UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary, Advanced Level and AICE

MARK SCHEME for the November 2004 question papers

9709/0390 MATHEMATICS

9709/06, 0390/06   Paper 6 (Probability and Statistics 1), maximum raw mark 50

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the November 2004 question papers for most IGCSE and GCE Advanced Level syllabuses.

Grade thresholds taken for Syllabus 9709/0390 (Mathematics) in the November 2004 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 6	50	41	37	22

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

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 $\sqrt{}$" 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.

GCE A, AS LEVEL and AICE

MARK SCHEME

MAXIMUM MARK: 50

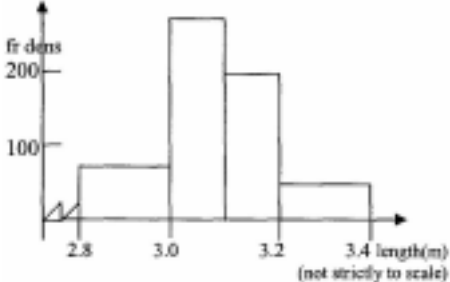**SYLLABUS/COMPONENT: 9709/06, 0390/06**

MATHEMATICS
(Probability and Statistics 1)

1	(i)	$\dfrac{9!}{2!2!}$ = 90720	B1		For dividing by 2! or 2 once or twice, or $_9P_7$ or $_9C_7$ seen, can be implied
			B1	2	For correct answer
	(ii)	$\dfrac{5!4!}{2!2!}$ = 720 OR could do by probs and multiply by their **(i)**	B1		For 5! or 4! or $_4P_4$ or $_5P_5$ seen in num
			B1		For $5! \times 4! \times k$ in num of a term, k = 1 or 2 only
			B1	3	For correct final answer
2	(i)	a = 8/0.2 (= 40)	B1	1	
	(ii)		M1		Uniform linear scales from at least 2.8 to 3.4 on the x-axis and 0 to 240 on the y-axis, both axes labelled, accept m or length, on x-axis
			B1		Correct widths, no 0.05s, no gaps
			B1 ft	3	Four bars correct, ft on their **(i)** consistent with their vertical labelling, heights within ½ small square
	(iii)	$\dfrac{17+24+19}{17+24+19+8}$	M1		For three terms in num and 4 terms in denom (can be implied) NB fd.s ie 85 + 240 + 190/555 get M1 A0
		= 60/68 or 0.882	A1	2	For correct answer, a.e.f .
3	(i)	P(L) = 0.5 x 0.04 + 0.3 x 0.06 + 0.2 x 0.17	M1		For summing three relevant 2-factor terms
			A1		For correct expression
		= 0.072 (9/25)	A1	3	For correct answer
	(ii)	P (B$|$L) = $\dfrac{0.3 \times 0.06}{0.072}$	B1 ft		For their 0.3 x 0.06 in numerator, must be divided by $k \neq 1$
			M1		For dividing by their P(L)
		= 0.25	A1	3	For correct answer

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4 (i)	Mean $= 745/18 = 41.4$	B1		For correct answer, a.e.f.
	sd $= \sqrt{\dfrac{33951}{18} - \left(\dfrac{745}{18}\right)^2}$	M1		For $\sqrt{\ }$ [33951/18 – (their 41.4)^2] or ÷ 17
	$= 13.2$	A1	3	For correct answer 13.1 gets A0 with PA # 1
(ii)	$17 \times 41 = 697$	M1		For multiplying 17 by 41
	$745 - 697 = 48$	A1	2	For correct answer
	sd $= \sqrt{\dfrac{33951 - 48^2}{17} - 41^2} = 13.4$	M1		For subtracting *their* 48^2 from 33951 (ignore anything else)
		A1	2	For correct answer
5 (i)	$z = 0.674$ or 0.675 allow 0.67 to 0.675	B1		For correct z, can be + or -
	$\dfrac{52 - \mu}{5} = 0.674$	M1		For an equation relating 52, 5, μ and any $z \neq 0.5987$ or 0.7734 ish
	$\mu = 48.6$	A1	3	For correct answer
(ii)	$z_1 = \dfrac{40 - 48.63}{5} = -1.726$	M1		For standardising 40 or 46, 5 or $\sqrt{5}$ in denom or 5^2 with their mean, no cc
	$z_2 = \dfrac{46 - 48.63}{5} = 0.526$			
	prob $= 0.9578 - 0.7005 = 0.2573$	M1		For subtracting two probs consistent with their mean ie usually $\Phi_1 - \Phi_2$ or $(1 - \Phi_1) - (1 - \Phi_2)$ but could be of type $\Phi_1 - (1 - \Phi_2)$ if their mean is in between 40 and 46
	$(0.2573)^4$	M1		For raising their answer above to a power 4
	$= 0.00438$ or 4.38×10^{-3} accept 0.00449×10^{-3} NB 0.0045 gets A0 and RE #1	A1 ft	4	For correct answer

