Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

MATHEMATICS **9709/61**

Paper 6 **October/November 2017**

MARK SCHEME

Maximum Mark: 50

Published

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2017 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

® IGCSE is a registered trademark.

© UCLES 2017

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 FT 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.

© UCLES 2017

The following abbreviations may be used in a mark scheme or used on the scripts:

AEF/OE Any Equivalent Form (of answer is equally acceptable) / Or Equivalent

AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)

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

SOI Seen or implied

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

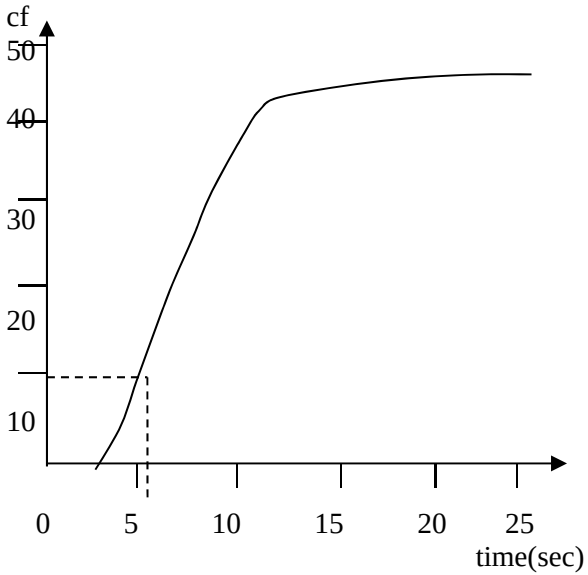
MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through" marks. MR is not applied when the candidate misreads his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

© UCLES 2017

Question	Answer	Marks	Guidance
1	$p + q = 0.45$	**M1**	Equation involving $\Sigma P(x) = 1$
	$0.15+ 2p + 1.2 + 6q = 3.05$	**M1**	Equation using $E(X) = 3.05$
	$q = 0.2$	**M1**	Solving simultaneous equations to one variable
	$p = 0.25$	**A1**	Both answers correct
		4	

© UCLES 2017

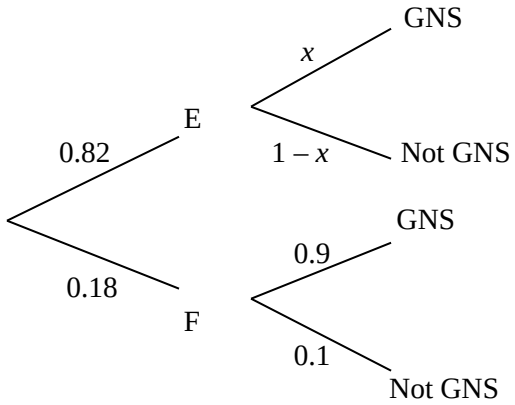
Question	Answer	Marks	Guidance
2(i)	Points (5.5,10), (8.5,25), (11.5,42), (16.5,46), (25.5,48)  	**B1**	Correct cfs values seen listed, in or by table or on graph, 0 not required
		B1	Axes labelled “cumulative frequency” (or cf) and “time [or t etc.] (in) seconds (or sec etc.)”. Linear scales – cf 0–48, time 2.5 – 25.5 (ignore <2.5 on time.) At least 3 values stated on each axis, but (0,0) can be implied without stating.
		B1	All points plotted accurately, (5, 10) etc. scores **B0**. Curve or line segments drawn starting at (5.5,10) and passing within ‘1 scale unit’ vertically and horizontally of plotted points
		3	

Question	Answer	Marks	Guidance
2(ii)	48 – 35 = 13 t = 6.5 sec	**M1**	Subt 35 (checked ±1 mm on graph) from 48 or 50,
		A1	6 ⩽ Ans ⩽ 7
		2	

Question	Answer	Marks	Guidance
3(i)	p = 0.207	**B1**	
		1	
3(ii)	Var = 30 × 0.207 × 0.793 = 4.92	**B1**	
		1	
3(iii)	P(⩾ 2) = 1 – P(0, 1)	**M1**	
	$= 1 - (0.793)15 - \binom{15}{1}(0.207)(0.793)14$	**M1**	1 – P(0, 1) seen n =15 p = any prob
	= 0.848	**A1**	
		3	

© UCLES 2017

Question	Answer	Marks	Guidance
4(i)	$\frac{(48.7\times12+38.1\times7)}{19}$	**M1**	Accept unsimplified (may be separate calculations)
	= 44.8	**A1**	
		2	
4(ii)	$7.65^2 = \frac{\Sigma x^2}{12} - 48.7^2$ $\Sigma x^2 = 29162.55$	**M1**	Substitution in one correct variance formula
	$4.2^2 = \frac{\Sigma y^2}{7} - 38.1^2$ $\Sigma y^2 = 10284.75$	**A1**	One Σx^2 or Σy^2 correct (can be rounded to 4sf))
	Combined var = $\frac{(29162.55+10284..75)}{19} - 44.79^2$ $= \frac{39447.3}{19} - 44.79^2$	**M1**	Using their Σx^2 and Σy^2 and their **4(i)** in the variance formula
	Combined σ = 8.37 or 8.36	**A1**	
		4	

