CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 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.

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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.

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.

1	$z = -2.326$ $\frac{250 - 260}{\sigma} = -2.326$ $\sigma = 4.30$	B1 M1 A1 **3**	± 2.325 to ± 2.33 seen Standardising and = or < their z, no cc, sq, sq rt Correct ans
2	**(i)** $0.7 - 2.4 + 2.2 - 0.5 + 6.3 + 4.9 + 0 + 0.3$ $= 11.5$	B1 **1**	
	(ii) $(0.7^2 + 2.4^2 + 2.2^2 + 0.5^2 + 6.3^2 + 4.9^2 + 0.3^2)$ $= 75.13$ (75.1)	B1 **1**	
	(iii) mean = 63.4375 Variance = $75.13/8 - (11.5/8)^2$ $= 7.32$	B1√ M1 A1 **3**	ft 62 + their (i)/8 their(ii)/8 – ((i)/8)^2 correct answer
	OR mean = 507.5/8 = 63.4375 Var = $32253/8 - 63.4375^2 = 7.32$	B1 M1 A1	subst in correct variance or standard deviation formula correct answer – allow 6.62, 6.93–7.04, 7.260–7.325 Marks can be awarded in (i) or (ii) if not 'contradicted' by further working
3	**(i)** max = 12 $P(12) = (0.7)^{12} = 0.0138$	B1 B1 **2**	(Implied by P(12) with power 12) Accept 0.014
	(ii) P(fewer than 10) = 1– P (10, 11, 12) $= 1 - {}^{12}C_{10} \times (0.7)^{10}(0.3)^2 - 12 \times (0.7)^{11}(0.3) - (0.7)^{12}$ $= 1 - 0.2528$ $= 0.747$	M1 A1 A1 **3**	Binomial term ${}^{12}C_r(0.7)^r(0.3)^{12-r}$ or ${}^{12}C_r(p)^r(q)^{12-r}$, $0.99 \leqslant p + q \leqslant 1.00$ Correct unsimplified expression oe Correct answer

4 (i)

Stem	leaf
1	4 5 7 8 9 9
2	1 2 2 3 4 5 6 6 8 8
3	0 2 6 8
4	1 2 5 6 7

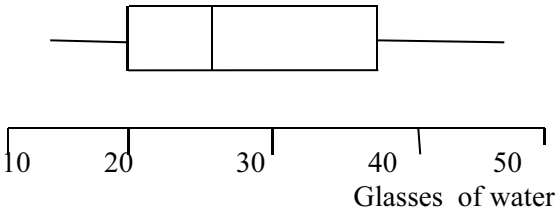
Key 1|4 represents 14 glasses (of water)

B1 Correct stem (or reversed order)

B1 Correct leaves, ordered in numerical sequence, with ½ 'column' tolerance

B1 **3** Key must include 'glasses' or similar drinking item

(ii) LQ = 20 Med = 26 UQ = 37



B1 Correct median
B1 Correct quartiles
B1√ Correct on diagram ft any wrong med or quartiles.
Linear scale based upon 3 quartiles plotted
B1 Correct end points of attached whiskers not through box
B1 **5** Linear axis, label, both must be seen

SC No values stated
3 quartiles on diagram in correct relative positions
End points of attached whiskers not through box correct relative to quartiles

B2

B1

5 (i) $P(<1.2)=P\left(z<\frac{1.2-1.9}{0.55}\right)=P(z<-1.2727)$

$= 1-\Phi(1.273)=1-0.8986$

$= 0.1014$

$P(>2.5)=P\left(z<\frac{2.5-1.9}{0.55}\right)=P(z>1.0909)$

$= 1-\Phi(1.0909)=1-0.8623$

$= 0.138$

$P(1.2 < wt < 2.5) = 1 - 0.101 - 0.138$

$= 0.761$

M1 Standardising for wt 1.2 or 2.5, no cc, sq, sq rt
May be awarded in (ii) if not attempted in (i)
Accept 0.102

A1 First correct proportion seen

A1 Second correct proportion seen

M1 Third proportion 1 – their previous 2 proportions or correct attempt for remaining proportion

