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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2007 question paper

9709 MATHEMATICS

9709/06 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.

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.

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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.

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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.

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1 (i) –73.2/24 (= -3.05) $a = 8.95 + 3.05 = 12$ OR 8.95×24 (= 214.8) $\Sigma x - \Sigma a = -73.2$ $\Sigma a = 288 \quad a = 12$	M1 A1 M1 A1	**2**	Accept (-72.4 + anything)/ 24 Correct answer For 8.95×24 seen Correct answer obtained using Σx and Σa
(ii) standard deviation = $\sqrt{\frac{2115}{24} - (-3.05)^2}$ $= 8.88$ OR sd = $\sqrt{\frac{3814.2}{24} - 8.95^2}$ $= 8.88$	M1 A1 M1 A1	**2**	For $\frac{2115}{24} - (\pm \text{ their coded mean})^2$ Correct answer For $\frac{\text{their } \Sigma x^2}{24} - 8.95^2$ where Σx^2 is obtained from expanding $\Sigma(x-a)^2$ with $2a\Sigma x$ seen Correct answer
2 (i) $2p + p + 3p = 1$ $p = 1/6$ (= 0.167)	M1 A1	**2**	Equation involving ps and summing to 1 Correct answer
(ii) E(X) = $-2 \times 2/6 + 0 + 4 \times 3/6$ $= 4/3$ (=1.33) Var (X) = $4 \times 2/6 + 0 + 16 \times 3/6 - (4/3)^2$ $= 7.56$ (68/9)	M1 A1ft M1 A1	**4**	Using correct formula for E(X), in terms of p or their $p < 1$ Correct expectation ft on their p if $p \le 1/3$ Substitution in their Σpx^2 – their $E^2(X)$ need 2 terms Correct answer
3 (i) $\frac{6!}{3!} = 120$	M1 A1	**2**	For dividing by 3! Correct answer
(ii) 5 ….7 = $\frac{4!}{2!} = 12$ 7…. 5 = $\frac{4!}{2!} = 12$ 7…. 7 = 4! = 24 total = 48	M1 B1 B1 A1	**4**	For identifying different cases For 4!/2! seen For 4! alone seen or in a sum or product Correct final answer

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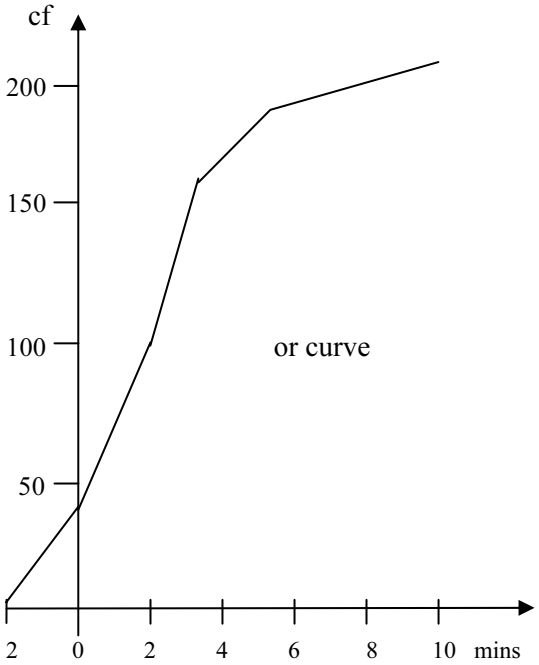
4 (i) $z = \pm 1.68$ $z = \frac{5.5 - 4.5}{\sigma}$ $\sigma = 0.595$ accept 25/42	B1 M1 A1	**3**	Number rounding to 1.68 seen Standardising and attempting to solve with their z, ; must be z value, no cc, no σ^2 ,no $\sqrt{\sigma}$ Correct answer
(ii) $z_1 = \frac{3.8 - 4.5}{0.5952} = -1.176$ $z_2 = \frac{4.8 - 4.5}{0.5952} = 0.504$ prob = $\Phi(0.504) - (1-\Phi(1.176))$ $= 0.6929 - (1-0.8802)$ $= 0.573$	M1 A1ft M1 A1	**4**	For standardising 3.8 or 4.8, mean 4.5 not 5.5, their σ or $\sqrt{\sigma}$ or σ^2 in denom One correct z-value, ft on their σ Correct area ie $\Phi_1 + \Phi_2 - 1$ or $\Phi_1 - \Phi_2$ if μ taken to be 5.5 Correct answer only
5 (i) some trains were up to 2 minutes early	B1	**1**	Or sensible equivalent, must use the idea 'early' 2 not needed
(ii) cf table Min late, less than: 0, 2, 4, 6, 10 C freq: 43, 94, 163, 185, 204  Median = rounding to 2.1 to 2.4 min IQ range = rounding to 3.2 to 3.6 min	M1 M1 M1 M1 B1 A1	**7**	NB All M marks are independent. Attempt at C F table with upper limits no halves Uniform linear scales from at least 0 to 10 and 0 to 204 and at least one axis labelled, CF or mins or t Attempt at graph their 5 points. (-2, 0) not nec (could be midpoints or lower bounds not f d) Attempt at median along 102 or 102.5 line Attempt at LQ along 51/52 line and UQ along 153/154 line from graph Correct median Correct IQ range allow from midpoints etc

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6 (i) $P(X=5) = (0.65)^5 \times (0.35)^2 \times {}_7C_5$	M1		Expression with 3 terms, powers summing to 7 and a ${}_7C$ term
$= 0.298$ allow 0.2985	A1	**2**	Correct answer
(ii) $\mu = 50 \times 0.65\ (= 32.5)$, $\sigma^2 = 50 \times 0.65 \times 0.35\ (= 11.375)$	B1		32.5 and 11.375 seen or implied
$P(\text{fewer than } 29) = \Phi\left(\frac{28.5 - 32.5}{\sqrt{11.375}}\right)$	M1		standardising, with or without cc, must have sq rt
	M1		for continuity correction 28.5 or 29.5
$= 1 - \Phi(1.186)$	M1		correct area ie < 0.5 must be from a normal approx
$= 1 - 0.8822$			
$= 0.118$	A1	**5**	correct answer
(iii) $0.65\,n \geq 8$	M1		equality or inequality with np and 8
smallest $n = 13$	A1	**2**	correct answer
7 (i) $P(W, R) = 1/6 \times 7/10$	M1		For a single product with 6 and 10 in denoms
$= 7/60\ (0.117)$	A1	**2**	Correct answer
(ii) $P(R, R) = 5/6 \times 8/10\ (= 40/60)$	M1		For finding their $P(R, R)$ and adding it to their (i)
$P(\text{red}) = 47/60\ (= 0.783)$	A1	**2**	Correct answer
(iii) $P(R \mid R) = \frac{P(R \cap R)}{P(R)}$	M1		Their $P(R, R)$ / their $P(R)$ ie something $\times 5/6$ $\div$ their (ii)
$= \frac{40}{47}\ (= 0.851)$	A1	**2**	Correct answer
(iv) $P(R, W) = 5/6 \times 2/10 = 10/60$	B1		$x = 0, 1, 2$, only, seen, no probabilities needed
$P(W, W) = 1/6 \times 3/10 = 3/60$	B1		one correct probability
	B1		another correct probability
	B1ft	**4**	ft if only one prob correct and $\Sigma p = 1$

x	0	1	2
$P(X=x)$	3/60	17/60	40/60

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