Question	Answer	Marks	Guidance
5(i)		**B1**	Must see at least 4 probs correct including one with an *x* in, correct shape
		B1	Shape, clear labels/annotation and all probs correct
		2	
5(ii)	$0.82x + 0.18 \times 0.9 = 0.285$	**M1**	Eqn with *x* in , two 2-factors on one side
	$x = 0.15$	**A1**	
		2	
5(iii)	$P(E \mid notGNS) = \frac{P(E \cap notGNS)}{P(notGNS)}$	**M1**	Attempt at P(E∩not GNS) seen as num or denom of fraction
		M1	Attempt at P(not GNS) seen anywhere
	$= \frac{0.82 \times 0.85}{1 - 0.285} = 0.975$	**A1**	Correct answer
		3	

© UCLES 2017

Question	Answer	Marks	Guidance
6(a)(i)	${}^{40}P_5$	**M1**	${}^{40}P_x$ or ${}^{y}P_5$ oe seen, can be mult by $k \geqslant 1$
	= 78 960 960	**A1**	
		2	
6(a)(ii)	not front row e.g. WEJ** in 3× 3! = 18 ways	**B1**	3! seen mult by $k \geqslant 1$
	7 rows in 7 × 18= 126 ways	**B1**	mult by 7
	front row: e.g. *MA** in 4 × 2 = 8 ways	**M1**	attempt at front row arrangements and multiplying by the 7 other rows arrangements, need not be correct
	Total 126×8 = 1008	**A1**	
		4	
6(b)	*EITHER:* e.g. *R** in ${}^{8}C_3$ ways = 56 ways *L** in ${}^{8}C_3$ = 56 ways	**(M1**	Considering either R or L only in team
	**** in ${}^{8}C_4$ = 70 ways	**M1***	Considering neither in team
		DM1	summing 3 scenarios
	Total 182 ways	**A1)**	
	OR1: No restrictions ${}^{10}C_4$ = 210 ways	**(M1**	${}^{10}C_4$ – , Considering no restrictions with subtraction
	RL = ${}^{8}C_2$ = 28	**M1***	Considering both in team
	210 – 28	**DM1**	subt
	= 182 ways	**A1)**	

© UCLES 2017

Question	Answer	Marks	Guidance
6(b)	*OR2:* R out in $^9C_4 = 126$ ways L out in $^9C_4 = 126$ ways	**(M1**	Considering either R out or L out
	Both out in $^8C_4 = 70$	**M1***	Considering both out
		DM1	Summing 2 scenarios and subtracting 1 scenario
	126 + 126 – 70 = 182 ways.	**A1)**	
		4	

Question	Answer	Marks	Guidance
7(i)	$P(< 570) = P\left(z < \frac{570-500}{91.5}\right) = P(z < 0.7650)$ $= 0.7779$	**M1**	Standardising for either 570 or 390, no cc, no sq, no √
	$P(< 390) = P\left(z < \frac{390-500}{91.5}\right) = P(z < -1.202)$	**A1**	One correct z value
	$= 1 – 0.8853 = 0.1147$	**A1**	One correct Φ, final solution
	Large:0.222 (0.2221) Small: 0.115 (0.1147)	**A1**	Correct small and large
	Medium: 0.663 (0.6632)	**A1FT**	Correct Medium rounding to 0.66 or ft 1 – (their small + their large)
		5	

© UCLES 2017

Question	Answer	Marks	Guidance
7(ii)	$1.645 = \left(\frac{x-500}{91.5}\right)$	**B1**	± 1.645 seen (critical value)
		M1	Standardising accept cc, sq, sq rt
	$x = 651$	**A1**	$650 \leqslant$ Ans $\leqslant 651$
		3	
7(iii)	P($x > 610$) = 0.1147 (symmetry)	**M1**	Attempt to find upper end prob $x > 610$ or $\Phi(x)$, ft their P(< 390) from **(i)**
	$0.3 + 0.1147 = 0.4147 \Rightarrow \Phi(x) = 0.5853$	**M1**	Adding 0.3 to *their* P($x > 610$) or subt 0.5 from $\Phi(x)$ or 0.8853 – 0.3
	$z = 0.215$ or 0.216	**M1**	Finding $z = \Phi^{-1}(0.5853)$
	$0.215 = \frac{k-500}{91.5}$	**M1**	Standardising and solving, accept cc, sq, sq rt
	$k = 520$	**A1**	
		5	