UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2007 question paper

9709 MATHEMATICS

9709/07 Paper 7, 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.

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 discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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 H_0 $p = 0.3$ H_1 $p < 0.3$	B1	Both hypotheses correct
$P(0, 1, 2) = 0.7^{18} + 0.3 \times 0.7^{17} \times {}_{18}C_1 + 0.3^2 \times 0.7^{16} \times {}_{18}C_2$ $= 0.001628 + 0.01256 + 0.04576$ $= 0.0599$	M1 A1	For finding P(0, 1, 2) at least two terms of this sum needed Correct answer accept 0.06(0)
This is > 0.05 Accept Isaac's claim.	M1 A1ft	Comparing with 0.05 must be 0.05 Correct conclusion ft their test statistic – no contradictions
OR Using N(0.3,0.0116) H_0 p=0.3 H_1 p<0.3	B1	Both hypotheses correct
$z = \frac{0.111 + 1/36 - 0.3}{\sqrt{0.0116}} = -1.49159$ -1.49159>-1.645 Accept Isaac's claim	M1 A1 M1 A1ft	For attempt at z with or without cc For correct z For comparison Correct conclusion ft their test statistic
OR Using N(5.4,3.78) H_0 μ=5.4 H_1 μ<5.4	B1	Both hypotheses correct
$z = \frac{2.5 - 5.4}{\sqrt{3.78}} = -1.49159$ -1.49159>-1.645 Accept Isaac's claim	M1 A1 M1 A1ft **5**	For attempt at z with or without cc For correct z For comparison Correct conclusion ft their test statistic
2 (i) $-1.645 = \frac{c - 3.2}{1.4/\sqrt{10}}$ $c = 2.47$ rejection region is $\bar{x} < 2.47$	M1 B1 A1 A1ft **4**	For standardising, must have sq rt. and z value For ± 1.645 used For 2.47 For inequality correct way round (ft their 2.47 but must be <3.2)
(ii) $m < 2.47$	B1ft **1**	ft on their (i)
3 (i) a sample where every element has an equal chance of being chosen OR a random sample of size n is a sample chosen in such a way that each possible group of size n has the same chance of being picked.	B1 **1**	
(ii) 130/350 (0.371) $0.371 \pm 1.96 \times \sqrt{\frac{(0.371)(0.629)}{350}}$ $= 0.371 \pm 0.050609$ $= (0.321, 0.422)$	B1 M1 B1 A1 **4**	For proportion used Correct shape $\bar{x} \pm zs/\sqrt{n}$ Correct z value 1.96 used Correct limits (written as interval)
(iii) $1.96\sqrt{\frac{(0.371)(0.629)}{n}} = 0.02$ n = 2241or 2242 or 2243 or 2240	M1* M1*dep A1 **3**	Seeing an equation involving 0.02 or 0.04, n in denom and a sq rt and proportions used For equation of correct form Correct whole number answer

4 (i) E (cost to Stella) = 600 + 5.52 × 500 = 3360 Var (cost to Stella) = $5.52^2 \times 7.1^2$ = 1540 (1536)	M1 A1 M1 M1 A1	**5**	For multiplying by 5.52 and adding 600 Correct mean For mult $7.1/7.1^2/50.41^2$ by $\mathbf{5.52^2}$ For $5.52^{(2)}$ x $7.1^{(2)}$ or 50.41^2 with **no addition/subtraction** For correct answer
(ii) P ($D > 2S$) = P($D - 2S > 0$) $D - 2S \sim$ N(-120, 421 + 4 × 1536) ~ N(-120, 6565) P(D-$2S > 0$) = P($z > \frac{120}{\sqrt{6565}}$) = P(z > 1.481) = 0.0693	M1 B1 A1ft M1 A1	**5**	For attempt (D-$2S$) (or equiv) either < or > 0 For correct mean (seen or implied) For correct unsimplified variance For standardising attempt For correct answer, accept 0.069
5 (i) $E(X) = \int_0^b \frac{x}{b} dx = \left[\frac{x^2}{2b}\right]_0^b = \frac{b}{2}$ Var $(X) = \int_0^b \frac{x^2}{b} - \frac{b^2}{4} = \frac{b^2}{12}$	B1 M1 A1	**3**	Correct answer (accept unsimplified) For (substituted) attempt at $\int x^2 f(x)dx - [E(X)^2]$ ie $-[E(X^2)]$ must be seen even if ignored in next line Correct answer. Accept unsimplified – but must be a single fraction.
(ii) 9.5 = b/2 b = 19 AG	M1 A1	**2**	Equating their mean to their 9.5 Correct answer
(iii) 8/19 or 0.421	B1	**1**	Correct answer
(iv) $\overline{X} \sim N(9.5, 30.08/336)$ or using totals N(3192,10106.88) P($\overline{X} < 9$) = $P\left(z < \frac{9-9.5}{\sqrt{30.08/336}}\right)$ or equiv = P(z < -1.671) = 1 – 0.9526 = 0.0474	M1 A1ft M1 A1	**4**	Dividing their $b^2/12$ by 336 Correct mean and variance Standardising (must involve 336) and area < 0.5 or consistent with their figures Correct answer

6 (i) $\frac{e^{-\lambda}\lambda^2}{2!} = 3\frac{e^{-\lambda}\lambda^4}{4!}$	M1		Poisson equation involving λ
$\lambda = 2$	A1		Correct mean
new λ = 7	B1ft		New mean ft 3.5 × previous one
$P(X > 3) = 1 - e^{-7}\left(1 + 7 + \frac{7^2}{2!} + \frac{7^3}{3!}\right)$	M1		Poisson probs with their mean (at least 3 probs) and 1-
= 0.918	A1	**5**	Correct answer
(ii) (a) $\lambda = 1.3k$	B1		Correct new mean
$P(X > 0) = 1 - e^{-1.3k} = 0.96$	M1		Equation with *k* or λ in involving 1 – P(0) = 0.96
$0.04 = e^{-1.3k}$	A1		correct equation
$k = 2.48$	A1	**4**	correct answer
(b) $X \sim N(1300, 1300)$	B1		correct mean and variance
$P(X > 1250) = P\left(z > \frac{1250.5 - 1300}{\sqrt{1300}}\right)$	M1		standardising must have sq rt with or without cc
= P(z > -1.373)			
= 0.915	A1	**3**	correct answer