CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 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 2014 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

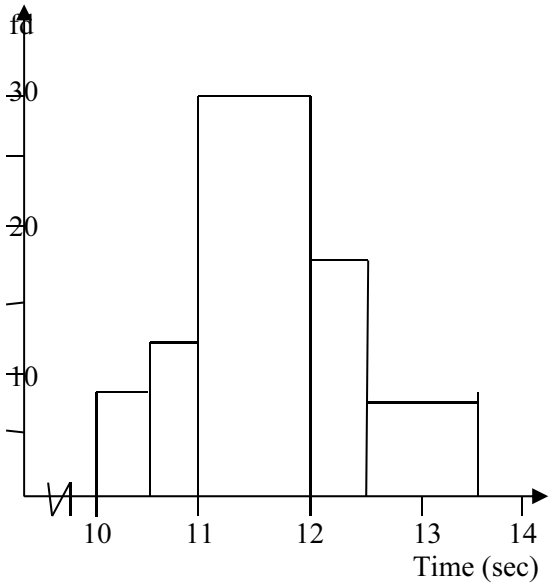
MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads 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	$X \sim B(19, 0.12)$ $P(X < 4) = P(0, 1, 2, 3)$ $= (0.88)^{19} + {}^{19}C_1(0.12)^1(0.88)^{18} +$ $^{19}C_2(0.12)^2(0.88)^{17} + {}^{19}C_3(0.12)^3(0.88)^{16}$ $= 0.813$	M1 M1 M1 A1	**4**	Any binomial term ${}^{19}C_x\, p^x(1-p)^{19-x}$, $0<p<1$ Any binomial term ${}^nCx(0.12 \text{ or } 0.88)^x(0.88 \text{ or } 0.12)^{n-x}$ P(0, 1, 2, 3) binomial expr with at least 2 consistent terms Correct answer
2	Y1(7) Y2(2)Y3(2) 1 2 2 $= 7 \times 1 \times 1 = 7$ 2 1 2 $= {}^7C_2 \times {}^2C_1 \times 1 = 42$ 2 2 1 $= {}^7C_2 \times 1 \times {}^2C_1 = 42$ 3 1 1 $= {}^7C_3 \times {}^2C_1 \times {}^2C_1 = 140$ Total = 231	B1 B1 M1 A1	**4**	One unsimplified correct 3-factor product of combinations A second unsimplified correct 3-factor product of combinations Summing 3 or 4 options allow perms, wrong combs but second numbers must sum to 5 etc. Correct answer
3	**(i)** $P(RR) = 0.6 \times 0.7 = 0.42$ $P(AA) = 0.4 \times 0.75 = 0.3$ $P(2 \text{ sets in match}) = 0.72$	B1 B1 B1√	**3**	Only 2 factors Only 2 factors ft previous answers
	(ii) $\dfrac{P(A \text{ wins and } 2 \text{ sets})}{P(2 \text{ sets})} = \dfrac{P(AA)}{P(2 \text{ sets})}$ $= \dfrac{0.3}{0.72} = \dfrac{5}{12}$ (0.417)	B1√ B1√	**2**	Correct num or correct denom of a fraction ft their **(i)** Correct answer ft their or recovered AA/their or recovered **(i)**
4	**(i)** A:P(H) = 2/3, P(T) = 1/3 B: P(H) = ¼, P(T) = 3/4 P(1H) = P(HTT) + P(THT) + P(TTH) $= (2/3 \times 1/3 \times 3/4) + (1/3 \times 2/3 \times 3/4)$ $+ (1/3 \times 1/3 \times 1/4) = 13/36$ **AG**	M1 M1 A1	**3**	Using some of 2/3, 1/3, ¼ or 3/4 in a calculation involving prod of 3 probs Summing 3 options not all the same Correct answer
	(ii) x | 0 | 1 | 2 | 3 P | 3/36 | 13/36 | 16/36 | 4/36 P(0H) = P(TTT) = 1/3 × 1/3 × 3/4 = 1/12 P(2H) = P(HHT) + P(HTH) + P(THH) $= (2/3 \times 2/3 \times 3/4) + (2/3 \times 1/3 \times 1/4)$ $+ (1/3 \times 2/3 \times 1/4) = 4/9$ not $2/3 \times 2/3$ P(3H) = P(HHH) = 2/3 × 2/3 × 1/4 = 1/9	B1 B1 B1 B1√	**4**	0, 1, 2, 3 seen for table no probs needed, table not absolutely necessary if calcs shown One prob correct other than (i) condone 0.083 for 0.0833 A second prob correct need 3 factors can be implied A third prob correct ft 23/36 – Σ their 2 probs
	(iii) $E(X) = 13/36 + 32/36 + 12/36$ $= 57/36$ (19/12) (1.58)	M1 A1	**2**	Attempt to evaluate Σxp at least 3 vals of x in table Correct answer

