UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 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 May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

PMT

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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 $\sqrt{}$" 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.

1 mean $= 10 \times 0.15 \, (=1.5)$, var$=10 \times 0.15 \times 0.85 \, (=1.275)$ $P(\overline{X} > 1.4) = 1 - \Phi\left(\dfrac{1.4(+1/100) - 1.5}{\sqrt{\dfrac{1.275}{50}}} \right)$ $= \Phi(0.5636) = 0.713 \text{ or } 0.714$ or 0.734 without cc	B1 B1 M1 M1 A1	**5**	Mean and variance correct (OR if working with totals mean=75, var=63.75) Standardising with (correct) or without cc must have $\sqrt{var/50}$ in denom (OR equiv standardisation using totals) Correct area i.e. > 0.5 Correct answer, accept either
2 Σ 60 obs $\sim N(60 \times 3.2, \, 60 \times 1.2^2)$ $\sim N(192, 86.4)$ $P(S > 200) = 1 - \Phi\left(\dfrac{200 - 192}{\sqrt{86.4}} \right)$ $= 1 - \Phi(0.861)$ $= 0.195$	B1 B1 M1 M1 A1	**5**	192 or 60×3.2 seen 86.4 or 60×1.2^2 or equivalent seen standardising with sq rt and no cc correct area i.e. < 0.5 correct answer OR $200/60$ (B1) $1.2/\sqrt{60}$ (B1) $\dfrac{3_{1/3} - 3.2}{1.2/\sqrt{60}}$ (M1) etc.
3 $H_0: \mu = 22$ $H_1: \mu \neq 22$ Under H_0, test statistic $z = \dfrac{21.7 - 22}{\sqrt{0.19 / 8}}$ $= -1.947$ Cr value $z = \pm 1.96$ Not in CR, not enough evidence of change.	B1 M1 A1 M1 A1ft	**5**	Both correct, alternative hypothesis must be $\neq$ Standardising, must see $\sqrt{8}$ in denom Correct test statistic $\pm$ (accept rounding to 1.95) Comparison with correct CV must be ± 1.96 (or z consistent with H_1) or area comparison Correct conclusion ft their test statistic and CV (OR $22 \pm 1.96\sqrt{(0.19/8)}$ or z consistent with H_1 M1 A1ft then comparison with 21.7 M1 A1ft)
4 (i) $X \sim B(22, 0.2)$ $P(0, 1) = 0.8^{22} + 0.2 \times 0.8^{21} \, _{22}C_1$ $= 0.0480 \, (4.8\%)$	M1 M1 A1	**3**	For identifying the correct probability For binomial probs with C and powers summing to 22 Correct answer accept 0.048
(ii) P(Type I error) $= 0.0480$	B1ft	**1**	Ft on their (i) NB M1 M1 from (i) can be recovered in (ii) if not scored in (i)
(iii) P(Type II error) $= 1 - P(0, 1)$ $= 1 - (0.91^{22} + 0.09 \times 0.91^{21} \times \, _{22}C_1)$ $= 0.601$	M1 M1 A1	**3**	Identifying the correct probability Binomial probs with 0.09 and 0.91 Correct answer

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5 (i) people call randomly, independently, at an average uniform rate	B1 B1	**2**	Any two seen, or equivalent words in context SR If B0 B0 scored and two correct reasons seen but not in context score B1
(ii) $P(8) = e^{-10} 10^8 / 8!$ $= 0.113$	M1 A1	**2**	10 seen in a Poisson calculation correct answer
(iii) $X \sim N(240, 240)$ $P(X=250)= \Phi\left(\dfrac{250.5-240}{\sqrt{240}}\right) - \Phi\left(\dfrac{249.5-240}{\sqrt{240}}\right)$ $= \Phi(0.678) - \Phi(0.613)$ $= 0.7512 - 0.7301$ $= 0.0211$ (accept 3sf or more rounding to 0.021)	B1 M1 M1 A1	**4**	mean and variance = 240 standardising with their mean and variance subtracting the two relevant Φs correct answer SR If 0/4 scored $P(250)=e^{-240}.240^{250}/250!$ seen scores B1
6 (i) $\bar{x} = 1050$ $s^2 = \dfrac{1}{29}\left(33141816 - \dfrac{31500^2}{30}\right)$ $= 2304$	B1 M1 A1	**3**	Correct mean Correct formula with 29 in denom Correct answer
(ii) $1050 \pm 2.326 \times \dfrac{48}{\sqrt{30}}$ $= (1030, 1070)$	M1 B1 A1ft	**3**	Correct shape with $\sqrt{30}$ in denom 2.326 seen or equivalent, ft on their mean and variance
(iii) $1.96 \times \dfrac{48}{\sqrt{n}} = 6$ $n = 246$	M1* M1dep A1	**3**	Correct form of LHS of equation/inequality involving 1.96, 48, $\sqrt{n}$ Equated to 6 and attempt to solve (accept factor of 2 errors) correct answer SR If M0 M0 scored but only error is in z value score M1

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7 (i) no values outside $1 \leqslant x \leqslant 2$ curve through (1,0) and (2, 2.25)	B1 B1	**2**	1 and 2 seen, no f vals needed, correct shape

(ii) $\mu = \int_1^2 3x^3/4 - 3x/4 \, dx = \left[3x^4/16 - 3x^2/8\right]_1^2$
    $= [3 - 12/8] - [3/16 - 3/8]$
    $= 27/16$ (1.6875)
	M1
	M1
	
	A1
		
		3
			attempt to integrate xf(x), any limits
			correct limits on an integration
			
			correct answer legit obtained

(iii) $\sigma^2 = \int_1^2 3x^4/4 - 3x^2/4 \, dx$ – mean^2
    $= \left[3x^5/20 - 3x^3/12\right]_1^2 - 1.6875^2$
    $= [96/20 - 2] - [3/20 - 3/12] - 1.6875^2$
    $= 0.052343$
  sd $= 0.2288$ to 4 dp **AG**
	M1
	
	A1
	
	A1
		
		3
			attempt to integrate x^2f(x), with – mean^2 seen
			
			correct integral
			
			correct answer legit obtained

(iv) $\int_1^{1.9163} 3x^2/4 - 3/4 \, dx$
 	
    $= \left[x^3/4 - 3x/4\right]_1^{1.9163}$
    $= 0.822$ or 0.821
	M1
	
	A1
	A1
		
		3
			attempt to integrate f(x), with limits attempted
			
			correct limits (4 s f)
			correct answer

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