6 (i)	Options 123, 124, 125, 134, 135, 145, 234, 235, 245, 345	**M1**		For listings options, at least 4 different ones
	P (odd) = 0.4	**B1**	**2**	For correct answer, legit obtained
(ii)	P(largest is 4) = 0.3	**B1**	**1**	For correct answer
	OR $\dfrac{1 \times _3C_2}{_5C_3}$			**SR** if 9 options in **(i)** give B1 for 3/9 or 2/9 depending on their missing option
(iii)	$\begin{array}{cccc} l & 3 & 4 & 5 \\ P(L=l) & 0.1 & 0.3 & 0.6 \end{array}$	**M1**		For 3, 4, 5, in table or 1, 2 as well, no need for any probs but need to see an (uncompleted) second line
		M1		For evaluating another probability based on their list
		A1	**3**	For correct answer
(iv)	E(*L*) = $\sum lp = 3 \times 0.1 + 4 \times 0.4 + 5 \times 0.6 = 4.5$	**B1 ft**		For correct answer, ft if their ∑p= 1
	Var (*L*) = $3^2 \times 0.1 + 4^2 \times 0.3 + 5^2 \times 0.6 -$ (their 4.5^2)	**M1**		For evaluating their $\sum l^2 p - $ (their 4.5^2) (must see $-$ their 4.5^2) each *p* < 1, in first numerical instance, ie can forget the sq rt subsequently
	= 0.45	**A1**	**3**	For correct answer

7	(i)	constant p, independent trials, fixed number of trials, only two outcomes	B1		For an option
			B1	2	For a second option
	(ii)	P(X<4) = $0.72^{14} + {}_{14}C_1 \times 0.28 \times 0.72^{13}$ $+ {}_{14}C_2 \times 0.28^2 \times 0.72^{12}$ $+ {}_{14}C_3 \times 0.28^3 \times 0.72^{11}$	M1		For adding with some C in P(0 + 1 + 2 + 3) or P(1 + 2 + 3) or P(0 + 1 + 2 + 3 + 4) or P(1 + 2 + 3 + 4)
			M1		For 0.28 and 0.72 to powers which sum to 14 Need 2 or more terms
		(= 0.0101 + 0.0548 + 0.1385 + 0.2154)	A1		For completely correct unsimplified form
		= 0.419	A1	4	For correct final answer NB 0.418 is A0 if PA # 1 or A1 if PA # 2
	(iii)	$\mu = 50 \times 0.28 \, (= 14)$	B1		For 14 and 10.08 seen, can be implied
		$\sigma^2 = 50 \times 0.28 \times 0.72 \, (=10.08)$	M1		For standardising with or without cc, must have sq root
		P(more than 18) = $1 - \Phi\left(\dfrac{18.5-14}{\sqrt{10.08}}\right)$	M1		For continuity correction 17.5 or 18.5 AND a final answer < 0.5
		$= 1 - \Phi(1.417)$			
		$= 1 - 0.9218 \text{ or } 0.9217$			
		$= 0.0782 \text{ or } 0.0783$	A1	4	For correct answer NB 0.078 is A0 if RE # 1 or A1 if RE # 2

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