A1√ **5** Correct answer or 1 – *their* 2 previous correct proportions

(ii) $P(x > k) = 0.8 + 0.1377 = 0.9377$

$z = -1.536$

$-1.536=\frac{k-1.9}{0.55}$

$k = 1.06$

M1 Valid method to obtain $P(x > k)$ or $P(x < k)$

A1 ± 1.536 seen accept 3sf rounding to 1.53 or 1.54

M1 Attempt to solve equation with their 'correct' area z value, k, 1.9 and 0.55

A1 **4** Correct answer or rounding to 1.05

6	**(a)**	1*****3 or 3*****1 or 2*****2 $= 6^5 \times 3$ $= 23328$	M1 M1 A1 **3**	Mult by 6^5 (for middle 5 dice outcomes) Mult by 3 or summing 3 different combinations (for end dice outcomes) Correct answer accept 23 300
	(b)	W J H 1 1 7 = ${}^9C_1 \times {}^8C_1 \times 1 = 72$ 1 7 1 = ${}^9C_1 \times {}^8C_7 \times 1 = 72$ 7 1 1 = ${}^9C_7 \times {}^2C_1 \times 1 = 72$ 1 3 5 = ${}^9C_1 \times {}^8C_3 \times 1 = 504$ mult by 3! 3 3 3 = ${}^9C_3 \times {}^6C_3 \times 1 = 1680$ Total 4920 If no marks gained Listing all 10 different outcomes	M1 A1 A1 M1 M1 A1 **6** SCM1	Multiplying 3 combinations (may be implied) 1 unsimplified correct answer (72, 504, 1680, 216 or 3024) A 2nd unsimplified different correct answer Summing options for 1,1.7 or 1,3,5 oe (mult by 3 or 3!) Summing at least 2 different options of the 3 Correct ans If games replaced M1M1M1 max available If factorials used M0M1M1 max available
7	**(a)**	**(i)** P($X = 3$) = P(GRR) + P(RGR) $\frac{2}{4} \times \frac{2}{3} \times \frac{1}{2} + \frac{2}{4} \times \frac{2}{3} \times \frac{1}{2}$ $\frac{1}{3}$ **AG**	M1 M1 A1 **3**	Mult 3 probs Summing 2 options Correct working with appropriate justification and fraction sequencing
		(ii) X: 2, 3, 4 Prob: $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{2}$ P($X = 2$) = P(RR) = $\frac{2}{4} \times \frac{1}{3} = \frac{1}{6}$ P($X = 4$) = $1 - \left(\frac{1}{6} + \frac{1}{3}\right) = \frac{1}{2}$ Or P(GGRR) + P(RGGR) + P(GRGR) $= \left(\frac{2}{4} \times \frac{1}{3} \times \frac{2}{2} \times \frac{1}{1}\right) \times 3 = \frac{1}{2}$	B1 B1 B1√ **3**	Values 2, 3, 4 only in table Condone X=0,1 if P(X)=0 stated One correct prob other than (i) Second correct prob ft 1 – their previous 2 probs

(iii) P(3 orange | at least 2 O) = $\frac{P(3O)}{P(at\ least\ 2O)}$			
P(3 orange) = P(OOO)	M1		Atttempt at P(OOO) one three-factor option, not added
$= \frac{5}{7}\times\frac{4}{6}\times\frac{3}{5}=\frac{2}{7}$	A1		Correct unsimplified num of a fraction
P(at least 2O) = P(YOO) + P(OYO) + P(OOY) + $\frac{2}{7}$			
$=\frac{2}{7}\times\frac{5}{6}\times\frac{4}{5}+\frac{5}{7}\times\frac{2}{6}\times\frac{4}{5}+\frac{5}{7}\times\frac{4}{6}\times\frac{2}{5}+\frac{2}{7}$	M1		Attempt at P(at least 2O) sum 3 or 4 three-factor options
$=\frac{6}{7}$	A1		Correct unsimplified answer seen anywhere
P(30 | at least 2O) = $\frac{2}{7}\div\frac{6}{7}=\frac{1}{3}(0.333)$	A1	**5**	Correct answer evaluated
<u>Alternative 1</u>			
3 Orange = $^5C_3$	M1		Attempt at combinations for 3 orange oe, not added
	A1		Correct unsimplified num of a fraction
At least 2 Orange = $^5C_2 \times {}^2C_1 + {}^5C_3$	M1		Attempt at combinations for at least 2 orange condone omission of $+{}^5C_3$
	A1		Correct unsimplified answer seen anywhere
P(3O | at least 2O) = $\frac{{}^5C_3}{{}^5C_2\times{}^2C_1+{}^5C_3}=\frac{1}{3}$	A1	**5**	Correct answer evaluated
<u>Alternative 2</u>			
No Yellow = $^2C_0$	M1		Attempt at combinations for 0 yellow oe, not added
	A1		Correct unsimplified num of a fraction
No more than 1 Yellow = $^2C_1 + {}^2C_0$	M1		Attempt at combinations for no more than 1 yellow. Condone omission of +2C0
	A1		Correct unsimplified answer seen anywhere
P(3O | at least 2O) = $\frac{{}^2C_0}{{}^2C_1+{}^2C_0}=\frac{1}{3}$	A1	**5**	Correct answer evaluated
<u>Misread – with replacement</u>			
MR–1 applied to first Accuracy Mark earned	M1		Attempt at P(OOO) one three factor option oe not added
P(3O) = $\frac{5}{7}\times\frac{5}{7}\times\frac{5}{7}=\frac{125}{343}$	A1		Correct unsimplified num of a fraction
P(at least 2O) = $\frac{5}{7}\times\frac{5}{7}\times\frac{2}{7}\times{}^3C_2+\left(\frac{5}{7}\right)^3$	M1		Attempt at P(at least 2O) sum of 3 or 4 three factor options
	A1		Correct unsimplified seen anywhere
P(3O | at least 2O) = $\frac{5}{11}$	A1	**4 max**	Answer evaluated