UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

9709 MATHEMATICS

9709/61 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 must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of 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.

© University of Cambridge International Examinations 2011

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

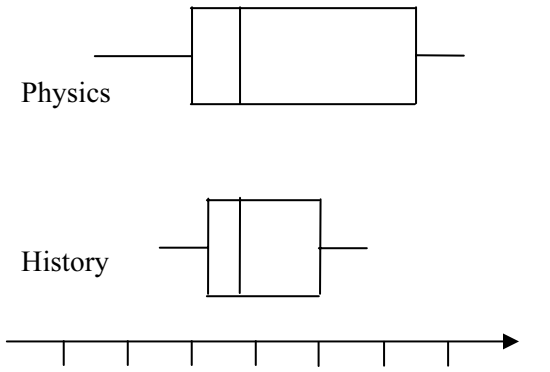
MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads 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.

© University of Cambridge International Examinations 2011

1	$\mu = 250 \times 0.86 = 215$	B1		250 × 0.86 and 250 × 0.86 × 0.14 seen o.e
	$\sigma^2 = 250 \times 0.86 \times 0.14 = 30.1$	M1		Standardising, with or without cc, must have sq rt in denom
	$P(X > 210) = 1 - \Phi\left(\frac{210.5 - 215}{\sqrt{30.1}}\right)$	M1		Continuity correction 210.5 or 209.5 only
	$= \Phi(0.820)$	M1		Correct region (> 0.5) ft their mean
	$= 0.794$	A1	[5]	Correct answer
2	**(i)** $133/n + 25 = 28.325$	M1		Equation involving 133, 25 and 28.325
	$n = 40$	A1		Correct answer for n
	$3762/40 - 3.325^2 = 82.99$	M1		Using coded mean in variance formula
	standard deviation = 9.11	A1	[4]	Correct answer
	(ii) $82.99 = \Sigma x^2/40 - 28.325^2$	M1		Using uncoded material in variance formula
	$\Sigma x^2 = (82.99 + 28.325^2) \times 40$			
	$= 35412$ (35400)	A1		Correct answer
	OR			
	$\Sigma(x - 25)^2 = \Sigma x^2 - 50\Sigma x + 40 \times 25^2$	M1		Expanding and substituting for Σx
	$\Sigma x^2 = 3762 + 50 \times 1133 + 25000$			
	$= 35412$	A1	[2]	Correct answer
3	**(i)** $P(X = 1) = P(GBBB)\ 4 \times {}_1C_1$	M1		Considering values of X of 1, 2, 3, 4
	$= 5/8 \times 3/7 \times 2/6 \times 1/5 \times 4 = 1/14$	M1		Attempting to find the probability of at least 2 values of X
	$P(X = 2) = P(GGBB) \times {}_4C_2 = 3/7$			
	$P(X = 3) = P(GGGB) \times {}_4C_3 = 3/7$	A1		One correct probability
	$P(X = 4) = P(GGGG) \times {}_4C_4 = 1/14$	A1		All correct
	OR			
	$P(1) = {}_5C_1 / {}_8C_4 = 1/14$	M1		Considering values of X of 1, 2, 3, 4
	$P(2) = {}_3C_2 \times {}_5C_2 / {}_8C_4 = 3/7$	M1		Dividing by ${}_8C_4$
	$P(3) = {}_3C_1 \times {}_5C_3 / {}_8C_4 = 3/7$	A1		One correct probability
	$P(4) = {}_5C_4 / {}_8C_4 = 1/14$	A1	[4]	All correct
	(ii) $\text{Var}(X) = 1/14 + 12/7 + 27/7 + 16/14 - (5/2)^2$	M1		Using a variance formula correctly with mean^2 subtracted numerically, no extra division
	$= 15/28$ (0.536)	A1	[2]	Correct final answer

© University of Cambridge International Examinations 2011

4	**(i)**	History: lowest 27, highest 57, LQ = 33 med = 39 UQ = 50  	M1 [1]	Attempt to find history quartiles and median by putting in order or stem and leaf (can be implied if the answer is reasonable) Correct history median and quartiles Uniform scale and labels Correct history graph ft their quartiles line not through box Correct physics graph
	(ii)	Physics marks are more spread out than History marks	B1 [1]	Any sensible comment
5	**(i)**	$z = 1.882$ or 1.881	B1	± 1.882 or ± 1.881 seen
		$1.882 = (32 - 20) / \sigma$	M1	Equation using their z (must be a z-value) 32, 20 and s
		$\sigma = 6.38$	A1 [3]	Correct answer
	(ii)	$P(x > 13) = P\left(z > \frac{13-20}{6.376}\right)$	M1	Standardising
		$= P(z > -1.0978)$	M1	Correct area > 0.5
		$= 0.864$	A1 [3]	Correct answer
	(iii)	P(at least 2) = 1 – P(0, 1)	M1	Using 0.03 and 0.97 or 0.06 and 0.94 in a binomial expression powers summing to 7
		$= 1 - (0.97)^7 - (0.03)(0.97)^6{}_7C_1$	M1	Correct unsimplified binomial expansion
		$= 0.0171$	A1 [3]	Correct answer
6	**(a)**	**(i)** $\frac{12!}{2!3!2!} = 19958400$ (20,000,000)	M1 A1 [2]	Dividing by 2! 3! 2! Correct answer
		(ii) $\frac{4!}{2!} \times \frac{9!}{2!3!} = 362880$	B1 B1 B1 [3]	4! seen multiplied 9! or 9 × 8! seen multiplied Correct final answer
	(b)	**(i)** $3876 \times 4!$	M1	Multiplying by 4!
		$= 93024$	A1 [2]	Correct answer
		(ii) $(3!)^4 \times 4!$	M1	3! or 6 or 4! seen
		$= 31104$	A1 [2]	Correct final answer

© University of Cambridge International Examinations 2011

7	**(i)** P(2, N2, 2) = 1/4 × 1 × 1/7 = 1/28	M1		Considering at least two options of 2s and 8s
	P(8, 8, N8) = 1/4 × 2/5 × 3/7 = 3/70	M1		Considering three options for the 8s
	P(8, N8, 8) = 1/4 × 3/5 × 4/7 = 3/35	M1		Summing their options if more than 3 in total
	P(N8, 8, 8) = 3/4 × 2/5 × 4/7 = 6/35	B1		One option correct
	Σ = 47/140 (0.336)	A1	[5]	Correct answer
	(ii) P(2, 2 given same) = $\frac{1/28}{47/140}$	M1		1/28 in numerator of a fraction
	= 5/47 (0.106)	A1	[2]	Correct answer
	(iii) P(X) = 47/140	M1		Attempt to compare P(A and B) with P(A) × P(B) or using conditional probabilities
	P(Y) = 1/4			
	P(X and Y) = 1/28 ≠ 47/140 × 1/4	A1		Legitimate correct answer
	Not independent		[2]	

© University of Cambridge International Examinations 2011