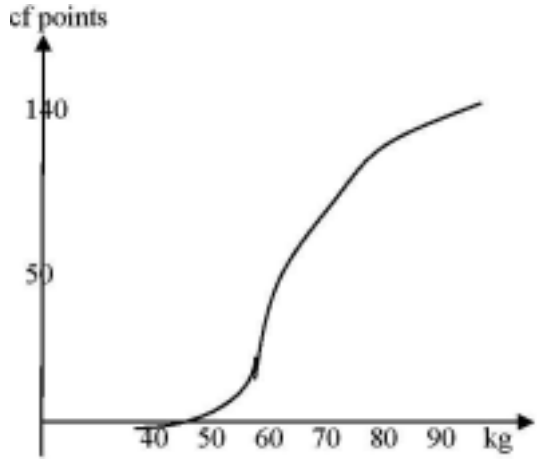
MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads 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	$P(Q) = \frac{4}{36}$ or $P(S) = \frac{1}{2}$	B1		oe
	$P(Q \cap S) = \frac{2}{36}$ or $P(S\|Q) = \frac{1}{2}$ or $P(Q\|S) = \frac{2}{18}$	B1		oe
	$P(Q \cap S) = P(Q) \times P(S)$ or $P(S\|Q) = P(S)$ or $P(Q\|S) = P(Q)$	M1		Comparing correct pair of terms $0 \leq$ all probabilities < 1
	Independent	A1	**[4]**	Correct conclusion must have all probs correct
2	P(at least 2) = P(2, 3) or 1 – P(0, 1)	M1		Summing, or 1–, two different three-factor prob expressions, ${}_3C_2$ not needed
	$= \frac{5}{12} \times \frac{4}{11} \times \frac{7}{10} \times {}_3C_2 + \frac{5}{12} \times \frac{4}{11} \times \frac{3}{10}$	M1		12, 11, 10 seen or implied in denominator
		M1		Mult a prob by ${}_3C_2$ or ${}_3C_1$ oe
	$= \frac{4}{11}$ (0.364)	A1	**[4]**	Correct answer
	OR $\frac{({}_5C_3) + ({}_5C_2 \times {}_7C_1)}{{}_{12}C_3}$	M1		${}_5C_3$ seen added in numerator
		M1		${}_5C_2$ seen mult alone or in numerator
		M1		${}_{12}C_3$ seen in denom
		A1		Correct answer
3	**(i)** $P(\text{tall}) = P\left(z > \frac{70-50}{16}\right) = P(z > 1.25)$	M1		+ve/-ve Standardising no cc no sq rt no sq
	$= 1 - 0.8944$ $= 0.106$	A1	**[2]**	Correct answer
	(ii) P(short) = (1 – 0.1056)/3	M1		Subt their **(i)** from 1 or their **(i)** and multiplying by $\frac{1}{3}$ or $\frac{2}{3}$
	$= 0.2981$	A1 ft		Rounding to 0.298, only ft for $\frac{(1 - \textbf{(i)})}{3}$
	$z = -0.53$	A1		± z-value rounding to 0.53, condone ±0.24
	$-0.53 = \frac{x - 50}{16}$	M1		Standardising with their z value (not a probability), no cc sq rt etc.
	$x = 41.5$	A1	**[5]**	Correct answer