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5	**(i)** 5! × 3! or 6!	B1		5! or 3! or 6! oe seen mult or alone
	= 720	B1	**2**	Correct final answer
	(ii) 3**4, 3**8, 4**8	M1		considering at least 2 types of 4-figure options ending with 4 or 8 and starting with 3 or 4
		B1		One option correct unsimplified can be implied
	= 5 × 4 + 5 × 4 + 5 × 4 = 60	A1	**3**	Correct final answer
	(iii) 5, *5, **5,	M1		Appreciating that the number must end in 5 (can be implied)
	= $1 + 7 + 7^2$	M1		summing numbers ending in 5 with at least 2 different numbers of digits
	= 57	A1	**3**	Correct final answer
6	**(i)** 6	B1	**1**	Must see in **(i)**
	(ii) freqs 4 6 30 9 8 fd 8 12 30 18 8	M1		Attempt at scaled freq or fd (must be f/cw) at least three f/cw
		A1		Correct heights seen on graph
		B1		Correct-looking widths from 10, 10.5 etc. no gaps no extra lines
		B1	**4**	Labels and linear axes or squiggle need time or secs, fd,
	(iii) E(X) = (10.25 × 4 + 10.75 × 6 + 11.5 × 30 + 12.25 × 9 + 13 × 8)/57	M1		Using mid-point attempt (not end points) with their freq or cf at least 2 sensible ones
	= 11.7(11.662)	A1		Correct mean
	Var(X) = (10.25^2 × 4 + 10.75^2 × 6 + 11.5^2 × 30 + 12.25^2 × 9 + 13^2 × 8) / 57 – $(11.662\ldots)^2$	M1		numerical attempt at correct variance formula with mean^2 subt ft their "midpoints" i.e. ucb, cw, etc.
	= 0.547	A1	**4**	accept answers between 0.547 and 0.610 condone 0.6, 0.60

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7	**(i)**	$z = -0.842$	B1	± rounding to 0.84 seen
		$P(x > 1.35) = P\left(z > \frac{1.35 - 1.9}{\sigma}\right)$	M1	$\pm\frac{1.35 - 1.9}{\sigma}$ = a prob or a z-value NOT 0.8 or 0.2 allow a 1–...
		$-0.842 = -0.55/\sigma$		
		$\sigma = 0.653$	A1 **3**	Correct answer from correct working
	(ii)	$P(x < 2) = P\left(z < \frac{2 - 1.9}{0.6532}\right)$	M1	± standardising no continuity correction their σ
		$= P(z < 0.1531)$		
		$= 0.561$	A1 **2**	Correct answer
	(iii)	$X \sim N(160, 32)$	B1	Unsimplified 160 and 32 seen
		$P(162.5 < x < 173.5) =$		
		$P\left(\frac{162.5 - 160}{\sqrt{32}} < z < \frac{173.5 - 160}{\sqrt{32}}\right)$	M1	Standardising need sq rt
		$P(0.442 < z < 2.386)$	M1	Any of 162.5, 163.5, 172.5, 173.5 seen
		$= \Phi(2.386) - \Phi(0.442)$	M1	$\Phi_2 - \Phi_1$ oe
		$= 0.9915 - 0.6707$	A1	One correct Φ to 3sf
		$= 0.321$	A1 **6**	Correct answer accept 0.320

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