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4 **(i)** $(0.8)^n < 0.001$	M1		Eqn or inequ involving 0.8^n or 0.2^n and 0.001 or 0.999
$n > 30.9$	M1		Trial and error or logs (can be implied)
$n = 31$	A1	**[3]**	Correct answer **MR** 0.01, max available M1M1A0
(ii) $\mu = 120 \times 0.2 = 24$	B1		24 and 19.2 or $\sqrt{19.2}$ seen
$\sigma^2 = 120 \times 0.2 \times 0.8 = 19.2$	M1		Standardising with or without cc, must have sq rt in denom
$P(x < 33) = P\times\left(z < \frac{32.5 - 24}{\sqrt{19.2}}\right)$	M1		Continuity correction 32.5 or 33.5
$= P(z < 1.9398)$ $= 0.974$	A1	**[4]**	Correct answer
5 **(a)** $P(W_2) = P(W_1W_2) + P(L_1W_2)$	B1		0.3×0.6 alone as num or denom of a fraction
$= 0.3 \times 0.6 + 0.7 \times 0.15$	M1		Attempt at $P(W_2)$ as sum of two 2-factor options seen anywhere
$= 0.285$			
$P(W_1 \mid W_2) = \frac{P(W_1 \cap W_2)}{P(W_2)} = \frac{0.18}{0.285}$	A1		Correct unsimplified $P(W_2)$ as num or denom of a fraction
$= 0.632,\ \frac{12}{19}$	A1	**[4]**	Correct answer
(b) $x + 4$ oe seen	B1		Seen anywhere
$\frac{10}{15} \times \frac{7}{x+4} = \frac{7}{18}$	M1		Mult two probabilities, one containing x and equating to $\frac{7}{18}$
	A1		Correct unsimplified equation
$x = 8$	A1	**[4]**	Correct answer
6 **(i)** (40, 0), (50, 12) etc. up to (90, 144)	B1		Axes, (cf) and labels (kg), uniform scales from at least 0–140 and 40.5–69.5 either way round
			
	B1	**[2]**	All points correct, sensible scale (not 12), polygon or smooth curve
(ii) 80 weigh less than 67.2 kg	M1		Subt 64 from 144
$c = 67.2$	A1 ft	**[2]**	Accept anything between 67 and 68 ft from incorrect graph

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(iii) freqs 12, 22, 30, 28, 52	M1 A1		frequencies attempt not cf Correct freqs
mean wt = (45 × 12 + 55 × 22 + 62.5 × 30 + 67.5 × 28 + 80 × 52) / 144	M1		Using mid points attempt, i.e. 44.5, 45, 45.5, in correct mean formula, unsimplified, no cfs, condone 1 error.
= 9675 / 144 = 67.2 kg	A1		Correct mean
Var $(45^2 \times 12 + 55^2 \times 22 + 62.5^2 \times 30 + 67.5^2 \times 28 + 80^2 \times 52) / 144 - (9675/144)^2 = 127.59$	M1		Substituting their mid-pts squared (may be class widths, lower or upper bound) in correct var formula even with cfs with their mean^2
sd = 11.3, allow 11.2	A1	**[6]**	Correct answer
7 (i)			
S(10) R(14) P(6) 1 2 4 = 10C1×14C2×6C4= 13650 1 3 3 = 10C1×14C3×6C3= 72800 2 2 3 = 10C2×14C2×6C3= 81900 Total = 168350 or 168000	M1 M1 B1 A1	**[4]**	Summing 2 or more 3-factor options perms or combs Mult 3 combs or 4 combs with $\Sigma r=7$ 2 options correct, unsimplified Correct answer
(ii) 2! × 2! × 5!	M1 M1		2! × 2! oe, seen mult by an integer ≥1, no division Mult by 5!, or 5! alone, seen mult by an integer ≥ 1 no division
= 480	A1	**[3]**	Correct answer
If M0 earned $\frac{2!\times 2!}{2!\times 2!}$ or $\frac{5!}{3!}$ or both, seen mult by an integer ≥ 1 Or 2!×2!×5! divided by a value	SCM1		
(iii) spaniels and retrievers in 4! ways gaps in 5P3 or 5 × 4 × 3 ways = 1440	M1 M1 A1	**[3]**	4! seen multiplied by an integer >1 Mult by 5P3 oe Correct answer
If M0 earned $\frac{4!}{2!\times 2!}$ or $\frac{{}_5P_3}{3!}$ or both, seen multiplied by an integer > 1	SCM1		${}_5C_3$ oe
or 7! – 5! × 3! – {(4! × 2 × 4 × 3!) + (4! × 3 × 4 × 3!)} = 1440	M1 M1 A1		oe oe, e.g. 6 × 5 × 4 × 4!
If M0 earned 3! × 2! × 2! used as a denominator in all 4 terms	SCM1		Marks cannot be earned from both methods.

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